WATSONIA

Journal of the Botanical Society of the British Isles

Volume 20 Part 1 March 1994

Editors: J. R. Akeroyd, J. R. Edmondson, R. R. Mill, E. C. Nelson, C. D. Preston, B. S. Rushton

ISSN: 0043-1532

Botanical Society of the British Isles

Patron: Her Majesty Queen Elizabeth the Queen Mother

Applications for membership should be addressed to the Hon. General Secretary, c/o Department of Botany, The Natural History Museum, Cromwell Road, London, SW7 5BD, from whom copies of the Society's Prospectus may be obtained.

Officers for 1993-94

Elected at the Annual General Meeting, 15th May 1993

President, Dr F. H Perring

Vice-Presidents, Mr P. S. Green, Dr G. Halliday, Mr A. C. Jermy, Mr A. O. Chater

Honorary General Secretary, Mrs M. Briggs

Honorary Treasurer, Mr M. Walpole

Editors of *Watsonia*

Papers and Notes, J. R. Edmondson, R. R. Mill, E. C. Nelson, B. S. Rushton*

Plant Records, C. D. Preston

Book Reviews, J. R. Edmondson

Obituaries, J. R. Akeroyd

*Receiving editor, to whom all MSS should be sent (see inside back cover).

Editorial

A NEW DIRECTION FOR *WATSONIA*

For many years, *Watsonia* has published Papers and Short Notes "concerning the taxonomy, biosystematics and distribution of British and Irish vascular plants, as well as topics of a more general or historical nature" and has rarely accepted papers on the conservation of plant species and never accepted papers on their ecology. However, in recent years the Botanical Society of the British Isles has found itself becoming more and more involved in the conservation and ecology of the British flora through the Scarce Plants Scheme, the Monitoring Scheme, the Recovery Programme, etc. Consequently, the Editorial Committee of the Journal and the Publications Committee of the Society have agreed to increase the scope of the Journal to allow publication of a wider range of articles in the areas of conservation and ecology, particularly the ecology of single species. We do not anticipate including papers on community ecology nor the more physiological aspects of ecology. Therefore, in future, the scope of *Watsonia* will be "the taxonomy, biosystematics, ecology, distribution and conservation of British and Irish vascular plants, as well as topics of a more general or historical nature". We will welcome papers and notes related to topics such as population monitoring (particularly of rare or endangered species but including other species as well), conservation of individual species or habitats, habitat requirements of species, transplantation or relocation experiments, distribution of indictor species, the 'performance' of individual species in particular habitats, germination requirements, etc., though this should not be seen as an exhaustive list. In this way, we hope to provide a journal which is even more relevant to both the members of the Society and the greater scientific community.

Prospective authors who are concerned whether their work falls within the now wider scope of the Journal should consult the Honorary Receiving Editor before submission of any manuscripts.

BRIAN S. RUSHTON
Honorary Receiving Editor

Watsonia, **20**, 3–24 (1994)

Floristic change in English grazing marshes: the impact of 150 years of drainage and land-use change

J. O. MOUNTFORD

Institute of Terrestrial Ecology (Natural Environment Research Council), Monks Wood, Abbots Ripton, PE17 2LS

ABSTRACT

Grazing marshes have assumed a significant role in the conservation of British wetlands, but their biodiversity has declined as a result of drainage and land use change. Using as wide a range as possible of published and archive sources from 1840 to the present, changes in species abundance and distribution over 150 years were reconstructed in three English grazing marshes: the Somerset Levels and Moors, the Romney and Walland Marshes and the Idle/Misson Levels. Of 526 species studied, over half showed a decline, which was severe in 123 species. Only 34 species, often aliens or adventives, increased. Published accounts, land use and drainage data, together with knowledge of the species' ecology suggest that drainage has been the most important factor in species decline. Raised bog and fen have experienced the greatest extinction of species. Species of wet grassland and watercourses survive, but often at much reduced abundance.

KEYWORDS: agriculture, drainage channel, grassland, mire, wetland, conservation.

INTRODUCTION

Much attention has been focused on wetland conservation and the relationship between land use change and the survival of particular species and communities. This attention stems from the belief that wetlands are particularly threatened by human activity intended to increase agricultural production or to protect and extend urban areas. Evidence from species decline and extinction supports this view (Ratcliffe 1984).

Concern for the survival of particular species of plants and animals has led ecologists and conservationists to widen their research to include communities which in no sense are natural but which hold populations of vulnerable species. The traditional grazing marshes of Britain represent a stage in the conversion of 'virgin' land into farmland and as such support vegetation that is neither typical of primeval wetland nor of intensive cultivation (Moss 1907; Williams 1970).

Agricultural drainage has been a major factor in the reduced extent of wetlands (Sheail & Wells 1983). The environmental effects of drainage works are many (Hill 1976). They include:

a. Removal or modification of wetland plant communities (reduced species richness and altered diversity).
b. Reduction of breeding (and feeding) areas for animals.
c. Degradation and accelerated loss of organic matter.
d. Higher mineralisation rate, leakage of nitrogen-nitrate to ground-water in the years following drainage and run-off of other nutrients and chemical residues.
e. Change in the local water regime, with impacts on ground-water quantity and quality (channel form, sediment load, water temperature and water chemistry).
f. Increased use of fertilisers and pesticides including aquatic herbicides (for drainage channel maintenance).
g. Reduction of landscape and amenity values.
h. Removal of hedgerows, trees, scrub, small woodlands, ponds, field enlargements, etc. coincidental with drainage works.
i. Drainage effects on land that has itself not been drained, but lies adjacent to such land.

In English grazing marshes, drainage for agriculture and associated land-use change have affected the distribution and abundance of plants through: 1. changes in water-table; 2. peat cutting; 3.

channelisation; 4. changes in water-quality; 5. ditch elimination; and 6. management of the watercourses.

In the present paper, the main objective has been to assess the relationship between drainage and land use change since 1840 and the status of plant species in grazing marshes. The approach has been to marshall the information provided by botanists over the period 1840–1990 and demonstrate changes in species abundance and distribution, a method previously used in Broadland (Driscoll 1982), the Fenland (Sheail & Wells 1980) and Gwent Levels (Wade & Edwards 1980). An aim has been to demonstrate the need for plant ecologists to pay attention to the historical context in which the communities that they study developed (Salisbury 1927).

METHODS

THE STUDY AREAS

Different grazing marshes reflect different stages in the transition from primeval wetland to drained, reclaimed and intensively farmed land. Three areas in England were selected that display the increasing impact of modern agriculture (Fig. 1):

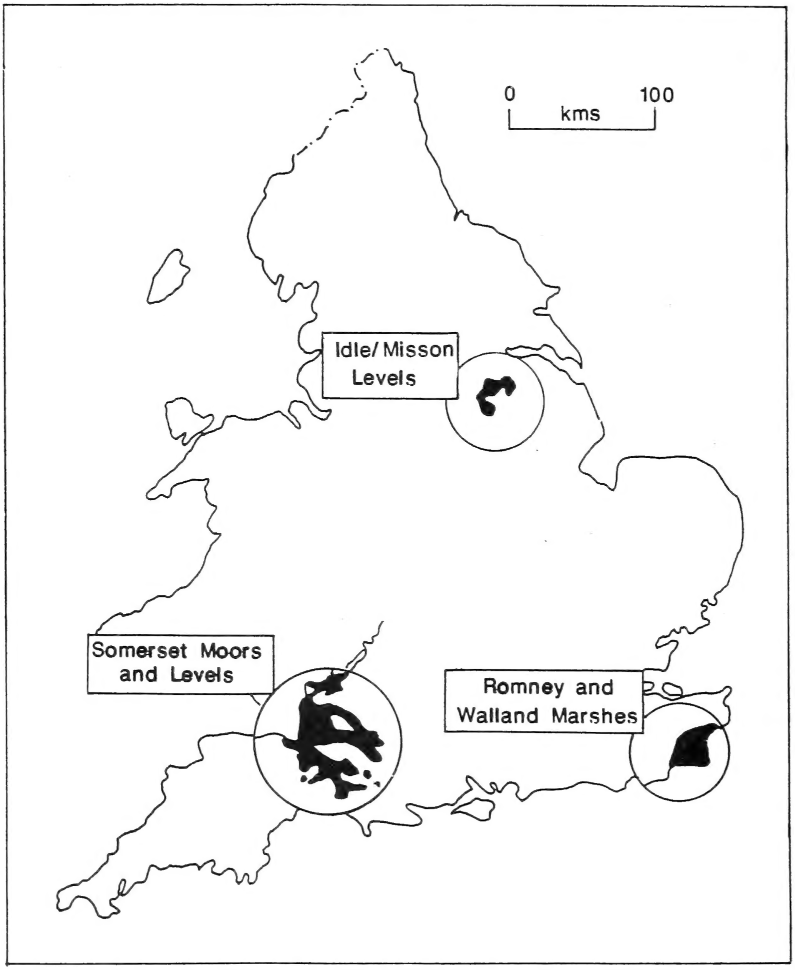


FIGURE 1. Location of three grazing marsh study areas in England. The sites are depicted at twice the base map scale.

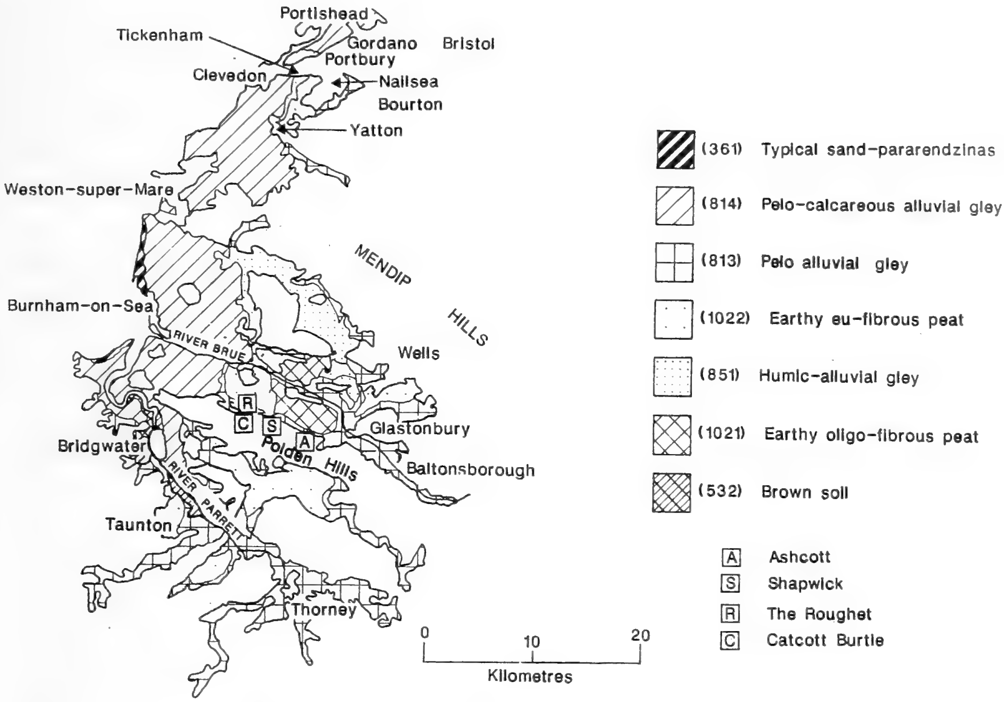


FIGURE 2. The Somerset Levels and Moors – map of study area showing major soil types and localities mentioned in the text. Upland (altitude >10 m) and sea areas left blank. Soil data derived from the Soil Survey of England & Wales (1983).

1. THE SOMERSET LEVELS AND MOORS – chosen as a largely unimproved grazing marsh. The study area takes in all the land on ground-water gley and peat soils between sea level and the 30′ (10m) contour and corresponds with the area defined by the 1:100,000 soil map (Soil Survey 1978) (Fig. 2).

2. THE ROMNEY AND WALLAND MARSHES – chosen as an area where marked changes in drainage and land use occurred after 1940. The study area includes the land south-east of the Royal Military Canal, with Shirley Moor and the Rother Levels west to Potman's Heath (Fig. 3).

3. THE LOWER IDLE VALLEY AND MISSON LEVELS – chosen to study the effect of a long period of intense cultivation on the plants of pasture and drainage channels. The study area was defined as that to benefit from the location of new pumps at West Stockwith, where the R. Idle joins the R. Trent (i.e. between Epworth and Bawtry, and up the R. Idle to Mattersey) (Fig. 4).

SELECTION OF SPECIES

Over 500 species of vascular plant and Charophyte were included in an archive search. The species chosen met one or more of the following habitat criteria, growing: 1. in standing or flowing fresh water; 2. in mire vegetation at altitudes <300 m; 3. in mesotrophic grasslands below 300 m; 4. in flood-plain or fen woodland; 5. on the banks of water-courses; 6. associated with occasionally flooded sites, muddy ground, or where compaction of the soil leads to transient standing water; and 7. in or by brackish water or where saltmarsh gives way to freshwater communities.

SOURCES OF FLORISTIC DATA

In order to trace changes in the distribution and abundance of species since 1840, as complete a set of sources as possible was used to build up a picture of the history of individual species in each study

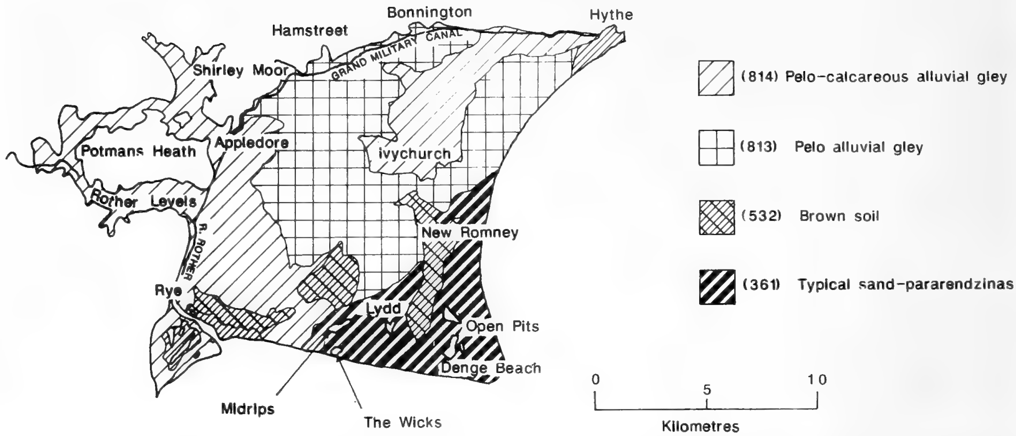


FIGURE 3. The Romney and Walland Marshes – map of study area showing major soil types and localities mentioned in the text. Upland (altitude >10 m) and sea areas left blank. Soil data derived from the Soil Survey of England & Wales (1983).

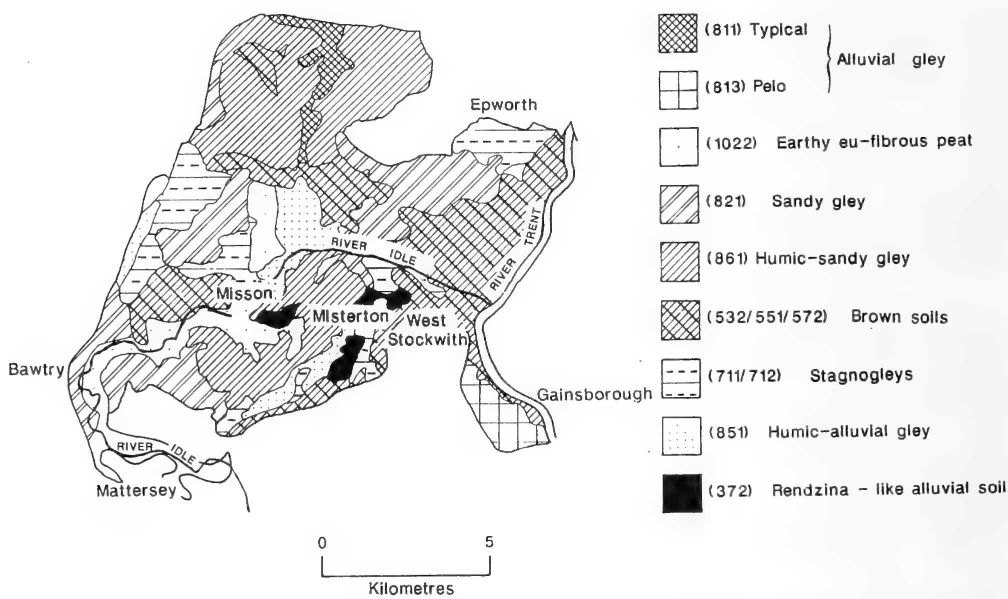


FIGURE 4. The Lower Idle valley and Misson Levels – map of study area showing major soil types and localities mentioned in the text. Upland (altitude >10 m) and sea areas left blank. Soil data derived from the Soil Survey of England & Wales (1983).

area. The sources used in the study areas are set out in Appendix 1. There is great variation in the detail and comprehensiveness of the earlier county or regional Floras. Recent plant atlases record information systematically but often omit local detail useful in interpreting species distribution.

The journals of naturalists' societies contain site-specific data, providing the detail required to evaluate accounts in Floras and plant atlases. Manuscript data (card indices, etc.) were consulted both in private hands and in herbaria, where accompanying specimens may be used to substantiate the accuracy of records. When these sources were prepared by authors of (or contributors to) Floras, they clarify and amplify the published accounts.

Many botanists have kept notebooks or annotated maps detailing their finds and the notes referring to a single visit may be enough to reconstruct the contemporary vegetation. Such sources were traced through the recorder network of the Botanical Society of the British Isles.

Both the national Biological Records Centre at Monks Wood and local centres provided species distribution data and were consulted extensively in all three study areas. Local centres may also store material on a site basis, giving an insight into floristic change at particular locations.

English Nature (formerly the Nature Conservancy Council) commissioned inventories of watercourse vegetation for each of the study areas between 1978 and 1982. These accounts provided detail on specific sites and a valuable baseline from which to measure change.

RECONSTRUCTION OF FLORISTIC CHANGE: THE EXAMPLE OF GOLDEN DOCK (*RUMEX MARITIMUS* L.)

The range and quality of material used can be demonstrated by a detailed example. Appendix 2 reproduces the information gathered about the Somerset distribution of *Rumex maritimus*. From such material, trends in the distribution and frequency of *R. maritimus* can be discerned:

To 1900, it was common on the peat-moors, and also scattered by the R. Parrett and its estuary, with outlying records near Wells and at Portishead.

Between 1901 and 1940, the dock may have spread further up the R. Parrett and near the R. Tone also. It maintained its abundance on the peat-moors.

Between 1941 and 1975, *R. maritimus* was not seen in the Parrett valley (except on the coast and a transient site at Thorney). It was present on the peat-moors but recorded only from *specific* sites rather than described as generally 'plentiful'.

After 1975, it was only found in a small area at the centre of the peat-moor between Catcott Burtle and the R. Roughet.

There is a strong suggestion that *R. maritimus* declined on the Somerset Levels and Moors, surviving only on the peat moors (the core of its former range) where peat cutting and ditch clearance created the open, bare, wet conditions where the dock could germinate, flourish and seed.

A similar marshalling and assessment was undertaken for each of the 500 species covered by the archival search, though for the commonest taxa there may only be summary data. Judgement had to be exercised in the interpretation of a wide range of disparate sources. Any trends identified in the abundance of species might be 1. marked, 2. moderate but unambiguous or 3. slight and based upon data of doubtful quality (Mountford 1994). Species with similar environmental needs which show consistent population or distribution changes were grouped together. Where the abundance or distribution of a species changed between 1840 and 1990, the extent of its preferred habitat can often be shown to have changed also. When species from one habitat show similar changes, there is circumstantial evidence that the cause of the change is some alteration to that habitat. Land-use and drainage data were examined to test whether any changes in the habitat had occurred. Changes in the study areas are described in detail elsewhere (Sheail & Mountford 1984; Mountford & Sheail 1989).

RESULTS

MAJOR TRENDS IN PLANT DISTRIBUTION AND ABUNDANCE

Trends in distribution are summarised in Tables 1–5, which list all taxa for which the sources used provide some evidence of change 1840–1990 (References and Appendix 1). Over half the taxa showed a population change in one or more area.

SPECIES SHOWING NO CHANGE IN POPULATION OR DISTRIBUTION

There were 206 species for which no convincing evidence of population change could be found. This total included:

– Species where the published sources differed in precision (giving an impression of change), e.g. *Carex pilulifera* L.

– Taxonomically difficult plants, identified by very few botanists, producing insufficient data from which to infer trends, e.g. *Rorippa* × *anceps* (Wahlenb.) Reichb.
– Species where opposing pressures (some favourable, others unfavourable) balanced, resulting in no perceptible change, e.g. *Phragmites australis* (Cav.) Trin. ex Steudel.
– Species whose habitat requirements limited them to a few sites from 1840–1990, e.g. *Potamogeton coloratus* Hornem.
– Ubiquitous species occupying habitats which were as widespread in 1990 as 1840, e.g. *Agrostis stolonifera* L.

SPECIES SHOWING AN INCREASE IN ABUNDANCE AND DISTRIBUTION

50 species showed evidence of spread in at least one study area, although 16 of these declined in another of the three areas (Tables 1 & 2). Of the remaining 34, there is some doubt attached to the quality of the data for 18 (due to taxonomic problems or unevenness of coverage). Only seven spread markedly *and* unambiguously – *Azolla filiculoides* Lam., *Chamerion angustifolium* (L.) Holub, *Elodea canadensis* Michaux, *E. nuttallii* (Planchon) H. St John, *Impatiens glandulifera* Royle, *Nymphoides peltata* Kuntze and *Puccinellia distans* (Jacq.) Parl. Table 1 includes many aliens and colonists (species introduced into grazing marshes from other habitats or parts of Britain). Increasing abundance might be presumed for some species whose preferred habitat became more widespread between 1840 and 1990, but cannot be demonstrated from the sources. These species were classified as unchanged in abundance.

SPECIES INCREASING IN SOME AREAS AND DECREASING IN OTHERS

In most cases, presumed causes of population change and the resulting trends in species were similar in all study areas (Table 6). However, 16 species showed conflicting trends in distribution when the study areas are compared (Table 2). Wade & Edwards (1980) note several species in the Gwent

TABLE 1. SPECIES SHOWN TO HAVE INCREASED IN POPULATION SIZE OR DISTRIBUTION FROM 1840 TO 1990

(a) In all three study areas	
Elodea canadensis	*Potamogeton berchtoldii*?
Elodea nuttallii	*Ranunculus trichophyllus*?
Populus alba?	*Rorippa microphylla*?
(b) In two of the study areas (absent/unchanged in third)	
Azolla filiculoides	*Mimulus guttatus*
Callitriche platycarpa?	*Myriophyllum spicatum*?
Carex acuta?	*Nymphoides peltata*
Chamerion angustifolium	*Petroselinum segetum*
Festuca arundinacea?	*Potamogeton pusillus*?
Glyceria declinata?	*Salix triandra*?
Impatiens glandulifera	*Veronica catenata*?
Lemna gibba	
(c) In one study area (absent/unchanged in other two)	
Alopecurus bulbosus	*Leucojum aestivum*
Barbarea stricta	*Myosurus minimus*?
Chara globularis	*Nitella mucronata*?
var. *annulata*?	*Potamogeton pectinatus*
var. *virgata*?	*Puccinellia distans*
Eleocharis uniglumis?	*Rorippa* × *sterilis*?
Elodea callitrichoides	*Salix viminalis*?
Leersia oryzoides	

Notes: i. Where a question mark follows the species name, there is some doubt about the trend. Data may be inadequate, there may be some taxonomic problem, etc. ii. Where a species has clearly changed in one area, but in one or both the others there is some doubt, no ? is marked. iii. Some species have only ever been recorded in one or two of the study areas. iv. Nomenclature follows Stace (1991) for vascular species, Moore (1986) for Charophytes and local sources (Appendix 1) for some infraspecific taxa.

TABLE 2. SPECIES SHOWN TO HAVE INCREASED IN POPULATION SIZE OR DISTRIBUTION IN ONE OR MORE STUDY AREAS, AND TO HAVE DECREASED IN THE OTHERS FROM 1840 TO 1990

Althaea officinalis	*Potamogeton trichoides*
Bromus commutatus	*Ranunculus baudotii*
Carex vesicaria	*Ranunculus circinatus*
Carex viridula subsp. *viridula*?	*Rorippa amphibia*
Chara hispida subsp. *hispida*?	*Schoenoplectus tabernaemontani*
Epilobium tetragonum subsp. *tetragonum*	*Symphytum officinale*
Persicaria bistorta	*Tolypella nidifica*
Potamogeton natans	*Wolffia arrhiza*

Notes: see Table 1.

Levels whose distribution trends differ from those observed in the present study, reflecting the importance of local factors in determining floristic change.

SPECIES SHOWING A DECREASE IN ABUNDANCE OR DISTRIBUTION

Just over half the species included in the archive search underwent an apparent contraction in range or decline in frequency after 1840 (Tables 3 & 4). Of these, 123 species declined markedly, 94 becoming extinct in at least one, and 23 in two or all study areas (Table 4). In all areas, many more species declined from 1840–1990 than increased (Tables 5 & 6).

The sources used note plants that decreased during the lifetime of the botanist, frequently suggesting reasons for that decline. Most of the causes advanced involve the activities of a burgeoning human population (especially agricultural improvement), but some natural changes were also suggested as factors in species decline. Suggested causes include:

Drainage: the commonest factor proposed as a cause for species loss in wetlands, e.g. *Myrica gale* L., *Parnassia palustris* L., *Ranunculus lingua* L., *Lythrum salicaria* L., *Narthecium ossifragum* (L.) Hudson and *Vaccinium oxycoccos* L. (Gibbons 1975); *Thelypteris palustris* Schott, *Dryopteris cristata* (L.) A. Gray, *Drosera rotundifolia* L., *Empetrum nigrum* L., *Viola persicifolia* Schreber and species of the Misson "fenny fields" (Howitt & Howitt 1963); *Valeriana dioica* L. and *Carex pulicaris* L. (Roe 1981); *Althaea officinalis* L. (Hanbury & Marshall 1899); *Cyperus longus* L. (White 1912).

Peat-digging: e.g. *Hypericum elodes* L. (White 1912; Sandwith files; Roe files); *Andromeda polifolia* L. (Roe 1981); *Rhynchospora fusca* (L.) Aiton f. (Murray 1896; Roe 1981).

Flooding acid peat and alkaline water: *Utricularia minor* L. (Storer 1985 and files; Roe, pers. comm. 1982).

Enclosure and grazing: e.g. *Vaccinium myrtillus* L. (Lees 1888); *Juncus effusus* L. (Raine 1980).

Cultivation (fertilisers, liming, ploughing or reseeding): e.g. *Colchicum autumnale* L., *Orchis morio* L. and *Primula veris* L. (Roe 1981); *Genista tinctoria* L. (White 1912); *G. anglica* L. and *Rhinanthus minor* L. (Lees 1888); *Botrychium lunaria* (L.) Sw. and *Sanguisorba officinalis* L. (Gibbons 1975).

Watercourse management and pollution: e.g. *Hottonia palustris* L. and *Rumex hydrolapathum* Hudson (Gibbons 1975); *Stratiotes aloides* L. (Roe files); *Rorippa sylvestris* (L.) Besser, *Valeriana officinalis* L. (Gibbons 1975) and submerged aquatics especially pondweeds – herbicide (Howitt day-book); *Ranunculus fluitans* Lam. – colliery effluent (Howitt & Howitt 1963).

Sea defences: e.g. salt-tolerant species at the Midrips and Wicks, Kent (N. W. Moore, pers. comm. 1981).

Industrialisation and urbanisation: e.g. *Blysmus compressus* (L.) Panzer ex Link (White 1912; Roe files); *Cladium mariscus* (L.) Pohl and *Carex elata* All. (Roe files; Sandwith files); *Salix aurita* L. (Howitt & Howitt 1963).

Deliberate eradication or collection: e.g. *Colchicum autumnale* (Roe 1981); *Lychnis flos-cuculi* L. (Willis & Jefferies 1959); *Osmunda regalis* L. (White 1912); Pteridophyta (Gibbons 1975).

TABLE 3. SPECIES SHOWN TO HAVE DECREASED IN POPULATION SIZE OR DISTRIBUTION FROM 1840 TO 1990

(a) In all three study areas

Alnus glutinosa	*Nymphaea alba*
Anagallis tenella	*Ophioglossum vulgatum*
Apium inundatum	*Orchis morio*
Baldellia ranunculoides	*Osmunda vulgaris*
Bidens cernua	*Pedicularis palustris*
Caltha palustris	*Potamogeton alpinus*
Carex diandra	*Potamogeton polygonifolius*
Carex pulicaris	*Potentilla palustris*
Chara globularis subsp. *globularis*?	*Primula veris*
Chara vulgaris var. *longibracteata*?	*Ranunculus lingua*
Dactylorhiza praetermissa	*Rumex maritimus*
Eriophorum angustifolium	*Rumex palustris*
Galium uliginosum	*Sium latifolium*
Hydrocotyle vulgaris	*Sparganium natans*
Juncus squarrosus	*Stellaria uliginosa?*
Menyanthes trifoliata	*Veronica scutellata*
Myriophyllum verticillatum	

(b) In two of the study areas (absent/unchanged in third)

Achillea ptarmica	*Lotus glaber*
Acorus calamus	*Lychnis flos-cuculi*
Apium graveolens	*Mentha pulegium*
Briza media	*Molinia caerulea*
Butomus umbellatus	*Montia fontana?*
Callitriche truncata	*Myrica gale*
Carex curta	*Myriophyllum alterniflorum*
Carex disticha	*Narcissus pseudonarcissus*
Carex divisa	*Narthecium ossifragum*
Carex echinata	*Nuphar lutea*
Carex elongata	*Pedicularis sylvatica*
Carex hostiana	*Persicaria laxiflora*
Carex pallescens	*Persicaria minor*
Carex viridula subsp. *brachyrrhyncha*	*Peucedanum palustre*
Catabrosa aquatica	*Platanthera bifolia*
Chara vulgaris	*Potamogeton gramineus*
var. *papillata*?	*Potamogeton lucens*
var. *vulgaris*?	*Potamogeton perfoliatus*
Cirsium dissectum	*Radiola linoides*
Cirsium palustre	*Ranunculus flammula*?
Cladium mariscus	*Ranunculus hederaceus*
Coeloglossum viride	*Ranunculus peltatus*
Colchicum autumnale	*Ranunculus penicillatus*?
Dactylorhiza incarnata subsp. *incarnata*	*Rhinanthus minor* s.l.
Dactylorhiza maculata	*Rhynchospora alba*
Drosera intermedia	*Sagittaria sagittifolia*
Eleocharis quinqueflora	*Sagina nodosa*
Epipactis palustris	*Salix aurita*
Erica cinerea	*Salix repens*?
Erica tetralix	*Schoenus nigricans*
Eriophorum vaginatum	*Senecio aquaticus*
Frangula alnus	*Spirodela polyrhiza*
Groenlandia densa	*Stachys × ambigua*
Hippuris vulgaris	*Stachys palustris*
Hottonia palustris	*Stellaria palustris*
Hydrocharis morsus-ranae	*Succisa pratensis*
Juncus bulbosus	*Thelypteris palustris*
Juncus effusus?	*Utricularia minor*
Lathyrus palustris	*Utricularia vulgaris* s.s.

TABLE 3. *cont.*

Vaccinium oxycoccos
Valeriana dioica
Valeriana officinalis
Veronica anagallis-aquatica?
Viola canina
Viola palustris

(c) Clearly declined or extinct in one study area (absent or unchanged in other two)

Alopecurus aequalis +
Alopecurus pratensis
Antennaria dioica +
Aster tripolium
Bidens tripartita
Blechnum spicant
Blysmus compressus +
Blysmus rufus +
Bupleurum tenuissimum
Calluna vulgaris
Carex distans
Carex elata
Carex extensa +
Carex laevigata
Carex limosa +
Carex nigra
Carex panicea +
Carex paniculata
Carex pseudocyperus
Carex rostrata +
Ceratophyllum submersum
Chenopodium chenopodioides
Danthonia decumbens
Deschampsia cespitosa
Dryopteris carthusiana
Dryopteris cristata +
Eleocharis multicaulis +
Eleogiton fluitans
Empetrum nigrum +
Euphrasia arctica
Galeopsis segetum +
Genista anglica +
Gentiana pneumonanthe +
Geum rivale
Gnaphalium uliginosum
Gymnadenia conopsea
subsp. *conopsea*
subsp. *densiflora*
Hammarbya paludosa +
Hordeum marinum
Huperzia selago +
Hypericum maculatum
Iris pseudacorus
Isolepis setacea +
Juncus gerardi
Juncus subnodulosus
Lactuca saligna
Lepidium latifolium +
Limosella aquatica +
Lycopodiella inundata +
Lycopodium clavatum
Lysimachia thyrsiflora +
Lysimachia vulgaris
Lythrum salicaria
Mentha × *verticillata*
Mimulus moschatus +
Nardus stricta
Oenanthe lachenalii +
Ononis spinosa
Orchis ustulata
Petasites hybridus
Peucedanum ostruthium +
Pinguicula lusitanica
Potamogeton compressus +
Potamogeton × *lintonii* +
Potamogeton × *salicifolius* +
Potamogeton × *sparganifolius*
Prunus padus
Puccinellia fasciculata
Puccinellia maritima
Pyrola minor +
Ranunculus fluitans
Ranunculus omiophyllus +
Ranunculus sardous
Ranunculus tripartitus +
Rhynchospora fusca +
Ribes rubrum
Rumex hydrolapathum
Ruppia cirrhosa
Ruppia maritima
Salicornia ramosissima
Sanguisorba officinalis
Saxifraga granulata
Scheuchzeria palustris +
Schoenoplectus lacustris
Scirpus sylvaticus +
Selaginella selaginoides +
Sparganium angustifolium +
Suaeda maritima
Taraxacum palustre +
Thalictrum flavum
Triglochin maritimum
Triglochin palustre
Utricularia australis
Veronica beccabunga
Viola persicifolia +
Wahlenbergia hederacea
Zannichellia palustris

(d) Possibly declined or extinct (?) in one study area (absent or unchanged in other two)

Angelica sylvestris
Berula erecta
Calamagrostis canescens
Callitriche hamulata
Carex remota
Carex vulpina s.s.
Ceratophyllum demersum
Chara pedunculata
Chara vulgaris
var. *crassicaulis*

TABLE 3. *cont.*

Eupatorium cannabinum	*Nitella translucens*
Filipendula ulmaria	*Oenanthe crocata*
Glyceria maxima	*Persicaria hydropiper*
Hypericum tetrapterum	*Potamogeton praelongus*
Juncus acutiflorus	*Ranunculus aquatilis*
Juncus ambiguus	*Salix purpurea*
Juncus bufonius s.s.	*Scrophularia auriculata*
Juncus conglomeratus	*Scutellaria galericulata*
Juncus × *diffusus*	*Sison amomum*
Lotus pedunculatus	*Tolypella intricata*
Luzula pallidula +	*Tolypella prolifera*
Mentha × *smithiana*	*Utricularia intermedia*
Myosotis scorpioides	*Viburnum opulus*

Notes: Where a species has become extinct in one study area, but is unchanged or unrecorded in the others, it is marked as +. (Species which have become extinct in more than one study area are included in Table 4.) See also Table 1.

TABLE 4. SPECIES SHOWN TO HAVE BECOME EXTINCT IN MORE THAN ONE STUDY AREA BEFORE 1990, WITH DATES OF LAST RECORD IN EACH STUDY AREA

(a) In all three study areas	
Littorella uniflora (S 1895, R 1899, I 1876)	
Myosotis secunda? (S 1960, R 1960, I 1888)	
Scutellaria minor (S 1914, R 1829, I 1880)	
Stratiotes aloides (S 1976, R 1875, I 1855)	
(b) In the Somerset Levels and Moors and Romney Marsh	
Cyperus longus (S 1896, R c. 1830)	*Juncus squarrosus* (S 1912, R c. 1850)
Eleocharis acicularis (S 1907, R c. 1900)	*Potamogeton friesii* (S 1914, R 1909)
(c) In the Somerset Levels and Moors and Idle/Misson Levels	
Andromeda polifolia (S 1920, I 1833)	*Parnassia palustris* (S 1782, I 1847)
Botrychium lunaria (S 1955, I 1955)	*Pinguicula vulgaris* (S 1928, I c. 1905)
Carex dioica (S 1855, I 1840)	*Potamogeton alpinus* (S 1881, I 1944)
Cicuta virosa (S 1888, I 1850)	*Rhinanthus angustifolius* (S 1918, I 1960)
Drosera longifolia (S 1970, I 1893)	*Trichophorum cespitosum* (S 1972, I 1905)
Hypericum elodes (S 1914, I 1896)	*Vaccinium oxycoccos* (S 1919, I 1815)
(d) In the Romney Marsh and Idle/Misson Levels	
Anagallis tenella (R 1959, I 1855)	*Oenanthe silaifolia* (R 1839, I 1930?)
Drosera rotundifolia (R ?, I 1959)	

Note: Numbers in brackets after species name are the dates of the last record, annotated with the appropriate study area: S (Somerset Levels and Moors), R (Romney Marsh) and I (Idle/Misson Levels).

Succession: "upright-leaf and floating-leaf formations" (Moss 1907); *Sparganium natans* L. (Storer files).

Drought: e.g. *Drosera longifolia* L. (Gibbons 1975); *Schoenus nigricans* L. (White 1912); *Stratiotes aloides* (Roe files).

For most species, contemporary accounts do not suggest the cause of observed population changes. Table 7 groups species that have declined in at least one of the study areas according to their habitat and the probable cause of their decline. Species are allotted to a group when archive sources (Appendix 1) indicate a link with some environmental change or where they are typical of the plant community affected by this change (Ellenberg 1988; Rodwell 1991a, 1991b, 1992, MSS).

TABLE 5. TOTAL NUMBER OF SPECIES INCREASING OR DECREASING IN POPULATION AND DISTRIBUTION IN THREE ENGLISH GRAZING MARSHES – 1840–1990

I. Species increasing in population and distribution (35 species)			
	Pronounced increase	Moderate increase	Data poor
Three study areas	2	0	4
Two study areas	4	3	8
One study area	1	7	6
Totals	7	10	18
II. Species increasing in some and decreasing in other study areas: 16			
III. Species decreasing in population and distribution (269 species)			
	Pronounced decrease	Moderate decrease	Data poor
Three study areas	19	14	4
Two study areas	53	39	8
One study area	51	47	34
Totals	123	100	46
IV. Species with no change in population and distribution: 206			

DISCUSSION

The importance of documenting the declining status of species was realised as early as the nineteenth century (Sheail 1982) and the value of artificial habitats such as grazing marsh ditches for "substituted plant associations" identified by Moss (1907) long before the contribution of these modified wetlands was generally accepted. Written records, herbaria and published accounts have been used to reconstruct the past vegetation pattern. Such sources contribute to an assessment of the scale and speed of environmental change over the past 150 years. Broad trends can be identified and, following comparison with knowledge of the species' ecology and present distribution, inferences made as to the cause for such trends (Table 7).

SPECIES INCREASING IN ABUNDANCE AND DISTRIBUTION

Aliens and denizens showed the clearest evidence of increased abundance. Such species were often absent from the study areas in 1840. Some were deliberately introduced later as ornamentals (e.g. *Nymphoides peltata* and *Populus alba* L.) or as crops (e.g. *Rorippa* × *sterilis* Airy Shaw and *Salix* spp.). Others escaped from gardens (e.g. *Impatiens glandulifera* Royle and *Mimulus* spp.) or from aquaria and ponds (e.g. *Azolla filiculoides* Lam. and *Elodea nuttallii*).

Amongst native species, some increased because their preferred habitat became more extensive e.g. drainage for peat-cutting combined with burning created a dry, disturbed soil favouring *Chamerion angustifolium*. Others were favoured by particular management, enabling them to compete effectively e.g. increased dredging, resulting in more deep water, may explain the increase of *Potamogeton berchtoldii* Fieber. Field survey showed *P. berchtoldii* was typical of newly dredged ditches both in the study areas and in Gwent (Wade & Edwards 1980).

Changes in water quality contributed to the spread of certain species. *Lemna gibba* L. and *Potamogeton pectinatus* L. tolerate eutrophic, polluted water (Ellenberg 1988). Once rather rare and largely coastal in the Somerset Levels, *L. gibba* is now common throughout the area, especially in managed drains with high nutrient levels. Reduced salinity (by improved sea defences and flood control) alters water quality. Some plants may have spread into the coastal levels from which they were previously excluded by salinity e.g. *Myriophyllum spicatum* L. (Scotter *et al.* 1977).

Locally increased salinity led to the spread of some plants. In the Romney Marsh, *Puccinellia distans* was once confined to coastal salt-marshes and a few sites inland with saline ground-water in

TABLE 6. NUMBERS OF SPECIES SHOWING A CHANGE IN ABUNDANCE IN EACH OF THREE ENGLISH GRAZING MARSHES OVER THE PERIOD 1840–1990
(Modified after Mountford & Sheail 1989)

(a) Somerset Levels and Moors

Increase in abundance and/or distribution				Decrease in abundance and/or distribution				
+++	+	?	Total	†	—	–	?	Total
6	12	18	36	31	48	43	31	153

(b) Romney and Walland Marshes

Increase in abundance and/or distribution				Decrease in abundance and/or distribution				
+++	+	?	Total	†	—	–	?	Total
4	2	14	20	37	25	55	40	157

(c) Idle/Misson Levels

Increase in abundance and/or distribution				Decrease in abundance and/or distribution				
+++	+	?	Total	†	—	–	?	Total
2	3	15	20	53	30	53	15	151

Increases: +++ = marked; + = moderate; ? = trend slight or doubtful.
Decreases: — = marked; – = moderate; ? = trend slight or doubtful; † = extinct.

TABLE 7. SPECIES DECREASING IN POPULATION SIZE AND DISTRIBUTION IN AT LEAST ONE OF THREE ENGLISH GRAZING MARSHES, CLASSIFIED IN TERMS OF TYPICAL HABITAT AND SUSPECTED CAUSE OF DECLINE, 1840–1990

Preferred habitat or vegetation type	Suspected cause of decline	Total number of species
Wet woodland	Felling and drainage	21
Acid bog and heath	Peat cutting and drainage	76
Rich fen and tall wet meadow	Drainage and conversion to pasture or arable	60
Old wet grassland	Drainage and conversion to intensive grassland or arable	55
Grazing marsh ditches and pools	1. Regrading conversion to trapezoidal section 2. Overgrowing, increased shade and siltation 3. Elimination due to field rationalisation	73
Open water	Aquatic herbicides	28
Open water	Pollution and increased turbidity	39
Bare wet mud and peat	Fencing of ditches and control of water-levels	13
Saline habitats	Tidal control and sea defence improvement	17
Varied	Urbanisation and industrial development	17
Varied	Weed control and collection by botanists	8
Varied	No clear cause	7

peaty layers (Green 1968). In recent years it has increased along those more important roads that receive regular de-icing salt during the winter (Philp 1982).

SPECIES DECREASING IN ABUNDANCE AND DISTRIBUTION

1. Drainage: water-table change and plant community structure. Community composition may be in equilibrium with a particular water-regime, such that either drainage or flooding can change that composition (Thibodeau & Nickerson 1985). Wetland drainage may influence community structure not only through changes in water-table, but also through altered inputs of dissolved nutrients (Meade & Blackstock 1988). Those species requiring high water tables and oligotrophic peat are the first to disappear, followed by those needing wet pasture, fen and open water (Sheail & Wells 1983).

a. Decline due to drainage and felling of wet woodland. 21 species which prefer wet alder woodland with birch and willow declined in the study areas. Most are typical of waterlogged soils that are nitrogen-deficient or mesotrophic (Ellenberg 1988). Those present in the study areas are mainly planted and were not extensive: birch and osiers on peat in Somerset (Moss 1907) or pine on sand and gravel near the R. Idle. In recent years, woodland has been cleared and the water-table lowered for extraction of gravel. The Idle/Misson woods on sand were vulnerable to drying out following the upgrading of the Stockwith pump, and though the total wooded area did not diminish from 1840 to 1990, the older woods were felled and new plantations have not acquired a shade flora. There are no woods on the Romney Marsh, though woodland plants occur on overgrown drain banks.

b. Decline due to drainage and peat cutting on acid bog. Peat-cutting for fuel or horticulture and reclamation for farming have greatly reduced the area of raised bog (Goode 1981; Limbert 1988), though new mire communities may develop on abandoned cuttings (Giller & Wheeler 1986; Smart *et al.* 1986). Wet heath and bog species grow in permanently wet, acid sites poor in nitrogen and many are typical of the oceanic fringe of Europe (Ellenberg 1988).

Peat cutting is the single most important cause of species extinction in the study areas, particularly Somerset and the Idle valley. Of the 76 species typical of wet heath and bog to have declined, almost 30 have become extinct. This scale of extinction was also observed at Holme Fen in Huntingdonshire (Sheail & Wells 1980). All but one of the 33 wetland species to have become extinct at Holme Fen since 1800 also show a serious decline in one or more of the study areas. The turbary peats of the Brue valley in Somerset have been cut for many years and those species which require an actively growing raised bog surface have been exterminated (Hope-Simpson & Willis 1955). When the peat surface was lowered, calcifuge species were displaced as the bog became flooded by alkaline water from the adjacent limestone uplands.

c. Decline due to drainage and cultivation/grazing of fen. Primevally, fens were extensive in all three areas, notably Somerset (Moss 1907; Williams 1970). Fens occur on peaty soils and are minerotrophic wetlands, dominated by tall grasses, sedges and rushes (Wheeler 1983). Fen species are typical of moist to permanently wet sites, on weakly acid or basic soils that are nitrogen-deficient (Ellenberg 1988). Fen peat shrinks and oxidises rapidly following drainage. The consequent lowering of the land surface puts pressure on the capacity of pumps to remove water and may necessitate the installation of more powerful pumps (Hutchinson 1980). 60 plants of rich fen and tall wet meadow declined in one or more study area. In contrast to the many extinctions in acid bog, most fen species showed only a moderate decline, surviving in fragmented wetlands or on ditch banks in the grazing marsh (Moss 1907). Early drainage and cultivation converted much fen into grassland. Typical tall fen species survived in wet hay meadow but were eradicated from pasture.

Fen fragments survived in Somerset in 1990, especially on Altcar soils at the edge of the turbary moors or where cutting has removed acid peat. Fen meadows are more widespread, both on Altcar and Midelney soils. In the nineteenth century, fens survived in the Romney Marsh by 'fleets' (creeks), near the south coast and, in a modified form, in the >700 ha of rough grazing. By 1980, some fleets had been eliminated or affected by farming; improvements to sea defences and drainage had altered coastal wetlands, and rough grazing had been reduced to under 400 ha (M.A.F.F. 1968; Latimer 1980). Near the R. Idle, washlands, fens and fen meadows occurred widely in the nineteeth century. The land downstream of Misson was still ". . . a sea of *Glyceria maxima* . . ." in 1955

(Howitt day book – 21 July). The fen meadows were drained in the 1950s, and the washes converted to arable in the 1970s after the upgrading of the Stockwith pump (Howitt & Howitt 1963; Severn-Trent Water Authority 1974). By 1980, most of the area was intensive arable land with fen vegetation present largely confined to a few ditch banks.

d. Decline due to drainage of old wet grassland, followed by reseeding or conversion to arable agriculture. Traditional management of grazing marsh grassland involved either year-round sheep-grazing or a summer hay cut and aftermath grazing, followed by waterlogging in winter. Agricultural improvement, with increased use of fertiliser and pesticides, resulted in the conversion of pasture to arable or increased stocking rates which altered grassland composition. In most grazing marshes, much grassland was converted to arable in the twentieth century. For example, in 1930, all Broadland marshes were under grass, but by 1984, 37% of the area was tilled (Driscoll 1985) whilst in East Essex, coastal grazing marsh declined by 82% after 1938 (Williams & Hall 1987). The composition of the wet grassland flora overlaps with that of fens but grassland species are more light-loving, typical of warmer conditions and soils that are somewhat more acidic (Ellenberg 1988). Nitrogen mineralisation can increase 5–10 fold in meadows following lowering of the water-table. Thus drainage (with no other agricultural improvement) can also reduce species richness (Grootjans *et al.* 1985).

In the study areas, most of the grassland species which have declined are typical of moist meadows, though some are associated with manured meadows, fairly dry calcareous or poor swards. Wet grassland species may have spread during the early phase of drainage when mires were reclaimed for grazing, but with the expansion of arable land, they became restricted to farms practising traditional grazing. 55 species of wet grassland have declined in one or more of the study areas, 70% showing only a slight decline. In Somerset, permanent grass is the main land use, but much of this has been improved resulting in the loss of the old grassland flora (Bradford 1978). Fertiliser use suppresses sedges, rushes and low-growing wetland forbs (Mountford *et al.* 1993). In the Romney Marsh, the proportion of permanent grass fell from 81% in 1939 to 35% in 1980 (M.A.F.F. parish returns). In the R. Idle area, old grassland is less extensive than in the other study areas and much rarer than formerly, only surviving near Bawtry, locally elsewhere on the Idle washlands and around the Misson Line Bank (Mountford & Sheail 1985).

2. *Open water: grazing marsh ditches and pools.* Mires naturally include areas of open water but when they are reclaimed, grazing marshes, ditches for drainage and ponds for watering stock are created. This open water may be further modified as the needs of agriculture change.

a. Decline due to the altered management of ditches and pools. The ability of drainage ditches to act as refuges for wetland plants was affected by the methods used to manage them. After 1840, the ditches and ponds of grazing marshes underwent two changes. On the one hand, with improvement of main channels, pump and under-drainage, some field ditches became redundant and were either filled in or allowed to silt up, losing their aquatic vegetation through succession. In contrast, the remaining ditches were liable to more intense management to ensure effective removal of excess water.

There are rather few quantitative data on ditch removal. In Broadland, 33.5% of dykes were lost between 1973 and 1981 when old grassland was ploughed for arable farming (Driscoll 1983, 1985). In similar circumstances in the Pevensey Levels, the loss of dyke habitat was 40% (Palmer 1986). From 1908 to 1986 in Hatfield Chase, the length of ditch managed by farmers decreased by 36% (Wingfield & Wade 1988). In Gwent, still mainly pastoral, the loss of ditch length between 1882 and 1975 was only 14% (Wade 1977).

Much of the Somerset Levels remained under grass after 1840, with little under-drainage. Consequently, few ditches became redundant, overgrown or were eliminated. In contrast, there is ample evidence of ditch elimination in the Romney Marsh, particularly where grassland has changed to arable (Latimer 1980; Mountford & Sheail 1982). Field survey of the Idle valley in 1983 indicated that 25% of ditches had been destroyed since 1950 (Mountford & Sheail 1985).

Ditches or natural streams are often regraded during drainage schemes, to accommodate increased run-off of water. Aquatic and bankside vegetation are removed (Hill 1976). If there is no further dredging, however, most species will return within two years (Haslam 1978). Channel maintenance and weed control can have a profound effect on the vegetation of ditches (Mitchell 1974). Ditch maintenance methods changed after 1950, with mechanical and chemical techniques replacing manual ones (Newbold *et al.* 1989). The intensity of management varies, from more than once each year in main channels to less than once in ten years in field ditches. Floristic composition depends both on the management method used (Beltman 1984, 1987) and the frequency and date of the last maintenance (Wade 1978).

Changes in the extent or management of watercourses were involved in the decline of 73 species. Most were typical of well-lit sites, but representing the wide range of aquatic and swamp communities present in grazing marsh ditches (especially *Lemnetea*, *Potamogetonetea* and *Phragmitetea*, but also, locally, three other classes and three alliances (Ellenberg 1988)).

A particular method of ditch maintenance (chemical weed control) may be partly responsible for the decline of 25 flowering plants and three genera of stonewort (*Chara*, *Nitella* and *Tolypella*). Aquatic herbicide use is usually confined to drains managed by the National Rivers Authority or Internal Drainage Boards. Herbicides have short-term effects on aquatic habitats and longer term impacts dependent on the degree of habitat destruction and herbicide persistence. Different species have differing susceptibilities (Newbold 1975). Although implicated in the decline of some species (Howitt, pers. comm. 1983), Wade & Edwards (1980) thought it unlikely that herbicide use had been responsible for the extinction of any macrophyte in Gwent where there was little evidence of long term change in the ditch flora. In contrast, all the present study areas showed a decline in aquatic macrophytes.

b. Decline due to pollution of ditches and pools. Drainage of wetlands and farmlands alters water chemistry through: 1. increased nitrate nitrogen derived from fertiliser; 2. increased release of calcium, magnesium and potassium; 3. reduced phosphorus transport due to reduced surface run-off; 4. soluble pesticides; and 5. oxidation of iron pyrites to colloidal iron hydroxide ('iron ochre') in acid sulphate soils (Hill 1976; Marshall 1981, 1984; Swales 1982). Increased nutrient loads lead to an increase in the biomass of some macrophytes, whilst others decline (Boar *et al.* 1989). Overall, eutrophication reduces species diversity, alters the dominants, increases turbidity and the rate of sedimentation and causes anoxic conditions to develop (Mason 1981).

In all study areas species whose decline is associated with pollution include those typical of nitrogen-poor sites (N indicator value <4) (Ellenberg 1988). In addition, in the Romney Marsh and Somerset, other *submerged* species have declined, with wider nutrient tolerance but vulnerable to the reduced light levels following increased turbidity. This may explain the observed spread of *Potamogeton pusillus* L. in Broadland and the decline of *P. perfoliatus* L. (Driscoll 1982).

c. Decline due to fencing or penning of water levels. Open wet soil occurs where water levels are allowed to vary naturally in response to weather or where stock trample the margins. Conversion to arable or fencing halts bank poaching (Driscoll 1984) and control of water level (penning in summer to maintain wet fences or pumping down) eliminates wet mud or alters its seasonal occurrence. The filling in of redundant farm ponds, once intensely grazed and trampled, has further contributed to the reduction of the wet mud habitat.

A well defined group of 13 declining species was typical of herbaceous vegetation in this habitat including wet, often winter-flooded, depressions, newly flooded sites and peat cuttings. The species are mostly annuals of well-lit sites, over a wide range of soil acidity, but with some trend toward sites richer in available nitrogen (Ellenberg 1988).

3. *Coastal and other habitats.* Grazing marshes are usually coastal in Britain, created as a late stage in the impoundment and reclamation of saltmarsh. Certain species have declined in the study areas but their reduced population has been caused by factors other than, or additional to, drainage and watercourse management.

a. Decline due to tide control and improved sea defences. Impoundment leads to decreased salinity and less exchange between marsh water and estuarine water, both in nutrients and biota (Montague *et al.* 1987; Wade & Edwards 1980). In Gwent, main drains were much less saline than the less frequently dredged minor channels (Wade 1978) whilst in Broadland, saline ground-water seeped into ditches from the adjacent water-table after drainage (Driscoll 1985).

There is salt water adjacent to all the study areas, but sea-floods and tidal rivers are now much more carefully controlled than formerly, reducing the saline input. Hence, 17 coastal species declined from 1840 to 1990. Such species once occurred not only where coastal vegetation gave way to grazing marsh but also further inland (Green 1968).

b. Decline due to urbanisation and industrialisation. Human habitation and industry greatly expanded from 1840 to 1990, and within the study areas, became particularly extensive near the coast. Certain species, often coastal or halophytic, once mainly occurred in those areas since urbanised. Such development often cannot be distinguished from the improvement of sea defences as the cause of their decline. Contemporary accounts record how housing and industry destroyed notable plant localities, both in the study areas (see Results) and elsewhere (Wade & Edwards 1980).

Increased human population has had indirect effects on the flora. Disposal of urban or industrial waste puts pressure on wetlands, e.g. pulverised fuel ash in Gordano. Improved transport systems were built to accommodate traffic, damaging adjacent sites. Sand and gravel extraction is a feature of the Idle valley, but was not cited as a cause of species decline, and indeed subsequent flooding of the pits may have increased the diversity of wetlands. However, gravel dredging near Camber destroyed a site for *Ruppia cirrhosa* (Petagna) Grande (Hall 1980).

c. Decline due to terrestrial weed control and collection. Some plants are identified by graziers as poisonous weeds in pasture and removed, e.g. *Colchicum autumnale*. Weed control and the drainage or destruction of grassland may be confounded as causes of species decline. A few wetland species were also arable weeds and were the target of improved cultivation. Direct effects of herbicides on the wet grassland were noted in Gordano (Willis & Jefferies 1959). Enthusiasm for plants, every bit as much as antipathy, may lead to them being removed deliberately. The Victorian fern craze led to the decline of many species, including several from the grazing marshes.

The cause of decline in seven species is unclear. These include taxonomically difficult plants that may now be overlooked and cultivated species that could require continued reintroduction to ensure survival in the wild.

CONCLUSIONS

Drainage and land use change modified or destroyed large areas of wetland in England. The resultant decline and local extinction of many wetland species was recognised by Salisbury (1927) who showed that the decrease of wetland species was both more pronounced and more comprehensive than in any other major habitat. If data on species decline since 1930 are examined at a national scale, the most significant decrease is observed in wetland and grassland species (Ratcliffe 1984).

This study of three English grazing marshes not only confirms the broad trend, but demonstrates that between 20 and 33% of declining wetland species have become locally extinct, even over as large an area as the Somerset Levels and Moors. The decline has been most severe in mires, particularly raised bogs. There is evidence that the watercourses have become a major refuge for plants, and that the decline in macrophytes was less marked (Moss 1907; Mountford & Sheail 1989). However, even in drainage channels, there is ample evidence of reduced populations and distribution, in which respect the study areas contrast with the relative lack of long-term change in Gwent (Wade & Edwards 1980). Despite the choice of study areas to reflect differing degrees of agricultural impact, comparable large declines were observed in all three. Only in the case of extinction did the intensively farmed Idle/Misson levels show the markedly greater effect that was predicted. The dependence of the present upon the past in community structure and conservation can clearly be observed in the flora of grazing marshes.

ACKNOWLEDGMENTS

The results presented here were gathered as part of the botanical component of a project funded by the then Nature Conservancy Council, whose national (Dr Chris Newbold and Margaret Palmer) and regional staff were a ready source of encouragement and information. My particular thanks go to Prof. John Sheail (I.T.E.), my collaborator in the larger project. The study depended for its success on access to a wide variety of published and manuscript information. The then vice-county recorders of the Botanical Society of the British Isles made available their files and records of plant distribution: the late Miss E. J. Gibbons, the late Mr R. C. L. Howitt, Mr E. G. Philp, Capt. R. G. B. Roe and the late Dr W. A. Sledge. Other individuals who had conducted surveys of a particular study area also provided data: Mr E. G. and Mrs L. B. Burt, Dr J. Hodgson, Dr W. Latimer, Dr F. Rose, Mr B. Storer, Prof. A. J. Willis and Mrs P. A. Wolseley. Archive material and unpublished data were contributed by Drs E. J. P. Marshall and P. M. Wade, as well as staff of the local biological records centres at Bristol, Doncaster, Nottingham and Scunthorpe. Access to data at the Biological Records Centre (Monk's Wood) was eased by D. M. Greene and C. D. Preston. The figures were drawn by Claire Malkowski.

REFERENCES

Beltman, B. (1984). Management of ditches. The effect of cleaning ditches on the aquatic coenoses. *Verhandlungen des Internationalen Vereins für Limnologie* **22**: 2022–2028.

Beltman, B. (1987). Effects of weed control on species composition of aquatic plants and bank plants and macrofauna in ditches. *Hydrobiological Bulletin* **21**: 171–179.

Boar, R. R., Crook, C. E. & Moss, B. (1989). Regression of *Phragmites australis* reedswamps and recent changes of water chemistry in the Norfolk Broadland, England. *Aquatic Botany* **35**: 41–55.

Bradford, R. (1978). *A report on the botanical evaluation of the meadows and other nature conservation interests in the Somerset Levels, 1977–8.* Nature Conservancy Council, Taunton.

Driscoll, R. J. (1982). The dyke vegetation at Oby and Thurne: a comparison of late nineteenth century and recent records. *Transactions of the Norfolk & Norwich Naturalists' Society* **26**: 43–49.

Driscoll, R. J. (1983). Broadland dykes: the loss of an important wildlife habitat. *Transactions of the Norfolk & Norwich Naturalists' Society* **26**: 170–172.

Driscoll, R. J. (1984). Changes in land use in the Thurne catchment area during the period 1931–32 to 1973. *Transactions of the Norfolk & Norwich Naturalists' Society* **26**: 282–290.

Driscoll, R. J. (1985). The effects of changes in land management on the dyke flora at Somerton and Winterton. *Transactions of the Norfolk & Norwich Naturalists' Society* **27**: 33–41.

Ellenberg, H. (1988). *Vegetation ecology of Central Europe*, 4th ed. Cambridge.

Gibbons, E. J. (1975). *The flora of Lincolnshire.* Lincoln.

Giller, K. E. & Wheeler, B. D. (1986). Past peat cutting and present vegetation pattern in an undrained fen in the Norfolk Broadland. *Journal of Ecology* **74**: 219–247.

Goode, D. A. (1981). The threat to wildlife habitats. *New Scientist* **89**: 219–223.

Green, R. D. (1968). *Soils of Romney Marsh.* Soil Survey of England & Wales, Harpenden.

Grootjans, A. P., Schipper, P. C. & van der Windt, H. J. (1985). Influence of drainage on N-mineralisation and vegetation response in wet meadows. I. *Calthion palustris* stands. *Acta Oecologica/Oecologia Plantarum* **6**: 403–417.

Hall, P. C. (1980). *Sussex plant atlas.* Brighton.

Hanbury, F. J. & Marshall, E. S. (1899). *Flora of Kent.* London.

Haslam, S. M. (1978). *River plants: the macrophyte vegetation of watercourses.* Cambridge.

Hill, A. R. (1976). The environmental effects of agricultural land drainage. *Journal of Environmental Management* **4**: 251–274.

Hope-Simpson, J. F., Newton, S. E. & Ricketts, M. J. (1963). Plant communities on Shapwick Heath, Somerset. *Proceedings of the Bristol Naturalists' Society* **30**: 343.

Hope-Simpson, J. F. & Willis, A. J. (1955). Vegetation, in MacInnes, C. M. & Whittard, W.F., eds. *Bristol and its adjoining counties*, pp. 91–109. Bristol.

Hope-Simpson, J. F. & Willis, A. J. (1973). Chapter 6. Appendix to MacInnes, C. M. & Whittard, W.F., eds. *Bristol and its adjoining counties*, pp. 340–342. Bristol.

Howitt, R. C. L. Day books, files and maps. [Consulted at owner's residence.]

Howitt, R. C. L. & Howitt, B. M. (1963). *A Flora of Nottinghamshire.* Privately published.

Hutchinson, J. N. (1980). The record of peat wastage in the East Anglian Fenlands at Holme Post, 1848–1978 A.D. *Journal of Ecology* **68**: 229–249.

Latimer, W. (1980). *A survey of the dyke flora of the Romney Marsh.* Nature Conservancy Council, Taunton.

Lees, F. A. (1888). *The flora of West Yorkshire.* (*Botanical Transactions of the Yorkshire Naturalists' Union* **2**.) London.

Limbert, M. (1988). West Moor and its botanical records. *Naturalist* **113**: 113–116.

Marshall, E. J. P. (1981). The ecology of a land drainage channel. I. Oxygen balance. *Water Research* **15**: 1075–1085.

Marshall, E. J. P. (1984). The ecology of a land drainage channel. II. Biology, chemistry and submerged weed control. *Water Research* **18**: 817–825.

Mason, C. F. (1981). *Biology of freshwater pollution*. London.

Meade, R. & Blackstock, T. H. (1988). The impact of drainage on the distribution of rich-fen communities in two Anglesey basins. *Wetlands* **8**: 159–177.

Ministry of Agriculture, Fisheries and Food (1968). *A century of agricultural statistics*. London.

Mitchell, D. S. (1974). *Aquatic vegetation and its use and control*. Paris.

Montague, C. L., Zale, A. V. & Percival, H. F. (1987). Ecological effects of coastal marsh impoundment: a review. *Environmental Management* **11**: 743–756.

Moore, J. A. (1986). *Charophytes of Great Britain and Ireland*. London.

Moss, C. E. (1907). *Geographical distribution of vegetation in Somerset: Bath and Bridgwater district*. Royal Geographical Society, London.

Mountford, J. O. (1994). Problems in reconstructing floristic change: interpreting the sources for English grazing marshes. *Watsonia* **20**: 25–31.

Mountford, J. O., Lakhani, K. H. & Kirkham, F. W. (1993). Experimental assessment of the effects of nitrogen addition under hay-cutting and aftermath grazing on the vegetation of meadows on a Somerset peat moor. *Journal of Applied Ecology* **30**: 321–332.

Mountford, J. O. & Sheail, J. (1982). *The impact of land drainage on wildlife in the Romney Marsh: the availability of baseline data*. I.T.E. Project 718, C.S.T. Report No. 456. Nature Conservancy Council, Huntingdon.

Mountford, J. O. & Sheail, J. (1985). *Vegetation and changes in farming practice on the Idle/Misson Levels (Nottinghamshire, Humberside and South Yorkshire)*. I.T.E. Project 718, C.S.T. Report No. 633. Nature Conservancy Council, Huntingdon.

Mountford, J. O. & Sheail, J. (1989). *The effects of agricultural land use change on the flora of three grazing marsh areas*. Nature Conservancy Council, Peterborough.

Murray, R. P. (1896). *The flora of Somerset*. Taunton.

Newbold, C. (1975). Herbicides in aquatic systems. *Biological Conservation* **7**: 97–118.

Newbold, C., Honnor, J. & Buckley, K. (1989). *Nature conservation and the management of drainage channels*. Nature Conservancy Council, Peterborough.

Palmer, M. (1986). The impact of a change from permanent pasture to cereal farming on the flora and invertebrate fauna of watercourses in the Pevensey Levels. *Proceedings of the European Weed Research Society/Association of Applied Biologists 7th Symposium on Aquatic Weeds*, pp. 233–238.

Philp, E. (1982). *Atlas of the Kent flora*. Maidstone.

Raine, P. (1980). *The flora of drainage ditches – an ecological study of the Somerset Levels*. Unpublished M.Sc. thesis, University College, London.

Ratcliffe, D. A. (1984). Post-medieval and recent changes in British vegetation: the culmination of human influence. *New Phytologist* **98**: 73–100.

Rodwell, J. S., ed. (1991a). *British plant communities. Volume 1. Woodlands and scrub*. Cambridge.

Rodwell, J. S., ed. (1991b). *British plant communities. Volume 2. Mires and heaths*. Cambridge.

Rodwell, J. S., ed. (1992). *British plant communities. Volume 3. Grasslands and montane communities*. Cambridge.

Rodwell, J. S., ed. *British plant communities. a) Aquatic communities & b) Swamps and tall herb fens*. MSS.

Roe, Capt. R. G. B. Notes, files and card index of Somerset records. [Consulted at owner's residence.]

Roe, Capt. R. G. B. (1981). *The flora of Somerset*. Taunton.

Salisbury, E. J. (1927). The waning flora of England. *South Eastern Naturalist*: 35–54.

Sandwith, N. Y. Card indices, files and notes. [Held by Prof. A. J. Willis, Sheffield University.]

Scotter, C. N. G., Wade, P. M., Marshall, E. J. P. & Edwards, R. W. (1977). The Monmouthshire Levels' drainage system: its ecology and relation to agriculture. *Journal of Environmental Management* **5**: 75–86.

Severn-Trent Water Authority (1974). *River Idle. A report on the feasibility of pumping the river Idle at West Stockwith*. Nottingham.

Sheail, J. (1982). Wild plants and the perception of land-use change in Britain: a historical perspective. *Biological Conservation* **24**: 129–146.

Sheail, J. & Mountford, J. O. (1984). Changes in the perception and impact of agricultural land improvement: the post-war trends in the Romney Marsh. *Royal Agricultural Society Journal* **145**: 43–56.

Sheail, J. & Wells, T. C. E. (1980). The Marchioness of Huntly: the written record and the herbarium. *Biological Journal of the Linnean Society* **13**: 324–330.

Sheail, J. & Wells, T. C. E. (1983). The fenlands of Huntingdonshire, England: a case study in catastrophic change, in Gore, A. J. P., ed. *Mires: swamp, bog, fen & moor. British regional studies*, pp. 375–393. Amsterdam.

SMART, P. J., WHEELER, B. D. & WILLIS, A. J. (1986). Plants and peat cuttings: historical ecology of a much exploited peatland – Throne Waste, Yorkshire, UK. *New Phytologist* **104**: 731–748.

SOIL SURVEY OF ENGLAND &WALES (1978). *Soils of the Levels and Moors in Somerset and Avon.* 1:100,000 map. Southampton.

SOIL SURVEY OF ENGLAND & WALES (1983). *1:250,000 Map of England and Wales: six sheets and legend.* Harpenden.

STACE, C. (1991). *The New Flora of the British Isles*. Cambridge.

STORER, B. Card indices, files and notes. [Consulted at owner's residence.]

STORER, B. (1985). *The natural history of the Somerset Levels*, 2nd ed. Wimborne.

SWALES, S. (1982). Environmental effects of river channel works used in land drainage improvement. *Journal of Environmental Management* **14**: 103–126.

THIBODEAU, F. R. & NICKERSON, N. H. (1985). Changes in a wetland plant association induced by impoundment and draining. *Biological Conservation* **33**: 269–279.

WADE, P. M. (1977). *Dredging of drainage channels – its ecological effects.* Ph.D. thesis, University of Wales Institute of Science and Technology.

WADE, P. M. (1978). The effect of mechanical excavators on the drainage channel habitat. *Proceedings of the European Weed Research Society 5th symposium on aquatic weeds*, pp. 333–342. Amsterdam.

WADE, P. M. & EDWARDS, R. W. (1980). The effect of channel maintenance on the aquatic macrophytes of the drainage channels of the Monmouthshire levels, South Wales, 1840–1976. *Aquatic Botany* **8**: 307–322.

WHEELER, B. D. (1983). British fens: a review, in MOORE, P. D., ed. *European mires*, pp. 237–281. London.

WHITE, J. W. (1886). *Flora of the Bristol coalfield.* Bristol.

WHITE, J. W. (1912). *The flora of Bristol.* Bristol.

WILLIAMS, G. & HALL, M. (1987). The loss of coastal grazing marshes in South and East England, with special reference to east Essex, England. *Biological Conservation* **39**: 243–253.

WILLIAMS, M. (1970). *The draining of the Somerset Levels.* Cambridge.

WILLIS, A. J. (1967). The vegetation of Catcott Heath, Somserset. *Proceedings of the Bristol Naturalists' Society* **31**: 297.

WILLIS, A. J. & JEFFERIES, R. L. (1959). The plant ecology of the Gordano Valley. *Proceedings of the Bristol Naturalists' Society* **29**: 469–490.

WINGFIELD, M. & WADE, P. M. (1988). Hatfield Chase: the loss of drainage channel habitat. *Naturalist* **113**: 21–24.

(*Accepted January 1993*)

APPENDIX 1: FLORISTIC HISTORY – SOURCES OF INFORMATION CONSULTED

OLD COUNTY FLORAS AND THE NINETEENTH CENTURY

I. Somerset Levels and Moors

SWETE, E. H. (1854). *Flora Bristoliensis*. London.

CLARK, T. (1856). Catalogue of the rarer plants of the Turf Moors of Somerset. *Proceedings of the Somerset Archaeological Society* **7**: 64–71.

WHITE, J. W. (1886). *Flora of the Bristol coalfield.* Bristol.

MURRAY, R. P. (1896). *The flora of Somerset.* Taunton.

WHITE, J. W. (1912). *The flora of Bristol.* Bristol.

MARSHALL, E. S. (1914). *A supplement to the Flora of Somerset.* Taunton.

[Marshall's own annotated copy of the supplement (held by his great grandson, Dr E. J. P. Marshall) was examined.]

II. Romney and Walland Marshes

ARNOLD, F. W. (1887: 1st ed.; 1907: 2nd ed.). *Flora of Sussex.* London.

HANBURY, F. J. & MARSHALL, E. S. (1899). *Flora of Kent.* London.

WOLLEY-DOD, A. H. (1937). *The flora of Sussex.* Hastings.

III. Idle valley and Misson Levels

DEERING, C. (1738). *Catalogus stirpium, &c. or a catalogue of plants naturally growing and commonly cultivated in divers parts of England, more especially about Nottingham.* Nottingham.

ORDOYNO, T. (1807). *Flora Nottinghamiensis or a systematic arrangement of the plants growing naturally in the county of Nottingham with their Linnean and English names, generic and specific characters in Latin and English, places of growth and time of flowering.* Newark.

HOWITT, G. (1839). *The Nottinghamshire flora.* Nottingham.

Lees, F. A. (1888). *The flora of West Yorkshire.* (*Botanical Transactions of the Yorkshire Naturalists Union* **2**.) London.
Woodruffe-Peacock, E. A. (1909). *A check-list of Lincolnshire plants*. Lincoln.
Carr, J. W. (1909–39). Manuscript 'Flora of Nottinghamshire'. [Copy held at Wollaton Hall Museum, Nottingham.]

MANUSCRIPTS AND INDICES, c. 1915–1960

I. Somerset Levels and Moors

1. J. W. White?: note-book (1918) entitled 'Brue Plants' [held by Prof. A. J. Willis of Sheffield University].
2. N. Y. Sandwith: Notes and files belonging to Sandwith [held by Prof. A. J. Willis]. Including: a. Complete series of '*Bristol Botany in 19—*' (*Proceedings of the Bristol Naturalists' Society*); b. Card index for period 1912–1965, including (all?) published records and data from other workers (e.g. I. M. Roper and H. S. Thompson); c. Annotated copy of White (1912).
3. Capt. R. G. B. Roe: Notes and files, including all the sources of records he could trace for the period between the first Flora writers and his own survey, e.g.: a. Card index begun by W. D. Miller (1919–1933), continued by Dr W. Watson (1933–1952), A. D. Hallam (1952–c. 1960) and Roe (c. 1960 onward); b. Transcriptions of data from County Museum, Taunton and other herbaria by Roe and Dr P. M. Wade.

II. Romney and Walland marshes

1. Dr F. Rose: manuscripts and field note-books including: a. Manuscript 'Ecological Flora of Kent', for period from 1942 to late 1960s; b. Note-books (especially 1954–1960 when most work on the Romney Marsh was done).
2. Maidstone Museum (E. G. Philp): both pre-1970 records for Kent and herbarium specimens.

III. Idle valley and Misson Levels

1. R. C. L. & B. M. Howitt: Note-books, files and maps covering Nottinghamshire: a. Day-books: record of botanical excursions, 1951–1978; b. Division files (essentially a manuscript Flora); c. 6-inch Ordnance Survey maps annotated with locations of rare species.
2. E. J. Gibbons: Files and day-books for Lincolnshire, from c. 1920 onward. [Similar to Howitt.]

ATLAS OF THE BRITISH FLORA AND *CRITICAL SUPPLEMENT* (1962 AND 1968)

Covers all three study areas. The maps depict the known distribution of species in the middle part of the present century with an indication of changes from earlier times. During the preparation of the *Atlas* more or less complete vice-county lists were supplied for East Kent by Dr F. Rose and North Lincolnshire by E. J. Gibbons. Other recorders who contributed records to the *Atlas* were A. D. and O. M. Hallam, R. C. L. & B. M. Howitt, Capt. and Mrs R. G. B. Roe and N. Y. Sandwith.

BIOLOGICAL RECORDS CENTRE

Data gathered during the B.S.B.I. Maps Scheme formed the nucleus of the Biological Records Centre (B.R.C.) at Monks Wood. The original data have been supplemented with records (grid reference, locality, date, recorder, vice-county). Printouts of B.R.C. data were searched.

MODERN COUNTY FLORAS, AFTER THE *ATLAS OF THE BRITISH FLORA*

I. Somerset Levels and Moors

Roe, Capt. R. G. B. (1981). *The flora of Somerset.* Taunton.

[The card index that formed the basis of the *Flora* and annotated since publication, includes tetrad maps for the period 1960–1980. Though not published, these data are very detailed and were transcribed fully.]

II. Romney and Walland Marshes

Hall, P. C. (1980). *Sussex plant atlas*. Brighton.
Philp, E. G. (1982). *Atlas of the Kent flora.* Maidstone.

III. Idle valley and Misson Levels

Howitt, R. C. L. & Howitt, B. M. (1963). *A Flora of Nottinghamshire.* Privately published.
Gibbons, E. J. (1975). *The flora of Lincolnshire.* Lincoln.
Gibbons, E. J. & Weston, I. (1985). *Supplement to the Flora of Lincolnshire*. Lincoln.

THE NOTE-BOOKS AND FILES OF CONTEMPORARY BOTANISTS

I. Somerset and Avon Levels

1. B. Storer: Data gathered during and after publication of *The natural history of the Somerset Levels* (1972); 2nd ed., 1985: a. Card index for parts of National Grid square ST/3.3; b. Detailed account of Catcott and Westhay Heaths in note-books; c. Maps, annotated with new records.

2. Prof. A. J. Willis: as well as data and indices inherited from earlier workers, his files include: a. Reprints of '*Bristol Botany*' since 1965; b. Scientific papers with data on Gordano, Shapwick and Catcott Heaths (Willis & Jefferies 1959; Hope-Simpson *et al.* 1963; Willis 1967; Hope-Simpson & Willis 1955, 1973).
3. Dr P. M. Wade: species lists made in 1975 in Somerset.

II. Romney and Walland marshes
1. Mrs L. B. Burt: day-books and summary of distribution of wetland plants in the area.
2. Dr F. Rose: note-books with accurate locations.
3. E. G. Philp: Manuscript maps for *Atlas*.

III. Idle valley and Misson Levels
1. Doncaster Museum (local B.R.C. for South Yorkshire, etc.): Site files and species maps on a 1-km square basis.
2. Nottingham Museum (Wollaton Hall – local B.R.C.): Site files and individual species data.
3. Scunthorpe Museum (local B.R.C.): Site files, especially L.N.R.s, S.S.S.I.s, etc. Records made after 1970 were noted.
4. Nature Conservancy Council (East Midlands office – Grantham): S.S.S.I. files.
5. Dr J. G. Hodgson (Unit of Comparative Plant Ecology, University of Sheffield): rare species and site data on detailed data base.

NATURE CONSERVANCY COUNCIL (N.C.C.) COMMISSIONED DITCH AND WETLAND STUDIES

I. Somerset Levels and Moors

SECCOMBE, P. (1977). *Report on the botanical evaluation of the Rhyne system.* N.C.C. (Somerset Wetlands Project [S.W.P.])
[Areas of conservation interest only.]

BRADFORD, R. (1978). *A report on the botanical evaluation of the meadows and other nature conservation interests in the Somerset Levels, 1977–8.* N.C.C. (S.W.P.)

RAINE, P. (1980). *The flora of drainage ditches – an ecological study of the Somerset Levels.* Unpublished M.Sc. thesis, University College, London.
[North, Southlake and both Salt Moors.]

WOLSELEY, P. A., PALMER, M. A. & WILLIAMS, R. (1984). *The aquatic flora of the Somerset Levels and Moors.* Huntingdon, N.C.C.
[All S.S.S.I.s and P.S.S.S.I.s.]

II. Romney and Walland Marshes

PHILLIPS, N. J. A. (1975). *Dykes of Romney Marsh.* Unpublished M.Sc. thesis, Wye College, University of London.

LATIMER, W. (1980). *A survey of the dyke flora of the Romney Marsh.* Taunton, N.C.C. [S.S.S.I. only.]

III. Idle valley and Misson Levels

PAGE, S. E. (1980). *River Idle Carrs: Botanical survey of Dykes.* Huntingdon, N.C.C. (East Midlands Region).
[Areas of conservation interest only.]

WINGFIELD, M. & WADE, P. M. (1988). Hatfield Chase: the loss of drainage channel habitat. *Naturalist* **113**: 21–24.
[Overlaps with northern part of study area.]

APPENDIX 2: *RUMEX MARITIMUS* L. – FLORISTIC HISTORY IN SOMERSET

Information given as provided in each source.
I. Nineteenth and early twentieth century records
1. White (1886)
In marshes. "Wedmore . . . June 1843. G. H. K. Thwaites", **herb. Stephens.** "Mouth of the Parrett; Steart Marsh. J. C. Collins, MSS", *New Botanist's Guide.* Frequent on the peat moors still further south.
2. Murray (1896)
Rare and very local in marshes. District 3 at the mouth of the Parrett and at Steart Marsh, J. C. Collins. District 8 ". . . in a bit of marshy ground SE of Tor Hill, Wells, several plants", Miss Livett; plentiful in many parts of the peat moor and abundant near Shapwick Station, Murray. District 9 (8?) at Wedmore, Thwaites; Knowle Bridge near Wells, Miss Livett; near Portishead, S. Rootsey.
3. White (1912)
Typical of peat. Rare and local in marshes in the southern portion of area. On the beach at Portishead, c. 1852, J. N. Duck. "Said to have been found at Portishead by S. Rootsey", *Fl. Som.* Several plants in 1884 in a marsh on

Tor Hill, E. of Wells; and at Knowle Bridge, Wookey, Miss Livett. Wedmore, 1843, *Thwaites* in **Herb. Stephens.** Salt-marshes near Highbridge, Sole, MS. Mouth of Parrett and Steart, J. C. Collins, MSS, in *New Botanist's Guide*. Plentiful on the peat moors after any fresh cutting of peat.
4. Marshall (1914)
District 3: by the towing-path of the canal below Maunsel, 1908, Marshall. District 5: Langport, W. Watson. District 8: salt-marshes near Highbridge (Sole, MS), *Fl. Bristol* (Wedmore locality is probably in this division).
5. White? (1918)
In marshes at Wedmore and on the moors.

II. Mid-twentieth century records
1. Sandwith files, etc.
Bank of a rhine on the Kenn side of Nailsea Moor, 1941, C. I. & N. Y. Sandwith, *Bristol Botany in 1941*. Annotated copy of White (1912) confirms status on the peat-moors.
2. Roe files, card indices, etc.
District 3: on the banks of the Parrett at Bridgwater, 1915, H. S. Thompson; between the bridge and the docks, Bridgwater, *H. S. Thompson* in **TTN**; North Newton, *Marshall*, **herb. Druce & Hanbury**; by a pool on the edge of West Sedgemoor below Burton Pynsent, 1918, W. Watson.
District 4: Thorney Moor, 1923 – rare H. Downes in *Proceedings of the Somersetshire Archaeological and Natural History Society* [*Proc. SANHS*].
District 5: on banks of the Parret, Bridgwater, 1915, H. S. Thompson; small pool, close to Wills Works, right bank of Parrett, *H. S. Thompson* in **TTN**; near Weston Zoyland, *C. E. Salmon* in **LSR**.
District 8: near Edington Junction, 1915, *J. Bot.*; in some quantity N. of Shapwick Station, 1926, *Bristol Botany in 1926*; by the sides of a rhine near the station, 5 July 1951, *Proc. SANHS*; Ashcott Moor, 27 July 1928, *H. J. Gibbons* in **LSR**; specimens from Shapwick dated 1933, **herb. J. E. Lousley** and *H. S. Thompson* in **LSR**. [Roe quotes W. Watson as suspecting that the plants at Tor Hill may have been *R. palustris*.]
District 9: specimen on the bank of a rhine on the Kenn side of Nailsea Moor, 1941, C. I. & N. Y. Sandwith; at Tickenham Moor, 1930, *H. J. Gibbons* in **LSR**.
3. *Atlas of the British flora* (1962)
Recorded before 1930 in ST/2.4, 3.3, 3.4, 4.2, 4.3, 4.4, 4.7, 5.4. No post-1930 records.

III. Records since 1960
1. Roe files, card indices, etc.
District 8: on old peat cuttings, the Roughet – rapidly appeared in quantity in 1969 after ditches had been cut across, *J. K. Hibberd* det. F. Rose [Roe noted there was very little at this site in 1970]; plentiful in some peat cuttings in Catcott Burtle in 1970, H. W. Boon in *Proc. SANHS*; several in old peat cuttings, Shapwick Heath in 1980, R. S. Cropper in *Bristol Botany in 1980*.
2. Roe tetrad maps (notation as Philp 1982) [100-km square ST]
2.3Y (1910s); 2.4Y (1950s); 3.2S (1910s), 3.2T?; 3.3D (1910s); 3.4D (1930s); 4.2G (1920s); 4.3P (1920s); 4.4A, 4.4B, 4.4F (all 1970s onward); 4.7F (1940s).
3. Roe (1981)
In marshes. Very rare and only seen recently in old peat cuttings on the moors near Shapwick and Westhay (District 8). Formerly more widespread on the levels in districts 3, 4, 5 and 9 also.
4. Mountford field work (1982–88)
Not recorded.

Problems in reconstructing floristic change: interpreting the sources for English grazing marshes

J. O. MOUNTFORD

Institute of Terrestrial Ecology (Natural Environment Research Council), Monks Wood, Abbots Ripton, PE17 2LS

ABSTRACT

In attempting to reconstruct floristic change in three English grazing marshes, a wide variety of sources, both published and manuscript, were employed. These sources cannot be used uncritically as though they represented points on a uniform monitoring scheme. The sources vary in 1. their objectives; 2. the scale and type of recording, including the basic recording unit employed; 3. the evenness of the coverage achieved, both taxonomic and geographical; and 4. in the precision or accuracy of the information included.

KEYWORDS: botanical recording, county flora, manuscript source, taxonomy, wetland.

INTRODUCTION

Many authors have attempted to trace the changing status of plant species over recorded history, using a wide variety of published and archive sources (e.g. Driscoll 1982; Sheail & Wells 1980; Wade 1983). There are fundamental problems in using data as disparate as anecdotal jottings and systematic surveys to reconstruct change in species distribution and vegetation type. The concept of recording area, changing understanding of the taxonomy and the rigour and motivation of the observer all affect the quality and quantity of the data on plant distribution, posing problems in their interpretation by modern students (Stott 1981).

The present paper describes some of the difficulties encountered in attempting to assess changes in the flora of three English grazing marshes since 1840: 1. the Somerset Levels and Moors; 2. the Romney and Walland Marshes; and 3. the Idle/Misson Levels (Mountford & Sheail 1989). The distribution and abundance of 526 species of vascular plant and species of Charophyte were investigated through a search of published and manuscript sources (Mountford 1994). Information on species distribution extracted from these sources was ordered by species and then compiled in chronological order. The sources employed in that study could not be regarded as representing parts of a uniform monitoring scheme. There was great variety in the objectives and methodology adopted in gathering the data both within and between study areas and from recorder to recorder. Some of the apparent trends over time in species abundance may thus be discounted as artefacts. To some extent, inconsistencies or inaccuracies could be identified by comparing different sources, but care had to be exercised in either rejecting or accepting data. Four major problems can be recognised in the interpretation of these data, arising from: a. the purposes of the survey; b. its unit of recording; c. the evenness of coverage; and d. the accuracy of the information. In practice, these problems are inter-related and strongly influenced by the motivation of the botanist which can introduce a bias into the survey (Rich & Woodruff 1992).

PROBLEMS IN THE INTERPRETATION OF SOURCES

PURPOSES OF THE SURVEY

Botanists have carried out surveys for widely varied reasons. When he set out to prepare an *Atlas of the Kent flora*, Philp (1982) wanted to ensure that every species was fully mapped. The smallest gap in the map of the distribution of an otherwise ubiquitous species was to be examined. He hoped to motivate botanists to fill these gaps. However, if the gap should prove genuine, that absence might provide an insight into the ecology of that species (E. G. Philp, pers. comm. 1981).

The motives of Victorian naturalists, keeping day-books of interesting finds, were very different. Many considered their own personal total, or that of their vice-county, to be more important than the fine detail of species distribution. Some Flora writers sought only to prove a species' presence in their county, division or parish. Other authors expected the published work to be simply a guide to visitors intent on finding interesting plants. More recently, authors hoped to understand the ecology of species, and gathered considerable environmental and community data to supplement those on distribution (Graham 1988; Rose MS; Sinker *et al.* 1985).

THE UNIT OF RECORDING

The purpose of the survey usually determined the basic recording unit employed, if any. The nature and size of this unit in turn affect the detail of the study and its compatibility with other studies, particularly if the modern student seeks to make comparisons between surveys. In recent years, the greater number of botanists, and particularly their increased mobility, has meant that more ambitious surveys, with smaller units of recording, can be attempted.

However, Flora writing and recording schemes have often been the province of the true amateur, and botanists have often found it easier to identify with the county or parish than the grid square. A vice-county and parish recording scheme may result in more enthusiastic and competent recording than the monotonous working of grid squares (Allen 1983). The parish approach may still be justified in the 1990s, since it allows direct comparison to be made with the nineteenth century accounts (D. A. Wells, pers. comm 1990).

The accurate reconstruction of floristic change ideally requires some measure of abundance to accompany the distributional data. A parish or tetrad record as published may reflect a single specimen in a precarious locality or a common species which is an important part of the local vegetation. This detail is seldom available except in an anecdotal form, and underlines the present need for systematic and regular site monitoring to measure environmental change (Hill & Radford 1986).

The vice-county, drainage basin and civil parish were used as recording units from the mid-nineteenth century Floras to the more modern studies of Nottinghamshire (Howitt & Howitt 1963) and Somerset (Roe 1981). There are weaknesses in the use of such units for recording due to their variable size and their tendency to include several contrasting types of topography. Parish boundaries were often originally set so as to include a variety of landscapes which could provide the crops, livestock, fuel and fisheries that the community required. In addition, the prevalence of winter flooding on the levels meant that villages mainly occurred on the upland fringe with the parish extending out into the grazing marsh from there, as along the Polden Hills in Somerset (Havinden 1981). Particularly in the grazing marshes, therefore, a parish is rarely confined to one soil or landscape type. Interpreting the past species distribution in terms of environmental variation may not be straightforward. For instance, the parish of Bonnington in Kent is almost equally divided between the Romney Marsh and the undulating, often wooded land to the north. It is not always possible to determine whether a record for 'Bonnington' refers to the grazing marsh, the upland, or to both. Specifically, an ancient woodland species is almost certain to be confined to the upland and a macrophyte of deep, still water is likely to be restricted to the grazing marsh. Species of wet grassland, however, could occur in either type of landscape.

In some cases, greater precision in recording was achieved with the introduction of the 10-km square and later the 2-km square 'tetrad' of the National Grid as standard recording units. For example, *Ranunculus flammula* L. was said to be "common and generally distributed" in Kent in the late nineteenth century (Hanbury & Marshall 1899). Modern atlases show it to be absent from the chalk and coastal marshland (Perring & Walters 1976; Philp 1982). It is possible that *R. flammula* has disappeared from the grazing marshes (and chalk) over the last century. However, it is more likely that the authors of *Flora of Kent* decided to publish a summary account, rather than give a lengthy list of parishes, thus disguising local but important gaps in the distribution of *R. flammula*. Although maps of 10-km square records can reveal patterns in geology, climate or altitude, much environmental variation is not revealed by such a coarse grid.

The 10-km square represents a large (and often varied) block of land e.g. ST/3.4, north of the Polden Hills in Somerset, includes parts of 19 civil parishes. In an attempt to assess the impact of land use change in the Idle/Misson Levels, it was important to include only records from west of the River Trent and south of the River Torne, since this was the area to benefit from the upgrading of drainage pumps at West Stockwith (Mountford & Sheail 1985; Severn-Trent Water Authority 1974). The study area included parts of 10-km grid squares SE/6.0 and SK/8.9. The *Atlas of the British flora* (Perring & Walters 1976) records many wetland species for these two squares which other archive sources and modern field survey indicate are absent from the study area proper. SE/6.0 includes parts of Potteric Carr and other well-recorded sites (Lees 1888), whilst SK/8.9 includes Laughton and Scotton Commons east of the Trent, which have had a diverse, but now impoverished, wet heath and bog vegetation (Gibbons 1975). Changes in these sites are irrelevant to a study of the Idle/Misson Levels.

At present, the tetrad is the preferred unit of recording for many county Floras and smaller projects (Crackles 1990; Hall 1980; Philp 1982). Tetrad maps are at a scale where broad soil and land-use patterns may emerge, showing those wetland species that are now typical of the grazing marshes e.g. *Eleocharis palustris* (L.) Roemer & Schultes, and those that are not, e.g. *Filipendula ulmaria* (L.) Maxim. (Philp 1982). With caution, the historical record may then be re-interpreted.

EVENNESS OF COVERAGE

From early accounts of each study area, it is clear that some sites acted as 'honey-pots' for botanists, whereas others, perhaps adjacent, were seldom visited. Botanists were (and still are) tempted to pursue new species for their own personal lists at reliable localities. This was particularly the case in the era of the Exchange Clubs when gathering material to trade with fellow botanists was an incentive. It was comparatively rare for botanists to seek out unvisited sites especially if, as in the instance of the levels, such areas had a reputation for monotony. For example, the Trent division of West Yorkshire was neglected by botanists who went instead to Potteric Carr (Don division) for wetland plants (Lees 1888). Similarly in Nottinghamshire, there were few records for the Misson and Misterton areas until J. W. Carr began his work at the end of the nineteenth century (Howitt & Howitt 1963). In Kent and Sussex, botanists crossed the Romney and Walland Marshes to visit and revisit the Denge Beach with the wetlands around the Open Pits (Rose MS). Whole counties may have been under-recorded in the past, whether due to a lack of botanists or of perceived interest (Wells 1989).

Sometimes accessibility led to areas being recorded preferentially (Sheail 1982). Many early records for the Somerset peat moors are in the Ashcott and Shapwick areas where the Somerset and Dorset Joint railway made it a simple task for botanists to visit the turbary peats (Marshall 1914; Murray 1896). Although now known to have a rich flora, West Sedgemoor is rarely mentioned in the records until the 1910s and 1920s when easier transport allowed Dr W. Watson and other botanists to reach more remote sites (Sandwith files). Access may still influence the data gathered (Rich & Woodruff 1992).

Thus many 'new' records, produced by modern systematic mapping, reflect the discovery of plants at sites that had not previously been visited rather than a genuine spread in range. Uneven coverage can also result from the lack of observers needed to record a large county. There have been many more active naturalists is Kent, Sussex and Somerset than in the counties making up the Idle/Misson area. Tetrad atlases require considerable personnel and some species patterns shown may simply reflect the absence of recorders in some areas. When using diverse sources to reconstruct floristic change in grazing marshes, it had to be assumed that the description 'widespread and common' implied an even and abundant distribution throughout the area, unless other sources contradicted that interpretation (Mountford 1994).

Even within a single source, sites may be listed with uneven precision. For example, Hanbury & Marshall (1899) both observed *Sium latifolium* L. in the Romney Marsh study area. Hanbury noted it as: ". . . abundant in trenches by the roadside, between Ham Street and Ivychurch, and by the military canal". This site can be located on modern maps and visited to confirm its presence. Marshall recorded *S. latifolium* "near Appledore", implying that it grew in Appledore parish, but making precise relocation impossible.

Herbaria present particular opportunities and problems as a source of historical plant records. They allow the modern student to assess the accuracy of past information, by providing corroborative evidence to the contemporary day-books (Sheail & Wells 1980). However, herbaria frequently suffer from uneven coverage of species, focusing on rare or taxonomically interesting plants. There may be many sheets of a species from classic sites, confirming its continued presence. There is little systematic gathering of common species, with the result that not only can their past status rarely be demonstrated but also important infraspecific variation may remain unrecognised (P. D. Sell, pers. comm. 1981).

ACCURACY OF INFORMATION

No two botanists will record exactly the same species in the same numbers at the same site. These differences are exaggerated when records are made at different times (Kirby *et al.* 1986). Botanists are not immune from error and opinions on taxonomy change. It is not always certain that what a Victorian writer intended by a species or by a site name is identical with what would now be understood.

The same population may be identified as several different taxa over a number of years. In addition to *Potamogeton pectinatus* L., three species of narrow-leaved pondweed proved widespread in field recording of grazing marsh ditches for the present study: *Potamogeton berchtoldii* Fieber, *P. pusillus* L. and *P. trichoides* Cham. & Schldl. Botanists have been confused as to what was meant by the Linnaean name *P. pusillus*, and at different times the other two species have been named as variants of *P. pusillus*. The name *P. panormitanus* Biv. was also applied to one or more of these pondweeds. In Somerset, a population at Baltonsborough was variously labelled *P. pusillus* (vars '*pseudotrichoides*' and *tenuissimus* Koch), *P. trichoides* and '*P.* × *franconicus*' until examination of material in the Cambridge University Herbarium from 1881 and modern recording identified it as *P. berchtoldii* (Murray 1896; Marshall 1914 – author's annotated copy; Roe 1981 and Roe files).

Distinct species may be confounded and botanists record two or more species as one taxon. This is clearly the case with the Water-Speedwells: *Veronica anagallis-aquatica* L. and *V. catenata* Pennell. Most post-1950 records for Water-Speedwells on the grazing marshes are referred to the pink-flowered V. *catenata* (Hall 1980; Howitt & Howitt 1963; Philp 1982; Roe 1981). *V. catenata* is hardly mentioned in the records covering the study areas before the Second World War, although it was described as distinct in 1921 (Pennell 1921). Marshall recorded *V. anagallis-aquatica* in a "pretty form, bearing white flowers tinged with pink" at Headcorn and Westenhanger Castle in Kent (Hanbury & Marshall 1899), which may have been *V. catenata*, but this assumption simply begs the question as to why he did not record it on the Romney Marsh where it is widespread. The earlier records all refer to one taxon, variously named *V. anagallis-aquatica*, *V. anagallis* L. or *V. aquatica* Bernh. The two species do sometimes occur together and hybridise (*V.* × *lackschewitzii* Keller), but *V. catenata* is confined to open, muddy sites with little or no water flow, whilst *V. anagallis-aquatica* has a much wider range, often occurring by streams. Taken at face value, the historical data suggest a huge expansion in the population of *V. catenata* with a proportionate decline in *V. anagallis-aquatica*. Clearly this has not been the case and no assertions as to changing abundance in the Water-Speedwells can be made from the historical record. However, not all instances of confusion are so apparent and real population change may be hidden.

In contrast, variation in one species may be interpreted as the presence of two or more species. The Creeping Forget-me-not (*Myosotis secunda* A. Murray) was noted in several of the early accounts of the Somerset flora:

1. Clevedon; Nailsea Moor; Yatton; Bourton, ditches nearby (Murray 1896).
2. Tickenham Moor; dykebanks near Portbury; moors near Wells (White 1912).
3. North Newton (Marshall 1914).

The only recent Somerset records for *M. secunda* are from the Blackdown Hills, the Bredon Hills, Exmoor, the Quantock Hills, Chard Common and sparingly on the Mendip sandstones (Roe 1981). None of the records for the Levels and Moors have been substantiated and it appears likely that forms of *Myosotis scorpioides* L. were mistakenly identified as the upland species (Roe 1981). As with *Veronica anagallis-aquatica*, the apparent decline of *M. secunda* is an artefact of changed understanding of the taxonomy.

Flora writers in different periods have included a different range of taxa. Some authors included records of *Salix* bushes where they may have been originally planted or derived from cultivated osiers, whilst others rigorously excluded them (listing only clearly native sites). Some authors avidly recorded aliens (e.g. *Azolla filiculoides* Lam.), others did not mention them until they became thoroughly established or confine their attention to native species (Rich & Woodruff 1992). Aliens (e.g. *Elodea nuttallii* (Planchon) H. St John) that resemble established species (e.g. *E. canadensis* Michaux) may be overlooked until their identity is clear. In 1982, *E. nuttallii* was observed in 10% of the watercourses sampled in the Somerset Levels and Moors, particularly in larger, more nutrient-rich rhynes and drains (Mountford & Sheail 1984). Previously it had been recorded once, in 1981, but the assumption must be that it had been overlooked for some years.

It would be wrong to imply that present workers are more accurate or observant than those of the past. Indeed the opposite may be true. Between 1850 and 1950, many hybrids and infraspecific taxa were noted that probably still occur in the grazing marshes, but which many modern recorders dismiss as specimens that do not quite fit the specification for the taxon. Reconstruction of floristic change from 150 years of botanical recording might seem to indicate the disappearance of many hybrids and varieties – a highly unlikely event.

The time span over which data were gathered may become a source of error. In the 'Plant Atlases' for Kent (Philp 1982) and Sussex (Hall 1980), records are only included from a period of ten or twelve years, thus giving an impression of the flora at one time. In the early Floras records dated as much as 50 years apart may be listed side by side, without distinction. In the particular case of Lincolnshire, the absence of a nineteenth century work impelled Gibbons (1975) to take stock of the flora from the beginnings of botanical recording. Thus records in *The flora of Lincolnshire* from the Isle of Axholme (embracing the Epworth and Wroot parts of the Idle/Misson study area) include those of Peck (1815) and those derived from her own studies. Gibbons was very careful to distinguish such records, but where the aim of the researcher is to trace trends over time, there may be some confounding of the data.

CONCLUSIONS

Reconstruction of floristic change from published and archive sources requires a critical approach. Sources vary in nature, scope and accuracy. Variation in the quality and quantity of data produces spurious trends in abundance over time, which must be identified as doubtful or discounted in any assessment of the scale of change. Data for 526 species were compiled from three English grazing marshes between 1840 and 1990 (Mountford 1994). Of the 34 species increasing in distribution, there was significant doubt in the trend for 18. Similarly, where decreasing species are considered, 46 of the 269 could not be definitely said to have declined. Thirdly, there were many species among the 526 studied where the sources provided an ambiguous or varied impression, such that the species had to be assumed to have remained unchanged in abundance or distribution since 1840.

Problems encountered in the use of such a wide range of sources may be summarised thus:

1. Botanists gathered information for widely different reasons – approaches including both systematic mapping and anecdotal records in day-books.
2. The method and standard unit of recording (if any) changed from 1840 to 1990. The size of the recording unit varied, and for the first 100 years was not standard.
3. Abundance information was often not noted – a species was simply recorded as present.
4. Coverage of an area was uneven in time and space. Some areas were recorded eagerly, others were neglected.
5. The systematic recording of 10-km or 2-km squares partly ensured a more thorough coverage of an area.
6. The accessibility of parts of the study areas changed with time, affecting the information gathered.
7. Where a species was recorded as 'widespread and common', subsequent recording cast doubt on whether it genuinely had been ubiquitous.
8. The identification and understanding of species' taxonomic limits and the names by which sites are labelled varied greatly over the period of study.
9. The range of taxa recorded varied over the 150 years and between recorders. There was particular variation in the quantity and quality of information available for alien, critical, infraspecific or hybrid taxa.

10. Particular sources may include information gathered over a long period, making the identification of trends in time difficult.

The problems described in this historical investigation of grazing marshes are similar to those met in contemporary studies of plant distribution (Rich & Woodruff 1992). In contrast to the *Atlas of the British flora* (Perring & Walters 1976) and the B.S.B.I. Monitoring Scheme, however, the sources used in this study could not be considered as part of a planned whole. The reconstruction of floristic change must make use of the data available, in all its variety. The investigator cannot influence the type or accuracy of data gathered post hoc but must be discriminating in which data are now used and how they are interpreted.

ACKNOWLEDGMENTS

The many individuals and organisations who contributed to this study are acknowledged in Mountford (1994). However, I would like to repeat my thanks to the B.S.B.I. recorders who were so generous with their time and resources: the late Miss E. J. Gibbons, the late Mr R. C. L. Howitt, Mr E. G. Philp, Capt. R. G. B. Roe and the late Dr W. A. Sledge. In writing an account of problems with botanical data, I would not want to imply any criticism of these distinguished botanists. On the contrary, it is partly due to their enthusiasm and critical approach to recording, that I was stimulated to assess the pitfalls that can arise in the reconstruction of floristic change.

REFERENCES

Allen, D. E. (1983). Vice counties: a defence. *B.S.B.I. News* **34**: 36.
Crackles, F. E. (1990). *Flora of the East Riding of Yorkshire*. Hull.
Driscoll, R. J. (1982). The dyke vegetation at Oby and Thurne: a comparison of the late nineteenth century and recent records. *Transactions of the Norfolk & Norwich Naturalists' Society* **26**: 43–49.
Gibbons, E. J. (1975). *The flora of Lincolnshire*. Lincoln.
Graham, G. G. (1988). *The flora and vegetation of County Durham*. Durham.
Hall, P. C. (1980). *Sussex plant atlas*. Brighton.
Hanbury, F. J. & Marshall, E. S. (1899). *Flora of Kent*. London.
Havinden, M. (1981). *The Somerset landscape*. London.
Hill, M. O. & Radford, G. L. (1986). *Register of permanent vegetation plots*. Institute of Terrestrial Ecology, Huntingdon.
Howitt, R. C. L. & Howitt, B. M. (1963). *A Flora of Nottinghamshire*. Privately published.
Kirby, K. J., Bines, T., Burn, A., MacKintosh, J., Pitkin, P. & Smith, I. (1986). Seasonal and observer differences in vascular plant records from British woodlands. *Journal of Ecology* **74**: 123–131.
Lees, F. A. (1888). *The flora of West Yorkshire*. (Botanical Transactions of the Yorkshire Naturalists' Union **2**.) London.
Marshall, E. S. (1914). *A supplement to the Flora of Somerset*. Taunton.
Mountford, J. O. (1994). Floristic change in English grazing marshes: the impact of 150 years of drainage and land-use change. *Watsonia* **20**: 3–24.
Mountford, J. O. & Sheail, J. (1985). *Vegetation and changes in farming practice on the Idle/Misson Levels (Nottinghamshire, Humberside and South Yorkshire)*. I.T.E. Project 718, C.S.T. Report No. 633. Nature Conservancy Council, Huntingdon.
Mountford, J. O. & Sheail, J. (1989). *The effects of agricultural land use change on the flora of three grazing marsh areas*. Nature Conservancy Council, Peterborough.
Murray, R. P. (1896). *The flora of Somerset*. Taunton.
Peck, W. (1815). *Topographical account of the Isle of Axholme*. Doncaster.
Pennell, F. W. (1921). *Veronica* in North and South America. *Rhodora* **23**: 29–41.
Perring, F. H. & Walters, S. M., eds. (1976). *Atlas of the British flora*, 2nd ed. Wakefield.
Philp, E. G. (1982). *Atlas of the Kent flora*. Maidstone.
Rich, T. C. G. & Woodruff, E. R. (1992). Recording bias in botanical surveys. *Watsonia* **19**: 73–95.
Roe, Capt. R. G. B. (1981). *The flora of Somerset*. Taunton.
Roe, Capt. R. G. B. Notes, files and card index of Somerset records.
Rose, F. *Ecological Flora of Kent*. (Unpublished MS.)
Sandwith, N. Y. Notes, files and card index for period 1912–1965. [Held by Prof. A. J. Willis, Sheffield University.]

SEVERN-TRENT WATER AUTHORITY (1974). *River Idle. A report on the feasibility of pumping the river Idle at West Stockwith.* Nottingham.

SHEAIL, J. (1982). Wild plants and the perception of land-use change in Britain: an historical perspective. *Biological Conservation* **24**: 129–146.

SHEAIL, J. & WELLS, T. C. E. (1980). The Marchioness of Huntly: the written record and the herbarium *Biological Journal of the Linnean Society* **13**: 324–330.

SINKER, C. A., PACKHAM, J. R., TRUEMAN, I. C., OSWALD, P. H., PERRING, F. H. & PRESTWOOD, W. V. (1985). *Ecological Flora of the Shropshire region.* Shrewsbury.

STOTT, P. (1981). *Historical plant geography.* London.

WADE, P. M. (1983). Changes in the aquatic macrophyte flora of the Snowdonia lakes, north Wales: 1726 to 1983. *Proceedings of the International Symposium on Aquatic Macrophytes*, pp. 282–286. Nijmegen.

WELLS, T. C. E. (1989). The effect of changes in land use on the flora of Huntingdonshire and the Soke of Peterborough in the period 1949–89, in WELLS, T. C. E., COLE, J. H. & WALKER, P. E. G., eds. *40 years of change in the county*, pp. 10–20. Huntingdonshire Fauna & Flora Society, Huntingdon.

WHITE, J. W. (1912). *The flora of Bristol.* Bristol.

(*Accepted January 1993*)

Aspects of the ecology and conservation of *Damasonium alisma* Miller in Western Europe

C. R. BIRKINSHAW

The Orchard, Stanedge Road, Bakewell, Derbyshire, DE45 1DG

ABSTRACT

Damasonium alisma Miller (Alismataceae) is rare and declining over at least the western part of its range. An account is given of some aspects of its ecology and life cycle. This information is used to discuss the reasons for its decline and to provide recommendations for its conservation.

KEYWORDS: Britain, France, life cycle, habitat restoration, Alismataceae.

INTRODUCTION

Damasonium alisma Miller (Alismataceae), Starfruit, is a semi-aquatic herb (Fig. 1), found in England, France, Italy, Spain and possibly south-western Asia where there is confusion between it and *D. bourgaei* Cosson.

Its populations have declined in recent decades and this species is now "very rare" in France (Aymonin 1974), "possibly nationally rare" in Spain (Smith 1988), and "endangered" in England (Perring & Farrell 1983) where it is protected under the Wildlife and Countryside Act (1981).

This paper examines aspects of the ecology and life cycle of *D. alisma* and considers how best this species may be conserved.

ECOLOGY AND LIFE CYCLE

METHODS

Between 1987 and 1990, information was collected from five habitats of *D. alisma* including data on the general nature of each habitat, vegetation structure and percentage of bare ground in 1 m^2 quadrats placed over *D. alisma* plants, associated species of vascular plants (within two metres of each *D. alisma* plant), and the physical composition and pH of the substrate (top 6 cm). Three sites were in England (one in Surrey, two in Buckinghamshire – referred to as Bucks. Sites A and B) and two in France (in the Loire valley close to Angers and in the Sologne region close to Marcilly-en-Gault).

Observations on its life cycle were made in the wild and in cultivation – a population was grown outside in a large tank for three years.

Information on germination was obtained from cultivation experiments; fresh seeds collected from cultivated plants were sown into pots of sterile loam.

HABITAT

The three English populations grow in shallow ponds, formerly used for watering livestock, on commons on acid soil. The Sologne population grows in a shallow pond originally dug for fish husbandry, and that at Angers grows in a periodically flooded sand pit, beside the River Loire. At each site water levels fluctuated seasonally – they were flooded in winter, but were dry, at least in part, during summer.

All the sites had disturbed soil, at least in the vicinity of the *D. alisma* plants; the causes of the disturbance varied from site to site and included recent pond restoration work (Surrey, Bucks. Site A), the occasional beaching of a small boat (Sologne), trampling by dogs and people (Bucks. Site B), and sand extraction (Angers). Many of the English populations of *D. alisma* recorded in the past were on grazed commons, where livestock drinking at the ponds would have caused soil disturbance.

At the sites examined, the vegetation was patchy with large areas of bare substrate where the *D. alisma* plants were growing. At the Surrey and Sologne sites *D. alisma* grew among sparse, stunted emergents (*Sparganium erectum* (Surrey) and *Typha latifolia* (Sologne)). Other small herbs were present but were infrequent. Bare substrate comprised 75–90% of each 1 m^2 quadrat. At Bucks. Site A, *D. alisma* grew among a sparse carpet of *Glyceria fluitans* and other small herbs, and bare substrate comprised 60–90% of the quadrat area. At Bucks. Site B only one plant of *D. alisma* was seen in an otherwise bare area. In the Angers sand pit, in the driest, sunniest part of the pit, *D. alisma* occurred as tiny terrestrial plants, in small depressions, with the minute, annual *Lythrum borysthenicum* and little else; bare ground amounted to 90–98% of the quadrat area. In slightly less extreme conditions, Starfruit grew scattered amongst a sparse, patchy carpet of small, mainly annual, herbs. In damp, shaded areas this association was enriched with perennial, creeping grasses; bare substrate comprised 35–75% of the quadrat area. At Angers a few feeble *D. alisma* plants were found in flower growing as true aquatics in shallow pools containing a dense stand of *Chara vulgaris*, filamentous algae, perennial grasses and other emergents. Species associated with *D. alisma* are listed in Table 1.

Pond vegetation is notoriously difficult to classify. Often it is narrowly zoned and contains several partly developed communities in close proximity. From year to year the prominence of each community may vary according to the water level and pond management. Moreover, as ponds are often artificial their flora is partly the product of chance colonisation. It has not been possible to classify satisfactorily the vegetation at the five sites as one distinct community, but elements from several different communities, as defined by Ellenberg (1988), may be recognised.

a. *Littorelletea*, comprising plants which grow in shallow water at the edge of nutrient-deficient pools of low pH on sand or gravel (indicator species for this community are marked 'L' on Table 1).
b. *Isoeto-Nanojuncetea*, comprising dwarf plants which grow on land that is inundated only in the winter (marked 'I').
c. *Plantaginetea*, a pioneer community of pathways and flooded or damp places (marked 'Pl').
d. *Phragmitetea*, a swamp community of tall reeds and sedges (marked 'Ph').
e. *Potamogetonetea*, a community of rooted aquatic plants (marked 'Po').

The environment preferred by Starfruit frequently resulted in the stunting of species characteristic of the *Phragmitetea* and *Potamogetonetea* communities.

Species not marked as indicators are either aliens (e.g. *Paspalum distichum*), or plants which occur in a wide range of damp or aquatic habitats (e.g. *Juncus articulatus*, *Solanum dulcamara*), or arable weeds (e.g. *Persicaria maculosa*).

The composition of the top 6 cm of soil at four of the study sites (data are not available for Bucks. Site B), and the pH range and parent material of all sites are shown in Table 2. These data support observations by Salisbury (1970), Hess *et al.* (1976), Lousley (1976), Rose (1981) and Meikle (1985) (see also Sowerby 1883).

LIFE CYCLE

D. alisma seeds germinate only below water. Two lots of 120 seeds were sown; eight germinated below water, while none germinated when sown in merely damp conditions. Most germination occurred within three months of sowing. Dormant, submerged seeds can be stimulated to germinate by allowing the seeds to dry and then resubmerging them. 200 seed were sown below water; 14 germinated within three months. The dormant seeds were divided into two lots, half being kept below water, and the other half was dried and resubmerged. None of the continuously submerged seeds germinated whereas 22% (20 out of 93) of the dried and resubmerged seeds germinated after seven months.

Although seed sown in damp conditions but not below water will not germinate, it remains viable for at least a year and a high proportion (93% of 150 seeds) germinate when submerged.

These observations suggest that dormant seeds remain dormant as long as they are either constantly damp or constantly submerged.

D. alisma seeds may remain dormant for a long time. In 1989, *D. alisma* re-appeared at Bucks. Site B after an apparent absence of 87 years (the last report was 1902). Although it is possible that *D. alisma* set seeds in intervening years, but was not seen by botanists, the pond was unsuitable for Starfruit, because of a dense stand of emergents, for at least a decade prior to its restoration. In

TABLE 1. SPECIES ASSOCIATED WITH *D. ALISMA* AT THE FIVE STUDY SITES (NOMENCLATURE FOLLOWS STACE (1991) AND *FLORA EUROPAEA*)

Species	Community code*	Study Sites				
		Surrey	Bucks. A	Bucks. B	Angers	Sologne
Agrostis stolonifera	Pl	X				X
Alisma lanceolatum						X
A. plantago-aquatica	Ph				X	
Alopecurus geniculatus	Pl			X	X	
Apium inundatum	L	X	X			X
Baldellia ranunculoides	L					X
Bidens tripartita		X		X	X	X
Callitriche spp.	Po	X	X			
Chara vulgaris					X	
Corrigiola litoralis					X	
Cynodon dactylon	I				X	
Elatine alsinastrum	I					X
E. hexandra	L					X
Eleocharis acicularis	L				X	X
E. palustris	Ph	X			X	
Epilobium montanum × ciliatum			X			
E. obscurum		X				
Eragrostis pectinacea					X	
Glyceria declinata				X		
G. fluitans	Ph		X			
Gnaphalium uliginosum	I					X
Hypericum humifusum	I	X				
Iris pseudacorus	Ph		X	X		
Juncus articulatus		X	X			
J. bulbosus	L	X				
J. effusus		X	X			
J. cf. *tenageia*	I					X
Lemna minor			X			
Limosella aquatica	I				X	
Lindernia dubia	I				X	
Lycopus europaeus				X		
Lythrum borysthenicum	I				X	
L. hyssopifolia	I				X	X
L. portula	I	X		X		
Mentha pulegium	I				X	
Myriophyllum alterniflorum	L		X			
Oenanthe aquatica	Ph					X
Paspalum distichum					X	
Plantago major	Pl			X		
Persicaria hydropiper						X
P. maculosa			X		X	X
Potamogeton crispus	Po					X
P. natans	Po	X	X			
Pulicaria vulgaris					X	X
Ranunculus flammula		X				
R. peltatus	Po	X	X	X		
R. repens		X	X			
Rorippa islandica				X		X
R. pyrenaica					X	
Solanum dulcamara		X	X			X
Sparganium erectum	Ph	X				
Stellaria uliginosa			X			
Typha latifolia	Ph					X
Veronica scutellata	L	X				

* community code – see text.

TABLE 2. PHYSICAL COMPOSITION, pH AND PARENT MATERIAL OF THE SUBSTRATE AT THE *D. ALISMA* SITES

	Site				
	Sologne	Angers	Surrey	Bucks. A	Bucks. B
Parent material	Sand/clay drift	Alluvial sand	Plateau drift/ mesozoic & tertiary sands	Plateau drift/clay with flints	Gault-lined pond on plateau drift
Composition (% dry wt)					
Stones (>1 cm diam.)	0·0	0·0	4·8	0·0	Clay with flint gravel
$CaCO_3$ (>1 cm)	0·0	0·0	0·0	0·0	
Stones (0·2–1 cm)	2·6	8·1	10·7	0·0	
$CaCO_3$ (0·2–1 cm)	0·0	0·0	0·0	0·0	
Coarse sand	72·4	72·7	21·2	6·0	
Fine sand	12·7	10·6	31·9	43·2	
Silt	8·8	2·8	7·7	21·8	
Clay	2·7	4·9	21·0	27·4	
$CaCO_3$ (<2 cm)*	0·0	0·4	0·9	0·0	
Organic matter**	0·8	0·5	1·7	1·5	
pH*** (range for five samples)	4·5–5·6	4·9–6·3	4·0–5·2	4·3–5·6	4·5–5·6

* using a Rothamsted Calcimeter
** by combustion at 350 °C
*** in slurry with water using Gallenkamp pH meter

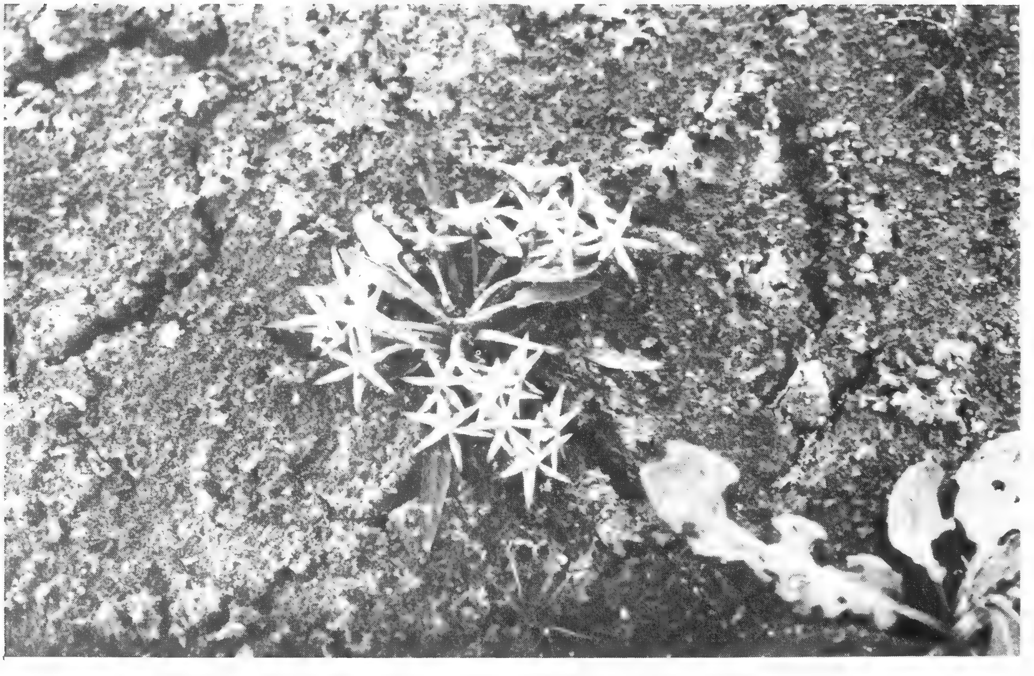


FIGURE 1. *Damasonium alisma* growing at the edge of a fish pond, Sologne, France (June 1989).

Surrey, *D. alisma* reappeared in 1973 (following disturbance of the pond) after an apparent absence of eight years (H. W. Mackworth-Praed, pers. comm. 1987).

In cultivation, germination is most prolific in early winter (November–January). The winter, submerged state of Starfruit has short, linear leaves and forms a small 'grassy' tuft. The tufts can be smothered by large pieces of sunken organic matter such as leaves; this vulnerability may explain the disappearance of Starfruit from ponds now surrounded by woodland. In the spring, long-petioled, floating leaves are produced. Water levels generally fall in early summer, and the young leaves of *D. alisma* plants are exposed. The floating leaves die and are replaced by short-petioled leaves as plants assume terrestrial growth form. Sometimes, during a wet summer when water levels remain high, plants retain floating leaves and produce flowers held above water on long peduncles. Flowers submerged by a rise in water level do not set seed. In cultivation, *D. alisma* grows well as a true aquatic plant, but in the wild it is often smothered by vigorous growth of other water plants.

In England anthesis occurs between June and August. Cultivated plants were visited by small flies (Agromyzidae), beetles (Nitidulidae) and hoverflies (Syriphidae) which feed on pollen or nectar. These insects often had *D. alisma* pollen on their bodies and are probably legitimate pollinators for this species. Starfruit is facultatively autogamous; self-pollination occurs but is infrequent (Vuille 1987).

Terrestrial plants vary in size and can bear from one to about 150 flowers or fruits. The size and fecundity of an exposed plant is limited by the length of time its substrate remains moist; the quicker it dries, the smaller the plant will be, and the fewer flowers it will bear. The larger, more floriferous plants are usually found in shaded habitats or in depressions which retain rain water whereas the smaller plants occur in exposed, sunny positions.

The fruit of *D. alisma* usually consists of six follicles arranged like the rays of a star, each containing one or two seeds. The follicles remain firmly attached to the plant until the fruit is submerged, after which they dissociate. The proximal seed in each follicle is then released but the other seed (if present) remains trapped in the follicle – despite being trapped, this seed can germinate and grow into a young plant.

In cultivation, individual plants, grown as aquatics in a competition-free environment, have survived for three years, although they become progressively weaker each year. Terrestrial plants always behave as annuals. No mature plants were seen on autumn visits to English habitats suggesting that Starfruit behaves as an annual.

CONCLUSION

D. alisma grows in fluctuating ponds with disturbed margins on soil of low pH. These conditions are not necessary for successful growth and regeneration but tend to reduce competition from more vigorous species.

Any pond with fluctuating water levels is a harsh, unreliable habitat. Several adaptations assist *D. alisma* to exploit this habitat; an annual life cycle, plasticity and two different life forms, and a germination strategy that prevents total commitment to a single, possibly unfavourable year.

CONSERVATION

THE DECLINE IN ENGLAND

D. alisma has been recorded from more than one hundred localities, in 50 10-km squares, mainly in the south-east of England. However, at any one time living plants were reported only from a fraction of these. Starfruit has been considered rare for at least a century (e.g. Sowerby 1883; Perring & Farrell 1983). During the present century it has become scarcer and by 1990 only three small populations were reliably reported. This apparent decline may be illustrated using the summary of records for this species compiled by the Biological Records Centre, Monks Wood:

Period	No. of populations verified
1830–1870	21
1870–1910	25
1910–1950	14
1950–1990	7

To identify possible reasons for the decline of *D. alisma* in England, the present conditions at a number of former sites for this species were surveyed. All these sites are now unsuitable habitats for the following reasons: ponds had been filled (e.g. Claygate (Surrey), Oxshott (Surrey), West Molesey (Surrey)); ponds had been abandoned and now contain dense stands of emergents and are surrounded by woodland (e.g. Whitmoor Common (Surrey), Withybed Corner Pond, Walton-on-the-Hill (Surrey), Naphill Common (Bucks.), Littleworth Common (Bucks.)); water levels are artificially regulated for fishing, etc. (e.g. Holmwood Common (Surrey), Wandsworth Common (Surrey), Earlswood Common (Surrey), Brittens Pond near Guildford (Surrey), Tylers Green (Bucks.), Coleshill (Bucks.)); ponds are habitats for large flocks of waterfowl (e.g. at Mitcham Common (Surrey) and the Mere Pond, Walton-on-the-Hill, (Surrey)), which by their trampling, feeding and defecation cause all but the most resilient aquatic plants to disappear.

MANAGING EXISTING POPULATIONS

The habitat of extant populations of Starfruit should be managed so that water-levels fluctuate seasonally, open vegetation with areas of bare soil is maintained by removing invasive plants if necessary, large quantities of smothering organic matter do not accumulate in ponds, and large flocks of waterfowl are discouraged.

RESTORING POPULATIONS AT FORMER SITES

It is possible that viable, dormant seeds of *D. alisma* survive at some of its former habitats. Appropriate restoration may allow populations to become established again through germination of the dormant seed. Restoration may require the dredging of accumulated organic matter (being careful not to deepen the pond or to remove the mineral mud which may contain dormant seed), removal of dense stands of emergents, felling trees, and promoting the seasonal fluctuation of water levels. The re-appearance of *D. alisma* following the restoration of a Buckinghamshire pond provides good grounds for hope that such restoration will be successful elsewhere.

If *D. alisma* does not re-appear of its own accord after the restoration, a population could be re-established by transferring seeds from elsewhere. However, this should only be done following the approval of the national conservation authority and must be fully documented.

CONCLUSIONS

D. alisma has specific habitat requirements and is vulnerable to changes in those habitats. However, an appreciation of its ecology suggests that extant populations can be managed and the apparent ability of viable seed to survive, probably for several decades, in the soil suggests that former populations may be resurrected by the restoration of former habitats.

ACKNOWLEDGMENTS

I am grateful to Dr C. D. Pigott, Ms L. Farrell and Ms J. R. Andrews for their comments on an earlier draft of this paper and Dr A. Jarman for determining the insects visiting *D. alisma* flowers. I would also like to thank the staff of Cambridge Botanic Garden, in particular Mrs J. Free, Mr P. Freeman and Mrs B. Stace, for their support during the course of my work there. The fieldwork in the U.K. was funded by the Nature Conservancy Council and the fieldwork in France by a British Ecological Society's Small Ecological Project Grant (No. 723).

REFERENCES

Aymonin, G. (1974). *Rapport sur les espèces végétales endémiques francaises et sur les espèces végétales les plus menacées en France.* Direction de la Protection de la Nature, Société Botanique de France. Paris.

Ellenberg, H. (1988). *Vegetation ecology of Central Europe.* Cambridge.

Hess, H. E., Landolt, E. & Hirzel, R. (1976). *Flora der Schweiz.* Basel.

Lousley, J. E. (1976). *Flora of Surrey.* London.

Meikle, R. D. (1985). *Flora of Cyprus* **2**. Kew.

Perring, F. H. & Farrell, L. (1983). *British red data books: I. Vascular plants.* 2nd ed. Lincoln.

Rose, F. (1981). *The wild flower key*. London.
Salisbury, E. (1970). Pioneer vegetation of exposed muds. *Philosophical Transactions of the Royal Society* **B 259**: 207–255.
Smith, A. (1988). *European status of rare British vascular plants*. Nature Conservancy Council, Contract Survey No. 33. Peterborough.
Sowerby, J. E. (1883). *English botany*. London.
Stace, C. A. (1991). *The New Flora of the British Isles*. Cambridge.
Vuille, F. L. (1987). Reproductive biology of the genus *Damasonium* (Alismataceae). *Plant Systematics and Evolution* **157**: 63–71.

(*Accepted May 1993*)

Ranunculus ficaria L. sensu lato

P. D. SELL

Herbarium, Department of Plant Sciences, Downing Street, The University, Cambridge, CB2 3EA

ABSTRACT

The taxonomy, nomenclature and typification of the segregates of *Ranunculus ficaria* L. (Ranunculaceae) in Europe are revised, taking particular notice of their biology. Five subspecies are recognised in Europe, four of which occur in the British Isles. Subsp. *calthifolius* is confined to east-central and south-east Europe. Subsp. *ficaria* is restricted to western Europe. Subsp. *bulbilifer* occurs throughout much of the range of the species, but is rare in the Mediterranean region. Subsp. *ficariiformis* is found in the central and west Mediterranean region and may be native north to the British Isles. Subsp. *chrysocephalus* is native in the east Mediterranean region and is grown in British gardens where it spreads naturally. All the subspecies can spread by tubers. Subsp. *bulbilifer* and subsp. *ficariiformis* can spread by axillary bulbils. All except subsp. *bulbilifer* can spread by seed. The chromosome number of subsp. *calthifolius* is unknown. Subsp. *ficaria* is diploid. The remaining three subspecies are tetraploid. Triploids have been recorded from the British Isles.

KEYWORDS: infraspecific taxonomy, reproductive biology, habitats, distribution, variation.

INTRODUCTION

In the broad sense, *Ranunculus ficaria* L. (Ranunculaceae), the Lesser Celandine, is a gregarious species, easily recognised by its heart-shaped, bluntly angled or crenate, usually dark green leaves and shining, golden yellow flowers with 7–13 petals. It is one of the heralds of spring, forming bright patches in woods, on banks and in other damp places from March to May.

In the taxonomic elucidation of the *Ranunculus ficaria* aggregate, too much emphasis has been placed on chromosome counts and not enough consideration given to morphology, ecology and biology. Five taxa are recognised in this account, which, if cultivated, or if examined at intervals through their flowering and fruiting periods, are easily recognised. If only seen once in the field, however, or only a single specimen is available, it is often difficult to identify the plant with certainty. For this reason and for the fact that intermediates occur and can spread vegetatively, I have treated them all as subspecies. Three have small flowers and two large flowers. Two of the small-flowered ones (subsp. *calthifolius* and subsp. *ficaria*) are without bulbils in the axils of their leaves; one (subsp. *bulbilifer*) has them. Subsp. *calthifolius* has short stems and leaves congested in a rosette at anthesis, whereas subsp. *ficaria* is more spreading with longer, leafy stems. One of the large-flowered plants (subsp. *ficariiformis*) has bulbils and the other (subsp. *chrysocephalus*) is without. Their ecology and their distribution appear to overlap, but tend to be different. There are three tetraploids and one diploid. Triploids are recorded. The chromosome number of subsp. *calthifolius* is unknown.

The nomenclature of the infraspecific taxa is in chaos. I have attempted to clarify it, but typification of taxa is difficult as ideal specimens are rarely collected, and one needs to know what a plant does in both flower and fruit. Only the early flowers reach full size. The best specimens are taken late when fruit and bulbils are developed, but at this stage any flowers still open are usually late ones, which are mostly smaller than those when the plant first comes into flower. Botanists should check their local populations, so that we know more about the distribution and ecology of the subspecies. On the first visit they should note flower size, checking the bulbils and fruits at a later date.

NOMENCLATURE

The first problem is to deal with the typification of *Ranunculus ficaria* L. The typification of Linnaean species is carried out by different authors in different ways. My method is that which I try to apply to all typifications, that is, to try to find material which was available to the author when the description was written, bearing in mind that the author of the taxon is not always the author of the description. In carrying out this typification I try not to be biased by my idea of the taxon, unless there is more than one equally applicable specimen, in which case I would choose one which would mean continuity of application.

Linnaeus usually validated his taxa in *Species plantarum* (1753) in one of three different ways:

1. By copying verbatim the description or descriptive name from his earlier works or from the works of other authors and following it by a reference in that work;
2. By altering the description slightly, but still giving the reference to the original work; or
3. By writing a completely new description with no reference after it.

In the first example the specimens available when the original description was made, or specimens of synonyms or illustrations cited with the original description, must in my opinion have priority over those added at a later date, which would not have been available when the description was written. This is supported by Art. 7.15 of the *International code of botanical nomenclature*: "When valid publication is by reference to a pre-starting point description, the latter must be used for purposes of typification". From the point of view of typification, I cannot see that there is any difference between reference to, or actually publishing again, that description. This view is supported by Heath (1991).

In the second case, although the description is slightly altered, Linnaeus still refers to its source and thus himself believes the alteration is not important. As the bulk of the description still applies to the original source and especially as the alteration is often made only because additional species are involved, I believe the type should still be chosen from the source material.

In the third case, Linnaeus has decided either the taxon is completely new, or none of the earlier descriptions are satisfactory and he needs to write a new description. In this case all the material in the protologue will have been seen by him before writing the description and be equally available for selection, although I would where possible choose the one in the Linnaean herbarium, as that is the one which is most likely to have been in front of him when writing it.

The diagnosis of *Ranunculus ficaria* L. (1753) reads "*Ranunculus foliis cordatis angulatis petiolatis*" and is referred to *Flora Suecica* (1745) and there to the *Hortus cliffortianus* (1738), where it occurs with the exception of '*dentatis*' instead of '*angulatis*'. The *Hortus cliffortianus* is also referred to in *Species plantarum* immediately following *Flora Suecica*. There is a single specimen in the herbarium of the Hortus Cliffortianus (**BM**) labelled "Chelidonia Minor Rotundifolia CBP [Caspar Bauhin's *Pinax*]", a synonym given in the *Species plantarum* (1753).

When I first became interested in the nomenclature of this species I entered into a correspondence with V. H. Heywood, and a letter from him dated 1 March 1960 reads "As regards the typification, I was with Tutin and Dandy when the choice of the Hort. Cliff. plant was made and for the record I think it fair to say that Dandy did not venture a taxonomic opinion. On the occasion I agreed with Tutin about the identity of the plant, but since then I am not sure that a conclusive determination can be made of the Hort. Cliff. specimen. However, I think it would be wiser to regard it as the non-bulbiliferous form so as to avoid disturbing the nomenclature again".

I have examined this sheet, which has on it in Dandy's handwriting, "Type of *R. ficaria* L.!" There is a single plant which has three flowers, all of which are about 30 mm in diameter with the petals probably contiguous. I can see no sign of bulbils in the leaf axils. I agree with Tutin that it is the small-flowered plant without bulbils. Benson (1954) designated the specimen in the Linnaean herbarium, Savage Catalogue 715/12, as the lectotype of *R. ficaria*. This sheet contains three flowering stems with smaller flowers and less obviously contiguous petals. They are too young to show any signs of bulbils. The one word changed in the diagnosis in *Species plantarum* '*angulatis*', is, if anything, more applicable to the Hort. Cliff. specimen. As stated above, in my opinion all syntypes are not equal and in this case the Hort. Cliff. specimen was available when the diagnosis was written and the Linnaean herbarium specimen was not. I am also less certain as to what the Linnaean herbarium specimen is, but if forced to give an opinion I would say it is probably subsp.

bulbilifer. I therefore reject Benson's lectotypification and designate the Hort. Cliff. specimen as the lectotype of *R. ficaria* L. Subsp. *ficaria* in this paper is thus as understood by Tutin in *Flora Europaea* **1**: 234 (1964) and most other current works.

Ficaria verna Hudson (1762) is a new name for *Ranunculus ficaria* L. and therefore has the same type. *Ficaria ranunculoides* Roth (1788) is also a new name for *Ranunculus ficaria* L. and has the same type, and for that reason must be regarded as an illegitimate substitute for *Ficaria verna* Hudson. *Ranunculus praecox* Salisb. (1796) is an illegitimate substitute for *R. ficaria* L.

R. ficaria var. *aurantiacus* Turrill (1954) was based on material collected by Miss Alethea Robson near Windsor, Berks., and plants reproduced from it vegetatively at Kew. A specimen in **K** is labelled "*Ranunculus ficaria* var., flowers Cadmium Yellow (Ridgw. Pl. III) on back suffused Vandyke Red (Pl. XIII), in a field near Windsor, as a solitary plant of this colour growing with many ordinary yellow-flowered plants, 27 April 1932, Miss Alethea Robson". I designate it as the lectotype. Another sheet labelled "*Ficaria verna* var. *aurea*, origin from near Windsor, Cult. Kew, 22 Feb. 1935" is a paralectotype, although presumably vegetatively produced from the same plant. The colour of the petals of *R. ficaria* varies from pale to deep yellow, and Cadmium Yellow is only a slight increase in the depth of colour and does not seem worthy of recognition. As the plant has no bulbils and produces good seed, it is placed in the synonymy of subsp. *ficaria*. *R. ficaria* var. *fertilis* A. R. Clapham (1952) was never described in Latin and has remained invalid.

The other small-flowered plant without bulbils was first named *Ficaria calthifolia* Reichenb. (1832).Gussone (1844) described a different plant from Sicily as *Ranunculus ficaria* var. *calthifolius*, but he referred back to Reichenbach's plant and this name must be regarded as a new combination based on that taxon. Jordan (1847) probably described the same taxon, but he referred back to Gussone and thus indirectly to Reichenbach and he must be regarded as making a new combination in *Ranunculus*. *R. nudicaulis* Kerner (1863), *Ficaria intermedia* Schur (1866), *F. transsilvanica* Schur (1866) and *F. pumila* Velenovsky (1887) are all referable to this taxon. *F. calthifolius* was made a subspecies of *R. ficaria* by Arcangeli in 1882, *R. nudicaulis* a subspecies of *R. ficaria* by Rouy & Foucaud in 1893, and *F. pumila* a subspecies of *F. verna* by Velenovsky in 1898.

The earliest name for the small-flowered plant with axillary bulbils is *Ficaria ranunculoides* var. *divergens* F. W. Schultz (1855). I have not designated a type, but have seen original Schultz material. The holotype of *R. ficaria* var. *bulbifer* Albert (Albert & Jahandiez 1908) is typical of this subspecies. The type of *R. ficaria* var. *sinuatus* Horwood (1916) is also referable to it. E. M. Marsden-Jones when describing *R. ficaria* var. *bulbifer* (1935) apparently did not know that Albert had used the same name for the same taxon. Marsden-Jones did not cite a type and apart from remarking that it occurs in all British vice-counties, mentions only two localities, Potterne in Wiltshire and Kew. I requested of **K** any material in their herbarium collected previous to the date of publication of *R. ficaria* var. *bulbifer* which could be regarded as types, and received five sheets all collected by W. B. Turrill at Kew in 1930 and all seen by Marsden-Jones. I have designated one of these sheets as the lectotype of *R. ficaria* var. *bulbifer* Marsden-Jones. It is labelled "*Ranunculus ficaria*, *bulbifer* [in pencil], Office of Works, Kew, under lime trees amongst Ivy. About 70 plants more or less female with some 100's hermaphrodite, 25 April 1930, W. B. Turrill (E. Marsden-Jones seen on 25 April 1930)". We shall never know which specimens the description was drawn up from, but at least this specimen was seen by Marsden-Jones during the studies which led to his publication of the name. The plants have rounded bulbils in the axils of the leaves and small flowers 14–16 mm in diameter. The name *R. ficaria* var. *bulbifer* Marsden-Jones is an illegitimate homonym of *R. ficaria* var. *bulbifer* Albert, and *R. ficaria* subsp. *bulbifer* Lawalrée (1955), based on Marsden-Jones' varietal name, is also illegitimate under Art. 64.4 of the *International code of botanical nomenclature*. Lambinon (1981), therefore gave it a new name, *R. ficaria* subsp. *bulbilifer*, the type of which is that of *R. ficaria* var. *bulbifer* Marsden-Jones. *Ficaria verna* subsp. *bulbifera* Á. & D. Löve and *Ficaria bulbifera* (Á. & D. Löve) Holub (1961) are both valid in that genus, and their type is that of *R. ficaria* var. *bulbifer* Marsden-Jones.

The name of the large-flowered plant with bulbils is the one most in doubt. *Ficaria grandiflora* Robert (1838) is probably it, but bulbils are not mentioned in the description and I have not seen a type. The epithet cannot be transferred to *Ranunculus* owing to *R. grandiflorus* L. (1753). Schultz (1858) thus gave it a new name *R. ficariiformis*. There are no specimens in Helsinki (**H**) or Geneva (**G**), the two herbaria which have some Robert material. Plants from the south of France, however, do seem to be the plant with bulbils. In view of the lack of original type material, I designate as the neotype of *Ficaria grandiflora*, and thus also that of *R. ficariiformis*, an F. Schultz specimen no. ad 407 from Nice in **CGE**. It shows clearly the axillary bulbils and large hairy achenes, but the flowers, which are late ones, are only 30 mm in diameter. *R. ficaria* subsp. *grandiflorus* (Robert) Hayek is valid, but later than, and made illegitimate by, *R. ficaria* subsp. *ficariiformis*, which is based on the same type. Gussone (1844) described the large-flowered plants with bulbils, but his epithet *calthifolius* is referable to another taxon. Jordan (1847) said his plant does not have bulbils, but he referred to Gussone's plant which does. A Jordan plant from Toulon I have seen is in flower and the specimen does not have bulbils, but it looks like the plant which does. The description of Arcangeli's *R. ficaria* subsp. *calthifolius* refers to this plant, but the name belongs to another taxon.

R. ficaria forma *luxurians* Moss (1920) was described from Jersey, and was illustrated by E. W. Hunnybun from specimens sent to him from St Aubyns, Jersey, by S. Guiton on 19 February 1913. The original drawings of Hunnybun are in the Cambridge University herbarium (**CGE**) and this information is written on the drawing in Hunnybun's hand. The drawing was at first labelled "var. *calthaefolia* vide Rouy & Foucaud *Flore de France* vol. 1, p. 73" and later "Moss says *R. ficariaeformis* F. Schultz". Both the material of Moss and of Hunnybun, used in their work on the *Cambridge British Flora*, is now to be found in **CGE**. The only specimens of this taxon to be found there are two sheets labelled "*Ranunculus ficariaefolia*, Jersey, 14 April 1913, E. W. Hunnybun". It is probable that Hunnybun did not keep the material he drew and these sheets were the only extant material available to Moss when he described forma *luxurians*. One of the sheets contains only basal leaves, the other, which I designate as the lectotype, contains one flower and one head of achenes. It is, in my opinion, *R. ficaria* subsp. *ficariiformis*.

I can find no name for the remaining large-flowered subspecies with no axillary bulbils, though some of the above mentioned names have been used for it, and I have described it below as subsp. *chrysocephalus*.

TAXONOMY

Ranunculus ficaria L., *Sp. Pl.* 550 (1753). Habitat in Europae ruderatis, umbrosis spongiosis. LECTOTYPE: Hort. Cliff. 228 (**BM**).

Vernacular name: Lesser Celandine.

Description: Perennial, gregarious herb, with whitish, fibrous roots and numerous, whitish or pale brown, fusiform or clavate root-tubers 5–50 × 3·5–6·0 mm. Stems 3–40 cm, whitish (sometimes tinted purplish) at base, pale green above, glabrous, branched, ascending or erect, often rooting at the decumbent base. Leaves numerous, medium to dark green above with paler veins, often blotched or mottled whitish or purplish, paler and slightly bluish beneath with darker veins, glabrous or nearly so, rather fleshy; the basal with lamina 0·5–8·0 × 0·5–9·0 cm, broadly ovate, usually rounded-obtuse at apex, bluntly angled or crenate, rarely shallowly dentate, cordate at base with basal sinus wide or with overlapping lobes, the petioles up to 28 cm, pale green, with a sheathing base; the cauline similar to basal but smaller and with short petioles, sometimes with whitish or pale brown axillary bulbils. Flowers 15–60 mm in diameter, solitary at the end of each stem branch. Sepals 3 (rarely more), 5–10 × 3–7 mm, pale green, sometimes with a whitish area at the apex or along the margin, ovate or ovate-lanceolate, concave, obtuse at apex, caducous. Petals 7–13, rarely 0, 6–26 × 3–15 mm, bright, pale to golden yellow, very rarely orange, shining on inside, dull on outside and sometimes tinted purplish or greenish, fading to white, often contiguous, narrowly elliptical-oblong, oblanceolate or obovate, obtuse at apex, gradually narrowed at base. Stamens 5–72; filaments 2·0–8·5 mm, yellow; anthers yellow. Styles 5–72, 1·5–2·0 mm, greenish; stigmas yellowish. Receptacle concave, with short, pale simple eglandular hairs. Achenes either abortive or maturing in a globular cluster, when mature 2·5–5·0 × 1·7–3·5 mm, more or less globular or obovoid, with a cuneate base, keeled, minutely beaked, usually with few to numerous very short simple eglandular hairs. 2n = 16 (+0-7B), 24, 32.

1. Leaves up to 8 × 9 cm; petioles up to 28 cm; flowers up to 60 mm in diameter; achenes up to 5·0 × 3·5 mm .... 2.

1. Leaves up to 4 × 4 cm; petioles up to 15 cm; flowers up to 40 mm in diameter; achenes up to 3·5 × 2·2 mm .... 3.
2. Stems rather robust, but straggling; bulbils present in leaf axils after flowering .... d) subsp. *ficariiformis*
2. Stems robust and erect; without bulbils in leaf axils after flowering ... e) subsp. *chrysocephalus*
3. Leaves crowded at base with few on short stems .... a) subsp. *calthifolius*
3. Leaves less crowded at base and more numerous on the elongated stems .... 4.
4. Bulbils not present in leaf axils after flowering; achenes well developed .... b) subsp. *ficaria*
4. Bulbils present in leaf-axils after flowering; achenes poorly developed .... c) subsp. *bulbilifera*

a. subsp. **calthifolius** (Reichenb.) Arcangeli, *Comp. Fl. Ital.* 11 (1882).

Synonymy
Ficaria calthifolia [*calthaefolia*] Reichenb., *Fl. Germ. Excurs.* 718 (1832); *R. ficaria* var. *calthifolia* (Reichenb.) Guss., *Fl. Sic. Syn.* **2**: 41 (1844) quoad basionym. exclud. descript.; *R. calthifolius* (Reichenb.) Jordan, *Obs. Pl. Crit.* **6**: 2 (1847) quoad basionym. exclud. descript.; *Ficaria nudicaulis* Kerner in *Oesterr. Bot. Zeitschr.* **13**: 188 (1863); *Ficaria intermedia* Schur, *Enum. Pl. Transs.* 14 (1866); *Ficaria transsilvanica* Schur, *Enum. Pl. Transs.* 14 (1866); *Ficaria verna* subsp. *calthifolia* (Reichenb.) Nyman, *Consp.* 7 (1878); *Ficaria pumila* Velen. in *Sitzb. Böhm. Gesell. Wiss.* **1887**: 438 (1887); *R. ficaria* subsp. *nudicaulis* (A. Kerner) Rouy & Fouc., *Fl. Fr.* **1**: 73 (1893); *Ficaria verna* subsp. *pumila* (Velen.) Velen., *Fl. Bulg.* Suppl. I: 6 (1898).

Illustrations: Reichenb., *Ic. Fl. Germ. Helv.* **3**: t. 1 (1838–1839); T. Săvulescu, *Fl. Rep. Pop. Rom.* **2**: 557, pl. 89, Fig. 6 (1953); M. Josifović, *Fl. Rep. Soc. Serb.* **1**: 253, t. 37, Fig. 2 (1970).

Description: Plant small, with short stems at anthesis. Leaves crowded at base, few on stems, up to 4 × 4 cm; petiole up to 7 cm, without bulbils in axils. Flowers up to 30 mm in diameter; petals 10–15 × 2·5–6 mm, contiguous; pollen viable. Achenes fertile, c. 2·5 × 2·0 mm, with few to numerous, short, rigid simple eglandular hairs.

b) subsp. **ficaria**

Synonymy
Ficaria verna Hudson, *Fl. Angl.* 214 (1762) nom. nov. pro R. *ficaria* L.; *Ficaria ranunculoides* Roth, *Tent. Fl. Germ.* **1**: 241 (1788) nom. nov. pro *R. ficaria* L., nom. superfl. illegit. pro *Ficaria verna* Hudson; *R. praecox* Salisb., *Prodr. Stirp. Allerton* 372 (1796) nom. superfl. illegit. pro *R. ficaria* L.; *R. ficaria* var. *aurantiacus* Turrill in *Bot. Mag.* **170**: 226 (1954) (LECTOTYPE: field near Windsor, Berks., v.c. 23, 27 April 1932, *A. Robson* (**K**)); *R. ficaria* var. *fertilis* A. R. Clapham in Clapham, A. R., Tutin, T. G. & Warb., E. F., *Fl. Brit. Isles* 101 (1952) nom. invalid. sine diagn. latin.; *R. ficaria* subsp. *fertilis* Lawralrée in Robyns, *Fl. Gén. Belg.* (*Spermat.*) **2**: 50 (1955) nom. invalid., sine diagn. latin.; *R. ficaria* var. *incumbens* auct., non F. W. Schultz, *Arch. Fl. Jour. Bot.* 122 (1855).

Illustration: Ross-Craig, *Draw. Brit. Pl.* **1**: pl. 35 (exclud. H) (1948).

Description: Plant rather rigid, erect and with elongated stems. Leaves up to 5 × 5 cm, numerous on stems; petiole up to 15 cm, without axillary bulbils. Flowers usually 20–40 mm in diameter; petals 10–20 × 4–9 mm, often contiguous; pollen largely viable. Achenes mostly fertile and well-developed, 2·5–3·5 × 1·7–2·2 mm, with few to numerous simple eglandular hairs. 2n = usually 16, sometimes 16 + 1–7B, sometimes 24.

c) subsp. **bulbilifer** Lambinon in *Bull. Jard. Bot. Nat. Belg.* **51**: 462 (1981) nom. nov. pro *R. ficaria* var. *bulbifer* Marsden-Jones, non Albert.

Synonymy
Ficaria ranunculoides var. *divergens* F. W. Schultz, *Arch. Fl. Jour. Bot.* 122 (1855) (Described from the Wissembourg area, France); *R. ficaria* var. *bulbifer* [*bulbifera*] Albert in Albert & Jahandiez,

Cat. Pl. Vasc. Var 7 (1908) (HOLOTYPE: Champs inondés l'hiver, Ampus, Var, France, 27 May 1880, *A. Albert* (**TLON**)); *R. ficaria* var. *sinuata* Horwood in *Rep. botl Exch. Club. Brit. Is.* **4**: 312 (1916) (LECTOTYPE: Ratcliffe, Leicester, 29 April 1909, *A. R. Horwood* (**NMW**)); *R. ficaria* var. *divergens* (F. W. Schultz) Horwood in Horwood & Noel, *Fl. Leicester* 19 (1933); *R. ficaria* var. *bulbifer* [*bulbifera*] Marsden-Jones in *J. Linn. Soc. London (Bot.)* **50**: 40 (1935) (LECTOTYPE: Office of Works, Kew, under lime trees amongst ivy, 25 April 1930, *W. B. Turrill* (**K**)), non Albert (1908); *R. ficaria* var. *ficaria* sensu A. R. Clapham in Clapham, A. R., Tutin, T. G. and Warb., E. F., *Fl. Brit. Isles* 101 (1952); *R. ficaria* subsp. *bulbifer* Lawalrée in Robyns, *Fl. Gén. Belg.* (*Spermat.*) **2**: 60 (1955) pro *R. ficaria* var. *bulbifer* Marsden-Jones, non Albert, nom. illegit.; *Ficaria verna* subsp. *bulbifera* Á. & D. Löve in *Bot. Not.* **114**: 52 (1961) pro *R. ficaria* var. *bulbifer* Marsden-Jones, non Albert; *Ficaria bulbifera* (Á. & D. Löve) J. Holub in *Preslia* **33**: 400 (1961) pro *R. ficaria* var. *bulbifer* Marsden-Jones, non Albert.

Illustrations: *J. Linn. Soc. London (Bot.)* **50**: 45, Figs 6, 7, 8, 10 (1935).

Description: Plant rather slender, with elongated stems and a loose spreading habit. Leaves up to 4 × 4 cm; petiole up to 15 cm with small, globular, rounded-obtuse, axillary bulbils which reproduce the plant vegetatively. Flowers usually not more than 25 mm in diameter; petals 6–11 × 2–5 mm, usually narrow and not contiguous; pollen largely non-viable. Achenes rarely fertile, but sometimes yielding up to six well-developed ones per flower. 2n = usually 32, sometimes 24.

d) subsp. **ficariiformis** (F. W. Schultz) Rouy & Fouc., *Fl. Fr.* **1**: 73 (1893).

Synonymy
Ficaria grandiflora Robert, *Pl. Phan. Toul.* 112 (1838) (NEOTYPE: Lieux cultivés, prairies humides, bords des fosses, champs à Nice, Alpes Maritimes, France, 1866, Rec. Choulette, F. Schultz, herb. Norm. Suppl. 1, no. ad 407 (**CGE**)), non *R. grandiflorus* L., *Sp. Pl.* 555 (1753); *R. ficaria* var. *calthifolius* [*calthefolius*] sensu Guss., *Fl. Sic. Syn.* **2**: 41 (1844) quoad descript. exclud. syn.; *R. calthifolius* sensu Jordan, *Obs. Pl. Crit.* **6**: 2 (1847) quoad descript., non *Ficaria calthifolia* Reichenb., *Fl. Germ. Excurs.* 718 (1832), nec *R. ficaria* subsp. *calthifolius* (Reichenb.) Arcangeli, *Comp. Fl. Ital.* 11 (1882) quoad basionym.; *R. ficariiformis* [*ficariaeformis*] F. W. Schultz, *Arch. de Flore* 260 (1858) nom. nov. pro *Ficaria grandiflora* Robert, non *R. grandiflorus* L.; *R. ficaria* subsp. *grandiflora* (Robert) Coutinho, *Fl. Port.* 232 (1913); *Ficaria ranunculoides* subsp. *grandiflora* (Robert) Cadevall & Sallent, *Fl. Catalunya* **1**: 42 (1913); *R. ficaria* forma *luxurians* Moss, *Camb. Brit. Fl.* **3**: 126 (1920) (LECTOTYPE: Jersey, 14 April 1913, *E. W. Hunnybun* (**CGE**)); *Ficaria verna* subsp. *grandiflora* (Robert) Hayek in *Feddes Repert.* **30**: 327 (1927) quoad basionym, exclud. descript.; *Ficaria calthifolia* subsp. *grandiflora* (Robert) Trinajstic in *Zborn. I. Simp. Biosist. Jugosl.* 160 (1971).

Illustrations: Moss, *Camb. Brit. Fl.* **3**: pl. 128 (1920) as forma *luxurians*.

Description: Plant up to 40 cm, rather robust but stems and leaves arching and straggling. Leaves up to 7 × 7 cm; petioles up to 28 cm, with ovoid or globular axillary bulbils. Flowers up to 50 mm in diameter; petals 17–26 × 4–12 mm, contiguous or overlapping; pollen largely viable. Achenes 4–5 × 2·5–3·5 mm, covered with numerous very short, rigid, pale simple eglandular hairs. 2n = 32.

e) subsp. **chrysocephalus** P. D. Sell in *Bot. J. Linn. Soc.* **106**: 117 (1991) (HOLOTYPE: Hort. E. A. Bowles, Waltham Cross, 4 April 1931, *W. T. Stearn* (**CGE**).)

Illustration: Bot. Mag. **153**: t. 9199 (1927) as *R. ficaria grandiflorus*.

Description: Plant up to 40 cm, robust and erect. Leaves up to 8 × 9 cm; petioles up to 21 cm, without axillary bulbils. Flowers up to 60 mm in diameter; petals 18–25 × 9–15 (−18) mm, contiguous or overlapping; pollen largely viable. Achenes 3–4 × 2·0–2·5 mm, covered with numerous, very short, rigid, pale simple eglandular hairs. 2n = 32.

HABITAT AND DISTRIBUTION

This is difficult to assess, as a large proportion of herbarium sheets cannot be determined with certainty and my field experience is restricted to the British Isles. There is, however, quite a lot of published information, which I have been able to put together with reasonable certainty. The species, as defined here, occurs in a wide range of communities in deciduous woodlands and hedgerows, on roadsides and ditch banks, in damp pasture, on cliff-ledges and cliff-tops and as a weed in gardens and lawns. It is found in open habitats and in deep shade on both heavy and light soils (especially those which are periodically wet), with a pH which varies from 4·4–6·9. Its altitudinal range in the British Isles is from sea-level to 360 m in N. England, 730 m in N. Wales, 550 m in Sutherland and 720 m in Kerry. In Continental Europe it reaches 305 m in S. Norway, 1200 m in the Tatra, 1620 m in the Pre-Alps and 1900 m in the Greek mountains. It ranges throughout Europe to approximately 60° E. in central and south-eastern parts of the former U.S.S.R., and is introduced in N. America (cf. Meusel *et al.* 1965, 168; Jalas & Suominen 1989, map 1833).

Subsp. *calthifolius* is a plant of east-central and south-east Europe, particularly on wood margins, roadside banks and neglected grassland. *Ficaria stepporum* Smirnov, from the southern area of the former U.S.S.R., is a plant I know nothing about, but appears to be similar to this subspecies.

Subsp. *ficaria* is restricted to western Europe from south-west Norway southwards through France to the westernmost Mediterranean region. It is rare in Belgium, the Netherlands and Denmark. I question the records for the central Mediterranean (Jalas & Suominen 1989, map 1836).

Subsp. *bulbilifer* probably occurs throughout the range of the species, but is rare or absent in the Mediterranean region. It is probably the only subspecies of cliffs and mountainous regions in many areas. It is an abundant weed of lawns and gardens, where it spreads rapidly and is very difficult to eradicate.

Subsp. *ficariiformis* occurs in the central and west Mediterranean region and may be native north to the British Isles. Plants from Jersey, Guernsey, the Isles of Scilly and a small patch of low woodland at St Ishmaels, Pembrokeshire are certainly it. It may be a native in some of these localities, but in 1979 D. E. Coombe and C. D. Preston failed to find any large-flowered *R. ficaria* outside gardens in Guernsey. Elsewhere, it may occur in and escape from gardens. In the drive from Grange Road to Leckhampton House, Cambridge, it has survived since 1940 (*J. Rishbeth* in **CGE**).

Subsp. *chrysocephalus* would appear to be native of the east Mediterranean region. Hayek (1927 as *Ficaria* subsp. *grandiflora*) says the large-flowered plants of Greece and Crete are without bulbils, and J. R. Akeroyd (pers. comm.) says this is also his experience both in the field and when cultivating them. In the spring of 1991 he found that it was common in Crete in minimally cultivated fields, edges of copses and by streams, especially on plateaux between 700 and 800 m; in April 1993 he observed it in S.W. Turkey. Meikle (1977) (as *R. ficaria* subsp. *ficariiformis*) says the large-flowered plant of Cyprus is without bulbils. Turrill first drew attention to this plant when he published a fine illustration of it in the *Botanical Magazine* in 1930. W. T. Stearn collected a specimen of it (**CGE**) from the garden of E. A. Bowles, which Bowles said was the clone from which the specimen was taken for this illustration. This is confirmed by an annotation on a specimen in **K**. This also seems to be the clone which Marsden-Jones & Turrill (1952) discovered was tetraploid, but without bulbils. I have used the Stearn specimens as the type of subsp. *chrysocephalus*.

P. D. Williams grew plants in his garden at Lanarth, Cornwall, which he obtained from Bowles. Lavender Williams transferred some of these to St Tudy, near Camelford, some of which she also sent to D. E. Coombe at the Cambridge Botanic Garden. Dr Coombe went to live in Chesterton Towers, Cambridge in 1982. In the spring of 1983 he discovered it in the garden of 1, Chesterton Towers, since when it has spread at least 100 m. It there grows with subsp. *bulbilifer* and appears to produce no intermediates. In 1979 D. E. Coombe and C. D. Preston collected plants in the garden of Dr and Mrs D. G. Jameson, Les Fontanelles, Forest, Guernsey, which had been transplanted from Mill House, Balsham, Cambridgeshire. This suggests that subsp. *chrysocephalus*, which is a handsome plant, may be fairly widespread in British gardens, where it could easily spread and become mixed with the common weed, subsp. *bulbilifer*.

RELATIONSHIP TO MAN, ANIMALS AND FUNGI

Ranunculus species contain the glycoside ranunculin, from which the irritant substance protoanemonin is formed. This is recorded in *R. ficaria*. The highest concentration of protoanemonin is present when the plant is flowering. All domestic animals appear to be susceptible to protoanemonin poisoning, from which various symptoms develop, but it rarely kills them.

To the adherents of the Doctrine of Signatures, the tubers looked like piles and it was formerly recommended for them both internally and externally, hence its alternative name, Pilewort. Its acrid nature makes it more suitable as an ointment. The tuber was also likened to a cow's udders and hung in the byre to produce more cream in the milk. As a harbinger of spring it is a plant mentioned by poets. The chocolate brown teleutosori of *Uromyces ficariae* (Alb. & Schw.) Lév. are very common on its petioles from March to early June, and honey-coloured spermogonial and orange aecidial stages of *Uromyces dactylidis* Otth are common on the undersides of leaves and on the petioles from March until May. *Entyloma ficariae* Fischer & Waldh. commonly forms yellowish to brown spots (delimited by the veins) on the leaves in April and May. *Septoria ficariae* Desm. is common on the fading leaves of the plants from May to July.

REPRODUCTIVE BIOLOGY

Plants are diploid (2n = 16), triploid (2n = 24) or tetraploid (2n = 32). Gill *et al.* (1972) record up to seven B-chromosomes in diploid plants, but none are recorded for triploids and tetraploids. In the British Isles diploids are widespread, though tetraploids are more common in the east. Diploid plants with B-chromosomes are virtually confined to southern England and the Midlands. Triploids have been recorded from a number of widely separated localities and may be frequent (cf. Marchant & Brighton (1974)). The diploid records for the British Isles will be referable to subsp. *ficaria* and the tetraploid mostly, if not all, to subsp. *bulbilifer*. The triploids are possibly hybrids between these two subspecies as they are recorded in their area and may or may not have bulbils. The flowers are protandrous, the anthers dehiscing extrorsely. The species is normally hermaphrodite, but male plants (usually diploids) with large petaloid perianth segments, no nectaries and numerous stamens and carpels abortive or absent occur in some populations, while some plants of tetraploid subsp. *bulbilifer* sometimes produce a few smaller female flowers as well as hermaphrodite ones. It is entomophilous, but self-pollination occurs in the absence of visits by insects, which include Coleoptera (particularly *Meligethes* sp.), Diptera, Hymenoptera (particularly *Apis mellifera* L.) and Lepidoptera. For a detailed list of species visiting *R. ficaria*, see Marsden-Jones (1935 & 1937a). A large proportion of the pollen of those plants found to be triploids and the tetraploid subsp. *bulbilifer* is non-viable and few seeds are set, but pollen from diploids and the large-flowered tetraploids is viable and many achenes are produced. *R. ficaria* is unusual among the dicotyledons in having only one cotyledon, and Marsden-Jones (1937b) has shown that it is a single foliar organ, on which after two or three months, a rudimentary root tuber develops. Clones of all the subspecies can be produced by division of the root tubers. A greater and quicker spread of clones occurs in subsp. *bulbilifer* and subsp. *ficariiformis*, where axillary bulbils separate off as the shoot system dies and can produce flowering plants in the first year. Subsp. *calthifolius*, subsp. *ficaria*, subsp. *ficariiformis* and subsp. *chrysocephalus* also spread by seed. Marsden-Jones (1935) says seedlings of subsp. *ficaria* do not begin flowering until the second year. Flowering normally takes place between February and May. More detailed accounts of the species occur in Taylor & Markham (1978) and Grime *et al.* (1988), but the general biology and ecology will not properly be understood until detailed studies of the individual subspecies are made.

By the drive which runs from Grange Road to Leckhampton House at Cambridge, there is a colony of subsp. *ficariiformis* which has been there since at least 1940 (fide J. Rishbeth). Subsp. *bulbilifer* is also present along the whole length of the drive. Although I have searched there over a number of years, I have never seen any plants I would call intermediate in morphology. Along a stream in the Cambridge Botanic Garden, subsp. *ficariiformis* used to grow with subsp. *ficaria*. In that locality there did seem to be morphological intermediates, but they were never examined cytologically.

Plants from the Leckhampton colony of subsp. *ficariiformis* and the Coombe/Preston plants from

La Gouffre, Guernsey, of subsp. *chrysocephalus*, were grown in pots in the Botanic Garden, Cambridge, together with examples of subsp. *ficaria* and subsp. *bulbilifer*. I was there able to watch them all together right through the season and R. A. Finch kindly counted their chromosomes for me. The tetraploid count of subsp. *chrysocephalus* confirms that made by Marsden-Jones (Marsden Jones & Turrill 1952). As the plants of subsp. *chrysocephalus* die, the stalks bend over so that the falling seeds form a ring round the old plant and later produce a circle of seedlings.

VARIATION

As well as the variation given in the formal account of the five subspecies, there is considerable variation in flower colour, number of petals, leaf-blotching and width of basal sinus of leaf which to some extent is genetically controlled, but can occur in all subspecies (Marsden-Jones & Turrill 1952). Var. *aurantiacus* with orange petals seems to have been found only once, but you can buy it as 'Cupreus' from no fewer than 13 nurseries. It did not come true from seed produced either from self-pollination or cross pollination, but was easily multiplied vegetatively. Its chromosome number was given as 2n = 20 (presumably 16 + 4B). In Philip & Lord (1991) 25 variants are listed as being available for sale in a wide range of nurseries. More work is needed on these garden variants to establish to which subspecies they belong.

ACKNOWLEDGMENTS

I am much indebted to D. E. Coombe, who has continually discussed this aggregate with me throughout the time I have been working on it, to R. A. Finch for counting the chromosomes of plants grown in the Cambridge Botanic Garden, and to J. G. Murrell for measuring plants in several populations and helping to prepare the manuscript. A. O. Chater, C. D. Preston and S. M. Walters have kindly read drafts of the manuscript.

REFERENCES

Albert, A. & Jahandiez, E. (1908). *Catalogue des plantes vasculaires qui croissent naturellement dans le Départment du Var*. Paris.

Arcangeli, G. (1882). *Compendio della Flora Italiana*. Turin.

Benson, L. (1954). Supplement to the treatise on the North American Ranunculi. *American Midland Naturalist* **52**: 328–369.

Clapham, A. R., Tutin, T. G. & Warburg, E. F. (1952). *Flora of the British Isles*. Cambridge.

Gill, J. J. B., Jones, B. M. G., Marchant, C. J., McLeish, J. & Ockendon, D. J. (1972). The distribution of chromosome races of *Ranunculus ficaria* L. in the British Isles. *Annals of Botany* n.s. **36**: 31–47.

Grime, J. P., Hodgson, J. G. & Hunt, R. (1988). *Comparative plant ecology*. London.

Gussone, G. (1844). *Florae Siculae synopsis*, **2**. Naples.

Hayek, A. (1927). Prodomus florae peninsulae Balcanicae. *Feddes Repertorium* **30**(1): 327.

Heath, P. V. (1991). Article 7.15 and the lectotypification of Linnaean specific names. *Taxon* **40**: 94–95.

Holub, J. (1961). Polznámky k málo známyn rostlinám kvetany Č.S.S.R. *Preslia* **33**: 399–404.

Horwood, A. R. (1916). *Ranunculus Ficaria* L. nov. var. *sinuata* mihi. *Report of the Botanical Exchange Club of the British Isles* **4**: 312–313.

Hudson, W. (1762). *Flora Anglica*. London.

Jalas, J. & Suominen, J. (1989). *Atlas florae Europaeae*. Helsinki.

Jordan, A. (1846–1849). *Observations sur plusieurs plantes nouvelles rares ou critiques*. Paris & Leipzig.

Kerner, A. (1863). Descriptiones plantarum novarum florae Hungaricae et Transsilvaneae. *Österreichische botanische Zeitschrift* **13**: 188.

Lambinon, J. (1981). Le nom correct de la ficaire à bulbilles: *Ranunculus ficaria* L. subsp. *bulbilifer* Lambinon nom. nov. *Bulletin du Jardin botanique national de Belgique* **51**: 461–463.

Lawalrée, A. (1955). Ranunculaceae, in Robyns, W., *Flore générale de Belgique. Spermatophytes*, **2**. Brussels.

Linnaeus, C. (1738). *Hortus cliffortianus*. Amsterdam.

Linnaeus, C. (1745). *Flora Suecica*. Stockholm.

Linnaeus, C. (1753). *Species plantarum*. Stockholm.

Marchant, C. J. & Brighton, C. A. (1974). Cytological diversity and triploid frequency in a complex population of *Ranunculus ficaria* L. *Annals of Botany* n.s. **38**: 7–15.

Marsden-Jones, E. M. (1935). *Ranunculus ficaria* Linn.: life-history and pollination. *The Journal of the Linnean Society of London* (*Botany*) **50**: 39–55.

Marsden-Jones, E. M. (1937a). Pollination of *Ranunculus ficaria* L. by insects. *The Journal of Botany (London)* **75**: 133–141.

Marsden-Jones, E. M. (1937b). An interpretation of the morphology of the single cotyledon of *Ranunculus ficaria* based on embryology and seedling anatomy. *Annals of Botany* n.s. **1**: 103–120.

Marsden-Jones, E. M. & Turrill, W. B. (1952). Studies on *Ranunculus ficaria*. *Journal of Genetics* **50**: 522–534.

Meikle, R. D. (1977). *Flora of Cyprus*, **1**. Kew.

Meusel, H., Jäger, E. & Weinert, E. (1965). *Vergleichende Chorologie der zentraleuropäischen Flora*. Jena.

Moss, C. E. (1920). *The Cambridge British flora*, **3**. Cambridge.

Philip, C. & Lord, T. (1991). *The plant finder*, 5th ed. Ashbourne.

Reichenbach, H. G. L. (1832). *Flora Germanica excursoria*. Leipzig.

Robert, G. N. (1838). *Plantes phanérogames qui croissent naturellement aux environs de Toulon*. Brignoles.

Roth, A. W. (1788). *Tentamen florae Germanicae*. Leipzig.

Rouy, G. C. C. & Foucaud, J. (1893). *Flore de France*, **1**. Asnières, Paris & Rochefort.

Salisbury, R. A. (1796). *Prodromus stirpium in horto ad Chapel Allerton vigentium*. London.

Savage, S. (1945). *A catalogue of the Linnaean herbarium*. London.

Schultz, F. W. (1854–1861). *Archives de Flore*. Wissembourg.

Schur, P. J. F. (1866). *Enumeratio plantarum Transsilvaniae*. Vienna.

Taylor, K. & Markham, B. (1978). Biological flora of the British Isles. *Ranunculus ficaria* L. *Journal of Ecology* **66**: 1011–1031.

Turrill, W. B. (1954). *Ranunculus ficaria* var. *aurantiacus*. *The Botanical Magazine* **170**: t. 226.

Tutin, T. G. (1964). *Ranunculus* L., in Tutin, T. G. *et al.*, eds. *Flora Europaea* **1**: 223–237. Cambridge.

Velenovsky, J. (1887). Neue Beiträge zur Kenntnis der Flora von Ost-Rumelien und Bulgarien. *Sitzungsberichte der Königl. böhmischen Gesellschaft der Wissenschaften* **1887**: 436–467.

Velenovsky, J. (1898). *Flora Bulgarica*. Supplementum I. Prague.

(*Accepted April 1993*)

Calamagrostis stricta (Timm) Koeler, *C. canescens* (Wigg.) Roth and their hybrids in S. E. Yorks., v.c. 61, northern England

F. E. CRACKLES

143 Holmgarth Drive, Bellfield Avenue, Hull, HU8 9DX

ABSTRACT

The taxonomy of *Calamagrostis* Adans. (Poaceae) species occurring along Leven Canal, S.E. Yorks., v.c. 61, has been studied. The populations examined include *C. canescens* (Wigg.) Roth, *C. stricta* (Timm) Koeler, the hybrid *C. canescens* × *C. stricta* at two chromosome levels (2n = 28 and 2n = 56), and a strongly introgressed *C. canescens* population. The two species show only slight separation in bract length/width and panicle length, but clear separation in the length of the lowest panicle branch, glume length/width, awn length and point of awn insertion. The hybrids are variously intermediate in all but one of these characters between those of the presumed parents. The hybrid with 2n = 28 is sterile and produces little well-formed pollen; that with 2n = 56 produces well-formed pollen and is partially fertile (unlike Swedish *Calamagrostis* with high chromosome numbers which produce empty pollen and are apomictic).

KEYWORDS: introgression, taxonomy, reproductive biology, chromosome counts.

INTRODUCTION

My interest in the taxonomy, distribution and ecological requirements of *Calamagrostis stricta* (Timm) Koeler (syn. *C. neglecta* auct., *Deyeuxia neglecta* auct.) was aroused in 1951 by my discovery that this rare British grass was locally dominant along stretches of the edge of Leven Canal, S. E. Yorks., v.c. 61 (Crackles 1953). *C. canescens* (Wigg.) Roth was common along the canal bank and plants with some morphological features intermediate between those of this species and *C. stricta* were present with the two species and believed to be the hybrid *C. canescens* × *C. stricta* which had not previously been recorded for the British Isles.

The morphology of *C. stricta, C. canescens* and the putative hybrid at Leven was studied during 1951 and 1952 and these studies formed an invaluable basis for later work on the taxa. Herbarium specimens to show inflorescences at different stages of development were displayed, alongside corresponding stages of *C. stricta* and *C. canescens* from the same locality together with drawings to show how floral and vegetative structures of the intermediate material differed from those of the supposed parents at the Exhibition Meeting of the Botanical Society of the British Isles in 1952 (Crackles 1953). A representative series of specimens was also deposited in **K**.

Calamagrostis stricta is a very variable grass in the British Isles (Hubbard 1968). At Leven, plants of *C. stricta* are less than 95 cm tall and grow by the water's edge. The leaves are narrow, firm and rough, the bract making an acute angle with the culm. The short panicle (14 cm or less) is narrow and tight except during the short flowering period. *C. canescens* plants are significantly taller and grow on the canal bank. The leaves are limp, usually with white hairs on the upper leaf surface. The panicle is lax and nodding after flowering, the hairs surrounding the florets (callus hairs) being conspicuous in the fruiting panicle.

Plants of the putative *C. canescens* × *C. stricta* found in 1951 were of similar height to those of *C. canescens* or taller and grew on the sloping canal bank extending to the water's edge. The leaves were fairly firm and slightly rough and some had white hairs on the upper leaf surface as in *C. canescens*; the bract was horizontal. The panicle, which is fairly rough to touch, was conspicuous after flowering being tight, orange-brown in colour and significantly broader and usually longer than in *C. stricta*. The ligule of the putative hybrid was often longer than that of *C. canescens* (ligule of *C. stricta* less than 3 mm, of *C. canescens* rarely greater than 4 mm, that of *C. canescens* × *C. stricta* often to 5 mm).

In April, 1952, Dr Hubbard agreed with the identification of the hybrid (pers. comm.), but some months later seemed to have some misgivings, saying that no British hybrid grass is male fertile even though the putative hybrid at Leven was. In 1954, Dr Nygren of Ultima Agricultural College, Sweden, saw putative hybrid material from Leven Canal and confirmed its identity, although he considered that this taxon was morphologically distinct from its Swedish counterpart and forecast a high chromosome number.

In 1970, Dr D. W. Shimwell suggested that I should make a biosystematic and taxonomic study of the Leven *Calamagrostis* populations. Several visits were paid to the canal in that year and the *Calamagrostis* populations examined carefully.

The stretch of bank on which the putative *C. canescens* × *C. stricta* was found in 1951 was by now overgrown with *Phragmites australis* (Cav.) Trin. ex Steudel and surviving plants flowered rarely. However, morphologically similar plants to those studied in 1951 and with characters intermediate between those of *C. stricta* and *C. canescens* and previously described in this paper were found to be dominant along a stretch of 22 m of the north bank and approximately 450 m to the east of the Far Fox Aqueduct. This bed occurred on the slope of the bank above the canal edge footpath, except for the easternmost 8 m which was by the water's edge, thus occupying a very similar position on the canal bank to that occupied by the 1951 hybrid. In August, this population, which I shall call the H_1 population, is conspicuous by virtue of its broad orange-brown panicles as was the 1951 putative hybrid population. Pollen grains were well-formed as in that taxon.

Another population of the putative hybrid *C. canescens* × *C. stricta* was found in 1970 growing at the edge of the water along the north bank, nearly opposite to Carr Farm. The plants had narrow, more or less strict, spikes in the fruiting condition and could have been overlooked for *C. stricta*. This taxon was also intermediate between the two parents in a number of its characters; it was identified 'in the field' by the length and position of the awn. Using a hand-lens, the awn was seen to arise about half-way up the lemma as in the H_1 population and the 1951 putative hybrid and did not project beyond the lemma. This taxon differs from *C. stricta* in having a far longer, projecting bottom branch to the panicle and in other respects. This population, which I shall call the H_2, differs from the H_1 in having empty pollen and in being conspicuous in flower as the exserted anthers are yellow (purple in the H_1 and in the parental species).

A bed of *C. canescens* growing at the edge of a dyke, parallel to the northern bank of the canal and a few metres to the north of it was believed to be strongly introgressed (the I_1 population); since, for example, the glumes and callus hairs were of markedly different length in one spike and the panicle was not so lax and not nodding.

In addition, a single plant found on an unusually steep stretch of the canal bank, designated as the Leven H_3, is a recombinant with both *C. stricta* and *C. canescens* characters not present in the H_1 and H_2 populations.

Photographs of fruiting panicles of *C. canescens* × *C. stricta*, H_1 and H_2 individuals, are presented together with those of the parental species for comparison (Fig. 1).

THE AREA

Leven Canal is 5·2 km in length and extends from the village of Leven, GR TA/106.453, westwards to meet the River Hull, c. 12·5 km south of Great Driffield where spring-fed becks converge. The canal was cut in 1802 and was sealed off from the river in 1934. The River Hull valley, in common with the rest of Holderness, was formerly an area of extensive marshes and irregular meres with islands of higher ground here and there. Much of the valley was flooded for several months each year and the meres, variable in extent, represented the remains of the flood water which lingered in the lowest part throughout the summer (Sheppard 1957). The northern part of the valley remained relatively unchanged until the major drainage scheme of 1764 took effect (Sheppard 1958) but this caused little or no change to Leven Carrs. A plan of the Holderness level by A. Bower, dated 1781, in the Hull City local history library, shows irregularly shaped meres in Leven and Tickton Carrs. Comparison of this map with the Ordnance Survey 2·5 inch to 1 mile (sheet TA/0.4), suggested that the canal was cut through the meres. A later plan by E. Pearson, dated 1831, confirmed that the canal cut through two meres, or their sites, and that it passed through the edge of a lake at the place where *C. stricta* was first discovered (Crackles 1968). There is supporting evidence of standing water on Leven Carrs in the

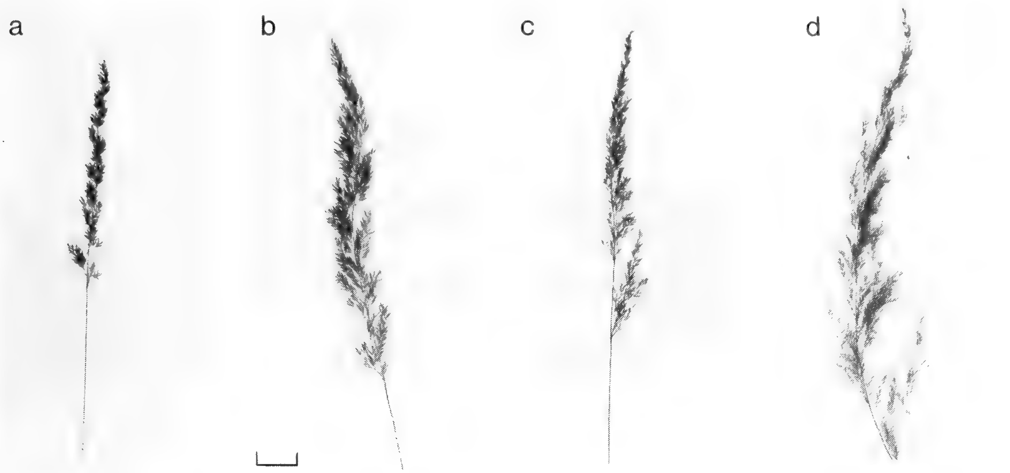


FIGURE 1. Fruiting panicles of specimens collected at Leven Canal in 1970: (a) *C. stricta*; (b) *C. canescens* × *C. stricta* (H_1 population); (c) *C. canescens* × *C. stricta* (H_2 population); and (d) *C. canescens*. The scale bar represents 2 cm.

nineteenth century in a manuscript herbal compiled by the Rev. W. Whytehead while he was vicar of Atwick, near Hornsea, S. E. Yorks. (1757–1817) in which he states that White and Yellow Water-lilies and Water Soldier occurred in "Leaven Carrs". This observation was made before the construction of the canal which is not mentioned in the manuscript.

The presence of scarce or local British species in or by the canal provides strong support for the view that the canal derived its flora from the former meres and adjacent marshes. Scarce British species recorded include *Calamagrostis stricta, Carex appropinquata* Schum., *C. elata* All., *Myriophyllum verticillatum* L., *Potamogeton friesii* Rupr. and *Sium latifolium* L. Other species recorded here included *Apium inundatum* (L.) H. G. Reichb., *Butomus umbellatus* L., *Carex paniculata* L., *C. rostrata* Stokes, *C. vesicaria* L., *Hippuris vulgaris* L., *Hottonia palustris* L., *Lysimachia vulgaris* L., *Lythrum salicaria* L., *Myriophyllum spicatum* L., *Nuphar lutea* (L.) Smith, *Nymphaea alba* L., *Oenanthe fistulosa* L., *Potamogeton alpinus* Balbis, *P. lucens* L., *P. natans* L., *Ranunculus circinatus* Sibth., *Sagina nodosa* (L.) Fenzl, *Sagittaria sagittifolia* L., *Samolus valerandi* L., *Schoenoplectus lacustris* (L.) Palla and *Utricularia vulgaris* L., several being uncommon or rare vice-county species.

In addition to extensive annual flooding of the carrland, which still occurred in winter until c. 40 years ago, there were springs in the carrs. For example, in the early 1970s, I noticed a spring in the canal, the resultant ripples reaching the north bank at the point at which beds of *Phragmites australis* end and those of *Schoenoplectus lacustris* and *Calamagrostis stricta* begin.

METHOD OF STUDY

25 shoots of *C. stricta, C. canescens* and the putative hybrids, population H_1 and H_2 and 20 shoots of the I_1 population were collected at random. Material was collected at the end of July or early August, 1970, when the panicles were in their after-flowering condition and comparison of the maximum number of floret characters could be made.

Measurements of bract length and width, and also of panicle length and width and length of the bottom branch of the panicle were recorded for each individual shoot of the population samples of each taxon. All bract measurements were obtained 'in the field' because of the tendency of the leaves of some taxa to inroll on drying. In the case of the spikelet characters, five spikelets for each individual shoot of each taxon, selected at random, were used to provide average values.

It is important to consider the variation between the different taxa, one character at a time. Such variation is shown for six characters (Figs 2–7) with the range of variation, mean and standard deviation given for each character.

REPRODUCTIVE BIOLOGY AND CHROMOSOME COUNTS

All the *Calamagrostis* material studied was perennial and all spread vegetatively by means of rhizomes; the H_1 population is particularly vigorous in this respect.

C. stricta is the first of the Leven *Calamagrostis* populations to flower. In most years, many spikes of *C. stricta* are open by mid-June, while *C. canescens* is not normally in good flower until the first week in July. There may be a slight overlap of flowering times as in 1952 when a few spikes of *C. stricta* were still open on 22 June when the first spikes of *C. canescens* were also open. When the early part of the summer is cold, as in 1972, flowering of *C. stricta* may be delayed by as much as ten days. Typically, each spike of *C. stricta* closes in five days, but in 1971 tightening of spikes was delayed, only some spikes being in the closed condition by 4 July. In both these situations, there was a significant overlap of flowering of the two species. The flowering time of the H_1 population is intermediate between that of the parents, full flowering usually being attained in the fourth week of June. Spikes of the H_1 population appear to take longer to close than those of *C. stricta*, closing over a period of ten days. The H_2 population flowers slightly earlier than *C. canescens* or at the same time.

In the case of all the Leven *Calamagrostis* plants studied, the anthers were found to be I-shaped and yellow, while still in the flower. The filament is coiled while the anthers are in the spikelet and more or less straight when the anthers are protruding, so that protrusion of anthers is presumably spontaneous.

A spike of *C. stricta* half-way out of the sheath was examined, while obtaining meiotic stages for a chromosome count. Spikelets near the top of that part of the spike still enclosed in the sheath were green and still contained pollen mother cells undergoing meiosis, while the purplish spikelets higher up the spike contained fully-formed pollen grains. On the same date, a spike fully out of the sheath was found to have pollen grains fully formed half-way up the spike.

Samples of ten anthers taken at random were examined. Observations concerning shape, measurements and colour of the anthers of the various taxa being studied were made and the percentage of well-formed pollen produced by each taxon was recorded (Table 1).

C. stricta plants from Leven Canal were found to set some seed by self-fertilisation while *C. canescens* appeared to be self-sterile, a conclusion also reached by Nygren (1946) in Sweden. The I_1 population, believed to be a *C. canescens* introgressant, is self-fertile.

The H_1 population produced a good percentage of fully-formed pollen grains. Isolated H_1 panicles produced an abundance of imperfect caryopses although two plants were reared from the contents of half an isolated panicle. Thus the evidence indicates normal sexual reproduction with slight self-fertility. No caryopses were produced by the H_2 plants.

All the caryopses of the *Calamagrostis* taxa examined are very small and the seeds are presumably shed enclosed in the lemma and palea to which the callus hairs are attached. *C. stricta* has short stubby caryopses less than 1 mm long. The *C. canescens* caryopsis is c. 1 mm long with a short narrow neck subtending a narrow platform. The caryopsis of the H_1 putative hybrid is 1·0–1·3 mm long, the top of the fruit being distinctively shaped, splaying out gradually from a restriction at the neck. The caryopses of the putative *C. canescens* introgressant, population I_1, was very heavily attacked by the gall-forming mite, *Steneotarsonemus spinosus* Schoarschmit, the effect of the attack being to cause the lemma and palea to harden and swell. Other *C. canescens* populations were not affected.

For the purpose of obtaining chromosome counts, root tips of each taxon were placed in 1% colchicine solution for up to four hours to spread the chromosomes. Squashes were then prepared and stained with aceto-carmine. Difficulty was experienced in perfecting the squash technique so that the very small chromosomes were sufficiently spread to count. Meiosis was also studied in all five taxa. Flowering spikes were fixed in 3:1 absolute alcohol to glacial acetic acid overnight and preserved in 95% ethanol. Squashes to show the meiotic stages were stained in aceto-carmine after pre-treatment with a drop of N HCl to aid the spreading of chromosomes.

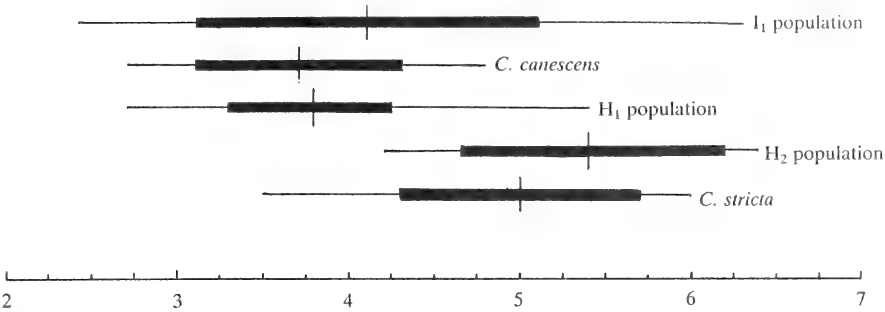


FIGURE 2. Bract length/bract width of *Calamagrostis* taxa showing mean (vertical line), range (thin line) and standard deviation (thick line) for Leven population samples.

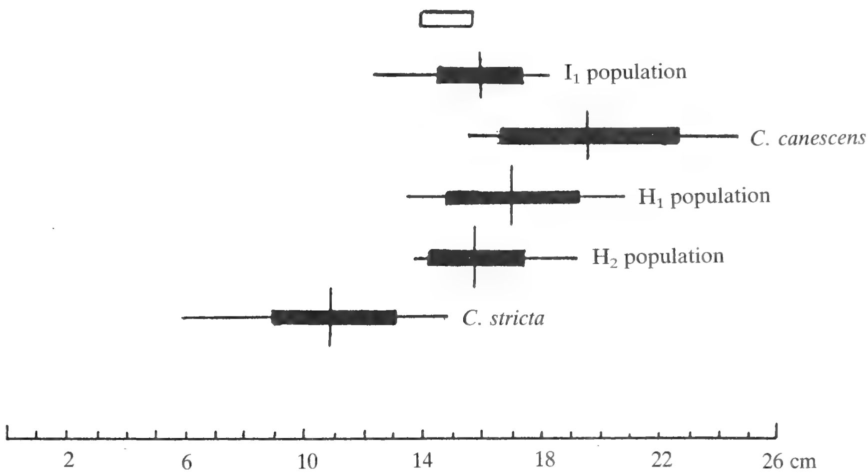


FIGURE 3. Panicle length of *Calamagrostis* taxa showing mean (vertical line), range (thin line) and standard deviation (thick line) for Leven population samples. The open horizontal bar depicts the zone mid-way between the limits of standard deviation for *C. stricta* and *C. canescens*.

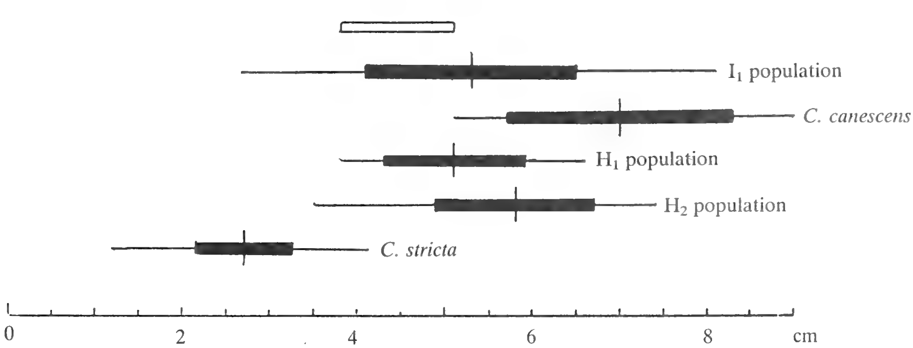


FIGURE 4. Length of bottom branch of the panicle of *Calamagrostis* taxa showing mean (vertical line), range (thin line) and standard deviation (thick line) for Leven population samples. The open horizontal bar depicts the zone mid-way between the limits of standard deviation for *C. stricta* and *C. canescens*.

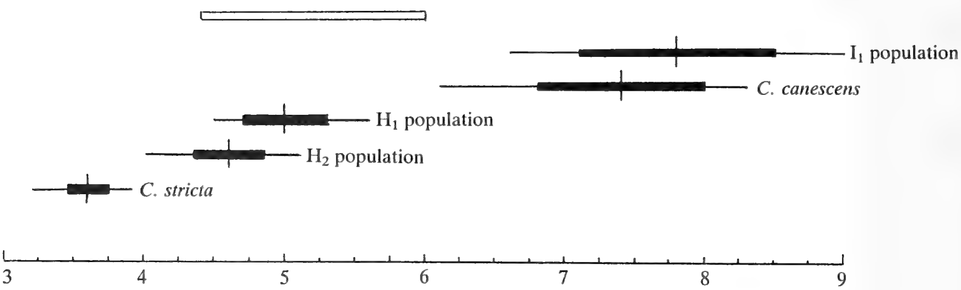


FIGURE 5. Glume length/glume width of *Calamagrostis* taxa showing mean (vertical line), range (thin line) and standard deviation (thick line) for Leven population samples. The open horizontal bar depicts the zone mid-way between the limits of standard deviation for *C. stricta* and *C. canescens*.

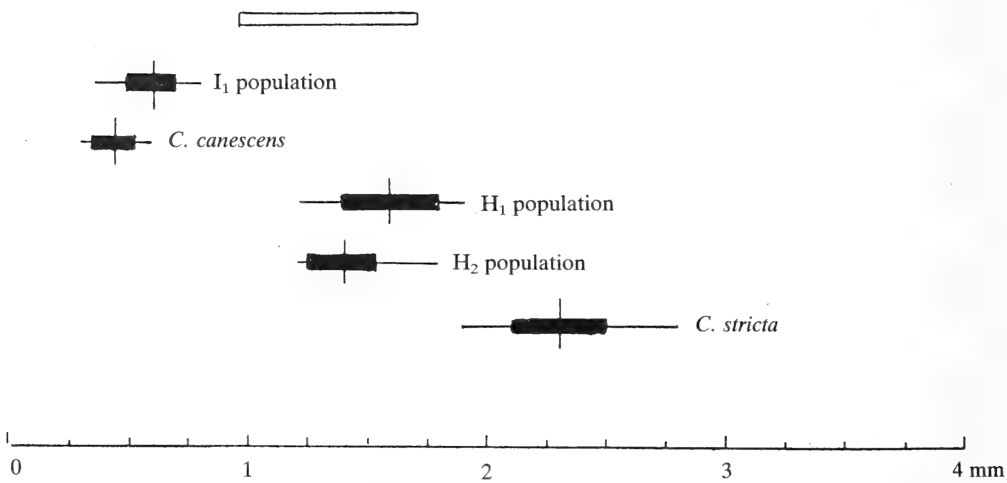


FIGURE 6. Awn length of *Calamagrostis* taxa showing mean (vertical line), range (thin line) and standard deviation (thick line) for Leven population samples. The open horizontal bar depicts the zone mid-way between the limits of standard deviation for *C. stricta* and *C. canescens*.

The chromosome number of the two parental species and the H_2 population is approximately 2n = 28, corresponding to counts determined by Nygren (1946) for the two species and the hybrid in Sweden. It was established from root tip squashes that the putative *Calamagrostis canescens* × *C. stricta* population H_1 had a significantly higher number. A good preparation of the second metaphase of the H_1 was finally obtained and the chromosome number found to be 2n = 56.

DISCUSSION

My understanding of the species *C. stricta* and *C. canescens* as a result of the Leven studies are in close agreement with a short description of the type specimen of *C. stricta (Arundo stricta* (Steifährichtes Rohr.)) by Siemssen (1795) and of the two species as described by Hylander (1953) and of that of *C. stricta* given by Nygren (1946). It was therefore decided to make the provisional assumption that the range of variation in Leven *C. stricta* and *C. canescens* gives an indication of variation usually found in populations of these species.

The hybrid population studied in 1951 was essentially the same taxon as the H_1 population and it

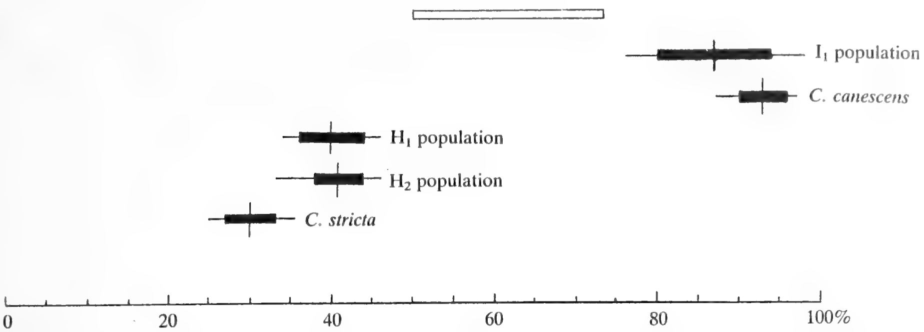


FIGURE 7. Point of awn insertion measured from the base of the floret, as a percentage of floret height, of *Calamagrostis* taxa showing mean (vertical line), range (thin line) and standard deviation (thick line) for Leven population samples. The open horizontal bar depicts the zone mid-way between the limits of standard deviation for *C. stricta* and *C. canescens*.

TABLE 1. ANTHER CHARACTERISTICS OF LEVEN *CALAMAGROSTIS* MATERIAL

	Populations				
Character	*C. stricta*	*C. canescens*	H_1	H_2	I_1
Length (mm)	(1·4–)1·8	1·6	2·0	1·4	1·4
Shape of exserted anther	I-shaped	X-shaped	Y-shaped	I-shaped	X-shaped
% fully-formed pollen	87%	85·5%	59%	4%	65%
Colour of anther	Purplish	Purple	Purple	Yellow	Purple

Numerical values are means of ten anthers.

occupied a very similar position on the canal bank, the stand extending from the canal edge, but mainly occupying a stretch of the upper part of the sloping bank. I did not have the facilities to obtain a chromosome count in 1951, but I have no doubt that the 1951 hybrid like the H_1 is the octoploid, *C. canescens* × *C. stricta*, $2n = 56$. The evidence for this is that the 1951 hybrid and the H_1 population are essentially similar morphologically, notably in length and width of glumes and the broad, tight fruiting panicle and also in producing well-formed pollen grains. The 1951 hybrid population was, however, much more morphologically uniform than the H_1 population. It is thought that the stand formed by the 1951 hybrid population may have arisen from one or more F_1 or F_2 plants. The plants were very vigorous as are those of the H_1 population.

In the case of both the H_1 and H_2 populations, the question arises as to whether the populations represent a clone or a hybrid swarm. Each population forms a continuous stand which leads one to suspect that each population is a clone; on the other hand the degree and nature of morphological variation in each appears to rule out this possibility.

In the case of the H_1 and H_2 populations, the range of variation for a character (Figs 2–7) may overlap markedly with the range for that character in one of the parents or be continuous or discontinuous with it. The range of measurements for a number of characters of the H_1 and H_2 populations were found to be intermediate when compared with the range of measurements for the corresponding character in each species. This was true of glume shape (Fig. 5), awn length (Fig. 6) and position of awn insertion (Fig. 7). However, the range of variation for each of these characters in the H_1 and H_2 populations do not lie in the same intermediate position in relation to the variation for the same character in the two species.

The range of measurements for the *C. canescens* I_1 population is seen to show a shift towards the range for the hybrids in the case of panicle (Fig. 3) and bottom branch length (Fig. 4). The awn tends to be longer and its insertion on the lemma lower than in typical *C. canescens*.

The study of the development of the anthers in *C. stricta* suggests a correlation between the change of glume colour from green to purple, the completion of meiosis and the change of anther colour from yellow to purple. In *C. canescens* and the H_1 hybrid population, the change of glume and anther colour is also associated with the change of anther shape from I-shape to X- or Y-shape respectively and the production of well-formed pollen. Such a correlation could explain the predominantly yellow colour and the I-shape of exserted anthers of the H_2 population which is almost male sterile. It is interesting to note in this connection that *Calamagrostis purpurea*, which produces empty pollen and is apomictic, was found by Nygren to have yellow, I-shaped anthers and these features were used by him to separate *C. purpurea* from other *Calamagrostis* taxa in Scandinavia (Nygren 1948). However, these are seen not to be exclusive characters of *C. purpurea* which is essentially a taxon at a higher chromosome level than the Leven H_2 population and morphologically distinct from it.

Observations regarding the reproductive biology of the H_1 and H_2 hybrid populations are at variance with the findings of Nygren (1946, 1962) concerning their Scandinavian counterparts. The Leven H_2 *C. canescens* × *C. stricta* (2n = 28) population appears to set no seed and to produce a very low percentage of morphologically good pollen while the F_1 and F_2 generations of this hybrid in Sweden were found to produce good pollen (Nygren 1946) and to have low fertility (Nygren 1962). The Leven H_1 *C. canescens* × *C. stricta* (2n = 56) population has morphologically good pollen and low self-fertility while all Swedish *Calamagrostis* taxa with a chromosome number of 2n = 46 upwards produce empty pollen grains and are apomictic (Nygren 1946) except when young and with the exception of one population of mature plants of *C. purpurea* in Gällivare (Nygren 1946). It is of interest that similar taxa may show differences in reproductive biology in different parts of their geographical range.

DESCRIPTION OF THE LEVEN *CALAMAGROSTIS* TAXA

Calamagrostis stricta (Timm) Koeler, 2n = 28
Occurs by standing water at Leven Canal. Perennial, forming tufts and having slender rhizomes. Height: 30–94 cm. Culm erect, 2–4 noded, rough or smooth near the panicle. Leaves green; bract narrow, stiff and rough, making an acute angle with the culm; short, more or less truncate ligule, that of the bract 1–3·2 mm long. One or more leaf sheaths are always hairy. The panicle is short, (6–)9–13(–15) cm long, tight and narrow before and after flowering; less than 2 cm wide, usually less than 1·5 cm wide after flowering. The lowest branch of the panicle is short being, less than 4 cm, average 2·7 cm. The glumes are less than 4 mm long and 1 mm wide at the broadest part; more or less acute and rough on the keel; the outer glume one-nerved and the upper three-nerved. The lemma is 2·6–3·2 mm long and five-nerved. The callus hairs (hairs surrounding the floret) are appreciably shorter than the lemma, 1·9–2·5 mm long, average 2·2 mm. The awn arises from one-third of the way up the lemma or below and is long (1·9–2·8 mm, average 2·3 mm) projecting beyond the top of the floret. The spikelet axis is prolonged as a minute bristle. The anthers are I-shaped, purplish and produce well-formed pollen. It is usually in full flower at Leven in mid-June, with all the spikes usually having tightened within eleven days, but the tightening of the spikes may be delayed in certain years.

Calamagrostis canescens (Wigg.) Roth, 2n = 28
Occurs on both the slopes and the top of the canal bank. Shade tolerant. Perennial, rhizomatous, forming beds. Usually a much taller plant than *C. stricta* (60–110 cm). Culm branched. Broad, yellow-green, limp and arcuate leaves are typical. The upper surface of the leaf blade usually has long, white hairs. The ligule of the bract is 2·6–6 mm long and tears readily. All leaf sheaths are glabrous. Culms (4–), 5– or 6-noded, smooth near the panicle. The panicle is long, (15–)19–22(–25) cm, lax and typically nodding after flowering. The lowest branch of the panicle is long, 5–9 cm. The glumes are narrowly lanceolate in side view, 4·5–6 mm long and drawn out to a point which breaks off at maturity; they are 0·6–0·7 mm wide at their broadest part. Both glumes are one-nerved. The lemma is 2·6–3·0 mm long and three-nerved. The callus hairs are appreciably longer (by 0·7–1·3 mm) than the floret. The awn is very delicate and short, leaving the lemma at or near the tip. The anthers are X-shaped and purple and produce well-formed pollen. The taxon is in full flower in early July at Leven. Self sterile.

Calamagrostis canescens I_1 population

Believed to be an introgressed *C. canescens* population arising by backcrossing from *C. canescens* × *C. stricta* to *C. canescens*. The population occurred by the side of a drainage dyke parallel to and near to Leven Canal. Perennial, rhizomatous, forming beds. Generally similar to *C. canescens* sensu stricto, but differs by having leaves narrower and more or less erect; culm rough near panicle; panicle not so lax and not nodding; glumes varying in length in one spike; awn insertion distinctly below the tip of the lemma, i.e. 0·3–0·6 mm below tip; tendency to greater awn length and for callus hairs to exceed the lemma only slightly. Self fertile.

Calamagrostis canescens × *C. stricta*

Both hybrid populations studied at Leven Canal show morphological features intermediate between those of the parents, notably glume shape, awn length and point of awn insertion, the awn leaving the lemma just below half-way. *C. stricta* features almost always occurring in the hybrids are culm rough just below the panicle, one or more bottom leaf sheaths hairy, the axis prolonged as a tuft of hairs and the panicle tightening after flowering. A *C. canescens* feature which commonly occurs in the hybrids is the long white hairs on the upper leaf surface.

Calamagrostis canescens × *C. stricta* Leven H_1 population, 2n = 56

Occurs mainly on the sloping part of the canal bank, extending to the edge of the canal, but not occurring on top of the bank. Perennial, rhizomatous, forming beds, very vigorous. Height: 62–147 cm. Leaves green, intermediate in width, with or without long white hairs on upper leaf surface; bracts typically taking up a horizontal 'flag flying' position. The ligule is long, that of the bract being 3–6 mm and it does not tear. At least one lower leaf sheath is usually hairy (24 out of 25 specimens examined). Culm 5-noded and branched, rough near the panicle. The panicle is intermediate in length or *C. canescens*-like, 13·5–20·8 cm, intermediate to feel, tightening after flowering, but conspicuously broader than in *C. stricta*. The lowest branch of the panicle is intermediate in length or *C. canescens*-like, 3·8–6·6 cm. The glumes are intermediate in shape, being similar to those of *C. canescens* in length, 4·9–5·9 mm, and to those of *C. stricta* in width or slightly wider, 1·0–1·2 mm wide; the tips of the glumes do not break off at maturity. The glumes are somewhat rough, the spike being fairly rough to feel and intermediate between the species in this respect. The lemma is notably long, 3·2–3·8 mm, longer than in both parents. The callus hairs more or less equal the floret in length or are very slightly shorter to 4 mm longer, the actual length of the majority of hairs being similar to those of *C. canescens*. The awn is intermediate in length, 1·2–1·9 mm, is like that of *C. stricta* in type, and leaves the lemma from just below the middle, so that it falls short of the top of the lemma, by 0·3–0·8 mm. The spikelet axis is prolonged as a minute bristle as in *C. stricta*. The anthers are intermediate in shape, the lobes at one end being more or less parallel and at the other end splaying out; they are purple and at Leven produce 60% well-formed pollen. Flowering time is intermediate between that of the parents, but there is some overlap; the population flowers typically in the third week of June.

C. canescens × *C. stricta* Leven H_2 population, 2n = 28

Occurs by the edge of the Leven Canal. Perennial, rhizomatous, forming a narrow belt. Height: 70–109 cm. Leaves green, intermediate in width, with or without long white hairs on the upper leaf surface. The ligule is variable in length, but usually intermediate, 2·2–4·9 mm. At least one lower leaf-sheath is usually hairy (24 out of 25 examined). Culm 4-noded and usually rough near the panicle (24 out of 25 examined). The panicle is intermediate in length or *C. canescens*-like, 13·7–19·2 cm, tightening after flowering except that the long bottom branch may protrude. The lowest branch of the panicle is longer than in *C. stricta*, (3·5–)4·6–7·4 cm. The glumes are intermediate in shape, similar to those of *C. stricta* in length to slightly longer, 3·5–4·2 mm, but narrower, 0·8–0·9 mm wide, so that the panicle has a delicate appearance. The lemma is similar in length (2·6–3·0 mm) to that of the parents. The callus hairs usually more or less equal the floret in length or are slightly shorter, but occasionally are appreciably shorter (0·9–0 mm less than the floret) as in *C. stricta*. The awn is intermediate in length, 1·2–1·8 mm, and leaves the lemma just below the middle and usually falls slightly short (0–0·4 mm) of the top of the floret. The anthers are I-shaped and yellow, rarely slightly purple, when exserted. It is almost male sterile, c. 4% morphologically good pollen being noted, while over 90% of the pollen grains are empty. No fruit has been observed. Flowering time is intermediate between that of the parents.

C. canescens × *C. stricta* Leven H_3

This is a recombinant represented by a single plant on an unusually steep stretch of the canal bank.

The awn length and position was similar to that of *C. canescens*, while in its panicle, ligule and bottom branch of panicle length and short callus hairs it resembled *C. stricta*.

ACKNOWLEDGMENTS

The work described in this paper formed part of a thesis accepted for the degree of M.Sc. at the University of Hull. I am indebted to Dr D. W. Shimwell for advice and encouragement during the early stages of the research and to Mr G. Nicholson for assistance with chromosome counts. My thanks are also due to the late Mr P. Smith, Mr R. Wheeler-Osman and Miss A. Braithwaite for technical assistance and to Dr Michael Proctor for reading the manuscript and making helpful suggestions.

REFERENCES

Crackles, F. E. (1953). *Calamagrostis stricta* in S.E. Yorkshire. *B.S.B.I. Year Book*: p. 54.
Crackles, F. E. (1968). Some plant associations of the River Hull valley. *East Yorkshire Field Studies* **1**: 13–24.
Hubbard, C. E. (1968). *Grasses*. Harmondsworth.
Hylander, N. (1953). *Nordisk Kärlväxtflora* **1**: 315–317.
Nygren, A. (1946). The genesis of some Scandinavian species of *Calamagrostis*. *Hereditas* **32**: 131–262.
Nygren, A. (1948). Further studies in spontaneous and synthetic *Calamagrostis purpurea*. *Hereditas* **34**: 113–134.
Nygren, A. (1962). Artificial and natural hybridization in European *Calamagrostis*. *Symbolae botanicae upsalienses* **17**: 1–105.
Sheppard, J. A. (1957). The medieval meres of Holderness. *Institute of British Geography: Transactions & Papers* **23**: 75–85.
Sheppard, J. A. (1958). *The draining of the Hull valley*. 24 pp. East Yorkshire Local History Society, York. (East Yorkshire Local History Series, **8**.)
Siemssen, M. A. C. (1795). *Arundo stricta* (Steifährichtes Rohr.). *Magazin für die Naturkunde und Oekonomie Mecklenburgs* **2**: 235. Schwerin & Leipzig.

(*Accepted August 1993*)

Notes

RUBUS AGHADERGENSIS D. E. ALLEN (ROSACEAE): A NEW NAME FOR AN IRISH BRAMBLE

In the 1890s W. Moyle Rogers began receiving from Canon H. W. Lett specimens of a white-flowered, eglandular bramble new to him from various localities in Lett's parish of Aghaderg, near Loughbrickland, in County Down, v.c. H38. It was subsequently distributed through the Watson Botanical Exchange Club, and in 1901 Rogers had the opportunity of studying it in the field himself. In keeping with his preference for a hierarchy of taxa in *Rubus*, he decided it was best placed under *R. lindleianus* Lees as a variety, for which he coined the manuscript epithet *latifolius* (after the very broad leaflets of the stem leaves). Later, after his death, H. J. Riddelsdell felt that its discovery in a second vice-county, Armagh, v.c. H37 – though the locality in question was close by and only just across the boundary – warranted publishing the name at last, which he accordingly did in their joint names (Rogers & Riddelsdell 1925).

Although this taxon has been ignored in subsequent monographs of the group, it is manifestly no mere local variant of *R. lindleianus* but a distinct entity that deserves to be regarded as a species in its own right. That would not be sufficient justification, even so, for burdening the already very lengthy list of British and Irish *Rubus* species with yet another name, were this bramble confined to just the one small area from which it has so far been recorded. In 1991, however, D. A. Doogue collected in Ravensdale (GR J/09.14), in the hill country of the north of Louth, v.c. H31, a specimen (now in **BM**) of what is clearly this same plant. This extends the known range by over 25 km. It is, moreover, suspicious that Praeger (1901) describes *R. lindleianus* as "frequent" in Armagh, for recent fieldwork has shown that species to be rare over Ulster as a whole: much of what has been taken for it in that vice-county may in reality be Lett's bramble.

In view of this much wider range, extending into three vice-counties, raising the taxon to specific rank now seems appropriate. That requires a new name, however, as the epithet *latifolius* is preoccupied at that level:

Rubus aghadergensis D. E. Allen, **nom. et stat. nov.**
R. lindleianus var. *latifolius* Rogers & Riddelsd., *Journal of botany* **63**: 14 (1925).
LECTOTYPE: side of road, parish of Ballymore, near Scarva station, v.c. H37, 4 August 1894, *H. W. Lett* as *R. rhamnifolius*, herb. Barton & Riddelsdell no. 6783 (**BM**), det. B. A. Miles 1964.

The species belongs in series *Sylvatici* (P. J. Mueller) Focke.

REFERENCES

PRAEGER, R. L. (1901). *Irish topographical botany*. Dublin.
ROGERS, W. M. & RIDDELSDELL, H. J. (1925). Some varieties of *Rubus*. *Journal of botany* **63**: 13–15.

D. E. ALLEN
Lesney Cottage, Middle Road, Winchester, Hants., SO22 5EJ

THE NATIVE BRITISH *COTONEASTER* – GREAT ORME BERRY – RENAMED

The only *Cotoneaster* species (Rosaceae) native to the British Isles grows on the Great Orme's Head, Llandudno, North Wales. It was discovered in 1783 by John Wynne Griffith and was subsequently rediscovered in 1821 by William Wilson of Warrington. The number of shrubs was stated as being plentiful, but has now been reduced to only four individuals (Smith 1979). Over-collecting and hard grazing by sheep and goats are thought to have been the main causes of its decline. By fencing and propagation of plants for re-introduction to the limestone ledges it is hoped to save this taxon from further decline (Morris 1978).

The North Wales shrub has been included within *Cotoneaster integerrimus* Med., but when Hrabětová-Uhrová (1962) studied members of the genus *Cotoneaster* in former Czechoslovakia, she observed that the Great Orme taxon differed from those of Central Europe and therefore made it a new variety of *Cotoneaster integerrimus*, namely var. *anglicus* Hrabětová.

Apomixis is common in the genus *Cotoneaster*, most species having been found to be tetraploids (2n = 68) and coming true from seed. By tradition, apomictic taxa within the genus are given the rank of species.

In France three species related to *C.integerrimus* have long been separated: *C. intermedius* Coste, *C. juranus* Gandoger and *C. obtusisepalus* Gandoger. Two new species have also recently been described in Scandinavia: *C. scandinavicus* Hylmö and *C. canescens* Hylmö. The former is closely related to *C. cinnabarinus* Pojarkova from the Kola Peninsula, Russia.

By courtesy of Mr Maurice Morris, Penmachno, Gwynedd, N. Wales and Dr Nigel Brown, Treborth Botanic Garden, University of North Wales, we have had access to seed and plants of the Great Orme taxon making it possible to study this *Cotoneaster* in cultivation both in Britain and Sweden. We have concluded that the N. Wales plant clearly differs from the taxa of Central Europe and feel it is time to raise it to the rank of species.

Cotoneaster cambricus J. Fryer & B. Hylmö, **nom. et stat. nov.**
(section *Cotoneaster*, series *Cotoneaster*)
Synonym: *C. integerrimus* Medicus var. *anglicus* Hrabětová, *Acta Acad. Scient. Czechoslov. Basis Brunensis* **34** (6): 217, tab. 4a (1962).
HOLOTYPUS: Llandudno, Caernarvonshire, c. 1836, *L. Price* no. H.899(60)4 (**K**).
A low deciduous shrub. Young branches greenish-brown, villous. Leaves on young growth broadly elliptic to suborbicular, apex obtuse or acute; upper surface grey, moderately pilose, hairs persisting or becoming subglabrous; veins slightly depressed. Inflorescence 1–2(–3) flowered, pedicels and peduncles short 2–3(–5) mm; petals equal to or less than 1 mm longer than the calyx. Fruit small 5–8 mm, globose, clear red with orange tones; pyrenes 2–3.

Chromosome count 2n = 68, courtesy of Dr Hugh McAllister, Ness Botanic Gardens, University of Liverpool.

DIAGNOSTIC KEY TO THE MOST CLOSELY RELATED SPECIES

1a Hypanthium and calyx pilose; upper surface of leaves persistently pilose; flowering shoots 25–45 mm with 4 leaves and 3–7 flowers; pyrenes 3–4(–5).
France: Massif Central and the Alps (Haute Savoie) .... *C. intermedius* Coste
1b Hypanthium and calyx glabrous 2
2a Upper surface of leaves glabrous from the beginning, leaves on sterile shoots ovate, apex acute, surface smooth with veins only slightly depressed; flowering shoots 15–25(–35) mm with 2–4 leaves and 1–3(–4) flowers; pyrenes (2–)3–4(–5); shrub 0·1–1·0 m, arching or decumbent with weak stems.
France: Vosges and Jura, and throughout the Alps (above zone of *C. integerrimus*) ....
C. juranus Gandoger
2b Upper surface of leaves pilose when young 3
3a Leaves on sterile shoots broadly ovate, apex acute or acuminate; upper surface pilose becoming glabrous, rugose with depressed veins; flowering shoots 15–25(–35) mm usually with 2–3 leaves and (1–)3–4(–7) flowers; pyrenes 2–3(–4); shrub arching, 1·0–1·5 m.
Central Europe and the Alps (zone below *C. juranus*) .... *C. integerrimus* Medicus
3b Leaves on sterile shoots elliptic or suborbicular, apex obtuse or acute 4
4a Leaves broadly elliptic or suborbicular, upper surface densely pilose becoming subglabrous or glabrous; petals equal to or less than 1 mm longer than calyx lobes, off-white; flowering shoots 10–20 mm with c. 2 leaves and 1–2(3) flowers; pyrenes 2–3; shrub ± erect c. 1·0(–1·5) m.
Endemic to Wales .... *C. cambricus* J. Fryer & B. Hylmö
4b Leaves elliptic, upper surface with long pilose hairs becoming subglabrous with only single long

hairs or entirely glabrous; petals more than 1 mm longer than the calyx lobes, off-white with reddish stripes; flowering shoots 15–25 mm with usually 2–3 leaves and 3–5 flowers; pyrenes 3–4; shrub arching 1·1–1·5 m.
France: Alps (Isère) .... *C. obtusisepalus* Gandoger

ACKNOWLEDGMENTS

We are grateful to Dr David Allen for his assistance with historical research, and to David McClintock for his insistence that we publish this work.

REFERENCES

Hrabětová-Uhrová, A. (1962). Beitrag zur Taxonomie und Verbreitung der Gattung *Cotoneaster* in der Tschekoslowakei. *Práce Brněnské Základny Československé akademie vědecké Brno* **34**: 197–246.
Morris, M. (1978). *Cotoneaster integerrimus* – a conservation exercise. *B.S.B.I. Welsh Bulletin* **28**: 6–8.
Smith, M. E. (1979). And then there were four. The wild Cotoneaster in Britain. *Country Life*, 13 September 1979, p. 788.

J. Fryer
Trooper Bottom, Froxfield, Petersfield, Hampshire, GU32 1BH
B. Hylmö
Bygatan 30, S–267 40 Bjuv, Sweden

CONTRIBUTIONS TO A CYTOLOGICAL CATALOGUE OF THE BRITISH AND IRISH FLORA, 4

We present here chromosome counts for 121 populations of 108 vascular plant species from documented localities in Britain. This note continues a series, the previous one of which was Al-Bermani *et al.* (1993). One plant from each population was studied, except where noted. All counts were made on squashes of root-tips, except in the case of *Ophioglossum vulgatum* where meiosis in microspore mother-cells was examined. Supernumerary chromosomes are designated by the suffix 'S'. Voucher specimens for most counts have been deposited in **LTR**, the remainder are at **K** or **CGE** as indicated.

Althaea officinalis L., 2n = 42: E. Suffolk, v.c. 25, S.E. side of Benacre Broad, near Covehithe, TM/5.8 (**K**).
Anagallis arvensis L. subsp. *arvensis*, 2n = 40: Caerns., v.c. 49, Botwnnog, SH/26.32.
Anagallis tenella (L.) L., 2n = 22: W. Lancs., v.c. 60, near Lancaster, SD/491.603; Westmorland, v.c. 69, Lowick Common, SD/292.847 (no voucher).
Anthyllis vulneraria L. subsp. *vulneraria*, 2n = 12: Dorset, v.c. 9, Melbury Hill, ST/87.19.
Apium nodiflorum (L.) Lagasca, 2n = 22: Oxon, v.c. 23, Little Bourton, farm near M40 motorway, SP/4.4.
Aquilegia vulgaris L., 2n = 14: W. Lancs., v.c. 60, Silverdale, Gait Barrows N.N.R., SD/479.774.
Artemisia absinthium L., 2n = 18: Caerns., v.c. 49, Abersoch, N. end of Porth Fawr, SH/31.27.
Aster tripolium L., 2n = 18: W. Sussex, v.c. 13, Pagham Harbour nature reserve, near Sidlesham, SZ/8.9 (**K**).
Avena fatua L., 2n = 42: N. Wilts., v.c. 7, near Calne by the A4, ST/9.7 (**K**).
Beta vulgaris L. subsp. *maritima* (L.) Arcang., 2n = 18: N. E. Yorks., v.c. 62, Scarborough, TA/0.8.

Brassica nigra (L.) Koch, 2n = 16: Dorset, v.c. 9, St Alban's Head, 0·4 km E.N.E. of lookout, SY/963.756 (**K**); Dorset, v.c. 9, Weymouth, landward shore of Fleet Lagoon, SY/66.76; Cambs., v.c. 29, Bar Hill, TL/38.63.
Bromopsis ramosa (Hudson) Holub, 2n = 42: W. Lancs., v.c. 60, Silverdale, Gait Barrows N.N.R., near Hawes Water, SD/47.76 (no voucher).
Bromus interruptus (Hackel) Druce, 2n = 28: Cambs., v.c. 29, Pampisford, TL/4.4 (**CGE**).
Bryonia dioica Jacq., 2n = 20: E. Sussex, v.c. 14, Beachy Head, c. 1·8 km N. of Hodcombe Farm, TV/576.968.
Buxus sempervirens L., 2n = 28: Surrey, v.c. 17, Silent Pool, near Shere, TQ/06.48.
Chenopodium vulvaria L., 2n = 18: Dorset, v.c. 9, c. 1·5 km W. of Burton Bradstock, SY/47.89.
Cirsium heterophyllum (L.) Hill, 2n = 34: Main Argyll, v.c. 98, Black Mount, off road between Ballachulish and Tyndrum, NN/2.4 (no voucher).
Cirsium palustre (L.) Scop., 2n = 34: Caerns., v.c. 49, Garn Fadryn, SH/27.35; W. Lancs., v.c. 60, Lower Salter, near Barkin Bridge, SD/601.636 (no voucher).
Cirsium vulgare (Savi) Ten., 2n = 68: W. Lancs., v.c. 60, Lancaster, near River Lune, SD/484.636.
Conopodium majus (Gouan) Loret, 2n = 22: W. Sutherland, v.c. 108, Nedd, NC/137.319 (no voucher).
Crepis paludosa (L.) Moench, 2n = 12: W. Lancs., v.c. 60, near Millbeck footbridge, SD/648.638 (no voucher).
Daucus carota L. subsp. *carota*, 2n = 18: W. Lancs., v.c. 60, Carnforth, SD/499.711.
Dipsacus fullonum L., 2n = 18: W. Lancs., v.c. 60, near Lancaster, SD/467.624.
Drosera rotundifolia L., 2n = 20: S. Devon, v.c. 3, Dartmoor, c. 2 km N.E. of Postbridge, SX/66.80.
Echium vulgare L., 2n = 32: E. Suffolk, v.c. 25, Felixstowe, Landguard Nature Reserve, TM/2.3 (**K**).
Elymus caninus (L.) L., 2n = 28: Westmorland, v.c. 69, Brigsteer Park, 2·5 km S. of Brigsteer, SD/48.87.
Elytrigia repens (L.) Desv. ex Nevski subsp. *repens*, 2n = 42: Oxon, v.c. 23, Little Bourton, farm near M40 motorway, SP/4.4.
Erica tetralix L., 2n = 24: W. Sutherland, v.c. 108, near Allt na Claise, NC/174.327.
Erodium maritimum (L.) L'Hér., 2n = 20: Dorset, v.c. 9, near Moreton, SY/80.89.
Euonymus europaeus L., 2n = 32: E. Suffolk, v.c. 25, Great Wenham, TM/077.383.
Euphorbia lathyris L., 2n = 20: W. Lancs., v.c. 60, White Land Industrial Estate, near Lancaster, SD/453.625.
Euphorbia portlandica L., 2n = 16: Dorset, v.c. 9, Isle of Portland, Church Ope Cove, SY/69.70.
Gagea lutea (L.) Ker Gawler, 2n = 72: Westmorland, v.c. 69, Sedgwick, E. bank of R. Kent, SD/510.878.
Geranium lucidum L., 2n = 40: Derbys., v.c. 57, Dovedale, SK/14.53 (three plants counted).
Glaucium flavum Crantz, 2n = 12: W. Lancs., v.c. 60, R. Keer estuary, S.W. of Carnforth, SD/482.699.
Gnaphalium luteo-album L., 2n = 14: Channel Is., v.c. S, Alderney, Platte Saline, WA/567.078.
Heracleum sphondylium L. subsp. *sphondylium*, 2n = 22+1S: Derbys., v.c. 57, Milldale, SK/14.55.
Hippophae rhamnoides L., 2n = 24: N. Lincs., v.c. 54, Gibraltar Point, TF/56.57; W. Lancs., v.c. 60, near Heysham harbour, SD/407.604.
Honckenya peploides (L.) Ehrh., 2n = 68: W. Lancs., v.c. 60, W. of Cockerham, near Bank Houses, SD/431.531.
Hordeum marinum Hudson, 2n = 14: W. Kent, v.c. 16, Higham Marshes, near Gravesend, TQ/69.74.
Hordeum murinum L. subsp. *murinum*, 2n = 28: Caerns., v.c. 49, Abersoch, dunes at N. end Porth Fawr, SH/314.277; W. Lancs., v.c. 60, W. of Cockerham, near Bank Houses, SD/432.531.
Humulus lupulus L., 2n = 20: Berks., v.c. 22, Cothill Fen, SU/46.99.
Hyacinthoides non-scripta (L.) Chouard ex Rothm., 2n = 16: W. Lancs., v.c. 60, Lancaster University grounds, SD/48.57.
Iberis amara L., 2n = 14: Surrey, v.c. 17, Box Hill, Juniper Hall nature reserve, TQ/176.528.
Lathyrus aphaca L., 2n = 14: Dorset, v.c. 9, Weymouth, landward shore of Fleet Lagoon, SY/66.76.
Leucanthemum vulgare Lam., 2n = 18: Channel Is., v.c. S, Alderney, Essex Hill, WA/592.074.

Limonium britannicum Ingrouille subsp. *celticum* Ingrouille var. *celticum*, 2n = 36: Cheshire, v.c. 58, Hilbre Island, SJ/185.878; var. *pharense* Ingrouille, 2n = 36: Caerns., v.c. 49, Bardsey Island, E. of Pen Cristin, Ogof y Gaseg, SH/12.21 (150 m N.E. of site given in Hollingsworth *et al.* (1992)).
Linaria vulgaris Miller, 2n = 12: W. Lancs., v.c. 60, near Carnforth, SD/493.714.
Lobelia dortmanna L., 2n = 14: W. Sutherland, v.c. 108, loch c. 1 km N.E. of Duartmore Bridge, NC/211.383 (no voucher).
Lonicera periclymenum L., 2n = 54: Leics., v.c. 55, Swithland Wood, SK/5.1.
Lotus corniculatus L., 2n = 24: W. Lancs., v.c. 60, Carnforth, SD/499.711.
Luzula sylvatica (Hudson) Gaudin, 2n = 12: W. Lancs., v.c. 60, near Millbeck footbridge, SD/648.638; Westerness, v.c. 97, Glen Nevis, along path to Stob Ban, NN/15.66.
Malva moschata L., 2n = 42: E. Sussex, v.c. 14, Ardingly, Wakehurst Place, Bloomers Valley, TQ/3.3 (**K**).
Matthiola incana (L.) R. Br., 2n = 14: E. Sussex, v.c. 14, Peacehaven cliffs to Castle Hill, TQ/4.0 (**K**).
Medicago lupulina L., 2n = 16: Westmorland, v.c. 69, Whitbarrow, Ravens Lodge, underneath Whitescar, SD/46.85.
Melica nutans L., 2n = 18: W. Lancs., v.c. 60, Silverdale, Gait Barrows N.N.R., SD/481.776.
Narthecium ossifragum (L.) Hudson, 2n = 26: Westmorland, v.c. 69, Lowick Common, SD/292.847 (no voucher).
Onopordum acanthium L., 2n = 34: Dorset, v.c. 9, near Bere Regis, SY/84.94.
Ophioglossum vulgatum L., n = c. 270: Leics., v.c. 55, Leicester, Oadby, Botanic Garden meadow, SK/61.01.
Ornithopus perpusillus L., 2n = 14: Caerns., v.c. 49, Boduan, opposite entry to Mathan Uchaf farm, SH/319.369.
Parapholis strigosa (Dumort.) C. E. Hubb., 2n = 28: W. Kent, v.c. 16, Higham marshes, near Gravesend, TQ/69.74.
Persicaria lapathifolia (L.) Gray, 2n = 22: W. Lancs., v.c. 60, near Heysham harbour, SD/404.599.
Phalaris arundinacea L., 2n = 28: W. Lancs., v.c. 60, River Lune, near Lancaster, SD/483.633.
Phleum phleoides (L.) Karsten, 2n = 14: W. Norfolk, v.c. 28, Brettenham, near Thetford, S. of A1066, TL/907.844 (**K**).
Polypogon monspeliensis (L.) Desf., 2n = 28: S. Hants., v.c. 11, Southampton Water, Hythe, SU/4.0.
Potentilla argentea L., 2n = 14: Dorset, v.c. 9, 1·6 km N. of Wool, SY/84.87.
Potentilla palustris (L.) Scop., 2n = 64: Warks., v.c. 38, Sutton Coldfield, Sutton Park, SP/10.97.
Primula vulgaris Hudson, 2n = 22: Westmorland, v.c. 69, Brigsteer Park, 2·5 km S. of Brigsteer, SD/48.87.
Pulicaria dysenterica (L.) Bernh., 2n = 18: W. Lancs., v.c. 60, near Lancaster, SD/465.624.
Ranunculus flammula L. subsp. *flammula*, 2n = 32: S. Lancs., v.c. 59, Ainsdale dunes, SD/31.11.
Ranunculus sceleratus L., 2n = 32: Oxon, v.c. 23, Little Bourton, farm near M40 motorway, SP/4.4.
Rumex crispus L., 2n = 60: E. Sussex, v.c. 14, Cuckmere Haven, E. side of river, TV/5.9 (**K**).
Saponaria officinalis L., 2n = 28: W. Lancs., v.c. 60, River Lune, near Lancaster, SD/483.634.
Scilla autumnalis L., 2n = 28: Channel Is., v.c. S, Alderney, Essex Hill, WA/592.074.
Scutellaria galericulata L., 2n = 30: Salop, v.c. 40, Crose Mere, S. end, SJ/433.303.
Seriphidium maritimum (L.) Polj., 2n = 54: W. Lancs., v.c. 60, W. of Cockerham, near Bank Houses, SD/428.532.
Serratula tinctoria L., 2n = 22: Dorset, v.c. 9, Melbury Hill, ST/87.19.
Silene noctiflora L., 2n = 24: Dorset, v.c. 9, 2 km S. of Winterborne Kingston, SY/85.96.
Sison amomum L., 2n = 14: Middlesex, v.c. 21, Monken Hadley Common, S. edge, 0·25 km E. to bridge over railway, TQ/2.9 (**K**).
Sonchus arvensis L., 2n = 54: Warks., v.c. 38, Ingon Grange Farm, near Snitterfield, SP/214.590.
Stachys officinalis (L.) Trev., 2n = 16: Dorset, v.c. 9, Melbury Hill, ST/87.19.
Stellaria holostea L., 2n = 26: W. Lancs., v.c. 60, near Yealand Conyers, SD/509.746.
Suaeda vera Forssk. ex J. Gmelin, 2n = 36: E. Sussex, v.c. 14, Cuckmere Haven, E. side of river, TV/5.9 (**K**).
Succisa pratensis Moench, 2n = 20: W. Lancs., v.c. 60, outskirts of Lancaster, SD/491.603.

Tanacetum parthenium (L.) Schultz-Bip., 2n = 18: W. Lancs., v.c. 60, River Lune estuary, near Sunderland Point, SD/426.556.
Teucrium botrys L., 2n = 32: Surrey, v.c. 17, Box Hill, Juniper Hall nature reserve, TQ/176.528.
Thlaspi arvense L., 2n = 14: W. Lancs., v.c. 60, near Lancaster, near River Lune, SD/486.637.
Torilis nodosa (L.) Gaertner, 2n = 24: Dorset, v.c. 9, c. 1·5 km W. of Burton Bradstock, SY/47.89; Caerns., v.c. 49, Aberdaron, 2 km E. of Aberdaen, Penrhyn-mawr Farm, SH/190.261.
Tragopogon pratensis L. subsp. *minor* (Miller) Wahlenb., 2n = 12: Dorset, v.c. 9, Melbury Hill, ST/87.19.
Trientalis europaea L., 2n = c. 160: Moray, v.c. 95, Grantown-on-Spey, NJ/02.26.
Trifolium campestre Schreber, 2n = 14: W. Suffolk, v.c. 26, Lakenheath, Maidscross Hill, TL/72.82 (**K**).
Trifolium fragiferum L. subsp. *fragiferum*, 2n = 16: Dorset, v.c. 9, Small Mouth, ST/66.76.
Trifolium glomeratum L., 2n = 16: E. Suffolk, v.c. 25, Aldeburgh, North Warren Nature Reserve, TM/4.5 (**K**).
Trifolium incarnatum L., 2n = 14: Dorset, v.c. 9, Zelstan, SY/89.98 (no voucher); subsp. *molinerii*, 2n = 14: W. Cornwall, v.c. 1, The Lizard, N. of Caerthillian Cove, SW/69.12.
Trifolium ochroleucon Hudson, 2n = 16: Cambs., v.c. 29, Orwell Hill, TL/36.50 (**K**).
Trifolium scabrum L., 2n = 10: W. Cornwall, v.c. 1, Marazion, SW/50.31.
Trifolium squamosum L., 2n = 16: N. Essex, v.c. 19, Little Oakley, near Harwich, TM/225.278 (**K**).
Trifolium striatum L., 2n = 14: W. Suffolk, v.c. 26, Icklingham, Kings Forest, TL/7.7 (**K**).
Urtica urens L., 2n = 24: Oxon, v.c. 23, Little Bourton, farm near M40 motorway, SP/4.4.
Verbascum virgatum Stokes, 2n = c. 64: E. Cornwall, v.c. 2, Saltash, SX/4.5 (**K**).
Veronica chamaedrys L., 2n = 32: Dorset, v.c. 9, Wareham, Washer's Pit, SY/86.94; W. Lancs., v.c. 60, Silverdale, Gait Barrows N.N.R., SD/479.776.
Veronica hederifolia L. subsp. *hederifolia*, 2n = 54: E. Gloucs., v.c. 33, Ashton under Hill, SO/99.37.
Veronica polita Fries, 2n = 14: Dorset, v.c. 9, Upton Park, SY/99.92.
Veronica serpyllifolia L. subsp. *serpyllifolia*, 2n = 14: N. Wilts., v.c. 7, Lockeridge, S.W. of Marlborough, SU/150.675; Caerns., v.c. 49, Crugan, Llanbedrog, SH/33.32; W. Lancs., v.c. 60, near Stirk Close, SD/634.650.
Vicia hirsuta (L.) Gray, 2n = 14: Dorset, v.c. 9, Weymouth, landward shore of Fleet Lagoon, SY/66.76; Salop, v.c. 40, Sunny Hill, W. of N.-S. minor road from Brockton to Clunton, SO/3.8 (**K**).
Vicia sylvatica L., 2n = 14: Salop, v.c. 40, Bucknell, on N. E. edge of Tueshill Wood, SO/3.7 (**K**) (two plants counted).
Vicia tetrasperma (L.) Schreber, 2n = 14: E. Sussex, v.c. 14, Ardingly Reservoir, Hanging Meadow, TQ/3.3 (**K**).

ACKNOWLEDGMENTS

We should like to thank English Nature and the R.S.P.B. for permission to collect from their reserves, and J. Terry (Seed Bank Officer at the Royal Botanic Gardens, Wakehurst), B. Bonnard, H. J. M. Bowen, P. Evans and J. Partridge for sending us plant material.

REFERENCES

Al-Bermani, A.-K. K. A., Al-Shammary, K. I. A., Bailey, J. P. & Gornall, R. J. (1993). Contributions to a cytological catalogue of the British and Irish flora, 3. *Watsonia* **19**: 269–271.
Hollingsworth, P. M., Gornall, R. J. & Bailey, J. P. (1992). Contributions to a cytological catalogue of the British and Irish flora, 2. *Watsonia* **19**: 134–137.

R. E. Dempsey, R. J. Gornall & J. P. Bailey
Botany Department, University of Leicester, Leicester, LE1 7RH

VARIATION AND HYBRIDISATION OF *ALNUS* MILLER IN IRELAND

The Common Alder, *Alnus glutinosa* (L.) Gaertner (Betulaceae) is known to be morphologically variable. McVean (1953a, b) has shown that weak clinal variation in leaf and catkin dimensions exists along a gradient running from S. W. England to N. W. Scotland.

During 1987 and 1988, samples were taken from 17 populations from as wide a range of geographical localities in Ireland as possible. Most populations were in semi-natural habitats such as riverside banks and carr communities, and none showed evidence of planting. At each site, from a normal minimum of ten individual trees, I made five measurements from ten mature leaves and three measurements from ten mature female catkins (if present), plus an assessment of leaf apex shape and number of teeth on leaf margin, number of pairs of secondary veins and number of glands on the leaf surface. Two ratios were calculated from these data. The following characters were recorded: 1. Lamina length (measured from the top of the petiole along the main vein to the leaf tip); 2. Maximum lamina width; 3. Lamina length to widest point; 4. Number of pairs of secondary veins; 5. Angle of divergence of the mid-secondary veins from the main vein; 6. Angle of divergence of the leaf-apex; 7. Angle of divergence of the leaf-base; 8. Size of the tufts of hairs in the axils of the secondary veins (arbitary scale 0–5); 9. Length of the petiole; 10. Apex acute, subacute or rounded; 11. Number of teeth on one side of the lamina; 12. Ratio of lamina length/lamina length from base to widest point; 13. Ratio of lamina width/(ratio of lamina length/lamina length from base to widest point); 14. Number of glands present on a randomly chosen area of 2 mm^2 on the abaxial leaf surface; 15. Mature female catkin length (following anthesis); 16. Mature female catkin width; and 17. Length of stalk of female catkin.

McVean (1953a, b) found weak clinal changes of size in leaf length and width and female catkin length – effectively he showed that leaf and catkin dimensions were correlated, though the largest-leaved plants did not necessarily bear the largest catkins. Unfortunately I had considerable difficulty in sampling a sufficient number of mature female cones and was unable to confirm this finding. However, in Fig. 1 I have plotted data for lamina length and width for Irish populations alongside re-calculated values derived from McVean (1953a, b), all with 95% confidence limits and arranged along a north-east/south-west axis. In Ireland there is great variation in leaf size, but it is not clinal, nor is there any difference in leaf size between alders from different regions of Ireland. This contrasts with Britain (McVean 1953a, b)

The differences in the variation pattern of Common Alder in Britain and Ireland may be due to a number of causes. The first and most obvious potential cause is that the geographical and climatic span of Ireland is much less than that found in Britain and selection pressures may be insufficient to generate a cline. Secondly it could be that Common Alder populations in Britain are more genetically isolated from each other than they are in Ireland. Highly isolated small populations are likely to experience genetic drift (Levin 1981) and it is possible for clinal variation to develop under these circumstances even in the absence of selection. Most flowering plant populations in which clines have been found are in fact highly genetically isolated (Nic Lughadha & Parnell 1989). *Alnus* pollen, however, is frequently transported over long distances (Huntley & Birks 1983), so the real potential for genetic drift in *Alnus* is likely to be small. There is no evidence that there is any difference in the degree of genetic isolation between populations of Alders in Britain and Ireland. Thirdly it could be that the origins of *A. glutinosa* in Britain and Ireland are different, and that most present-day Irish populations were derived from a few founder individuals or populations. This is unlikely given the speed of the spread of *A. glutinosa* into Ireland following the last glaciation (Huntley & Birks 1983). Fourthly it is possible that *A. glutinosa* is not native at all in Ireland but was derived from a few original planted introductions. Current evidence suggests that, following the most recent glaciation, wild *Alnus* reached and rapidly colonised Ireland some 1500 years later than it did in Britain, between 6500 and 7000 B.P. (Huntley & Birks 1983), and there is no evidence that it subsequently became extinct. So I conclude that the difference in the variation pattern in Common Alder between Ireland and Britain is due to the relatively lesser geographical span of Ireland.

Of the populations sampled, one (population 15) from Charlestown House, near Jamestown (Co. Leitrim) in Co. Roscommon (v.c. H25) (see Kelly 1985) contained trees whose leaves were unusually variable in outline and appeared intermediate between *A. glutinosa* and *A. incana* (L.) Moench (Grey Alder). *A. incana* differs from *A. glutinosa* in its subacute to acuminate leaves

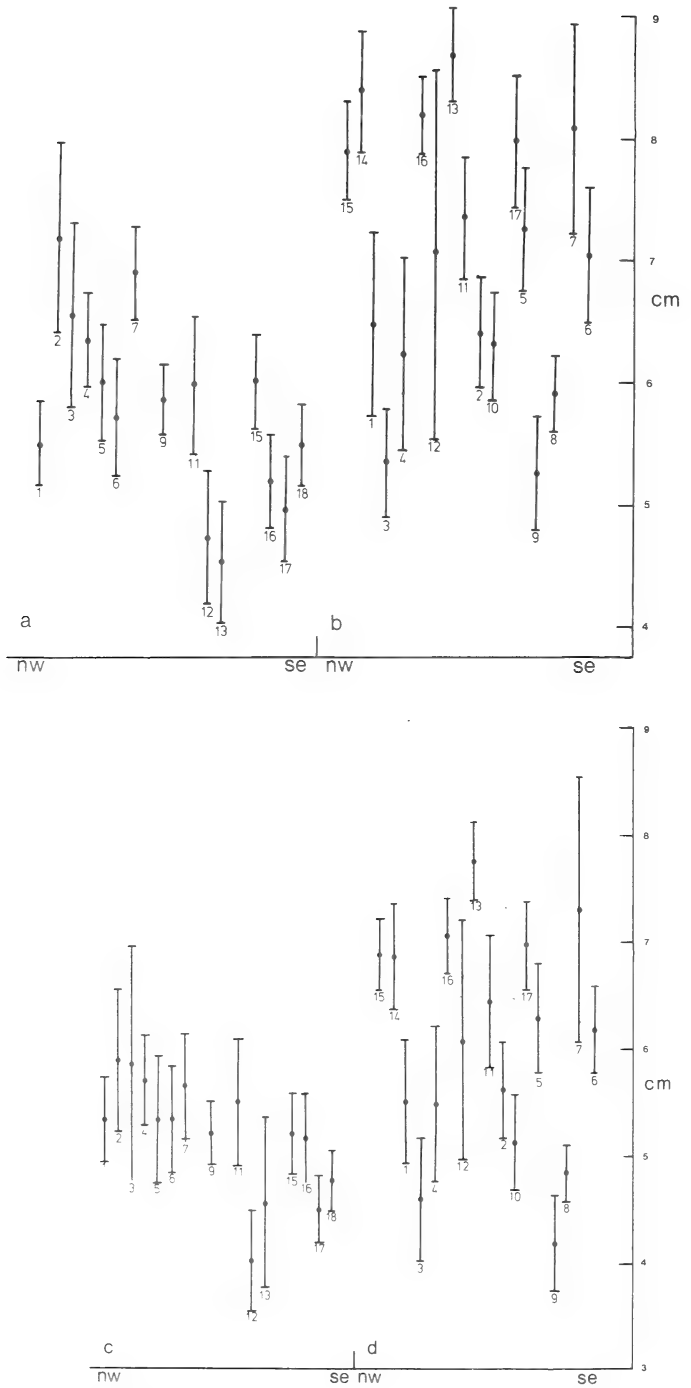


FIGURE 1. Means for leaf length (a,b) and breadth (c,d) (cm), with 95% confidence limits, for populations of *A. glutinosa* recorded in Ireland (b,d) and Britain (a,c). The data from the populations are arranged to show a gradient from north-west to south-east. Data for plants from Britain are plotted from revised data of McVean (1953a, b). The code numbers identify the different populations.

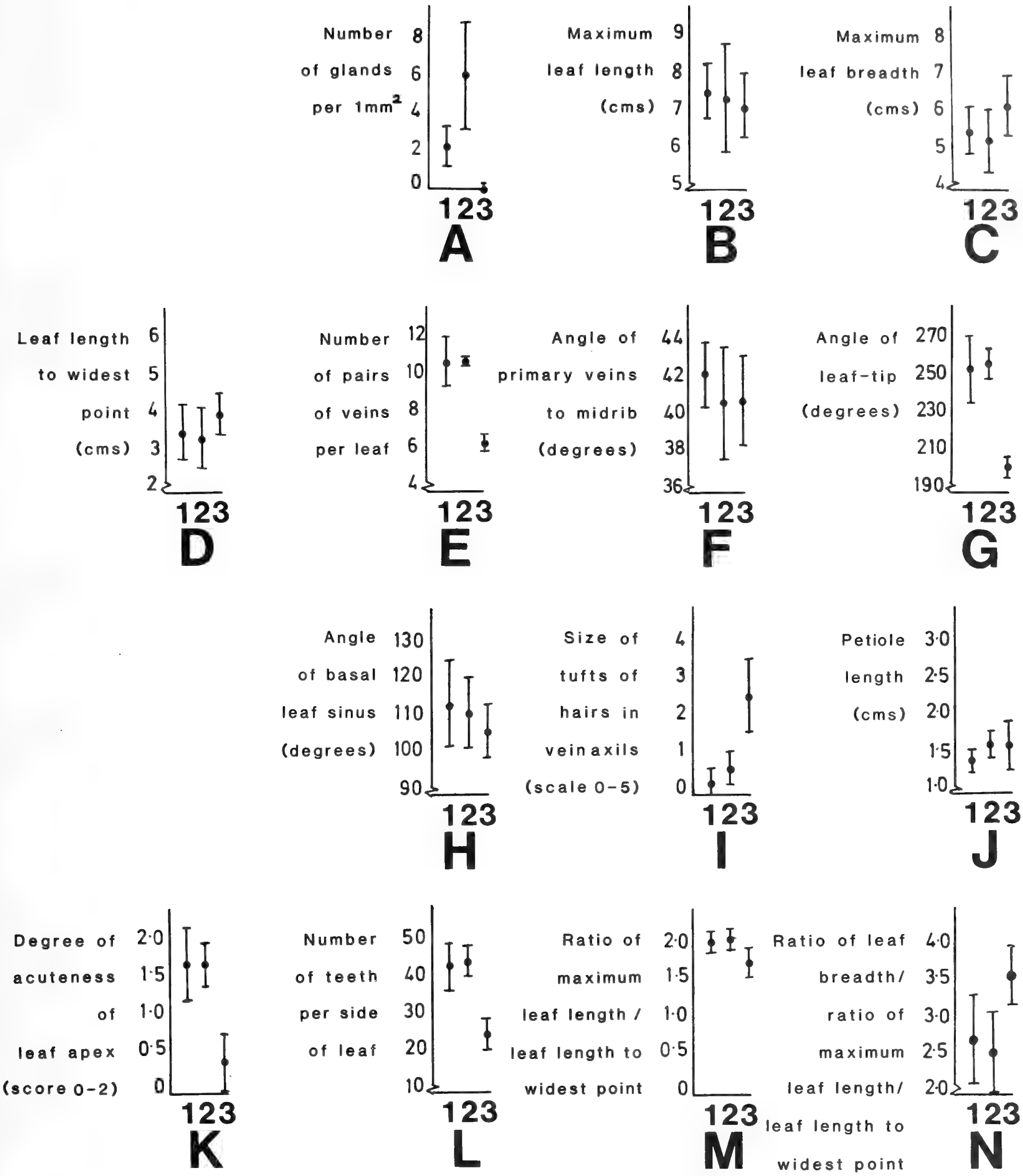


FIGURE 2. Character means with 95% confidence limits for all plants in population 15 (1 = *A. incana*, 2 = *A.* × *pubescens*, 3 = *A. glutinosa*).

(truncate to emarginate in *A. glutinosa*), the greater number of vein pairs in its leaves (10–15 versus 4–7) and in its sessile as opposed to pedunculate female catkins. The hybrid between these two species, *A.* × *pubescens* Tausch, has only been recorded twice in Ireland (v.cc. H14, Laois & H25, Co. Roscommon) under natural conditions (Scannell & Synnott 1988). *A.* × *pubescens* seems to be recognisable only, with difficulty, on the basis of intermediate morphology between its parents. Fig. 2 shows the means of the measurements made on plants in population 15. For the majority of characters, putative hybrids overlap with one or other or both of the parents, and they appear morphologically closer to *A. incana* (Fig. 2C,D,H,I,K,L,M,N). However, putative hybrids are intermediate between the parental species in some characters (Fig. 2B). In other characters the hybrid is clearly different from, and not intermediate between, its parents; for example, it has a much higher gland density on its leaves than either of the parents (Fig. 2A). Given the difficulty in recognising the hybrid, this previously unnoticed characteristic may well prove useful in its identification.

ACKNOWLEDGMENTS

I thank Professor D. H. S. Richardson and Drs Q. C. B. Cronk and D. L. Kelly for helpful comments on a manuscript draft of this paper, and to D. L. Kelly for drawing my attention to the Alder population containing *A.* × *pubescens*.

REFERENCES

Huntley, B. & Birks, H. J. B. (1983). *An atlas of past and present pollen maps for Europe: 0–13,000 years ago*. Cambridge.

Kelly, D. L. (1985). Plant records from about Ireland 1965–1983. *Irish Naturalists' Journal* **21**: 416.

Levin, D. A. (1981). Dispersal versus gene flow in plants. *Annals of the Missouri Botanical Garden* **68**: 233–253.

McVean, O. N. (1953a). Regional variation of *Alnus glutinosa* (L.) Gaertn. in Britain. *Watsonia* **3**: 26–32.

McVean, O. N. (1953b). Biological flora of the British Isles. *Alnus glutinosa* (L.) Gaertn. *Journal of Ecology*. **41**: 447–466.

Nic Lughadha, E. & Parnell, J. (1989). Heterostyly and gene flow in *Menyanthes trifoliata* L. *Botanical Journal of the Linnean Society* **100**: 337–354.

Scannell, M. J. P. & Synnott, D. M. (1988). *Census catalogue of the flora of Ireland*. Dublin.

J. Parnell
School of Botany, Trinity College Dublin, Dublin 2, Republic of Ireland

PEDICULARIS SYLVATICA L. SUBSP. *HIBERNICA* D. A. WEBB (SCROPHULARIACEAE) NEW TO WALES

During a botanical excursion to the Gower Peninsula, Glamorgan (v.c. 41) in May 1993, *Pedicularis sylvatica* subsp. *hibernica* was found in three sites, new to Wales. Subsequent investigation revealed that plants with hairy calyces occur elsewhere in Wales, and it has probably been overlooked.

Pedicularis sylvatica subsp. *hibernica* was described by Webb (1956), and differs from subsp. *sylvatica* in having the calyx and pedicels clothed in rather long white curled hairs (glabrous in subsp. *sylvatica*). In Ireland it is frequent on the blanket bogs of the west coast, and has been occasionally recorded elsewhere, mainly near the coast. In Britain it has been reported only from Kintyre and the Outer Hebrides (Perring & Sell 1968). Slightly hairy plants (transitional to subsp. *sylvatica*) are not common in Ireland, and they seem to occur chiefly near the eastern limit of subsp. *hibernica* (Webb 1956). Plants of subsp. *hibernica* on the Gower Peninsula were similar to those examined in western Ireland.

The records seen are listed below; it is probable that the plant is widespread elsewhere in Wales, and possibly in south-west and north-west England. I would welcome any other British records.

1. Overton Cliff, Gower, Glamorgan, v.c. 41 (SS/454.849). Two plants in coastal heath, with subsp. *sylvatica*, May 1993, *T. C. G. Rich et al.*
2. Broad Pool, Gower, Glamorgan, v.c. 41 (SS/51.91), abundant on *Molinia caerulea* bog to north-east of Broad Pool (one plant of subsp. *sylvatica* was also present), especially common in areas burnt two years previously, May 1993, *T. C. G. Rich et al.* (**NMW**).
3. Fairwood Common, Gower, Glamorgan, v.c. 41 (SS/568.922), occasional on *Molinia caerulea* bog north of airport, May 1993, *T. C. G. Rich et al.*
4. Portmead Common, Gower, Glamorgan, v.c. 41 (SS/627.967), May 1993, *Q. O. N. Kay*. All ten plants examined had hairy calyces.

5. Clyne Common, Gower, Glamorgan, v.c. 41 (SS/600.900), May 1965, *Q. O. N. Kay*.
6. Near Caerphilly, Glamorgan, v.c. 41 (ST/1.8, tetrad B), 31 May 1920, *A. W. Wade* (**NMW**).
7. Ponypriddy area, Glamorgan, v.c. 41 (ST/0.8 or ST/0.9), 16 May 1938, *A. Jones* (**NMW**).
8. Glyn Neath, Glamorgan, v.c. 41 (SN/8.0, tetrad B), peaty pasture, 23 July 1941, *H. A. Hyde* (**NMW**).
9. Between Beddau and Llantwit Fadre, Glamorgan, v.c. 41 (ST/068.848), damp ground near the railway, 24 September 1967, *A. Pinkard* (**NMW**).
10. Ystradowen Moors, near Cowbridge, Glamorgan, v.c. 41 (ST/02.78), grass/sedge community on damp peat, 21 May 1968, *S. G. Harrison* (**NMW**).
11. Nanthenfoel, Pont Creuddyn, Cardigan, v.c. 46 (SN/542.521), heathy pasture, scattered over several hectares with subsp. *sylvatica*, 9 June 1993, *A. O. Chater*.

Whether this taxon merits subspecific rank is another matter, and further work on the genetics of the expression of hairiness is required. It almost always grows with or near subsp. *sylvatica*, and differs in no other character. Webb (1956) points out that a "difference of this kind, confined to apparently a single character, would scarcely be worth taxonomic recognition (any more than say albinism, which is not uncommon in this species), were it not for the fact that the hairy forms occur only in a well-defined geographical area".

ACKNOWLEDGMENTS

I am grateful to Eimear Nic Lughadha, Paul A. Smith, Rebecca Warren, and Wyn, Cennydd, Daniel Owen and Hywel Richards for their assistance in the field, and Arthur Chater, Gwynn Ellis and Quentin Kay for assistance with other records.

REFERENCES

WEBB, D. A. (1956). A new subspecies of *Pedicularis sylvatica* L. *Watsonia* **3**: 239–241.
PERRING, F. H. & SELL, P. D., eds. (1968). *Critical supplement to the Atlas of the British flora*. London.

T. C. G. RICH
37 Hartfield Road, Forest Row, East Sussex, RH18 5DY

Book Reviews

The concise Oxford dictionary of botany. Edited by M. Allaby. Pp. vi + 442. Oxford University Press, Oxford & New York. 1992. Price £18.95 (ISBN 019–866163–0 hardback); £6.99 (ISBN 019–286094–1 paperback).

Dictionaries are keys to information; they cannot replace monographs and detailed subject text-books, and no single-volume dictionary can ever be a complete reference work on all matters within a subject. On the whole Allaby's handy, pocketable dictionary succeeds in being up-to-date and, as far as I could tell, accurate within reasonable parameters. Certainly this is likely to be a valuable ready-reference for undergraduates and postgraduates of all ranks, serving as a source of modern definitions and concise explanations. I do not think it is designed, as claimed, for the non-specialist unless the person is already well-versed in the biological sciences.

For example, if you look up "Microbiota", the entry leads you to "the smallest soil organisms, comprising *bacteria, *fungi, *algae, and *protozoa", which will be a trifle confusing if you needed to find out what the plant named *Microbiota* is! You can discover what the Fagaceae are, but not the Fabaceae unless you know this is the alternative name for Leguminosae. From obscure (to this reviewer) genera of gram-negative bacteria to world vegetation zones, by way of killing frost and island hopping, from micro-consumers to BP – "Before the present (which is taken to be 1950). The initials should not be confused with BC" – not to mention silage and *Bulgaria* (order Helotiales), this is an omnium gatherum of botanical jargon, arcana and facts, but it is not a dictionary of genera of cryptogams and phanerogams.

Criticizing a dictionary is a thankless task, and could be an endless one too. Leaving aside the editor's choice of entries, especially of genera, on which no agreement is likely, there is one criticism that must be levelled at Allaby's editing. As I 'explored' the world's vegetation zones, I noticed that the explanations included such phrases as "Part of Good's (1974) boreal kingdom . . .", but nowhere could I discover who Good was, nor what his 1974 work was titled. Likewise there is no entry about boreal kingdom. Unfortunately, there is no bibliography nor even a brief list of select references.

Apart from that criticism, I can understand that this particular dictionary will serve the academic fraternity of botanists, but a copy is unlikely to be used frequently by an amateur botanist who is seeking enlightenment about native wild plants.

E. C. Nelson

Wild orchids of Scotland. B. Allan & P. J. B. Woods; photography by Sidney Clarke. Pp. vii + 135; illustrated. H.M.S.O. Edinburgh. 1993. Price £24.95 (ISBN 0–11–494246–3).

During the 20 years I lived in Scotland I took a very active interest in most of the wild and cultivated flora of the country, but I carefully avoided the wild orchids as one of the groups, along with the grasses, hawkweeds and mosses, which were difficult and best left to the specialist. This book has changed all that and is a first rate guide which makes accurate identification easy and also makes orchids and orchid biology accessible.

The fact that I know many of the people responsible for this book and that some of them are old friends is not going to stop me from giving it a rave review. Having declared my interest I cannot say anything other than that this is a marvellous book and it deserves all the praise which will, I confidently expect, be heaped upon it.

Let me list just a few of the virtues of this book: the identification key *works* and is illustrated in a way which gives confidence, even to a novice both in the use of keys and in the structure of the orchids, that one is on the right track; the distribution maps which show the range of each species and subspecies before and after 1970 tell interesting stories about plant colonisation and disappearance (or on a different level tell us about the collecting habits and knowledge of botanists); Mary Bates' drawings are clear, effective and well labelled; the text is informative and accessible and the book itself is attractively but unpretentiously designed with a clarity which fully supports the book's purpose but which also gives it an approachable and enjoyable feel by devices such as the simple, uncluttered, airy layout of pages which start each chapter.

This unpretentious clarity extends to the photographs which add a whole new dimension to the book. I have long admired Sidney Clarke's photography both for its technical professionalism and for the way in which he shows plants, either as individuals or as elements in a habitat, in an unembroidered and direct way. He uses his photographic art in the service of science and good communication: there is no artiness in the pictures (though I would enjoy seeing the book's endpapers as a furnishing fabric or wallpaper). In a short chapter of only four pages on photography he tells us how he does it but he doesn't mention the lifetime of walking the Scottish hills in pursuit of plants, his deep personal interest in photography and his commitment to the Scottish flora and its conservation which are the essential foundation of his success. The photographs were taken in only three seasons and one is tempted to ask if it ever rains on Scotland's orchid habitats.

To call the text scientific is to hint that it might be scholastic, accurate but rather dull: far from it. Here is a well-written text in the best tradition of good communication. It perfectly complements the photographs by being concise, clear and free of any taint of jargon. Again this artlessness conceals, and is a result of, a lifetime of enthusiasm for the study of orchids by Patrick Woods and his co-authors.

So, is there anything I do not like about this book? No: my admiration for this initiative is unqualified – there are no buts. Everyone associated with its production can be proud of their roles in what is an excellent example of the way in which a variety of different talent can be brought together to deliver an elegant product. It is an outstanding example of what botanic gardens can do so well as 'packagers' of sound scientific knowledge for a wider, enthusiastic and demanding audience. I invite the audience to join me in the applause.

R. B. Burbidge

The vegetation of ultramafic (serpentine) soils. Edited by A. J. M. Baker, J. Proctor & R. D. Reeves. Pp. 509. Intercept, Andover, Hampshire. 1993. Price £47.50 (ISBN 0–946707–62–6).

The Proceedings of the First International Conference on Serpentine Ecology, held in California in June 1991, is a well-focused collection of 36 papers from ecologists, soil scientists, plant physiologists, taxonomists, geneticists and evolutionary and molecular biologists. Approached from these different viewpoints, the volume contains a wide global representation of studies which contribute towards an understanding of ultramafic ecology. Editing and production standards of the book are well above that which we often expect from conference proceedings; this book is a valuable reference work, broader in scope and more comprehensive than a previous excellent review edited by B. A. Roberts & J. Proctor (*The ecology of areas with serpentinized rocks* (1991)).

Soils derived from ultramafic rocks such as serpentine occupy less than 1% of the earth's surface, being widely scattered throughout temperate and tropical regions. They are rich in ferromagnesian minerals, with low silica content, but otherwise they are rather variable. Most evidence suggests that different combinations of nickel toxicity, magnesium toxicity in relation to calcium deficiency, low nutrient status and drought are responsible for an often unusual and distinctive vegetation. Ultramafic floras are often rich in endemic and rare species. In New Caledonia, ultramafic soils occupy about a third of the archipelago and contain 60% of the native flora with 1,844 species, 90.6% of which are endemic. In Cuba, serpentine endemic species represent 15% of the flora, with a much higher proportion found on old serpentine soils exposed for 10–30 million years rather than on soils exposed for 1 million years or less. The endemic content of other serpentine floras may be considerably less, for example accounting for only 3% in the Apennines in northern Italy where they consist mostly of neo-endemics. Plant communities on ultramafic soils range from arctic-alpine, through meadows, communities dominated by trees and shrubs, to rain forests. However, it appears that vegetation cannot be described as 'serpentine' merely as indicated by geological maps; on ultramafic outcrops in Ireland there is no distinctive vegetation or endemism and no occurrence of rare species.

Hyperaccumulation of nickel by plants, to exceptionally high tissue concentrations of $>1000\mu g$ g^{-1} dry weight (compared to normal concentrations in plant tissues of $<5\mu g\ g^{-1}$), is an unusual phenomenon that has received considerable attention and has now been identified in nearly 200 species (1–2%) on ultramafic soils. This extreme metal tolerance trait occurs surprisingly widely in 33 families of plants, although is more common in some such as the Brassicaceae and Euphorbiaceae. It is thought that high levels of nickel in plant tissues may confer greater resistance to attack by insect herbivores.

Ultramafic soils and vegetation provide a valuable resource for ecological study, but many areas remain undescribed biologically. The importance of implementing a conservation strategy for ultramafic sites is addressed in a conference resolution. A large number of sites are substantially disturbed by mining for iron, chrome, nickel and asbestos, or else by burning, grazing, urbanization and agriculture. This book should appear on the shelves of all science libraries, where hopefully it will encourage more people to become interested in ultramafic ecology.

N. M. Dickinson

The eternal yew. T. Baxter. Pp. 192, illustrated. The Self Publishing Association Ltd, Units 7/10 Hanley Workshops, Hanley Swan, Worcestershire, in association with Trevor Baxter. 1992. Price £19.50 (ISBN 1–85421–148–X).
The yew tree. A thousand whispers. Biography of a species. H. Hartzell Jr. Pp. xvi + 320, illustrated. Hulogosi, Eugene, Oregon 97440. Price US$ 19.95 paperback (ISBN 0–938493–14–0).

The yew is an intriguing plant because there is excellent evidence that some individual living trees of *Taxus baccata* are many centuries old. *Taxus* comprises perhaps seven species, including *T. baccata* (yew) native in western Europe and *T. brevifolia* (Californian or Pacific yew) of western U.S.A. and Canada. Baxter's eternal yew is strictly *T. baccata*; Hartzell misunderstands the word species so his 'biography' is a rambling thesis about both *T. baccata* and *T. brevifolia*, but principally the latter.

Trevor Baxter is an enthusiast, and the author of a couple of 'poems' and some impenetrable prose about yew trees. His book, published in association with a self-publishing co-operative, would have been much less painful to read had it been severely cut by a rigorous editor who could also have corrected Baxter's botanical orthography, and his woeful punctuation, capitalization and grammar. On the positive side, Baxter's chronicle is illustrated with recent black and white photographs of many of the famous, age-less yews that grow in Great Britain and a few in Ireland; as an appendix he has included a list of yew trees with recent measurements. In essence Baxter's book is a modern directory of churchyard yews, and he has not fallen into the trap of assuming that the bigger a tree's various dimensions – whether height, trunk girth, or canopy circumference – and the more decrepit its appearance, the more ancient it is. Yew trees are, as Baxter points out, notoriously impossible to age even by ring-counts due to their capacity to produce 'compound' trunks.

Like Baxter, Hartzell has great difficulties writing lucid prose, and his book would also have benefited from the vigorous attentions of an editor with a good knowledge of the history of botany and horticulture. Among his many extraordinary sentences is this one (p. 125):

> "Many of these remarkable old trees [churchyard yews in England, Ireland, Wales, Scotland and Normandy] bear their myths and historical significance, their stories, legends and poetic inspiration well, surviving a past so long that the entire duration of humankind on earth is only a minute in the day to the span of the yew, whose own ancestors stretch back 200 million years in time".

Hartzell's principal purpose in writing his book was to highlight the need to help protect the splendid yew forests of the Pacific Northwest of America which are being logged so that taxol, an anti-cancer drug, can be extracted from the bark of *T. brevifolia.* The figures are stark; 13·6 kg of yew bark yield only 1 gm of taxol, and 125,000 ancient yew trees may produce about 340-500 kg of bark. The clear-felling of the entire Pacific yew population might yield 334 kg of taxol.

Perhaps this ramshackle tome will help, but it is a confused and confusing work, interweaving

European and American Indian folk-lore with studies of taxol and its anti-cancer properties, uncritically mixing fact with fiction. The section headings are "Old World yew", "Botany and geography", "Living witness of human history", "Culture and geography of Pacific yew", "The modern dilemma" and "The metaphorical yew", with appendices on "Yew trees larger than 20 feet in girth in England and Wales", "Notable topiary and hedges in England", and "Yew species and cultivars". Hartzell's knowledge of the use of yews in gardens is poor – the garden at Castle Drogo, Devon, was created in the 1920s, and the presence elsewhere of Irish yews, none of which can have been planted *before* 1780, clearly indicates nineteenth century embellishments.

Concerning the Irish yew (*T. baccata* 'Fastigiata'), sometimes called the Florencecourt yew, a footnote is required to both books. This distinctive cultivar has a well-recorded history but neither author cited the correct dates which were given in The nomenclature and history in cultivation of the Irish yew, *Taxus baccata* 'Fastigiata', *Glasra* **5**: 33–44 (1981).

The dust-jacket blurbs inaccurately describe Baxter's work as "comprehensive" and Hartzell's as "authoritative" – do not be deceived. For members of this Society, Baxter's book is the more interesting, but neither can be recommended. I suggest that you spend your pocket-money on a well-used second-hand copy of W. Dallimore's *Holly, yew and box* (1908), or J. Lowe's *The yew trees of Great Britain and Ireland* (1897); these may be antique tomes but they are well written and a pleasure to read.

E. C. Nelson

Phylogeny and classification of the Orchid family. R. L. Dressler. Pp. 314, 16 pages (96 photographs) of colour plates, numerous line drawings. Cambridge University Press, Cambridge. 1993. Price £35 (ISBN 0–521–45059–6).

The invitation to review this book came to me not *despite* my lack of specialist knowledge of the orchids, but precisely *because* of it. One of the tragedies of orchidology is that, in proportion to its verbal output, it has given rather little to botany in general. Dr Dressler's earlier book (*The orchids: natural history and classification*, 1981) was a step towards redressing the balance. I was, therefore, happy to review a new book by the same author.

First, however, one must deal with the relationship between this book and its predecessor. Despite the change of title, this is a revised, updated and expanded version of the earlier volume. There has been a great output of orchid literature in the intervening years, and this has obviously been carefully sifted and taken on board. But where there has been no new information of value, then the treatment in the 1981 volume has been retained more or less verbatim. For instance in chapter 2, many of the entries are scarcely changed and eleven out of 16 text figures are the same: but the section on seed-coats has been completely revised (based on recent work by Barthlott and his school). In the colour section at least 25 of the 96 photographs are the same. The classification has been revised by the re-positioning of Neottieae, and by the dispersal of the 'vandoid' orchids: some sections (e.g. Oncidiinae, p. 177) have undergone considerable change, others virtually none; and many of the illustrations are the same. Title page and dust jacket make no mention of the earlier book: a word or two there would have avoided the need for this paragraph.

The better-known aspects of orchid-pollination were well-covered in the first book. That section has now been dropped, but there are two pages (pp. 222–223: 'pollination' does not occur in the index!) with the provocative heading "False advertisement and the evolution of efficiency". The first phrase refers to such devices as the display of dummy anthers (patches of yellow hairs on yellow swellings) that attract pollen collectors but offer nothing in return; or the mimicking by orchids of nectariferous flowers amongst which they grow, without offering nectar themselves. Insects are quick learners: false advertisement depends on a good supply of gullible, inexperienced, insects. The mimics may show only 2–50% pollination compared to 80–95% in related species offering nectar. This is the 'evolution of inefficiency'. The pay-off comes because the insects usually visit only one flower in an unrewarding spike; thus most of the fruits set have been cross-pollinated. The higher fruit-set of nectariferous species is due to pollination from one flower to another on the same spike. These two pages offer no 'false advertisement': they give real food for thought.

Dr Dressler is not afraid to set out his views on species. They show a very sensible approach to the taxonomist's problems, and lead to the conclusion that only special creation could have given us a world with all species neatly defined, whereas under evolution "we should find a spectrum of not species, almost species, just barely species, and clearly defined species, and that is exactly what occurs in nature". An admirably clear statement – but it is a statement of the situation. The problem of where to apply binomial nomenclature remains.

Parallelism is a central feature of evolution, and orchids provide a treasure trove for its study. (The index takes one only to a brief entry on p. 233: the meat of the subject is on pp. 218–222). After listing some early straightforward examples, the author introduces two new terms: integrational and contingent parallelism. Here only two comments are possible. His definition covers really only the qualifying adjectives. He writes "By 'contingent parallelism' I refer to features that may evolve only after another feature is present . . . Thus feature A permits the evolution of feature B, and B may . . .". This defines an evolutionary pattern (see Burtt in *Transactions of the Botanical Society of Edinburgh* **42**: 138, 1974); it only becomes a parallelism if it is recurrent in different lineages. Dressler's voice on such wide topics is not authoritative, but it is a fine stimulant for the reader to put in some hard thinking for himself.

Don't pass over this book because of its title. Even if you cannot tackle the orchid-classification amidships, fore and aft, it is well worth any botanist's time.

B. L. Burtt

Květena Česke Republiky (Flora of the Czech Republic). Edited by S. Hejny & B. Slavik. Vol. 1. Huperziaceae – Urticaceae. Pp. 557 with numerous line drawings. 1988. Vol. 2. Fagaceae – Empetraceae. Pp. 540 with numerous line drawings. 1990. Vol. 3. Brassicaceae – Malvaceae. Pp. 542 with numerous line drawings. 1992. Academia, Praha. Price not given (ISBN 80–200–0256–1).

These are the first three volumes of the *Flora of the Czech Republic*, describing the flora of a key area in central Europe. The work covers the Czech Republic (the western half of the old Czechoslovakia), the Slovak flora being covered in a separate series.

The work is in Czech. The first volume includes a summary and glossary in English by M. Kovanda, and each other volume includes a brief introduction in English, and it does not take long to make sense of the accounts. The books are hardback, in A4 format and are clearly printed with a good binding.

Accounts of families or genera have been prepared by specialist collaborators in addition to the editors and their assistants. Each family is given a description and a key to genera, and likewise each genus. Relevant literature is listed. For each species, Latin and Czech names are given, with synonymy and representative specimens where appropriate. The descriptions of each species are very detailed. Flowering times and chromosome numbers are given. There are often notes on the morphological variation, ecology, vegetation types and distribution, both in the Czech Republic by the phytogeographical district and elsewhere. Hybrids are treated in full.

There are numerous black and white line drawings of the majority of species (cross referenced in the text). These are beautifully drawn in large format and capture the look of the plants perfectly.

Such a detailed comprehensive flora will be invaluable for any British botanists visiting the Czech Republic, which has a huge potential for botanical holidays and excursions. It will also be a valuable reference book for armchair botanists. It is highly recommended; if only we had a flora like this in Britain!

T. C. G. Rich

Nouvelle flore de la Belgique, du nord de la France et des régions voisines. 4th edition. J. Lambinon, J.-E. De Langhe, L. Delvosalle & J. Duvigneaud. Pp. cxx + 1092; illustrated. Editions du Patrimonie du Jardin botanique national de Belgique, Meise. 1992. Price BEF 1,720 (ISBN 90–72619–07–2).

This is a concisely written excursion Flora of Belgium, Luxembourg, N.E. France, S. Netherlands and a small part of Germany. The fourth edition is extensively revised, having drawn on the detailed work of the Institut floristique belgo-luxembourgeois and the Institut floristique franco-belge for distributional data as well as on recent taxonomic and nomenclatural studies. Many more adventives are treated than in the third edition, and a new key is presented to the trees, shrubs and lianes using mainly vegetative characters; this allows rapid identification not only of native arborescent species but also of cultivated and planted specimens.

One of the most valuable features of this Flora, written in French but with additional Dutch and German vernacular names, is the attention paid to infraspecific variation. Despite the concise format, in which almost all comparative descriptive data are confined to the keys, space is found for detailed observations on taxa such as *Parnassia palustris* var. *condensata* Travis & Wheldon; subspecies and interspecific hybrids of *Mentha* alike are treated in a single key. Special attention is paid to the zinc-loving variants of species such as *Armeria maritima* and *Thlaspi caerulescens*, and notes are also provided on the varied medicinal and other uses of many of the plants.

An exhaustive glossary is provided, and the Latin, French, Dutch and German indexes are preceded by a list of nine new combinations dated "December 1992" but seemingly published in April 1993. One of these establishes a new subspecies of *Scabiosa columbaria* (subsp. *pratensis* (Jord.) Duvigneaud & Lambinon) for material with several pairs of more frequently divided cauline leaves, inhabiting deeper alluvial soils than the typical subspecies. This taxon could perhaps occur in old meadows in southern England, although in Belgium it is "en fort régression".

Numerous illustrations are interspersed in the text, largely of diagnostic characters; in this respect the Flora should prove specially useful to the inexperienced botanist. In size the book is similar to the first edition of Clapham, Tutin & Warburg's *Flora of the British Isles* (1952); the price (which approximates to £35 at mid-1993 exchange rates) represents good value for a work of over 1200 pages. The book deserves to be bought by private purchasers as well as by institutional libraries.

J. R. Edmondson

The fern guide. A field guide to the ferns, clubmosses, quillworts and horsetails of the British Isles. J. Merryweather & M. Hill. Pp. 101–188, with numerous drawings and 29 colour plates. AIDGAP, Field Studies Council, Preston Montford. 1992. Price £5.25 incl. p&p (ISBN 1–85153–211–0).

There are now several field guides to the ferns and fern allies of the British Isles. *The fern guide* is in the usual AIDGAP format of extended, copiously illustrated keys, and is aimed at teaching field identification to beginners. For someone with plenty of time in the field (and prolonged fine weather as it takes a while to work through the main fern key of 48 pages) it should provide a great deal of pleasure and names for most of what one can find. One is led efficiently step by step, and the very good illustrations, including 29 colour photos, are integral to the process and make it generally clear whether one is on the right lines. (When one isn't, backtracking can be difficult as there are no back references to the dichotomy one has come from.) The book contains many helpful hints, including one for *Equisetum* × *littorale* that works and that was new to me. The forms of *Athyrium filix-femina* in open and shaded situations, so distinct and so puzzling to the beginner, are for example mentioned and well illustrated in colour. There are, though, some cases where the book misleads. For example, the glands on the indusium of *Dryopteris oreades* are not as constant a character as is implied, and the much better character of the broad, divergent teeth at the apex of the pinnules is not mentioned and is indeed belied by the drawing.

The book has several major drawbacks. It may enable users to put names to the plants they see, but it does little to teach them about fern classification and relationships. It thus fails to provide any basis for a deeper understanding of the group and hence any hope of real certainty in identification. Genera, for example, are not described, and as their constituent species often key out in different parts of the key the reader gets no idea of how the species are grouped into genera. In several groups of ferns, microscopic characters are essential to confirm identifications. While it is obviously reasonable for a field key to omit these, it should surely be stated that, for example in *Polypodium*, such characters must be used if the identification is to be definite. In *Isoetes* it is misleading to say that hand lens examination of the megaspores of *I. lacustris* and *I. echinospora* "may help" to confirm the species. The vegetative characters are often completely unreliable and examination of the megaspores, by something more powerful than a hand lens, is *essential*. (The AIDGAP key to woodlice uses microscopic characters quite extensively, and several groups of ferns are at least as difficult to identify as are the woodlice, with or without a microscope. Why should the identification of ferns be taken any less seriously?) It is not in the long run helpful to anyone to suggest that the identification of ferns is easier and more foolproof than it really is.

The list of books under 'Further reading'' would have been more helpful if it had been annotated so that the beginner had some idea of what to turn to next, and for what. Infuriatingly, we still lack a comprehensive book for identifying ferns, that would combine the clarity and wealth of characters (including microscopic ones) provided by Jermy & Camus in *The illustrated field guide to ferns and allied plants of the British Isles* (1991), the descriptive detail and the coverage of hybrids provided by Page in *The ferns of Britain and Ireland* (1982) and the taxonomic and educative framework provided by Hyde, Wade & Harrison in *Welsh ferns* (1969). Of these main contenders, Jermy & Camus is the best as a field guide but has the great drawback of having very little on hybrids. Page, magisterial though it is, is inadequately illustrated and has only very partial keys, making it daunting for the beginner. Hyde, Wade & Harrison is very out of date and inadequately illustrated. The book under review can be recommended to anyone wishing to take up fern identification from scratch, but it should not on its own be relied on to give foolproof identifications and, if it does its job, its users will very soon need to graduate to Jermy & Camus and to Page.

A. O. CHATER

Supplement to Flora of Cheshire. A. Newton, with cover illustration by W. Young. Pp. 52. Privately published, Leamington Spa. 1991. Price £5.75; available post free from N.M.G.M. Enterprises, P.O. Box 33, Liverpool L69 3LA.

This nicely produced booklet brings knowledge of the Cheshire flora up-to-date (1990), and monitors changes over the past 20 years. Aquatic species are particularly vulnerable as the remorseless destruction of the water-filled marl pits so characteristic of the Cheshire scene continues. On the other hand, the number of alien and adventive species grows, and many appear here in a two-page listing. Attention might have been drawn to the misguided practice of introducing into Nature Reserves species not native to the area (e.g. *Rosa rugosa*).

It is pleasant to find that some species supposed extinct or nearly so have been refound, such as *Rhamnus catharticus* at Kingsmarsh. The troublesome genera *Taraxacum* and *Rubus* are well covered with 90 species of the former and 27 of the latter.

The index is unsatisfactory; the page references are all one page in advance of the text; thus *Salicornia* is indexed as on p. 15 whereas it actually appears on p. 14. Nevertheless, with colourful stiff covers the *Supplement* is a valuable addition to the county *Flora*.

N. F. McMILLAN

Marianne North at Kew Gardens. L. Ponsonby. Pp. 128, 128 colour and four black and white illustrations. Webb & Bower, in association with the Royal Botanic Gardens, Kew. 1990. Price £15.95 (ISBN 0–86350–309–8).

Outstanding among the women who were lone explorers and botanical painters in those Victorian days of more difficult travel, Marianne North gave her 832 paintings of plants in many countries to the Royal Botanic Gardens, Kew. Many visitors will have seen these in the Marianne North Gallery at Kew, now extensively renovated in recognition of the centenary of her death. Laura Ponsonby, an authority on Marianne North, selected 130 of the paintings, many of which have not before been published, to illustrate her biography and extensive account of those remarkable travels. An added interest in the book are the detailed captions to these paintings which show scenes of plant life and natural beauty from around the world. Sadly, now a hundred years later, it would be hard to find such unspoilt scenery and such a profusion of flowers in many of the places visited by Marianne North.

M. Briggs

Stearn's dictionary of plant names for gardeners. W. T. Stearn. Pp. viii + 363. Cassell, London. 1992. Price £16.99 (ISBN 0–304–34149–5).

The latin (or latin-form) names given to plants by botanists are often a great puzzle to gardeners. How plants got the names they have and what those names mean or represent are matters that are dealt with cursorily, if at all, in most of the horticultural-botanical literature. The present book, which covers these subjects, is a revision of A. W. Smith's *Dictionary of plant names for gardeners* of 1963, including "the addition of many more entries, the expansion and emendation of others [and] the omission of materials considered irrelevant . . .". These changes are so extensive that the book is really a new one, and has been so treated by the publishers.

The main part of the book (pp. 27–315) consists of an alphabetical listing of generic names and specific epithets used for garden plants, with explanations of their meanings and origins. Though Professor Stearn makes no claims for completeness, I have not been able to dig up any names that are not included. Most of the entries are short and concise, but some are more extensive, for example, those for 'Forsythia' (17 lines) and 'paxtonii' (14 lines). Professor Stearn brings a lifetime's experience to his task and the range of erudition he displays is enormous: names from many languages are cited (including Thraco-Palasgian (pre-Greek, see the entry under 'Hyacinthus')) and the amount of biographical information condensed into a small space is astonishing. In spite of his quotation of Dr Johnson's definition of a lexicographer on p. 316, Professor Stearn wears this erudition lightly and many of the entries include touches of humour or even the grotesque.

Gardeners will use this section extensively to find out the meaning of such unlikely words as 'aiolosalpinx' (as in *Rhododendron aiolosalpinx* – it means the trumpet of Aeolus, the god of the winds) and to discover, for instance, who was the Rudbeck after whom the well-known Composite genus *Rudbeckia* was named, thus increasing the interest provided by the plants they grow.

This main index is preceded by an "Introduction to Botanical Names" (pp. 17–26) which discusses the principles used by botanists in naming plants and the various kinds of name that are used. It also touches on the rules of botanical nomenclature especially as they affect such thorny subjects as why familiar names seem to be wilfully changed by botanists in order to confuse and irritate the gardener.

The final section (pp. 317–329) is a very sensible essay entitled "An Introduction to Vernacular Names". The advantage (". . . vernacular names should not be despised and disregarded. When only a few plants need to be distinguished within a limited area, vernacular names can be just as useful, precise and stable as their scientific equivalents intended for international use." – p. 318) and disadvantages of these are presented calmly and rationally. This is a section that could be read with advantage by taxonomic botanists as well as gardeners.

A glossary, bibliography and index complete the volume, which is well produced and contains few printing errors. It should be on the shelves (or, more likely, on the desk or bench) of every gardener or botanist interested in garden plants.

J. Cullen

Red data books of Britain and Ireland: Stoneworts. N. F. Stewart & J. M. Church. Pp. 144, 14 colour photographs, numerous line drawings and maps. Joint Nature Conservation Committee, Peterborough. 1992. Price £15 (ISBN 1–873701–24–1).

This particular *Red data book* breaks new ground in covering the entire British Isles: the vascular plant red data books for Great Britain and Ireland were published independently in 1983 and 1988. In this instance, however, we have the pleasure of a single volume introduced to us by both Ministers responsible for the environment of the U.K. and the Republic of Ireland.

Although technically algae, stoneworts have always been treated as being within the legitimate purview of the B.S.B.I. – their large size makes them conspicuous in the field, so that many vascular plant botanists have been attracted to pay some attention to them. In recent years, active interest in the group has increased. The sensitivity of stoneworts to pollution makes them of considerable value as indicators of good water quality.

As defined by the authors, there are 33 British and Irish species of stonewort, with about 400 worldwide; two species are endemic to these islands. Problems of nomenclature and taxonomic ranking are dealt with briefly on pp. 37–39, and in a useful table. There are considerable differences between the species as defined in this work and those of the B.S.B.I. handbook of 1986. However, the authors have striven to include sufficient synonymy to enable the user to locate a species in the major earlier works.

The book is well illustrated by colour plates of habitats, and there are excellent line drawings by Margaret Tebbs (many previously published in the B.S.B.I. handbook) of individual species. The section on habitats stresses among other things, the difference between calcium carbonate-rich and nutrient-rich water bodies, and the damaging effects of pollution. The chapter includes a table where the habitat preferences of each of the 33 species are presented.

The principal criteria for listing a species as a red data book species are that for Great Britain it should have been recorded in 15 or fewer, and for Ireland ten or fewer 10-km grid squares since 1970. Together with other qualifications this produces a total of 57% and 48% (17 and 12 species) of the stonewort floras respectively. Table 4 tabulates the threats to each species and gives each a Threat Status (Extinct, Endangered, Vulnerable, Rare, etc).

The species accounts give useful notes on identification (with a line drawing), the distributions in Great Britain and Ireland (with a distribution map), world distribution, ecology, main threats, existing protection and conservation priorities. An appendix gives a key to all British and Irish species using field characters requiring only the use of a hand lens. It is interesting to compare the distribution maps with those in the B.S.B.I. handbook. For those few species where there are two exactly corresponding maps additional records appear in the *Red data book*.

The book is an attractively presented and well designed summary of the conservation status of stoneworts in the British Isles and is a model of clarity. I found it readable and packed with fascinating and useful information as well as the expected data on threat status, etc. Anyone interested in these plants, or in plant conservation generally, should purchase a copy.

P. Hackney

Flora Europaea, second edition, vol. 1: Psilotaceae to Platanaceae. Edited by T. G. Tutin *et al.*, assisted by J. R. Akeroyd & M. E. Newton. Pp. xlvi + 581. Cambridge University Press, Cambridge. 1993. Price £100 (ISBN 0–521–41007–X).

The publication of the 5-volume *Flora Europaea* between 1964 and 1980 was a landmark in European botany. Various reviewers of volumes of the first edition predicted that this work would stimulate further taxonomic research on the European flora and this has indeed been the case. The initial volume was published in 1964 and, because it was the pioneer part, of necessity it was the one most in need of revision since it contained more errors than subsequent volumes. All European botanists will therefore welcome this revision, produced 29 years after the original. It is partly financed by using the royalties from sales of the series which were lodged in a trust fund, administered by the Linnean Society of London. This new edition continues to remind us of the great vision of the original group of taxonomists who initiated and successfully saw the project through to completion. *Flora Europaea* has received much acclaim and has been recognised as the definitive reference for botany by the Council of Europe.

Volume 1 contains treatments of the 25 families of Pteridophyta present in Europe, the five families of gymnosperms and the first 49 families of angiosperms from the Salicales to the Rosales (in part). Major families include the Caryophyllaceae, Chenopodiaceae, Cruciferae and Ranunculaceae. This is certainly not just a reissue of the previous edition because the editors have carried out extensive work on updating. Any taxa new to Europe since 1964 have been incorporated and many descriptions have been improved. The keys have also been extensively revised and, in many cases, made easier to use, while all synonyms are cited in the text. The fact that 250 species and 150 subspecies have been described from Europe as new to science in the 79 families covered by Volume 1 shows that there is still much taxonomic activity on the Continent and that there is still much to do in order to have a definitive taxonomic account of the region. The new records and alien species included means that the new edition has about 350 extra taxa; in compensation, only 20 taxa have been deleted. The useful appendices of the first edition have been revised by R. R. Mill. It is a pity that the author abbreviation appendix has not adopted the standard abbreviations of Brummitt & Powell *Authors of plant names* (1992) or for the book citations those of Stafleu & Cowan *Taxonomic literature*, 2nd ed. (1976–1988), or indeed of any other standard work. Researchers will be glad to see the inclusion of the complete synonymy of the species which will greatly facilitate comparison with previous works.

Seeing the result of the revision, we should be grateful that the *Flora Europaea* editorial committee was not just disbanded after the publication of Volume 5, but decided to embark on a revision of Volume 1. Given the extent to which new taxa have been added in this revision, it is a pity that there are no current plans for revisions of the other four volumes. It is much more useful to have the changes and additions gathered together into a revised volume than spread throughout the literature in a large number of papers.

The principal editors of this revision of Volume 1, J. R. Akeroyd and M. E. Newton, are to be congratulated on the thoroughness of their work. Botanists truly interested in the European flora will need to have this new volume, rather than rely on the first edition, because it contains so much additional information.

G. T. Prance

Origin and geography of cultivated plants. The late N. I. Vavilov, translated by D. Löve, foreword by A. A. Filatenko. Pp. xxxiii + 498, 28 line diagrams and 33 half-tones. Cambridge University Press, Cambridge. 1992. Price £75 (ISBN 0–521–40427–4).

This is an English translation of a work first published in Russian under the (transliterated) title *Proiskozhdenie i Geografia Kul'turnykh Rastenii* by the Leningrad (now St Petersburg) branch of 'Nauka', the Russian science publishing house, in 1987, to commemorate the centenary of the birth of the great Russian plant geographer, ecologist and plant breeder Nikolai Ivanovich Vavilov (1887–1943). That volume, in turn, was a collection of 25 of Vavilov's most important papers, originally published in various Russian journals from 1920 onwards, some of them posthumously. The volume under review is the first in which all these papers, many of them of seminal importance, have appeared collectively in translation. Doris Löve's translation is masterly on the whole, although there are a few idiosyncrasies.

The titles of the papers show the immense breadth of Vavilov's interests in cultivated plants (and domesticated animals) and their origins. They range from 'On the origin of plants', 'Asia – the source of species', 'Plant resources of the world and the mastering thereof' to 'On Soviet science and the study of the problem concerning the origin of domesticated animals'. Most papers are quite short, but the book includes his magnum opus, 'Centres of origin of cultivated plants', which runs to 112 pages. This contains, among other sections, a long, detailed, and utterly absorbing account of the origins of cultivated hemp, *Cannabis sativa* – of more than academic interest to British botanists now that E.C. legislation allows *Cannabis* to be legally grown, for fibre, once again in the British Isles!

Vavilov was a great explorer in his search for elusive genotypes. As well as travelling through most of Asia, he also visited the New World, in particular Mexico and Central America. Two papers, 'Mexico and Central America as a basic centre of origin of cultivated plants in the New World' and 'The important agricultural crops of pre-Columbian America and their mutual relationship' resulted from these explorations.

The sense of amazement and wonder that Vavilov so obviously had on his travels, expressed with deep feeling in many of his papers, shines through with undiminished radiance in the translation. The papers contain a deep, rich mine of information and theory on the origin of almost every one of the world's economic plants. Some of this is now outdated, if only because radical changes in agricultural practices in the last five decades have sadly reduced the gene pool of ancestral species to a fraction of what it was in many of the areas where Vavilov carried out his pioneering studies. The nomenclature has also been largely left as it was in the original papers; the correct current name is, however, always indicated in square brackets in the index to Latin plant names, and occasionally there are helpful insertions by Doris Löve, also in square brackets, in the main text to clarify or update Vavilov's writings.

The book has been sumptuously produced by Cambridge University Press. As supplied for review, it had no dust jacket; instead, there is a striking gold-embossed Oat panicle on the dark green cover, with the title and author's name gold-embossed on a black background. The rather small print is nevertheless easy to read; misprints appear to be extremely few, although, disconcertingly, Nikolai Ivanovich's first name appears in no fewer than three other variants (Nickolay, Nikolay and Nicolay) in the first few pages of introductory matter, pp. i–xiv. One irritating feature is the use of American English spellings throughout. I do not mind, indeed I expect, "centers of origin" in a book published in America, but in one published by one of Britain's most highly respected houses I abhor it. Sadly, this appears to be a growing trend, but should be strongly resisted. My other main criticism is the very high price. This will deter many a student or library from acquiring this book – indeed, a colleague from Jerusalem actually told me that his library could not afford it. That is a pity, because it is a fitting memorial, not just to an almost legendary Russian scientist the likes of whom we are unlikely to see again, but also to the richness of a genetic 'landscape' now greatly diminished. I hope that a much cheaper, durable paperback edition will be made available so that a wider public can appreciate Vavilov's enthusiasm and lifetime's energies.

R. R. MILL

Report

ANNUAL GENERAL MEETING, 16 MAY 1993

The Annual General Meeting of the Society was held at the Lincolnshire College of Agriculture and Horticulture, Riseholme Hall, Riseholme, Lincoln, at 12.30 p.m. 80 members were present. Dr P. Macpherson, retiring President, taking the Chair for the first three items on the Agenda, welcomed the members present, then stated that his first sad duty was to report the recent death of Mr R. W. David, C.B.E., M.A., a past President and Honorary member of the Society, and joint author of the B.S.B.I. Handbook *Sedges of the British Isles*.

Apologies for absence were read and the Minutes of the 1992 Annual General Meeting, published in *Watsonia* **19**: 205–207 (1993), were approved and signed by the President.

REPORT OF COUNCIL

The Chairman summarised the highlights of the year in his Report, which had been circulated to members; the adoption was proposed by Dr N. K. B. Robson, seconded by Mrs M. Lindop, and the Report was accepted unanimously.

HON. TREASURER'S REPORT AND ACCOUNTS

The Hon. Treasurer, proposing the adoption of his Report and Accounts, which had been circulated to members, referred to the Welch Bequest Fund from which a number of grants had been paid during the year, including to the B.S.B.I. Database (Leicester) project which was proving to be an asset to the Society. Mr Walpole also reported that all Handbooks destroyed in the flood had been reprinted. He invited queries on the Accounts, and there being none the adoption of the Report and Accounts, seconded by Mr R. G. Ellis, were accepted unanimously.

ELECTION OF PRESIDENT

Dr P. Macpherson, retiring President, commented that as President he had been given an insight into the committee structure of the Society, and had gained an awareness of the amount of work undertaken for the Society by members of the various committees, by the committee chairmen and secretaries in particular, and also by the Honorary Editors. He thanked all these on behalf of the Society. The Hon. General Secretary he thanked for keeping him in touch with Society affairs, by phone and by many postcards, and for general communications within the Society. Mr M. Walpole, as Hon. Treasurer and as Chairman of the Publications Committee he thanked with appreciation for discussions and advice throughout his Presidency. Thanking the members of his President's Energising Panel, and of the Executive Committee, Dr Macpherson referred to the honour of being President of the B.S.B.I., also thanking the members who had elected him, saying that he was very appreciative of their support.

Introducing Dr F. H. Perring, O.B.E., F.L.S., F.I.Biol., Dr Macpherson commented that the President-elect was well-known to members as an author, broadcaster and enthusiast for the conservation of wild plants, who had many contacts in the conservation world with whom he would aim for liaison and publicity for the Society. Dr Perring was unanimously elected, and taking the Chair he said that he would be very happy to repay the enormous debt of gratitude that he owed to the Society on being a member for 40 years. He hoped to contact many members and would value highly their thoughts and comments on the Society.

On behalf of the Society he particularly thanked Dr Macpherson for his Presidential Address, for his regular attendance and firm chairmanship of meetings, undeterred by the distances involved. As President at two Royal occasions Dr Macpherson had also represented Scotland by wearing kilt and sporran, and Dr Perring remarked that the retiring President was leaving a hard act to follow.

ELECTION OF VICE PRESIDENT, 1993–1997

Mr A. O. Chater had been nominated by Council and was known to many members as a past Secretary of the Publications Committee, a Referee for *Carex* and for nomenclature, the Recorder for Cardiganshire and his work on the Records Committee and also as joint author of the B.S.B.I. Handbook *Sedges of the British Isles*. His unanimous election was welcomed, with applause.

RE-ELECTION OF HON. GENERAL SECRETARY AND HON. TREASURER

Proposing the re-election of these Officers from the chair, the President endorsed Dr Macpherson's comments, and again thanked these Officers for the wonderful service which they gave to the Society. They were unanimously re-elected, with applause.

ELECTION OF COUNCIL MEMBERS

In accordance with Rule 10 nominations had been received for Mr B. A. Gale, Mr D. J. McCosh and Dr G. Wynne. Profiles had been published, and these members were elected unanimously by the meeting.

ELECTION OF HONORARY MEMBERS

Council had nominated two members: proposing Mr R. H. Roberts, M.Sc., Mr R. G. Ellis described him as well-known to north-western botanists in Britain, and to those with special interests in ferns and the genus *Dactylorhiza* as a Referee for these groups, as Recorder for Anglesey and also as a long-serving member of the Committee for Wales and author of *The flowering plants and ferns of Anglesey*.

Dr Perring proposing Mr P. J. O. Trist, O.B.E., B.A., introduced him as being based in East Anglia for many years, and editor of *An ecological Flora of Breckland*, but was also well-known to many members as a Referee for *Bromus*, *Festuca* and other grasses. Mr Trist, now retired as a *Gramineae* Referee, had named 1,891 grass specimens for members during his time as Referee.

The election of Mr Roberts and Mr Trist as Hon. Members was unanimous, and with applause.

AMENDMENTS TO B.S.B.I. RULES, 1993

Re-wording Rules 3c) and 4a), under *Management of the Society* and the addition of Rule 10 under *The Officers*, with subsequent adjustment to the numbering of Rules 11–39, was approved by the meeting, and copies are available to members on request.

RE-ELECTION OF HON. AUDITORS

The Hon. Treasurer proposing the re-election of Grant Thornton, West Walk, Leicester, reported that they were willing to continue as Hon. Auditors and the re-election was passed unanimously, with applause. The President would write to express the appreciation of the Society.

ANY OTHER BUSINESS

On behalf of those present the President thanked Mrs I. Weston as local organiser, and her team of local helpers for the excellent arrangements and very good facilities provided at Riseholme Hall. He again thanked the Speakers, and Mrs M. D. Perring and Mr J. and Mrs S. M. Atkins for bringing new and second-hand botanical books.

There being no other business, the meeting closed at 1.25 p.m.

MARY BRIGGS

B.S.B.I. HANDBOOKS

Each handbook deals in depth with one or more difficult groups of British and Irish plants

No. 1 SEDGES OF THE BRITISH ISLES
A. C. Jermy, A. O. Chater and R. W. David. 1982. 268 pages, with a line drawing and distribution map for every species. Paperback. ISBN 0 901158 05 4.

No. 2 UMBELLIFERS OF THE BRITISH ISLES
T. G. Tutin. 1980. 197 pages, with a line drawing for each species. Paperback. ISBN 0 901158 02X. Out of print: new edition in preparation.

No. 3 DOCKS AND KNOTWEEDS OF THE BRITISH ISLES
J. E. Lousley and D. H. Kent. 1981. 205 pages, with many line drawings of British native and alien taxa. Paperback. ISBN 0 901158 04 6. Out of print: new edition in preparation.

No. 4 WILLOWS AND POPLARS OF GREAT BRITAIN AND IRELAND
R. D. Meikle. 1984. 198 pages, with 63 line drawings of all species, subspecies, varieties and hybrids. Paperback. ISBN 0 901158 07 0.

No. 5 CHAROPHYTES OF GREAT BRITAIN AND IRELAND
J. A. Moore. 1986. 144 pages, with line drawings of 39 species and 17 distribution maps. Paperback. ISBN 0 901158 16X

No. 6 CRUCIFERS OF GREAT BRITAIN AND IRELAND
T. C. G. Rich. 1991. 336 pages, with descriptions of 140 taxa, most illustrated with line drawings and 60 with distribution maps. Paperback. ISBN 0 901158 20 8.

No. 7 ROSES OF GREAT BRITAIN AND IRELAND
G. G. Graham and A. L. Primavesi. 1993. 208 pages, with descriptions and illustrations of twelve native and eight introduced species, and descriptions of 83 hybrids. Distribution maps are included of 32 native species and selected hybrids. Paperback. ISBN 0 901158 22 4.

No. 8 PONDWEEDS OF GREAT BRITAIN AND IRELAND
C. D. Preston. In preparation.

INSTRUCTIONS TO CONTRIBUTORS

Scope. Authors are invited to submit Papers and Notes concerning British and Irish vascular plants, their taxonomy, biosystematics, ecology, distribution and conservation, as well as topics of a more general or historical nature.

Manuscripts must be submitted *in duplicate*, typewritten on one side of the paper, with wide margins and double-spaced throughout.

Format should follow that used in recent issues of *Watsonia*. Underline where italics are required. Names of periodicals should be given in full, and herbaria abbreviated as in *British and Irish herbaria* (Kent & Allen 1984). The latin names and English names of plants should follow the *New Flora of the British Isles* (Stace 1991). Further details on format can be found in *B.S.B.I. News* **51**:40–42 (1989).

Tables, figure legends & appendices should be typed on separate sheets and attached at the end of the manuscript.

Figures should be drawn in black ink and identified in pencil on the back with their number and the author's name. They should be drawn no more than three times final size, bearing in mind they will normally be reduced to occupy the full width of a page. Scale-bars are essential on plant illustrations and maps. Lettering should be done with transfers or high-quality stencilling, although graph axes and other more extensive labelling are best done in pencil and left to the printer. Photographs can be accepted if they assist in the understanding of the article.

Contributors are advised to consult the editors before submission in cases of doubt. Twenty-five offprints are given free to authors of Papers and Notes; further copies may be purchased in multiples of 25 at the current price. The Society takes no responsibility for the views expressed by authors of Papers, Notes, Book Reviews or Obituaries.

Submission of manuscripts

Papers and Notes: Dr B. S. Rushton, Department of Biological and Biomedical Sciences, University of Ulster, Coleraine, Co. Londonderry, N. Ireland, BT52 1SA.

Books for Review: Dr J. R. Edmondson, Botany Department., Liverpool Museum, William Brown St, Liverpool, L3 8EN.

Plant Records: the appropriate vice-county recorder, who should then send them to C. D. Preston, Biological Records Centre, Monks Wood Experimental Station, Abbots Ripton, Huntingdon, PE17 2LS.

Back issues of Watsonia are handled by Dawson UK Limited, Cannon House, Folkestone, Kent, CT19 5EE to whom orders for all issues prior to Volume 18 part 1 should be sent.

Recent issues (Vol. 18 part 1 onwards) are available from the Hon. Treasurer of the B.S.B.I., 68 Outwoods Road, Loughborough, Leicestershire, LE11 3LY.

Watsonia

March 1994 Volume twenty Part one

Contents

Published by the Botanical Society of the British Isles

UK ISSN 0043-1532

Filmset by
WILMASET LTD, BIRKENHEAD, MERSEYSIDE
Printed in Great Britain by
EATON PRESS LIMITED, WESTFIELD ROAD, WALLASEY, MERSEYSIDE

WATSONIA

of the Botanical Society
British Isles

20 Part 2 August 1994

R. Akeroyd, J. R. Edmondson,
ill, E. C. Nelson, C. D. Preston,
hton

Botanical Society of the British Isles

Patron: Her Majesty Queen Elizabeth the Queen Mother

Applications for membership should be addressed to the Hon. General Secretary, c/o Department of Botany, The Natural History Museum, Cromwell Road, London, SW7 5BD, from whom copies of the Society's Prospectus may be obtained.

Officers for 1993-94

Elected at the Annual General Meeting, 15th May 1993

President, Dr F. H. Perring

Vice-Presidents, Mr P. S. Green, Dr G. Halliday, Mr A. C. Jermy, Mr A. O. Chater

Honorary General Secretary, Mrs M. Briggs

Honorary Treasurer, Mr M. Walpole

Editors of *Watsonia*

Papers and Notes, J. R. Edmondson, R. R. Mill, E. C. Nelson, B. S. Rushton*

Plant Records, C. D. Preston

Book Reviews, J. R. Edmondson

Obituaries, J. R. Akeroyd

*Receiving editor, to whom all MSS should be sent (see inside back cover).

Changes in the distribution of *Erica ciliaris* L. and *E.* × *watsonii* Benth. in Dorset, 1963–1987

S. B. CHAPMAN* and R. J. ROSE**

Furzebrook Research Station, Natural Environment Research Council, Institute of Terrestrial Ecology, Wareham, Dorset, BH20 5AS

ABSTRACT

The distribution in south-eastern Dorset of *Erica ciliaris* (Dorset Heath) and *E.* × *watsonii* (Ericaceae) is described. Between 1963 and 1987 the distribution of these taxa and their relative proportions within populations changed. These changes have been caused mainly by the afforestation of the area which forms the centre of the plant's distribution, and by heathland fires. Further evidence for the hypothesis that *E. ciliaris* is still spreading in Dorset is provided.

Keywords: afforestation, heathland, *Erica tetralix*.

INTRODUCTION

Erica ciliaris L. (Dorset Heath) has a 'Lusitanian' distribution, being found in Morocco, the coastal regions of Portugal, Spain and France, and locally in southern England (Fig. 1) and western Ireland. The plant is listed in the *British red data book* (Perring & Farrell 1983), and is classified as rare in Great Britain. It occurs at a single site in Ireland (Webb 1966). In southern England, *E. ciliaris* is most abundant on the heathlands of south-eastern Dorset where it was first recorded in 1848 (Mansel-Pleydell 1895). *E.* × *watsonii* is a hybrid of *E. ciliaris* and *E. tetralix* L.; backcrossing may occur as a range of variants intermediate between the two parent species are found (Gay 1957; McClintock 1971). The distribution of *E. ciliaris* has been described by a number of workers. Good (1948) commented on the static nature of the population, stating that "local geographical limits follow no obviously recognisable edaphic or climatic boundary". Gay (1957, 1960) suggested that the population was contracting as a result of introgressive hybridisation, and Chapman (1975) proposed that the pattern of distribution of *E. ciliaris* and *E.* × *watsonii* "can be explained in terms of an expanding population".

Evidence that *E. ciliaris* was increasing its range in Dorset was provided by Haskins (1978) who examined sub-fossil seed remains in peat deposits. The oldest sub-fossil seeds were found in peat from Wytch Heath, near the centre of the present distribution of *E. ciliaris*, with more recent remains at locations on the edge of the present range.

This paper examines the current distribution pattern of *E. ciliaris* and discusses changes in the relative proportions of *E.* × *watsonii* in certain populations against the background of changes in heathland in Dorset over a period of 24 years.

METHODS

THE SURVEY

The distribution of *E. ciliaris* was mapped by field surveys in 1963, 1973 and 1987. In 1963 and 1973 the boundaries of its populations were mapped and measured by planimetry. In 1973 and 1987 the

* Present address: Hope House, Winterborne Zelston, Blandford, Dorset, DT11 9EU.
** To whom correspondence should be addressed.

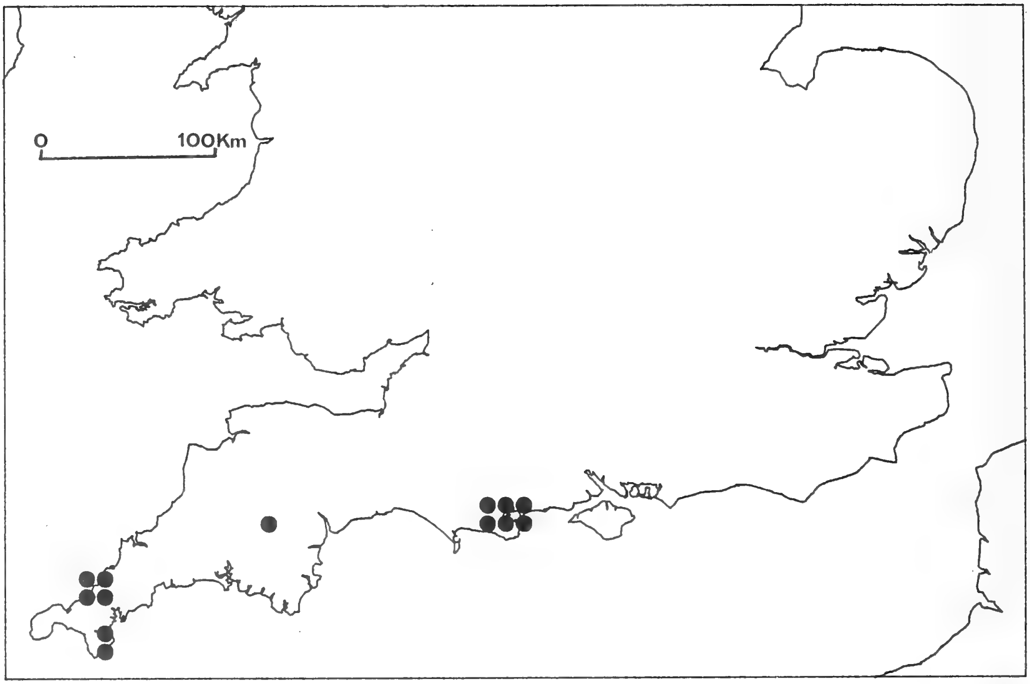


FIGURE 1. The distribution of *Erica ciliaris* in Great Britain; 10-km square records from the *Atlas of the British flora* (Perring & Walters 1962) with recent additions.

abundance of *E. ciliaris* in 200 m × 200 m grid squares was recorded. This size of sampling unit and a similar method were employed in more general surveys of heathland in Dorset (Webb & Haskins 1980; Chapman, Clarke & Webb 1989; Webb 1990). Within each grid square abundance was recorded using a four point scale of cover:

1 = present as only single or isolated plants, <1% of the grid square area.
2 = more than isolated plants, 1% to 10% of the grid square area.
3 = plants present in 10% to 50% of the grid square area.
4 = present in more than 50% of the grid square area.

Estimates of the areas of vegetation containing *E. ciliaris* have been derived using the mid-values of the scores for each grid square. For example, squares with a score of category 4, which has a mid-score value of 75%, were taken to have a mean area of 3 ha. Similarly, squares with scores of 3, 2, and 1 were assumed to have mean areas of 1·2, 0·2 and 0·02 ha respectively.

VEGETATION CLASSIFICATION

In 1973 the dominant heathland vegetation type in each square was recorded. In 1987, data relating to general heathland features such as classification of vegetation types, changes in land use and heathland fires were taken from the Dorset heathland survey databases for 1978 (Webb & Haskins 1980) and 1987 (Webb 1990). These surveys were based upon the same 200 m × 200 m recording grid used for the *E. ciliaris* surveys described in this paper.

Some populations of *E. ciliaris* situated in areas that were formerly heathland are now within conifer plantations. Data from these sites have been included in the distribution maps and analyses, but omitted from the analysis of the population composition and vegetation type.

POPULATION COMPOSITION

In the field *E.* × *watsonii* can be distinguished from its parents by its more robust growth form and the intermediate nature of the inflorescence shape. Where there was difficulty in assigning plants to

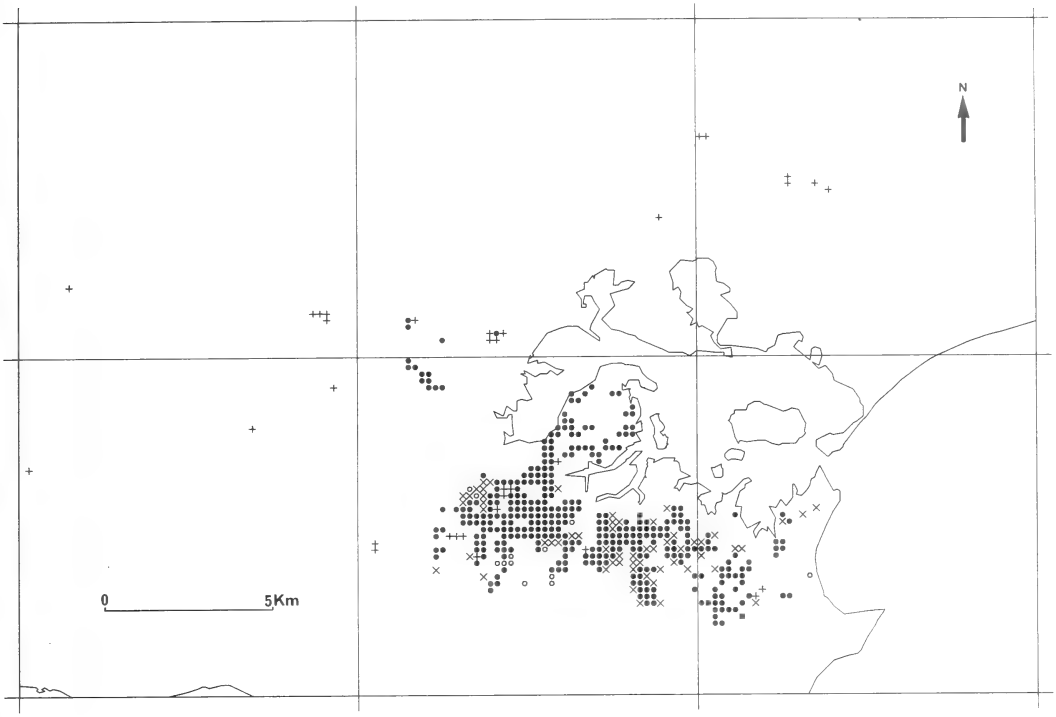


FIGURE 2. Distribution of *Erica ciliaris* populations in Dorset (10-km grid lines shown): ● indicates present 1963–1987; + new records 1973–1987; ○ sites lost 1963–1973; × sites lost 1973–1987.

a taxon the presence or length of the anther awns was examined. This character is the most reliable for separating *E. ciliaris, E. tetralix* and *E.* × *watsonii* (Chapman 1975).

In 1973 and 1987 the grid squares were classified according to the relative proportions of *E. ciliaris*, *E. tetralix* and *E.* × *watsonii* (Chapman 1975). This classification, and a simple four category version in which the population was deemed to be mixed if no one taxon dominated and pure if one of the three taxa of *Erica* accounted for more than 50% of the population.

The degree of change in population composition using the four category classification was represented by a three point scale; no change, class 1 change and class 2 change. A class 1 change was defined as a change from a pure population to a mixed population or vice versa. A class 2 change represents a change from one pure population to another pure population.

RESULTS

DISTRIBUTION AND ABUNDANCE OF *ERICA CILIARIS*

The total area in which populations occurred was measured in 1963 and 1973 by planimetry and for all three surveys using the mid-value scores for the 4 point abundance scale. The two methods were in close agreement (Table 1) with less than 5% error in the mid-score abundance value estimate. The changes in total area between 1963 and 1973 were very small; however, in the 14 years between 1973 and 1987 a reduction of 199 ha (27·7%) occurred.

The distribution of *E. ciliaris* and *E.* × *watsonii* in south-eastern Dorset is shown in Fig. 2. *E. ciliaris* populations have been recorded from 445 grid squares in the period 1963 to 1987; from 423 grid squares in 1963, 411 in 1973, and 388 in 1987 (Table 1). The loss of populations from 13 grid squares between 1963 and 1973 (all in abundance categories 1 and 2) and the discovery of only one new population (abundance category 1) resulted in little change in the overall abundance or distribution. However, between 1973 and 1987 there was a loss of *E. ciliaris* from 58 grid squares, and reductions in the numbers of category 3 and 4 squares by 26 and 32 squares respectively. The smaller losses of *E. ciliaris* during the period 1963 to 1973 were mainly due to agricultural reclamation, while the losses recorded between 1973 and 1987 were due to a wider range of activities (Table 2). Of these losses eleven were from sites that were still described as heathland; such losses, often caused by scrub invasion, are generally of small populations or isolated plants. The losses from 25 squares attributed to forestry was caused by the closure of the canopy in conifer plantations. These populations were previously recorded as existing in heathland amongst young plantation conifers.

Several of the new records in the outlying areas of heathland were the result of records obtained from observers during the period 1973 to 1987. These were small populations or even single plants that did not significantly increase the total area occupied by the plant but changed the known range (Fig. 2).

VEGETATION AND LAND USE CHANGES

In 1973 a number of populations were recorded in heathland that had been planted with conifers. By 1987, 119 grid squares, which were recorded as heathland in 1973, were classified as woodland of which 100 were conifer plantation, seven semi-natural conifer, and twelve scrub or carr. In addition to afforestation, land use change through agricultural reclamation and the construction of homes and roads also occurred. These activities either destroyed or modified the habitat, resulting in a shift in the proportions of the different habitat types. In 1973, 393 squares were recorded with both *E. ciliaris* or *E.* × *watsonii*; of these 373 (95%) were classified as predominantly humid heath, wet heath or peatland. In 1987, 383 squares were recorded, but only 183 (48%) were classified as being

TABLE 1. ESTIMATES OF THE AREAS OF VEGETATION CONTAINING *ERICA CILIARIS* AND *E.* × *WATSONII* IN DORSET IN 1963, 1973 & 1987

	1963	1973	1987
Number of squares in each area category			
Cat. 1	38	29	22
Cat. 2	167	163	205
Cat. 3	145	145	119
Cat. 4	73	74	42
Total number of squares	423	411	388
Number of new squares	–	1	35
Number of lost squares	–	13	58
Area (ha) (from mid-value scores)	427	429	310
Area (ha) (from planimetry)	419	408	–

TABLE 2. LOSSES OF *ERICA CILIARIS* FROM NUMBERS OF 200 M × 200 M GRID SQUARES IN DORSET, ACCORDING TO THE LAND USE, OR CHANGES OF LAND USE, OF THOSE GRID SQUARES, IN THE PERIODS 1963–1973 AND 1973–1987

	Period	
Land use	1963–1973	1973–1987
Heathland	1	11
Agriculture	11	21
Forestry	0	25
Other	1	1
Total	13	58
Area (ha)	+2	−119

TABLE 3. PROBABILITY VALUES OF ASSOCIATIONS BETWEEN POPULATION TYPE AND VEGETATION FROM SITES ASSESSED IN 1973, USING A 2-SIDED VERSION OF FISHER'S EXACT SIGNIFICANCE TEST

	Vegetation type			
Population type	Dry	Humid	Wet	Peatland
Erica ciliaris	0·13	0·40	0·21	1·00
Erica × *watsonii*	1·00	0·0053(−)	0·057	0·000002(+)
Erica tetralix	0·62	1·00	0·0048(+)	0·092
Mixed	1·00	0·37	0·60	0·89

humid heath, wet heath or peatland. However, those sites which have not undergone land use change remained remarkably constant between the 1973 and 1987 survey data.

POPULATION COMPOSITION

The distribution of the different population types, classified according to the proportions of *E. ciliaris*, *E. tetralix* and *E.* × *watsonii* in 1973, was presented by Chapman (1975). Several associations between vegetation type and the population composition were shown. These analyses were repeated in 1987 but no significant associations were found. This was due to the changes that took place in the afforested areas of central Purbeck; these reduced the number of populations and make it impossible to make comparisons or reassessments of grid squares where a part of the original habitat had been lost.

Using the simplified classification of populations, the same 1973 data were re-examined using a 2-sided version of Fisher's exact significance test. Significant associations were found between *E.* × *watsonii* populations and humid heathland and peatland (Table 3).

When this analysis was repeated for the 1987 data no significant associations were found. This was due to fewer squares being classified as *E.* × *watsonii*. Thus changes in population composition between years, in different vegetation types, could not be analyzed. However, no significant differences in the proportion of change of population composition in humid heath, wet heath and peatland were found.

Having established that changes in population composition were not related to vegetation type, the data were examined for changes after fire. Using the 1978 heathland survey data to identify areas that had been burnt in 1974–1977, a significant association between burnt sites and change towards *E.* × *watsonii* populations ($p<0.001$, Fisher's exact test) was found (see Fig. 3).

In Fig. 3, in addition to the association with fire, it can be seen that a line of six grid squares (arrowed) show two class changes in an unburnt area; these six squares are roadside sites and the changes are probably due to increased management (mowing) of the road verge between 1973 and 1987.

DISCUSSION

Since the survey in 1973, isolated or small populations of *E. ciliaris* have been recorded from several locations outside the centre of distribution. The history of origin of these populations is uncertain. Some sites are near houses or under power lines and may have been introduced by human activity. Whether any introduction has been made intentionally is not known. However, these isolated sites should be monitored closely as their performance and survival should provide data to test the hypothesis that *E. ciliaris* may still be establishing and colonising suitable habitats in south-east Dorset.

The reduction in the number of *E. ciliaris* sites between 1973 and 1987 was not the result of additional afforestation during this period, but due to the closure of the canopy of existing plantations. Such losses indicate that the potential for future loss remains as plantations mature even if further afforestation of heathland is prevented.

Apart from the loss of populations of *E. ciliaris*, the continuing fragmentation and increased

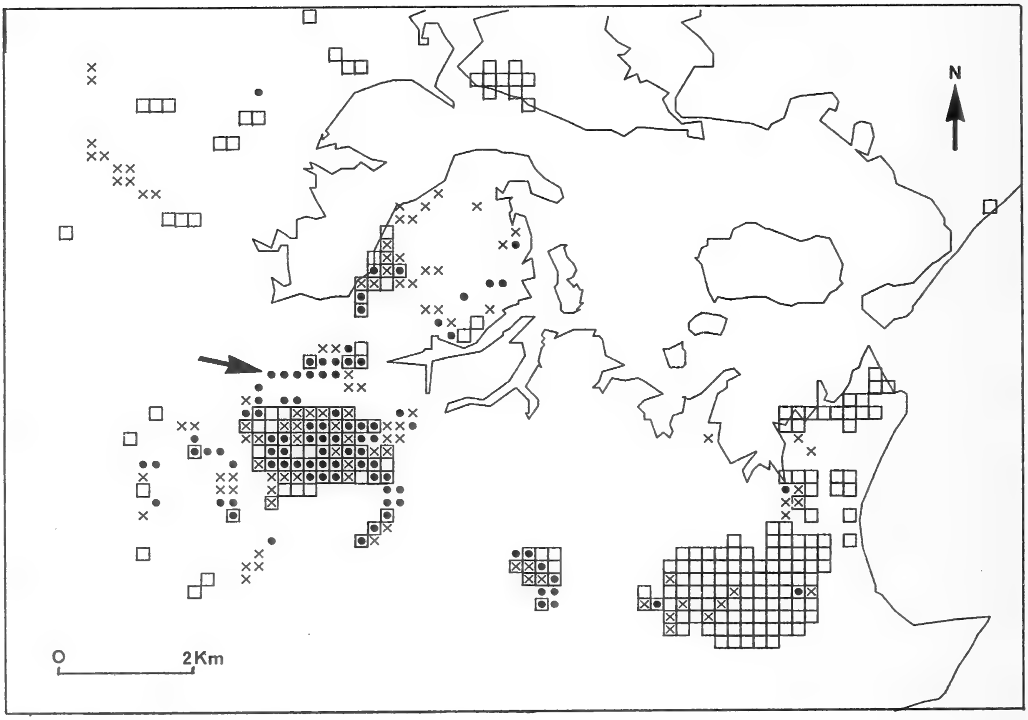


FIGURE 3. Change in population composition of *Erica ciliaris* sites in relation to heathland fires during the period 1973 to 1987 in south-eastern Dorset: ● site with a changed hybrid status, unchanged sites are marked ×; burnt areas are shown □.

isolation of the remaining heathlands (Chapman *et al.* 1989) is likely to have an important effect on future spread, and on colonisation, of suitable sites. Colonisation and establishment of fragmented or isolated areas will be more dependent on chance introductions than natural dispersal.

The results obtained by Chapman (1975) showed a number of significant associations between particular population types and the dominant vegetation types present in the 200 m × 200 m grid squares. However, within a period of 14 years the loss of sites and changes due to afforestation have produced a situation where the examination of data and the testing of a hypothesis relating particular types of population and habitat are no longer possible. Such a situation demonstrates the need for detailed recording of information regarding less common species especially where they are subject to loss of habitat or changes in land use.

Mowing and burning appeared to promote the establishment of *E.* × *watsonii*, whereas more severe disturbance, such as ploughing on Soussons Down in Devon, and in the Purbeck Forest, encouraged the establishment of *E. ciliaris* and *E. tetralix*. This may be related to the more vigorous vegetative regrowth of *E.* × *watsonii* after mowing or burning, and regrowth of *E. ciliaris* and *E. tetralix* from seed following ploughing.

In Dorset, *E. ciliaris* occurs in areas of peat and wet heathland and does less well in drier heathland communities. However, in Cornwall and elsewhere in Europe the plant favours dry heathland. More comparative work is needed on the requirements and behaviour of the plant under different edaphic and climatic conditions.

Although *E. ciliaris* may be expanding its range in Dorset, concern must be expressed about the decline in the area the plant occupies. While there was little change in the distribution of *E. ciliaris* between 1963 and 1973, there was a marked loss of populations in the period 1973 to 1987. Furthermore many of the populations that have been lost were predominantly *E.* × *watsonii*. The fragmentation of the heaths and changes in population composition make it difficult to predict the natural spread of the plant over its potential range in south-eastern Dorset.

ACKNOWLEDGMENTS

We thank English Nature and the individual landowners who have allowed access to their property over the period of this study. Thanks are also due to Dr L. E. Haskins for site records and permission to quote from her Ph.D. thesis, and BP Petroleum Development Ltd for funding of a survey, the results of which provided the impetus for the remaining survey that was completed in 1987.

REFERENCES

Chapman, S. B. (1975). The distribution and composition of hybrid populations of *Erica ciliaris* L. and *Erica tetralix* L. in Dorset. *Journal of ecology* **63**: 809–824.

Chapman, S. B., Clarke, R. T. & Webb, N. R. (1989). The survey and assessment of heathland in Dorset, England, for conservation. *Biological conservation* **47**: 137–152.

Gay, P. A. (1957). *Aspects of the phytogeography of some Lusitanian Ericaceae in the British Isles*. Unpublished Ph.D. thesis, University of London.

Gay, P. A. (1960). A new method for the comparison of populations that contain hybrids. *New phytologist* **59**: 218–226.

Good, R. (1948). *A geographical handbook of the Dorset flora.* Dorchester, Dorset Natural History and Archaeological Society.

Haskins, L. E. (1978). *The vegetation history of south-east Dorset.* Unpublished Ph.D. thesis, University of Southampton.

Mansel-Pleydell, J. C. (1895). *The Flora of Dorsetshire*, 2nd ed. Dorchester.

McClintock, D. (1971). Recent developments in the knowledge of European Ericas. *Botanische Jahrbücher* **90**: 509–523.

Perring, F. H. & Farrell, L. (1983). *British red data book 1, Vascular plants,* 2nd ed. Nettleham.

Perring, F. H. & Walters, S. M. eds. (1962). *Atlas of the British flora.* London.

Webb, D. A. (1966). *Erica ciliaris* L. in Ireland. *Proceedings of the Botanical Society of the British Isles* **6**: 221–225.

Webb, N. R. (1990). Changes on the heathlands of Dorset, England, between 1978 and 1987. *Biological conservation* **51**: 273–286.

Webb, N. R. & Haskins, L. E. (1980). An ecological survey of heathlands in the Poole basin, Dorset, England, in 1978. *Biological conservation* **17**: 281–96.

(*Accepted October 1993*)

A comparison of the growth and morphology of native and commercially obtained continental European *Crataegus monogyna* Jacq. (Hawthorn) at an upland site

A. T. JONES and P. R. EVANS

A.F.R.C. Institute of Grassland and Environmental Research, Plas Gogerddan, Aberystwyth, Dyfed, SY23 3EB

ABSTRACT

1. The growth and morphology of native *Crataegus monogyna* Jacq. (Rosaceae) obtained from an upland population in mid-Wales was compared with that of commercially obtained material of Hungarian provenance in an upland trial.
2. Six months after planting, the native plants were 35% taller, 70% more branched and had twice the total stem length and four times as many thorns per thorny plant than the commercial material. 91% of native plants were thorny compared with only 20% of commercial plants. Commercial plants had larger leaves, longer petioles and a greater severity of powdery mildew attack than the natives.
3. It was possible, using vegetative characters, to separate 88% of the natives from 80% of the commercial plants on the basis of their growth and morphology using discriminant analysis. Native seed was significantly smaller in size than the commercial seed which suggests that the measurement of reproductive characters would allow further discrimination between the two groups.

KEYWORDS: invasive species, amenity plantings, alien species, hedges.

INTRODUCTION

Crataegus monogyna Jacq. (Hawthorn) is the most commonly planted shrub species in new hedges and in the repair of derelict hedges in Britain (Brooks 1980). For the purposes of hedge-planting, whips are bought from nurseries where they are propagated from seed. There is circumstantial evidence that for commercial purposes seed has been obtained in many cases and from at least the early 1970s from the continent and especially eastern Europe (Dunball 1982). This is motivated by costs as foreign seed is often less than half the price of British collected seed.

Continental *C. monogyna* (henceforth referred to as alien) is a common constituent of hedges which have been planted along new roads and motorways and following recent road-widening operations. It can be identified by its habit of early bud-burst, often in early February when it contrasts with the unopened buds of native *C. monogyna* in neighbouring old hedges. This may indicate a phenology in the aliens which is poorly adapted to the British oceanic climate with its mild winters and a lack of rapid and reliable temperature increases more typical of spring in a continental climate. *C. monogyna* as a species has low bud dormancy (Murray *et al.* 1989) and is responsive to spring temperature increases. It is possible that natives have a higher dormancy than the aliens.

There is prima facie evidence that the use of alien *C. monogyna* material is inappropriate in British upland or exposed sites as it shows poor growth, is swamped by grasses and is susceptible to dieback both by wind scorching and powdery mildew. In contrast, it may be expected that native upland populations of *C. monogyna* would have a high degree of adaptation to exposure, poor soils and possibly grazing. A comparison of the growth and morphology of native and continental material at a worst-scenario upland site might identify whether locally obtained material is more suitable for upland planting than continental material.

MATERIALS AND METHODS

In November 1989, seed collections were made from a hawthorn population in mid-Wales that is unlikely to have been planted in recent decades because of its remote location, natural appearance and great age. This population forms a woodland scrub at an altitude of 350 m on the southern side of Cader Idris (SH/746.713), the second highest mountain in mid-Wales. The site is extremely exposed, as the valley runs to the coast in a south-westerly direction, the most frequent wind direction. Near the population the valley narrows and wind is funnelled through a pass to the east. Part of the population covers large block scree derived from a neighbouring cliff, which may have given some protection from grazing. The hawthorn trees at the site differ in size and probably age, some of the multi-stemmed trees appearing very old. Good *et al.* (1990) working in upland North Wales found the age of single-stemmed hawthorn bushes to be from ten to 115 years and also found suckering in some individuals. The trees at the mid-Wales site would be expected from their size to be at least as old as the oldest at the former site although suckering was not apparent.

Native seed was cleaned of fleshy covering by fermenting in water at room temperature. It was then placed in seed-trays at a depth of 1 cm in a 50:50 mixture of grit and compost outdoors. Alien seed that had been chitted (treated with concentrated sulphuric acid for 30 minutes, thoroughly rinsed in water and then mixed with compost and kept in polythene bags at 5°C for three months in order to break dormancy) was obtained from Forestart Ltd, Hadnall, Gloucester, who stated that it was of Hungarian provenance.

Samples of clean native seed ($n = 121$) and chitted alien seed ($n = 25$) were measured for length and width with calipers. Following germination in March 1991, seedlings were pricked out into individual cells of compartment seed trays. In July the plants were potted into 9 cm diameter pots containing John Innes compost no. 2. In March 1992 the material was planted at an exposed site at Pwllpeiran Experimental Husbandry Farm at an altitude of 330 m in well-drained soil. The site was on a small level area on a steep (30°) south-facing slope.

A total of 192 plants, comprising 63 aliens and 129 natives, were planted at a spacing of 0.5 m between seedlings in a rectangular plot of cultivated ground measuring 7 m by 10.5 m. In order to minimise the effect of environmental variation on the inter-group comparison, the plot was divided into four blocks within each of which 15–16 alien seedlings and 32–33 native seedlings were planted in completely random order. Seedlings were planted through a landscape fabric mulch (Tensar) which suppresses weeds but is permeable to rain.

Measurements of morphology, growth and powdery mildew score (Table 1) were made after shoot extension had finished in August 1992. The mildew infecting the plants is hawthorn powdery mildew (*Podosphaera clandestina* Lev.), a common disease causing dieback of the growing points which can reach epidemic status (Khairi & Preece 1978).

TABLE 1. MORPHOLOGICAL CHARACTERS, GROWTH AND DISEASE OF *CRATAEGUS MONOGYNA* SEEDLINGS STUDIED
(all measurements were made to the nearest mm)

1. Height
2. No. of branches
3. Total branch length including main stem
4. Stem diameter (single measurement at base)
5. Petiole length (mean of three petioles)
6. Leaf width (mean of three leaves)
7. Leaf length (mean of three leaves)
8. Bract length (mean of three bracts which are situated at the base of the petiole)
9. Total no. of thorns
10. Mildew incidence score:
    1) no disease,
    2) < three mature leaves with infection (silver and/or red blotches),
    3) mature leaves with or without infection and with at least two immature leaves and stem apex infected,
    4) as 3 above but with some length (> 1 cm) of stem affected.

N.B. Characters 5, 6, 7 and 8 above were sampled on the main stem at as near as possible to half-plant height.

Data were analysed using the multivariate statistical technique, discriminant analysis (DA) available in the Genstat statistical package (Genstat 5 Committee 1987; Digby 1989). DA is a statistical technique based on canonical variate analysis (Mardia *et al.* 1979) and finds the best linear combination of variables that discriminate between prior groupings. The resulting discriminant function has the greatest variable between-group variation relative to within-group variation. DA can be used to examine the validity of an a priori classification or to allocate new members to an existing classification. DA has been used in taxonomy, particularly at the intraspecific level, e.g. to examine the taxonomic groupings within *Hordeum vulgare* L. (Baum & Bailey 1983) and hybridisation between native and alien cultivar forms of *Lotus corniculatus* L. (Bonnemaison & Jones 1986). Using DA it is possible to determine how morphologically distinct the native and alien hawthorn groups are from each other. The analysis also determines which characters make major contributions to any discrimination between the two groups.

RESULTS

Alien seed was significantly larger (ANOVA, $p \leq 0.001$) than native seed with mean dimensions for width 5·0 mm and length of 6·4 mm compared with 4·4 mm and 5·5 mm for native seed. There was no significant difference in the shape of seeds (ratio of length to width) between the two groups.

The native and alien groups exhibited different morphology and growth characteristics (Table 2) at the upland site. The native plants showed overall greater growth than the alien plants. Native plants were on average 35% taller, had twice the total stem length and 70% more branches than the alien plants. Mean stem diameter was also greater in native plants. The alien plants had larger leaves and longer petioles than the native plants but bract size was similar in both groups.

Of the native plants, 91% were thorny compared with only 20% of alien plants. Native plants also had a greater number of thorns per thorny plant so that mean thorn density per unit length of stem was approximately three times greater than in the aliens. The mean powdery mildew score for the aliens indicates a higher incidence of disease of the stem apex than the natives.

Some morphological characters were highly and significantly positively correlated (Table 3): leaf width with leaf length (indicating a uniform leaf outline shape), leaf width with petiole length, and leaf length with petiole length. Some growth characters were also significantly and positively correlated: stem diameter and total stem length, stem diameter and branch number, and branch number and total stem length. The regular spacing of thorns, where they occurred, was indicated by the high correlation of thorn number per plant with total stem length. Powdery mildew score was significantly positively correlated with petiole length.

In the discriminant analysis the natives and aliens were introduced as separate groups. This

TABLE 2. MEAN VALUES AND THEIR STANDARD DEVIATIONS FOR MORPHOLOGICAL CHARACTERS AND GROWTH PARAMETERS OF NATIVE (N = 129) AND ALIEN (N = 63) MATERIAL OF *CRATAEGUS MONOGYNA*
(all measurements in mm)

	Native		Alien	
	mean	s.d.	mean	s.d.
Height	107·0	37·5	79·3	34·0
No. of branches	3·1	1·7	1·8	1·4
Total stem length	235·6	134·7	129·8	84·0
Stem diameter	4·2	1·4	3·6	1·5
Petiole length	4·3	1·7	6·3	3·1
Leaf width	12·7	3·5	15·3	5·1
Leaf length	15·4	3·9	19·5	6·7
Bract length	3·4	1·3	3·5	1·8
No. of thorns	10·6	13·1	0·6	1·5
Thorn number +	12·4	13·3	3·0	1·8
Mildew score	1·5	0·8	2·0	1·1

N.B. Thorn number + indicates the mean of only the thorny plants; s.d. = standard deviation.

TABLE 3. CORRELATION COEFFICIENTS BETWEEN VEGETATIVE CHARACTERS OF *CRATAEGUS MONOGYNA*

	ht	n.b.	s.d.	p.l.	l.w.	l.l.	b.l.	n.t.	m.s.
Height (ht)									
No. of branches (n.b.)	0·377 ***								
Stem diameter (s.d.)	0·416 ***	0·381 ***							
Petiole length (p.l.)	0·139	0·003	0·168						
Leaf width (l.w.)	0·135	0·067	0·275 **	0·706 ***					
Leaf length (l.l.)	0·132	0·068	0·218 *	0·719 ***	0·893 ***				
Bract length (b.l.)	0·306 **	0·147	0·264 **	0·386 ***	0·485 ***	0·445 ***			
No. of thorns (n.t.)	0·312 **	0·425 ***	0·387 ***	−0·162	−0·037	−0·074	0·071		
Mildew score (m.s.)	0·083	−0·004	−0·182	0·194 *	0·113	0·186	0·017	−0·075	
Total stem length	0·609 ***	0·656 ***	0·522 ***	0·015	0·148	0·129	0·233 *	0·819 ***	0·001

N.B. significance levels for the correlations coefficients are as follows: * = $p \leq 0.05$; ** = $p \leq 0.01$; *** = $p \leq 0.001$.

analysis reclassified 88% of the natives into the initial native group and 80% of the alien plants into the initial alien group. The natives and aliens are, therefore, reasonably distinct in terms of their growth and morphological characteristics, but there was an overall 15% overlap of the two groups (Fig. 1), i.e. 12% of the natives and 20% of the aliens were classified incorrectly. Some of this overlap might have been due to the effect of the harsh environment on growth and establishment. Most of the alien plants classified by the analysis as natives had small leaves and short petioles compared with those classified correctly as alien plants.

Those characters which are positively correlated with the discriminant function (Table 4), i.e. high values correlated with the native group are, in decreasing order of importance, number of thorns per plant, total stem length and branch number per plant. Characters that are negatively correlated with the discriminant function, i.e. high values correlated with the alien group are, in decreasing order of importance petiole length, leaf width, leaf length and mildew score.

DISCUSSION

In this study, the native *Crataegus monogyna* plants were discriminated from the aliens on the basis of higher stem length, a higher number of branches, higher thorn number and lower powdery mildew score. It would be expected that the relatively high mildew score and low growth rates in the aliens would be associated with low establishment rates following hedge-planting. If sufficient growth is not made, especially as a result of dieback due to mildew, then there is often the danger of planted hawthorn quickly becoming overgrown and shaded by grasses in a fenced situation.

The above would suggest that the natives are more suited to hedge-planting in upland situations than the alien material and because of their thorniness combined with a bushy habit, they may also be more grazing tolerant where fencing is insufficient to provide protection from grazing animals. The natives have smaller leaves and shorter petioles than the aliens and thus at nodes where thorns are present there is less unguarded leaf to graze. Certainly, from the degree of variation present in the natives, it would be possible to select for bushy, fast-growing, thorny plants, e.g. a plant which had shown the most growth in the experiment also had 109 thorns at a density of one thorn every 9 mm of stem. From the significant differences in seed size of the two groups, the gathering of

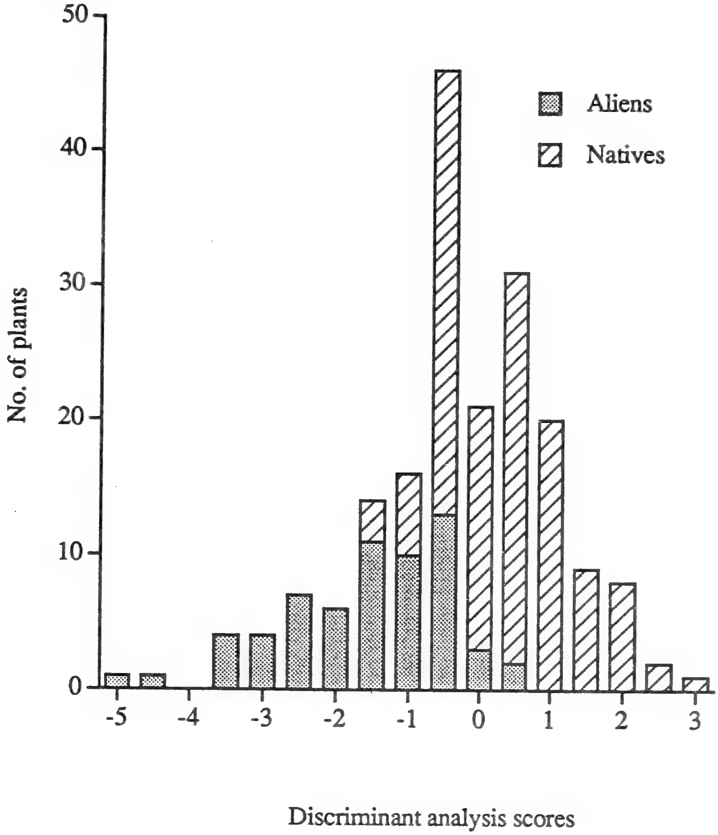


FIGURE 1. Bar chart of discriminant analysis scores for alien and native groups of *Crataegus monogyna*.

TABLE 4. CORRELATION BETWEEN DISCRIMINANT FUNCTION SCORES AND CHARACTER SCORES FOR *CRATAEGUS MONOGYNA*

Character	Correlation coefficient	Probability
No. of thorns	0·594	***
Total stem length	0·560	***
No. of branches	0·535	***
Height	0·494	***
Stem diameter	0·269	**
Petiole length	−0·582	***
Leaf length	−0·541	***
Leaf width	−0·440	***
Mildew score	−0·362	***
Bract length	−0·083	

N.B. Significance levels for correlation coefficients are as follows: ** = $p \leq 0.01$; *** = $p \leq 0.001$.

reproductive data may enable a further separation of the native and alien material on morphological grounds.

The escape and spread of exotic plant species following their movement by man across geographical boundaries is a potential danger to many endemic vegetation types (Salisbury 1961). Examples include the South American *Lantana montevidensis* (K. Spreng.) Briq. which is invading natural vegetation across the tropics (Ridley 1930) and *Rhododendron ponticum* L. from Turkey which is infiltrating oak woodland in the British Isles (Cross 1974). A much more insidious threat is the spread of material which is of alien provenance though conspecific with or closely related to an indigenous species and thus able to hybridise and potentially introgress. The planting of alien *Crataegus monogyna* represents such a threat. Across Europe there are six recognised subspecies of *C. monogyna* (do Amaral Franco 1968) and 22 species within the genus, at least four of which commonly hybridise with *C. monogyna*. A hybrid of *C. monogyna* and *C. laevigata* (Poiret) DC. (Midland Hawthorn) which naturally occurs in the south of England, *Crataegus* × *media* (Bradshaw 1971) and which may occur in imported seed, would probably be unsuitable for hedge planting. *C. laevigata* is typically an understorey species of lowland woodland and would be expected to be intolerant of exposed sites. There is always the possibility that importations of seed may contain alien subspecies, hybrids and even other species of the *Crataegus* genus which are then sold as common Hawthorn.

The natives sampled in this trial may represent an extreme locally adapted ecotype of *Crataegus monogyna* subsp. *nordica* franco (do Amaral Franco 1968) but the taxonomy of this species has yet to be completely resolved. However, as alien material continues to be planted in hedges from where it is highly likely that bird dispersal will take place, further taxonomic investigation of the British forms will be difficult to progress.

At upland sites in the British Isles, it can be argued that native *C. monogyna* should be planted for two reasons, namely that it has a higher growth performance than the aliens and also that it is more appropriate for conservation purposes to use native provenances as these represent a component of local biodiversity. Grant awarding bodies should ensure that in hedge-planting, British provenance is used at the very least.

ACKNOWLEDGMENTS

We would like to thank the Ministry of Agriculture, Fisheries and Food for funding this work as part of a 3-year open contract and Dr Roger Haggar for his advice. We also acknowledge the help of John Wildig at Pwllpeiran Experimental Husbandry Farm and Derek Jones (Institute of Grassland and Environmental Research) in providing assistance with the selection and maintenance of a suitable experimental site.

REFERENCES

Baum, B. R. & Bailey, L. G. (1983). Morphometric relationships in *Hordeum vulgare* (Triticeae, Poaceae). I. *H. spontaneum*. *Canadian journal of botany* **61**: 2015–2022.

Bonnemaison, F. & Jones, D. A. (1986). Variation in alien *Lotus corniculatus* L. 1. Morphological differences between alien and native British plants. *Heredity* **56**: 129–138.

Bradshaw, A. D. (1971). The significance of hawthorns, in *Hedges and local history*, pp. 20–29. Standing conference for local history. National Council of Social Service, London.

Brooks, A. (1980). *Hedging: a practical handbook*. British Trust for Conservation Volunteers, Berkshire.

Cross, J. R. (1974). *Rhododendron ponticum* L., in Biological Flora of the British Isles. *Journal of ecology* **63**: 345–364.

Digby, P. G. N. (1989). Procedure Discriminate, in Payne, R. W., Lane, P. W., Ainsley, A. E., Bicknell, K. E., Digby, P. G. N., Harding, S. A., Leech, P. K., Simpson, H. R., Todd, A. D., Verrier, P. J. & White, R. P. eds. *Genstat procedure library manual. Release 1.3(2)*. Lawes Agricultural Trust, Oxford.

do Amaral Franco, J. (1968). *Crataegus* L., in Tutin, T. G. *et al.*, eds. *Flora Europaea* **2**: 73–77. Cambridge.

Dunball, A. P. (1982). The management and planting of motorway verges, in Perring, F. H. ed. *The flora of a changing Britain*, pp. 84–89. London.

Genstat 5 Committee (1987). *Genstat 5 reference manual*. Oxford.

Good, J. E. G., Bryant, R. & Carlill, P. (1990). Distribution, longevity and survival of upland hawthorn (*Crataegus monogyna*) scrub in North Wales in relation to sheep grazing. *Journal of applied ecology* **27**: 272–283.

Khairi, S. M. & Preece, T. F. (1978). Hawthorn powdery mildew: occurrence, survival and ascospore productivity of *Podosphaera clandestina* cleistotheca in England. *Transactions of the British Mycological Society* **71**: 289–293.

Mardia, K. V., Kent, J. T. & Bibby, J. M. (1979). *Multivariate analysis*. New York.

Murray, M. B., Cannel, M. G. R. & Smith, R. I. (1989). Date of budburst of fifteen tree species in Britain following climatic warming. *Journal of applied ecology* **26**: 693–700.

Ridley, H. N. (1930). *The dispersal of plants throughout the world*. Ashford, Kent.

Salisbury, E. (1961). *Weeds and aliens*. Collins New Naturalist, London.

(*Accepted September 1993*)

Bracken (*Pteridium aquilinum* (L.) Kuhn) infestation of rough grazing land in the catchment of the River Tyne, northern England

A. J. CHERRILL* and A. M. LANE†

Centre for Land Use and Water Resources, Department of Agricultural and Environmental Science, University of Newcastle-upon-Tyne, Newcastle-upon-Tyne, NE1 7RU

ABSTRACT

The distribution of bracken (*Pteridium aquilinum* (L.) Kuhn)within the catchment of the River Tyne, Northern England, was surveyed in the field by stratifying sampling effort within land classes of a national environmental landscape classification developed by the Institute of Terrestrial Ecology (I.T.E.). A total of 182 1-km squares were surveyed in 1991 (equivalent to 6.3% of the catchment). The areas of bracken and rough grazing land differed significantly between land classes. Bracken was estimated to cover 0·7% of the total land surface, and 1·9% of rough grazing land, within the catchment. The results are compared with those of previous surveys of bracken, and it is concluded that a standard survey method is needed if such comparisons are to be statistically reliable. It is proposed that the I.T.E. land classes offer a suitable framework for the organisation of future surveys.

KEYWORDS: ferns, agricultural weed, survey, landscape classification.

INTRODUCTION

Bracken, *Pteridium aquilinum* (L.) Kuhn (Dennstaedtiaceae), is generally regarded as a serious weed of agriculturally marginal land throughout Britain (Smith & Taylor 1986; Taylor 1990). It is an invasive species which thrives in a wide range of habitats (Grime *et al.* 1988). Worldwide it is said to be the most widespread of all vascular plant species (Page 1982). The success of bracken lies in its ability to withstand grazing, burning and chemical control measures through survival of its rhizomes, and the ability of its spores to colonise readily disturbed habitats (Page 1976, 1982; Kirkwood & Archibald 1986; Dyer 1990; Marrs *et al.* 1993; Pakeman & Marrs 1992).

Dense stands of bracken reduce the area of forage available for livestock. Its fronds are poisonous to sheep and cattle (Evans *et al.* 1982; MacLeod 1982; Miller *et al.* 1990). Stands can also act as a reservoir for disease-carrying sheep ticks. They make it difficult to herd and monitor the condition of a flock. Similar problems occur on grouse moors where heather can be replaced by bracken (Hudson 1986). Bracken may also be a source of carcinogens in supplies of water and milk destined for human consumption (Taylor 1990).

The present paper describes the results of a sample-based field survey of the distribution of bracken and other land cover types within the catchment of the River Tyne in northern England, an area of almost 3,000 km^2. An approach used in previous surveys of land cover has been to stratify sampling efforts within zones (or strata) which are perceived to be relatively homogeneous in terms of the variables to be recorded (e.g. Bunce *et al.* 1975). Extrapolation of the results from such sample based surveys requires that the distribution of the sampling strata are well-defined (Cochran 1977). A number of studies have shown that the objective definition of strata can be achieved via

* Corresponding author.
† Present address: Institute of Terrestrial Ecology, Merlewood Research Station, Cumbria, LA11 6JU.

numerical classification of physical attribute data derived from extant thematic databases, including Ordnance Survey (O.S.), soil, geological and meteorological maps (Bunce *et al.* 1981a; Blankson & Green 1991; Cooper & Murray 1992). Numerical classification techniques have included both agglomerative clustering (e.g. Blankson & Green 1991) and divisive indicator species analysis methods (e.g. Hill *et al.* 1975), but their applications have had the common aim of categorising grid squares into a number of groups. Squares which fall into each group are similar in terms of their measured physical attributes, but different from the squares in other groups. These groups of squares are termed 'land classes'.

The land classification used in the stratification of sampling effort in the present study was that developed by the Institute of Terrestrial Ecology (I.T.E.) (Bunce *et al.* 1981a, 1983). This classification was selected because it has a resolution of 1 km (a suitable areal unit for field survey) and because all 1-km squares within Britain have been assigned to one of 32 land classes. This second feature enables the results of the survey to be placed in a national context (Bunce *et al.* 1981a).

A total of 182 1-km squares, stratified by I.T.E. land classes, were visited in 1991 and areas of bracken were mapped at a scale of 1:10,000. This paper describes the distribution of bracken between land classes, and provides an estimate of the degree of infestation of rough grazing in the catchment.

THE I.T.E. LANDSCAPE CLASSIFICATION

The I.T.E. land classification uses the 1-km cells of the O.S. national grid as its spatial unit. Grid squares are grouped into 32 land classes on the basis of a wide range of map attribute data. The development of the classification was in two phases (Bunce *et al.* 1981a, 1991).

Initially, the land classes were identified from a classification of a nationally distributed sample of 1,228 1-km squares, each of which was situated at the intersection of a national 15 km × 15 km grid. For each sample square, 282 attributes were recorded from existing maps. The attributes included environmental variables (such as altitude, slope, geology, drift and climate), semi-natural land cover features (such woodlands and lakes) and anthropogenic features (such as roads and buildings). The sources of these data included 1:50,000 O.S. maps, 1:1,000,000 climatological maps and geological maps. On the basis of these data, the sample squares were classified using Indicator Species Analysis (I.S.A.) (Hill *et al.* 1975). The method is a divisive polythetic method of numerical classification which produces a hierarchical, dichotomous key. At each division in the key, 'indicator species' are identified. This feature enabled grid squares not included in the original I.S.A. classification procedure to be allocated to a land class on the basis of their attributes. Descriptions of the 32 land classes are provided by Bunce *et al.* (1981a) and Benefield & Bunce (1982).

The second phase of development in the I.T.E. land classification system was the assignment of all 230,000 grid squares in Britain to the 32 land classes. In theory this could have simply involved use of the extant key derived from the Indicator Species Analysis. Collation of the necessary 'indicator species' data for every one of the grid squares in Britain, however, was logistically impractical. A reduced set of some 60 attributes was more readily available for all grid squares. These attributes came under eight broad headings; physiography, coastal features, climate, geology, geological drift, land cover/use, offshore island status and distance from coast. These data were used to create a new classification of squares. Correspondence between the two classifications was assessed by comparing the 'new' and 'old' land classes of the original sample of 1,228 grid squares. A range of numerical classifications were tested. That giving the closest agreement between the 'new' and the 'old' land classes involved application of both multivariate discriminant analysis and logistic regression algorithms (Bunce *et al.* 1991). This hybrid approach was therefore used to assign all 230,000 grid squares in Britain to one of 32 land classes.

The hierarchical nature of the I.T.E. land classification allows land classes to be aggregated into broad landscape types. In the present study, the land classes are categorised under three types of landscape, namely: Lowland, Marginal Upland and Upland (after Bunce 1992).

FIGURE 1. The location of the catchment of the River Tyne (shaded).

THE STUDY AREA

The study area was the catchment of the River Tyne in northern England (Fig. 1). The boundary of the catchment was supplied by the Institute of Hydrology (Wallingford). It enclosed an area of 2,903 km^2, comprising 16 I.T.E. land classes. The distributions of the I.T.E. land classes within the catchment were provided by the Institute of Terrestrial Ecology (Merlewood) and are shown in Fig. 2. The composition of the catchment in terms of the proportions of I.T.E. land classes is shown in Table 1. In addition, the table shows the mean altitudes and main land forms within each I.T.E. land class. In the west the catchment is characterised by two upland blocks, separated by the River Tyne-River Solway gap. In the east, lowland landscapes predominate.

METHODS

SELECTION OF GRID SQUARES FOR FIELD SURVEY

The field survey was intended to obtain land cover data from a representative sample of the grid squares within the catchment. There were insufficient resources to survey a representative sample of all 16 land classes in a single summer. The five least frequent land classes, which together represented 0·3% of the total area of the catchment (Table 1), were therefore omitted. In total, 182 squares were selected for survey.

Sample squares were selected from each of the eleven most frequent I.T.E. land classes in approximate proportion to their total areas within the catchment (Table 1). Selection of squares from within ten of these land classes was at random. Within the most frequent I.T.E. land class (i.e. land class 22), however, sampling was further stratified. Equal numbers of squares of land class 22 were selected at random from within each of the upland blocks north and south of O.S. Northing

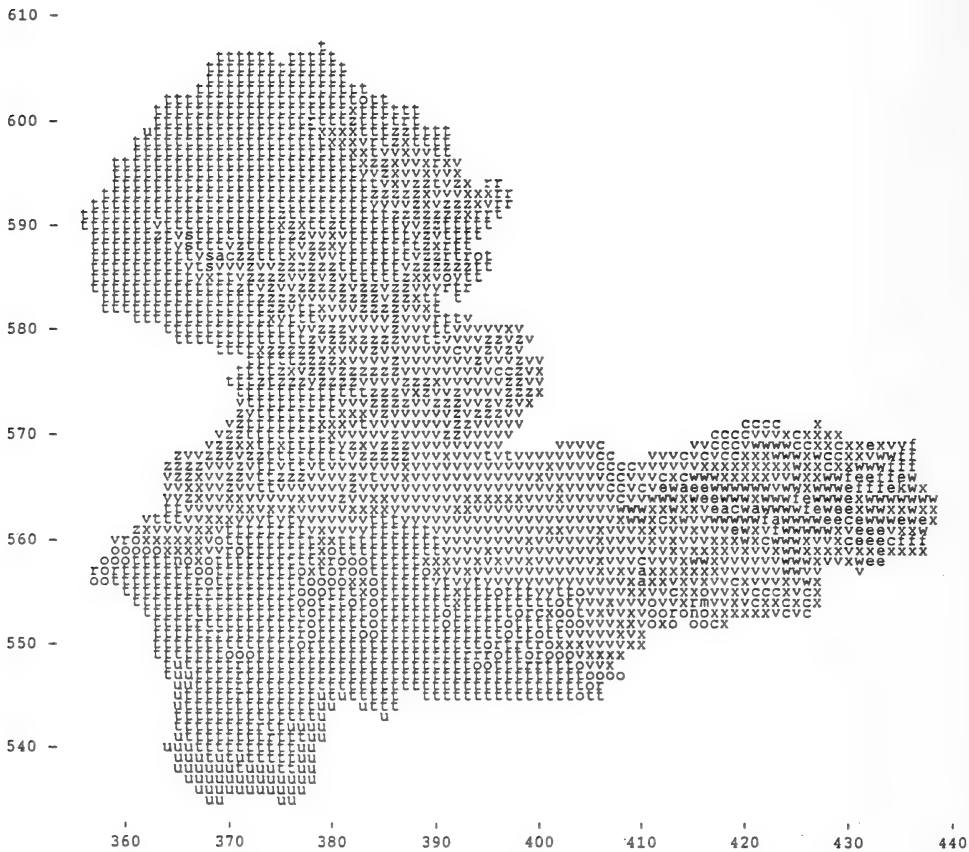


FIGURE 2. The distribution of I.T.E. land classes within the River Tyne catchment: land class 9 – a, 10 – c, 13 – e, 14 – f, 15 – k, 17 – m, 18 – n, 19 – o, 20 – r, 21 – s, 22 – t, 23 – u, 25 – v, 26 – w, 27 – x, 28 – z. Figures at margins are Ordnance Survey coordinates.

564000 (Fig. 2). This was done to allow a more detailed analysis of geographical variation in land cover within I.T.E. land class 22, which represents 43·2% of the total area of the catchment.

FIELD SURVEY METHODS

Field work was undertaken between mid-April and October 1991. Each of the survey squares was visited and the areas of the land cover types defined by the Nature Conservancy Council (N.C.C. 1990) were mapped on to 1:10,000 O.S. maps. Only 20 ha out of the total survey area of 18,200 ha remained unsurveyed due to problems of access. Bracken was mapped as a distinct land cover type where its canopy extended over greater than 25% of the land surface. Dense stands were readily delineated, while the mapping of sparse bracken was more subjective.

PROCESSING AND ANALYSIS OF FIELD DATA

The 182 field survey maps were digitised using the Geographical Information System (G.I.S.) ARC/INFO. The total areas of each of the land cover types within each of the survey squares were calculated from this digital database. The areas of rough grazing were calculated by aggregating the areas of the following cover types: heath, bog, moorland, unimproved grassland and land dominated by bracken. Certain types of unimproved grassland which were not used for livestock grazing (e.g. sand-dunes and maritime grasslands) were excluded, as were small areas of bracken on derelict land in industrial areas.

TABLE 1. LAND CLASSES IN THE CATCHMENT OF THE RIVER TYNE: SELECTED CHARACTERISTICS (FROM BUNCE *ET AL*. 1981B, 1991), FREQUENCY OF OCCURRENCE AND NUMBERS INCLUDED IN THE PRESENT STUDY

Landscape	Land class no.	Mean altitude (m)	Main land forms	% of squares in catchment	No. of squares surveyed
Lowland	9	90	Valley floors, flood plains, bluffs, large rivers	0·2	0
	10	95	Valley floors, alluvial plains with scarps on margins	2·1	8
	13	44	Varied: ridges in alluvial plains to river valley	1·1	10
	14	23	Marine or alluvial flood plains of estuaries	0·7	8
	15	138	Varied: dissected plateaus to valley floors	<0·1	0
	25	119	Alluvial flood plains and glacial moraines	24·0	34
	26	53	Valley floors, coastal plains of glacial origin	3·6	12
	27	133	Varied: valley floors and bluffs	9·9	20
Marginal Upland	17	325	Plateau, table lands, dissected scarps, small rivers	<0·1	0
	18	285	Glaciated river valleys with steep scarps	<0·1	0
	19	288	Broad ridges, summits, small rivers	3·2	10
	20	248	River valleys with tributaries and scarps	1·9	10
	28	138	Varied: meandering rivers, peneplains, alluvial plains	7·2	20
Upland	21	295	Peneplain surfaces or broad ridges	0·1	0
	22	358	Slopes of plateaus, glacial valleys, rounded summits	43·2	41
	23	621	Ridges, scarps, corries, mountain summits	2·5	9

The mean areas of rough grazing and bracken were calculated for each land class. Estimation of the total areas of rough grazing and bracken within the catchment as a whole, and within lowland, marginal upland and upland landscapes, followed Cochran (1977), as did estimation of the standard deviations for these figures. Estimation of mean percentage infestation levels of bracken within land classes used the ratios of the means for bracken and rough grazing. Estimation of the variances for mean percentage infestation levels used the approximation given by Colquhoun (1971: p. 41). The same approach was used in the estimation of percentage infestation levels (and associated variance estimates) at the landscape and catchment scales.

Statistical comparison of the areas of bracken and rough grazing between land classes used Duncan's multiple range test within the SAS package (SAS 1989). Prior to these analyses the data were transformed by adding 1·0 to all observations and conversion to $\log_{10}$. Comparison of the mean infestation levels between land classes used Student's two sample t-test for samples of unequal variance (Zar 1984). Bonferroni's correction for multiple comparisons was used to minimise the chance of Type I errors (Miller 1977).

RESULTS

LAND COVER WITHIN THE I.T.E. LAND CLASSES

The land cover composition of each of the I.T.E. land classes is summarised in Table 2. The lowland land classes are dominated by arable crops, sown grassland, woodland and urban development, although the areas of these cover types varied between the land classes. The areas of rough grazing land were also variable, but overall this cover type was a minor component of the lowland landscapes. Rough grazing was most frequently encountered in the form of unimproved grassland.

The marginal upland land classes had markedly smaller areas of arable crops and urban development than the lowland land classes, and were dominated by sown grassland. Woodland and rough grazing were consistent features of these land classes. Rough grazing was composed primarily of unimproved grassland, but areas of heathland and bog were also important (Table 2).

TABLE 2. ESTIMATED MEAN AREAS OF (a) MAJOR LAND COVER TYPES (EXCLUDING ROUGH GRAZING), AND (b) COVER TYPES COMPRISING ROUGH GRAZING, WITHIN EACH I.T.E. LAND CLASS OF THE RIVER TYNE CATCHMENT

	Land Classes											
	Lowland					Marginal Upland				Upland		
	10	13	14	25	26	27	19	20	28	22N[3]	22S	23
(a) Land uses (excluding rough grazing):												
arable	31·2	17·6	17·7	12·9	4·7	15·8	2·7	–	8·2	–	0·6	–
sown grassland[1]	28·6	14·1	17·7	45·3	11·3	22·1	61·6	30·2	47·2	2·0	22·7	–
woodland	9·1	6·2	1·7	12·1	3·5	16·3	11·1	18·9	12·0	42·0	3·4	–
urban[2]	26·7	47·7	49·9	9·8	75·3	27·8	3·2	2·1	3·6	0·5	0·6	0·2
others	3·1	12·6	9·6	1·8	3·1	3·8	0·5	0·7	1·4	1·5	0·3	1·7
(b) Components of rough grazing:												
unimproved grassland	0·9	1·8	3·4	11·8	2·1	9·2	11·1	9·1	16·0	19·9	24·4	27·4
marshy grassland	0·4	+	+	2·6	–	1·3	4·5	0·9	8·5	6·9	2·5	0·4
dry heath/grassland mosaic	–	–	–	–	–	–	0·1	3·0	–	2·7	8·1	0·3
wet heath/grassland mosaic	–	–	–	–	–	–	–	–	–	0·6	–	–
dry heath	–	–	–	2·1	–	0·1	2·5	27·1	0·1	9·2	13·0	3·7
wet heath	–	–	–	0·1	–	2·3	+	1·9	1·2	3·0	0·5	0·3
bog and flush	–	–	–	1·2	–	0·8	1·9	4·1	1·7	10·3	23·1	66·0
bracken	–	+	–	0·3	–	0·5	0·8	2·0	0·1	1·4	0·8	–

[1] Including sown grasslands infested with *Juncus effusus* L.
[2] Including allotments and recreation areas.
[3] 22N and 22S refer to squares of land class 22 in the North and South of the catchment.
+ = <0.1%, – = 0.0%.

The upland land classes were dominated by rough grazing, with limited areas of arable crops and urban development. In the north, squares of land class 22 had large areas of woodland, whilst in the southern squares of this land class sown grassland was more important. Heathland, bog and unimproved grassland were important components of rough grazing land. Land class 23 was notable for the dominance of bog and unimproved grassland (Table 2).

DISTRIBUTION OF BRACKEN

Bracken was recorded in 10·9% of lowland sample squares, 25·0% of marginal upland squares and 22·0% of upland squares, but contributed a mean area greater than 1% of land cover per square in only two land classes (Table 3). The mean areas of bracken differed significantly ($p < 0.05$) between certain land classes (Table 3). However, although bracken was encountered in a higher proportion of sample squares in the marginal uplands and uplands, there was no clear altitudinal pattern in the variation of the mean areas of bracken by land class (Tables 3 & 4). The mean areas of rough grazing, in contrast, showed a clear increase from the lowlands to the uplands (Tables 3 & 4). Mean infestation of rough grazing land by bracken ranged from 0·0% to 4·23%, but did not differ significantly between any pair of land classes (Table 3).

TABLE 3. MEAN AREAS OF ROUGH GRAZING LAND AND BRACKEN IN SAMPLE SQUARES OF EACH LAND CLASS IN THE RIVER TYNE CATCHMENT AREA

Landscape	Land Class	Rough grazing ($ha\ km^{-2}$) $\bar{x}$	Rough grazing s.d.	Bracken ($ha\ km^{-2}$) $\bar{x}$	Bracken s.d.	% Infestation $\bar{x}$	% Infestation s.d.
Lowland	10	1·27^{d}	1·21	0·0^{g}	–	0·0^{h}	–
	13	1·82^{d}	2·33	0·02^{g}	0·06	1·10^{h}	3·59
	14	3·45^{d}	6·55	0·0^{g}	–	0·0^{h}	–
	25	18·09^{bcd}	29·17	0·25^{fg}	0·58	1·38^{h}	3·90
	26	2·16^{d}	3·04	0·0^{g}	–	0·0^{h}	–
	27	14·19^{cd}	27·46	0·54^{fg}	2·00	3·81^{h}	15·92
Marginal	19	20·82^{abc}	20·04	0·84^{efg}	2·09	4·03^{h}	10·75
	20	48·20^{ab}	39·37	2·04^{e}	4·17	4·23^{h}	9·3
	28	27·60^{ab}	31·44	0·07^{fg}	0·21	0·25^{h}	0·80
Upland	22N	53·81^{ab}	38·51	1·36^{ef}	2·93	2·53^{h}	5·74
	22S	72·22^{a}	33·81	0·82^{fg}	2·59	1·14^{h}	3·64
	23	97·92^{a}	4·90	0·0^{g}	–	0·0^{h}	–

$\bar{x}$ = mean; s.d. = standard deviation.
Means labelled with the same letter are not significantly different at $p < 0.05$.

TABLE 4. ESTIMATED TOTAL AREAS OF ROUGH GRAZING LAND AND BRACKEN, AND MEAN PERCENTAGE INFESTATION OF ROUGH GRAZING LAND, IN LOWLAND, MARGINAL UPLAND AND UPLAND LANDSCAPES, AND IN THE WHOLE CATCHMENT OF THE RIVER TYNE

Landscape[1]	Total area km^2	Rough grazing ha	Rough grazing s.d.	Bracken ha	Bracken s.d.	% Infestation $\bar{x}$	% Infestation s.d.
Lowland	1202	17111	3804	333	141	1·95	0·93
Marginal upland	359	10405	1635	205	89	1·97	0·91
Upland	1327	81530	7952	1500	606	1·84	0·76
Catchment	2888	109046	8966	2038	628	1·87	0·60

[1] Land classes 9, 15, 17, 18 and 21 excluded.
$\bar{x}$ = mean; s.d. = standard deviation.

Extrapc ıtion from the mean areas of bracken and rough grazing in the land classes indicates that bracken a· ·ounted for around 1·9% of rough grazing land in each of the lowland, marginal upland and uplanu landscapes (Table 4). The estimated total area of bracken, 2,038 ha, was equivalent to 0·7% (s.d. ± 0·2%) of the land surface of the catchment (Table 4).

DISCUSSION

A number of surveys of bracken distribution have been conducted in Britain, but each has used a different approach or has focused on a limited geographical region (Lawson *et al.* 1986; Miller *et al.* 1990). This may, in part, explain variation in the estimates of the total extent of bracken in Britain, which range from 1·2% to 2·7% of the land surface (Lawson *et al.* 1986; Taylor 1986). The only study which is directly comparable to that presented here is that of Bunce *et al.* (1981a). In 1978, these authors mapped land cover (including bracken) in a nationally distributed sample of 1-km squares of each of the 32 I.T.E. land classes. They estimated that bracken covered 316,703 ha (1·3%) of the land surface of Britain. Comparison with the present study suggests that bracken is less common in the catchment of the R. Tyne than elsewhere.

Comparison of the results of the present study with those of others conducted in north-east England is difficult. The Countryside Commission (1991) used a visual interpretation of aerial photography to estimate that 4·1% of the Northumberland National Park (which impinges upon the catchment of the R. Tyne) is covered by bracken. Varvarigos & Lawton (1991) conducted a postal survey of farmers, and estimated that 14·7% of rough grazing land within the Less Favoured Areas (L.F.A.) of Northumberland and Durham supported bracken. The L.F.A.s in the catchment of the R. Tyne lie predominantly within land classes 19, 20, 22, 23, 25, 27 and 28. Conversely, 90% of squares of these land classes possess L.F.A. status in the study area (unpublished). Although the catchment does not include all L.F.A. land within either County Durham or Northumberland, the present study suggests that Varvarigos & Lawton (1991) overestimated the extent of bracken infestation. Only around half of farmers targeted in their survey returned questionnaires, but whether the probability of farmers returning the questionnaires was related to the extent of bracken infestation was not addressed. It is possible that farmers with severe infestations would have been more likely to respond. This interpretation is supported by preliminary analyses of LANDSAT data, which suggest that bracken covers around 1·5% of the catchment of the R. Tyne (Cherrill *et al.* in press).

Use of the I.T.E. land classification system in field surveys enables estimates of land cover to be viewed in the context of broad patterns of environmental variation summarised by the land classes (Tables 1 & 2) (Bunce *et al.* 1981a, 1981b, 1983; Benefield & Bunce 1982). Thus, for example, the absence of bracken from land class 23 can be attributed to the effects of altitude and the predominance of waterlogged mires in this land class. Bracken is rarely found above altitudes of 600 m and is known to prefer well drained soils (Thompson *et al.* 1986; Grime *et al.* 1988; Ader 1990). In this context, it is relevant to note that although the nature of the vegetation beneath bracken was not investigated, bracken stands were most frequently associated with areas of dry heath and unimproved grassland (Table 2). It is these ecologically interesting cover types which are likely to be at greatest risk of colonisation and which have probably lost most ground to bracken within the study area.

In conclusion, the present study has followed others in being restricted to a limited geographical region. However, it differs from many of its predecessors in one major respect, namely the use of a national landscape classification system in the stratification of sampling effort. The use of a diversity of methods in previous studies has led to difficulties in the collation of national statistics and a failure to produce consistent regional estimates of the extent of bracken. The need for a standardised method of field survey is clear. Use of the I.T.E. land classes allows the extrapolation of sample based survey data to give regional estimates of land cover. In the future, use of the I.T.E. land classification system would have the additional advantage of permitting comparisons between temporally and spatially separated field surveys. Although remote sensing offers a potential solution to the standardised collection of land cover data (e.g. Miller *et al.* 1990), its capabilities are often overstated and there will be a continuing need for 'ground-truth' data (Price 1986; Townshend 1992). The I.T.E. land class system has recently been used as a framework for the stratification of sampling effort in field surveys designed to aid the interpretation of satellite data (Cherrill *et al.* in press). The classification, therefore, offers a framework for the organisation of traditional field surveys, but also provides a link with modern remote-sensing technologies (Bunce *et al.* 1992).

ACKNOWLEDGMENTS

Miss A. Marler and Mr J. Dargie did much of the field work. Thanks are also due to the I.T.E. Land Use Research Group, the Institute of Hydrology, Dr R. Sanderson, Dr E. Martin and the many people who allowed access to land in their care. The work was funded jointly by the Natural Environment Research Council and the Economic and Social Research Council.

REFERENCES

Ader, K. G. (1990). The effect of climate and soils on bracken vigour and distribution in Scotland, in Thomson, J. A. & Smith, R. T., eds. *Bracken biology and management*, pp. 141–151. Sydney.

Benefield, C. B. & Bunce, R. G. H. (1982). *A preliminary visual presentation of land classes in Britain*. Merlewood Research and Development Paper No. 91. Grange-over-Sands, Cumbria.

Blankson, E. J. & Green, B. H. (1991). Use of landscape classification as an essential prerequisite to landscape evaluation. *Landscape and urban planning* **21**: 149–162.

Bunce, R. G. H. (1992). *The distribution and aggregation of I.T.E. land classes*. Report to the Department of the Environment and the Natural Environment Research Council. Grange-over-Sands, Cumbria.

Bunce, R. G. H., Barr, C. J. & Fuller, R. M. (1992). Integration of methods for detecting land use change, with special reference to Countryside Survey 1990, in Whitby, M., ed. *Land use change: the causes and consequences*, pp. 69–78. London.

Bunce, R. G. H., Barr, C. J. & Whittaker, H. (1981a). An integrated system of land classification. *Annual report of the Institute of Terrestrial Ecology*, pp. 28–33.

Bunce, R. G. H., Barr, C. J. & Whittaker, H. (1981b). *Land classes in Great Britain: preliminary descriptions for users of the Merlewood method of land classification*. Merlewood Research and Development Paper No. 86. Grange-over-Sands, Cumbria.

Bunce, R. G. H., Barr, C. J. & Whittaker, H. (1983). A stratification system for ecological sampling, in Fuller, R. M., ed. *Ecological mapping from ground, air and space*, pp. 39–46. Huntingdon.

Bunce, R. G. H., Lane, A. M. J., Howard, D. C. & Clarke, R. T. (1991). *I.T.E. land classification: classification of all 1 km squares in Great Britain*. Report to the Department of the Environment. Grange-over-Sands, Cumbria.

Bunce, R. G. H., Morrell, S. K. & Steel, H. E. (1975). The application of multivariate analysis to regional survey. *Journal of environmental management* **3**: 151–165.

Cherrill, A. J., Lane, A. M. & Fuller, R. M. (in press). The use of classified LANDSAT 5 Thematic Mapper imagery in the characterisation of landscape composition: a case study in Northern England. *Journal of environmental management*.

Cochran, W. G. (1977). *Sampling techniques*. New York.

Colquhoun, D. (1971). *Lectures on biostatistics*. Oxford.

Cooper, A. & Murray, R. (1992). A structured method of landscape assessment and countryside management. *Applied geography* **12**: 319–338.

Countryside Commission. (1991). *Landscape change in the National Parks*. Manchester.

Dyer, A. F. (1990). Does bracken spread by spores?, in Thomson, J. A. & Smith, R. T., eds. *Bracken biology and management*, pp. 35–42. Sydney.

Evans, W. C., Patel, M. C. & Koohy, Y. (1982). Acute bracken poisoning in homogastric and ruminant animals. *Proceedings of the Royal Society of Edinburgh* **81(B)**: 29–64.

Grime, J. P., Hodgson, J. G. & Hunt, R. (1988). *Comparative plant ecology*. London.

Hill, M. O., Bunce, R. G. H. & Shaw, M. W. (1975). Indicator species analysis, a polythetic method of classification, and its application to a survey of native pinewoods in Scotland. *Journal of ecology* **63**: 597–613.

Hudson, P. J. (1986). Bracken and ticks on grouse moors in the North of England, in Smith, R. T. & Taylor, J. A., eds. *Bracken. Ecology, land use and control technology*, pp. 161–170. Carnforth.

Kirkwood, R. C. & Archibald, L. (1986). The rhizome as a target site for the control of bracken using foliage-applied herbicides, in Smith, R. T. & Taylor, J. A., eds. *Bracken. Ecology, land use and control technology*, pp. 341–350. Carnforth.

LAWSON, G. J., CALLAGHAN, T. V. & SCOTT, R. (1986). Bracken as an energy resource, in SMITH, R. T. & TAYLOR, J. A., eds. *Bracken. Ecology, land use and control technology*, pp. 239–248. Carnforth.

MACLEOD, A. (1982). The bracken problem in the Highlands and Islands. *Proceedings of the Royal Society of Edinburgh* **81(B)**: 11–18.

MARRS, R. H., PAKEMAN, R. J. & LOWDAY, J. E. (1993). Control of bracken and the restoration of heathland. V. Effects of bracken control treatment on the rhizome and its relationship with frond performance. *Journal of applied ecology* **30**: 107–118.

MILLER, D. R., MORRICE, J. G. & WHITWORTH, P. L. (1990). Bracken distribution and spread in upland Scotland: an assessment using digital mapping techniques, in THOMSON, J. A. & SMITH, R. T., eds. *Bracken biology and management*, pp. 121–132. Sydney.

MILLER, R. G. (1977). Developments in multiple comparisons. *Journal of the American Statistical Association* **72**: 779–788.

NATURE CONSERVANCY COUNCIL (1990). *Handbook for Phase 1 habitat survey: a technique for environmental audit*. Peterborough.

PAGE, C. N. (1976). The taxonomy and phytogeography of bracken – a review. *Botanical journal of the Linnean Society* **73**: 1–34.

PAGE, C. N. (1982). The history and spread of bracken in Britain. *Proceedings of the Royal Society of Edinburgh* **81(B)**: 3–10.

PAKEMAN, R. J. & MARRS, R. H. (1992). Vegetation development on moorland after control of *Pteridium aquilinum* with asulam. *Journal of vegetation science* **3**: 707–710.

PRICE, M. (1986). The analysis of vegetation change by remote sensing. *Progress in physical geography* **10**: 473–491.

SAS (1989). *SAS/STAT User's guide. Volume 2, Version 6*. North Carolina.

SMITH, R. T. & TAYLOR, J. A., eds (1986). *Bracken. Ecology, land use and control techniques*. Carnforth.

TAYLOR, J. A. (1986). The bracken problem: a local hazard and global issue, in SMITH, R. T. & TAYLOR, J. A., eds. *Bracken. Ecology, land use and control techniques*, pp. 21–42. Carnforth.

TAYLOR, J. A. (1990). The bracken problem: a global perspective, in THOMSON, J. A. & SMITH, R. T., eds. *Bracken biology and management*, pp. 3–19. Sydney.

THOMPSON, T. R. E., RUDEFORTH, C. C., HARTNUP, R., LEA, J. W. & WRIGHT, P. S. (1986). Slope and soil conditions under bracken in Wales, in SMITH, R. T. & TAYLOR, J. A., eds. *Bracken. Ecology, land use and control technology*, pp. 101–108. Carnforth.

TOWNSHEND, J. R. G. (1992). Land cover. *International journal of remote sensing* **13**: 1319–1328.

VARVARIGOS, P. & LAWTON, J. H. (1991). Farmers' perceptions of the scale of the bracken problem on farms in Less Favoured Areas in England and Wales. *Journal of applied ecology* **28**: 988–1003.

ZAR, J. H. (1984). *Biostatistical analysis*. New Jersey.

(*Accepted December 1993*)

The status of *Bupleurum falcatum* L. (Apiaceae) in the British flora

M. H. FIELD

Sub-department of Quaternary Research, Botany School, University of Cambridge, Downing Street, Cambridge, CB2 3EA

ABSTRACT

The umbellifer *Bupleurum falcatum* L. has only been recorded from one locality in the British Isles and its status as a native in the modern British flora is uncertain. Recent analyses of fossiliferous Pleistocene temperate stage sediments from two English sites have yielded mericarps of *B. falcatum* subsp. *falcatum*. These finds show that this taxon was once naturally occurring on the British mainland and had a more northerly range than at present. It is difficult to determine whether the one extant British population has a native status as a result of natural dispersal from the continent during the Flandrian Stage, is a relic of a Late Pleistocene temperate stage population that survived in Britain during the last cold stage (Devensian), or alternatively has an alien status with a relatively recent introduction by human activity. Its occurrence in the Late Pleistocene fossil record may support the opinion that the extant population is native.

KEYWORDS: Fossil record, native status, Pleistocene, Umbelliferae, Sickle-leaved Hare's-Ear.

INTRODUCTION

The first British record of *Bupleurum falcatum* L. (Apiaceae) was made by Thomas Corder in 1831. He described the plant as being abundant on either side of the turnpike between Chelmsford and Ongar, Essex (Corder 1833). A number of authorities have debated whether or not this population is indigenous to the British Isles. Gibson (1862) said it "appears truly indigenous", whilst Jermyn (1974) and Tutin (1980) have expressed reservations about its native status. In 1962 hedgerow clearance and ditch cleaning destroyed the population in southern Essex (Jermyn 1974), but Stace (1991) says it reappeared in 1979.

Palaeobotanical investigations of fossiliferous organic sediments from two gravel-pits at Frog Hall, Warwickshire (SP/413.734) and Somersham, Cambridgeshire (TL/373.799) yielded mericarps of *B. falcatum* subsp. *falcatum*. These finds show that this taxon was once naturally occurring in Britain and add to the discussion about the status of this taxon in the British flora.

The macroscopic remains of *B. falcatum* subsp. *falcatum* came from assemblages that were dominated by waterside, damp ground and aquatic taxa. It is probable that deposition at both sites took place in a low energy, fluviatile environment or in a pond on a floodplain. The taxa represented in both assemblages show that contemporary conditions were temperate and were probably similar to those in southern Britain today.

The age of the temperate stage deposits at Frog Hall is controversial. The deposits stratigraphically overlie the nearby type section of the cold Wolstonian Stage at Wolston. If the accepted British stratigraphical sequence is applied (Mitchell *et al.* 1973) then these deposits are last interglacial (Ipswichian) in age. However, the age of the Wolston cold stage sediments has been disputed (Sumbler 1983). The Somersham deposits which yielded the mericarps of *B. falcatum* subsp. *falcatum* have been correlated with Ipswichian pollen zone II (R. G. West, pers. comm. 1993).

THE FOSSIL SPECIMEN

The best preserved mericarp was recovered from Frog Hall, but three flattened and less well preserved mericarps were found at Somersham (R. G. West, pers. comm. 1993). It is possible to determine the fossil specimen to subspecies level because the two recognised subspecies are distinguished by the characteristics of the fruits (Tutin 1968). *B. falcatum* subsp. *cernuum* (Ten.) Arcangeli can be identified by its relatively large fruits (c. 5 mm in length) which have winged ridges running longitudinally. *B. falcatum* subsp. *falcatum* has a smaller fruit (c. 3 mm in length) and the longitudinal ridges are usually not winged. Despite the variability of this species, noted by Tutin (1968), there is no problem in the placement of the fossil specimens into the latter subspecies. Tutin (1980) states that the modern British population belongs to subsp. *falcatum* also.

The fossil mericarp from Frog Hall is 2·9 mm long and has a maximum width of 1·1 mm (Fig. 1). There are five prominent, slender, longitudinal ridges which are not winged. It is difficult to say whether these ridges were winged or not, as delicate features are not always preserved. The commissure is relatively broad and has a fairly deep longitudinal groove.

DISCUSSION

The occurrence of *B. falcatum* subsp. *falcatum* in British Pleistocene deposits is of botanical interest because today this plant only occurs in one locality in the British Isles and the native status of this population has been questioned. Both the fossil records are found north of the present day occurrence at North Heath, Essex and show that this taxon was naturally occurring on the British mainland in the Late Pleistocene.

There are three possible origins of the extant British population: it may be a remnant of a Late Pleistocene temperate stage population, it may have been naturally dispersed from the continent, or it may have been introduced by human activity.

If the modern population is a remnant of a Late Pleistocene temperate stage population it must

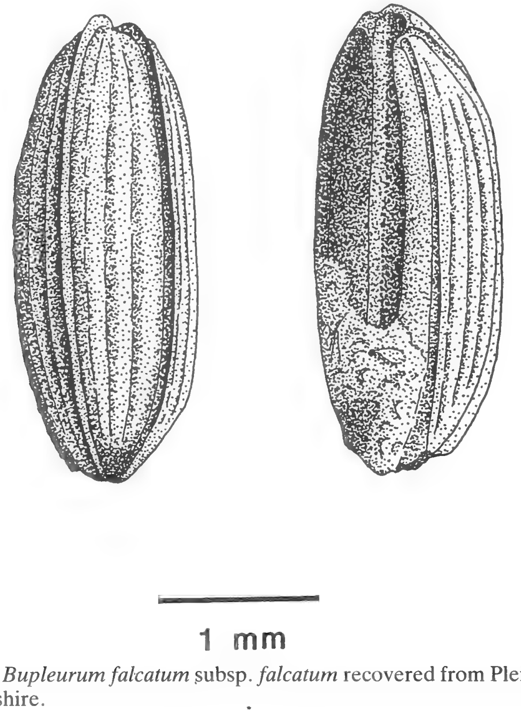


FIGURE 1. The mericarp of *Bupleurum falcatum* subsp. *falcatum* recovered from Pleistocene sediments collected from Frog Hall, Warwickshire.

have survived the glacial and periglacial conditions that prevailed during the Devensian Stage. If this taxon was absent from the British mainland in the Devensian and Early Flandrian then it may have been transported to southern England by natural dispersal from the continent. Alternatively, the modern population may have an alien status with a relatively recent introduction by human activity. Jermyn (1974) did speculate that fruits may have been transported to Essex by soldiers who were returning from the Napoleonic wars. On the continent the modern distribution of this taxon extends north-westwards along stretches of the French coastline (Fitter 1978). The Dover Strait and the English Channel appear to have acted as an effective barrier to a more extensive colonisation of Britain by this taxon from continental populations in the Flandrian Stage.

The lack of knowledge about the distribution and behaviour of *B. falcatum* subsp. *falcatum* in the Late Pleistocene, due to its poor representation in the fossil record, makes it difficult to determine the precise time and mode of arrival in England. However, the occurrence of *B. falcatum* subsp. *falcatum* in the Late Pleistocene fossil record adds support to the opinion that the extant population is native.

ACKNOWLEDGMENTS

I would like to thank Mrs M. Petitt and Prof. R. G. West.

REFERENCES

CORDER, T. (1833). *Bupleurum falcatum* L., in SMITH, J. E., *English botany supplement* **2** (35): plate 2763. London.

FITTER, A. H. (1978). *An atlas of the wild flowers of Britain and northern Europe*. London.

GIBSON, G. S. (1862). *The Flora of Essex*. London.

JERMYN, S. T. (1974). *Flora of Essex*. Colchester.

MITCHELL, G. F., PENNY, L. F., SHOTTON, F. W. & WEST, R. G. (1973). A correlation of Quaternary deposits in the British Isles. *Geological Society of London, Special Report No. 4*: 1–99.

STACE, C. A. (1991). *New Flora of the British Isles*. Cambridge.

SUMBLER, M. G. (1983). A new look at the type Wolstonian glacial deposits of central England. *Proceedings of the Geologists' Association* **94**: 23–31.

TUTIN, T. G. (1968). *Bupleurum* L., in TUTIN, T. G. *et al.*, eds. *Flora Europaea* **2**: 345–350. Cambridge.

TUTIN, T. G. (1980). *Umbellifers of the British Isles*. London.

(*Accepted December 1993*)

Seven new species of *Taraxacum* Wigg. (Asteraceae), native to the British Isles

A. A. DUDMAN

Holebeck House, Cleator Moor, Cumbria, CA25 5HD

and

A. J. RICHARDS

Department of Agricultural and Environmental Science, Ridley Building, University of Newcastle-upon-Tyne, Newcastle-upon-Tyne, NE1 7RU

ABSTRACT

Taraxacum breconense C. C. Haw., **sp. nov.** (sect. *Celtica* A. J. Richards), **T. edmondsonianum** H. Øllg., **sp. nov.** (sect. *Ruderalia* Kirschner, H. Øllg. & Stepanek), **T. haworthianum** A. A. Dudman & A. J. Richards, **sp. nov.** (sect. *Erythrosperma* (H. Lindb.) Dahlst.), **T. hirsutissimum** C. C. Haw., **sp. nov.** (sect. *Naevosa* M. P. Christ.), **T. latens** H. Øllg., **sp. nov.** (sect. *Ruderalia*), **T. nigridentatum** T. Edm., **sp. nov.** (sect. *Ruderalia*) and **T. sahlinianum** A. A. Dudman & A. J. Richards, **sp. nov.** (sect. *Hamata* H. Øllg.) are described as new species, native to the British Isles.

KEYWORDS: Denmark, Germany, Netherlands, Czech Republic, Compositae.

INTRODUCTION

Before his untimely death in 1989, C. C. Haworth was planning to publish an account of British and Irish *Taraxacum* as part of the handbook series of the Botanical Society of the British Isles. Preliminary to this, he lectotypified the Dahlstedt British species (Haworth & Richards 1990) and described six new species (Haworth 1990).

We are proceeding with the publication of this handbook, and in order to do so we need to publish a further seven species. They appear here under a variety of authors. *T. breconense* and *T. hirsutissimum* appear here under Haworth's authorship, as he left manuscript descriptions for them. *T. nigridentatum* is named and described by T. Edmondson, and appears here under his authorship. Two species are named and described by the Danish authority Hans Øllgaard, and we are grateful to him for his permission to publish them within this paper. The remaining two species are described by ourselves. Haworth (and others) formerly referred to *T. haworthianum* as *Taraxacum* "British laetum", and *T. sahlinianum* as *Taraxacum* "British atactum".

THE SPECIES

1. **Taraxacum breconense** C. C. Haw., **sp. nov.**
HOLOTYPUS: Nant Sere, Breconshire, v.c. 42, GR SO/041.247, wall/bank of lane, 13 May 1992, *M. Porter 92/38* (**OXF**). (Fig. 1).
ISOTYPUS: **herb. A. A. Dudman.**

FIGURE 1. Holotype of *Taraxacum breconense* C. C. Haw. (top specimen).

Planta magnitudine mediocris. Folia patentia viridia immaculata epiceata, fere glabra et plana, late lanceolata, ad 150 mm longa; lobi laterales 2–4, recurvati acuti, apice angusti, ad basem latiores, saepe margine distali sat sigmoideo vel convexo in foliis bene evolutis, lobis inferioribus margine distali plusminusve irregulariter denticulata; lobus terminalis submagnus subhastatus, late acutus, valde subdivisus irregulariter profundeque dentatus; petiolus viridis exalatus. Scapus sub anthesi saepe foliis brevior, interdum purpurascens, ad apicem sat pilosus. Involucri squamae exteriores 7–10 × 2·5 mm, patentes subrecurvataeve, supra canescentes purpureo suffusae, subtus obscure virides, interdum albo roseove indistincte submarginatae. Calathium 15–30 mm in diametro, subclausum, pallide luteum; ligulae subbreves involutae; stylus stigmataque inserti lutei; antherae epolliniferae. Achenium stramineo-brunneum, 3·5 mm longum pyramide exclusa, superne spinulosum, pyramide subconica 0·7 mm longa; rostrum 8 mm longum; pappus albus.

Plant medium-sized. Leaves spreading, mid-green, lacking spots or dark markings, flat and almost glabrous, broadly lanceolate, to 150 mm in length; leaf-lobes 2–4, acute and recurved with a narrow apex, broader proximally with the distal margin sigmoid or convex in shape in well-developed leaves, the proximal lobes more or less irregularly denticulate on the distal margin; terminal lobe rather large and somewhat hastate in shape, broadly acute, markedly subdivided and irregularly and deeply dentate; petiole green, unwinged. Scape often shorter than the leaves at flowering, sometimes becoming purplish, hairy above. Exterior bracts 7–10 × 2·5 mm, spreading to somewhat recurved, greyish green suffused with purple above, dark green below, sometimes indistinctly bordered with white or rose. Capitulum 15–30 mm in diameter, not opening fully, pale yellow, the ligules short and involute; style and stigmas inserted, yellow, anthers lacking pollen. Achene straw-brown, 3·5 mm long (excluding the cone), spinulose above, cone more or less conical, 0·7 mm long; rostrum 8 mm long, pappus white.

T. breconense is a close relative of *T. ostenfeldii* Raunk., with similar involucres and sharing small capitula with short yellow styles which lack pollen. However, the ligules are notably involute, a rare condition amongst British *Taraxacum* species (compare *T. argutum* Dahlst.), and the relatively large and complexly subdivided end-lobes are distinctive and diagnostic. *T. breconense* is classified within sect. *Celtica* A. J. Richards.

T. breconense is so far recorded from seven sites in four 10-km squares in v.c. 42 (Brecon). It has been recorded from limestone cliffs, walls and lane-banks. Our knowledge of this species depends entirely on the enthusiasm and expertly prepared collections of Michael Porter.

2. **Taraxacum edmondsonianum** H. Øllg., **sp. nov.**

HOLOTYPUS: Denmark, Jylland [Jutland], distr. 11, Hadsund, Hornbechsvej, ved en sti [by a footpath], 2 May 1981, *H. Øllgaard 81–28 2./2* (**C**). (Fig. 2).

ISOTYPUS: **OXF** (*HØ 81.28 1./2*).

The type specimens were collected and the plant taken into cultivation; the achenes were described from the cultivated plant (Birgittelyst, 1982).

Planta magnitudine mediocris, 30–40 cm alta. Folia sat laete canescenti-viridia, sparsim vel in foliis interioribus sat manifeste araneosa, late lanceolata, plerumque uniformiter lobata, margine proximali loborum lateralium sat crispo, minute denticulato; petiolus alatus, plus minusve amoene roseus, non striatulus; lobi laterales patentes subfalcati, raro plus minusve pagodiformes (ut in *Taraxaco aequilobo*); lobus terminalis triangularis vel triangulari-hastatus, brevis, marginibus distalibus plus minusve concavis, integris vel interdum incisis, apice lobis ibi saepe rotundatus. Scapus pallidus vel leviter brunnescens, sub involucro dense araneoso-pilosus alibi parce. Involucrum c. 14 mm longum, c. 11 mm latum, laete vel sat obscure viride, haud pruinosum. Squamae exteriores lanceolatae, 14 (–16) mm × 4 (–5) mm, non vel vix marginatae, retroflexae, sat regulares, supra pallide virides. Calathium 45–55 mm in diametro, luteum convexum radians; ligulae marginales planae vel saltem haud canaliculatae, subtus stria cano-violacea ornatae; antherae polliniferae, granis pollinis in diametro variantibus; stylus luteus, stigmata lutea vel in sicca levissime virescentia. Achenium fusco-stramineum, ad 4 mm longum pyramide inclusa, superne grosse spinulosum, alibi plus minusve verrucosum vel fere laeve, in pyramidem cylindricam (0·4–) 0·5(–0·6) mm longam abrupte abiens. Rostrum c. 11 mm longum. Pappus albus.

Plant medium-sized (30–40 cm). Leaves light greyish-green, slightly or (on inner leaves) markedly araneose-hairy, broadly lanceolate, mostly uniformly lobate, the proximal margins of the lateral leaf-lobes somewhat crisped, minutely denticulate; petiole narrowly winged, more or less a beautiful rose-pink, the midrib faintly reddish or brownish, lacking a striatulate pattern. Lateral leaf-lobes patent, subfalcate, rarely more or less pagoda-shaped (as in *T. aequilobum* Dahlst.).

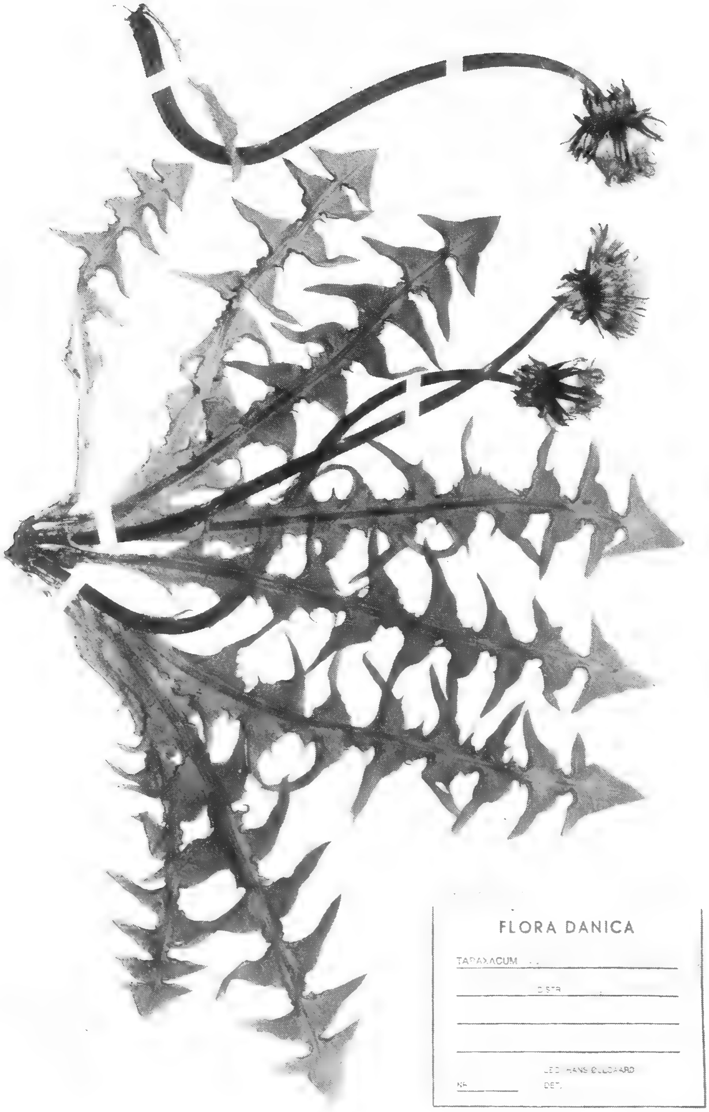


FIGURE 2. Holotype of *Taraxacum edmondsonianum* H. Øllg.

Terminal leaf-lobe triangular to triangular-hastate, short, more or less concave on distal margins, entire or sometimes incised, and then the apices of the lobules rounded. Scape pale or becoming slightly brownish, densely araneose-pilose under the head, the remainder slightly pilose. Involucre about 14 mm long and 11 mm wide, pale or somewhat darkish green, not pruinose. Exterior bracts lanceolate, 14(–16) × 4(–5) mm, unbordered or scarcely bordered, somewhat regularly arranged, pale green above. Capitulum 45–55 mm in diameter, yellow, convex, the marginal ligules spaced, flat or at least not furrowed, with grey-violet stripes beneath. Anthers bearing pollen with grains of varying diameter (suggesting agamospermous behaviour). Styles yellow, stigmas yellow or in the dry state very slightly greenish. Achene brownish-straw coloured, to 4 mm long (including the cone), strongly large-spinulose above, the rest more or less verrucose or almost smooth, abruptly contracted into a cylindrical cone of (0·4–)0·5(–0·6) mm. Rostrum about 11 mm long. Pappus white.

T. edmondsonianum is classified within sect. *Ruderalia* Kirchner, H. Øllg. & Stepanek. Morphologically, it is a relative of the common and widespread *T. aequilobum*, having many uniform leaf-lobes and more or less winged petioles. The latter species is recognised by the lateral leaf-lobes, usually shaped like the roof of a pagoda, and by the conspicuously irregular and twisted exterior bracts. In contrast, the leaf-lobes of *T. edmondsonianum* are more patent, less acuminate and more straight-sided on the distal margin; the proximal margin to these lobes is convex and bent upwards throughout. Also, the exterior bracts of *T. edmondsonianum* are strongly and regularly reflexed, and are not twisted. Other good marks of recognition are the delicate and beautiful rose-pink petiole, and the small terminal leaf-lobes with usually concave upper margin. Often, some terminal lobes are incised, the lobules so formed being rounded. *T. edmondsonianum* has a paler leaf colour than *T. aequilobum* and the stigmas are yellow when fresh. The constancy of these differences has been confirmed after cultivation in standard conditions.

T. edmondsonianum is named after T. Edmondson of Chester, who recognised it as a new species during his very thorough investigation of the *Taraxacum* flora of the Chester district. In the British Isles it is so far known from Herefordshire (v.c. 36), Cheshire (v.c. 58), South Lancashire (v.c. 59), West Lancashire (v.c. 60) and Cumberland (v.c. 70), where it has been recorded from seven 10-km squares. It is known from at least seven separate localities in the city of Chester. Outside England, it is recorded from nine localities in five recording districts (TBU02, 10, 11, 13a, 49) in Jutland, Denmark, and from a single locality in Hessen, Germany. (A full list of authentic specimens identified up until now can be obtained from the species' author at Lupinstien 7, Birgittelyst, Viborg 8800, Denmark.)

3. **Taraxacum haworthianum** A. A. Dudman & A. J. Richards, **sp. nov.**
Holotypus: Druridge Bay, Northumberland, v.c. 67, GR NZ/276.965, sand-dune grassland 100 m from the sea, 20 May 1987, *A. J. Richards 87/41* (**OXF**). (Fig. 3).
Isotypi: **herb. A. A. Dudman, H. Øllgaard, J. Stepanek.**

Planta parva. Folia prostrata viridia glabra, immaculata epiceata, nervo mediano basin versus viride purpureove, anguste lanceolata, ad 100 mm longa; lobi laterales 6–8, subintegri subrecurvati, regulatim triangulares vel margine distali sigmoideo, apice angusto, subacuto subobtusove vel interdum expanso; lobus terminalis subsagittatus integer in apicem acutum protractus; petiolus angustus exalatus ad basem vivide atropurpureus, distaliter interdum viridescens. Scapus tenuis purpureus adscendens, superne pilosus. Involucri squamae exteriores ovatae breves, 4–6 × 2 mm, subadpressae, margine anguste albo-scarioso vel roseo-scarioso, apice abrupte purpureo-corniculato. Calathium 25–30 mm in diametro, luteolum; ligulae breves lataeque, stria cano-violescenti subtus notatae, dentibus apicalibus purpureis; stylus stigmataque sordide lutei; antherae polliniferae. Achenium 3·0 mm longum pyramide exclusa, angustum, in stato maturo atropurpureum, in statu juveniliore rubescens, superne acute spinulosum, alibi fere laeve, pyramide anguste cylindrica 0·8–1·1 mm longa; rostrum 6–7 mm longum; pappus albus. 2n = 24*.

Plant small. Leaves prostrate, green, glabrous, lacking spots or dark markings, the midrib green or purple, narrowly lanceolate, to 100 mm in length; lateral leaf-lobes 6–8, subentire, somewhat recurved, regularly triangular, or with the distal margin sigmoid, with narrow subacute to subobtuse, or sometimes somewhat expanded apices; terminal lobe entire and subsagittate, drawn out into an acute apex; petiole narrow and unwinged, brilliantly purple at the base. Scapes narrow, purple, ascending, hairy above. Exterior bracts ovate, short, 4–6 × 2 mm, subadpressed to the involucre, narrowly white- to rose-bordered, abruptly ending in a marked purple corniculation. Capitulum 25–30 mm in diameter, pale yellow, the ligules short and wide with a grey-violet stripe and purple teeth; style and stigmas dirty yellow; pollen present. Achene 3·0 mm (excluding the cone), narrow, dark purple when mature, reddish when immature, acutely spinulose above, the rest almost smooth, the cone narrowly cylindrical, 0·8–1·1 mm; rostrum 6–7 mm; pappus white. 2n = 24*.

FIGURE 3. Holotype of *Taraxacum haworthianum* A. A. Dudman & A. J. Richards (top right hand specimen).

T. haworthianum is a close relative of *T. laetum* (Dahlst.) Raunk., a widespread sect. *Erythrosperma* (H. Lindb.) Dahlst. species of the sand-dunes and other dry grasslands of northern Europe. It was included within this species in Richards (1972), where some material was also referred to *T. laetiforme* Dahlst. In later years, it was recognised that such British and Irish material differs from *T. laetum*, notably by the narrow, bright purple petioles of all leaves (these are short and green in *T. laetum*), and also by the grey-violet, not purple, ligule stripes, a slightly longer achene body, and by dirty yellow, not brilliantly gold stigmas.

Øllgaard (1986) showed that *T. laetiforme* is a very localized and rare Danish species, and he gave the name *T. discretum* to the widespread plant from the Netherlands and Scandinavia which had been called "T. laetiforme" by Haglund and van Soest. This species has achenes that are chestnut-brown when mature, and petioles that are green in outer leaves, but purple on inner leaves. The stigmas are a dirty greenish colour. In 1986, it was considered that *T. discretum* occurred in the British Isles, but Haworth later showed that such plants were in fact forms of what is described here as *T. haworthianum* with immature achenes.

For some time, Haworth considered the possibility that the future *T. haworthianum* could be equated with another relative of *T. laetum*, the Dutch *T. agaurum* Soest. However, that species always has winged, green petioles and golden stigmas, and in our view *T. agaurum* is very closely allied to *T. laetum* itself. After testing these species in cultivation, it was Haworth's opinion, with which we concur, that no British plants can be referred to *T. laetum*, *T. agaurum* or *T. discretum*.

Haworth himself referred to this British relative of *T. laetum* and *T. discretum* as *Taraxacum* "British laetum", and also as "T. sublaetum". However, we would like to abandon these Haworth worknames, and to take this opportunity to recognise Chris Haworth's substantial contribution to British taraxacology.

T. haworthianum is widespread in species-rich, calcareous grassland (most commonly in sand-dunes) in Britain and Ireland, having been recorded from 83 10-km squares in the following vice-counties: 1–4, 6, 13, 15, 25, 27–29, 41, 42, 45, 46, 48, 49, 52, 55, 57–60, 67–69, 73–75, 82, 85, 90, 93–95, 102–104, 106, 107, 109, 110, S, H9, H12, H21, H28, H39, H40.

With its prostrate rosettes of highly dissected leaves with narrow, purple petioles, and very pretty, rounded involucres of bordered, purple corniculate exterior bracts, *T. haworthianum* is a distinctive and attractive little plant. It bears more than a passing resemblance to a sect. *Obliqua* Dahlst. species, *T. platyglossum*, Raunk. from which its slender, deep blackish-purple achenes will immediately distinguish it.

4. **Taraxacum hirsutissimum** C. C. Haw., **sp. nov.**
Holotypus: Dunrossness, Shetland, v.c. 112, GR HU/3.2, above the source of the Red Burn, near Williamsetter, roadside verge, 20 June 1979, *W. A. Scott 2618* (**OXF**). (Fig. 4).

Planta mediocris. Folia adscendentia canescentia, per paginam superiorem breve subdense hirsuta, sparse puncto-maculata vel immaculata, epiceata, nervo mediano viridi vel plus minusve purpureo-tincto, oblanceolata, ad 200 mm longa; lobi laterales 4–7, patentes subrecurvative, apice anguste acuti, margine distali saepe angulato-concavi, fere edentati; lobus terminalis sagittatus integer, apice subprotractus acutus; petiolus purpureus, vix alatus. Scapus purpurascens, superne pilosus. Involucri squamae exteriores leviter recurvatae, lanceolatae, 12 × 2·5 mm, supra pallide virides, subtus pruinoso-glaucae, vix marginatae. Calathium intense luteum, ad 30 mm in diametro; ligulae stria obscurocanescenti subtus notatae, dentibus apicalis luteis; stylus stigmataque aurantiaci; antherae polliniferae. Achenium stramineum, 3·5 mm pyramide exclusa, pyramide conica 0·5 mm longa; rostrum 9–10 mm longum; pappus albus.

Plant medium-sized. Leaves ascending, greyish, shortly and rather densely hairy throughout the upper surface, unspotted or with scattered punctate spots, lacking dark markings, the midrib green or faintly purple, oblanceolate, to 200 mm long; lateral leaf-lobes 4–7, patent or slightly recurved, with narrow acute apices, the distal margins concave, often with a concave angle, almost lacking teeth; terminal leaf-lobe sagittate, entire, with an acute, somewhat extended apex; petiole purple, scarcely winged. Scape purplish, hairy above. Exterior bracts somewhat recurved, lanceolate, 12 × 2·5 mm, pale green above, bluish pruinose green beneath, scarcely bordered. Capitulum deep yellow, to 30 mm in diameter, ligules striped dark grey beneath, ligule teeth yellow; style and stigmas orange; pollen present. Achene straw-coloured, 3·5 mm (excluding the cone), the cone conical, 0·5 mm; rostrum 9–10 mm; pappus white.

Over more than two decades, Richard C. Palmer and Walter A. Scott have thoroughly examined the *Taraxacum* species of Shetland. A number of their gatherings relate to a distinctive member of sect. *Naevosa* that is immediately recognised by its leaves, which are rendered greyish by their dense

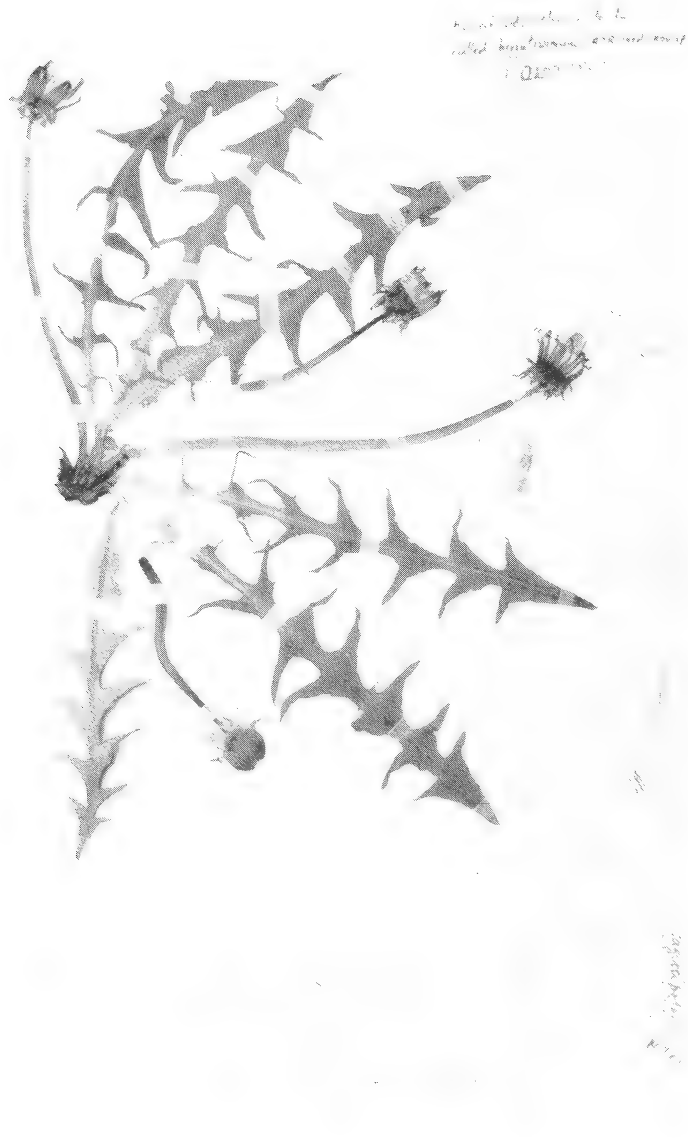


FIGURE 4. Holotype of *Taraxacum hirsutissimum* C. C. Haw.

covering of short even hairs, and by the orange stigmas. Among its British relatives, this plant is most closely related to *T. euryphyllum* (Dahlst.) Hjelt, and the achenes, leaf-shapes and involucres of the two species are quite similar, although the leaves of *T. hirsutissimum* are generally more multilobate and the end-lobes more sagittate. However, apart from differing in the stigma colour and in the hairiness of the leaves, *T. euryphyllum* also virtually lacks pollen, while the sparse punctate leaf spots of *T. hirsutissimum* are distinctive. Haworth cultivated this species from achenes sent by Scott, and it retained its distinctive features in cultivation. So far, *T. hirsutissimum* is only known from v.c. 112 (Shetland), where it has been recorded from eleven sites in two 10-km squares.

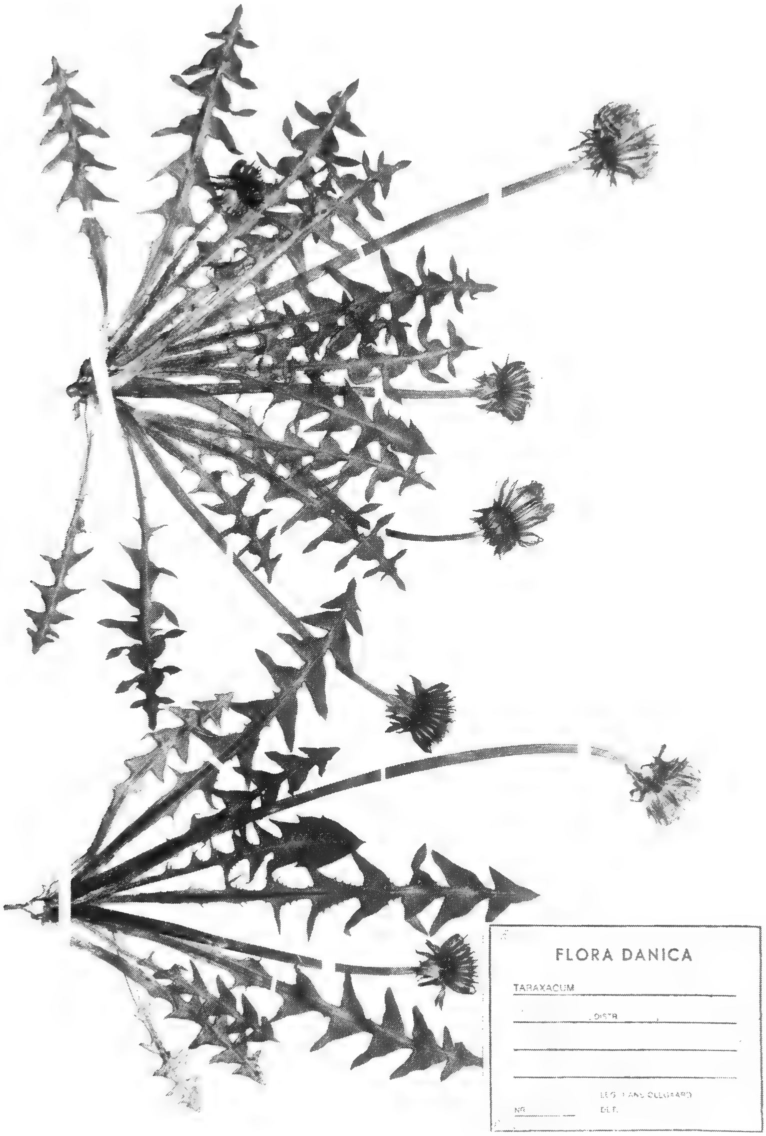


FIGURE 5. Holotype of *Taraxacum latens* H. Øllg. (top specimen).

5. **Taraxacum latens** H. Øllg., **sp. nov.**
HOLOTYPUS: Denmark, Jylland (Jutland), distr. 14, 5 km SSW Viborg, road 13 at the 86·6 km mark, *Picea* plantation, 3 May 1993, *H. Øllgaard 111.01* (part of exsiccata (HØ 93–111.xx)) (C). (Fig. 5).

Planta magnitudine mediocris c. 30 cm alta. Folia flavescenti-viridia vel viridia, sparsim araneosa, nec piceata nec maculata; nervo mediano viridi vel rarius subrubescenti, colore non striatulo; lobi laterales plerumque 6–8, deltoidei, in speciminibus tenuibus plerumque plus minusve falcati, parce dentati vel integri vel interdum incisione alta subfissi, margine proximali integro vel denticulato, apice loborum subobtusi vel acuti; lobus terminalis foliorum exteriorum intermediorumque parvus, saepe incisus, apice brevi indefinito vel gradatim sat longe protracto, in foliis interioribus conspicuo, cordato-hastato, subacuto vel subobtuso; interlobi partis superioris folii lobis lateralibus perdensis saepe subtecti, in medio plus minusve acutanguli, non vel parum plicati; petiolus roseo-purpureus, anguste alatus. Scapus folia aequans vel superans, viridis vel leviter brunnescens, sub involucro densissime araneoso, alibi sparsim araneosa. Involucrum subobscure viride, curtum, saepe fere globosum, leviter pruinosum. Squamae exteriores lanceolatae, c. 14 × 4 mm, recurvae vel retroflexae, regulares, apice ecorniculata, laete virides vel colore roseolo tinctae, plus minusve manifeste marginatae. Calathium mediocre, c. 45 mm in diametro, intense luteum; ligulae marginales planae vel parum canaliculatae, subtus stria cano-violacea ornatae, dentibus apicalibus rubescentibus; antherae polliniferae, granis pollinis diametro variis; stigmata plus minusve virescentia. Achenium fusco-stramineum, 3·5 mm longum pyramide subcylindrica laevi c. 0·6 mm longa bene definita inclusa. Rostrum 11 mm longum; pappus albus.

Plant medium-sized, about 30 cm high. Leaves yellowish-green to green, slightly araneose-hairy, neither spotted nor blotched dark, the midrib green or rarely slightly reddish, but not striatulate; lateral leaf-lobes usually 6–8, deltoid, sometimes more or less falcate in slender specimens, sparsely dentate to entire or sometimes with deep subdivisions, the proximal margin entire or denticulate, the apex subobtuse to acute; terminal lobe of the outer and intermediate leaves small, often subdivided, the apex short and obscure or varying towards somewhat long-protracted, of inner leaves conspicuous, cordate-hastate, subacute or subobtuse; interlobes of the distal part of the leaf partially hidden by dense, overlapping lateral lobes, in the median part of the leaf more or less acute, not or scarcely plicate; petiole rose-purple, narrowly winged. Scape equalling or exceeding the leaves, green or lightly brownish, very densely araneose-hairy underneath the involucre, the remainder sparsely hairy. Involucre rather dark green, short, often almost globose in bud, lightly pruinose. Exterior bracts lanceolate, c. 14 × 4 mm, recurved or reflexed, regular in arrangement, the apex ecorniculate, pale green or faintly suffused with rose, more or less strongly bordered. Capitulum medium-sized, about 45 mm in diameter, deep yellow; marginal ligules flat or slightly canaliculate, striped grey-violet beneath, the apical teeth reddish; anthers bearing pollen, the pollen grains of varying diameter; style and stigmas more or less greenish. Achene fuscous-straw-coloured, 3·5 mm including the well-defined and smooth subcylindrical cone, about 0·6 mm long. Rostrum 11 mm long; pappus white.

T. latens is classified within sect. *Ruderalia* (= sect. *Vulgaria* nom. illegit.). Amongst the numerous, mostly anthropochorous species in this section, it is recognized by the rose-pink, somewhat winged petioles, the pale green, more or less densely lobate leaves bearing entire proximal margins to the lateral lobes, and the light green, strongly recurved to reflexed, regularly arranged exterior bracts with an obviously differentiated border. The lateral leaf-lobes tend to become falcate, with a broad basal part and a well-differentiated linear distal process, especially in old plants, or in modifications from exposed positions. The terminal lobes of the outer and middle leaves are usually small and inconspicuous, more or less incised, with a gradually elongate apex, while those of inner leaves are large and conspicuous, with gross teeth almost of the stature of confluent lateral leaf-lobes.

The closest morphological relative of *T. latens* seems to be *T. crispulum* G. E. Haglund, a little-known species not recorded from the British Isles, which, however, according to the description (Haglund 1934) and the type material, has crispate interlobes with obvious dark blotchings, and much larger teeth. Also, *T. crispulum* does not produce inner leaves with large terminal lobes, the proximal margins of the lateral leaf-lobes are more or less subulate-dentate, and the achene cone is a little shorter.

Amongst commoner *Taraxacum* species, *T. latens* is best compared with *T. aequilobum* (the leaf-shape is somewhat similar, but in *T. aequilobum* the exterior bracts are very irregular and more or less twisted), *T. vastisectum* Markl. ex Puol. (again, the leaf-shape is somewhat similar, but the latter species has a darker and faintly bluish leaf colour, usually well-developed teeth on the proximal margins of the lateral leaf-lobes, no elongation at the apex of the terminal leaf-lobe, and less reflexed, dirty purplish exterior bracts) and *T. amplum* Markl. (similar in leaf and petiole colour, and in the border to the exterior bracts, but with more or less patent exterior bracts, and the sagittate, usually entire, terminal lobes to the inner leaves).

In the British Isles, *T. latens* has so far been recorded from five 10-km squares in north Essex (v.c. 19), Shropshire (v.c. 40), Denbighshire (v.c. 50) and Cheshire (v.c. 58). Its distribution here suggests that it may be introduced. Elsewhere, it has been recorded from 17 recording districts (TBU09, 10, 11, 14, 15, 20, 26, 28, 33, 37, 39b, 47, 48, 49, 50, 52, 53) in Jutland, Denmark, from three sites in the Netherlands, from two sites in Germany, and from three sites in the Czech Republic. (A full list of authentic specimens identified up until now can be obtained from the species' author at Lupinstien 7, Birgittelyst, Viborg 8800, Denmark.)

6. **Taraxacum nigridentatum** T. Edm., **sp. nov.**
HOLOTYPUS: Hapsford, Cheshire, v.c. 58, GR SJ/468.745, 3 May 1985, *T. Edmondson 1985.57* **(OXF)**. (Fig. 6).

Planta robusta, magnitudine mediocris vel magna. Folia adscendentia erectave, obscure viridia, immaculata, interlobis dentibusque utrinque valde piceata, nervo mediano sordide roseo, lanceolata, ad 250 mm longa, multilobata; lobi laterales 5–8, subpatentes recurvative, sat longi, acuti, margine distali recto sigmoideo, multos dentes nigros vel unum dentem grossum ferenti; lobus terminalis subhastatus subsagittatusve, folii partibus inferioribus angustior, 1–2- saepe unilateraliter inaequaliterve subdivisus vel dentatus, apice protractus subacutus; petiolus alatus, interdum late alatus, roseus vel basi albus. Scapus sub anthesi folia aequans, sordide roseus. Involucri squamae exteriores patentes vel eae infimae recurvatae, 12–14 × 2–3 mm, emarginatae, supra pallide virides vel purpureo suffusae, subtus obscuriores. Calathium luteum, 40–50 mm in diametro, ligulis stria cano-brunnescenti subtus notatis; stylus stigmataque sordidi; antherae polliniferae. Achenium stramineo-brunnescens spinulosum, 3·3 mm longum pyramide exclusa, pyramide minima, ad 0·3 mm longa; rostrum 5–6 mm; pappus albus.

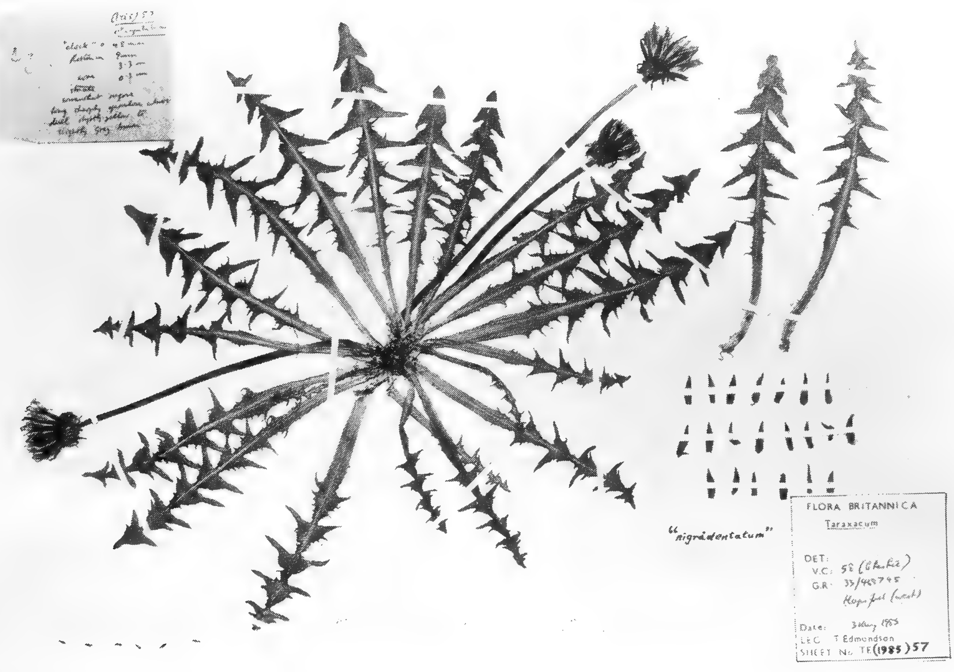


FIGURE 6. Holotype of *Taraxacum nigridentatum* T. Edm.

Plant robust, medium-sized to large. Leaves ascending or erect, dark green, unspotted, the interlobes and teeth heavily marked with black on both sides, midrib dirty pink, lanceolate, to 250 mm in length, multilobate; lateral leaf-lobes 5–8, patent to recurved, rather long, acute, with many black teeth on the distal margin or with one large tooth on distal lobes, the distal margin straight-sided or sigmoid; terminal leaf-lobe subhastate to subsagittate, narrower than lower parts of the leaf, with 1–2 subdivisions or teeth, often on one side only, or if on both sides, then usually alternately arranged, with an attenuate subacute apex; petiole winged, sometimes widely so, pink, or white at the base. Scape equalling the leaves at flowering time, dirty pink. Exterior bracts mostly spreading, the lower recurved, 12–14 × 2–3 mm, unbordered, pale green or suffused purplish above, darker below. Capitulum deep yellow, 40–50 mm in diameter, the ligules striped greyish-brown beneath; style and stigmas dirty coloured; pollen present. Achene straw-brown, spinulose, 3·3 mm (excluding the cone), the cone very small, to 0·3 mm; rostrum 5–6 mm; pappus white.

T. nigridentatum is a weedy species classified within sect. *Ruderalia*. These plants of anthropogenic habitats tend to be much more mobile than species of more natural habitats, and consequently they rarely occur as localized endemics. Approximately 130 species classified within this section are recorded from the British Isles, but of these only four have yet to be recorded in another country. So far, *T. nigridentatum* is not recorded with certainty away from western Britain, where it may be endemic, although similar plants may occur in the Netherlands. It has been recorded from 29 10-km squares, but so far is known from only the following western vice-counties: East Gloucestershire (v.c. 33), West Gloucestershire (v.c. 34), Monmouthshire (v.c. 35), Breconshire (v.c. 42), Flintshire (v.c. 51), Cheshire (v.c. 58) and Cumberland (v.c. 70).

T. nigridentatum is a relative of *T. pannulatum* Dahlst., and morphologically it is particularly close to *T. pannulatiforme* Dahlst., although in well-developed leaves, the leaf-lobes of *T. nigridentatum* tend to be narrower and more multidentate. However, *T. nigridentatum* is invariably and characteristically heavily blotched with black on the interlobes and leaf-teeth, while the midrib and the petiole (except usually the very base outside which is white) are a dirty reddish-pink. In comparative cultivation with *T. pannulatiforme*, Haworth showed that the distinctive leaf colour and the minor differences in leaf shape of *T. nigridentatum* were maintained (the leaves of *T. pannulatiforme* are essentially green throughout).

7. **Taraxacum sahlinianum** A. A. Dudman & A. J. Richards, **sp. nov.**
HOLOTYPUS: Woodside, Maryport, Cumberland, v.c. 70, GR NY/047.343, roadside, 8 May 1991, *A. A. Dudman s.n.* (**OXF**). (Fig. 7).

Planta magnitudine mediocris, sat robusta. Folia suberecta plana, sordide obscuroviridia, immaculata epiceataque, nervo mediano ordinatione intertexto sordide purpureo notato, late oblanceolata, ad 200 mm longa; lobi laterales 2–4, patentes subrecurvative, lati subbrevesque, triangulares subacuti, margine distali saepe recto vel subconvexo, lobis inferioribus margine distali dentibus filiformis ornatis; lobus terminalis submagnus, obtusus sed apice ipso mucronatus, inaequaliter grosse 1–3-dentatus; petiolus alatus vel saepe late alatus, dentatus, ordinatione intertexto purpureo notatus. Scapus sub anthesi folia aequans, erectus. Involucri squamae exteriores pruinosae, patentes sed decurvatae, 10 × 3 mm, vix marginatae, supra pallide virides interdum purpureo suffusae, subtus obscuriores. Calathium luteum, 40–45 mm in diametro, ligulis stria obscura griseo-violacea subtus notatis; stylus stigmataque sordidi; antherae polliniferae. Achenium fulvo-stramineum, apice rugosum alibi laeve, 3·8–4·0 mm pyramide exclusa, pyramide conica 0·6 mm longa; rostrum 10 mm longum; pappus albus.

Plant medium-sized, somewhat robust. Leaves suberect, flat, dark and dirty green, lacking spots or dark markings, the midrib dirty purple in an interwoven pattern, broadly oblanceolate, to 200 mm long; lateral leaf-lobes 2–4, patent to somewhat recurved, broad and rather short, triangular, subacute, the distal margins straight or slightly convex, filiform dentate on lower lobes; terminal leaf-lobe rather large, obtuse but mucronate, unequally provided with 1–3 large teeth; petiole winged, often broadly so, filiform dentate, purple in an interwoven pattern. Scape equalling the leaves at flowering time, erect. Exterior bracts spreading but downcurved, pruinose, 10 × 3 mm,

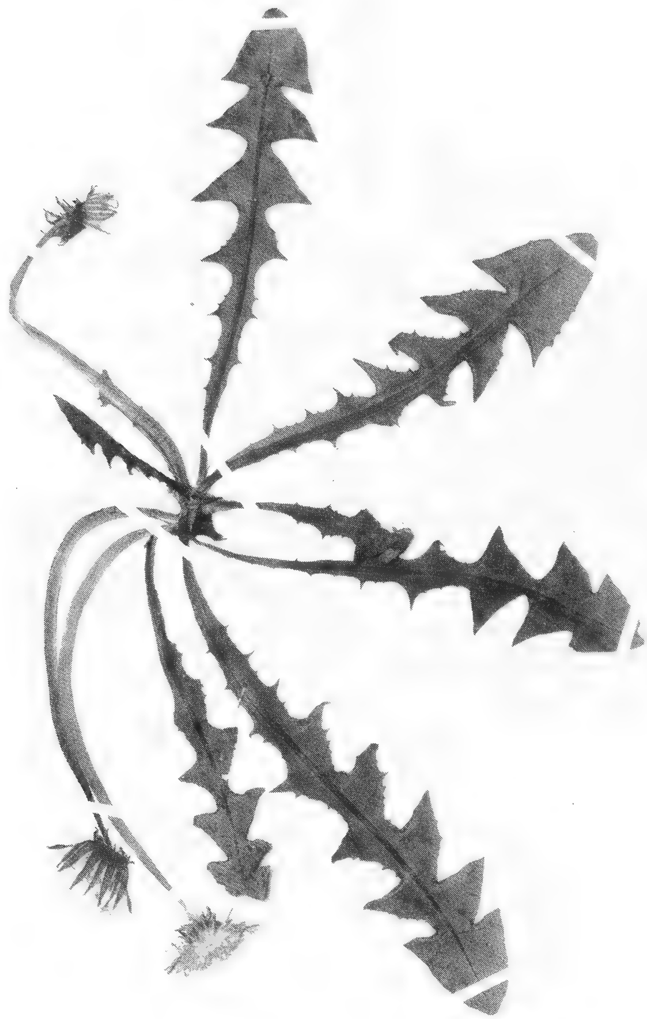


FIGURE 7. Holotype of *Taraxacum sahlinanum* A. A. Dudman & A. J. Richards.

scarcely bordered, pale green but sometimes suffused purple above, darker green below. Capitulum deep yellow, 40–45 mm diameter, the ligules striped dark grey-violet below, style and stigmas dirty coloured; pollen present. Achene fulvous-straw coloured, rugose above, the remainder smooth, 3·8–4·0 mm (excluding the cone), the cone conical, 0·6 mm; rostrum 10 mm; pappus white.

From the shape, size, posture and pruinosity of the exterior bracts, the colour and lobation of the leaves, and the characteristically 'interwoven' pattern of the colour in the midrib and petiole, it is clear that *T. sahlinianum* should be classified with sect. *Hamata* H. Øllg. Within this section, *T. sahlinianum* is most closely allied to *T. atactum* Sahlin & Soest. In particular, the large, subrounded end-lobes to the leaves, which are often one-sidedly provided with one or a few large teeth, are reminiscent of this species. Although *T. atactum* is a widespread British species, some early records in fact refer to *T. sahlinianum*.

Øllgaard first pointed out that not all British material referred to *T. atactum* was typical of that species, and this was confirmed by the late C. I. Sahlin, one of the authors of the name *T. atactum*. Since then, Haworth and Richards have recognised a distinctive taxon which was given the workname *Taraxacum* "British atactum". Now that we believe that we understand this taxon well, we feel that the time has come to describe it formally. In doing so, we would like to commemorate the Swedish taraxacologist Carl Ingemar Sahlin who died in 1990.

T. sahlinianum is best distinguished from *T. atactum*, and indeed from its other relatives in sect. *Hamata*, by the broad, broadly lobed leaves with an often widely winged petiole, and by the large achene. Apart from *T. atactum*, no relative has a long toothed end-lobe to the leaf. The dull, dark and rather dirty hue of the leaf is also distinctive.

T. sahlinianum will probably prove to be a widespread and frequent species of semi-natural grassland habitats, particularly in the west of Britain. At present it is recorded from 15 10-km squares in the following vice-counties: West Gloucestershire (v.c. 34), Monmouthshire (v.c. 35), Breconshire (v.c. 42), Carmarthenshire (v.c. 44), West Lancashire (v.c. 60), Westmorland (v.c. 69), Cumberland (v.c. 70) and Wexford (v.c. H12).

So far, *T. sahlinianum* has not been recorded outside the British Isles.

ACKNOWLEDGMENTS

We would like to thank those British workers whose efforts have led to a fuller understanding of the species described here, particularly Tom Edmondson, Michael Porter, Merle Marsden, Richard Palmer and Walter Scott. As always, we are indebted to authorities in other countries for critical comments, notably Hans Øllgaard and Piet Oosterveld.

REFERENCES

Haglund, G. E. (1934). Några nya eller i Sverige nyfunna *Taraxacum*-arter. *Botaniska notiser* **1934**: 1–41.

Haworth, C. C. (1990). Six native species of *Taraxacum* new to the British Isles. *Watsonia* **18**: 131–138.

Haworth, C. C. & Richards, A. J. (1990). The lectotypification and revision of Dahlstedt's species of *Taraxacum* Weber based on British or Irish plants. *Watsonia* **18**: 125–130.

Øllgaard, H. (1986). *Taraxacum discretum* sp. nov. (Compositae). *Nordic journal of botany* **6**: 21–24.

Richards, A. J. (1972). *Taraxacum* flora of the British Isles. *Watsonia* **9** (suppl.): 1–141.

(*Accepted March 1994*)

New species of *Rubus* L. (Rosaceae) from Wales and the Welsh Marches

A. NEWTON

10, The Fairways, Leamington Spa, Warwickshire, CV32 6PR

and

M. PORTER

Aberhoywy, Cyffredin Lane, Llangynidr, Crickhowell, Powys, NP8 1LR

ABSTRACT

The relationships and distributions of five brambles (*Rubus* L.) in the *Corylifolii* section occurring in Wales and the Welsh Marches are discussed. Three new species from this section and one from series *Hystrices* are described: **Rubus ariconiensis** A. Newton & M. Porter, **sp. nov.**, **R. iscanus** A. Newton & M. Porter, **sp. nov.**, **R. vagensis** A. Newton & M. Porter, **sp. nov.** and **R. segontii** A. Newton & M. Porter, **sp. nov.**

KEYWORDS: Apomictic species, distribution, brambles.

INTRODUCTION

Considering their abundance in many regions, the brambles of sect. *Corylifolii* Lindl. have been a neglected component of the genus *Rubus*. In his conclusions to a review of the section, Edees (1975) noted "Much remains unknown. A great deal of fieldwork must be done and probably many more taxa described before a comprehensive account can be written." Visits to many parts of Britain have corroborated this view. Growing in profusion in the hedges of the southern Welsh Marches are several brambles of the *Corylifolii* section which have puzzled generations of batologists. Recent research has shown that four of these brambles are widespread in South Wales and the West Midlands; these and their allies are discussed below and three are described as new species. The opportunity is taken to describe a new bramble of the *Hystrices* series from North Wales.

THE SPECIES

Rubus iscanus A. Newton & M. Porter, **sp. nov.**

Turio arcuatus in apricis fusco-purpureus pruinosus obtuse angulatus faciebus planis glabrescens glandulis stipitatis sparsis aculeis crebris plerumque ad angulos dispositis aequalibus patentibus rectis vel obfalcatis aculeisque brevibus raris armatus.

Folia (3)–5-nata pedata imbricata superne parce strigosa inferne capillis simplicibus vestita. Foliolum terminale apice cuspidatum vel acuminatum, late ellipticum vel subrotundum basi emarginatum vel subcordatum inaequaliter serratum vel biserrate dentatum interdum lobatum petiolulo triplo longius; foliola infima subsessilia.

Inflorescentia cylindrica fere ad apicem foliosa inferne 2–4 foliis ternatis superne 1–3 foliis simplicibus instructa; ramuli inferiores foliis breviores 3–7 flori. Rachis vix flexuosa pilosa tomentosa aculeis 4–6 mm rectis vel declinatis validis glandulisque stipitatis nonnullis armata. Flores 3–4 cm diam.; sepala post anthesin reflexa mox fructum laxe amplectantia tomentosa albo-marginata glandulis subsessilibus rubris ornatis. Petala rosea elliptica vel obovata interdum apice emarginata fimbriata; stamina stylos roseos vix superantia; anthera glabra; filamenta rosea; carpella glabra; fructus subglobosus.

Stem low-medium arching, angled with flat sides, brownish-purple on exposed sides, pruinose, initially with short tufted or simple hairs becoming almost glabrous, with scattered sessile glands and occasional short-stalked glands; prickles c.15–25 per 5 cm mainly on the angles but some on the faces, ± equal, 5–6 (−7) mm, about equal to the stem diameter ± straight or slightly upswept at the tip, patent or slightly declining, purple with straw coloured tips, rarely one or two short prickles c. 1 mm. Leaves pedate, leaflets (3–) 5, imbricate, mid-green, slightly strigose above, soft beneath rather thinly clothed with simple hairs; terminal leaflet c. 7.5 × 6.5 cm, broadly elliptical, ovate, obovate or subrotund with an acuminate or cuspidate apex c. 1 cm and emarginate or cordate base, compound serrate or unevenly biserrate with flat or slightly undulate margin, the petiole c. 1/3 as long as the lamina; basal leaflets subsessile or with petiolules up to 2 mm; petioles about the same length or slightly longer than basal leaflets, coloured like the stems, with rather dense spreading simple or tufted hairs and occasional very short stalked glands, c. 12–15 ± straight, slightly declining prickles c. 2 mm. Flowering branch with 3-foliate leaves below and up to 3 simple leaves above, usually leafy almost to apex; inflorescence cylindrical consisting of a terminal head of a few flowers borne on widely diverging peduncles and pedicels with several ± distant axillary peduncles shorter than their leaves (bearing up to 7 flowers). Rachis slightly flexuose coloured like the stem with dense whitish spreading and adpressed simple or tufted hairs and stellate hairs, sparse to frequent sessile or short-stalked glands, several straight slightly declining stout-based prickles 4–6 mm, crimson with straw coloured tips; peduncles clothed like the rachis but with denser more adpressed hairs so that they appear greyish in colour, prickles straight slightly declining, up to 4 mm; pedicels clothed as peduncles but with shorter hair and prickles ± straight patent or slightly declining, up to 3 mm, sparse to frequent dark red short or very short stalked glands especially just below the flowers. Flowers c. 3.5 cm in diameter; sepals greyish-green with dense felt and short simple hairs, few short acicular prickles, occasional short stalked glands and few or many subsessile glands, white-margined, short pointed, reflexed at petal fall, erect to clasping in fruit; petals c. 15 × 10 mm bright pink elliptical to obovate, sometimes notched or erose at apex, with short hairs on the margins; stamens slightly exceeding styles, filaments pink, anthers glabrous; styles pink or pink-based; carpels glabrous, receptacle glabrous or slightly hairy; fruit small-medium ± round sometimes partly abortive, consisting of rather few drupelets. Flowering from June to September.

HOLOTYPUS: Canal bank, Llangynidr, Brecs., v.c. 42, GR SO/165.195, 20 June 1992, *M. Porter* (**NMW**).
ISOTYPI: **BIRM**, **BM**.

The bramble takes its name from the Roman name (Isca) for the River Usk. *Rubus iscanus* is one of the first brambles to flower in the Usk valley, its large pink blooms being conspicuous from early June in thickets and hedges from Brecon to the Severn estuary. It has also been recorded from localities scattered across Monmouthshire (v.c. 35), from the Usk to the Wye. A specimen at **NMW**, collected from Mounton near Chepstow by W. A. Shoolbred in 1892, was determined as *R. eupectus* (Sudre) W. C. R. Watson by Watson in 1949.

R. iscanus has been recorded from v.cc. 34, 35, 36 and 42. Its known distribution is shown in Fig. 1.

Rubus ariconiensis A. Newton & M. Porter, **sp. nov.**

Turio arcuato–decumbens in apricis rubiginosus angulatus superficiebus planis vel concavis vix pruinosus glabrescens aciculis glandulisque stipitatis 0.5–4 mm longis sparsis, aculeis aculeolisque 1–7 mm longis nonnullis glanduliferis haud ad angulos limitatis e basi lata rectis vel declinatis vel devexis copiose armatus. Folia (3-) 5- nata, pedata. Foliola contigua superne parce strigosa inferne capillis simplicibus brevibus vestita, foliolum terminale (c. 7 × 4.5 cm) ellipticum cuspidatum basi integra vel emarginata margine denticulata. Foliola infima sessilia vel subsessilia; petioli foliolis

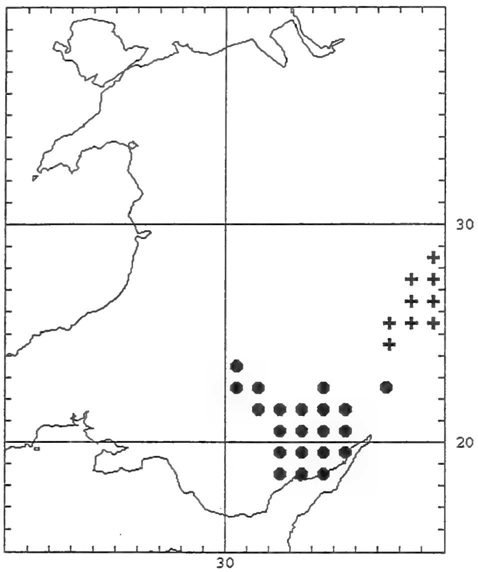


FIGURE 1. Distribution of *Rubus tenuiarmatus* (+) and *R. iscanus* (●).

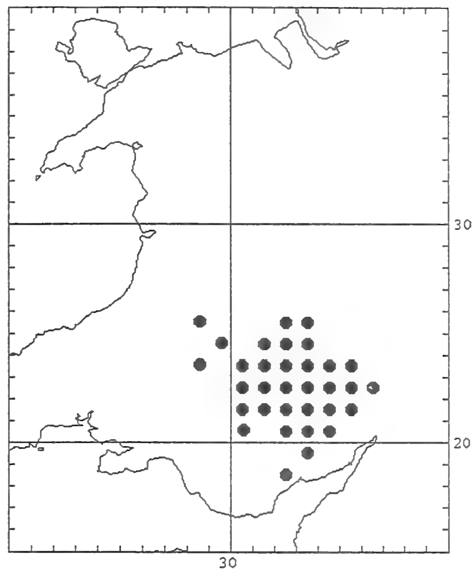


FIGURE 2. Distribution of *Rubus ariconiensis*.

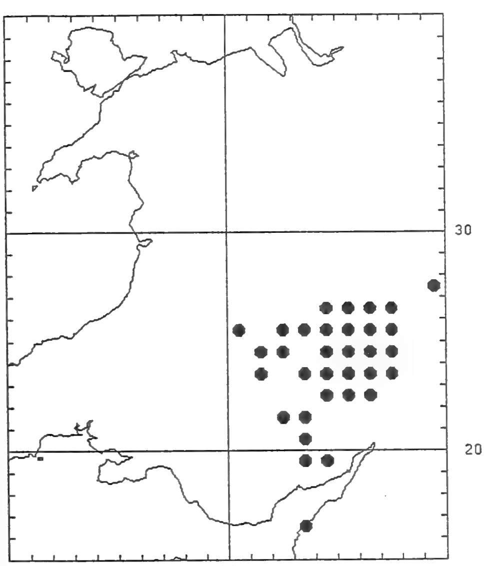


FIGURE 3. Distribution of *Rubus vagensis*.

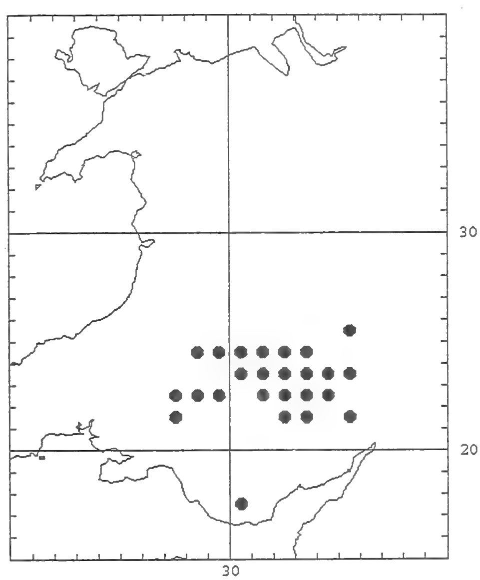


FIGURE 4. Distribution of *Rubus pictorum* excluding Scotland.

longiores aculeis – 3 mm longis curvatis nonnullis muniti. Inflorescentia angustata elongata infime foliis ternatis instructa ad apicem congestum aphylla, ramuli infimi et medii adscendentes 30–45°, 5–10 flori. Rachis vix flexuosa, pilosa, glandulis stipitatis magnitudine variis, aculeolis glanduliferis aculeis usque 5 mm longis inaequalibus tenuibus rectis vel leviter curvatis crebris praedita. Pedicelli superiori parti rachidis similes dense pilosi et tomentosi, aculeis patulis, aculeolis glanduliferis et glandulis stipitatis muniti.

Flores c. 2–2.5 cm diam. Sepala griseoviridia albo-marginata, hirsuta et tomentosa, glandulis stipitatis brevibus numerosis aciculisque raris vestita, primo patentia mox fructum amplectantia. Petala roseata parum distantia elliptica vel obovata fimbriata; stamina stylos roseos vix superantia; anthera glabra, filamenta rosea; carpella glabra; fructus subglobosus.

Stem low-arching, angled with flat or slightly concave sides, green becoming brownish-red on exposed sides, with sparse simple and tufted hairs, glabrescent, occasional sessile glands and scattered stalked glands of various lengths grading into gland-tipped prickles to 4 mm; prickles numerous, sometimes crowded, not confined to the angles, unequal, to 7 mm, the longest about as long as the stem diameter, narrowed abruptly from a broad compressed base, patent or declining, straight or curved, red with yellow tips.

Leaves pedate; leaflets usually 5, sometimes 3 or 4, contiguous or not, mid or yellowish green, sparsely strigose above, with medium to dense short simple hairs beneath; terminal leaflet c. 7 × 4.5 cm, elliptical or slightly obovate with cuspidate apex c. 1 cm and entire or emarginate base, finely but unevenly serrate occasionally with principal teeth retrorse, flat, the petiolule rather more than 1/3 as long as the lamina (av. c. 36%); basal leaflets sessile or subsessile; petiole normally longer than basal leaflets, with about 16 slightly curved ± equal prickles 2–3 mm and sometimes a few smaller prickles. Flowering branch with 3–5 ternate leaves and usually one simple leaf above, not leafy to apex. Inflorescence consisting of a compact terminal head of up to 10 flowers, 3–7 cm in length, with distant ascending axillary peduncles up to 8 cm, usually shorter than their leaves, bearing about 5–10 flowers mainly in a terminal cluster with one or two distant below; rachis almost straight, becoming reddish on exposed side with numerous spreading and adpressed simple and tufted hairs, numerous stalked glands from short to long grading into gland-tipped pricklets, frequent straight or slightly curved patent or declining unequal prickles up to 5 mm; pedicels with dense mainly spreading simple or tufted hairs, stalked glands of various lengths grading into gland-tipped pricklets, prickles ± straight, patent, 1–3 mm.

Flowers c. 2.5 cm in diameter; sepals greyish-green with white margins, with dense short simple hairs, stellate hairs and numerous short or very short stalked glands and rare acicles, short or medium pointed, loosely reflexed at petal fall, later erect to clasping; petals c. 14 × 9 mm, pink, obovate or elliptical, ± cuneate at base, notched or erose at apex, numerous very short hairs on margin, usually not contiguous; stamens exceeding styles, filaments lilac-pink, anthers glabrous; styles pink, carpels glabrous; receptacle glabrous or occasionally with a few hairs; fruit round with few drupelets, sometimes partly abortive. Flowering from June until August.

HOLOTYPUS: hedge, Llangynidr, Brecs., v.c. 42, GR SO/162.193, 9 July 1992, *M. Porter* (**NMW**). ISOTYPI: **BIRM**, **BM**.

This bramble seems to have been noticed first by W. M. Rogers during his tour of Breconshire and Radnorshire in 1898. At first he identified it as *R. marshalli* Focke & Rogers var. *semiglaber* and recorded it at Llangorse Common and in several places in the upper Wye valley. In the report of his visit (Rogers 1899) he notes that the bramble is "widely spread in Wales and somewhat variable in character. It also crosses the border into Herefordshire and is especially abundant at Cusop near Hay." Later, in his *Handbook* (1900), he comments "The Breconshire and West Herefordshire plant is abundant in hedges and at times recalls *R. dumetorum* but its rather large drupelets are neither glaucous nor caesian in flavour. It has very showy flowers with deep pink petals, stamens and styles." The petals turn a deeper pink on drying.

From a study of A. Ley's herbarium at **BIRM**, which includes several gatherings of this plant, it appears that from about 1903 Rogers referred it to *R. diversifolius* Lindl., which at this time was used as a collective name for several hystrican *Corylifolii* including *R. tuberculatus* Bab. However, as E. S. Edees (1975) has pointed out, *R. diversifolius* is a nom. superf. illegit. for *R. vestitus* Weihe & Nees: the Breconshire and West Herefordshire plant is therefore described above as a new species.

A recent survey of its distribution has shown that *R. ariconiensis* occurs in v.cc. 35, 36, 42 and 43. It is particularly abundant in that part of Herefordshire west of the River Wye which in post-Roman times formed the Kingdom of Irching or Archenfield, thought to have derived its name from the Roman settlement of Ariconium. The bramble is common in hedges but also occurs in woods and thickets and reaches an altitude of 370 m on the limestone cliffs of Craig-y-cilau near Crickhowell. When growing in shade, as at Mouse Castle near Cusop, the flowers remain deep pink but the stem armature is much reduced. *R. ariconiensis* is allied to *R. tuberculatus*, *R. vagensis* and *R. tenuiarmatus*.

The known distribution is shown in Fig. 2.

Rubus vagensis A. Newton & M. Porter, **sp. nov.**

During fieldwork to trace the distribution of *R. ariconiensis* a closely related bramble was encountered in hedges in several places in Herefordshire. At first it was thought that this might be the long-lost *Rubus tenuiarmatus* described by Edwin Lees in *Botany of the Malvern Hills*, 2nd ed. (1852), where he mentioned that it grew in hedges and thickets about Great Malvern. During the following decade *R. tenuiarmatus* was recorded on several field meetings of both the Woolhope Club (based in Hereford) and the Worcestershire Naturalists. Then suddenly it disappeared from the batological scene, submerged by C. C. Babington under *R. balfourianus* Blox. (*R. nemorosus* Hayne & Willd.). Later however he seems to have lost faith in this judgement (MS notes in **LIV**).

In 1993 specimens of the Herefordshire bramble collected during 1991–2 were compared with the type specimens of *R. tenuiarmatus* at **CGE**, at the time thought to be the sole surviving herbarium specimen, upon which the account in *Brambles of the British Isles* (Edees & Newton 1988) was based. The type specimen was collected at Bromsgrove Lickey in Worcestershire (v.c. 37) in October 1850 by William Mathews, a life-long friend of Edwin Lees. Comparison was made difficult both by the age of the type and the fact that it was collected so late in the year. The two brambles are indeed similar in many respects but there are significant differences which are noted in Table 1; consequently the Herefordshire bramble is described below as *Rubus vagensis*. Vaga as a Latin name for the River Wye was an invention of 16th century scholars (Bannister 1916).

TABLE 1. DIFFERENCES BETWEEN *RUBUS TENUIARMATUS* AND *R. VAGENSIS*

Character	*R. tenuiarmatus*	*R. vagensis*
T. S. stem	Almost round	Distinctly angled
Number of largest prickles per 5 cm of stem	(6–) 10 (–14)	(15–) 20 (–25)
Largest prickles	Very slender	Stronger with wider base
Terminal leaflet shape	Ovate	Obovate – suborbicular
Terminal leaflet tip	Acuminate	Cuspidate
Leaf colour	Bright green	Mid – dark green
Leaf margin	Jagged – sharply biserrate	Shallowly serrate with some principal teeth retrorse
Number of petiole prickles	(5–) 9 (–12)	(10– 16 (–21)
Petal colour	Bright pink	Very pale lilac pink often fading to off-white
Filament colour	White	Usually lilac pink, darkening when dried
Carpels	± glabrous, sometimes one or two hairs	Hairy
Fruit size	Small – medium	Medium – large

Turio arcuato-decumbens in apricis purpurascens angulatus superficiebus planis capillis simplicibus stellatisque vestitus, glandulis stipitatis numerosis, aciculis sparsis, aculeis aculeolisque usque 6 mm longis, haud ad angulos limitatis rectis vel leviter curvatis patentibus vel obliquis armatus. Folia (3-) 5-nata, pedata. Foliola contigua vel imbricata superne parce strigosa inferne capillis simplicibus stellatisque interdum vestita; foliolum terminale (c. 8 × 6 cm) late obovatum vel ellipticum apice cuspidatum basi integra vel emarginata margine denticulata. Rachis vix flexuosa pilosa tomentosa glandulis stipitatis numerosis aciculis sparsis aculeis aculeolisque 1–7 mm longis inaequalibus rectis fere patentibus numerosis praedita. Inflorescentia angustata elongata ad apicem aphylla; ramuli infimi et medii adscendentes foliis breviores, supremi pauciflores distantes. Flores 2.5–3 cm diam. Sepala griseo-tomentosa glandulis aciculisque ornata primo laxe reflexa tandem fructum amplectantia. Petala pallide roseo-lilacina elliptica vel late obovata fimbriata; stamina stylos virides vix superantia; filamenta pallide roseo-lilacina vel alba; antherae glabrae; carpella hirsuta; fructus subglobosus.

Stem low-arching, angled, becoming purple on exposed sides, with sparse to numerous short simple and tufted hairs, numerous stellate hairs, sparse or numerous short and medium stalked glands and occasional gland-tipped acicles; prickles 15–25 per 5 cm, not confined to the angles, mostly 5–6 mm but with some short prickles 1–2 mm and sometimes a few prickles of intermediate length, straight or curved, patent or declining, narrowed abruptly from a compressed base, purple with straw coloured tip. Leaves pedate; leaflets (3–) 5, usually contiguous, sometimes imbricate, mid to dark green with adpressed simple hairs above and dense short simple hairs beneath, with sometimes an underlayer of stellate hairs; terminal leaflet c. 8 × 6 cm, broadly obovate or suborbicular, with a cuspidate apex c. 1 cm and entire or slightly emarginate base, slightly unevenly but shallowly serrate with some principal teeth retrorse, flat, the petiolule 1/4–1/3 as long as lamina; basal leaflets sessile or subsessile; petiole about the same length or longer than basal leaflets with about 15 straight or gently curved declining ± equal prickles c. 3 mm.

Flowering branch with 2–4 ternate leaves below and 0–1 simple leaf above, not leafy to apex; inflorescence consisting of a narrow, cylindrical, rather open, few-flowered terminal head c. 4–8 (–10) cm and distant ascending axillary peduncles rather shorter than their leaves; rachis nearly straight, greyish-green or purple in colour, with spreading and adpressed short and medium simple or tufted hairs and dense stellate hairs, frequent to numerous medium and long stalked glands and rare acicles, numerous straight slightly declining unequal prickles up to 7 mm and a few shorter prickles 1–3 mm; pedicels with dense mainly adpressed short simple or tufted hairs and stellate hairs, stalked glands of various lengths but mostly longer than the indumentum, a few acicles and straight slender ± patent prickles 2–4 mm.

Flowers c. 2.5–3 cm in diameter; sepals greyish-green with dense stellate hairs and short or very short simple hairs, numerous short medium stalked glands and some acicular pricklets, short or medium pointed, weakly reflexed at petal fall, later erect to clasping; petals c. 14 × 9 mm pale lilac pink, broadly elliptical or obovate, sometimes shallowly notched or erose with hairy margin; stamens ± same length or slightly longer than styles, filaments usually pale lilac rarely white, anthers glabrous; styles pale green, carpels hairy; fruit round to oblong (15–20 mm) with 15–30 drupelets, sometimes partly abortive. Flowering June to August.

HOLOTYPUS: edge of wood, Aconbury, Herefs., v.c. 36, GR SO/518.327, 4 July 1992, *M. Porter* (**NMW**).
ISOTYPI: **BM**, **BIRM**.

Field studies during the past three summers have shown *R. vagensis* to be widespread and locally abundant in Monmouthshire (v.c. 35) and Herefordshire (v.c. 36). In a few places, e.g. Aconbury Hill near Hereford, *R. vagensis* and *R. ariconiensis* grow close together, but generally *R. vagensis* tends to replace its ally east of the River Wye and extends across Herefordshire to the Malvern Hills and Worcestershire (v.c. 37). There are specimens collected by A. Ley in Herefordshire at **BIRM** and **NMW**, usually determined as *R. diversifolius* Lindl. *R. vagensis* has been recorded from v.cc. 6, 35, 36, 37, 42 and 43. The known distribution is shown in Fig. 3.

Rubus tenuiarmatus Lees

After a careful study of the lectotype at **CGE** in 1993, localities in Worcestershire where Lees had recorded *R. tenuiarmatus* were searched, resulting in its rediscovery in several of the old sites. In addition further specimens collected by William Mathews came to light in the herbarium of the City Museum, Worcester (**WOS**). An undated specimen collected by Lees from Great Malvern and labelled *R. diversifolius* Lindl. was found at **CGE** (*Babington no. 162*). This is the only specimen of *R. tenuiarmatus* collected by Lees we have seen and it probably dates from before 1850, since following the publication of *R. tenuiarmatus* in 1852 *R. dumetorum* var. *diversifolius* was dropped from the two later editions of *Botany of the Malvern Hills* (Lees 1852, 1868). Later in the 19th century batologists used *R. diversifolius* as a collective name for at least four hystrican *Corylifolii* and there is a specimen of *R. tenuiarmatus* at **BIRM**, collected by A. Ley near Whitbourne in Herefordshire in 1907 as *R. dumetorum* var. *diversifolius* Lindl. That it was so labelled by Ley was doubtless due to the inclusion of *R. tenuiarmatus* under *R. balfourianus* by Babington (1869) and its subsequent eclipse. Various comments by Lees after 1865 indicate that his concept of *R. tenuiarmatus* was broadened in later years: "It is a general bramble, the blueish fruit showing its affinity to *R. caesius*" (1867) and "When very well developed this becomes the *R. balfourianus* of Bloxam" (1868), deferring to Babington's view. However it is noteworthy that all the contemporary gatherings labelled *R. tenuiarmatus* that have been found so far clearly belong to the same taxon and closely match the lectotype.

The following exsiccatae have been seen, in addition to the lectotype: Bromsgrove Lickey, Worcs., 3 October 1850, *W. Mathews*, **WOS**; Uffmoor Lane, Halesowen, Worcs., 4 October 1850, *W. Mathews*, **WOS**; Huddington, Worcs., 12 August 1853, *W. Mathews*, **WOS**; Churchill, Kidderminster, Worcs., 23 August 1853, *W. Mathews*, **WOS**; Great Malvern, Worcs., undated, *E. Lees*, **CGE**, as *R. diversifolius* Lindl; Whitbourne, Herefords., 6 August 1907, *A. Ley*, **BIRM**, as *R. dumetorum* var. *diversifolius* Lindl.

During 1993 *R. tenuiarmatus* was recorded from the following sites in Worcestershire (v.c. 37): Lane near Clent, SO/926.784, A.N. & M.P., 19 July; Hollies Hill Lane near Belbroughton, SO/928.777, M.P., 31 July; Bridle path near Churchill, SO/876.795, M.P., 4 August; Broughton Green, SO/954.616, M.P., 25 August; Monk Wood near Sinton Green, SO/808.608, M.P., 25 August; Huddington, SO/941.576, M.P., 25 August; Upper Broadheath, SO/797.557, M.P., 25 August.

Additional information, particularly on floral structure, has provided a clear picture of a hitherto shadowy bramble. *R. tenuiarmatus* is more closely related to *R. vagensis*, *R. ariconiensis* and *R. tuberculatus* than to *R. nemorosus* under which it was submerged by Babington (1869). Watson (1958) equated *R. triangularis* (Ley) Edees with *R. tenuiarmatus* but the two brambles are very different, as Edees pointed out (1975). Both can be seen in hedges in the Teme valley along the boundary between Herefordshire and Worcestershire.

The known distribution of *R. tenuiarmatus* is shown in Fig. 1.

Rubus pictorum Edees

A white-flowered bramble with very prickly and glandular stems is common in the foothills of the Black Mountains in Herefordshire and Breconshire. Herbarium studies revealed that this plant had been collected on numerous occasions by A. Ley and usually determined as *Rubus britannicus* Rogers. In his report of a field meeting of the Woolhope Field Naturalists' Club in the Black Mountains in 1897 Ley comments ". . . all through the district the hedges and bushy banks produced abundantly the rare bramble *Rubus britannicus*." W. M. Rogers recorded the plant as fairly frequent during his visit to Breconshire and Radnorshire in 1898. In his *Handbook* (Rogers 1900) it is recorded as *Rubus dumetorum* Weihe var. *britannicus* Rogers, from eleven vice-counties in England, Scotland and Wales.

W. C. R. Watson seems to have followed Rogers' wide interpretation of the taxon, although he mistakenly equated the Scottish representatives with his *R. iodnephes* of the Richmond (Surrey) district, but in 1975 E. S. Edees restricted *R. britannicus* Rogers to the plant of southern England with a specimen from Munstead, Surrey, collected by Rogers as lectotype. Following this separation, in 1980, the Staffordshire representatives were described as a new species *R. intensior*

Edees, and two years later their Scottish allies were segregated as *R. pictorum* Edees. This reorganisation left our Marches plant in limbo. Clearly it does not fit the restricted concept of *R. britannicus* Rogers, as described in Edees & Newton (1988). At first it seemed most likely, on geographical grounds, that it might be *R. intensior* Edees, but closer study showed our local examples differed from *R. intensior* in precisely those features which Edees (1982) used to distinguish *R. pictorum* from *R. intensior*. Comparison with the holotype and other specimens, including some authenticated by Edees, confirmed that our plant matched *R. pictorum* Edees. The striking violet-red colour of the stems is clearly shown and occasionally, as in Scottish *R. pictorum*, the flowers are pale pink in bud. Although some of the Herefordshire gatherings are more robust and prickly than much of the Scottish material examined, it is now evident that the plant from the Welsh Marches, formerly referred to as *R. britannicus* Rogers, is identical with *R. pictorum* Edees. However not all of Ley's determinations of *R. britannicus* can be accepted as this taxon: one sheet from Carmarthenshire (v.c. 44) in **BIRM** is *R. hylocharis* W. C. R. Watson and another from the same area is a mixture of *R. hylocharis* and *R. merlinii* A. Newton & M. Porter.

R. pictorum Edees has now been recorded from the following additional v.cc. 6, 35, 36, 41–44, adding an intriguing outlier to its previously known distribution, as shown on the map (Fig. 4).

Recent studies in North Wales, particularly the Lleyn peninsula, have found the following bramble to be widespread in the area. A description follows:

Rubus segontii A. Newton & M. Porter, **sp. nov.**

R. dasyphyllo similis, a quo praecipue differt facie grisea, turione minus pilosa, aciculis densioribus armata; foliis inferne primo griseo-tomentosis, foliolo terminali angustiori basi cuneata; inflorescentia ad apicem latiore, densiore, magis florifera; petalis albis attenuatis, sepalis insigniter per anthesin laxe amplectantibus. Copiose in Mona et Arvonia crescit.

Similar to *Rubus dasyphyllus*, from which it differs in details as follows: Plant with an overall greyish cast, stem less densely hairy, more closely beset with long acicular prickles; leaves at least at first grey-tomentose beneath, the terminal leaflet consistently narrow with a cuneate base. Inflorescence with a more substantial ultra-axillary portion, broader, denser and more floriferous at the summit. Petals white, narrow; sepals noticeably clasping in flower and fruit.

HOLOTYPUS: hedgebank, Penbodlas, Caernarvon, v.c. 49, GR SH/282.336, August 1991, *A. Newton* (**NMW**).

Frequent in Caernarvon and Anglesey. North Merioneth. First found by Babington c. 1850 in the Llanberis district: distributed by J. E. Griffith from Treffos and Pen-y-garnedd in Anglesey whence it was named "aggregate *R. hirtus*" in 1884. Many specimens were collected by W. C. Barton in 1922 around Portmadoc and Tremadoc and given the MS name 'portmadocensis' in his notes (**BM**). Widespread in the Lleyn peninsula (Conolly & Newton 1993).

ACKNOWLEDGMENTS

We are most grateful to J. R. Edmondson (**LIV**), R. G. Ellis and G. Hutchinson (**NMW**), N. Gordon (**WOS**), R. N. Lester (**BIRM**) and P. D. Sell (**CGE**) for their courtesy and help in locating exsiccatae and references, and to R. R. Mill (**E**) for checking the Latin descriptions.

REFERENCES

AMPHLETT, J. & REA, C. (1909). *The botany of Worcestershire*. Birmingham.
BABINGTON, C. C. (1869). *The British Rubi*. London.
BANNISTER, A. T. (1916). *The place-names of Herefordshire*. Cambridge.

CONOLLY, A. & NEWTON, A. (1992). *Rubus* in West Lleyn 1990 and 1991. *Welsh bulletin of the B.S.B.I.* **54**: 12–15.
EDEES, E. S. (1975). Notes on British Rubi, 3. *Watsonia* **10**: 331–343.
EDEES, E. S. (1980). Notes on British Rubi, 6. *Watsonia* **13**: 31–34.
EDEES, E. S. (1982). A new bramble from Scotland. *Watsonia* **14**: 180–182.
EDEES, E. S. & NEWTON, A. (1988). *Brambles of the British Isles*. London.
LEES, E. (1852). *Botany of the Malvern Hills*, 2nd ed., p. 51. London.
LEES, E. (1853). A descriptive list of the British Rubi. *Phytologist* **4:** 818.
LEES, E. (1867). *The botany of Worcestershire.* Worcester.
LEES, E. (1868). *Botany of the Malvern Hills*, 3rd ed., pp. 67–68. London.
LEY, A. (1898). Botanical notes. *Transactions of the Woolhope Naturalists' Field Club*: 268.
LEY, A. (1902). Two fresh *Rubus* forms. *Journal of botany* (*London*) **40**: 69.
LEY, A. (1905). Notes additional to the Flora of Herefordshire. *Transactions of the Woolhope Naturalists' Field Club*: 69–116.
MATHEWS, W. (1899). Midland County plants observed . . . 1849–1884. *Transactions of the Worcestershire Naturalists' Club* II.
PURCHAS, W. H. & LEY, A. (1889). *A Flora of Herefordshire*. Hereford.
ROGERS, W. M. (1894). Rubi notes. *Journal of botany* (*London*) **32**: 49.
ROGERS, W. M. (1895). On the Rubi list in the London Catalogue 9. *Journal of botany* (*London*) **33**: 103.
ROGERS, W. M. (1899). Radnorshire and Breconshire Rubi. *Journal of botany* (*London*) **37**: 193–198.
ROGERS, W. M. (1900). *Handbook of British Rubi*. London.
WATSON, W. C. R. (1958). *Handbook of the Rubi of Great Britain and Ireland.* Cambridge.

(*Accepted December 1993*)

Four new Anglo-Sarnian species of *Rubus* L. (Rosaceae)

D. E. ALLEN

Lesney Cottage, Middle Road, Winchester, Hampshire, SO22 5EJ

ABSTRACT

Four new species of *Rubus* L. (Rosaceae) are described, all with ranges extending to both sides of the English Channel. **R. transmarinus** D. E. Allen, **sp. nov.** (sect. *Corylifolii* Lindley), locally common round Bournemouth and in the Isle of Wight and found widely across Hampshire, also occurs in Jersey and Sark and on coastal heaths in France east of Cherbourg. **R. caesarius** D. E. Allen, **sp. nov.** (ser. *Vestiti* (Focke) Focke), abundant in many parts of Jersey, is also known in one English locality, between Southampton and Portsmouth. **R. couchii** Rilstone ex D. E. Allen, **sp. nov.** (ser. *Sylvatici* (P. J. Mueller) Focke) is frequent in the extreme south-east of Cornwall and common in the north-east of Jersey; it was also distributed last century from Cherbourg. **R. percrispus** D. E. Allen & R. D. Randall, **sp. nov.** (ser. *Micantes* Sudre ex Bouvet) is known from eight vice-counties in the southern half of England, with concentrations round Colchester and Bristol. There are also single records of it for Jersey and Guernsey.

KEYWORDS: Channel Islands, England, France, brambles, apomictic species.

INTRODUCTION

Intensive investigation in recent years of the *Rubus* flora of the Channel Islands and of that part of France most immediately adjacent to them, the Cotentin Peninsula of Normandy, has brought to light numerous forms that it has not proved possible to match with published taxa. This was no more than to be expected, for all areas in which *Rubus fruticosus* agg. occurs in any diversity tend to have a proportion of putative local endemics, most of them too restricted in quantity and range to warrant adding to the formidable number of species described already in this group. In order to keep the taxonomy within manageable limits, it is now the convention among *Rubus* specialists to bestow names on only those forms that reveal a 'regional' (as opposed to merely 'local') distribution. The four described in this paper not only fall into this category, but qualify additionally by reason of their occurrence on both sides of the English Channel. Britain and France have many *Rubus* species in common, but an increasing number are being detected with ranges that (so far at least) seem to be only narrowly trans-Channel in character. Three examples are *R. boulayi* Sudre (abundant round Bournemouth), *R. thyrsigeriformis* (Sudre) D. E. Allen (locally abundant round Southampton) and *R. corbieri* Boulay (locally abundant in the Purbeck district of Dorset). Each of these is well-distributed in the coastal area of France more or less opposite the main English concentrations, namely the Cotentin Peninsula, but only the first has been recorded outside that strictly limited territory (and whether correctly needs to be confirmed). Three of the species described below have ranges of broadly this same pattern, though one has its English concentration much further to the west. The fourth is much more widespread in England and, so far as is known, has been found only twice on the other side of the Channel, on both occasions seemingly transiently.

DESCRIPTIONS OF NEW SPECIES

1. **Rubus transmarinus** D. E. Allen, **sp. nov.**

Turio arcuato-decumbens, obtusangulus, rubro-purpureus, sparsim pilosus, aculeolis saepe glanduliferis et aciculis et glandulis stipitatis numerosis et aculeis numerosis vel densis non ad angulos dispositis inaequalibus rectis e basi plana declinatisque vel curvatis teñuibus munitus. Folia 5-nata, pedata, imbricata, superne sparsim pilosa, subtus molliter pubescentia, quorum petioli aculeis (2–3 mm) numerosis declinatis vel leviter falcatis tenuibus et aculeolis et aciculis et glandulis plerumque brevibus muniti. Foliolum terminale subrotundum vel rotundo-ovatum, paullatim acuminatum, serratum dentibus nonnullis aduncis, planum, basi emarginata, eiusdem petiolulo ter longius. Inflorescentia usque ad apicem foliata, superne saepe condensata, inferne ramulis axillaribus distantibus adscendentibus aucta. Rachis vix flexuosa, supra copiose pilosa, aculeis (4–6 mm) tenuibus subaequantibus plerumque rectis vel declinatis et aciculis et glandulosis numerosis munita. Flores 2–3 cm diametro. Sepala griseoviridia, dense pilosa, leviter aculeolata, glandulifera, attenuata, albo-marginata, patula tandem reflexa. Petala alba vel subroseola, obovata vel subrotunda, ad marginem sparsim pilosa, integra, plana, non contigua. Stamina alba stylos flavos superantia. Antherae et carpella glabri vel pilis raris praediti. Receptaculum glabrum. Fructus rotundus.

Stem low-arching, bluntly angled, reddish-purple, with sparse medium simple and tufted hairs, numerous stalked glands and acicles and often also numerous gland-tipped pricklets of varying lengths; prickles numerous to crowded, not confined to the angles, unequal, the longest c. 6–9 mm, as long as the stem diameter or a little longer, patent or slanting or curved, slender, subulate from a narrow compressed base, with yellowish points. Leaves pedate; leaflets 5, imbricate, pale green with sparse short simple hairs above and soft beneath with a dense layer of short simple and tufted hairs; terminal leaflet c. 6–9 × 5–7·5 cm, subrotund or roundish ovate or (rarely) obovate, with a gradually acuminate apex c. 1·5 cm and emarginate base, unevenly serrate with some teeth retrorse, flat, the petiolule $\frac{1}{3}$ as long as the lamina; basal leaflets subsessile; petiole as long as or a little longer than the basal leaflets, with few to many medium simple and tufted hairs, scattered short acicles and mostly short stalked glands, and 15–25 declining or slightly curved prickles 2–3 mm together with a varying number of pricklets. Flowering branch with 3-foliolate and simple (trifid and entire) leaves extending nearly to the apex; inflorescence consisting of a flat or rounded usually condensed top and distant ascending 4–7-flowered axillary peduncles 3–7 cm $\frac{1}{2}$ as long as their leaves, the lowest sometimes much longer and divaricate; rachis slightly flexuose or ± straight, with numerous short to medium simple and tufted hairs, numerous mostly short and medium stalked glands, very short to medium acicles and numerous mostly subequal patent or declining slender prickles 4–6 (–7) mm. Flowers 2–3 cm in diameter; sepals greyish-green, with dense short and medium tufted and simple hairs, few to many short stalked and sessile glands and scattered short acicles, white-bordered, long-pointed, patent at first then reflexed; petals 9–10 × 5·5–9 mm, 5 or 6, white or pinkish, obovate to subrotund, with sparse to very sparse short simple and tufted hairs on the margin, entire, flat, not contiguous; stamens exceeding the styles, filaments white, anthers glabrous or with an occasional hair; styles yellow; young carpels glabrous or slightly hairy; receptable glabrous; fruit globose. Flowering from June to August.

HOLOTYPUS: hedge, Whitemoor Lane, near Copythorne, SU/323.149, S. Hants., v.c. 11, 26 June 1982, *D. E. Allen* s.n. (**BM**).

This distinctive member of section *Corylifolii* has been known to British batologists since the 1890s, when it was distributed by W. Moyle Rogers from Bournemouth, S. Hants., v.c. 11, as no. 49 in the historic Set of British *Rubi*, under the erroneous name of '*R. dumetorum* var. *ferox* Weihe'. There is, however, a specimen in **BM** from nearby Poole in Dorset, v.c. 9, labelled '*R. fuscoater*', collected by T. Bell Salter as early as 1837. It is locally plentiful in the Bournemouth area and parts of the Isle of Wight, v.c. 10, and extends widely across S. Hants., v.c. 11, and here and there into N. Hants., v.c. 12, as well, exhibiting a preference for dry, sunny heaths and commons (though not averse to chalk near the coast). It is also present in some quantity in at least two of the Channel Islands, Jersey and Sark, and may well be in Guernsey too, for Rogers & Rogers (1898) recorded '*R. dumetorum* var. *ferox*' as generally distributed there; Rogers, though, is known to have included other members of section *Corylifolii* under that name and this statement has yet to be confirmed. It is, however, absent for certain from Alderney, where its place is taken by *R. tuberculatus* Bab. In addition, I have collected it in a chain of French localities, on and near the coastal heaths running east from Cherbourg (Le Becquet; Lande de Carneville; Petit Bois, Parc du Château, St-Pierre-Église: vouchers deposited in **BM**). Rogers (1900) claimed to have seen '*R. dumetorum* var. *ferox*' also in both Normandy and Brittany, presumably on the visit he is known to have made to small parts of each of these in 1897; but he appears to have passed far to the south of Cherbourg en route to Rouen and, again, his interpretation of the taxon is in any case liable to have been over-broad. That *R. transmarinus* may not occur in France more widely is suggested by the fact that Sudre (1904, 1913), after examining *Rubus* material from all parts of that country, regarded it as a form restricted to Britain, combining it with *R. rubriflorus* Purchas (no. 131 of the Set of British *Rubi*), a quite different bramble of the North Midlands, under the new name of *R. dasyphylloides* – which is consequently illegitimate – as the supposed product of recent crossing between *R. caesius* L. and *R. dasyphyllus* (Rogers) E. S. Marshall. Watson (1958) was the first to give specific rank to Rogers' taxon as an entity in its own right, but unfortunately he referred it, erroneously, to the apparently non-British *R. scabrosus* P. J. Mueller (Edees 1975). It features as 'H39' in my forthcoming account of *Rubus* in Hampshire (Allen, in press).

Unlike most other members of section *Corylifolii*, *R. transmarinus* has a characteristically neat appearance. When extreme, its dense-topped panicle, neat-looking flowers, crowded slender prickles and roundish leaflets render it unmistakable.

2. **Rubus caesarius** D. E. Allen, **sp. nov.**

Turio arcuato-decumbens, atropurpureus, obtusangulus, faciebus planis vel excavatis, striatis; pilis paucis vel numerosis, aculeolis nonnullis, glandulis stipitatis aciculisque brevibus paucis, aculeis crebris ad angulos dispositis inaequalibus e basi lata et compressa tenuibus declinatis vel curvatis rubro-purpureis munitus. Folia 5-nata, digitata, saepe imbricata, superne glabrescentia, subtus molliter cinereo-albo-tomentosa, dense pilosa. Foliolum terminale ovatum vel subrotundum, apice cuspidatum vel acuminatum, basi emarginatum vel subintegrum, inaequaliter et saepe acute serratum vel dentatum, planum, eiusdem petiolulo ter longius; foliola infima breviter pedicellata. Inflorescentia usque ad apicem non foliata, longa, superne angusta et thyrsoidea vel lata et pyramidalis, ramulis axillaribus omnibus patulis vel inferioribus adscendentibus aucta. Rachis parum flexuosa, cinerea vel cinereo-atropurpurea, copiose pilosa, aciculis et glandulis stipitatis et aculeolis (interdum glanduliferis) paucis, aculeis e basi longa tenuibus patulis vel declinatis vel curvatis purpureis numerosis munita. Flores c. 2–2·5 cm diametro. Sepala cinereo-tomentosa, glandulis stipitatis aciculisque paucis praedita, semper reflexa. Petala dilute rosea, elliptico-obovata vel subrotunda, ad marginem sparse pilosa, integra, plana, non contigua. Stamina alba stylos virides vix superantia. Antherae glabrae. Carpella pilosa. Receptaculum glabrum. Fructus parvus rotundus.

Stem low-arching, dark purple, blunt-angled with flat or furrowed sides, striate, with few to many very short to medium simple and tufted hairs, numerous sessile and subsessile glands, a few pricklets and scattered or rare short stalked glands and short acicles; prickles 10–14 per 5 cm, confined to the angles, unequal, (3–)4–6 mm, slender from a rather broad compressed base, declining or curved, reddish purple with pale point. Leaves digitate; leaflets 5, often imbricate, pale or dark green, glabrescent above, softly greyish-white-felted beneath with dense short simple and tufted hairs; terminal leaflet 5–7(–10) × 4–6(–7·5) cm, ovate or subrotund, with a cuspidate or acuminate apex 0·5–1·5 cm and an emarginate or subentire base, unequally and often finely serrate or dentate with the principal teeth sometimes patent, flat, the petiolule $\frac{1}{3}$ as long as the lamina; petiolules of basal leaflets 1–4 mm; petiole as long as or a little longer than the basal leaflets, coloured and clothed like the stem, with 8–11 curved prickles 2–4 mm. Flowering branch with 3- foliolate leaves below and 0–4 simple leaves above, not leafy to the apex; inflorescence long, with a dense truncate top, sometimes narrow and thyrsoid above, sometimes broad and pyramidal, the upper, middle and sometimes even the lowest peduncles patent, more often the lower peduncles ascending and sometimes longer than their leaves, all divided about half-way or well above the middle; rachis slightly flexuous, greyish or dark greyish-purple, with numerous adpressed and patent short to medium simple and tufted hairs, sparse sessile glands, scattered purple short and medium stalked glands, rarer short acicles and (sometimes gland-tipped) pricklets, and numerous long-based, slender-pointed, patent or declining or curved purple prickles 2–6 mm; pedicels clothed like the upper part of the rachis, with numerous slender declining or curved prickles 1–2 mm. Flowers 2–2·5 cm in diameter; sepals grey with dense stellate hairs and few to many medium simple and tufted hairs, numerous sessile and scattered short stalked glands and short acicles, short- or long-pointed, reflexed; petals 9–10 × 5–6 mm, pale pink, elliptical-obovate to subrotund, entire, with sparse very short simple and tufted hairs on the margin, flat, not contiguous; stamens equalling or slightly exceeding styles, filaments white, anthers glabrous; styles pale green; young carpels hairy; receptacle glabrous; fruit small, globose. Flowering in July and August.

HOLOTYPUS: heathy scrub, Le Jardin d'Olivet, par. Trinity, WV/673.543, Jersey, v.c. S, 1 July 1990, *D. E. Allen* s.n. (**BM**).

The epithet *caesarius*, also borne by the subspecies of Bank Vole endemic to Jersey, *Clethrionomys glareolus caesarius* (Miller), is taken from the alleged Roman name for the island, *Caesarea*.

R. caesarius is not only a characteristic member of series *Vestiti*, but was actually mistaken by Rogers for *R. vestitus* Weihe (MS note by him on sheet ex herb. Barton & Riddelsdell no. 9318 in **BM**, where he omits the qualifying "but usually untypical" of Rogers & Rogers 1898), a species now known to be absent from the Channel Islands, the Cornish Peninsula and extreme north-west France. The two are in fact readily distinguished, and it would seem that Rogers played down the differences evidently in a wish to satisfy himself that the *Rubus* flora of the Channel Islands is broadly similar to that of southern England (which, however, has turned out to be anything but the case). As he noted, this bramble is second only in abundance in Jersey to the ubiquitous *R. ulmifolius* Schott, occurring in profusion on banks, roadsides and heathland in many parts (e.g. La Grève de Lecq; Bouley Bay; Rue de l'Aleval; Val de la Mare), though scarce or absent in others, most noticeably in those which harbour the putatively oldest substratum of *Rubus* species (as at the top of Waterworks Valley). This suggests that it may be a relatively late incomer, a possibility rendered the more likely by its prevalence in Jersey despite its apparently total absence from all the other Channel Islands. It can hardly, however, have come from Britain, for only a single small population is known from there: midway between Southampton and Portsmouth, on hedgebanks along Segensworth Road, Park Gate, SU/526.078–9, S. Hants., v.c. 11, at the north end of the one-time Titchfield Common (a surviving fragment of which, further south, holds the only-known Hampshire patch of *R. imbricatus* Hort). On the other hand, unlike *R. corbieri* (Allen 1992), it would appear not to have come from the part of the French mainland that is closest either, for no sign of it has been met with in the Cotentin Peninsula after three seasons' extensive sampling of that area's *Rubus* florula. Should it be a species of French origin, therefore, the source must lie further to the east or south. Although no match for it has been found among the limited French material in British herbaria, it may yet turn out to have been among the numerous taxa described by French botanists prior to 1914, type material of many of which cannot now be located.

A representative series of *R. caesarius* from Jersey and Hampshire has been deposited in **BM**. In **OXF** there is a stem-piece of it in a mixed gathering by Rogers from Les Marais and Fauvic, misdetermined as a weak form of *R. radula* Weihe ex Boenn. There is also in **OXF** an undated specimen of G.C. Druce's from St Aubin, variously misdetermined as *R. vestitus* and *R. boraeanus* Genev., that may be this too. Otherwise no previous specimens have been detected in British herbaria.

3. **Rubus couchii** Rilstone ex D. E. Allen, **sp. nov.**

Turio alte arcuatus fuscus vel nigrescens, obtuse vel acute angulatus, faciebus planis vel concavis, striatis, glaber vel pilis paucis vel numerosis, aculeis crebris ad angulos dispositis saepe geminatis inaequalibus e basi lata et compressa attenuatis patulis vel declinatis vel curvatis purpureis munitus. Folia 5-nata, pedata vel digitata, vix imbricata, superne glabrescentia, subtus viridia (raro cinereo-tomentosa), leviter pilosa. Foliolum terminale subrotundum vel elliptico-obovatum vel oblongum, apice acuminatum, basi emarginatum vel integrum, inaequaliter acute serratum et dentatum, planum, eiusdem petiolulo ter longius; foliola infima breviter pedicellata. Inflorescentia usque ad apicem non foliata, foliis nonnullis quinatis ternatisque inferne instructa, saepe longa, anguste pyramidalis truncata, ramulis axillaribus infimis distantibus adscendentibus et mediis subpatulis vel divaricatis aucta. Rachis flexuosa vel recta, infra sicut turio vestita, ad apicem pilis densis longioribus, glandulis stipitatis brevissimis paucis et aculeis purpureis numerosis declinatis vel curvatis vel falcatis 2–6 mm munita. Flores c. 2·5–3 cm diametro. Sepala cinereo-tomentosa, pilis flavescentibus numerosis vestita, aculeolata, anguste albo-marginata, omnia attenuata, patula vel reflexa tandem fructum amplectantia. Petala rosea vel roseola, subrotunda vel late ovata vel oblonga, subtus et ad marginem pilosa, saepe imbricata. Stamina alba stylos virides vel flavescentes, saepe basi erubescentes, superantia. Antherae glabrae vel pilis raris praeditae. Carpella dense pilosa. Receptaculum glabrum. Fructus rotundus.

Stem high-arching, light brown to blackish, bluntly to rather sharply angled, with flat or shallowly furrowed sides, striate, glabrous or with few to many short and medium simple and tufted hairs, numerous sessile glands and very rare pricklets; prickles 11–15 per 5 cm, confined to the angles, often in pairs, unequal, the longest c. 6–8 mm, as long as or rather shorter than the stem diameter, patent or slanting or curved, narrowing from a broad compressed base, purple with yellowish tip. Leaves pedate or digitate; leaflets 5, not or scarcely overlapping, dark green with sparse simple hairs above and green (rarely, greyish-white) beneath with few to many medium simple hairs mostly on the veins; terminal leaflet c. 6–10 × 4–7 cm, subrotund or elliptical-obovate or oblong, with a gradually acuminate apex c. 0·5–1·5 cm and entire or emarginate base, unevenly and finely serrate-dentate with some principal teeth patent, flat, the petiolule c. $\frac{1}{3}$ as long as the lamina; petiolules of basal leaflets 1–6 mm; petiole usually well exceeding the basal leaflets, with few to many short and medium simple and tufted hairs, rare subsessile glands and 12–20 curved prickles. Flowering branch with 3–5-foliolate leaves below and 1–4 simple (trifid and entire) leaves above extending to usually well short of the apex; inflorescence often large, "usually somewhat narrowly pyramidal and truncate" (Rilstone ms.), with distant ascending 5–6-flowered lower axillary peduncles 4–10 cm as long as their leaves to only half as long and subpatent or divaricate middle peduncles; rachis flexuose or straight, with many mostly adpressed simple and tufted hairs becoming dense, more spreading and longer above together with numerous sessile and subsessile glands, a few short stalked glands and numerous declining or curved or falcate prickles 2–6 mm. Flowers largish, 2·5–3 cm in diameter; sepals greyish, with dense yellowish short and medium tufted hairs, numerous sessile glands and few to many short and medium acicles, narrowly white-bordered, all long-pointed from bud, in flower subpatent or reflexed, in fruit reflexed and ultimately erect and clasping; petals 8–12 × 5–9 mm, mid or pale pink, entire or erose, subrotund to broadly oval or oblong, not or scarcely clawed, with numerous hairs beneath and few to many short and medium simple and tufted hairs on the margin, moderately concave, spaced or overlapping; stamens usually exceeding the styles, filaments white or faintly pink, anthers glabrous or with a rare hair; styles green or yellowish, often red-based; young carpels densely hairy; receptacle glabrous; fruit globose. Flowering from June to August.

HOLOTYPUS: Polperro, E. Cornwall, v.c. 2, 10 September 1932, *F. Rilstone no. 793*, herb. Barton & Riddelsdell no. 7782 (**BM**).

This bramble was first brought to notice in Britain in 1920 by Rilstone, who distributed specimens of it from around his then home village of Polperro through the Botanical Exchange Club, remarking that it was "a common and constant plant over this locality". On that occasion H. J. Riddelsdell determined it as *R. macrophylloides* Genev.; after seeing it for himself in the field in 1924–25, however, he queried it instead as *R. leucanthemus* P. J. Mueller before settling for *R. hirtifolius* P. J. Mueller & Wirtgen. All three of these taxa were at that time mistakenly thought to be British. Through some confusion Riddelsdell meanwhile led Rilstone into believing that the revised determination was *R. chrysoxylon* (Rogers) Rogers, a species of north-west Wales and the north end of the Welsh Marches. Unable to accept this, Rilstone used "Cornish *chrysoxylon*" as a working name for what he increasingly became convinced was an undescribed species and eventually, in 1946, annotated the sheets of it in his herbarium with the MS name "*R. couchii*" – in honour of the celebrated nineteenth-century Polperro naturalist Jonathan Couch (1789–1870). In that same year, in a letter to W. C. Barton (the relevant extract of which the latter subsequently attached to the sheet which now bears the holotype), Rilstone wrote: "It is frequent rather than abundant, but I have seen it in a good many places in Polperro valley and in the east and west Looe valleys, almost always on the edge of thickets in the bottom of the valley." Presumably because of this very local distribution, in the far south-east corner of Cornwall, he did not include it among the several new Cornubian species whose descriptions he was to publish four years later (Rilstone 1950).

Were that indeed the full extent of its range, *R. couchii* would still be undeserving of a published name. In 1992, however, I realised that it was identical with a bramble known to me for some years in the north-east corner of Jersey, v.c. S. Common and widespread in the district between Bouley Bay and Flicquet Bay, it rises to abundance in Rozel Woods (WV/69.53, 69.54, 70.52). Though evidently preferring shade, it occurs also on sunny banks and roadsides and among gorse scrub on heathland. Representative material from four different Jersey localities has been deposited in **BM**, to join the considerable number of gatherings of the species therein from Cornwall made at different times by Rilstone, Riddelsdell, Barton and myself respectively.

Like *R. caesarius*, *R. couchii* appears not to occur in any of the other Channel Islands; it differs from it, however, in extending to the neighbouring Cotentin Peninsula – or at least in having done so formerly. For no. 893 of the specimens distributed late last century through the Association Rubologique (a set unfortunately not in any British herbarium but which I have been able to examine in Paris (**P**) and Geneva (**G**)) is clearly *R. couchii* too. It was collected by the Cherbourg botanist L. Corbière in 1889 from a shady hedge near the farm of Le Maupas on what was then the outskirts of that city (but now largely built over). Although put out under the name of *R. obvallatus* Boulay & Gillot, it does not match other material so named in various herbaria and the characters noted by Corbière on the label in fact fit *R. couchii* impressively exactly. There is a handwritten addition to these in the sheet in **G** to the effect that "l'indument en *brillant* assez semblable celui du *vestitus*." If the species is still to be found in the Cotentin Peninsula, it would appear to be at best very local, for in my own extensive sampling of the area I have failed to encounter it.

In **BM** there is a specimen collected by G. Didier (no. 1010) in the Forêt de Verrières, dép. Seine-et-Oise, in 1933 and labelled "*R. elongatispinus* Sudre var." which, while patently distinct from the *Batotheca Europaea* material of that Pyrenean species distributed by Sudre, closely approaches *R. couchii*. It differs, however, in having fewer and longer prickles and in lacking the yellowish tomentum on the sepals and upper rachis.

With its long, narrow pyramidal inflorescence and pale pink flowers, *R. couchii* superficially resembles *R. phaeocarpus* W. C. R. Watson. Unlike that species, however, it is more or less eglandular; the larger flowers and finely serrate-dentate leaves additionally distinguish it from that at once. In the numerous curved prickles, especially on the rachis and peduncles, it also recalls *R. crudelis* W. C. R. Watson, though readily told from that as well by its much shorter axillary peduncles, differently-shaped leaflets and glabrous anthers. It seems best placed in series *Sylvatici*, even though the leaves of at least the inflorescence are sometimes grey-felted beneath.

4. **Rubus percrispus** D. E. Allen & R. D. Randall, **sp. nov.**

Turio arcuatus, acute angulatus, faciebus planis vel leviter excavatis, atropurpureus vel purpureo-erubescens, parce pruinosus, sparsim pilosus vel glabrescens, aciculis glandulisque pluribus inaequalibus, aculeis numerosis 5–20 per 5 cm inaequalibus plerumque ad angulos dispositis rectis tenuibus e basi lata vel compressa patentibus vel declinatis, aculeolis nonnullis munitus. Folia 3–5-nata, subdigitata undulata, inferne albo-tomentosa et pilosa. Foliolum terminale 5–8 × 4–5 cm, obovatum vel subrotundum vel ovatum, apice cuspidatum vel acutum vel acuminatum, acutissime et tenuissime serrulato-denticulatum; foliola infima breviter pedicellata. Inflorescentia longa anguste pyramidalis, foliosa inferne foliis 3–4-natis et bracteis trilobatis vel simplicibus instructa, ramulis axillaribus longis superioribus adscendentibus aucta. Rachis ± recta vel parum nutans, superne dense tomentosa, glandulis numerosis brevibus aculeisque inaequalibus tenuibus declinatis 1–9 mm munita. Flores c. 2–2·5 cm diametro; sepala albescens-tomentosa, glandulifera, semper valde reflexa. Petala alba, late elliptica vel oblonga vel obovata, adscendens, unguiculata, saepe emarginata, non contigua. Stamina alba stylos flavescentes vel viridescentes superantia. Antherae glabrae. Carpella glabra. Receptaculum ± glabrum. Fructus parvus rotundus.

Stem arching, sharply angled with flat or slightly furrowed sides, dull blackish- or reddish-purple, striate, somewhat pruinose, with a few simple and tufted hairs or sometimes glabrescent; prickles numerous, 5–20 per 5 cm, unequal, 3–10 mm, patent or slightly declining, mostly confined to the angles, straight, subulate from a broadish or compressed base, usually accompanied by a few pricklets and more numerous unequal acicles and stalked glands. Leaves subdigitate; leaflets 3–5, dark green and ± glabrous above, white-felted and pilose beneath, undulate on the margins, very deeply and finely serrate-dentate with some of the principal teeth recurved; terminal leaflet 5–8 × 4–5 cm, varying from obovate-cuspidate or roundish- or rhomboid-acute towards the stem base to ovate-acuminate towards the stem apex; petiolules of basal leaflets usually less than 3 mm; petiole 1–1.5 times as long as the basal leaflets with 8–18 declining and slightly curved prickles 2–5 mm; stipules and sometimes leaf margins deep red. Flowering branch with 3–4-foliolate leaves below; inflorescence long, narrowly pyramidal, leafy with trifid and simple bracts when well-developed, cymose-racemose, peduncles long, the upper ones ascending, 2–3-flowered, overtopping the central axis. Rachis ± straight or somewhat nodding, angled or furrowed below, felted above with dense simple and stellate hairs and abundant short stalked glands (some longer than the hairs), usually almost unarmed towards the apex but with unequal, slender, slanting prickles 1–9 mm below. Flowers c. 2–2·5 cm in diameter; sepals whitish-felted, usually short-pointed, dotted with very short stalked glands, strongly reflexed throughout; petals 8–17 × 5–9 mm, faintly mauve or lilac in bud, opening pure white, ascending, broad elliptical or oblong or obovate, clawed, often notched, not contiguous; stamens exceeding the styles, filaments white, anthers glabrous; styles yellowish or greenish; young carpels glabrous; receptacle inconspicuously hirsute at the base; fruit small, globose. Flowering in July and August.

HOLOTYPUS: hedgebank, Thorrington, TM/095.213, N. Essex, v.c. 19, 16 July 1971, *J. R. I. Wood no. 71/99* (**BM**).

Representative exsiccatae:

v.c. S, Jersey: old quarry, Le Jardin d'Olivet, WV/672.544, 23 July 1978 (gone by 1990), *D.E.A.* s.n. (**BM**).
Guernsey: Fermain Bay, WV/33.76, 30 June 1897, *F. A. Rogers* s.n. (**K**).

v.c. 4, N. Devon: hedgerow, Kingsland Barton, South Molton, SS/697.257, 26 July 1989, *R.D.Randall no. 89.46* (**herb. R.D.R.**).

v.c. 5, S. Somerset: by bridge, Dulverton, SS/91.27, 4 August 1976, *L. J. Margetts no. 99* (**NMW**: herb. E. S. Edees no. 23122).

v.c. 6, N. Somerset: Stanton Wick, ST/613.626, 16 August 1986; near Publow Wood, ST/625.640, 16 August 1986; Sandy Lane, Easton-in-Gordano, ST/512.744, 7 July 1988; junction of A368 and A37, Chelwood, ST/624.618, 29 July 1989; Young Woods Farm, Nailsea, ST/443.694, *R.D.R. nos. 86.29, 86.32, 88.11, 89.77, 90.24* respectively (**herb. R.D.R.**).

v.c. 11, S. Hants.: in a holly on B3055, Brockenhurst, SU/297.018, 12 July 1986; wooded roadside, South Baddesley, SZ/350.960, 4 August 1987; Agar's Lane, between Sway and Hordle, SZ/273.970, 17 June 1989, *D.E.A.* s.n. (**BM**). Roadside park, Wick, near Christchurch, SZ/152.922, 13 July 1991, *R.D.R.* s.n. (**herb. A. D. Marshall**).

v.c. 19, N. Essex: Great Horkesley, TL/98.30, 1 September 1890, *J. D. Gray* s.n. (**BRISTM**). Heathland below ballast pits, Stanway, TL/960.246, 27 June 1920, *G. C. Brown* s.n. (**BM**). Hedgebank, St Osyth, TM/145.205, 17 July 1972; Stour Wood, Wrabness, TM/187.307, 1 August 1972, *J. R. I. Wood nos. 72.57, 72.119* respectively (**BM**). Scrub, Fordham Heath, TL/94.26, 23 July 1982, *A. L. Bull & J. J. Heath no. 1296* (**CLR**; **herb. A.L.B.**); 1 August 1991, *R.D.R.* (**herb. R.D.R.**).

v.c. 25, E. Suffolk: Dodnash Wood, Bentley, TM/107.364, 19 July 1972, *J. R. I. Wood no. 72/81* (**BW**). Lady Anne Wake-Walker's field, East Bergholt, TM/06.35, 24 July 1973, *E. S. Edees no. 20880* (**NMW**).

v.c. 30, Beds.: Folly Wood, near Flitwick, TL/04.35, 5 August 1956, *E. S. Edees no. 12099* (**NMW**).
v.c. 34, W. Gloucs.: old Midland Railway, Oldland Common, ST/677.723, 13 July 1987, *R.D.R. no. 87.55* (**herb. R.D.R.**); ST/670.710, 19 July 1990, *R.D.R. no. 90.34* (**herb. R.D.R.**; **herb. L. J. Margetts**; **herb. R. W. Gould**).

In the early 1970s J. R. Ironside-Wood, in preparing the account of *Rubus* which he contributed to the new *Flora of Essex* (Jermyn 1974), came across an unfamiliar glandular bramble on hedgebanks around Colchester, taking examples of it for his herbarium from four localities in N. Essex, v.c. 19, and one in E. Suffolk, v.c. 25. He noted that it resembled *R. raduloides* (Rogers) Sudre, but that it differed from that most noticeably in having white petals and a much less vigorous habit. Unbeknown to him, it had in fact been collected in that same district twice previously, respectively 52 and 82 years earlier. On the second of those occasions it had been queried by Riddelsdell as *R. griffithianus* Rogers, a species at that time not well understood.

A decade later R. D. Randall began finding what was subsequently to prove to be this same bramble in numerous, widely-scattered localities in N. Somerset, v.c. 6, and W. Gloucs., v.c. 34. Again, *R. raduloides* was noted as the species which it resembled most closely (and to which specimens from sunny spots were often referred), though some resemblance to *R. echinatoides* (Rogers) Dallman was also apparent, while in semi-shade it was seen to approach *R. dentatifolius* (Briggs) W. C. R. Watson.

On being shown a specimen by R.D.R. in 1990, I immediately recognised it as an unnamed bramble that I too had known for some years (as "H589"), having collected it in four widely-separated localities in S. Hants., v.c. 11, and, earlier still, in one place in Jersey. About the same time it was established that A. L. Bull and J. J. Heath had also collected it in N. Essex, and a Guernsey specimen was discovered in **K** which had been collected late last century and referred by Rogers successively to *R. anglosaxonicus* Gelert (now *R. micans* Godron) and *R. rudis* Weihe. R.D.R. and Bull have since studied the bramble round Colchester, and it has also been shown in the field to several other *Rubus* specialists. The general conclusion is that it does not correspond to any species so far described from the British Isles. Although its presence in the Channel Islands and the pattern of its Hampshire occurrences (isolated bushes or patches scattered across the south of the county, mainly near the coast) strongly suggest that its range may extend to France, no sign of it has been found in the Cotentin Peninsula of Normandy and a search of Continental *Rubus* material in British herbaria as well as in Geneva (**G**) and Leyden (**L**) has proved negative as well. The Belgian specialist H. Vannerom has also been unable to come forward with any Low Countries bramble that convincingly matches the British Isles plant.

A member of series *Micantes*, *R. percrispus* favours hedgerows and scrub on sandy or gravelly soils, occasionally also occurring in open woods but there tending to keep to the margins or rides. When growing in a dry, sunny situation the armature is well-developed and reminiscent of that of *R. raduloides* and *R. heterobelus* W. C. R. Watson, but the panicle is at the same time small, more or less cylindrical and lacks the characteristic leafy bracts. In moister conditions the plant becomes much more robust and the panicles well-developed, while in shade the prickles are less frequent and the secondary armature and glandular development very much reduced.

The epithet *percrispus* refers to the strikingly undulate leaf margins, which are rendered additionally distinctive by their very deep and fine teeth. The dark green upper side of the leaflets stands out in marked contrast to the white under side, which in turn forms a strong contrast to the dark purple stem and rachis.

ACKNOWLEDGMENTS

I am indebted to R. D. Randall for drawing up the description of *R. percrispus* and providing notes of its habitat preferences and many of the exsiccata details. To A. L. Bull thanks are also due for drawing attention to the material of that species collected by J. R. Ironside-Wood. I further wish to thank A. Newton for nomenclatural advice in connection with *R. transmarinus*, Mrs F. Le Sueur for hospitality and assistance in studying *R. caesarius* and *R. couchii* in Jersey, and Professor V. Nutton for guidance on certain words in the Latin diagnoses.

REFERENCES

Allen, D. E. (1992). *Rubus corbieri* Boulay (Rosaceae) in the British Isles. *Watsonia* **19**: 131–133.

Allen, D. E. (in press). *Rubus*, in Bowman, R. P., Brewis, A. & Rose, F., eds. *Flora of Hampshire*. Colchester.

Edees, E. S. (1975). Notes on British *Rubi*, 3. *Watsonia* **10**: 331–343.

Jermyn, S. T. (1974). *Flora of Essex*. Colchester.

Rilstone, F. (1950). Some Cornish *Rubi*. *Botanical journal of the Linnean Society* **53**: 413–421.

Rogers, W. M. (1900). *Handbook of British Rubi*. London.

Rogers, W. M. & Rogers, F. A. (1898). On the *Rubi* and *Rosae* of the Channel Islands. *Journal of botany (London)* **36**: 85–90.

Sudre, H. (1904). Observations sur 'Set of British *Rubi*'. *Bulletin de la Société d'Études Scientifiques d'Angers* **33**: 106–145.

Sudre, H. (1913). *Rubi Europae*, fasc. 6. Albi.

Watson, W. C. R. (1958). *Handbook of the Rubi of Great Britain and Ireland*. Cambridge.

(*Accepted February 1994*)

Notes

JUNCUS EFFUSUS VAR. *SPIRALIS* J. McNAB IN THE INNER HEBRIDES

Henderson (1992) drew attention to the occurrence in N.W. Scotland (W. Ross, Outer Hebrides and Orkney) of a variant of *Juncus effusus* L. with suberect, gently spiral stems; he named this var. *suberectus* Henderson, with a type from Big Sand, Gairloch, W. Ross. Nelson (1993) reviewed the taxonomy of this plant in relation to the cultivated plants of *J. effusus* with spiral stems and concluded that they were all referable to one taxon, for which the correct name is var. *spiralis* J. McNab or forma *spiralis* (J. McNab) Hegi. He also cited additional herbarium specimens. In this note I accept Nelson's conclusion that var. *suberectus* should be regarded as a synonym of var. *spiralis*, but I prefer to treat the plant at varietal rank rather than as a form.

I have been familiar with the plant described by Henderson since 1987, when it was first pointed out to me by N. F. Stewart. As Henderson (1992) stated, the most striking feature of the plant is its open habit, with the stems prostrate to ascending but never erect. The stems are straight or slightly spirally coiled, but I have never seen plants in the wild with stems tightly coiled like a corkscrew. At first I thought that it might be a phenotype resulting from exposure or heavy grazing. Subsequent field observations have led me to the conclusion that it is genetically distinct. Plants of var. *spiralis* can be found in ungrazed grassland (e.g. the roadside verge along the street at Arinagour, Coll); furthermore, there is no reason to believe that grazing pressure is more intensive in N.W. Scotland than in other areas where only erect plants of *Juncus effusus* occur. I have also seen at least one population where var. *spiralis* grew amongst dense upright tussocks of *J. effusus*, in a pasture (S. of Loch an Duin, Coll) where both varieties would be subject to a similar degree of exposure and grazing. Henderson (1992) reported mixed populations, and he also made direct observations on seedling plants which demonstrated that the variant has a genetic basis.

Unfortunately I did not make a note of the locality in the Outer Hebrides (v.c. 110) where I first saw var. *spiralis*. Since 1989 I have noted the sites where I have seen 'Hebridean *Juncus effusus*', as I called the plant. These records, all of which are from the Inner Hebrides, are listed below. Most were seen when I was looking for aquatic plants, which explains why they are from pastures near lochs. I have never seen it growing close to water, however, as upright plants often do.

South Ebudes, v.c. 102: Noted as occasional on both Islay and Jura by N. F. Stewart from 1981 onwards, but no specific localities recorded.

Mid Ebudes, v.c. 103: N. of Loch an Eilein, Tiree, NL/98.43, 8 July 1989. Pasture on N. side of Loch Riaghain, Tiree, NM/03.47, 9 July 1989. Pasture near sea-shore, Lon Fhadamuill, Tiree, NM/073.493, 22 June 1990. Pasture, Vaul, Tiree, NM/04.48, 26 June 1990. Damp area in pasture, Urvaig, Tiree, NM/07.50, 26 June 1990. S.E. coast of Gunna, NM/10.50, 6 July 1989. Pasture between Crossapol and Caoles, Coll, NM/12.52, 5 July 1989. Near pool at Cnoc na h'Osnaiche, N.E. of Loch Fada, Coll, NM/198.587, 29 June 1990. Verge by village street, Arinagour, Coll, NM/22.57, 5 July 1989. Rough pasture S. of Loch an Duin, Coll, NM/21.57, 7 July 1989.

North Ebudes, v.c. 104: Bank of stream by outflow at S. end of Loch Mhor, Waterstein, Skye, NG/142.480, 13 July 1989, **CGE** (*Preston 89/202*).

J. effusus var. *spiralis* is occasional on Coll and Tiree, but much less frequent than the erect variant. I have done too little fieldwork on Skye to comment on its frequency there.

These records add to those already published by Henderson (1992) from v.cc. 105, 110 and 111 and Nelson (1993) from v.cc. 17, 44, 111, 112, H27, H28 and H34. The fact that *J. effusus* var. *spiralis* has a distinct habit and a geographical range which differs from the widespread varieties has led me to prefer to treat it as a variety rather than a form. This is similar to the taxonomic treatment of coastal ecotypes, which differ from the type in their dwarf or prostrate habit and are usually treated as varieties or subspecies.

ACKNOWLEDGMENTS

I am grateful to N. F. Stewart for drawing my attention to this variant of *Juncus effusus*, and for providing the records from Islay and Jura. Many of the above records were made with Nick Stewart and other friends on memorable B.S.B.I. meetings to Coll (1989) and Tiree (1990) organised by Dr A. Walker.

REFERENCES

Henderson, D. M. (1992). A new spiral variant of *Juncus effusus* L. (Juncaceae). *Watsonia* **19**: 133–134.
Nelson, E. C. (1993). Corkscrew rush (*Juncus effusus* L. forma *spiralis* (J. McNab) Hegi) (Juncaceae) in Ireland and Britain. *Watsonia* **19**: 275–278.

C. D. Preston
Biological Records Centre, I.T.E., Monks Wood, Abbots Ripton, Huntingdon, PE17 2LS

DISTRIBUTION OF LADY ORCHID (*ORCHIS PURPUREA* HUDSON) IN AN EAST KENT WOOD

In a strip of mixed woodland in East Kent, *Orchis purpurea* Hudson lies in a band roughly along the middle. This distribution invited explanation.

The wood clothes the west-facing slopes of a north-south dry valley on the upper and middle chalk. The higher ground is capped with clay-with-flints, an acid brown earth of the Winchester series, whereas the lower part directly over the chalk is covered by brown calcareous earth of Coombe and Upton series. Maps show that the upper slopes have been wooded since the 1840s (mostly coppice) and probably since the 1760s or before, whereas the lower ground has only become woodland since the 1880s. The canopy is now fairly continuous overall but here and there gives way to scrub; there are also small areas kept open as turf, and places where coppicing and scrub cutting are maintained.

In the absence of a soil survey the extent of the acid cap was approximately gauged by mapping the distribution of bluebell (*Hyacinthoides non-scripta* (L.) Rothm.) (Fig. 1). Fig. 2 gives the areas shown as wooded in the Waltham Parish Tythe Map of c. 1840; the remainder of the area, at present wooded, was shown as arable. Both figures also show the distribution of the flowering spikes of *O. purpurea* counted in the plentiful year of 1986. Fig. 1 confirms that the orchid is confined to the calcareous soil, and in Fig. 2 the orchid spikes are seen to follow more or less the boundary of the old woodland. We infer that this was the plant's original distribution, the old wood itself being probably too acidic (cf. Fig. 1: Summerhayes 1968), and that it has been gradually colonising more recently wooded chalky areas as they achieved the appropriate degree of partial shade.

The wood is an S.S.S.I. and a nature reserve belonging to the Kent Trust for Nature Conservation; it is the site of the two abnormal forms of *O. purpurea* described by Ettlinger (1987) and Ingram & Dunster (1991).

ACKNOWLEDGMENTS

We are indebted to the Librarian of the Cathedral Library, Canterbury for giving us access to the Waltham Parish Tythe Map; to the Librarian of the Local Studies Library, Springfield (Kent County Council) for access to other maps; to Dr S. G. McRae for laboratory measurements of soil pH; and to the Kent Trust for Nature Conservation for permission to publish.

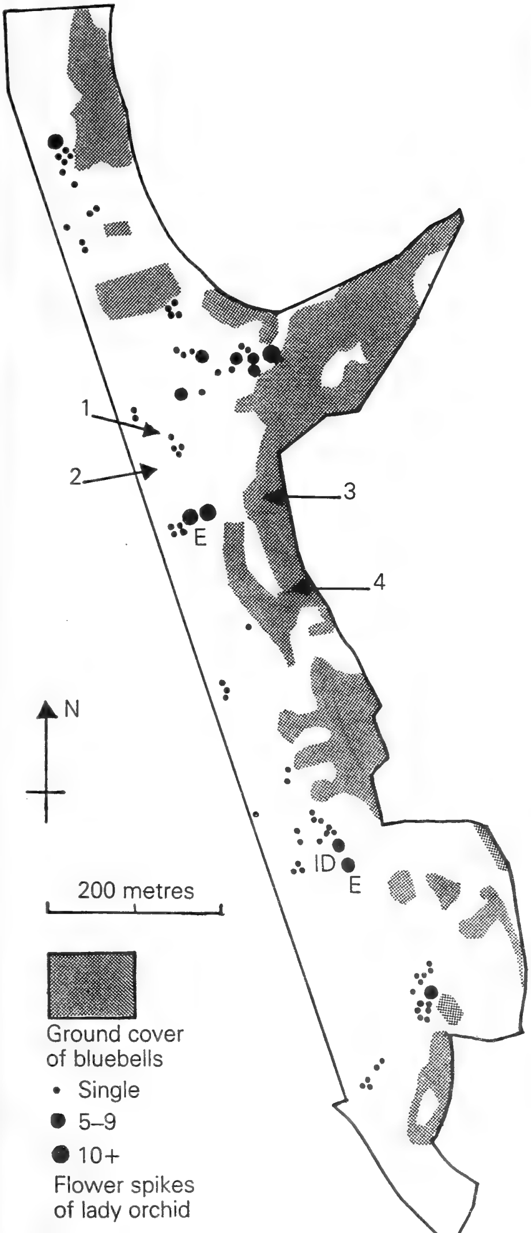


FIGURE 1. Bluebell areas (*Hyacinthoides non-scripta*) in 1988. Numerals indicate sites where pH measurements were made in 1990 (top soil – A horizon): 1, pH 7·7; 2, pH 7·8; 3, pH 4·3; 4, pH 4·0.

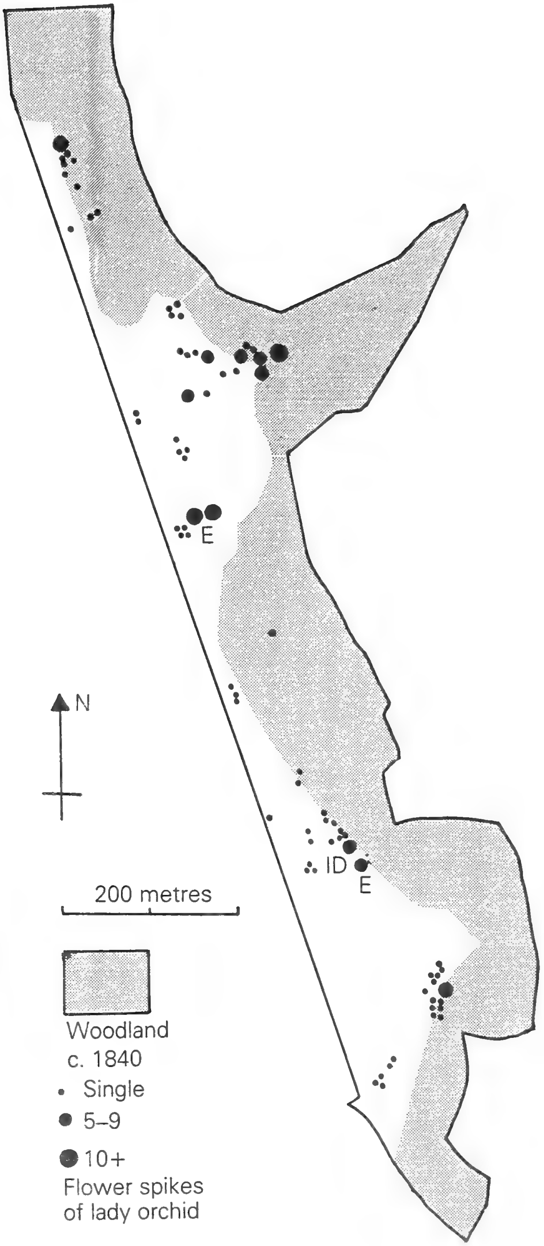


FIGURE 2. Woodland as shown on the Waltham Parish Tythe Map c. 1840 superimposed on the modern outline of the Reserve; the remainder was shown as arable.

Dots show *O. purpurea* flowering spikes in 1986. Sites of abnormal flower forms described by Ettlinger (1987), E, E; by Ingram & Dunster (1991), ID.

REFERENCES

Ettlinger, D. M. T. (1987). Peloric and duplex examples of *Orchis purpurea* Hudson in Kent. *Watsonia* **16**: 432.
Ingram, G. I. C. & Dunster, C. W. (1991). A non-resupinate abnormality in *Orchis purpurea* Hudson. *Watsonia* **18**: 317–319.
Summerhayes, V. S. (1968). *Wild orchids of Britain*, p. 253. Collins, London.

D. E. Wilson
The Keep House, Sutton Valence, Maidstone, Kent, ME17 3BS
G. I. C. Ingram
42 Burford Lodge, Pegasus Grange, White House Road, Oxford, OX1 4NA

Book Reviews

Mediterranean wild flowers. M. Blamey & C. Grey-Wilson. Pp. 560, with 192 pp. of colour plates and numerous marginal line drawings. Harper Collins, London. 1993. Price £25.00 (ISBN 0-00-219901-7).

This is a comprehensive field guide to the flowers of the Mediterranean coasts and islands, including trees and introduced species. More than 1,500 species are illustrated by Marjorie Blamey's colourful paintings which are bound together in the centre of the book. The format is similar to that of *The illustrated Flora of Britain and Northern Europe*, published by this artist and author in 1989, but the smaller size of the new volume makes it more easily carried and convenient for holiday field work. This compensates for losing the pleasing coloured marginal paintings in the earlier volume, and thus having text and illustrations together; in the new guide there are helpful line drawings illustrating significant characters of some of the plants. The species are listed by their Latin names in the text, followed by English names which give easy access for those not familiar with Latin; for me this is a great improvement on the format of the earlier book, which was arranged under English names.

Alas, on the dust jacket it is stated to be a "complete" guide to the native and introduced flowers of Mediterranean coasts, and also includes those species found growing up to 1000 m altitude. This reads like a publisher's description rather than the authors', as complete coverage of this very rich and varied area of considerable size would need a book of much larger dimensions.

The division of the region into three sections in the Introduction puts Crete and the Balkans into the Western Mediterranean, but these floras are generally considered to be more closely allied to those of Mediterranean countries further east than to those of the western Mediterranean and the Iberian peninsula. From my experience the marked differences between the floras of eastern and western Mediterranean have been insufficiently stressed in the distribution notes. We are told that the most commonplace northern European species have been omitted; but some are included.

Over such a wide area the distribution data must have been partly written from sweeps through the literature. As an example from Crete, where many new records have been published in recent years, *Lamium purpureum* and *Filago arvensis* are given as "not in Crete", but both are listed in *Crete: checklist of the vascular plants*, by Sir Colville Barclay (1986), and have been seen by the writer in western Crete. But the Cretan tulips are clearly set out and differentiated.

To be complete for any one area would not be within the scope of this guide, but it gives excellent general coverage. With the clear paintings, brief but diagnostic text, and the line drawings, it should be possible to identify a good proportion of plants seen, despite the absence of keys. The book will fulfil its aim to promote an understanding of this unique flora, and it is a reminder of the often magically beautiful Mediterranean coastal and island flowers.

M. Briggs

The genera of the Umbelliferae. M. G. Pimenov & M. V. Leonov. Pp. 156, one map, one table. Royal Botanic Gardens, Kew and Botanical Garden of Moscow University. 1993. Price £12.00 (ISBN 0-947643-58-3).

The Umbelliferae are traditionally labelled as 'difficult' by amateurs and professionals alike, so any new publication which may help to unravel the taxonomic complexities is always welcome. In a family containing over 3600 species in 455 genera the proportion growing as natives or aliens in the British Isles is significant with a maximum of about 120 species in some 40 genera, i.e. about 3% of the world's species and 10% of the world's genera are represented here.

The published work is a listing of data gathered on the GNOM (Generis NOMenclator) computer database which remains open for corrections and additions, thus reflecting current nomenclatural knowledge of genera in the Umbelliferae. Adopting a modified version of Drude's *Classification* (1897–98), the bulk of the work comprises an alphabetical list of genera with authorities, place of publication of the protologue, type, subfamily, tribe and subtribe. For each entry this is followed where appropriate by any generic synonyms, geographical distribution, number of species and finally any relevant literature. Unlike some works of this nature the information is easily read and well laid out with the appropriate use of a range of typefaces and adequate spacing between entries. About a fifth of the work is given over to a comprehensive list of references, which is more than adequate although omitting some of the regional Floras consulted by the authors.

The authors have adopted a relatively narrow generic concept throughout but admit to difficulties with critical genera such as *Peucedanum*. They recognize the genus as having perhaps only six or eight species closely related to the type, *P. officinale*, a rare species in our flora being confined to East Anglia, but much more widespread in continental Europe. However because many of the remaining species previously placed in the genus are of uncertain position, they list *Peucedanum* as having 100–120 species with the proviso that more work is needed and that this is probably the most complex taxonomic conglomerate in the Old World Umbelliferae.

Dedicated to Professor Lincoln Constance, who has spent most of his life studying the Umbelliferae, this is an excellent compilation of data which will be invaluable to any serious student of the family, but especially for those trying to grapple with the many problems of nomenclature and generic delimitation encountered in the subfamily Apioideae.

S. G. KNEES

The Flora of Ditchley: wild flowers of an Oxfordshire estate. A. J. Dunn. Pp. xi + 68, with twelve colour photographs and estate map. Privately published by Dr Catharine Wills, Sandford St Martin, Oxfordshire. 1992. Price £16.45 (ISBN 0–9521310–0–5).

This is the flora of a private estate in the foothills of the Cotswolds. The 17 ha (46 acres) consist mainly of farmland, several plantations and a few hectares of ancient woodland.

Miss Dunn gathered botanical records from 1985 until 1992, the most exciting one being a new site for the Downy Woundwort, *Stachys germanica*, one of our threatened species. She has studied the habitat requirements of this plant in great detail and published the findings in *Watsonia* **16**: 430–431 and **18**: 359–367. Thanks to the loving, careful management of the landowner, the late Mr Martin Wills, the range of species is impressive; indeed half of the 443 recorded species are additions to the official county records for the estate.

The book is well written and has some very readable chapters on the history and natural history of Ditchley, but I would have welcomed a better map. I also regret that the author does not give exact plant locations, though she mentions that index cards for each plant, carrying full details, are available on request. Whilst I understand her concern for secrecy in the case of a few rare plants, the general lack of precise data is bound to diminish the appeal of the book.

M. BAECKER

The Wiltshire Flora. Edited by B. Gillam. Pp. x + 386, with eight pages of colour plates and 622 maps. Pisces Publications, Newbury. 1993. Price £27.95 (ISBN 0–9508245–8–5).

Despite its large size (84 km from north to south), Wiltshire has traditionally shared the fate of Lincolnshire and Northumberland of lying off the main botanizing routes and enjoying too slight a reputation for rarities to lure outsiders into paying visits to it expressly. The task of investigating its flora has consequently fallen almost wholly on the shoulders of its resident botanists, a task which they have increasingly discharged with remarkable frequency and thoroughness. In the space of only 36 years they have given us a county Flora of the classic type of outstanding quality, an extensive supplement to that and now this further very substantial volume which is a kind of hybrid between the two.

Most attractively produced, this latest work embodies the results of the Wiltshire Flora Mapping Project of 1984–92, an undertaking which is shown to have had a complex gestation and to have given rise in turn to an unusually elaborate organizational structure, with a Steering Group, a Science Group, successive Project Coordinators and ultimately a Publication Working Party. The whole modus operandi, including the recording methods, is described in commendable detail on pages 3–6 and 112–118. Emphatically a team effort, in which the B.S.B.I. Recorders for the two vice-counties, David Green and Ann Hutchison, have played a major part (with responsibility, most notably, for the systematic list), it has ended up by giving rise, as in Surrey and Sussex, to a permanent body dedicated to carrying on the study of the county's flora into the future. Even had no publication resulted, this outcome alone would surely have been justification enough for all the work that the project has entailed.

J. D. Grose's 1957 *Flora* was a product of the pre-mapping era and the 1975 *Supplement* was essentially a mere appendix to that in concept. In the intervening years, however, the county's landscape had been drastically altered and the need had begun to be felt for a total re-survey on the basis of the standardized mapping units offered by the National Grid. A major feature of this latest volume is consequently over 600 tetrad distribution maps of all but the commonest and the more critical species. In addition, it has most of the introductory sections now standard for county Floras, 35 colour plates of various shapes and sizes depicting sample habitats and some of their more attractive individual species, and a series of short essays, by different hands, on certain plants of more particular local interest – a welcome and valuable innovation (if slightly marred by the choice of oppressively large type for the titles).

As usual, though, it is the systematic list which accounts for the main part of the text and to which most readers will turn in the first instance. One thing here that will strike them very quickly is the size of the floristic debt the county owes to the fact that its boundaries in H. C. Watson's day took in a tiny part of the super-rich New Forest (and ironically, if perhaps inevitably, most of the records resulting from this appear to have been a by-product of the concurrent fieldwork for the forthcoming *Flora of Hampshire*). No less eye-catching are the helpful figures at the foot of the accounts of the species indicating the percentage of 10-km and either 2-km or 1-km squares in which each was recorded during the project. These take the place of the inherently vaguer verbal estimates of frequency conventional till now in works of this kind. Impressive, too, is the care given to the precise detailing of habitats and of the extent to which species differ in quantity between one area and another. It is a pity, though, that a wish to keep wordage and punctuation to a minimum has had the result of making many of the lists of localities too condensed for ready comprehensibility.

Much less pardonable, by contrast, are the status categories adopted: each species is designated either "native" or "introduction", with no distinction made between arable weeds of age-old presence, putative relics of former cultivation, ephemeral adventives and established horticultural exotics. The traditional Watsonian terminology certainly has its defects but it is greatly more informative than this kind of despairingly aggregate treatment. To discard it wholesale, instead of seeking to improve it with modifications, is merely obscurantist and does no service to the army of local workers on whom the task of refining our notions of status so heavily depends. Even with just two categories in play, though, there is evidence in these pages of still some considerable inexactness: *Sinapis arvensis* is classed as a native, for example, but *Thlaspi arvense* and *Raphanus raphanistrum* are dismissed as introductions – for no reasons that are apparent. In common with nearly all local Floras, moreover, no allowance is made for the fact that many species are of multiple status locally: seemingly indigenous, maybe, in certain habitats, accidentally brought in in others, a relic of deliberate cultivation in yet others. To force every species into just the one, most 'respectable' category (as Watson himself unfortunately did) can only be to convey a seriously misleading idea of the more complex reality.

Lastly, the unwary should be warned that this work is, by deliberate design, a 'snapshot' Flora, a record of everything found within just the period under study, not an account of all the vascular plants known to have occurred in Wiltshire since records began. Because of this time restriction – and it is not clear why the work had to be so hurried – pre-1984 records are excluded except where necessary as a historical benchmark and the coverage of the larger critical groups is sketchy at best. On the one hand this has meant that many species for which reliable past evidence of their occurrence in the county exists have no place in these pages, even though the fact that they may still persist in the localities in question could serve as a fruitful challenge to present-day investigators. The recent exciting disinterment in **BM** of E. J. Tatum's century-old specimen of *Gentianella ciliata* consequently earns no mention (indeed, the combing of herbaria formed no part of the project, by definition). On the other hand it has seriously reduced the value of the book to anyone whose interest lies primarily in critical plants. The account of *Taraxacum* does not extend beyond three aggregates and that of *Rubus* is a bare list of species without localities, omitting (because observed a few years too early) what is probably the one flowering plant taxon confined to this county in Britain, namely *R. arrhenii*, as well as, with no such excuse, *R. stenopetalus*, the rediscovery of which in Wiltshire and confirmation as a result as British was reported in this journal during the duration of the project. As two *Rubus* specialists live in next-door counties, it seems a pity that more effort was not made to secure a better coverage of at least that group, the more so as the duplicates collected by Grose at W. C. R. Watson's side in 1948 have mostly been destroyed by insects and the correctness or otherwise of the determinations published in the *Flora of Wiltshire* badly needs to be established. Perhaps the splendidly hyperactive botanists of this county can now be induced to make a Critical Flora of Wiltshire the next object of their exertions?

D. E. ALLEN

Roses of Great Britain and Ireland: B.S.B.I. handbook No. 7. G. G. Graham & A. L. Primavesi. Pp. 208. Botanical Society of the British Isles, London. 1993. Price £11.50 (ISBN 0–901158–22–4).

This long awaited addition to the B.S.B.I. Handbooks continues the high standards set by earlier volumes in the series. The authors have produced an authoritative account which, for the first time, makes the genus accessible to British botanists. The excellent line drawings by Margaret Gold complement accurate and unambiguous descriptions of the twelve native and eight introduced species. Much research in the field and in herbaria has enabled the authors to describe 83 hybrids. Most hybrids are not mapped, but a list of v.c. records is given; I could find no explanation of "non-directional records" (it means the seed parent is not known and not that the plants have grown in all directions!).

The nomenclature and order of the species is the same as in Stace's *New Flora*. English names are given for all species though I doubt if "Columnar-styled Dog-rose" will be very popular! I was pleased to see "Eglantine" retained for *R. rubiginosa*, it would be sad to lose it to the cause of English binomials. One other change from Stace is the addition of "Northern Dog-rose" for *R. caesia*; this seems a little premature given the frequency of Leicestershire records for both subspecies on the maps.

The introductory chapters are essential reading for anyone wishing to study wild roses. I found the accounts on morphology and general characters particularly useful, with clear illustrations of growth forms, prickles, leaf shapes, leaf serration, hips and shape and disposition of the sepals. This account, together with a very useful section on collecting and pressing roses and a glossary which puts some of the more obscure terminology into plain English, should help the amateur rhodologist get started. The history of classification is described and the problems presented by the peculiar reproduction and promiscuous hybridisation show why the genus has been so difficult for taxonomists. The section on ecology and distribution is very interesting; several species appear to be limited only by lack of suitable soils or habitat. However, I suspect the influx of new records stimulated by this book may show up new patterns not yet visible from the paucity of accurately determined records available to the authors.

There are two dichotomous keys, one including alien species, the other just the natives. Both are effective and my trials with five named herbarium specimens all proved successful. Initially it seems odd to have two keys doing the same job, but I found it reassuring to reach the same conclusion using slightly different combinations of characters. Using the keys amply demonstrates the need for good specimens and for the annotation of characters such as sepal disposition and bush shape whilst in the field. The keys do not identify hybrids except for the frequent *R.* × *dumalis*.

32 distribution maps at a 10-km square scale cover the native species and selected hybrids; only accurately determined records have been used. As the authors point out, the maps of critical species

and hybrids are provisional. The maps for the *R. canina* groups, *R.* × *dumalis* and *R. caesia*, all show the authors' surveys of Leicestershire and Co. Durham, but little else. If these taxa are as frequent in other parts of the country as they appear in these two counties then a great deal more recording is needed before we have an idea of real distributions. The symbols used to show the two date classes on the maps are squares and triangles rather than the black and white circles of earlier volumes. I found this visually less effective, making it harder to pick out declines in range.

The book finishes with an extensive bibliography containing 289 entries. As 90% of these are pre-1975 and a third are foreign I feel much of this is of limited interest to most readers.

The new 'Demy 8vo' format (almost A5 size) is an improvement on the cramped feel of the earlier volumes, but there is a lot of white space and the layout does not make the best use of the larger page size. I do not like the sombre cover design; the black edges give a funereal feel to a book about such beautiful plants. Like *Crucifers*, the text has been printed from camera-ready copy, and this gives a slightly fuzzy look to the text as opposed to the crisp typesetting of Handbooks nos. 1 to 5. The use of hyphenation is bad, many words being split with only two letters left at the end of a line.

The fact that flowers are of little diagnostic use has meant they hardly feature in this book. This will perhaps disappoint those who, like me, were first attracted to wild roses by the dust-jacket of Keble Martin's *Illustrated Flora*. It may also limit its sales appeal, but this is a book which all B.S.B.I. members should buy. It has brought the study of British Roses into the twentieth century and will stimulate me, and I am sure, others, to take much more notice of this neglected genus.

M. N. SANFORD

Atlas of the bryophytes of Britain and Ireland. Edited by M. O. Hill, C. D. Preston & A. J. E. Smith. Volume 1: Liverworts (Hepaticae and Anthocerotae); pp. 351, including 293 distribution maps. Volume 2: Mosses (except Diplolepideae); pp. 400, including 367 distribution maps. Harley Books, Colchester. 1991, 1992. Price £25.00 (ISBN 0–946589–29–1, vol. 1); £30.00 (ISBN 0–946589–30–5, vol. 2).

Using the first volume of this bryophyte distribution atlas, it took me exactly 3 minutes and 47 seconds to find out which liverwort is the most widespread in Britain and Ireland. It is *Lophocolea bidentata* which is recorded from 2,421 10-km squares in the two countries (including the Channel Islands). Of course, this fact is not one of the most interesting ones to be taken from the *Atlas*. Nevertheless the example shows that the data are presented in a form that makes them readily available.

The complete *Atlas* will comprise three volumes and will present distribution maps for the whole bryophyte flora of Britain and Ireland amounting to nearly one thousand taxa. The area covered comprises about 3,500 mapping units (10-km squares of the British and Irish national grids and of the UTM grid in the Channel Islands).

The introductory chapters of the first volume deal with the history of bryophyte recording in the British Isles, the mapping scheme used (including information on the availability of records from the database), and the evenness of the survey. The first map provided shows the number of liverwort species recorded in each of the 10-km squares. No attempt is made to distinguish between differences in investigation effort and differences in regional species diversity. Will that problem be discussed in the "detailed analysis of geographical coverage" planned for the final volume?

The liverwort volume contains 289 distribution maps for the hepatics and four for the hornworts of Britain and Ireland. The map dots are differentiated as to the date of the last record (before or since 1950). Accompanying the maps, short texts by various authors give additional information for each taxon in standardized format. These texts include data on altitudinal distribution, ecology of the species, number of grid squares in which the taxon is mapped, sexuality, fertility, means of propagation and general distribution. Additional remarks on various subjects are given where appropriate.

The distribution maps are followed by eight maps showing selected environmental factors, including the mean concentration of sulphur dioxide in the atmosphere in 1987 (UK only). In a special chapter of the second volume Crundwell considers the bryophytes of Britain and Ireland in a European context. 367 moss distribution maps of the same type as for liverworts follow and deal with about half the moss flora of the archipelago.

Both published volumes conclude with bibliographic references and a "list of localities cited in the text" with their co-ordinates in the appropriate national grids that are shown in a separate map (for people not familiar with the grid system, an explanation of the use of it would have been useful); each includes an index to the taxa, including selected synonyms.

No mention is made of the total number of records on which the *Atlas* is based. It must be a question of hundreds of thousands. With the exception of the BeNeLux countries there is no region in continental Europe with a comparable state of knowledge. However, Crundwell's "guess" that "our present 10-km square records are a little over two-thirds of those we would have were our knowledge complete" seems to be somewhat optimistic. Of 17 relevant records from two small collections made without any special knowledge and intention in Scotland and in Southwest Ireland four are new to their squares. From my own experience in bryophyte mapping and considering the enormous task undertaken, I judge any degree of completeness of more than 50% an excellent result. Of course, the data ought to be examined for less obvious biases produced by the method of mapping. But the maps give the experienced user the decided impression that the high value of the data for various kinds of numerical interpretation are not substantially affected by errors or incompleteness.

I am looking forward to see the *Atlas of the bryophytes of Britain and Ireland* completed. It is an invaluable tool for bryologists, biogeographers, botanists, conservationists and ecologists, and an important work far beyond the area covered.

E. Urmi

The families and genera of vascular plants. Edited by K. Kubitzski. Vol. 2: flowering plants, dicotyledons, Magnoliid, Hamamelid and Caryophyllid families, edited by K. Kubitzski, J. G. Rohweder & M. Bittrich. Pp. x + 653; 140 figs. Springer-Verlag, Berlin. 1993. Price DM 478 (ISBN 3–540–55509–9).

The Englerian tradition of preparing integrative botanical monographs is alive and well, to judge from this latest volume in the series first reviewed in *Watsonia* **19**: 44–45, 1992. It covers three of the major subclasses of the dicotyledons, and an introductory chapter provides a chemosystematic overview of these together with a fourth, the Ranunculidae. The main body of the volume consists of a descriptive section for each family followed by keys to subfamilies and genera, generic synonymy and a short description of each genus, a sketch of its geographical distribution and an estimate of the number of species it contains. There is a selective bibliography at the end of each family treatment, and an index to scientific names is provided at the end of the volume. The quality of both printing and binding is excellent.

This is an encyclopaedic treatment, with one major limitation as a consequence. There was a need to prepare complete accounts for each family, and the editors were obliged to compile some treatments themselves when specialists either failed to deliver their promised contributions, or were unavailable; this makes the final product somewhat uneven. In Kubitzski's account of the Plumbaginaceae, for example, the generic splitting carried out by Linczevski in subfam. Staticoideae, resulting in around 30 species of *Limonium* sensu lato being transferred to 13 new genera, has been accepted but with reservations. The revision provides no new insights into the evolution of the family, and the key to genera uses characters such as leaf width and stigma shape to separate groups which the author admits will not stand the test of a critical revision. Other treatments, by contrast, such as that of the Fumariaceae, are up-to-date and definitive.

In the preface to this volume, Professor Kubitzski takes stock of the rapid development of molecular techniques for probing the relationships between genera, families and subclasses of dicotyledons, and the extent to which these discoveries have been incorporated into conventional classifications. There is still enormous scope for applying these new methods to the study of taxa at the level of genera and above, but relatively few authors have gone on to prepare monographic treatments at this level which specify morphological characters for the newly characterised taxa.

The present editorial team, with its mixture of youth and experience, must therefore be congratulated for attempting such an ambitious project, albeit one which is heavily dependent on outside contributions: 38 authors were responsible for the present work. The formidable price of this volume may well place it beyond the reach of all but the largest botanical reference libraries, but copies will no doubt be in demand from a wide range of users. Since the only analogous modern work, John Hutchinson's *The genera of flowering plants*, remains incomplete, one hopes that the present series may soon be continued and eventually completed.

J. R. Edmondson

Algarve plants and landscape. D. J. Mabberley & P. J. Placito. Pp. xvi + 300; 279 colour and 269 black and white illustrations. Oxford University Press, Oxford. 1993. Price £45.00 (ISBN 0–19–858702–3).

This is a difficult book to categorize. As its subtitle, "Passing tradition and ecological change" indicates, the authors have set out to characterize the flora of the Algarve province of Portugal within a detailed context of the region's geography, geology and, particularly, traditional agriculture. There is also a balanced assessment of the impact of tourism, the region's relatively recent, but certainly its currently most potent, economic factor.

The natural vegetation of the Algarve is described essentially within the framework of the province's three main subdivisions, the coastal zone, the more inland and largely base-rich soils of the 'barrocal', and the complex of acidic shales and other substrates of the upland 'serra'. The style is decidedly didactic, with observations for example on the derivation of plant names, their ecology and uses, details of pollination by pseudo-copulation in some orchid species, and, consistently, with Portuguese names for plants, communities, etc., given in parentheses. Many of these plants are illustrated with colour plates and a fine series of line drawings by Rosemary Wise. Unfortunately, the plates are reproduced in small format, grouped 15–18 to the page, and as a consequence are sometimes of limited value. The drawings are on the whole effective and helpful. A further section deals with the many exotic species encountered in streets and gardens in the province. A feature of this book is that the plant life is not presented in isolation, but rather is interspersed with sections on, effectively, local human geography. This extends to a survey of fishing practice, with lists of fish species and molluscs, and other aspects of local economy, such as sea-salt production along the coast, and above all, with an extensive exposition of traditional and more recent innovations in agricultural practice in the region. This includes accounts of olive, carob, figs, grapes, citrus and many other crops, each with extensive details of local cultivars. Indeed, this central section sometimes gives the impression of a text in economic botany.

Throughout, this book is profusely illustrated with black and white photographs of plant communities and landscapes (including a series which contrast scenes in nineteenth century aquatints by Landmann with the same locality captured in a recent photograph) and crop cultivars, and also with line drawings, e.g. of traditional agricultural implements, and over 20 maps. A more judicious selection of rather fewer maps would perhaps have been more helpful: e.g. a general introductory map with more place-names than the minimal Tavira, Faro and Silves provided in Fig. 1 would have given a useful orientation; and readers will be amazed at the extensive areas of the Algarve where, apparently, the average age of the population is over 100 years, as depicted in Fig. 238. An omission in the legend seems to be responsible. A more serious omission is the lack of author citation at relevant places in the text for any of the nearly 500 references listed in the bibliography. This can only hinder the reader who wishes to pursue a particular topic further.

For plant lovers who have acquired a property in, or who regularly visit the Algarve for what the tourist trade refers to as 'quality' holidays, this fact-laden book is recommended as a means of enhancing their understanding of the region. For those visitors who prefer to toast themselves on the beaches, with only the occasional excursion inland and minimal interaction with the local inhabitants, the detail provided in this book is likely to be offputting, as is its price. This is a pity, because mass-tourism, either by package-tour arrival at Faro airport, or via the new international bridge across the river Guadiana from Spain, is changing the flora and traditional life-style of the

Algarve at an accelerating pace. Mabberley and Placito's enthusiasm for the region, which is evident in this book, allows us to share something of its cultural heritage before it is too late.

P. E. Gibbs

Scandinavian ferns. B. Øllgaard, with illustrations by K. Tind. Pp. 317; 103 line drawings and 114 colour plates. Rhodos, International Science and Art Publisher, Copenhagen. 1993. Price paperback D.kr. 375 (ISBN 87–7245–530–6); hardback D.kr. 425 (ISBN 87–7245–532–2).

Scandinavian ferns is sub-titled "A natural history of ferns, clubmosses, quillworts and horsetails of Denmark, Norway and Sweden." It is natural history at its best. The text and illustrations recount meticulous and detailed observations of Scandinavian Pteridophytes. All that has been observed of their reproduction, variation, ecology, distribution and even the origin and meaning of their names, is presented to the reader.

The 114 water-colour plates are painted from living subjects and breathe a life rarely found in botanical illustrations. Clouds of spores erupting from *Botrychium lunaria* or shoots of *Equisetum variegatum* with huge mosquitoes hanging dangerously over-head convey an impression of life for these simpler Pteridophytes. Many of the fern illustrations are equally delightful – those of *Cystopteris* for example – but my feeling was that the bold style lost some of the intricate beauty of *Athyrium* and *Polystichum*. Whole plant illustrations invariably include rhizomes, and habitat paintings show other species for scale and context. Frequently there are details of scales, individual pinnae, sori, prothalli, young plants, croziers, even a droplet of water being excreted from an *Equisetum telmateia* sporeling. Line drawings inserted in the text illustrate spore architecture, cells in the annulus, stem cross-section and the fronds of hybrids and subspecies where appropriate.

There are keys to all species, and additional subspecies and varieties (eleven) and hybrids (25) are dealt with in the text. Taxonomically there are a few differences from recent British Floras; *Diphasiastrum alpinum* and *D. complanatum* are placed within *Lycopodium* for instance. As a nomenclatural romantic I was pleased to see *Asplenium viride* rather than the cumbersome and unfamiliar *Asplenium trichomanes-ramosum*.

The comprehensive text and illustrations might be of interest to British botanists wishing to complement their British Floras. 56 of the 72 species described in *Scandinavian ferns* are members of the British flora and all of the genera recorded from Britain bar only *Adiantum* and *Trichomanes* are represented in the book. *Diplazium sibiricum* (family Woodsiaceae) was a new species for me, and I was pleased to learn of an additional six *Botrychium* species not found in Britain. Taking this large format book into the field would be cumbersome and only spoil the paintings. It is definitely a book for the armchair where the text makes easy reading. I would recommend anyone contemplating a botanical excursion in Scandinavia to consider buying a copy.

G. Stark

The release of genetically-engineered organisms. Edited by B. Shorrocks & D. Coates. Pp. 48. British Ecological Society Ecological Issues No. 4. Field Studies Council, Shrewsbury. 1993. Price £3.50. (ISBN 1–85153–853–4).

The lack of easily obtainable and factual information on current ecological issues has led the British Ecological Society to produce a series of booklets. Each booklet, representing the work of a group of experts, deals with one topic and the fourth of the series is concerned with Genetically Modified Organisms (GMOs). An organism is genetically modified if new combinations of genetic material are achieved by techniques other than traditional breeding or other natural methods. In the first chapter the ways in which genetic information is transmitted and manipulated are summarized.

Although these booklets are aimed at a wide audience, including teachers and policy makers, this essential introduction on genetic engineering may be difficult to understand and possibly off-putting to readers without a good genetic background, despite a good two-page glossary. Subsequent chapters are easy to read and the second one discusses the risks associated with the release of GMOs into the environment and their potential environmental problems in relation to our knowledge of the ecology of invasions by exotic species. The two main problems posed by GMOs are firstly the transfer of a gene to a related species and secondly the creation of invasive organisms.

The following three chapters discuss the potential risks associated with the release of microbes, plants and animals. The section on plants deals essentially with genetically modified crops and arable weeds, and little mention is made of grasses and ornamental plants. Horticultural plants are unlikely to become the target of genetical engineering in the very near future. However, because of their economic importance, it is only a matter of time before transgenic ornamentals are produced. Traits such as frost resistance and those related to the reproductive biology (e.g. flower colour or structure) are likely to be targeted and these traits affect plant distribution and abundance. For example if flower attributes are modified the pollination success and associated seed production might be affected which could alter abundance. Since a very large proportion of invasive species are escaped ornamentals the potential threat is great, whereas few if any terrestrial plant crops are known to be invasive in natural or semi-natural vegetation. The problem with GMOs is that the outcome of a particular genetic change is uncertain and like exotic species we are not able to predict which species will become invasive in a particular environment.

The booklet is nicely produced and includes three pages of references giving readers the opportunity to investigate particular issues in greater detail. Despite the poor treatment of ornamental plants, this booklet, like the others in this series, is an essential source of information on a current and potentially increasing environmental problem.

P. BINGGELI

Flora of Northumberland. G. A. Swan. Pp. 351; eight transparent overlays, 14 pages of colour plates. Natural History Society of Northumbria, Newcastle-upon-Tyne. 1993. Price £36.00 (ISBN 0–9520782–0–1).

As children we would slide down the Willington ballast hills on pieces of cardboard, never realizing the diversity of plant colonists that occurred there. Sadly, these white hills and their diverse floras have disappeared, as have those of a vast number of lowland aquatic sites and many square kms of open moorland. My grandfather, a herbalist in the Hexham area, knew the flora well and regularly sent his children on collecting trips. Interestingly, a modern plant chemist has now produced a comprehensive treatment of the plants of Northumberland. George A. Swan has done a magnificent job of documenting and describing the native and naturalised flora of this large and botanically-understudied county.

As an expatriate Northumbrian convalescing in St Louis after some serious surgery, I had hours of pleasure reading of the plants that are now extinct, the ones I missed seeing when I lived in England and the new occurrences of some interesting taxa, especially *Ophrys apifera*, Bee Orchid. The format of the book is pleasing, with maps at the 5-km square level showing historical, recent and current occurrences, all checked by the author before being accepted, and the text is in a clear type on the quarto pages. A comprehensive gazetteer and a section on local habitat terms will help visitors find their way to the various cited links, slacks, slakes, denes, hopes, cleughs, and other areas of botanical interest. How fortunate that botanists have visited and thus ensured a mention in print for Blakehopeburnhaugh, a strong candidate for the longest English place-name! Incidentally, the terms Black and White in many settlement names may refer to former monastic orders, as suggested by the village of Blanchland, Blackfriars in Newcastle and the two churches in tiny Bywell.

The plants are listed in the *Flora Europaea* sequence but the names follow the recent publications of Stace and Kent. A 50 page section by Angus G. Lunn describes the environment of vice-counties 67 and 68. The 109 species of Dandelion, *Taraxacum* have received an expert treatment in the hands of John Richards. The remainder of the book is the sole effort of George Swan, although he does fully acknowledge the companionship and active assistance of his wife Margaret. The Natural History Society of Northumbria published the volume and Mrs Grace Hickling, our late heroine of local natural history, apparently persuaded Mr Swan to undertake the task.

The book will surely encourage further botanizing in the region. Who will be the first to confirm

Spring Gentian (*Gentiana verna*) and other plants not yet documented as county records? Incidentally, the Bee Orchid recently found in the very grass where decades of pupils from Wallsend Grammar School took their first ecology classes is probably a new colonisation because I am sure we would not all have missed such a beautiful plant. Horses at the annual fair could have introduced the seeds, and lime from the crumbling viaduct of Stephenson's Killingworth wagonway (which incidentally gave the world its standard railway gauge) could provide the necessary habitat. The book also suggests numerous M.Sc. and Ph.D. thesis topics to the reviewer. Plant taxonomy is still alive at the University of Newcastle and, hopefully, this new *Flora* may inspire school and college teachers in the area. Mr Swan is only in his 70s and I wish him at least a further couple of decades of botanising. After all, he will need them because he has recently added bryology to his list of interests.

P. M. RICHARDSON

Obituaries

PETER HADLAND DAVIS
(1918–1992)

Born at Weston-super-Mare on 18 June 1918, Professor Peter H. Davis died in Edinburgh on 5 March 1992. My first encounter with Peter Davis was in 1946, as a raw undergraduate, attending my first Botany I class at the University of Edinburgh, where I was planning to read Agriculture. I was somewhat taken aback at the sight of a slender figure in a long, hairy, sheepskin coat, who stutteringly introduced himself. Although he was ten years or more older than the rest of us, he soon became a dominant character in our group and certainly set the pace for us as regards systematic botany. This was easily explained by his earlier background, when he was influenced by his contacts with the Ingwersen plant nursery which led to what became a life-long passion for plant collecting. He had established contact with Sir William Wright Smith, Regius Keeper of the Royal Botanic Garden and Regius Professor of Botany at the University of Edinburgh. This resulted in his going there to read Botany, after spending most of the war years in the East Mediterranean where he was employed by the security service (mainly dealing with screening mail) and acquired an extensive knowledge of the flora which was to stand him in good stead later. It was, understandably, disconcerting in our practical Botany classes at the University when faced with having to identify as a test 100 specimens or illustrations of plants (a common practice under Sir William Wright Smith) to find that some obscure species amongst them had been discovered for the first time by Peter himself. Such was his disingenuous charm that we didn't even cry foul! He was awarded First Class Honours in Botany.

Peter Davis continued during his undergraduate years to work on his Mediterranean plant collections which he had brought with him to Edinburgh and he soon involved me in working up the Scrophulariaceae amongst which was a new species of *Digitalis* from Anatolia, *D. davisii*, the first new species I ever described. In the meanwhile, I had developed an interest in Spain, having gone there first on a plant-collecting expedition with Dr Paul Giuseppi, a Felixstowe surgeon and renowned collector and alpine garden plant specialist, who was also a friend of Peter Davis. Peter and I joined forces in a plant collecting tour of Spain in 1948, sponsored by the Royal Horticultural Society. I then accompanied him on an expedition to Anatolia in 1950. Botanising with Peter was an education in itself, for he was a real professional. Food, personal discomfort, physical exhaustion all counted for nothing: nothing mattered but the plant collecting. He taught me how to make sketches and accurate notes, drilled me in the meticulous preparation and numbering of the material, how to make collections of seeds and more subtle tricks such as how not to miss plants hidden in screes. Perhaps best of all was conversation, which ranged widely from Henry James and the use of punctuation to Mediterranean plant life and culture, all intermingled with anecdotes about colourful friends and acquaintances.

Thereafter, our ways separated – he remained in Edinburgh and joined the staff of the University Botany Department, where he eventually became Professor of Taxonomic Botany (1979–85), while I went to Cambridge and subsequently to Madrid and Liverpool. Our floristic interests too diverged and we did not collaborate further in our respective areas although we kept in close touch and it was as teachers of plant taxonomy that we both felt the need for a text that did justice to the subject, rather than the old-fashioned McGraw Hill volumes that were all that were available, apart from manuals of plant classification systems such as Hutchinson, Warming & Potter and Lawrence (this latter admittedly having a broader treatment of the subject matter). Thus began our collaboration on *Principles of Angiosperm Taxonomy*, which was published in 1963. Although individual chapters were drafted by one of us, we both revised and often rewrote each other's contributions. The intellectual clarity of the text which several reviewers commented on owed much to Peter's fine feel for language and style.

Peter was not at home with many of the ways in which plant taxonomy developed and was happiest with the more traditional morphological aspects and with exploring the basic principles of classification which he sought to clarify, based largely on his extensive practical experience of 'doing taxonomy'. Yet he enjoyed intellectual discussions with some of the leading figures in the rapidly changing field of modern systematics and genetics such as G. Ledyard Stebbins and C. H. Waddington. He did not engage in multivariate systematics, leaving others to master the techniques. Not for him were molecular systematics or cladistic approaches. Nor did he, with rare exceptions, participate in international meetings, congresses or symposia, conserving his energies for what had become his life's work, the preparation of the *Flora of Turkey*, begun in 1959. This ten-volume Flora will undoubtedly go down in the history of taxonomy as a landmark work. Its completion was a major achievement and very much a result of the energy he devoted to it and the enthusiasm with which he inspired the small team of collaborators who worked with him on each volume, although often driving them to near despair as he fussed over details.

He had a wide circle of friends in many different walks of life: when staying with him in his elegant town house near the Water of Leith, one never knew who would knock at the door at any time of day or night. He was a knowledgeable collector of modern paintings and drawings and an authority on Wemyss-ware of which he built up an impressive assemblage. He showed remarkable generosity to those he favoured and delighted in hosting parties at his home, whether for visiting Russian botanists or some distinguished artist.

He was one of the most colourful figures in plant taxonomy and will be sadly missed. The remembrance held for him on the occasion of his funeral was a strangely elating occasion. One could just imagine him in some botanical Nirvana, peopled with Wemyss cats and his comfortable furniture and objets d'art, looking down at us and giggling.

V. H. Heywood

RECOLLECTIONS OF PETER DAVIS

Important as it is to recognise the achievements of Peter Davis in taxonomy, it would be wrong not to try and record, both for those who knew him and those who did not, the colourful and irreverent side of his personality which co-existed with his dedication to science.

Unlike many nine-till-five academics, who go home to the worthy sameness of domestic care, his bachelor life enabled him to pursue wholeheartedly his interests in art, collecting, friendship and the wilder shores of human association. He was not a career aesthete for whom these things are a pose or an end in themselves: they were for him an essential and nourishing complement to his botany. His marvellous parties in St Bernard's Row, down in Stockbridge, used to bring together a great variety of congenial spirits from many walks of life, visitors from London as well as Edinburians. The essential requirement was that people should interest him, interest one another and never be dull.

He had a fine collection of paintings, mainly but by no means exclusively modern. Many were by contemporary Scottish artists, all of whom he knew and whose sensuous and assured use of colour strongly appealed to him. He had also assembled an original and diverse collection of furniture and bric-a-brac which came together in the pretty house to make a rich and highly distinctive whole. It was fastidiously organised but livable, not precious. Although he knew a lot about some things, Wemyss pottery for example, of which he was a pioneer collector, and he had a representative collection of the bizarre products of Barvas on the western shores of the island of Lewis, a place never reached by the potter's wheel, his acquisitions were stimulated by passion and appetite, not scholarship. A camp thread was discernible in some things, such as the collection of sporrans which hung like trophies in the downstairs loo, but this was not a dominant note. Everything was interesting and he had a wonderful eye for the strange and beautiful lurking in unexpected places. The spoils enlarged the sensibilities of many who came to St Bernard's Row.

On party nights the jacket of his dark suit would reveal a crimson lining, an uncharacteristic excess he would probably not have continued to affect had he been to Oxford instead of Edinburgh. In no other respect was he provincial. Sartorial effect was not otherwise something he bothered about at all although his invariable outdoor appearance, in winter at least, did achieve a certain idiosyncratic style. He wore a narrow cloth cap with sewn-down peak, muffler and a short, heavy twill overcoat. His hands would be thrust into its pockets as he walked, with short steps, elbows in, drawn up tight. With his disturbed complexion and ever-twinkling eyes behind his glasses, he looked like some unfrocked parson who had become the faintly disreputable associate of an on-course bookie.

It has been convenient for some to see Peter Davis as a sort of Jekyll and Hyde character: the eminent and reputable academic on the one hand and the frivolous and slightly 'sinister' eccentric on the other. I believe he was more of a piece than this suggests. The wit and judgement he exercised in personal relations and in his enjoyment of art and the intellectual and physical stamina he brought to his work were, in fact, a continuum. I once asked him what he thought about the fashionable trends in genetics and molecular biology as they affected botany. It was an unkind and disingenuous question as I was pretty sure taxonomy was thought by many at that time to have been upstaged by these developments, more then perhaps than now. He paused for a long time, as if searching for an unprejudiced comment on something he found uncongenial, even threatening. Then, quietly and deliberately: "It is very interesting, and very important; but I believe it loses sight of the whole plant, its community and its place in nature".

He detested pretentiousness, respected hard work, competence and above all integrity in whomsoever he found it. His favourite novel was that cruel analysis of dishonour among thieves, *The Wings of the Dove*. Looking back across the years since I was first taken to one of his parties in early 1960; an occasion from which so many Edinburgh friendships were to spring, I realise how keenly I used to enjoy seeing him: always acute, always interesting, always such fun. The last time I set eyes on him, after we had been in London for some years, was from the car in the twilight of a winter evening. He was turning out of Moray Place into Doune Terrace in his cap and twill overcoat, his hands in his pockets, elbows tucked in as he headed down to Stockbridge. The fading light of the western sky was reflected in his glasses, giving him an unwontedly blind look. I wanted to stop but we were in a hurry. Later, when I learned of his last illness, I consoled myself with the thought that the clouds of forgetfulness had perhaps already begun to envelop him and that he would simply have wondered whom this importunate stranger could be. I shall never know.

P. Harrison

RONALD D'OYLEY GOOD
(1896–1992)

Ronald Good M.A., Sc.D., F.L.S., died on 11 December 1992, at the age of 96. An intelligent and solitary man, he outlived most of his contemporaries. He was the son of a doctor who lived in High West Street, Dorchester, close to the County Museum, which Good visited regularly from the age of ten. What motivated his lifelong interests in botany and local history we do not know, but his teachers at Weymouth College must have encouraged his love of science, in an age when most intelligent boys were steered towards the classics. He was certainly recording wild flowers for the Dorset Natural History and Archaeological Society (D.N.H.A.S.) before 1914, when he made the outstanding record of *Ranunculus ophioglossifolius* near Tincleton (vide Baker, E. G., *Journal of Botany* (*London*) **52**: 277 (1914)). In 1915 the Society awarded him the Cecil Silver Medal for an essay on Radium.

During World War I he served with the Inns of Court O.T.C. in 1916, was commissioned in the 4th Dorsets in 1917, and served in France until wounded, after which he was moved to Ireland. He entered Downing College, Cambridge, in 1919 as an Exhibitioner, and later became a Foundation Scholar and obtained a double First Class Honours in Botany. One of his teachers was Albert Seward, who may have triggered his interest in plant evolution and geography. At Cambridge he rowed for his College Eight.

On leaving Cambridge in 1922, Good joined the herbarium staff at the British Museum (Natural History), with J. E. Dandy as a colleague. Here he built up his knowledge of the floras of the world, and produced a series of papers on plant geography. He also visited Canada with the British Association. He married in 1927.

In 1928 he joined the new University College at Hull as Head of the Botany Department, and remained there for 31 years, becoming Professor in 1946. During this time the student population at Hull rose from about 30 to several thousand. Among Good's students were Eva Crackles, Professor G. Lucas (Kew), Professor D. Read (Sheffield) and Professor W. Armstrong (Hull). Good used his time to produce three, scholarly books, one of which, *The geography of the flowering plants*, was to go through four editions and is still the standard work on the subject in English. Good preferred the Darwinian approach to research, involving many years of thought before producing a magnum opus, to the modern custom of writing or helping to write as many short papers as possible. Good's family (he had one daughter) lived at Cottingham near Hull, but every vacation was spent in his beloved Dorset, where from 1931 to 1939 he carried out an impressive survey of old roads, lost villages and the county's flora. This involved visiting 7500 sites and making over a quarter of a million records of plant species. During this time he co-operated with C. D. Day (an entomologist) and C. Diver in ecological work, but the survey of Dorset was a one-man effort. Good joined the D.N.H.A.S. in 1939 and won its Mansel-Pleydell silver medal. The next year he was able to publish his work on old Dorset roads, but the war delayed other publications. During World War II he served in the Home Guard in both Dorset and Yorkshire. He had to wait for peace before he could see through the press his *Geography of the flowering plants*, a local history of Weymouth and his *Geographical handbook of the Dorset flora*. Peace also allowed him to travel, notably to Bahrain where he collected specimens, and also to Australia, South America and the Caribbean.

In 1959 Good retired from Hull and came to live in Parkstone, Dorset, where he stayed for 18 years. During this time he was an active member of the D.N.H.A.S., leading many field meetings, editing the annual reports on botany and rainfall, acting as President between 1961 and 1964, and then becoming a Trustee. He was also a founder member of the Dorset Trust for Nature Conservation and was instrumental in drawing attention to one of the first Trust reserves at Brackets Coppice, saving it from devastation. He was an accomplished artist in pastels during this part of his retirement.

Good's wife died in 1975, and two years later he took a flat in Albury Park near Shere in Surrey, on the site of John Evelyn's 17th century garden. Here I recall commenting on the tidy state of the grounds during a visit, when he told me with his usual charm that all the able-bodied occupants helped with gardening chores, and he himself swept the paths. Though less mobile than before, he produced three more books at Albury, one on evolution, one on lost Dorset villages and a revised *Concise Flora of Dorset*. From 1989 his left leg became paralysed and he spent his last three years in a Henley nursing home.

Good's contributions to British botany were mostly made in Dorset. His extensive field survey during the 1930s resulted in many new county records for plants such as *Centaurium tenuiflorum*, *Epipactis leptochila* and *Euphrasia anglica* as well as new sites for *Dianthus armeria*, *Himantoglossum hircinum*, *Lobelia urens* and *Sparganium natans (minimum)*. It is not clear whether he himself saw *Simethis planifolia* at Branksome before its disappearance in about 1925. His extensive field notes, species maps and some specimens are preserved at the Institute of Terrestrial Ecology, Furzebrook. The 1948 *Geographical handbook* pioneered the publication of plant distribution maps, and he not only anticipated the National Grid by producing his own Grid of Dorset, but also subdivided each Grid square into 16 parts for mapping. All this work was done by hand, including the preparation of maps.

In the field of world botany Good was a loner who broke new ground. His broad view of plant geography was original and well-argued. He pointed out that affinities between the floras of Australia and South Africa, for example, were best explained by Wegener's theory of Continental Drift. At this time Wegener's theory was unpopular, but with the advent of plate tectonics it has become accepted. Another original conclusion was that the North Temperate flora is still in a state of flux following the catastrophe of repeated Ice Ages. He was the first botanist to suggest that the spread of *Himantoglossum hircinum* in southern England in the first half of this century was due to climatic change (*New Phytologist* **35**: 142–170 (1936)). His two books on plant evolution express his own ideas without reviewing the scientific literature. They emphasise our ignorance of most of the factors controlling the evolution of plants.

Good's herbarium specimens will be found in Dorchester Museum (**DOR**), the Natural History

Museum (**BM**) and I.T.E., Furzebrook, while his 1950 collection from Bahrain is at Kew (**K**). The list of his publications given below may be incomplete, but shows his eclectic interests.

I am grateful to Mrs Grinsley (daughter), Kate Hebditch (County Museum, Dorchester), Professor Gren Lucas (ex-pupil), Nigel Webb (I.T.E., Furzebrook) and others who have helped me to compile this obituary.

MAJOR PUBLICATIONS OF R. D. GOOD

1933 *Plants and human economics*. Cambridge University Press.
1940 *The old roads of Dorset*. Reprinted 1966. H. Cummin, Bournemouth.
1945 *Weyland: the story of Weymouth and its countryside*. Longmans, Dorchester.
1947 *The geography of the flowering plants*. Longmans, London (eds 2–4 1953, 1964, 1974).
1948 *A geographical handbook of the Dorset flora*. Dorset Natural History and Archaeological Society, Dorchester.
1956 *Features of evolution in the flowering plants*. Longmans, London (2nd ed., Dover, New York, 1974).
1979 *The lost villages of Dorset*. Dovecot Press, Stanbridge.
1981 *The philosophy of evolution*. Dovecot Press, Stanbridge.
1984 *A concise Flora of Dorset*. Dorset Natural History and Archaeological Society, Dorchester.

H. J. M. BOWEN

SONIA C. HOLLAND
(1912–1993)

With the death of Sonia Holland in January 1993, the B.S.B.I. has lost one of its most accurate and conscientious recorders and a field botanist who contributed in many ways to the study and conservation of the British flora. Her countryside interests were wide. She had a good working knowledge of birds and bird-song and latterly she became interested in dragonflies.

Sonia was one of the daughters of Dr C. A. Hill of Liverpool, where she was born on 4 April 1912. On her father's death in 1922, the family moved to Aberdovey, where her love of the countryside began. She met her future husband, Bill Holland, at an Artillery Camp at Towyn during World War II and they married and settled in Cheltenham in 1947. They had one son, Clive. Bill Holland died in 1972. Hers was a close-knit family; she kept in close touch with her sisters and enjoyed her visits to them in West Somerset, where she hunted Black Poplars.

Living in Cheltenham, with the Cotswolds and Severn Vale on her doorstep, she saw the need for an active natural history society. Thus she got together with some of her naturalist friends and in 1948 founded the Cheltenham and District Naturalists' Society. Sadly, the established Cotteswold Naturalists' Field Club was no longer filling that role. The Cheltenham Society flourished and expanded to become the North Gloucestershire Naturalists' Society in 1957 and the Gloucestershire Naturalists' Society in 1974. Sonia was Vice-chairman of the Society in 1961 and she edited its excellent bimonthly journal for many years. Sonia was a founder member of the Gloucestershire Trust for Nature Conservation (G.T.N.C.) in 1962; she sat on its Council for 15 years and served on its Conservation Committee. She joined the B.S.B.I. in 1969 and served on the Council (1970–74). She was the Society's recorder for v.cc. 33 and 34 until her death.

With the formation of the G.T.N.C., the Society for the Promotion of Nature Reserves (now R.S.N.C.) passed the management of Badgeworth Nature Reserve from the Cotteswold Naturalists' Field Club to the G.T.N.C. I had known the site, which protects the rare Adder's-tongue Spearwort (*Ranunculus ophioglossifolius*), since schooldays, before the reserve was established, and I had seen how a fence and no management could be harmful to a rare plant. Under the Cotteswold Naturalists there was a warden but no management was done for 28 years! I was so worried about it that I decided to get advice from the then Nature Conservancy's Regional Officer, J. H. Hemsley, a sound ecologist and a personal friend. In 1961, Jim Hemsley, the Warden and I visited the site in early June, flowering time of the buttercup, but none were to be seen. Jim suggested that management be carried out in the autumn, but the Cotteswold Naturalists' Field Club took no notice. The following year, the G.T.N.C. took over responsibility for the reserve and a Management Committee was formed, with Sonia Holland as Secretary and me as Chairman. So our paths met.

Jim Hemsley's management regime was applied in the autumn of 1962 and the buttercup flowered well in 1963. It has been seen in flower nearly every year since then. Our official management plan was compiled largely by Sonia and approved by the Committee. She was a conscientious and enthusiastic Secretary. She also produced the *Badgeworth Nature Reserve Handbook*, full of historical and biological information and listing the known flora and fauna of this small reserve, a fine example of such a guide. It is now in its third, enlarged edition. As I was living in Surrey and later in Suffolk, the task of seeing that the necessary management was carried out fell on Sonia's shoulders. She negotiated with the owners a small addition to the Reserve, known as Warren's Pool, and arranged for a movable fence to allow stock into the pool at certain times.

Sonia was keen to publicise the Reserve and got it an entry in the *Guinness Book of Records* as Britain's smallest nature reserve, 346 square yards (290 m^2) together with television and national newspaper coverage. She also encouraged local people to take an interest. The Badgeworth W.I. produced a tie with the buttercup on it, and crowning the Buttercup Queen is the main event of the village fete!

When Sonia was staying with us in Suffolk in 1972, we were out botanizing and I showed her some fine trees of Black Poplar (*Populus nigra*), as I was starting to survey its distribution in England and Wales for the B.S.B.I. On her return to Cheltenham she 'got her eye in' for this tree and began to send me records, not only from her vice-counties, but also from other parts of the country. Sonia visited her son in Ireland from time to time, and when driving around the countryside there spotted several Black Poplars. These records, however, were not published, but were confirmed when Desmond Hobson visited Ireland in 1990 (*Watsonia* **18**: 303–305, 1991).

Sonia was interested in the development of the Gloucestershire Farming and Wildlife Advisory Group (F.W.A.G.), and came to know the county advisor, John Hughes, who suggested that she should be his botanical advisor and accompany him when he was asked to visit farms. This she was pleased to do, as it gave her access to much private farmland where no botanist had previously trodden. This resulted in Sonia discovering new sites for a number of uncommon plants and she found several Black Poplars that could not be seen from public land. Gloucestershire F.W.A.G. was so grateful for her help and the advice she had given to farmers on their wildlife habitats, that it agreed to publish the results of her county Black Poplar survey as *The Black Poplar in Gloucestershire* (1992). In this work she recorded and localised 355 trees, many of them pollarded, all of which but one she had seen and described herself, "a labour of love", as the county F.W.A.G. president states in his foreword.

Sonia took a great interest in her local flora and discovered where most of the rarities grew and assisted their conservation. She travelled to London specially to see a solicitor regarding the threatened woods near Tewkesbury where the rare *Cynoglossum germanicum* (Green Hound's-tongue) grew, and succeeded in convincing him that the woods should be conserved. She personally encouraged the commoners of Painswick Beacon to remove dozens of seedling pines which were invading and smothering the best sites for *Herminium monorchis* (Musk Orchid) in the county, and she kept an eye on *Cephalanthera rubra* (Red Helleborine) in all its secret sites. She was delighted when *Antennaria dioica* (Mountain Everlasting) was rediscovered on Cleeve Clond, where I had seen it in the early 1920s.

Sonia's outstanding contribution to British botany was her work on the composition of the *Supplement to the Flora of Gloucestershire*, helped by her two friends, Miss Caddick and Mrs S. Dudley-Smith. Sonia decided on the format, selected the beautiful colour plates, edited the text and saw through its production. It is, in my opinion, a model of what a supplement to a county Flora should be.

Sonia was a member of the British Trust for Ornithology (B.T.O.) and she used to help the county bird recorder, Dennis Mardle, do the monthly B.T.O. waterfowl count on the numerous flooded gravel-pits of the Cotswold Water Park in the Upper Thames catchment area. She and Dennis Mardle jointly published *Bird watching in the Cotswold Water Park*, a booklet much in demand amongst birdwatchers. It was in the Water Park that she developed her interest in dragonflies, which resulted in her *Distribution of the dragonflies of Gloucestershire* (1991), a very good account, with much information about particular habitats.

Sonia was very unhappy about the future of the splendid wild daffodil bank at Ketford in the Leadon Valley, which had come on the market. The daffodils grew in species-rich meadows with other interesting plants such as *Gagea lutea* (Yellow Star-of-Bethlehem). She tried to get the G.T.N.C. to buy the site but the Trust was not interested, as the bank had no vehicular access. So eventually, following the example of that pioneer conservationist G. W. Hedley, who in 1932 bought the Badgeworth buttercup site with his own money, she purchased the freehold of the Ketford Daffodil Bank. It had been neglected for some years and Sonia, assisted by John Hughes, returned it to a satisfactory condition. It gave Sonia great pleasure to feel that she had been able to save this splendid wildlife site for future generations to enjoy.

Some years ago Sonia suggested to me that a very old, nearly dead, pollarded *Salix fragilis* (Crack-willow) in the Badgeworth Reserve might be replaced by a pollard Black Poplar. This was put to the Management Committee and was agreed. Sonia obtained a cutting from a local male tree, rooted it and planted it in the Reserve in March 1973. It grew well, but nobody knew how large a sapling had to be before its first pollarding. However, I discovered that John Evelyn in 1664 advised cutting a sapling off at the required height when it was as thick as one's arm: this Sonia did in March 1992. Sadly she did not live to see the development of the pollard. At the 1993 meeting of the management Committee it was agreed that this Badgeworth Black Poplar should be treated as a memorial to Sonia Holland, who had done so much to conserve Adder's-tongue Spearwort and so many other plants over the last 30 years.

E. Milne-Redhead

SONIA HOLLAND: IN MEMORIAM

Sonia was cremated in Cheltenham on 21 January 1993. The service was taken by her neighbour, the Rev. Walter Jennings, Vicar of All Saints' Church. In his address he talked about the life-history of a dragonfly, when the nymph, having lived at the bottom of a pond for some time, climbs a reed stem and eventually emerges as a mature dragonfly to live thereafter in the air and sunshine but unable to rejoin the other nymphs underwater. He said he was telling this story for Emily and Anthony Sonia's grandchildren, but I think it was enjoyed by everyone else in the large congregation particularly those who had helped in her Odonata recording.

Her son, Clive, chose Mothering Sunday as the day to scatter her ashes on her Daffodil Bank at Ketford. A large party of family and friends met in the village to walk to the reserve on the south bank of the River Leadon. Passers-by would have dismissed the gathering as just another field meeting – about 50 people in wellingtons with anoraks and field glasses. Hundreds of daffodils were flowering on this beautiful and peaceful bank. While Clive scattered the ashes over a large area of the reserve we talked to friends or enjoyed strolling about. We saw non-flowering plants of *Gagea lutea* (Yellow Star-of-Bethlehem) on the reserve and several good specimens flowering outside. Two large *Populus nigra* (Black Poplar) pollards upstream reminded us of yet another of Sonia's study subjects. Despite the sad circumstances, this really was an enjoyable morning in a lovely setting with the promise of spring and summer to come. I like to think that Sonia would have enjoyed and been touched by the occasion. She would also probably have approved of the fact that we repaired to the Rose and Crown on the way home.

S. Dudley-Smith

BRIAN THOMAS STYLES
(1934–1993)

Brian Styles was born on 26 September 1934 at Chedworth in the Cotswolds and died at Oxford of a heart attack on 27 June 1993. He was educated at Westwoods School, Northleach, Gloucs., and Wadham College, Oxford, where he read Botany. He remained at Oxford as a research student and worked at Oxford University's Forestry Institute (formerly the Commonwealth Forestry Institute, now part of the Department of Plant Sciences) throughout his career. His research revolved around the study of tropical trees, but his meticulous study of *Polygonum aviculare* (Knotgrass) and its allies will have made his name familiar to many members of the B.S.B.I., to whom he was a conscientious referee for the genus.

His D.Phil. thesis, submitted in 1959, was supervised by the late E. F. ('Heff') Warburg, one of the century's most gifted and influential British plant taxonomists and co-author, with A. R. Clapham and T. G. Tutin, of the much loved 'CTW' *Flora*. Brian successfully elucidated the taxonomy of the *Polygonum aviculare* group, that apparently intractable assemblage of annual weeds and pauciennial plants of strandline communities. His account of them, published in *Watsonia* **5**: 177–214 (1962), remains the basis of that published in April 1993 in the revised first volume of *Flora Europaea*. Warburg, who died in 1962, said that the thesis was the best he had seen in Oxford and more recent revisions of the classification of *Polygonum aviculare* sensu lato by botanists in northern and central Europe, Italy and North Africa have failed to add appreciably to that elucidated by Brian. He was for more than 30 years the Society's referee for the *Polygonum aviculare* group, latterly jointly with myself.

Brian joined the staff of the Forestry Institute in 1960 as a Research Assistant sponsored by the Colonial Welfare and Development Office (now subsumed within the Overseas Development Administration), later becoming the Department of Forestry's Senior Research Officer and Forest Botanist. He was employed as a tropical forest botanist long before the current concern and enthusiasm for the conservation of the world's threatened tropical forests. Brian was a botanist of the old school, a diligent researcher who published infrequently but well, a scholar, a linguist and a field botanist. In the best tradition of Oxford and Cambridge, he threw himself vigorously into the general work of his Department and the wider world of botany – teaching, supervising, editing and contributing to the work of the various committees that punctuate the routine of academic life. He gave information freely and generously to all his colleagues.

He will be remembered especially for his studies on the tropical forest trees of the family Meliaceae, notably in collaboration with Dr T. D. Pennington, with whom he produced *A generic monograph of the Meliaceae* (*Blumea* **22**: 419–540, 1975), a conspectus of the genus *Acacia* in Somalia (with A. S. Hassan) and his monographic work on tropical pines. His contribution on *Pinus* to *Flora Neotropica* was sadly unfinished at the time of his death. A 1976 conference volume on *Variation, breeding and conservation of tropical trees*, that he edited with J. Burley for the Linnean Society of London, remains a seminal work on the study of tropical forests.

He had a particular interest in nomenclature and served for many years on the committee for the nomenclature of cultivated plants. He was deeply concerned about the conservation of the earth's diminishing genetic resources, both in the wild and in cultivation. In September 1984 he organised a most successful conference at Oxford on intraspecific variation, under the auspices of the Systematics Association, the Royal Horticultural Society and other bodies, the proceedings of which were published under his editorship as *Infraspecific classification of wild and cultivated plants* (Systematics Association Special Volume 29, 1986).

In 1966 he married Cynthia Large, who was both wife and much valued secretary, not least in her help with the 'nuts-and-bolts' organisation of successful conferences. They have a son, Jonathan. Although not latterly connected with an Oxford College, Brian enjoyed the traditional university life of lively conversation and good food and wine. A courteous, kindly and deeply religious man, who rightly insisted that we began a symposium dinner with the appropriate Grace, he reminded me of a jolly abbot. I warmed to him immediately when first I knocked cautiously on his office door in the late 1970s to discuss our mutual polygonaceous interests. He was friendly to all those around him, not least the countless students from Britain and overseas whom he encouraged and helped. He was deeply sympathetic to the problems of the younger taxonomist, unable to obtain employment in the contemporary academic world. He loved a good gossip and on my visits to Oxford from Reading to work in the Fielding-Druce herbarium he would sidle up with a mischievous grin to ask "Is it true that Professor Heywood is about to leave Reading?" or merely to enquire about the progress of a younger colleague to the altar. He enlivened all those in his Department with his sense of humour.

Brian's research demonstrated the vital links between academic knowledge, economic resources and conservation. His early death deprives the botanical community of a scholar and gentleman at a time when plant taxonomy, beset by hostile forces, needs all the good people it can muster, especially in our Universities.

J. R. AKEROYD

IRENE MARY VAUGHAN
(1889–1993)

With the death of Irene Vaughan, M.A. (Oxon), M.B.E., F.L.S., on 27 January 1993 in her 104th year, the Botanical Society of the British Isles has lost not only its oldest member – indeed only the second centenarian of the Society's membership – but one of the most respected and foremost of field botanists in Wales of recent decades. Unlike H. N. Ridley (1855–1956), the B.S.B.I.s other centenarian, Mrs I. M. Vaughan was not a professional botanist. She had read history at St Anne's College, Oxford (1908–1911) but, as a woman, had not been permitted to take her degree 'officially'. Times changed, and so, when she was 86, her degree was duly conferred.

As Irene Mary Rope, she was born and 'raised' in Shrewsbury, where her doctor father was in

FIGURE 1. Mrs Irene M. Vaughan at Dryslwyn Castle, Carmarthenshire, 7 April 1978. (Photograph courtesy of W. Condry.)

practice with a Dr Burd, one of whose nine daughters he married. Irene must have accompanied her father on his rounds in pony and trap, and it is known that he greatly encouraged her, the youngest of his six children, in her love and enthusiasm for flowers and all wildlife; but he died when she was only nine. His family came from Suffolk (near Woodbridge) and much-loved visits were made to the family home there for many years – her earliest memory is said to be of butterflies and Zinnias in this Suffolk garden.

When World War I came, Irene joined a British team driving ambulances in Serbia. Then, joining the newly formed W.R.N.S., she was posted to Gibraltar, rapidly promoted, awarded the M.B.E. (Military), and was one of the first W.R.N.S. officers to serve overseas. Here in Gibraltar she met her future husband, a naval officer, one of whose duties was to test Irene in coding; this she did without error. Such meticulous attention to detailed exactitude stood her in good stead in later years and was surely the foundation of her precise keeping of plant records and data of all kinds, and of her ability to retain the voluminous character detail of the Roses, which became her speciality.

Meanwhile she had married Captain H. R. H. Vaughan R.N. whilst they were both still serving in Gibraltar; and it was here that their infant son died. In later years there were occasional visits to her husband during his three-year postings overseas; one was to the West Indies, and on another the high point must have been the desert picnic with the Emir of Kuwait when uncooked sheep's eyes were the special delicacy on offer.

Sadly, in 1938, their daughter died on the eve of her fifteenth birthday, and it was then that the move to Wales followed. Here, in a valley that the daughter had loved, Irene ran, single-handed throughout the war, the small farm at Rhandirmwyn near Llandovery, Carmarthenshire, until Capt. Vaughan's retirement in 1945.

It was now that both the Vaughans became involved in so many aspects of conservation, environmental 'welfare' and 'wildlife' organizations in Wales. He was closely concerned with revitalizing the Council for the Protection of Rural Wales with her support, but foremost was their work in rescuing the Red Kites of the upper Tywi valley from oblivion. Throughout the war, Mrs Vaughan had "carried out the greater part of the work of locating nesting pairs and verifying results" (H. M. Salmon, in Lacey, W. S. (ed.), *Welsh Wildlife in Trust*, pp. 67–79, Bangor, 1970) and gaining the co-operation of land-owners and farmers. In the early post-war years she and Capt. Vaughan were carrying the whole burden of the organisation of Kite conservation – he was Chairman of both an earlier and a later Kite Committee. For their immense services to Red Kite protection over 30 years and more, they jointly received first the R.S.P.B.'s Silver Medal and then their Gold Medal (cf. R. Lovegrove, *The Kite's Tale*, Sandy, Beds., 1990).

The West Wales Field Society (later Naturalists' Trust) was another joint concern, with Capt. Vaughan co-editing the first few issues of their journal, *Nature in Wales* (1955–1956). Mrs Vaughan had organized a short-lived 'Botanical Association' by then, and later was mainly responsible for starting their Carmarthenshire Branch. She undertook various surveys on this Society's behalf, and in 1971 helped pioneer the Farm Nature Reserve Scheme which the Reserve Committee of this branch had formulated. She served on the then Nature Conservancy's Committee for Wales (1958–1960) and made a botanical survey and site quality report for a prospective National Nature Reserve on the Castle Martin Tank Range. In 1965, with T. A. W. Davis, she visited and reported on the prospective Nature Reserve status for Ramsey Island. Her spirited submission was largely instrumental in saving the floristically rich Towyn Burrows from threat from the Ministry of Defence. In 1967 she partook in the opposing, by the Council for the Protection of Rural Wales, the Nature Conservancy and the B.S.B.I.'s Conservation Committee, of the construction of a road through Kenfig Burrows, Glamorgan. She was much concerned with safeguarding the upper Tywi valley from the threat of forestry and later from the Llyn Brianne reservoir project. She had worked closely with Dafydd Davies in opposing the building of the dam, giving evidence at the inquiry on behalf of the B.S.B.I. and the Brecknock County Naturalists' Trust. The *Quercus petraea* woods at Allt-rhyd-y-groes became a National Nature Reserve chiefly as a result of her reports, and near Rhandirmwyn are the R.S.P.B. reserves of Gwenffrwd and Dinas; near Cilycwm a Roadside Verge Nature Reserve protects *Epipactis helleborine* (Broad-leaved Helleborine).

Irene Vaughan was primarily a field botanist, with Carmarthenshire (v.c. 44) as her central interest. Here she explored extensively, gaining a wide knowledge of the flora. She joined the B.S.B.I. in 1952, and the start of the Maps Scheme must have been an added incentive for her. In addition to her own contribution, as County Referee, she checked all the field cards from v.c. 44 for the *Atlas of the British flora* (1962). She also edited the botanical notes and plant records for West Wales in the early issues of *Nature in Wales* (1955–1956). Increasing involvement with the B.S.B.I. in Wales followed: she had been local secretary for v.c. 44 (1955) and District Secretary for South Wales (1961–2), and then became vice-county Recorder (v.c. 44) in 1961, a post she held until 1978, just before her retirement to Suffolk in early 1979. From its inception she was on the B.S.B.I.s Welsh Committee, for which she was Representative to the Council from 1962–1970. When the Regional Committee for Wales was set up in 1962, Mrs Vaughan took the Chair at its first Annual Meeting and A.G.M. in September 1963, and was Vice-chairman until 1965. Subsequently she acted as joint and then general secretary up to 1970, and edited the *Welsh Region Bulletin* (later *B.S.B.I. Welsh Bulletin*) from 1971–1976, jointly with S. G. Harrison. She led many B.S.B.I. Field Meetings: to Llanstephan (1967), Towyn Burrows (1969), Kidwelly (1970), and in 1967 to the Upper Tywi Valley, visiting the Sessile Oakwood at Pen-y-rhiw-iâr (by the Allt-rhyd-y-groes N.N.R.), the site of the then proposed Llyn Brianne dam, and the Rhandirmwyn School Nature Reserve (later submerged). Carreg Cennan was another favourite haunt and on these and other occasions many new records were made which led to articles in the *Welsh Region Bulletin*, *Nature in Wales* or *Watsonia*. These are listed in the bibliography, below. These articles were succinct and concerned only the most outstanding finds. They were presented in their wider-than-Wales significance and their ecological, distributional, historical or taxonomic setting. Her numerous records, many of them new for the county, made a major contribution to R. F. May's *List of the flowering plants and ferns of Carmarthenshire* (1969); they are now in the safe-keeping of the present vice-county recorder, Richard Pryce. Many of her records too appeared in T. A. W. Davis' *Plants of Pembrokeshire* (1970).

Mrs Vaughan was widely acknowledged in Wales and beyond for her expertise at the determination of the wild species of *Rosa*, from at least the early 1960s onwards. This special interest must have been aroused early: perhaps during the last war, when she is known to have organized the collecting and making by the Women's Voluntary Service of rose hip and other wild fruit jams and jellies in a back room of her Rhandirmwyn home. She pioneered the study of *Rosa* in Carmarthenshire and already in 1953 had contributed 36 specimens for Sylvester Bradley's ill-fated Rose Survey of 1952–1954 (R. J. Gornall & A. Primavesi, *Watsonia* **17:** 356–359, 1989; R. J. Gornall, pers. comm. 1993). All came from Rhandirmwyn, and comprised six or more determinable taxa including hybrids; her *R. obtusifolia* specimen was one of the only five represented in the near-thousand surviving from the country-wide survey. By 1955 she had already made at least two *Rosa* records new to v.c. 44. Consulted widely long before becoming an official Referee (1975–1984), at first jointly with R. Melville and later with G. G. Graham as well, she had published (1965) an excellent key and synopsis on the "Recognition of the Roses" for taxa known or likely to occur in Wales. Although a follower of A. H. Wolley-Dod, she understood the limitations of his system and that many of his plethora of varieties and forms would ultimately become recognized as hybrids, and was well aware of the peculiarities of the genetical complications in this genus. Her penultimate publication, in 1982, was a digest of the 13 Suffolk taxa of *Rosa*, three of which she had added herself to the county flora, with yet another later that year; all this in her three years Suffolk residence at over 90. She was asking for the latest *Rosa* news just weeks before she died: what joy the *Rose Handbook* would have given her!

In 1962 Mrs Vaughan was responsible for tuition in Rose identification at the Critical Plants course held at Preston Montford Field Studies Centre. In 1962 too, Mrs Vaughan was elected a Fellow of the Linnean Society of London, and in 1971 held office in Sect. K at the Swansea meeting of the British Association. She was also instrumental in setting up the Llanelli Naturalists in 1971/2.

Mrs Vaughan's collections of *Rosa* are in the Welsh National Herbarium at Cardiff (**NMW**), with further specimens at the Ipswich Museum (**IPS**). Altogether she donated over a thousand flowering plants and ferns to **NMW**, as well as a number of bryophytes and lichens: most were from Wales, both north and south. Her interests covered a wide range of living things: on perhaps her last 'excursion' – to Dunwich – in late 1991, she showed delight in the fungi there. Dogs 'appear' throughout her life, from those early days in Gibraltar when she had a police summons for "unlawfully suffer[ing] a dog to be at large in a public highway"! Horses were another great love: she would extol the advantages of botanizing from horseback. And then we hear of mid-night visits to comfort a sick bull.

Irene Vaughan's friends and admirers have many affectionate memories. Although outwardly maybe intimidating to some, she gave unstinting encouragement and help to many a young botanist who recall – inter alia – her agility in scrambling up (and slithering down) steep slopes more easily than many half her age. Local legends abound – trundling bee-hives through the village at Rhandirmwyn, with Dafydd Davies, in a cloud of angry escaping bees; 'Mrs Vaughan's corner' – a sharp turn on the way to Llandovery invariably taken on the inside in her Mini, and other adventures in her unstable 'Bubble-car' in the 1960s. There are fond memories of fluttering leaves of her precious copy of 'Wolley-Dod' escaping in the Welsh wind (retrieved by younger members); the generosity with which she took so many young and inexperienced to see highlights of the Carmarthenshire flora, outings with local friends and the rush back to get Capt. Vaughan's 4 o'clock tea. There were 'immediate' delicious refreshments – "Oh! the Aga does them". This hospitality continued in Suffolk well into her late 90's – three-course meals, complete with sherry, coffee (and no washing up) for visitors from Wales. Although frustrated by increasing deafness and poor sight, her botanical enthusiasm continued to the end. Always a keen gardener, as witness the gardens at Rhandirmwyn and Cilycwm, and later at Woodbridge she extended her garden when 95 and planted a special *Sorbus domestica* (Service-tree) when 98; her nephew observes that she was still active in the garden up to six months before she died. By the time she reached 97 she remarked: "I don't like people to know I'm so old – they're beginning to look at me as if I were Exhibit A". For her 100th birthday she insisted on no publicity, no presents, or "for it to be thought that it made her more than one day older". A lunch party was held, with over 80 friends and relatives; the display of documents and photographs covering her life are now gathered in a commemorative album: a telegram from the Queen, a special Apostolic Blessing from the Pope, greetings from the Director of W.R.N.S. and many environmental and botanical organizations. The 'locals' from Rhandirmwyn and Cilycwm held a party. A special issue (**48**) of the *Welsh Bulletin* had articles recalling her life in Wales and photographs of her in the field aged 88, 89 and 96.

Her's was a remarkable, long and active life of service to Wales, its Roses and Kites and its lovely countryside. She gave credit to others but eschewed it for herself. It was a privilege to know her. The wife of Sir J. E. Smith, Lady Pleasance, likewise lived to 103, alert to the last, and held 'I am for inquiry': such was Irene Vaughan. Three botanical colleagues were at her funeral – the Mass in her beloved Latin. As William Condry wrote (*The Guardian*, 30 January 1993) "there must still be people living in . . . the beautiful country of the upper Tywi river who remember seeing this small figure on a large white horse disappearing up the tracks towards the hills. Perhaps Irene Vaughan, as a lone horse rider ever searching for her beloved kites, will pass into local legend."

I am indebted to her nephew, Crispin Rope, and sister-in-law, Mrs L. D. Rope, for personal details and for making available the commemorative volume, also to her many friends and admirers, from Wales and Suffolk, who supplied information and memories.

A. P. CONOLLY

PUBLICATIONS OF IRENE VAUGHAN

1964 Preliminary notes on the distribution of roses in Carmarthenshire. *B.S.B.I. Welsh Region Bulletin* **1**: 6–7.

1965 Recognition of the roses. *B.S.B.I. Welsh Region Bulletin* **4**: 1–5.

1965 [with T. A. W. DAVIS]. A visit to Ramsey Island, Pembrokeshire. *B.S.B.I. Welsh Region Bulletin* **6**: 5–6.

1967 *Rosa micrantha* Borrer ex Sm., *R. tomentosa* Sm., *R. afzeliana* Fr. and *R. sherardii* Davies (in notes and keys of Papers read at the Local Flora Writer's Conference, Bristol, 1966). *Proceedings of the Botanical Society of the British Isles* **6**: 283.

1967 Notes on the origin and distribution of *Narcissus obvallaris* Salisb. *B.S.B.I. Welsh Region Bulletin* **10**: 1–3.

1970 Towyn Burrows, Carmarthenshire, in LACEY, W. S., ed., *Welsh Wildlife in Trust*, pp. 136–143. Bangor.

1971 A note on Towyn Burrows. *Nature in Wales* **12**: 1974.

1972 [with J. W. DONOVAN & T. A. W. DAVIS]. Notes on the Dune Gentian. *Nature in Wales* **13**: 33–36.

1972 *Lathyrus palustris* L. in Carmarthenshire. *Watsonia* **9**: 137.
1972 Hedge destruction. *B.S.B.I. Welsh Region Bulletin* **17**: 6–7.
1973 Notes on the increase of *Pyrola rotundifolia* subsp. *maritima* (Kenyon) E. F. Warb. on Welsh dune systems. *B.S.B.I. Welsh Region Bulletin* **18**: 7–8.
1974 A *Molinia* meadow. *B.S.B.I. Welsh Region Bulletin* **20**: 6–8.
1974 [with Q. O. N. Kay & R. H. Roberts]. The spread of *Pyrola rotundifolia* L. subsp. *maritima* (Kenyon) E. F. Warb. in Wales. *Watsonia* **10**: 61–67.
1976 A note on *Sorbus torminalis* from *Silva, or a discourse of forest-trees, and the propagation of timber in His Majesties dominions*, by John Evelyn Esq. 1664. *B.S.B.I. Welsh Region Bulletin* **24**: 4.
1976 [ed. Mrs I. M. Vaughan] *Sorbus torminalis* in Powys, Cardigan and Carmarthenshire. *B.S.B.I. Welsh Region Bulletin* **25**: 4–6.
1976 Of conservation interest. *B.S.B.I. Welsh Region Bulletin* **25**: 9–10.
1977 *Lathyrus palustris* sites in Somerset and in Dyfed. *B.S.B.I. Welsh Bulletin* **27**: 15–17.
1977 *Pyrola minor* in Pembrey Forest, Carmarthenshire. *Watsonia* **11**: 388–389.
1978 *Lathyrus palustris* L. var. *pilosus* (Cham.) Ledeb. in v.c. 44. *B.S.B.I. News* **20**: 14.
1979 The decline of *Liparis loeselii* (L.) Rich. var. *ovata* on Towyn Burrows, Dyfed. *B.S.B.I. Welsh Bulletin* **30**: 8–10.
1981 Obituary: Thomas Arthur Warren Davis (1899–1980). *Watsonia* **13**: 357–358.
1982 An introductory note on the native Roses of Suffolk. *Transactions of the Suffolk Naturalists' Society* **18**: 304–307.
1985 Notes on the identification of species in the genus *Rosa* in Carmarthenshire. *Llanelli Naturalists' Newsletter*, June 1985.

EDGAR DUNSTAN WIGGINS
(1911–1993)

Edgar Wiggins, an Honorary Member of the Botanical Society of the British Isles, was born on 12 September 1911 and died on 23 January 1993. A Londoner born and bred, Edgar was educated at Latymer School, Hammersmith, and the University of Reading, where he graduated in 1932 with a B.Sc. in Agriculture. At that time, as now, jobs in botany were hard to find so he stayed on at Reading to take a post-graduate course in Education, after which he taught for some years at Fairlop Upper School, Ilford. In 1940, during World War II, he joined the staff of Seal Hayne Agricultural College, Devon, and worked subsequently for the Ministry of Agriculture on problems of home food production – particularly potato blight. After the war, Edgar was Manager of Bayer Agricultural's Crawley Research Station, then Liaison Officer on the construction and development of Fison's new Levington Research Station, and later Manager of Fison's Head Office Library and Technical Information Department.

Communication, both written and verbal, was one of Edgar's special talents, and one of his main interests outside work was in amateur dramatics. Another interest was gardening, and he was a founder member of Fison's Gardening Club, for whom he edited *Rakings*, the Club's newsletter, for some 20 years. For some 35 years during the Cold War period he was involved in the scientific aspects of Civil Defence. After taking a course at Cambridge University he became the Senior Scientific Intelligence Officer for the East Suffolk Civil Defence Corps. Later he became directly responsible to the Home Office as Scientific Adviser on Civil Defence for the Eastern Region. He also became joint editor of a periodical, *Fission Fragments*, produced for the information of Civil Defence scientists throughout the U.K.

Edgar joined the B.S.B.I. in 1957, and when the Society was in need of an Editor for *B.S.B.I. News* his offer of editing experience in technical journalism was accepted, and he was then Hon. Editor of 28 numbers of *B.S.B.I. News*, from April 1977 (No. 15) to April 1986 (No. 42). He then became known to us as Wiggy – at the time he lived at 'Cowpasture Farm' and when asked how he would like to be addressed, he replied: "Wigginius pascum-vaccarum – the general usage is *Wiggy*, free from any and all – an informal colloquialism, used universally; it comes naturally and trips easily off the tongue. *Edgar* – generally used by those with a professional relationship . . . *Dunstan* –

restricted, as far as possible to family and intimates. (But don't take this too seriously. I respond to 'Darling' or 'Hi you' from anyone.)"

During his years as Editor he furthered the scope, success and popularity with members, which *B.S.B.I. News* enjoys today, and he particularly promoted the use of plant drawings as illustrations. For these he sought and encouraged artists who donated their skills to *B.S.B.I. News*, contributing to a significant collection of plant drawings which is building up through the years. We all remember Wiggy during his time as Editor as a notable character at B.S.B.I. meetings, with his neat beard and friendly approach to all his potential authors and contributors, and he stamped his own brand of humour and communication on to *B.S.B.I. News*.

Failing eyesight forced him to resign and sadly he became blind in 1987. In his last years he was totally chairbound – a disability which must have been extremely frustrating to such a volatile spirit. His wife Julia nursed him throughout and we extend our sympathy to her in her loss.

M. Briggs

Report

THE ANNUAL GENERAL MEETING, 15 MAY 1993

Three papers were presented at the Annual General Meeting held at the Conference Hall, Lincolnshire College of Agriculture and Horticulture, Riseholme, Lincoln on 15 May 1993, two in the morning and one in the evening. The theme of the morning's papers was Sir Joseph Banks, 1993 being the 250th Anniversary of his birth, the theme of the evening paper being 'Nature Conservation', the papers thus linking up with the outdoor programme on Saturday afternoon and the Sunday field excursions.

Mr Harold B. Carter, F.R.S.E., F.L.S., eminent author on Sir Joseph Banks and in charge of the Banks Archive project at the British Museum and the Royal Society, first spoke on *Banks as a British botanist*. He enlarged on some of the Banks Lincolnshire and British record sources, regretting that much had been lost, and outlined Banks' Welsh itinerary with connections to New South Wales and also his Lincolnshire and Derbyshire background. Mr Carter illustrated his very scholarly address with slides of herbarium specimens and drawings – these were of particular interest as they had been collected and collated from a large number of sources during his phenomenal study of Banksian papers.

Mr David N. Robinson M.Sc., Hon. Secretary for the Lincolnshire Trust for Nature Conservation, next gave his address on *Sir Joseph Banks – the Lincolnshire connection*. Mr Robinson, himself a native of Horncastle and very much an expert on the Lincolnshire scene, illustrated his talk with both mounted display panels and slides. His very detailed account of the childhood environment of the young Joseph and his family at Revesby Abbey together with activities in later years on his Lincolnshire estates and with Lincolnshire agriculture – particularly fen drainage – was both entertaining and significant. This was ingeniously illustrated with slides of old Revesby and Horncastle, modern and old litho illustrations of fenland and also by slides of the portraits now at the Usher Gallery in Lincoln and at the museum in Boston.

The two papers were complementary and gave a much appreciated sketch of the activities of this celebrated botanist.

After the A.G.M. and lunch, two coach parties with 75 people travelled down through Lincoln to the R.S.N.C.s headquarters at Waterside South on the River Witham where the river flows through the celebrated Lincoln Gap. Here B.S.B.I. members were welcomed by the Chief Executive, Mr Tim Cordy (Dr Perring's successor at R.S.N.C.), Mr Tim Sands and the R.S.N.C. Executive Committee whose meetings had been relocated from London to Lincoln for this event.

A sparkling elderflower champagne and cake reception was attended by over 100, the cake being decorated splendidly with the logos of both the R.S.N.C. and B.S.B.I., with a conservation theme throughout. The newly elected President, Dr Franklyn Perring, ceremoniously cut the cake and replied on behalf of the Society to Mr Cordy's welcome. Dr Perring applauded the co-operation of the two groups in the past and looked forward to future links between them.

Two very adventurous coach drivers then proceeded to drive the party up the steep route to the Cathedral area, belying the usual vision of flat Lincolnshire. Here at the Lawn Visitor Centre the party was welcomed by Mr Glyn Stocker, Lincoln city landscape architect and designer of the Sir Joseph Banks Conservatory and the John Dauber garden. Designed to contain representative plants found on the journeys of Sir Joseph and subsequent collectors from Kew, these projects are part of the City of Lincoln's plan to commemorate one of Lincolnshire's great sons. Many plants are still to go in and both Kew and Chelsea Physic Garden are contributing relevant material. Mr Stocker led the group through the conservatory and then out to the garden – still in glorious May sunshine, with views down to the Trent Valley, of the Cathedral and of Lincoln City.

After the conference dinner Mr A. E. Smith, M.A., O.B.E., Chairman of the Lincolnshire Trust for Nature Conservation, took up the conservation theme with an illustrated address on *Nature in Lincolnshire*. This was a masterly resumé, with links to national policy and the original vision and formation of County Nature Reserves to which Ted Smith's contribution was highly significant. As Ted Smith had preceded Dr Perring at R.S.N.C. for many years the evening aptly rounded off the mood of the meeting and was also preparatory to the Sunday excursions.

Two book displays together with sales tables were arranged in the conference hall by Dr and Mrs Perring of B.S.B.I. Publications and Mr and Mrs Jon Atkins of Summerfield Books. These were much appreciated by members throughout the day.

FIELD EXCURSION HELD IN CONJUNCTION WITH THE A.G.M.

CENTRAL LINCOLNSHIRE NATURE RESERVES, N. LINCS (V.C. 54), 16 MAY 1993

About 60 members met at the Forestry Commission car-park at Chambers Wood, Langton by Wragby. The woods are part of the Bardney Forest ancient Small-leaved Lime woodlands S.S.S.I., now covered by a Forestry Nature Reserve Agreement between the Forestry Commission, English Nature and the Lincs. Trust. These have been worked extensively in the woodland surveys done by Dr George Peterken. The party was split up into groups led by Pat DeLap (Forestry Commission Officer), Keith Stephenson, a B.S.B.I. member and local Langton farmer, and I. Weston. A route was taken through Great Scrubbs Wood, Little Scrubbs Meadow (Lincs. Trust Reserve) and Little Scrubbs Wood. Many stages in the coppice management were observed. Notable of course were *Tilia cordata* (Small-leaved Lime) and *Sorbus torminalis* (Wild Service-tree) but there was also a very large *Tilia platyphyllus* (Large-leaved Lime). Both *Crataegus monogyna* (Hawthorn) and *C. laevigata* (Midland Hawthorn) together with hybrid material were seen with many other woodland plants. In the meadow *Orchis morio* (Green-winged Orchid), *Serratula tinctoria* (Saw-wort), swarms of violets – of hybrid origin? – and surprisingly *Molinia caerulea* (Purple Moor-grass) – uncommon in TF/1.7.

The party then proceeded in cars via Horncastle Market Square, which has the town house of Sir Joseph Banks, to the luncheon venue on the village green at Revesby. David Robinson met the party and pointed out features of note including the old and new Revesby Abbey sites and the Sir Joseph Banks almhouses. Despite a rush to the afternoon venue – the Moor Farm S.S.S.I. Lincs. Trust Reserve – all arrived on time. 54 members met here. Again the party split up into a number of groups led by Ted Smith and Mr Terry Bailey, the Reserve Warden, another by Lincs. B.S.B.I. members Ms R. Nickerson, Miss J. Knibb and Mrs R. Everatt, and one by I. Weston. The reserve includes a lowland raised *Sphagnum* bog, a nationally scarce habitat unique to Lincolnshire, with wet and dry heaths, acid marsh and birch and oak woodlands.

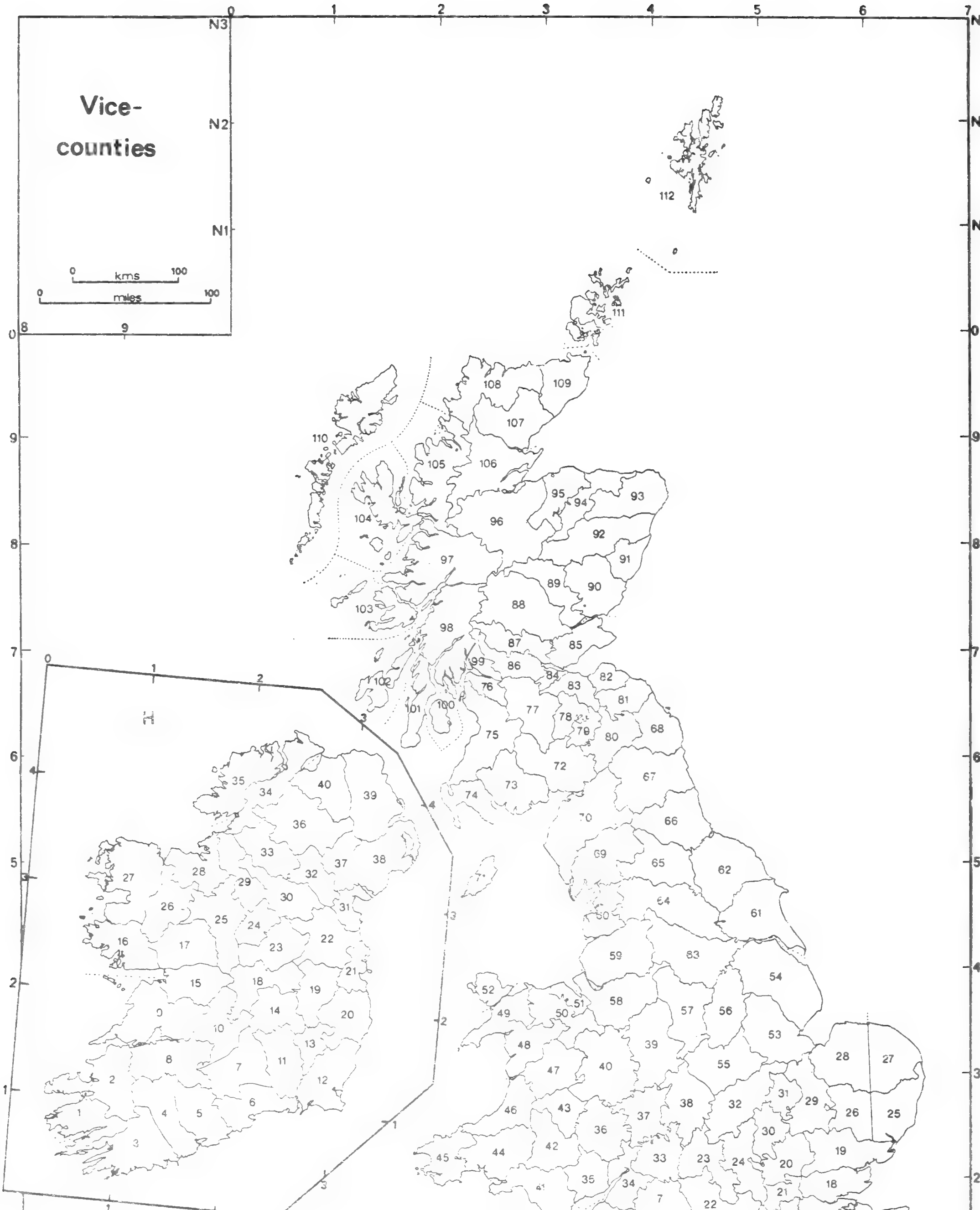
Teesdalia nudicaulis (Shepherd's Cress) was at its most prolific for years and dominant over a large area of dry heath. *Ornithopus perpusillus* (Bird's-foot), *Cerastium arvense* (Field Mouse-ear), *Rumex acetosella* subsp. *acetosella* (Sheep's Sorrel) and *Scleranthus annuus* (Annual Knawel) were noted, as were extensive swards of *Ceratocapnos claviculata* (Climbing Corydalis), dominating ground cover in the woodland. On the wet heath field *Montia fontana* (Blinks) was plentiful (not a common local plant) and *Ophioglossum vulgatum* (Adder's-tongue) and *Pedicularis sylvatica* (Lousewort) were amongst the sward. *Eriophorum angustifolium* (Common Cottongrass) had a dominant spot in the meadow. Mr Clive Jermy recorded *Dryopteris* × *deweveri* (*D. carthusiana* × *D. expansa*) – a new record for us.

Time overtook us here and only a handful of members embarked on a hasty visit to the adjacent Kirkby Moor Reserve to see fine swards of *Viola palustris* (Marsh Violet) in full flower in the marshy area – a plant seldom seen flowering well in Lincolnshire.

Thanks are due to the Principal and catering staff of the Agricultural College, the Chief Executive and staff of the R.S.N.C. and Lincoln City officers. Special thanks are also due to our generous guest speakers with their extra Sunday involvement – to B.S.B.I. member Mrs Thelma Brown for hospitality, to Mr Harold and Dr Mary Carter, and to Lincs. B.S.B.I. members for their support before and during the A.G.M. weekend.

IRENE WESTON

[The above Report arrived too late for it to be incorporated with the main Report of the A.G.M. in *Watsonia* **20**(1) – Ed.]


Vice-counties
kms
miles
H
S

INSTRUCTIONS TO CONTRIBUTORS

Scope. Authors are invited to submit Papers and Notes concerning British and Irish vascular plants, their taxonomy, biosystematics, ecology, distribution and conservation, as well as topics of a more general or historical nature.

Manuscripts must be submitted *in duplicate*, typewritten on one side of the paper, with wide margins and double-spaced throughout.

Format should follow that used in recent issues of *Watsonia*. Underline where italics are required. Names of periodicals should be given in full, and herbaria abbreviated as in *British and Irish herbaria* (Kent & Allen 1984). The Latin names and English names of plants should follow the *New Flora of the British Isles* (Stace 1991). Further details on format can be obtained from the Hon. Receiving Editor.

Tables, figure legends & appendices should be typed on separate sheets and attached at the end of the manuscript.

Figures should be drawn in black ink and identified in pencil on the back with their number and the author's name. They should be drawn no more than three times final size, bearing in mind they will normally be reduced to occupy the full width of a page. Scale-bars are essential on plant illustrations and maps. Lettering should be done with transfers or high-quality stencilling, although graph axes and other more extensive labelling are best done in pencil and left to the printer. Black and white photographs can be accepted if they assist in the understanding of the article.

Contributors are advised to consult the editors before submission in cases of doubt. Twenty-five offprints are given free to authors of Papers and Notes; further copies may be purchased in multiples of 25 at the current price. The Society takes no responsibility for the views expressed by authors of Papers, Notes, Book Reviews or Obituaries.

Submission of manuscripts

Papers and Notes: Dr B. S. Rushton, Department of Biological and Biomedical Sciences, University of Ulster, Coleraine, Co. Londonderry, N. Ireland, BT52 1SA.

Books for Review: Dr J. R. Edmondson, Botany Department, Liverpool Museum, William Brown St, Liverpool, L3 8EN.

Plant Records: the appropriate vice-county recorder, who should then send them to C. D. Preston, Biological Records Centre, Monks Wood Experimental Station, Abbots Ripton, Huntingdon, PE17 2LS.

Back issues of Watsonia are handled by Dawson UK Limited, Cannon House, Folkestone, Kent, CT19 5EE to whom orders for all issues prior to Volume 18 part 1 should be sent.

Recent issues (Vol. 18 part 1 onwards) are available from the Hon. Treasurer of the B.S.B.I., 68 Outwoods Road, Loughborough, Leicestershire, LE11 3LY.

Watsonia

August 1994 Volume twenty Part two

Contents

Published by the Botanical Society of the British Isles

UK ISSN 0043-1532

Filmset by
WILMASET LTD, BIRKENHEAD, MERSEYSIDE
Printed in Great Britain by
EATON PRESS LIMITED, WESTFIELD ROAD, WALLASEY, MERSEYSIDE

WATSONIA

Journal of the Botanical Society
of the British Isles

Volume 20 Part 3 February 1995

Editors: J. R. Akeroyd, J. R. Edmondson,
R. R. Mill, E. C. Nelson, C. D. Preston,
B. S. Rushton

ISSN: 0043-1532

Botanical Society of the British Isles

Patron: Her Majesty Queen Elizabeth the Queen Mother

Applications for membership should be addressed to the Hon. General Secretary, c/o Department of Botany, The Natural History Museum, Cromwell Road, London, SW7 5BD, from whom copies of the Society's Prospectus may be obtained.

Officers for 1994-95

President, Dr F. H. Perring

President-elect, Mr D. A. Pearman

Vice-Presidents, Mr P. S. Green, Dr G. Halliday, Mr A. C. Jermy, Mr A. O. Chater

Honorary General Secretary, Mrs M. Briggs

Honorary Treasurer, Mr M. Walpole

Editors of *Watsonia*

Papers and Notes, J. R. Edmondson, R. R. Mill, E. C. Nelson, B. S. Rushton*

Plant Records, C. D. Preston

Book Reviews, C. D. Preston

Obituaries, J. R. Akeroyd

*Receiving editor, to whom all MSS should be sent (see inside back cover).

Presidential Address, 1994

FRANKLYN PERRING

DRUCE IN NORTHAMPTONSHIRE

"In rising to address you . . . , after a study of various objects of scientific interest for more than half a century, it would seem mere hypocrisy if I told you I felt at all nervous in doing so". Thus Miles Berkeley began his address at the inaugural meeting of the Northamptonshire Natural History Society in 1876. He is one of the characters in the tale I am about to tell and I could find no better way to express my own feelings today: after 42 years as a member of the Society which has given me so much pleasure and has for much of my life been at its centre I do not feel nervous, I feel amongst friends and I am hopeful that you will be indulgent towards the incompleteness of what I have prepared for this occasion.

I decided to concentrate my address on Druce in Northamptonshire when I realised that the choice of Oxford for our A.G.M. this year would mean that, as a resident of Northamptonshire for the last 23 years, I would be following the path which Druce took when he left the county for Oxford in 1879. Druce's move brought him into the mainstream of British field botany and ultimately to the position where he was effectively the full-time, unpaid coordinator of the Society's affairs. But by further happy coincidence I find myself arriving in Oxford from Northamptonshire at the very moment that the Society is taking steps to appoint a coordinator of its scientific affairs. I will touch upon this briefly at the end of my address because I believe the consequences for the Society could be as important as those which Druce brought about here in Oxford nearly a century ago.

George Claridge Druce (Fig. 1) was perhaps destined to be a great botanist from the day of his birth, 23 May 1850 – the same day as Linnaeus, 143 years his senior– and, incidentally, of my colleague and past-President Max Walters. But in other respects his birth was not so fortunate. He was the illegitimate son of Jane Druce and no father is named on his birth certificate: there is some speculation that his second name Claridge links him with a local family where his mother might have been a maidservant. Druce writes later of "his patrimony" (Druce 1930), so his father's family were surely people of substance. He was born in Potterspury, a village in the south of the county which had other connections with the Druce family – a Phoebe Druce married Thomas Woodward at Potterspury on 14 October 1813. Although he made no secret of his birth elsewhere, towards the end of his life, in writing the introduction to his *Flora of Buckinghamshire* (1926), he fudges the issue a little: "Death early deprived me of paternal care, but in an unlimited degree there was showered on me the devotion and love of an all too unselfish mother." He added that his father's family were Northamptonshire people but "my mother's family were natives of and farmers in Buckinghamshire". Their area appears to have been around Woughton-on-the-Green, about 14 km to the S. E. "where my botanical baptism was received".

Soon after his birth the family moved 3 km to Old Stratford, on the county boundary with only the River Ouse between him and Buckinghamshire. There he spent the first five or six years of his life and, as he records in both the *Flora of Buckinghamshire* and the *Flora of Northamptonshire*, the river on the one hand and the nearby Whittlebury Forest only 3 km to the west on the other were wonderful areas in which to become 'turned on' by wild life. "Whittlebury Forest . . . with its myriads of Primroses, and the four kinds of Violets which I grew in my tiny garden, the glossy leaved Spurge Laurel, and Bluebells" (Druce 1926). The Ouse "had the White and Yellow Water Lilies; the banks were fringed with the sweet *Acorus* and canary-yellow anthered Sedge, and its meads were fragrant with Meadow Sweet or silvered with Lady's Smock, and the hedges shaded the beautiful *Geranium pratense*" (Druce 1926).

When Druce was five or six (he gives 1855 in the *Flora of Buckinghamshire* and 1866 (sic) in *Flora of Northamptonshire*) the family moved 3 km N.W. to Yardley Gobion into 13 Chestnut Road (fide

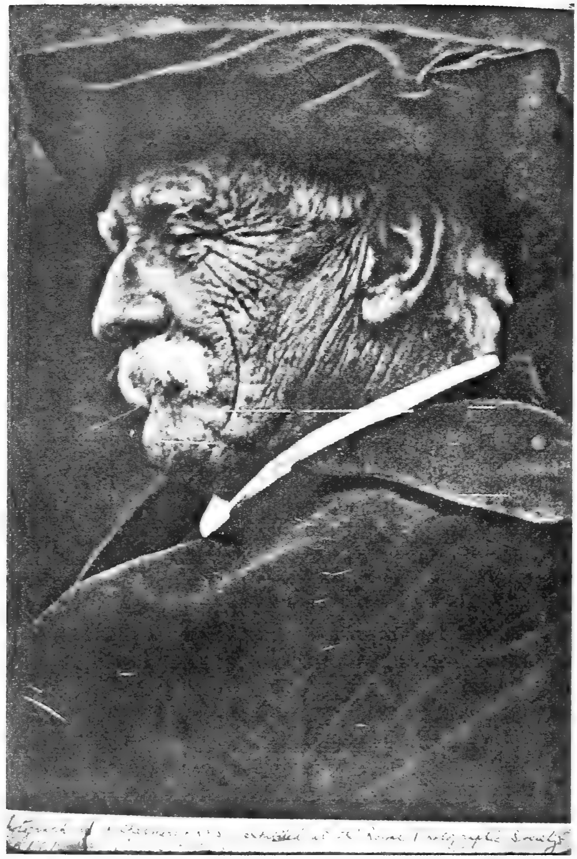


FIGURE 1. Photograph of George Claridge Druce by Robert Chalmers F.R.P.S.

Andrew Robinson, Northamptonshire botanist who lives in the village) which runs into the rather pleasant Chestnut Green. Here he lived with his mother and an aunt, Ann Blunt, according to Sylvia Chandler who has looked at the 1861 Census where they are described as:

Blunt, Ann Widow 63 Fundholder born Wollstone, Bucks
Druce, Jane Niece 33 born Woughton on the Green, Bucks
Druce, George Nephew 10 Scholar born Potterspury

But, still close to Whittlebury Forest, his interest in wildlife expanded and he developed an interest in entomology. He recalls (Druce 1926) "by the age of fourteen a very representative collection of its lepidoptera was made, including an *Antiopa* [Camberwell Beauty] and plenty of *Sinapis* [Wood White], *Paniscus* [Chequered Skipper] and rare clearwings. Pupae were dug for and larvae bred, so that the various Sallows, Poplars, Buckthorn, Verbascums, etc., were familiar objects". Wood White is still a feature of the area and some of the finest colonies in Britain occur in Salcey Forest 5 km N.E. of Yardley Gobion. The Chequered Skipper sadly no longer occurs at Whittlebury, or in the N.E. of Northamptonshire around its former stronghold in Rockingham Forest or indeed anywhere in England. The only sign of it now to be seen in Northamptonshire is the pub sign at Ashton, the estate village developed by Charles Rothschild, founder of the Society for the Promotion of Nature Reserves (S.P.N.R.), at the beginning of the century and where his daughter Miriam Rothschild still lives. Druce's friendship with Charles Rothschild, which I shall return to later, was surely based on their mutual interest in butterflies.

Druce regarded Yardley Gobion as his home village. He named his house in Oxford Yardley Lodge and even 'Lodge' may have local connections as houses at the edge of forests in

Northamptonshire are often so called and the school in the village of his birth is called Potterspury Lodge School. His mother probably kept her connections with Yardley for the rest of her life. In the 1881 Census (fide Sylvia Chandler) Jane Druce is listed as a Visitor at the Potterspury Union Workhouse, which is in Yardley Gobion, and she is described as a housekeeper. Druce (1930) said that his mother went to live with him in Oxford in 1879 and that ". . . much of my after success was due to her energy help and cheerfulness". Perhaps she continued to help until he was well established but may then have returned to Yardley from time to time, though she was living with her son in Oxford at the time of the 1891 Census where she is described as a widow! Druce erected a memorial tablet to her in St Leonard's Church, Yardley and gave a burial ground to the village in her memory in 1924.

Druce was privately educated "under my guardian. Since he had little foresight a public school education was debarred" (Druce 1926) but at an early age "Two ministers of the Independent chapel at Potterspury, J. and T. B. Slye took an interest in the boy and his education" (*Dictionary of National Biography Suppl.*). But despite his love of nature and his ability to recognise 400 species of plants by the time he was 16 (though he did not know their names) his "desire was to be a chemist

FIGURE 2. Philadelphus Jeyes' shop at 6, The Drapery, Northampton where Druce worked for 13 years (1866–1879). Above: at the firm's foundation in 1810. All Saint's Church is to the left. Beneath its portico Druce, as a boy, saw John Clare. Below: at the celebration of the firm's 150th jubilee in 1960. View from beneath the portico.

. . . thanks to the generosity of my aunt, the rather heavy premium was paid and I became duly apprenticed to a large wholesale and retail business in Northampton" (Druce 1926).

The business was Philadelphus Jeyes of 6, The Drapery in the centre of the town, close to the market place and opposite All Saint's Church which was largely built after the fire of 1675 (Fig. 2). It was under the portico of the church incidentally that Druce (1930) recalls seeing, as a boy, Northamptonshire's treasured poet/naturalist John Clare. Clare spent the last 22 years of his life in the Northampton Asylum but was occasionally allowed out and would sit in the portico watching children at play or, as Druce recalls, as a little, pathetic, distraught figure, gazing at the sky.

Druce was obviously very good at his work. An assistant left after he had been there only a year and he was promoted. At the end of his second year he became senior assistant and, when he was still only 19, the manager left and he was given that post temporarily, but he held it for the next eleven years.

He lived on the premises. At the time of the 1871 Census of Northampton 6, The Drapery was recorded as a boarding house providing 'digs' for young pharmacists (Fitzhugh 1985; Fig. 3). They were under the care of the housekeeper, Sarah Foll and Druce's three companions were Frederick Branson, Edmond Cooke and Anthony Chibnall. The first named came from Hanslope, Buckinghamshire, just across the River Ouse from Yardiey, and Druce was still in touch with him in 1920 when he visited him in Leeds (letter from Frederick Jeyes to 'Betsy' Jeyes 25 January 1920).

At this time the owner, Philadelphus Jeyes II, lived in a splendid Victorian folly he had built for himself at Boughton 6 km to the north called Holly Lodge and Druce records (1905, 1930) how he used to visit him rising at six o'clock, especially in the summer, and taking his Lindley's 'Introduction' to read on the four miles' [6 km] walk, have breakfast at 7.30 a.m., discuss the business of the day and then either walk back or ride with one of the boys, who went to school in Northampton, in time to open the shop at 8.30 a.m. By this time he had also studied Latin in the evenings sufficiently well to pass his preliminary pharmaceutical examinations.

Mr Jeyes not only promoted Druce the chemist but promoted Druce the botanist. In 1868 he gave £15 for one of his sons and Druce to take a 13 day walking tour through Wales where they climbed Snowdon, Moel Eilio and Cader Idris. Though the main interest seems to have been castles, Druce noted ferns and golden rod and they even brought back some change because he suggests (Druce 1926) hotel-keepers were over generous – the bill for two at Harlech (dinner, bed and breakfast) was four shillings.

The next year, 1869, Mr Jeyes gave the two young men £20 and they went third class on wooden

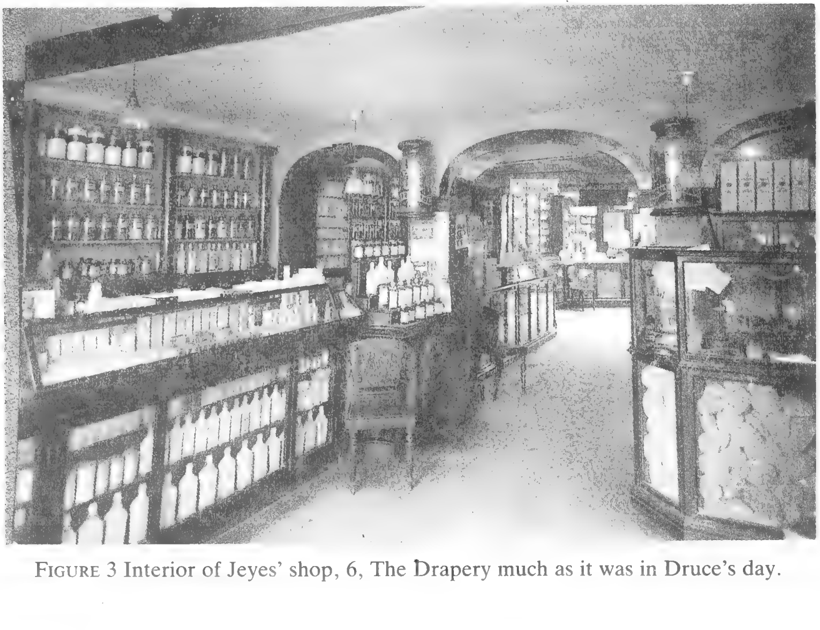


FIGURE 3 Interior of Jeyes' shop, 6, The Drapery much as it was in Druce's day.

seats to Edinburgh where they climbed Arthur's Seat: they then went to Blair Atholl and climbed Ben-y-Gloe. The next stop was Kingussie from which they went by 6.00 a.m. train to Aviemore, walked to the top of Cairngorm and back, reaching Inverness at 10.00 p.m. "more dead than alive, for we had little to eat all day". They also climbed Ben Nevis and passed through Glasgow on their way back to Edinburgh. The overnight train took them to Blisworth where, with sixpence left, they bought some buns and walked the 6 km into Northampton (Druce 1926).

Strangely, although Druce refers to these important formative journeys on several occasions he never identifies the son by name. Now, however, thanks to the help of a direct desendant of Philadelphus Jeyes still living at Holly Lodge, Mr Anthony Jeyes, we have evidence that this was almost certainly Theophilus Frederick Jeyes who was two years younger than Druce. Druce (1905) says he was about his age. He was a problem child, violent at times, who terrorised the village (A. Jeyes, pers. comm.) so perhaps Philadelphus' generosity in sending the two boys off to Wales and Scotland was not entirely altruistic.

Letters in Anthony Jeyes' possession between Frederick and his elder sister Betsy show that, after the First World War, Frederick was living in Oxford [at 97 St Aldates] and frequently met Druce taking tea with him [at Yardley Lodge?] – so they were still on friendly terms after 50 years.

Philadelphus Jeyes not only stimulated Druce's interest in plants by giving him the means to explore Britain but, when his apprenticeship was complete in 1870, he gave him a £20 microscope "selected by Henry Deane of Clapham, which is still before me" (Druce 1926).

Before following Druce during the third and last decade of his life in Northamptonshire, which was to be his most significant scientifically, a small digression about Philadelphus Jeyes and the family which influenced Druce so extensively seems timely: and for what follows I am much indebted to Anthony and his nephew David Jeyes and their families.

Philadelphus Jeyes II was the son of Philadelphus I who, with a John Perrin, founded the business in The Drapery in 1810. Philadelphus II was born in 1814, one of two surviving brothers; the other, John, was two years younger. During their early years both boys studied botany encouraged by a Mr Dickens, a local nurseryman and, in the late 1830s John entered into partnership with James Atkins – a nurseryman regarded as one of the most prominent in the provinces.

Philadelphus' father died when he was 14 and he eventually decided to follow him into the business. Having qualified and become one of the earliest members of the newly formed Pharmaceutical Society in 1842 he seems to have bought out John Perrin and taken over the business in 1846. He was a successful business man and became a prominent radical non-conformist politician and was Mayor of Northampton in 1852 when he was only 38. His knowledge of local politics was undoubtedly invaluable to Druce in the 1870s when he was thinking of forming a local natural history society. Druce (1918) says himself that at this time Northampton was divided into many sects comparable with the situation in other Midlands towns described by George Eliot in *Scenes of clerical life*.

John Jeyes was not a great businessman but he was a competent and inventive chemist. He left Northampton in 1859 for London where he registered a total of 21 patents covering a variety of subjects one of which, in December 1877, was his most famous and effective 'Jeyes Fluid'. Though Philadelphus may be translated as brotherly love and it is clear that they were the best of friends, after their deaths, at the beginning of the century, the John Jeyes branch of the family considered that a new product of the Philadelphus Jeyes branch called Carbocide was being sold to the detriment of their Jeyes Fluid and a 13 year legal battle ensued.

The business at The Drapery continued under the name Philadelphus Jeyes until 1969 when it was bought, gutted and run by two national multiples in succession and finally closed as a chemist's shop in the mid 1980s: today it is a sportswear shop though the building itself, parts of which predate the great fire, is now protected by a conservation order.

Happily, however, the name of Jeyes was not lost to pharmacy in Northamptonshire for ever. In 1981 David Jeyes, great grandson of Philadelphus II, opened a chemist's shop in Earls Barton 13 km east of Northampton taking with him relics of the old shop in The Drapery.

Though as a boy Druce had been equally attracted to botany and entomology his choice of profession now tilted the balance in favour of the former. In 1871 he helped found the Pharmaceutical Association, "the members of which had many botanical walks. Indeed, its Field Botany was its most successful branch" (Druce 1918).

Botany was one of the subjects for his final pharmaceutical examinations in 1872 and he clearly excelled in this and all the other subjects with the result that he won a special prize which included Sowerby's *Plants of Britain*, Carpenter's *Microscope*, and Francis' *Ferns* (Druce 1926).

So at the age of 22 he was fully qualified, acting manager of the leading chemist's shop in town, possessor of a microscope and some essential botanical books – what was this energetic, resourceful young man to do next? The answer came "One night in the autumn of 1872, as in a feverish cold I lay awake waiting for sleep that would not come, I determined that in the following year I would begin a Herbarium, and commence a Flora of my native county. . . . These feverish thoughts, instead of melting like a morning mist into nothing, crystallised into action, and in 1873 I collected over 700 species . . ." (Druce 1930). In the next six years he visited almost all the numerous villages in the county and he records (Druce 1918) that he and fellow members of the Northampton Pharmaceutical Association had the use of a room in Jeyes' shop rent free: in 1879 it was a well-fitted laboratory with a good collection of Materia Medica and specimens.

Sometime in 1875 he dined with Charles Jecks, a "local gentleman of independent means, and a strong Darwin supporter" (Druce 1918), and discussed the formation of a natural history society. The problems of dealing with the many factions in the community at that time have been referred to earlier. However, with advice from influential people like Jecks and Jeyes and with the ability to involve people of distinction and with titles which was to be his forte throughout his life, he went ahead. By 7 March 1876 the rules of the Northamptonshire Natural History Society had been formulated and Lord Lilford had agreed to become its first President. (Lilford was the county's leading ornithologist, publishing *The birds of Northamptonshire* in 1895: Lilford Hall, sadly now empty, stands beside the River Nene 5 km south of Oundle.)

Miles Berkeley became an honorary member and President of the botanical section with Druce as Secretary. Berkeley was born at Biggin 3 km west of Oundle (Druce 1930) and became a priest serving as Curate of Apethorpe and Woodnewton nearby. But he also became an international authority on fungi. He was in touch with Henslow and Darwin at Cambridge in the late 1820s and, when Henslow retired as Professor of Botany in 1860, Berkeley was encouraged to apply for the Chair but did not do so. Seven years later he did however apply for the Chair at Oxford but was turned down because he was in Holy Orders (Ramsbottom 1948). In 1868 at the age of 65 he was transferred to the more valuable living of Sibbertoft near Market Harborough. Druce first met him at the inaugural meeting of the Northamptonshire Natural History Society on 21 April 1876 and he later (1930) described him as "my botanical godfather, for he proposed me for the Linnean Society". Druce was elected on 17 April 1879 when he was only 28 and those who recommended him in addition to Berkeley were Lord Lilford, J. G. Baker, Henry Trimen and E. M. Holmes – a distinguished group.

The Society had 60 members at that inaugural meeting, when Lord Lilford spoke against gamekeeping and in favour of birds-of-prey, and it clearly flourished (Druce 1918). In February 1877 Druce read a paper, "Contributions towards a Northamptonshire Flora" which was printed in extenso in the Northampton Mercury. Druce took over as Hon. Secretary in 1878 on the resignation of Charles Jecks who left the town. The following year at a meeting in Leicester on 20 May 1879 he was appointed as one of the two Hon. Secretaries of the Midland Union of Natural History Societies. On 16 June the Northamptonshire Natural History Society decided to start its own journal and Druce, with Sanders and Scriven, became the editorial committee. Yet only two weeks later Druce had left Jeyes and bought a chemist's shop at 118 High Street, Oxford (Druce 1930).

The reasons for this precipitate departure when he was becoming ever more deeply involved in local affairs in Northamptonshire and in the Midlands are recorded by Druce somewhat ambiguously. In one place he writes "It was my wish to also save enough money from my salary to enable me to purchase a business out of my own earnings, and not to touch my patrimony. Having once visited Oxford and the Thames valley in search of *Orchis militaris*, the county so attracted me, that in 1879 a pharmacy in the celebrated High Street of Oxford was purchased for £400" (Druce 1926). But elsewhere (Druce 1930) he confesses "It had been a great desire of mine to acquire the business of my employer, which he had led me to believe would take place, but private matters made him loathe to sell it, so on June 30, 1879, I left a town in which I knew "every one", and a county which I dearly loved. . . .". "The undulating, well-wooded country from which I drew my birth and infant nurture and in which I spent my early years . . . will be an abiding memory" (Druce 1918).

The truth probably lies between the two. Philadelphus had eleven children all but one of whom showed no interest in following their father into the business. However the one, Arthur Albert

Jeyes, younger brother of Frederick, studied at Guy's Hospital and subsequently qualified as a chemist. He was old enough in 1879 to join his father and, towards the end of the century, he succeeded him as head of the firm (Fitzhugh 1985). So Druce was passed over in favour of Jeyes' son and, as a document in the possession of Anthony Jeyes suggests, he was probably forced to leave the Northampton area by the terms of his employment. In an agreement with another employee dated 10 March 1876 it states that if he leaves Jeyes' employment he may not for three years enter into business of chemist and druggist in the town of Northampton or within 30 miles [50 km] thereof with a fine of £100 if he did so. This explains why Druce, once he knew there was no future for him in Northampton, looked as far afield as Reading and Oxford (Druce 1930).

Moreover there are no indications that he left with anger and cut his connections with the county or his employers. He began to publish the *Flora* which he started in 1873 in the first issue of the *Journal of the Northamptonshire Natural History Society* in 1880, completing it in eight parts in 1893–1894: and he contributed other articles to it until the mid-1920s. He continued to botanise in the county: many parts were especially worked "some owing to the generous kindness of the Hon. N. C. Rothschild, who was my kind host on several occasions" (Druce 1930). This friendship was evident in 1912 when Charles Rothschild formed the S.P.N.R.: Druce was not only a member of the Council but one of a select group on the Executive (see Rothschild 1987). And, when Rothschild died in 1923, Druce wrote an extensive appreciation (Druce 1924). However it is also clear that he concentrated his field work for almost all of the next 50 years in preparing Floras of other areas, notably the three B.B.O.N.T. counties, Berks, Bucks and Oxon, and that he did not return to serious work on Northamptonshire until he had finished the last of these, Buckinghamshire, in 1926. Over the following four years he rewrote the 'Flora in Parts' and it was finally published, as a rather colourless paperback, in 1930, in his eightieth year. Apart from the Introduction, which is marvellous and a mine of historical information (much of it used here), it is the least satisfactory of his great quartet of Floras and I am sure we are all looking forward eagerly to the publication of the new Flora, in about a year's time.

That Druce kept in touch with his home area is evident from the plaque in the church at Yardley Gobion in memory of his mother, already referred to. The connection with the Jeyes family continued, as we know, with periodic meetings with Frederick in Oxford. But it went further than that and I was delighted to be shown by Mr Anthony Jeyes, grandson of Arthur Jeyes who had stood between Druce and his ambitions for the business in Northampton, his 'Baptismal Book' recording his christening in 1930 where Dr Druce appears as one of his godfathers and in Druce's will, in the library of the Department of Plant Sciences in Oxford, appears "to Master Jeyes 20 guineas"!

In preparing this part of my address I am sincerely grateful to those who have been so generous in lending me their time and knowledge: I am especially indebted to Sylvia Chandler for notes about Druce's early years; to Andrew Robinson for local knowledge about Druce around Yardley Gobion; to Ioan Thomas for access to his researches, particularly on Miles Berkeley; to Gina Douglas in the Linnean Society library for helping locate Druceana; and finally to Anthony and David Jeyes and their families for access to their family history and other papers and for their hospitality in Boughton and Earls Barton.

Though Northamptonshire would undoubtedly have had a better Flora if Druce had not moved to Oxford the botanical world and the B.S.B.I. in particular has every reason to be grateful. His impact was immediate and decisive. Within a year, despite the demands of building up his new business, he had helped start a natural history society which held its meetings in the Lecture Room in the Botanic Garden (Druce 1930): already a demonstration of the energy and drive which was to take him to the pinnacle of success, not only in Botany, but in the Pharmaceutical Society and in local politics.

Druce was so successful in business that he was able to retire in 1905, 18 months after he had been made Secretary of the Botanical Exchange Club, and devoted the remaining 27 years of his life to changing it from an Exchange Club with a membership of just 42 into a national botanical field society with a sixfold increase in numbers. He personally approached every amateur and professional botanist. Moreover many of the new members were men and women of substance (Allen 1986). There is little doubt that the Club was known to all those who would benefit from membership. I fear that the same cannot be said of the B.S.B.I. today.

Clive Stace's *New Flora of the British Isles* has sold over 6000 copies since it was published three years ago: the *Atlas of the British Flora* and our Sedges Handbook have sold similar numbers, yet the membership of the Society stands today at only 2683 and, if family members are removed and we assume that every member has a 'Stace', only one in three of those who bought it (and how many more are using it in libraries?) are members of the Society.

Mary Briggs has kindly provided some figures on the changing membership of the Society since 1955, appropriately the year after the launch of the Distribution Maps Scheme from which the *Atlas* flowed. What the figures show, alarmingly (Fig. 4), is that whereas for the 21 years from 1955–1976 the annual increase in membership was 60/annum and our junior membership rose to at least 116 (7%), between 1976–1988 recruitment had dropped to 33/annum and the juniors to about 80 (3·5%), and that today our membership growth is negligible (1988–1994 mean of c.13/annum) whilst the juniors with 43 are under 2%. These figures are reinforced by the results of the Membership Survey we carried out in the autumn of 1993 in which we asked respondents to indicate their age class. For the 728 who answered this section the figures were:

Under 18	1	0%
18–24	6	1%
25–34	66	9%
35–44	144	20%
45–54	167	23%
55–64	165	23%
65+	175	24%
Don't know!	4	

Even allowing for some bias because older, retired members may have more time to fill in a questionnaire (though I do not find that to be true for me or most of my friends!) there can be little doubt that, taking the membership figures and the survey results together, we are a static, ageing Society which is failing to attract the young. Yet this has been happening at a time when there has

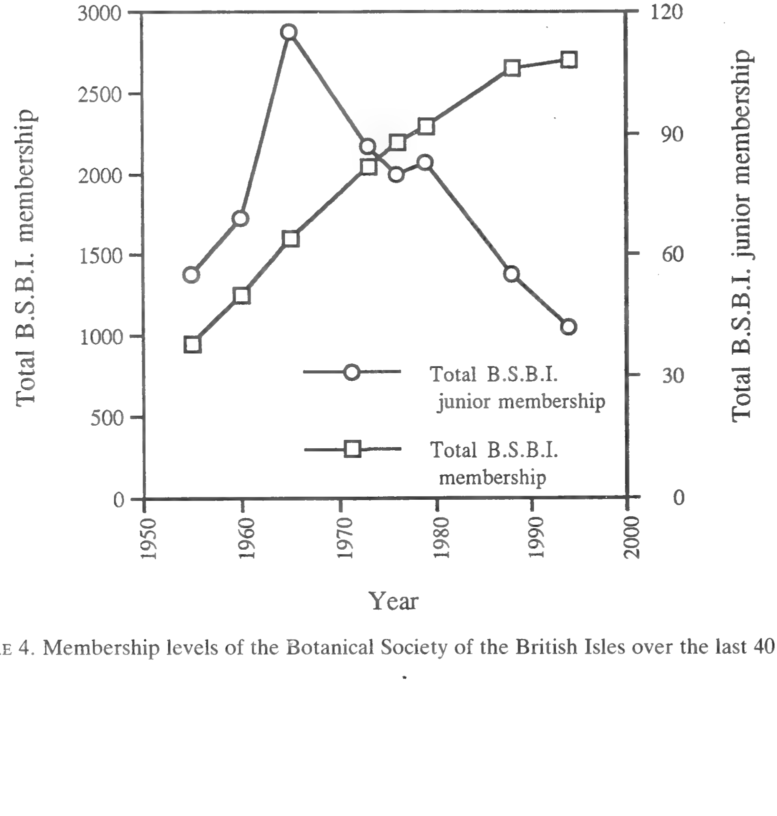


FIGURE 4. Membership levels of the Botanical Society of the British Isles over the last 40 years.

been an enormous increase in the number of posts for field naturalists in the Nature Conservancy Council and its successor bodies, in wildlife trusts, national parks, environmental agencies and the like, and whilst the British Trust for Ornithology has risen from 2000 in 1951 to over 10,000 today, with more than 2000 of this increase in the last three years.

Yet you and I know that the Society is very much alive: we are involved in a range of activities of vital importance to the botanical community of the British Isles – and further afield – with publications like the Handbook series, the *List of vascular plants* and the *Scarce plants in Britain*. I am sure this latter will become the most widely quoted B.S.B.I. publication since the *Atlas* of 1962, and we have the new Atlas project yet to come. We also have the enormously impressive database at Leicester which will shortly produce the long-awaited successor to Druce's *Comital Flora* of 1932 (typically published in the week that he died) – and much, much more. Then there is the amazing series of local Floras produced by members of the Society (ten in the last twelve months) increasingly backed by computerised databases of immense and growing importance to national and local conservation agencies which, together with up-to-date field work, are the basis for national and county Red Data Books and lists.

The B.S.B.I. is indispensable and the need for our expertise grows rapidly. In the last few months there have been significant developments which suggest that in future the Country Conservation Agencies – English Nature, Scottish Natural Heritage and the Countryside Council for Wales – will be looking increasingly to voluntary organisations like the B.S.B.I. for the information they need about the changing flora of Britain and will be prepared to pay for it. It is in the light of this, and three or four individual offers of contracts, that your Council has taken the decision to appoint a coordinator. We must surely now appreciate, and make others appreciate, that we are the vascular plant equivalent of the B.T.O. and, though I am not suggesting we need to aim for the staff of 60 and the impressive H.Q. they inhabit at Thetford, we should at least acknowledge that in determining what is happening to the fauna and flora of the British Isles, birds and vascular plants are the two groups which provide the greatest opportunities for detailed study – and that the number of plant species is an order of magnitude greater than the number of birds. We must devise a policy for monitoring change, engage the minimum staff needed to carry it through, and aim for that objective.

I suggest that policy shall be:

The study of the vascular plant populations of the British Isles in respect of distribution and numbers and of the ecological factors, including those of human origin, affecting them. It shall be one of the principal objects of this policy to answer the following questions:– In what way is contemporary man affecting wild plants and, in particular, how are changes in forestry, agricultural and horticultural practice influencing plant populations?

I hope this does not seem too avant-garde: it should not as it is a paraphrase of the B.T.O.'s policy published in its Annual Report for 1962 (Hickling 1983), the year we published the *Atlas* and were leaders in this field.

The functions of the coordinator were admirably summarised by the indefatigable David Pearman in a statement sent to members in April, 1994. A primary function will be to ensure that all the organisations which could benefit from the B.S.B.I.'s expertise, at national and local level, are aware of the Society and act as an interface between them and the membership. But he or she cannot be effective working alone. I am convinced that, if the Society is to achieve its full potential and attract to its membership all those who would benefit from its resources in publications, meetings, identification services, etc., the coordinator must be supported at the county level by voluntary members prepared to give time to promoting the Society. For them I have coined the term 'Link People'. They would be additional to that remarkable, but overworked, band of county recorders in most cases, but would work in close collaboration with them whilst having a special responsibility to bring the Society constantly to the attention of the changing botanical staffs of universities, colleges, wildlife trusts, local authority ecologists and so on.

One bonus of our age structure is that we must have nearly 1000 members who have retired or are about to retire who might have time to act as 'Link People'. Once these two elements, Coordinator and 'Link People', are in place and the *New Atlas* project gets under way, I predict that we can, and should, achieve a membership of 5000 by the end of the century. I strongly urge the Society to move in that direction. Perhaps in honour of Druce and of the place from which he laid the foundation of the Society at the beginning of the century, it might come to be known as the Oxford Movement.

REFERENCES

ALLEN, D. E. (1986). *The Botanists*. St Paul's Bibliographies, Winchester.

DRUCE, G. C. (1905). My apprenticeship. Typed copy of extract from *Chemist & Druggist* deposited in The Library, Department of Plant Sciences, University of Oxford.

DRUCE, G. C. (1918). Formation of the Northamptonshire Natural History Society. *Journal of the Northamptonshire Natural History Society* **19**: 131–142.

DRUCE, G. C. (1924). Obituary. The Hon. N. Charles Rothschild. *Journal of the Northamptonshire Natural History Society* **22**: 135–141.

DRUCE, G. C. (1926). *The Flora of Buckinghamshire*. T. Buncle & Co., Arbroath.

DRUCE, G. C. (1930). *The Flora of Northamptonshire*. T. Buncle & Co., Arbroath.

FITZHUGH, J. (1985). Philadephus Jeyes – the firm and the family. MS in keeping of Anthony Jeyes, Boughton, Northampton.

HICKLING, R. (1983). *Enjoying ornithology*. T. & A. D. Poyser, Waterhouses, Staffordshire.

RAMSBOTTOM, J. (1948). In *Phytopathological Classics* **8**: 5–12. American Phytopathological Society.

ROTHSCHILD, M. (1987). Changing conditions and conservation at Ashton Wold, the birthplace of the S.P.N.R. *Biological journal of the Linnean Society* **32**: 161–170.

20TH CENTURY DICTIONARY OF NATIONAL BIOGRAPHY SUPPLEMENT. Compact ed., p. 2607.

The Cambridge British Flora (1914–1920)

M. J. BUNTING*, D. BRIGGS AND M. BLOCK

Department of Plant Sciences, University of Cambridge, Botany School, Downing Street, Cambridge, CB2 3EA

ABSTRACT

The reasons for the failure of *The Cambridge British Flora* after the publication in 1914 and 1920 of the first two volumes have been investigated. The financial constraints imposed on Cambridge University Press by the First World War were important, but the personal, social and financial problems of the author, Charles Edward Moss, were crucial, since they led to his emigration to South Africa in 1917 and his subsequent loss of interest in a project that belonged to his life in England.

KEYWORDS: biography, bibliography, history, Charles Edward Moss, Edward Walter Hunnybun.

INTRODUCTION

At the British Association for the Advancement of Science meeting in Sheffield in 1910, Professor J. W. H. Trail, Regius Professor of Botany at the University of Aberdeen, gave the Presidential Address to the Botanical Section. In surveying the Floras of Britain then in use, he argued that there was a pressing need for a new definitive work (Trail 1910). In his view, both teaching and research would be stimulated by the production of an up-to-date, encyclopaedic work in which the nomenclature was clarified. He suggested that such a Flora would probably be in the form of monographs by specialists presented in a uniform style.

The need for a new Flora was already widely felt. In 1898, Rev. E. F. Linton's intention to produce just such a work was announced (Anonymous 1898), although nothing came of that particular proposal. *The Cambridge British Flora*, under the editorship of C. E. Moss, was planned as a ten-volume encyclopaedic survey of the flora of Britain, with accounts of critical genera contributed by specialists. The two published volumes are of a very high standard, and it is therefore of considerable interest to discover why the project was abandoned.

In considering the fate of *The Cambridge British Flora*, we have consulted a number of primary sources, including documents in the archives of the University Library, Cambridge, the Department of Botany, Natural History Museum, London, and the departments of plant sciences in the universities of Cambridge, Oxford and Witwatersrand (South Africa). The relevant minute-books of the meetings of both the Syndics and the Business Sub-Syndicate of Cambridge University Press (hereafter 'the Press') were studied. These primary sources were used, together with contemporary journal articles, to investigate the preparation and publication of each volume of the Flora, the reaction of the botanical community, and the eventual abandonment of the project.

CHARLES EDWARD MOSS (1870–1930)

Moss, the youngest son of a nonconformist minister, was born in Hyde, Cheshire on 7 February 1870 (Crump 1931; Desmond 1994). His interest in botany was stimulated in 1893 when, convalescing from a pulmonary abscess, he was ordered to spend a large amount of time out-of-doors. He occupied himself with long walks over the Halifax moors, alone or in the company of members of the Botanical Section of the Halifax Scientific Society, which he had joined in 1892, and within which he soon became a prominent figure.

*Author for correspondence; present address Department of Geography, University of Waterloo, Waterloo, Ontario, N2L 3G1, Canada.

In 1895, he entered Yorkshire College, Leeds (then part of the Victoria University) as a Queen's Scholar, and during this period was an editor of the *Halifax naturalist*, in which he published several botanical papers. In 1898 he began work at Fairweather Green School, but kept up his association with the college where he worked with W. G. Smith, mapping the vegetation associations of the West Riding using techniques pioneered by Smith's brother Robert in the Pentland Hills.

He became an assistant master at Sexey's School, Bruton, Somerset in 1901, and began to study the vegetation distribution of the area. At the end of 1902, he was appointed lecturer in biology at Manchester Municipal Training College. This post was less well paid, but he could continue to work for a higher degree, despite teaching every week day and several evenings.

The Central Committee for the Survey and Study of British Vegetation was set up by Tansley and Smith in 1904 (Sheail 1987), and Moss became a prominent member. His contribution to the committee and *Types of British vegetation* (Tansley 1911) was invaluable (Tansley 1931).

In 1907, Moss was awarded a doctorate by the University of Manchester for his work in Somerset (Moss 1907), and the Back Bequest by the Royal Geographical Society for his work on the vegetation of the Pennines (Moss 1904, 1913) which he had largely carried out at weekends and during the vacations. At the end of the year he was offered the post of Curator of the Herbarium at the University of Cambridge, which he took up in January 1908.

It is only at this point that his research interests turned to taxonomy. Whilst in Cambridge Moss lectured and led field expeditions, and had a marked effect on many of his students (e.g. Levyns 1977). His lectures were described as "not brilliant . . . but full of sense and philosophy" (Ramsbottom 1931). Soon after his arrival he proposed that he should write a new 'student's Flora' of the British Isles.

EDWARD WALTER HUNNYBUN (1848–1918)

Edward Walter Hunnybun, a Huntingdon solicitor, encouraged by the praise of his many botanical correspondents, conceived the idea of turning his hobby of making lifelike pen-and-ink sketches of plants into a 'lifework'. He decided to attempt to draw all the species in the British flora, and set about this task with single-minded determination and attention to detail. As his correspondence with numerous collectors and field botanists testifies, he never became skilled in taxonomy, but his network of supporters and advisors on different genera (e.g. Ley on *Rosa*) helped to ensure that he drew representative, correctly identified specimens of each species and subspecies. It was important that each specimen be representative, since he did not make an idealised drawing, but drew the individual specimen before him; he was fond of saying "I only draw what I see" (Wilmott 1920). His great enthusiasm for this task is shown in his daily dawn bicycle rides during the collecting season in search of specimens. Over the years, boxes of his exquisite drawings, drawn life-size in a brownish ink over a preliminary pencil sketch, travelled around the country, to be admired and commented on by his many correspondents.

As early as February 1901, F. J. Hanbury wrote to Hunnybun about "the possibility of publishing the drawings as a separate volume, reproduced by photographic means".[1] On 4 June 1903, this possibility became more likely, when a selection of 100 of his drawings was displayed at the Linnean Society (Anonymous 1903). If sufficient support was forthcoming, the intention was to issue fascicles of the drawings (Anonymous 1904). Although the pictures were much admired for their artistic merit, G. C. Druce questioned the advisability of publishing them for scientific purposes, since he considered the drawings to be scientifically inadequate, being "defective in detail" (Druce 1931).

Hunnybun considered bequeathing them to a private museum, but it is clear that he really desired publication of at least a selection (e.g. Anonymous 1904), and in February 1908 J. Groves wrote that "my brother and I have talked over the idea you mentioned of offering your splendid . . . drawings . . . to the Hon. Walter Rothschild for his museum *if he would agree to publish them*"[2] (our italics).

Sometime during the period 1908–1909 the drawings were donated to the Cambridge University Botany School (now the Department of Plant Sciences). The actual date is unclear, but by 1909 they were certainly in Moss' hands, for during that year he discussed with J. Ramsbottom (a botanical friend from his Halifax days) whether they should produce a Flora based on the drawings

(Ramsbottom 1931). Nothing seems to have come of this particular discussion, but Moss, unlike Druce, obviously considered Hunnybun's work worthy of publication.

PLANNING *THE CAMBRIDGE BRITISH FLORA*

When Hunnybun's drawings arrived in the Botany School, Moss conceived an altogether bolder plan than a 'student's Flora', deciding to write a complete and definitive account of the British flora classified according to Engler (1898). Hunnybun's drawings would be used to illustrate this work. As noted above, Moss initially considered preparing the work jointly with Ramsbottom (1931) or with G. C. Druce, his 'opposite number' at Oxford University's Fielding Herbarium (Druce 1931).

On 20 January 1911, Moss' proposal for a Flora, to be entitled *The Cambridge British Flora*, was favourably considered by the Syndics of the Press.[3] He had at this point apparently changed his plans, making it more of a solo project[3], with expert contributors writing the accounts of critical genera. Moss' decision can partly be explained by his deep belief in and commitment to the project, and his desire to see it completed to his own high standards. His conviction that his own views were correct, and that those who disagreed with him were, at best, ill-informed, a characteristic even his close friends attributed to him (e.g. Ramsbottom 1931), would have made any joint undertaking fraught with difficulty, especially if it involved the forthright and idiosyncratic Druce. Sole control and editorial power over the submitted manuscript would, therefore, have had great appeal to Moss. Druce (1931) suggested that Moss made the move to sole authorship because he felt that such a project might help him become a Fellow of one of the Cambridge colleges. Given his hardworking and ambitious nature this is a possibility, but it should be noted that Druce made this statement after they had quarrelled in 1915 (see below).

The contract with the Press was finally signed on 19 January 1912.[4] An advance notice (Anonymous 1911) makes much of Moss' achievements and publications, and concludes "no better choice could have been made".

On 7 March 1912, a meeting of potential contributors was held in the British Museum (Natural History). Here Moss' habitual authoritarianism did not go down well. Moss wrote to Rendle[5] (Keeper of Botany, British Museum (Natural History)), who had chaired the meeting, expressing his thanks for the "perfect impartiality with which you conducted what at times threatened to become a rather warm meeting!". Apparently this was a common feature of meetings involving Moss, at which he often "caused an uncomfortable liveliness" (Ramsbottom 1931). During the meeting (Anonymous 1912) there was much discussion about the citation of synonyms, etc., and Moss "undertook to consider" the points raised. Druce "entered a formal protest" (and in doing so appears to have spoken for the 'establishment') against "Germanising our flora" by adopting the Englerian system (Anonymous 1912). However, the meeting generated enthusiasm for, and interest in, the project and showed Moss firmly in charge. E. S. Marshall[6] describes himself as "much impressed by Moss' business aptitude . . . his clearness of view and botanical ability".

In October 1912, Moss compiled and sent out a list of 84 "Instructions to Contributors", which read more like an examination rubric than guidelines to acknowledged experts. Moss' arrogance in correcting the contributions that were eventually offered and even, on occasion, rejecting them as inadequate, did nothing to win him friends. His editorial style was extremely high-handed. For example, Druce[7] suggested that Linton withdrew his account of *Salix*, intended for volume ii, "choked off" and found Moss "most difficult to work with". However, a letter from Moss to Linton[8] was unambiguously a rejection, couched in schoolmasterly terms, describing the account as not sufficiently up-to-date in nomenclature. Many of the older British botanists were unwilling to accept such treatment and therefore "the editor was left with additional preparation and additional criticism" (Ramsbottom 1931).

The Cambridge British Flora was never intended to be anything other than a specialist book. The Press only intended to print 1250 copies before destroying the type.[9] This initial number was revised downwards to 1000.[10]

Moss had grandiose ideas about the format of the work, initially planning to include descriptions, maps and numerous photographs, as well as the expensive and complex plates of Hunnybun's drawings. This led to conflict with the Press. In the spring of 1913, a debate about whether to bind the plates with the text (as Moss desired) or in separate volumes (as the Press proposed) escalated to the point where Moss threatened to take the book elsewhere. The lively correspondence between A. C. Seward (Professor of Botany at Cambridge as well as a Syndic at the Press), attempting to defend Moss, and the Press' representative A. R. Waller, shows that it was indeed a major problem.[11] Throughout this period Seward supported Moss, speaking for him to the Press and excusing his abruptness and occasional outright rudeness. Moss eventually accepted the Press's preferred scheme, possibly under pressure from Seward.

THE ILLUSTRATIONS

In the summer of 1913, Hunnybun retired owing to increasing ill-health; he was a severe asthmatic and until his death in 1918 moved frequently to different parts of the country trying to find a climate that suited him. Now he could concentrate on completing and refining his drawings, replacing some with others drawn from better or more representative specimens. This habit of redrawing was to lead to problems with the Press.

The preliminary sketches, drawings and the copy of the *London catalogue of British plants* used by Hunnybun as a checklist are full of notes stating "Moss says" and "Moss thinks", generally referring to the identification or the representativeness of a particular specimen, and showing clearly that Moss was firmly in control of what was to be drawn as well as of what was to be written. Hunnybun, a mild and easygoing man, knew himself to be far less expert than Moss in matters taxonomic, and so proved to be more amenable than the contributing authors.

THE 'FIRST' VOLUME AND ITS RECEPTION

In 1914, after several delays, volume ii was published. In a lengthy, controversial introduction Moss expounded his ideas on nomenclature and classification, explaining how he wished to use the Englerian system to bring British Floras more into line with the continental Floras, but without using all the subspecific divisions favoured by many European taxonomists. Moss intended to use only species, varieties and formae (e.g. in the *Prospectus* for the *Flora*). However, this approach generated sufficient intraspecific subdivision to annoy many botanists (e.g. Anonymous 1914). Throughout the introduction, Moss reveals a remarkable grasp of the literature, especially considering that he had only turned to this field of botany six years earlier, and that a significant part was written in German.

The completeness and detail of the text's treatment of genera meant that no reviewer was inclined to attempt a critical analysis of the entire volume. Instead most looked at the overall schemes of nomenclature used (always a thorny subject). Moss' use of lower case initial letters for the specific epithet in all cases (e.g. *Hieracium leyi*, not *Hieracium Leyi*) was in direct contravention of a recommendation of the International Botanical Congress of Vienna (held in 1905). Moss introduced this in an attempt to simplify a confusing variety of conventions, but it was seen as unnecessary by one reviewer (Anonymous 1914), who wrote of "Dr Moss, who like the rest of us, likes to have his own way and is perhaps more fortunate because more insistent in getting it".

Moss also insisted that a species subdivided into varieties should be fully so divided, rather than selecting one 'type variety', which had only a binomial. Britten (1915), editor of *Journal of botany*, considered that the logical consequence of Moss' proposal was the "objectionable . . . American innovation" of a trinomial system of nomenclature. He held that, for example, *Populus tremula* var. *glabra* was essentially no different from *Populus tremula glabra*, and that Moss was breaking "unwritten rules". However, it is clear that Moss was strongly opposed to trinomials (e.g. Moss 1915), and he accused Britten of having sunk to "a Drucian level . . . of misrepresentation".[14]

The reaction of reviewers to the text was, on the whole, positive. However, the drawings were widely criticised. Something of the delicacy of Hunnybun's drawings was lost in the reproduction. Moreover, the extremely generous page size (36 × 26 cm) was not fully utilised by Hunnybun, whose obsession with precise scale reproduction of the specimen in front of him seemed to blind him to the space wasted in drawing small plants (e.g. *Sagina boydii*, Plate 27, volume ii, where less than 10% of the page was used). He also often drew twigs or sprays overlapping unnecessarily, obscuring important features (e.g. *Salix*, volume ii). In a letter to Waller at the Press[12], Hunnybun, encouraged by his many friends, hoped for a better reaction to his drawings for the next volume, which he felt were "better and more interesting than those already published".

BETWEEN VOLUMES

In 1915, Moss and Druce had a serious disagreement occasioned by the internal politics of the Botanical Exchange Club, of which Druce was then honorary secretary-treasurer. There was widespread discontent among the members, and Moss became spokesman for the disaffected faction. In the end he was forced to issue a formal apology to Druce, which no doubt both annoyed and embarrassed Moss (Allen 1986).

By 1916 Moss was a bitterly frustrated man. The Press, financially stressed by the war, was delaying the publication of further volumes of the *Flora* (originally supposed to be issued annually). The minutes of a Business Sub-Syndicate meeting held on 12 January 1915 record that "it was agreed to proceed slowly with the *Cambridge British Flora*".

Moss' own finances were also strained. He had had problems with the Press over his share of the cost of having new plates made for volume ii, to replace those he had decided were inadequate.[15] Delay in payment had culminated in a threat of legal action if he did not pay by the end of 1914.[16] By 1916, all teaching staff in the Botany School had suffered a 10% pay cut in an attempt to keep the department solvent in the face of drastically falling student numbers.[13] Departmental salaries were partly made up of payments for courses taught, at a rate of so much per lecture or demonstration, and this element also decreased, since fewer students meant fewer classes. Moss' pay fell by about £40, a loss of 20% relative to his pre-war pay. Moss described himself as "almost on half pay" by November 1915.[14]

At this time Moss had a great desire to be involved in the War effort, but his hopes were frustrated by his age (mid-40s). He managed to be assigned to training recruits in the O.T.C., and later transferred to a munitions factory.

Moss seems to have found the writing of the *Flora* time-consuming, and manuscripts were frequently late in arriving at the Press.[17] A new contract was drawn up in January 1915, under which Moss was only to be paid the final part of the monies due to him when he delivered the relevant manuscript.[18] Prospects of promotion or of obtaining a college fellowship must have seemed remote as problems with the *Flora* mounted and student numbers fell.

In 1916 his personal problems reached their height when his marriage broke down irretrievably, and by October 1916 divorce proceedings were under way. The severity of the scandal can scarcely be appreciated from a late twentieth century viewpoint, but in the close, formal society of post-Edwardian Cambridge divorce was extremely shocking. Moss appears to have been the innocent party[19]; Mrs Wedgwood (a collector and friend of Druce (Sandwith 1954)) wrote "it is difficult for us to put ourselves into his [Moss'] position – Mrs Moss entirely deceived me, she had no marks of the seductress about her".[20]

Embittered, overworked and stressed, Moss decided to cut his losses. In November 1916 he applied for a professorship at the School of Mining in Witwatersrand (later the University of Witwatersrand).[21] The School wanted him to take up the post as soon as possible, and on 3 February 1917, a week after he had given evidence in the divorce proceedings,[22] he and his school-age daughter Beatrice set sail on the *Balmoral Castle*.[23]

A letter from Mrs Wedgwood, who seems to have delighted in transmitting gossip, suggested that Moss was considering abandoning the *Flora*; "he [Moss] would have 'chucked' the *Flora* had I not been so shocked".[24] He did not do so; instead he appointed a former student, A. J. Wilmott, then working at the British Museum (Natural History), to see volume iii through the press.[25] He was obviously still committed to the project; in a letter to Hunnybun[25] he proposed that if Wilmott did well, then by volume iv or v he would be cited as co-author. In typical style Moss wrote that "it would have been a mistake to take Wilmott as joint author to begin with. He is young, and he must have something to grow up to".[25] Letters from the period provide evidence that Moss was as authoritarian as ever, but also that Hunnybun and Wilmott dealt independently with some problems that arose.

By April 1917 Moss appears to have been feeling more relaxed. He encouraged Wilmott to "use your own discretion in amending or altering my manuscript",[26] and was dismissive of Wilmott's and

Hunnybun's fears of libel over passages in the introduction to volume iii (see below), but agreed to changes; "with 7000 miles between us, act on your own judgement".[27] Moss appears to have been dissociating himself from the project and relaxing his previous rigid control over it.

By 1918, however, the letters suggest that Moss was less happy with life in South Africa, and that he wished to return to England before his three-year contract was completed, ostensibly to oversee the *Flora*. A letter from Seward exists, expressing a disinclination to have him back.[28] Although Moss obviously still had allies who would support his return to Cambridge, Seward appears to have had no desire to employ a man who had broken a contract.

VOLUME III

In 1920, after Wilmott had found that he had taken on a much larger task than he had envisaged and after many problems with the manuscript, the Press published volume iii. Moss' role was unclear. As late as April 1919, Wilmott had to write a firm letter to Waller, saying "there will be no need to wait for proof from Prof. Moss as he finished with this volume before he left the country. He left me to finish seeing it through the press".[29] Volume iii was issued at a markedly increased cost of £6 15s 0d (volume ii had cost £2 5s 0d), and the sum allocated to expenses for each volume had almost quadrupled.

The introduction to volume iii proved more controversial than that of volume ii, since it included Moss' final shot in the argument over nomenclature that waged between him and Britten (see above). He wrote the introduction in January 1917, just before his departure for South Africa. Hunnybun believed that the draft "was written when [Moss] was rightly very irritated with Mr Britten's conduct and when he was utterly worried by the domestic troubles which have driven him from the country. You [Wilmott] and I feel profound regret at all the trouble that has come upon him and we realise that in his happier days he would have worded the paragraph very differently".[30] Hunnybun then proposed rewording the passage. The original draft introduction made by Moss is extant, and is even more vituperative than the printed version. However, the section attacking Britten was left exactly as Moss had worded it. Hunnybun wrote that "Moss would never forgive me if I asked you to modify it" and adds wistfully "why botanical differences should occasion such bitter strife is what I have never been able to comprehend".[30]

The introduction contained several direct attacks on individuals which were frowned upon by reviewers such as Rendle (1920), who regretted the fact that "to perpetuate the differences of opinion which have arisen in matters of very secondary importance detracts from the dignity which such a work should possess" and suggests that the Syndics were remiss in not exerting "fatherly censorship" over parts of the introduction.

As with volume ii, the text itself was favourably received, but the drawings were criticised, even though Hunnybun had believed them to be far superior.

THE FATE OF THE PROJECT: 1920 ONWARDS

The Press delayed further volumes until financial restraints eased, and as early as 1918 Seward was beginning to express doubts about the future of the series.[31] In 1921 Moss married a co-worker at the University of Witwatersrand and became head of his department, increasing his commitment to his new life.

By 1923, no further volumes had been published. The Press decided to have the viability of the project assessed by a committee of botanists chaired by Professor Seward, who was also a Syndic.[32] In July of that year the Press decided that the work "should not proceed under the current contract".[33]

Moss initially expressed indignation, suggesting that the Syndics were under contractual obligation to the subscribers to complete the series. This was investigated by the Press,[33] but apparently no such obligation existed, since later meetings ignore the issue. The Press eventually decided either to proceed under tighter rules (to prevent the delays in obtaining manuscripts from Moss and the continual changing of plates) or to abandon the project. After consultations with their solicitor[34] about Moss' legal rights they decided to persuade Moss either to improve or take a lump sum payment in lieu of their contractual obligations.[35] On 27 July 1923, "it was agreed to recommend that Dr Moss be offered a payment in respect of work done on unpublished volumes . . . the amount under this head not to exceed £75 in respect of any one volume; Dr Moss to be also offered the sum of £100 (to be increased to £150, if necessary) as a solatium for the non-publication of later volumes. It was further agreed to recommend that in the event of the offer not being accepted . . . the Syndics proceed with the publication under the terms of the original agreement, provided that complete copy for volume iv be delivered one year after the date of acceptance of the offer, complete copy for subsequent volumes to be similarly delivered at annual intervals".[35] Moss seems to have accepted the financial offer with little protest, although he managed to extract the maximum sum the Press were prepared to offer; "£150, plus a further sum of £80 in respect of out-of-pocket expenses, in full discharge of any claim against the Syndics in respect of the agreement for the publication of *The Cambridge British Flora*".[36]

THE TEXT OF THE PUBLISHED VOLUMES

In the introduction to volume ii of *The Cambridge British Flora*, Moss listed three aims: to register the present state of knowledge with respect to British plants, including classification, nomenclature, characteristics and distribution; to attempt to relate British plants to allied forms in foreign countries; and to stimulate further research, particularly in the areas of variation and distribution. Hunnybun[37] wrote that Moss felt that "we shall make some howlers. *The Cambridge British Flora* is merely a step forward".

Many botanists consider that *The Cambridge British Flora*, with its ambitious scope and attention to detail, is one of the best taxonomic studies of the British flora. However, it has been suggested that the volumes suffered from "elephantiasis of the format" (A. O. Chater, personal communication). Despite being incomplete, it is still invaluable for the genera treated, although modern taxonomic ideas and conventions in nomenclature, especially the increased emphasis on the type concept, together with Moss' personalised methods of citing the author-attribution in the case of hybrids, make it out-of-date for the purposes of nomenclature. Moss' interest in, and observation of, variation within species meant that his subdivisions often corresponded better to the situation seen in the field than those of previous workers. For example, in *Salix* he subdivided *S. caprea* L. into var. *genuina* Syme (lowland; now *S. caprea* var. *caprea*) and var. *sphacelata* (J. E. Sm.) Wahlenberg (Scottish Highlands).

The analytical, formal style in which critical taxonomy was treated in *The Cambridge British Flora* is even now unusual. Pioneering work on distribution mapping had been carried out on the continent, and its use in a British Flora was also a significant step forward. Moss' interests in distribution mapping date back to his earliest work in the West Riding. In *The Cambridge British Flora*, he simply recorded location, according to a scheme based on geographical counties rather than the presently-preferred vice-comital system, without considering the ecology of the plant in any detail.

The contributing authors, kept firmly in line by Moss, produced contributions of a consistently high standard. A good example is H. W. Pugsley's treatment of *Fumaria*. The account can scarcely be bettered today.

Moss' second aim of comparing British and continental botany was achieved in part by his use of the Englerian classification system that was becoming commonplace in mainland Europe. Many British botanists were parochial in outlook, but Moss was strongly influenced by several European-minded workers such as H. Gilbert-Carter and his friend and colleague A. G. Tansley. Throughout *The Cambridge British Flora*, frequent references show Moss' familiarity with both British and continental taxonomic writings.

THE ILLUSTRATIONS

Hunnybun's drawings, later to be made into plates in *The Cambridge British Flora*, were well received as works of art when they were exhibited at the Linnean Society in 1903 and Hunnybun's extensive correspondence shows that this opinion was widespread. However, Blunt (1950) considers that the drawings "well demonstrate how lifeless a figure can become when sensitivity is lacking". Although faithful to the appearance of the living plant, they are inadequate for scientific purposes, where more diagrammatic representation of key features is required. They often lack fine detail and Hunnybun's uniformly fine line and the absence of shading give no sense of texture. Hunnybun's emphasis on drawing living material often seems to have led to him drawing 'weaker' looking specimens.

As Hunnybun's health deteriorated, he became increasingly reliant on plants sent to him by his many correspondents, rather than collecting his own. The annual lists of desiderata which he sent to these collectors include detailed instructions on the packing of specimens for posting, and suggest that specimens sometimes arrived in a damaged or unusable condition. Perhaps this meant that some of his drawings were based on less than perfect material.

Botanical illustration must always be a compromise. By accentuation of key characteristics, illustrations should convey the essence of a species rather than an image of an individual. An appreciation of this important principle is lacking in Hunnybun's work. Indeed, he complained that Pugsley wished him to produce "mental concepts of what the forms of each species should be"[38] and enlargements which were "absolutely diagrammatic".[39] Hunnybun felt that his enlargements, being based on living specimens, would be of more use to the student than a diagram. However, it appears that even Moss thought little of Hunnybun's enlargements, and instructed Wilmott, who was selecting illustrations for volume iii, to "rule out any enlargements you choose; but do not, in Heavens name, consult E.W.H. [Hunnybun] about this! It is like asking a parent which of his children shall be cut in half!"[39]

THE FAILURE OF *THE CAMBRIDGE BRITISH FLORA*

Tansley, in his foreword to the first edition of the *Flora of the British Isles* (Clapham, Tutin & Warburg 1952), wrote that "a new British Flora has been a desideratum for the past half century and urgently needed during the last thirty years . . . several attempts have been made to fill the gap but none have been carried through to success". Although Tansley does not mention *The Cambridge British Flora* by name, he is likely to be commenting on the work of his friend and former colleague when he notes that earlier attempts "were all too ambitious, aiming at a completeness and exhaustiveness unattainable except through years of laborious effort *and the collaboration of a large body of specialists*" (our italics).

In our view Tansley was pointing to the major weakness in *The Cambridge British Flora* project. To judge by the two volumes that were issued, there was no scientific reason why the project should have failed, although Hunnybun's drawings might have made the *Flora* less attractive to a potential buyer. However, the long-term viability of the project was doubtful, as there is abundant evidence that many of the taxonomic specialists of the day found it difficult or impossible to work with Moss, who "when satisfied that he had reached a sound conclusion was immovable" (Crump 1931). He was also prone to dismiss other people's views with "sweeping contempt" (Tansley 1931), although he could be a firm friend to those who "accepted his frank expressions in the same northern spirit in which they were given" (F.E.W. 1931). Obsessed by the *Flora* at its outset, Moss was unable to sustain his interest in the project after his emigration to South Africa. Wilmott performed the task of seeing volume iii through the press, but with his penchant for complex schemes and subtleties (Stearn 1981) he was unsuited to the task of rallying support for continuing the project. Indeed in the early 1920s he was involved in many projects of his own, such as editing the tenth edition of the *Manual of British botany* (Babington 1922).

Thus the project died. A modern, encyclopaedic, critical Flora of Britain has yet to be written, although an attempt was made between December 1973 and January 1985 (Stace 1991).

ACKNOWLEDGMENTS

We would like to thank C. E. Scarles of the Cambridge University Press and E. S. Leedham-Green of the University Library, Cambridge, for access to archive material. Thanks are due to Dr D. E. Allen for information from the Druce archives and other helpful comments, and to P. D. Sell, R. D.

Meikle and Dr S. M. Walters for information on the scientific aspects of the *Flora*. Dr D. E. Allen, Dr J. R. Akeroyd, D. H. Kent, Dr S. M. Walters and an anonymous reviewer commented on an earlier version of this manuscript, for which we are grateful.

NOTES

1 F. J. Hanbury to E. W. Hunnybun, 12 September 1901. Hunnybun Letters (HL), Department of Plant Sciences, Cambridge University (DPS UC).
2 J. Groves to E. W. Hunnybun, 7 February 1908. HL, DPS UC.
3 Syndicate Committee Meeting Minutes, 20 January 1911. Cambridge University Press (CUP).
4 Syndicate Committee Meeting Minutes, 19 January 1912. CUP.
5 C. E. Moss to A. B. Rendle, 11 March 1912. Rendle Correspondence in Carruthers Correspondence Box 4, BM–G, British Museum (Natural History) (BM–NH).
6 E. S. Marshall to G. C. Druce, 22 February 1911. Druce papers (DP) Box 19, Department of Plant Sciences, Oxford University (DPS OU) (D. E. Allen, personal communication).
7 G. C. Druce, draft of Druce 1931. DP Box 5, DPS OU.
8 C. E. Moss to E. F. Linton, 17 June 1912. Linton Autograph Collection, BM–B, BM–NH (D. E. Allen, personal communication).
9 Syndicate Committee Meeting Minutes, 14 February 1913. CUP.
10 Business Sub-Syndicate Meeting Minutes, 11 February 1913. CUP.
11 A. C. Seward to A. R. Waller, various letters, March and April 1913. Letters from the CUP, Pr. A., Cambridge University Library (CUL).
12 E. W. Hunnybun to A. R. Waller, 14 January 1915. HL, DPS CU.
13 Professor A. C. Seward's accounts book. DPS CU.
14 C. E. Moss to A. B. Rendle, 8 November 1915. Rendle Papers (RP), BM–R, BM–NH.
15 e.g. Syndicate Committee Meeting Minutes, 21 November 1913. CUP.
16 Business Sub-Syndicate Meeting Minutes, 10 November 1914. CUP.
17 e.g. Business Sub-Syndicate Meeting Minutes, 4 November 1913. CUP.
18 Syndicate Committee Meeting Minutes, 15 January 1915. CUP.
19 Certificate of making Degree Nisi Absolute (Divorce) in the High Court of Justice (Family Division).
20 M. Wedgwood to E. W. Hunnybun, 20 January 1917. HL, DPS CU.
21 C. E. Moss to A. B. Rendle, 27 October 1916. RP, BM–R, BM–NH.
22 C. E. Moss to A. B. Rendle, 4 February 1917. RP, BM–R.
23 C. E. Moss to A. R. Waller, 4 February 1917. Letters from CUP, Pr. A., CUL.
24 M. Wedgwood to E. W. Hunnybun, 3 February 1917. HL, DPS CU.
25 Business Sub-Syndicate Meeting Minutes, 24 October 1916. CUP.
C. E. Moss to E. W. Hunnybun, 12 January 1917. HL, DPS CU.
Business Sub-Syndicate Meeting Minutes, 27 February 1917. CUP.
Syndicate Committee Meeting Minutes, 2 March 1917. CUP.
26 C. E. Moss to A. J. Wilmott, 18 April 1917. Wilmott Papers (WP), BM–W, BM–NH.
27 C. E. Moss to A. J. Wilmott, 20 April 1917. WP, BM–W, BM–NH.
28 A. C. Seward to A. R. Waller, 13 September 1917. Letters from the CUP, Pr. A., CUL.
29 A. J. Wilmott to A. R. Waller, 26 April 1919. Letters from the CUP, Pr. A., CUL.
30 E. W. Hunnybun to A. J. Wilmott, 11 March 1917. WP, BM–W, BM–NH.
31 A. C. Seward to A. B. Rendle, 17 July 1918. RP, BM–R, BM–NH.
32 Syndicate Committee Meeting Minutes, 2 April 1923. CUP.
33 Syndicate Committee Meeting Minutes, 1 July 1923. CUP.
34 Townsend to A. R. Waller, 1923, several letters. Letters from the CUP, Pr. A. T., CUL.
35 Business Sub-Syndicate Meeting Minutes, 27 July 1923. CUP.
36 Syndicate Committee Meeting Minutes, 21 September 1923. CUP.
37 E. W. Hunnybun to A. J. Wilmott, 4 March 1917. WP, BM–W, BM–NH.
38 E. W. Hunnybun to A. J. Wilmott, 28 November 1913. WP, BM–W, BM–NH.
39 C. E. Moss to A. J. Wilmott, 23 April 1917. WP, BM–W, BM–NH.

REFERENCES

Allen, D. E. (1986). *The botanists: A history of the Botanical Society of the British Isles through 150 years.* St Paul's Bibliographies, Winchester.
Anonymous. (1898). A new British Flora. *Journal of botany, London* **36**: 94–96.

ANONYMOUS. (1903). *Proceedings of the Linnean Society of London* **115th session**: 39.
ANONYMOUS. (1904). Book-notes, news, etc. *Journal of botany, London* **42**: 318–320.
ANONYMOUS. (1911). A new British Flora. *Journal of botany, London* **49**: 119–121.
ANONYMOUS. (1912). Book-notes, news, etc. *Journal of botany, London* **50**: 205–208.
ANONYMOUS. (1914). Reviews. *Journal of botany, London* **52**: 131–136.
BABINGTON, C. C. (1922). *Manual of British botany*. Gurney & Jackson, London.
BLUNT, W. (1950). *The art of botanical illustration.* Collins, London.
BRITTEN, J. (1915). Reviews. *Journal of botany, London* **53**: 252–254.
CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F. (1952). *Flora of the British Isles*. Cambridge University Press, Cambridge.
CRUMP, W. B. (1931). In memoriam: Charles Edward Moss. *The Naturalist*: 55–59.
DESMOND, R. (1994). *Dictionary of British and Irish botanists and horticulturists.* Taylor & Francis Ltd, London.
DRUCE, G. C. (1931). Moss, Charles Edward (obituary). *Botanical Society of the British Isles: Report*: 326–327.
ENGLER, A. (1898). *Syllabus der Pflanzenfamilien.* Verlag von Gebrüder Borntraeger, Berlin.
LEVYNS, M. R. (1977). *Insnar'd with flow'rs.* Botanical Society of South Africa, Kirstenbosch.
MOSS, C. E. (1904). Peat moors of the Pennines: their age, origin and utilization. *Geographical journal* **23**: 660–671.
MOSS, C. E. (1907). *Geographical distribution of vegetation in Somerset: Bath and Bridgewater district.* The Royal Geographical Society, London.
MOSS, C. E. (1913). *Vegetation of the Peak District.* Cambridge University Press, Cambridge.
MOSS, C. E. (1914). *The Cambridge British Flora.* Volume ii. Cambridge University Press, Cambridge.
MOSS, C. E. (1915). Trinomials. *Journal of botany, London* **53**: 334.
MOSS, C. E. (1920). *The Cambridge British Flora.* Volume iii. Cambridge University Press, Cambridge.
RAMSBOTTOM, J. (1931). Charles Edward Moss (obituary). *Journal of botany, London* **69**: 20–23.
RENDLE, A. B. (1920). The Cambridge British Flora. *Nature* **106**: 337–338.
SANDWITH, N. Y. (1954). Obituaries: M. L. Wedgwood (1854–1953). *Proceedings of the Botanical Society of the British Isles 1954*: 114–115.
SHEAIL, J. (1987). *Seventy-five years in ecology.* Blackwell, Oxford.
STACE, C. A. (1991). *New Flora of the British Isles.* Cambridge University Press, Cambridge.
STEARN, W. T. (1981). *The Natural History Museum at South Kensington.* Heinemann, London.
TANSLEY, A. G., ed. (1911). *Types of British vegetation.* Cambridge University Press, Cambridge.
TANSLEY, A. G. (1931). Charles Edward Moss. *Journal of ecology* **19**: 210–214.
TRAIL, W. H. (1910). The study of the British flora. *Journal of botany, London* **48**: 241–250.
W[EISS], F. E. (1931). Charles Edward Moss. *The North Western naturalist*: 34–36.
WILMOTT, A. J. (1920). E. W. Hunnybun, in Moss, C. E. *The Cambridge British Flora.* Volume iii. Cambridge University Press, Cambridge.

(*Accepted May 1994*)

Senecio vulgaris L. subsp. *denticulatus* (O. F. Muell.) P. D. Sell and *S. vulgaris* subsp. *vulgaris* var. *vulgaris* on Jersey (Channel Islands)

H. P. COMES

*Institut f. Spezielle Botanik u. Botanischer Garten, Anselm Franz von Bentzel-Weg 9, Johannes Gutenberg-Universität Mainz, 55099 Mainz, Germany**

ABSTRACT

Evidence obtained from comparative cultivation confirms that *Senecio vulgaris* subsp. *denticulatus* (Asteraceae) and its presumed derivative var. *vulgaris* differ consistently in a number of morphological and life history characters. Field studies on Jersey revealed that both taxa are also ecologically distinct. Subsp. *denticulatus* is only known from coastal areas of dune grassland where it occurs on soils which have large amounts of carbonate and low amounts of mineral nutrients. Its associates include other winter-annuals and species of Mediterranean affinity. Results obtained from soil analyses do not provide any meaningful clue to the unusual and disjunct distribution of subsp. *denticulatus* and several community associates within one of its natural maritime habitats (Les Quennevais). Some observations on the pollination strategy, seed production and predation damage of subsp. *denticulatus* are reported. In contrast to subsp. *denticulatus*, var. *vulgaris* occurs in man-disturbed inland and coastal localities throughout the island. Both taxa seem to interact along an extensive coastal hybrid zone, particularly in the disturbed area north of Les Quennevais. Progeny-analyses of both short ligulate and discoid phenotypes from Les Quennevais showed them to produce patterns of germination, phenological and leaf shape characteristics typical of subsp. *denticulatus*. It is concluded that the low nutrient-supplying power of the Quennevais area is a factor of importance in limiting the distribution of the var. *vulgaris* genotypes to areas outside Les Quennevais. Information on the former distribution of subsp. *denticulatus* on Jersey suggests that its habitat is seriously endangered from progressive destruction by man.

KEYWORDS: *Senecio vulgaris* subsp. *vulgaris* var. *hibernicus*, ecological variation, hybrid zone, adaptation.

INTRODUCTION

Senecio vulgaris L. (2n = 40) is subdivided into two subspecies, namely the type subspecies with two varieties and subsp. *denticulatus* (O. F. Muell.) P. D. Sell†. Subspecies *vulgaris* var. *hibernicus* Syme, which is distributed sympatrically with var. *vulgaris* and in its distribution largely limited to the British Isles and Ireland, appears very likely to be a recently evolved stabilized introgressant between var. *vulgaris* and *S. squalidus* (2n = 20) (e.g. Abbott 1992). This taxon will not be considered here further. Thus all comparisons reported in this paper are between *Senecio vulgaris* subsp. *denticulatus* and *Senecio vulgaris* subsp. *vulgaris* var. *vulgaris*.

Information available from cultivation experiments (Kadereit 1984a; Gilmer & Kadereit 1989) and extensive herbarium surveys (Allen 1967; Perring & Sell 1968; Kadereit 1984a) indicates that subsp. *denticulatus* and var. *vulgaris* differ conspicuously with regard to germination behaviour, life cycle, morphology and reproductive output, but also geographical distribution and habitat preference. Although no unambiguous native habitat can be delineated for the cosmopolitan weed var. *vulgaris* (Kadereit 1984a), subsp. *denticulatus* is restricted either to natural maritime habitats (dunes, sandy fields and cliffs) along the coasts of N.W. Europe, i.e. from W. France, the Channel Islands, W. and S.W. Britain, to the S. and E. coasts of Sweden (Allen 1967), or can be found in the Mediterranean area, mainly in the mountains of S. Spain and Sicily (Kadereit 1984a). In the British

*Present address: School of Biological and Medical Sciences, Sir Harold Mitchell Building, University of St Andrews, St Andrews, Fife, KY16 9TH, Scotland, U.K.
†Nomenclature follows Stace (1991) for vascular plant species.

Isles only records from Ainsdale (Merseyside) and the Channel Islands have been confirmed in recent years (Ashton 1990; Harris & Ingram 1992). Rather surprisingly, no detailed ecological study of the natural habitat of subsp. *denticulatus* is available.

The present account provides some field data on the distribution, habitat and pollination strategy of subsp. *denticulatus* in a maritime site on Jersey, Channel Islands. As var. *vulgaris* is reported to be common on Jersey (e.g. Le Sueur 1984), another objective of the present study was to investigate whether the two taxa are isolated through habitat differentiation, or whether they co-occur and hybridize.

The most conspicuous morphological character of subsp. *denticulatus*, and certainly its most reliable diagnostic character in the field, is the presence of ray florets 2·3–3·0 mm long. Ray florets are absent in var. *vulgaris*. The presence of the ray florets is under simple genetic control of the 'ray floret locus', with subsp. *denticulatus* homozygous for the R allele, discoid plants of var. *vulgaris* homozygous for the r allele and short ligulate hybrids between both taxa heterozygous (Trow 1912; Comes 1994). Other less reliable field characters are the rather dense arachnoid indumentum, leaf shape characteristics (Allen 1967) and an irregular achene indumentum (Gilmer & Kadereit 1989). Plants of subsp. *denticulatus* differ further from var. *vulgaris* in showing pronounced seed dormancy, which also seems to be regulated by one major gene (Kadereit 1984a). Recently, however, Ren & Abbott (1991) reported the presence of innate seed dormancy in var. *vulgaris* from the Mediterranean area. The authors concluded that this feature probably evolved in adaptation to the climatic conditions of heavy winter rains and severe summer drought, and enables this taxon to grow as a 'typical Mediterranean' winter annual. Given the putative Mediterranean origin of subsp. *denticulatus* (Kadereit 1984b), the same explanation was previously put forward by Kadereit (1984a) to account for the presence of both these characters, seed dormancy and winter annual life cycle, in subsp. *denticulatus*. The distinctness of subsp. *denticulatus* from var. *vulgaris* is further emphasized by its substantially prolonged time of vegetative growth, first noticed by Trow (1912, 1916) and later by Kadereit (1984a), and its potentially smaller reproductive output under standard conditions in the greenhouse (Kadereit 1984a).

On Jersey, field studies were primarily focused on the sand dune system of St Ouen's Bay at the western end of the island, and in particular on the widest part of the dunes in the south, known as Les Quennevais. In this area, initial observations revealed that subsp. *denticulatus* becomes exceedingly rare c. 200 m away from the shore, but is present again 1,000 m or more farther inland. Since the Quennevais area is well-known for remarkable changes in soil pH and carbonate values (Böcher 1954; Ranwell 1975), a study was designed to investigate the distribution of subsp. *denticulatus* and its associated vegetation in relation to soil types along a transect, roughly coinciding with Ranwell's (1975) main study transect. Soil samples from outside this area were also analysed.

As I encountered discoid plants within the habitat of subsp. *denticulatus* which could not be assigned to either taxon using morphological criteria, a comparative cultivation experiment was designed to determine whether these variants exhibit (i) innate seed dormancy, (ii) a substantially slower speed of development and (iii) a smaller reproductive capacity than typical plants of var. *vulgaris* from Jersey and, as a control, var. *vulgaris* from the Botanic Garden, Mainz University (Germany).

MATERIALS AND METHODS

FIELD WORK

Studies on Jersey were carried out between 13 and 19 May 1992. Following Ranwell's terminology (1975), the transect area on Les Quennevais (Fig. 1a), ranging from the seawall south of the slipway at Le Braye to the inland limit of the dune system south of the enclosed valley below Ville des Quennevais (c. 1·6 km), was classified into four zones of landscape structure according to distance from the shore: 1. the coastal dune area (0–c. 100 m); 2. the dune plain (100–700 m); 3. the plateau scarp (700–1000 m); and 4. the plateau dunes including the crestline (1000–1600 m). Within 300 m distance from the shore, the number of plants of *S. vulgaris* was determined in 2 m × 2 m sampling areas at regular 2 m intervals. Beyond 300 m inland, only plants were counted that were found by walking over the terrain towards the plateau scarp, and to the plateau height (c. 1025 m inland).

Along the transect, it was impossible to distinguish between subsp. *denticulatus* and short ligulate plants identified as probable hybrids between subsp. *denticulatus* and var. *vulgaris*. Any attempt to quantify differences in ray floret length certainly would have resulted in confusing putative hybrids with small individuals of subsp. *denticulatus* bearing small ray florets. Accordingly, all radiate plants have been referred to as subsp. *denticulatus*. At various patches near the transect, however, in particular adjacent to rabbit faeces, plants grew larger. In those places, therefore, individuals could be classified according to their ray floret length as subsp. *denticulatus* (> 2 mm) and putative hybrids (<2 mm).

Seven soil samples were taken along the transect (sites 1–7), and five samples were collected from surrounding localities (sites 8–12) by removing soil to a depth of c. 6 cm (Fig. 1a,b). Soil samples were allowed to air dry, and subjected to chemical analysis by the Landwirtschaftliche Untersuchungs- und Forschungsanstalt at Speyer (Germany). The pH, percent organic matter, free carbonate, total nitrogen and extractable forms of magnesium (Mg) were determined for all samples, while extractable forms of phosphorus (P_2O_5), potassium (K_2O) and boron (B) were only analysed for samples 1–5. At all sites along the transect records of associated vegetation were made.

OBSERVATION OF PUTATIVE POLLINATORS

Observation of insects was carried out in two natural stands at St Ouen's Bay; stand 1 was situated in a mobile Marram (*Ammophila arenaria*) dune just behind the sea wall south of Le Braye slipway (near site 1 in Fig. 1a), and the other, stand 2, next to the bunker at La Tête du Nièr Côte (at site 10). Stand 1 was monomorphic for *Senecio vulgaris* subsp. *denticulatus*, while stand 2 contained a few short ligulate plants which appeared to be hybrids. Stand 1 consisted of 156 plants which were evenly scattered throughout the observation area. Plants were (5–)9–12(–18) cm tall and mostly had one to three open capitula. Stand 2 included much larger (up to 20 cm), often basally branched individuals with up to 30(–40) open capitula. Approximately 70 individuals (20–30 individuals/m^2) were distributed in several patches. On 18 May 1992, the flight sequences of all insect pollinators entering the observation area were recorded between 12.30 p.m. and 2.00 p.m. (stand 1) and 3.30 p.m. and 5.30 p.m. (stand 2).

COMPARATIVE CULTIVATION

Seed material (achenes) for comparative cultivation, including a germination experiment, was derived from each of eight individuals of subsp. *denticulatus* (in the following referred to as A1–A8), seven individuals of unidentified discoid plants (B1–B7), three individuals of short ligulate plants identified as probable hybrids between the two taxa (C1–C3) and eight individuals of var. *vulgaris* (D1–D8) collected in various locations around the coastal plain at St Ouen's Bay, the neighbouring Ouaisné Common, as well as interior waste ground or agricultural sites at the eastern landward edge of St Ouen's Bay. Between 14 and 19 May 1992 seed material was either directly harvested in the field, or, at the end of May, carefully removed from fruiting plants which had been pressed as herbarium specimens. In addition, achenes were collected from eight individuals of var. *vulgaris* (E1–E8) in the Botanic Garden, Mainz University, on 31 May 1992. Collecting codes of seed parents are used throughout the text to refer to their respective greenhouse progenies and are listed in Table 1. Collecting sites are also included, and their numbers refer to locations illustrated in Fig. 1a,b.

For a test of seed dormancy, samples of five achenes per seed parent were sown on five dates between 31 May and 8 September 1992 in 5 cm plastic pots filled with Frühstorfer Erde, Typ P, and were kept moist during the entire experiment. Germination was recorded daily over a period of 160 days from first sowing.

At 27, 50 and 72 days following first sowing, a variable number of seedlings (as available) from each of the five accessions (A–E) were transplanted individually into 8 cm diameter plastic pots filled with sterilized compost. On any one day, only samples that had germinated during the previous 20 days were transferred. A total of 154 plants, representing between one and nine offspring from each of the seed parents listed in Table 1 except A2, A5, A6, A8 and C3, were grown to first fruiting under a natural light regime in an unheated greenhouse at the Botanic Garden, Mainz University. As the experiment approached the winter period, plants were transferred to a heated greenhouse with supplemental lighting provided by incandescent lamps (16 hour day), and temperatures at 20 °C day / 15 °C night. Conditions were maintained this way until the end of the experiment on 21 January 1993.

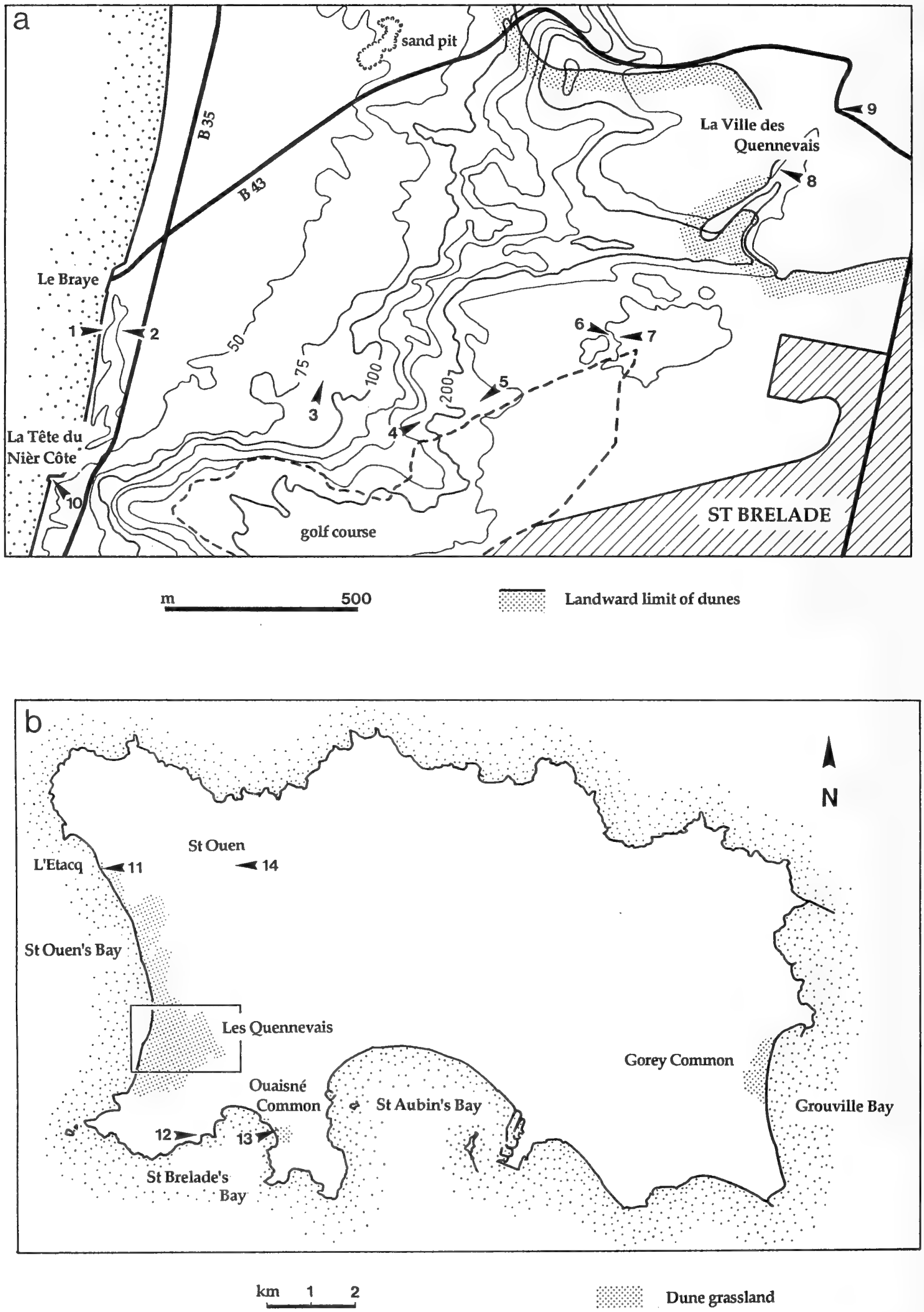


FIGURE 1. a. Topographic location of study sites on Les Quennevais (sites 1–7) and adjacent areas (sites 8–10). Based on the 1:25,000 States of Jersey Official Map, 1988; additional information on contours and sand pit outline compiled from the 1:25,000 Geological Survey Map, Jersey, 1982. Heights are in feet above M.S.L. based on a bench mark at St Helier Harbour, Jersey, of 29·9 feet (= 9·1 m). Built-up area hatched.
b. Map of Jersey showing the location of four study sites (11–14) outside the research area (outlined). The distribution of extant dune grassland (Le Sueur 1984) is indicated.

TABLE 1. COLLECTING SITES AND COLLECTING CODES OF SEED PARENTS OF *SENECIO VULGARIS* FROM WHICH EXPERIMENTAL PROGENIES WERE GROWN

Collecting site	Subsp. *denticulatus*	Unidentified discoid plants	Putative hybrids	Var. *vulgaris*
COASTAL PLAIN AT ST OUEN'S BAY, JERSEY				
Dune behind seawall, near waste ground, L'Etacq (11)		B1*, B2*		
Les Quennevais, coastal dune and dune plain south of slipway at Le Braye, 10–100 m inland from the shore (1/2)	A1*, A2, A3*, A4*, A5	B3*, B4*	C1*	
Les Quennevais, plateau dunes, c. 1320 m inland from the shore (6)	A6	B5*, B6*	C2*	
On sandy soil near bunker, La Tête du Nièr Côte (10)	A7*		C3	D1*
OUAISNÉ COMMON, JERSEY				
Coastal dune belt, Ouaisné Common (13)	A8	B7*		
INTERIOR SITES AT THE LANDWARD EDGE OF ST OUEN'S BAY, JERSEY				
Wayside in the valley below Ville des Quennevais (8)				D2*
Arable field, St Brelade (9)				D3*
Waste ground, St Ouen (14)				D4*–D8*
BOTANIC GARDEN, MAINZ UNIVERSITY, GERMANY				E1*–E8*

* Seed parents used both in the germination and the comparative cultivation experiment; numbers in brackets refer to locations in Fig. 1.

STATISTICAL ANALYSES

During the experiment, plants were examined for the phenological, vegetative and reproductive characters listed in Table 2. Means and standard errors for each character were computed. Multiple comparisons of group means were made using Tukey's test (VMS Version of SAS Release 6.07), considered appropriate for unequal sample sizes (Sokal & Rohlf 1981; SAS Institute Inc. 1988), and were evaluated at the 1% significance level. In order to represent interrelationships among groups graphically, the data were also subjected to canonical variate analysis (C.V.A.) (Reyment *et al.* 1984; Reyment 1991). Character LRAY (length of ray floret) was excluded from the C.V.A. because the character was known a priori to distinguish some of the accessions. The C.V.A. was carried out using the SAS procedure CANDISC (VMS Version of SAS Release 6.07). This procedure also computes both Hotelling's multivariate T^2-test, which tests the hypothesis that the canonical means of the groups are equal, and Mahalanobis' distances (D^2) between canonical means of groups.

RESULTS

DISTRIBUTION AND HABITAT

Senecio vulgaris subsp. *denticulatus* was only found in Jersey on two dune systems, namely Ouaisné Common and the coastal stretch along St Ouen's Bay with the largest and deepest dune system in the south, known as Les Quennevais (Fig. 1a,b). Jersey's third area of dune grassland, Gorey Common, at the eastern end of the island, was not visited. All populations seen in inland areas were var. *vulgaris*. By contrast, plants of subsp. *denticulatus*, putative hybrids, unidentified discoid plants

TABLE 2. CHARACTERS SCORED IN THE COMPARATIVE CULTIVATION EXPERIMENT OF *SENECIO VULGARIS*

Character	Abbreviations
Determined by the daily inspection of all plants:	
1. Days from germination to formation of first buds	BUD
2. Days from first buds to first anthesis	BA
3. Days from germination to first anthesis	ANTH
4. Days from anthesis to first fruiting	AF
5. Days from germination to first fruiting	FRUIT
Measured at the time of first fruiting:	
6. Stem height (cm) from soil surface to base of apical capitulum	STH
7. Number of capitula and buds	NCAP
8. Length (mm) of ray floret[a]	LRAY
9. Number of achenes per apical capitulum	NACH
10. Number of unfertilized ovules per apical capitulum	NUNFO
11. Number of florets per apical capitulum	NFLORET (=NACH+NUNFO)
12. Reproductive potential	REPRO (=NCAP×NACH)

[a] Only subsp. *denticulatus* and putative hybrid progenies.

and var. *vulgaris* grew in mixtures of varying composition in various places in the man-disturbed area north of Les Quennevais. This area, however, was not explored extensively. Near to plants of subsp. *denticulatus* found on Ouaisné Common was an extensive population of var. *vulgaris* growing at a building site. However, no putative hybrids were found in the latter location.

Particular attention was paid to the Quennevais area, where subsp. *denticulatus* characteristically grows either on seaward facing slopes of mobile coastal dunes dominated by Marram, and additionally characterized by *Phleum arenarium*, or grows abundantly as a component of an open turf vegetation, called fixed calcareous dune vegetation by Böcher (1954), which follows a little farther away from the coastal dune area. Common associates here are bryophytes and small herbaceous plants like *Myosotis ramosissima* and *Saxifraga tridactylites*, and plants of essentially Mediterranean affinity like *Lagurus ovatus*, *Mibora minima* and *Viola kitaibeliana*.

RELATIONSHIP OF PLANT FREQUENCIES TO SOIL PARAMETERS AND ASSOCIATED VEGETATION

The frequency distribution of plants of *Senecio vulgaris* subsp. *denticulatus*, including six unidentified discoid plants, in relation to the (approximate) topographic location of study sites 1–7 is illustrated in Fig. 2. It is evident that the frequency of plants of subsp. *denticulatus* declines dramatically beyond 200 m distance from the coast, with plants becoming extremely rare over most part of the dune plain and along the plateau scarp, an area c. 800 m wide. Surprisingly, plants of subsp. *denticulatus*, short ligulate hybrids and unidentified discoid plants were abundant again on the plateau dunes (beyond c. 1025 m inland from the shore), extending as far as the inland limit of the dune system. This observation, however, was not documented in detail. Abundance of *S. vulgaris* on the plateau dunes, nonetheless, might be exemplified by 97 individuals recorded in one subjectively chosen 1 m^2 quadrat at c. 1345 m distance from the shore (site 7, Fig. 1a), comprising 53 plants of subsp. *denticulatus*, 32 short ligulate hybrids and twelve unidentified discoid plants. This exceeded the density of plants found in the coastal dune area, where in a 3 m × 2 m sampling unit outside the transect area, c. 50 m inland from the shore, 105 radiate, eight intermediate and two discoid plants were counted among a total of 115 plants.

Soils of all sites from Les Quennevais have high pH and also high carbonate values (Table 3). In general, they are low in organic matter, total nitrogen, and, as far as analysed, all minerals including boron, magnesium, phosphorus and potassium. Also, it is evident that soil pH is largely similar in all soil samples analysed. One of the plateau dune sites (7), where vegetation cover of subsp. *denticulatus* was exceptionally high (see above), is more similar to the densely covered coastal open turf site (2) than to any other site analysed, including the second plateau site (6) nearest to it. This

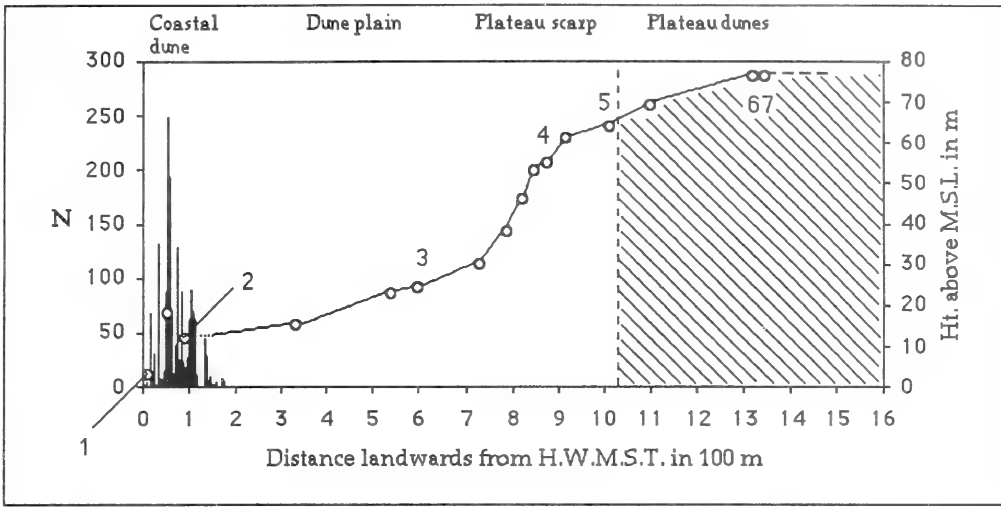


FIGURE 2. Frequency distribution of subsp. *denticulatus* (including six unidentified discoid plants) in relation to the approximate topographic location of study sites 1–7 on Les Quennevais. Note that the area c. 1025 m and more farther inland from the shore (hatched) harbours large populations of subsp. *denticulatus*, short ligulate hybrid, and unidentified discoid plants (not mapped in detail). Numbers correspond to sampling sites shown in Fig. 1a. N = number of individuals.

relates to higher amounts of organic matter and total nitrogen, as well as to lower levels of carbonate content, indicating a great amount of small scale variation of these edaphic factors across the transect zone. The results from the soil analyses reveal no distinct signs of leaching on the plateau dunes farthest east, thus confirming previous results obtained by Ranwell (1975).

Table 4 lists the species recorded in the area around the seven soil sampling sites on Les Quennevais. Among those plant species which were found to show a disjunct pattern of distribution along the transect similar to that observed in subsp. *denticulatus*, i.e. being present in the coastal area (sites 1 and 2) and on the plateau dunes (6 and 7), but virtually absent from most parts of the dune plain and the plateau escarpment (3–5), were *Honkenya peploides*, *Phleum arenarium*, *Saxifraga tridactylites* and *Viola kitaibeliana*. In contrast, other taxa, for example *Euphorbia portlandica*, *Mibora minima* and *Myosotis ramosissima*, were present along the entire transect. Chemical analysis, however, makes clear that the remarkable pattern of disjunct distribution exhibited both by *Senecio vulgaris* subsp. *denticulatus* and its four community associates is not reflected by the soil parameters (Table 3).

As regards the surrounding localities (Fig. 1a,b), the bunker site at La Tête du Nièr Côte (10), closest to Les Quennevais, harboured plants of subsp. *denticulatus* and putative hybrids, but also a single individual of var. *vulgaris* in a sheltered and shaded place nearby. This site is edaphically most similar to Les Quennevais, except for the lack of carbonate (Table 3), and, apart from *Armeria maritima*, has a rather similar set of species associates (not recorded in detail). In contrast, the seawall site near waste ground at L'Etacq (11), where scattered unidentified discoid plants of *Senecio vulgaris* were found, is the most unusual of all sites at St Ouen's Bay because it has relatively high amounts of organic matter, nitrogen and carbonate, and extremely high amounts of magnesium. Both localities are of high pH, similar to values found on Les Quennevais. The two interior sites (8 and 9), typical for var. *vulgaris*, are characterized by lower pH values than all sites at St Ouen's Bay, and have relatively high amounts of organic matter and nitrogen, but these values are lower than those found at L'Etacq. Carbonate is absent from both of these interior sites. In the maritime site at Beau Port (12) *S. sylvaticus* occurred profusely, but no plants of *S. vulgaris* were found. This certainly reflects an edaphic composition which is virtually intolerable for the latter species with respect to high levels of soil acidity, soil compactness, and, probably, nitrogen content (Table 3).

TABLE 3. RESULTS OF SOIL ANALYSES AND LOCATION OF SOIL SAMPLES COLLECTED BETWEEN 16 AND 18 MAY 1992 ON LES QUENNEVAIS (1–7) AND SURROUNDING LOCALITIES (8–12) ON JERSEY (CHANNEL ISLANDS)

Topographic location/ soil components	1 Coastal dune, south of Le Braye, mobile seaward facing slope	2 Coastal dune, south of Le Braye, open turf	3 Dune plain, stable landward site	4 Plateau scarp, semi stable slope dunes	5 Plateau scarp, footpath in low/medium shrub	6 Plateau stable dunes
Distance from H.W.M.S.T. (m)	10	50	595	875	1010	1320
Elevation (m above M.S.L.)	3	12	24	55	64	76
Presence of *S. vulgaris*	d	d,h	–	–	(d rare)	d,h,u
pH $H_2O/CaCl_2$	7·7/6·9	7·5/6·9	7·3/7·0	7·4/7·0	7·4/7·0	7·7/7·1
% OR	0·28	1·43	0·64	0·58	0·28	0·34
$CaCO_3$ (%)	3·3	2·7	3·1	3·3	3·3	4·2
N (%)	0·00	0·04	0·00	0·01	0·00	0·00
B	0·16	0·28	0·28	0·34	0·38	–
Mg	4/A	4/A	4/A	2/A	2/A	3/A
P_2O_5	3/A	3/A	2/A	2/A	4/A	–
K_2O	4/A	7/A	5/A	4/A	5/A	–

TABLE 3. *Continued.*

Topographic location/ soil components	7 Plateau stable dunes	8 Wayside in the valley below Ville des Quennevais, woodland	9 Arable field, St Brelade	10 On sandy soil nr. bunker, La Tête du Nièr Côte	11 Dune behind sea wall, adjacent to waste ground, L'Etacq	12 Maritime rocks, Le Beau Port
Distance from H.W.M.S.T. (m)	1345	1625	1740	0	0	50
Elevation (m above M.S.L.)	76	68	73	12	6	30
Presence of *S. vulgaris*	d,h,u	v	v	d,h, (v rare)	u	–
pH $H_2O/CaCl_2$	7·3/6·8	6·9/5·9	6·6/6·0	7·5/6·6	7·5/7·0	5·8/3·6
% OR	1·34	3·22	3·82	1·07	9·46	31·72
$CaCO_3$ (%)	2·2	0·0	0·0	0·0	15·9	0·0
N (%)	0·05	0·13	0·23	0·00	0·23	1·06
B	–	–	–	–	–	–
Mg	4/A	15/C	9/B	6/B	36/D	28/D
P_2O_5	–	–	–	–	–	–
K_2O	–	–	–	–	–	–

Notes: Letters indicate the presence of *Senecio vulgaris* as follows: d – subsp. *denticulatus*; v – var. *vulgaris*; h – putative hybrids; and u – unidentified discoid plants. Numbers of collecting sites correspond to numbers shown in Fig. 1. Soil parameters abbreviations as follows: percentage organic matter (% OR); percentage calcium carbonate ($CaCO_3$); total soil nitrogen (N); boron (B) in mg/kg dry weight soil; magnesium (Mg), phosphorus (as P_2O_5) and potassium (as K_2O) in mg/100 g dry weight soil. Content abbreviations: A = low, B = medium, C = very high, D = extremely high.

TABLE 4. VEGETATION ASSOCIATED WITH *SENECIO VULGARIS* AT SITES 1–7 IN JERSEY (CHANNEL ISLANDS)

Records from the adjacent sites 6 and 7 are pooled for comparison.

	Sites					
Taxa	1	2	3	4	5	6 and 7
Ammophila arenaria	+	+		+	+	+
Bellis perennis		+				
Calystegia soldanella	+					
Cerastium sp.						+
Cerastium diffusum		+		+		
Cerastium semidecandrum	+					
Cladonia rangiformis			+	+		
Claytonia perfoliata					+	
Crataegus monogyna					+	
Dactylis glomerata					+	
Eryngium maritimum	+					
Euphorbia portlandica		+	+	+		+
Fumaria muralis					+	
Galium verum						+
Geranium sp.					+	
Geranium molle		+				
Honkenya peploides†	+					+
Juncus sp.		+				
*Lagurus ovatus**	+	+				
*Mibora minima**		+	+	+		+
Myosotis ramosissima	+	+	+			+
Oenothera stricta				+		
Phleum arenarium†	+					+
Plantago maritima		+				
Pinus pinaster				+		
*Quercus ilex**				+	+	
Quercus robur						+
Ranunculus bulbosus		+		+		
Rosa pimpinellifolia		+	+	+		+
Rubus fruticosus agg.	+					
Saxifraga tridactylites†	+	+				+
Senecio vulgaris subsp. *denticulatus*†	+	+			(+)	+
Silene nutans			+	+		+
Trifolium occidentale		+				
Ulex europaeus			+			+
Vicia sativa		+	+		+	+
*Viola kitaibeliana**†		+				+

Notes: Taxa are indicated as + = present or (+) = rare. Taxa of Mediterranean affinity are marked * and those showing a pattern of disjunct distribution along the transect are indicated by †.

OBSERVATION OF PUTATIVE POLLINATORS

Within each of the two natural stands at St Ouen's Bay, flies were the most frequent visitors of subsp. *denticulatus* during the observation periods. Members of the family Sarcophagidae (*Sarcophaga dissimilis* Meigen) were caught and identified within stand 1. These flies showed a remarkable preference for the ray florets; systematically manipulating these florets one after the other possibly for nectar extraction, they often moved in a circle on the capitulum, largely neglecting the inner disc florets. Flies of the family Anthomyiidae were taken from stand 2. Though specimens attracted by the decaying *Fucus* tidal litter on the nearby shore were also members of the same family (Anthomyiidae), they were clearly a different species (P. Kirby, pers. comm., 1993).

Table 5 gives the number and the flight movements of insects in terms of number of plants visited during a flight sequence recorded within each of the two stands. The total number of insects

TABLE 5. OBSERVED NUMBER OF PUTATIVE POLLINATORS VISITING ONE TO FIVE DIFFERENT PLANTS OF *SENECIO VULGARIS* SUBSP. *DENTICULATUS* IN TWO NATURAL STANDS AT ST OUEN'S BAY, JERSEY

	No. of plants visited during flight sequence				
Stand	1	2	3	4	5
1	4	10	0	2	1
2	3[a]	2[b]	0	0	0

[a] Including one unidentified syrphid fly.
[b] Flights between long rayed plants.
Stand 2 harboured several short ligulate hybrids.

(including one syrphid fly) visiting stand 1 and stand 2 was 17 and 5, respectively. Mean number of plants visited per putative pollinator was 2·2 (stand 1) and 1·4 (stand 2).

Discrimination by flies in favour of the long rayed plants of *Senecio vulgaris* subsp. *denticulatus* in comparison to short ligulate hybrids was observed in stand 2, where both transitory flights occurred between long rayed individuals. The observation that long rayed plants were more attractive to insects than intermediate and discoid plants, was also made in a 12 m^2 mixed stand on the plateau dunes that was observed on 14 May 1992 for a windy one-hour period (2.30 p.m.–3.30 p.m.). This stand also comprised unequal numbers of radiate, intermediate and discoid plants of nearly equal height ((7–)17–21 cm) in an approximate ratio of 5:3:1. During this time, one unknown insect visited preferentially three long rayed plants during a flight sequence.

Outside observation periods, *Psilothrix viridicoeruleus* Fourcroy, a small beetle of the Melyridae family, was frequently seen visiting the capitula of *Senecio vulgaris* subsp. *denticulatus* in the dunes, not only foraging on pollen but probably also feeding on the ray florets, which often showed marked signs of damage.

A fly seen visiting var. *vulgaris* in the valley below Ville des Quennevais was *Siphona geniculata* De Geer (Tachinidae) which is a well-known and often abundant flower-visiting fly, with a strong preference for yellow composites (P. Kirby, pers. comm., 1993). Evidently it does not belong to the most frequently observed species of flies visiting *Senecio vulgaris* subsp. *denticulatus* at St Ouen's Bay.

SEED PRODUCTION AND PREDATION DAMAGE

The percentage seed set of subsp. *denticulatus* was recorded in a sample of 17 individuals chosen randomly from the area south of the slipway at Le Braye. Care was taken to collect capitula that had not shed their achenes. The proportion of well-developed achenes found within one capitulum of each plant examined averaged 88·0% and ranged between 48·8 and 98·2%. In the field, there was no indication of any impediment for setting seed under natural conditions, including plants identified as putative hybrids.

As indicated by decapitated, fruiting capitula which were often found lying near the base of the parent plant, achenes of subsp. *denticulatus* seem to be predated even before the time of seed dispersal. Birds are likely to be the predators, as small flocks of goldfinches have been reported to feed on subsp. *denticulatus* (Le Sueur 1976). In addition, subsp. *denticulatus* obviously suffers from grazing by herbivores (probably rabbits) which clip the main axis of the plants and thus affect their branching pattern by inducing the growth of lateral shoots from near the base.

GERMINATION BEHAVIOUR AND COMPARATIVE CULTIVATION

In the course of comparative cultivation, including the germination experiment, it became strikingly evident that in regard to the offspring of discoid plants only progeny of the unidentified discoid parent individuals from the Quennevais area (B3–B6) showed characteristics typical of subsp. *denticulatus*, while offspring of discoid plants from outside this area (B1, B2 from L'Etacq and B7 from Ouaisné Common) proved to be typical var. *vulgaris*. Taking account of the distinctiveness of progenies B1, B2 and B7 on the one hand, and B3–B6 on the other, as will be demonstrated below, results are presented separately. For all groups analysed, data were pooled over families for comparison.

The results of the seed dormancy experiment are illustrated in Fig. 3. Rather unexpectedly, no pronounced dormancy pattern was recorded for achenes of subsp. *denticulatus* from Les Quennevais, La Tête du Nièr Côte and Ouaisné Common. The minimum time required for germination was only 23 days after first sowing in this taxon. This was followed, however, by a period of continuous germination, which extended over 79 days. Thus, although a few achenes (all produced by parent individuals A1 and A3) germinated within four weeks from first sowing, a greater proportion of subsp. *denticulatus* achenes exhibited a pattern markedly skewed towards later germination, thus showing various degrees of dormancy. While cumulative percentages of total germination largely remained constant over all five successive dates of sowing, time to initial germination and time to final germination decreased from 23 (27) to 10 days and from 102 to 30 days after sowing, respectively. Hence, partial seed dormancy, though obviously present in subsp. *denticulatus*, had been completely lost by the last date of sowing (8 September 1992), i.e. after 14 week's storage at room temperature. There was no seed dormancy in var. *vulgaris* from the coastal site at La Tête du Nièr Côte and interior inland sites of Jersey, as well as from Mainz Botanic Garden. Independent of the date of sowing, the majority of seedlings emerged within 10 days (Fig. 3e,f). Of the achenes of unidentified discoid parent individuals, accessions from L'Etacq (B1 and B2) and the dune grassland on Ouaisné Common (B7) showed a pattern similar to var. *vulgaris*, although synchronization was less apparent during the first two dates of sowing (Fig. 3b). In contrast, achenes produced by unidentified discoid plants from Les Quennevais (B3–B6) and putative hybrids from the same location and La Tête du Nièr Côte (C1–C3) largely followed the germination pattern of subsp. *denticulatus* (Fig. 3c,d). Both differed from subsp. *denticulatus*, however, in that the discoid plants from the Quennevais showed a more rapid initial germination within the first four weeks following first sowing (mainly caused by achenes produced by parent individuals B3 and B4), while, in the case of the putative hybrids, storage at room temperature for 14 weeks was less effective in inducing more rapid and synchronizing germination.

Turning to the results of the cultivation experiment (Table 6), it was evident that subsp. *denticulatus* differed significantly (at the 1% level) from both accessions of var. *vulgaris* in taking a substantially longer time for each developmental stage analysed, and producing more florets per capitulum containing more unfertilized ovules. Number of achenes per capitulum and potential reproductive output, however, were not significantly different for the three groups. With regard to the two vegetative characters stem height and number of capitula (including buds), it was evident that only plants of var. *vulgaris* from Jersey performed similarly to subsp. *denticulatus*.

The two accessions of var. *vulgaris* also differed from each other in several phenological and vegetative characters. Plants from Jersey took approximately eleven days longer to complete their life cycle due to differences in the time from germination to first buds, were taller in stature, and – as was indicated by complete leaf collections of representative plants – produced more leaves along the main stem than var. *vulgaris* from Germany. The major morphological difference between both populations was leaf shape. Fig. 4c,d illustrates that the middle and upper cauline leaves of var. *vulgaris* from Jersey were more deeply divided, with conspicuously dentate lobes.

As regards the unidentified discoid accessions, progeny from L'Etacq and Ouaisné Common (B1, B2 and B7) were virtually indistinguishable from var. *vulgaris* from La Tête du Nièr Côte and interior sites in most characters, including leaf shape. The only exceptions were number of florets and number of achenes per capitulum, which were significantly higher in the former, although no differences were recorded for potential reproductive output. Conversely, progenies of both unidentified discoid parent plants (B3–B6) and putative hybrid individuals (C1 and C2) from Les Quennevais were generally closer in mean to each other and to subsp. *denticulatus*. In addition, all three groups had similar leaf shape characteristics, as shown in Fig. 4a,b, and were strikingly arachnoid. However, most developmental stages of the unidentified discoid plants from Les Quennevais were significantly shorter than those of subsp. *denticulatus*, though the differences were small.

Canonical variate analysis (C.V.A.) was conducted for the purpose of illustrating the interrelationships among accessions, and in particular to investigate the distinctiveness of both groups of unidentified discoid plants. Since the two groups were obtained a priori by visual impression during cultivation, there remains the possibility that differences between both groups

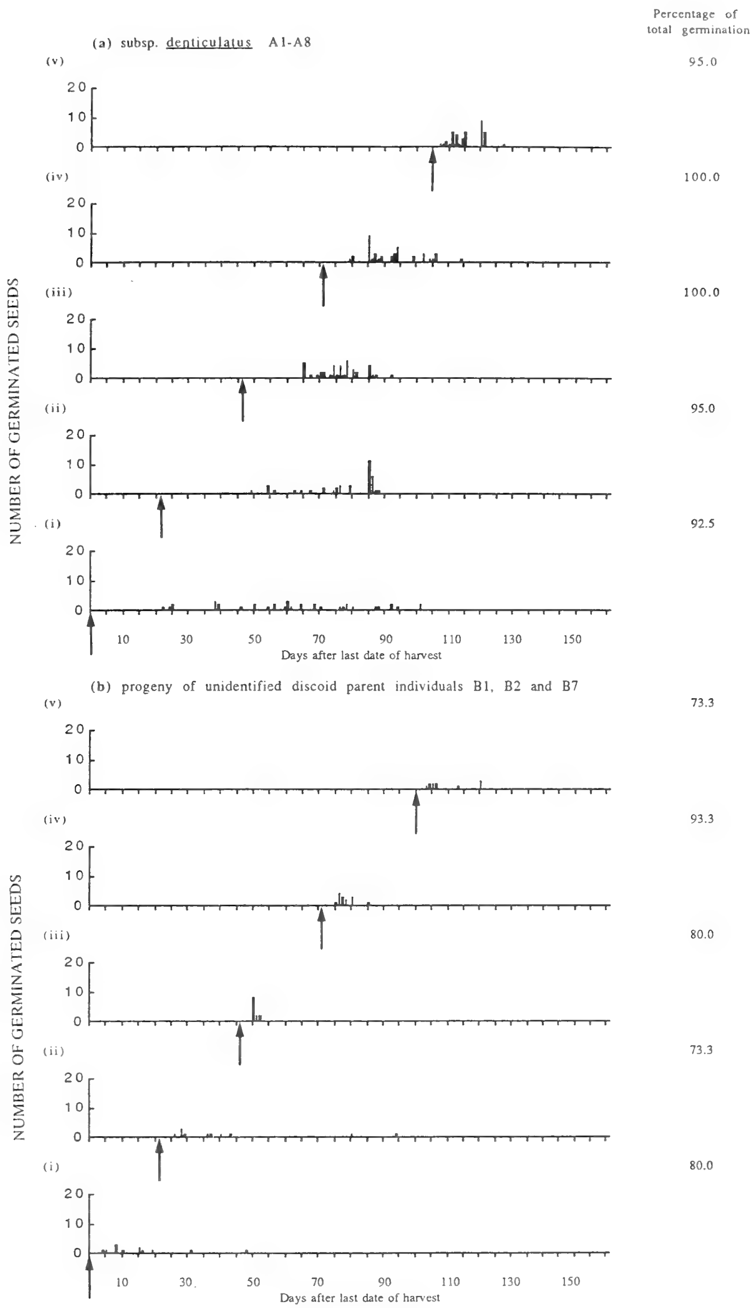


FIGURE 3. The germination behaviour of achenes of: (a) subsp. *denticulatus* (A1–A8); (b) unidentified discoid plants (B1, B2 and B7); (c) unidentified discoid plants (B3–B6); (d) putative hybrids (C1–C3); (e) var. *vulgaris*, Jersey (D1–D8); and (f) var. *vulgaris*, Germany (E1–E8). Achenes collected between 14 and 31 May 1992 were sown on five dates following the last date of harvest: i. 31 May, ii. 22 June, iii. 17 July, iv. 10 August, v. 8 September 1992. Arrows indicate the date of sowing. Also presented are percentages of total germination.

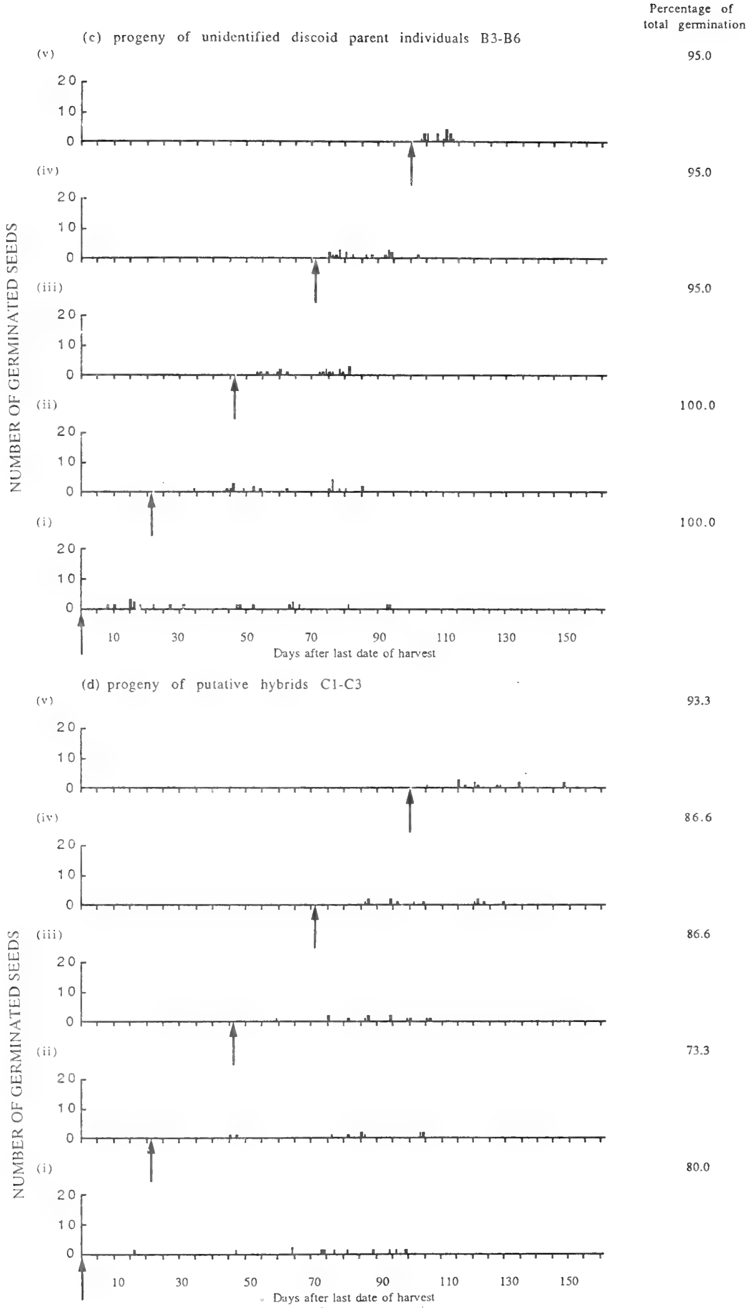


FIGURE 3. *Continued*.

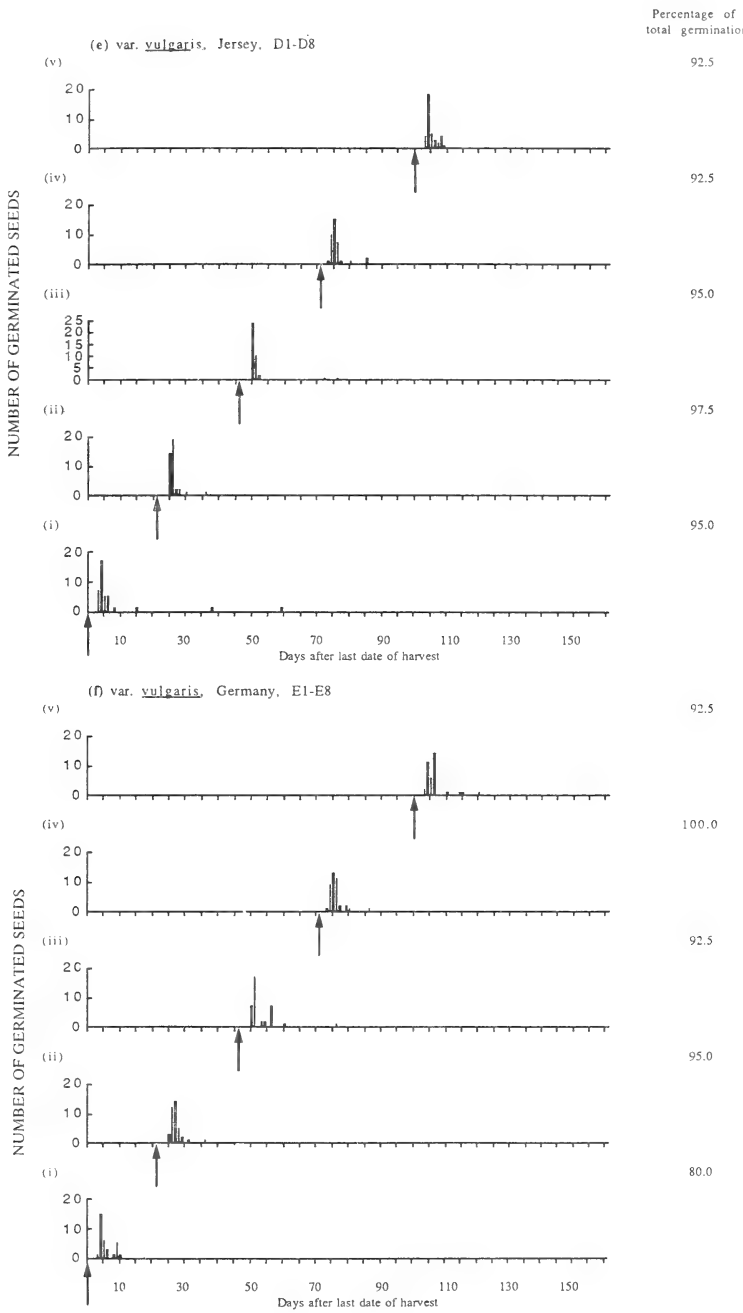


FIGURE 3. *Continued.*

TABLE 6. MEANS AND STANDARD ERRORS (S.E.) FOR CHARACTERS OF *SENECIO VULGARIS* RECORDED FROM PROGENY PLANTS CULTIVATED

The results of multiple comparisons of group means using Tukey's test (VMS Version of SAS Release 6.07) are given except for the hybrid progeny due to small sample size. Sample means for any character with the same superscript are not significantly different at the 1% level. Abbreviations of characters as in Table 2. N = sample size.

	1. Subsp. *denticulatus* (A1, A3, A4, A7)			2. Unidentified discoid plants (B1, B2, B7)			3. Unidentified discoid plants (B3–B6)			4. Putative hybrids (C1–C3)			5. Var. *vulgaris* Jersey (D1–D8)			6. Var. *vulgaris* Germany (E1–E8)		
Character	N	Mean	S.E.	N	Mean	S.E.	N	Mean	S.E.	N	Mean	S.E.	N	Mean	S.E.	N	Mean	S.E.
BUD	14	102·0^{a}	4·3	22	43·6^{c}	1·0	17	90·6^{b}	2·1	3	58·0	2·1	51	41·6^{c}	0·9	47	32·0^{d}	0·9
BA	14	48·1^{a}	3·4	21	13·0^{c}	0·8	16	37·6^{b}	3·3	3	40·3	14·7	51	12·8^{c}	0·4	44	12·1^{c}	0·4
ANTH	12	149·3^{a}	6·8	20	55·6^{c}	1·5	16	127·4^{b}	4·5	3	125·3	13·6	51	54·4^{c}	1·1	44	44·0^{d}	0·9
AF	12	20·2^{a}	1·3	20	9·6^{b}	0·3	14	23·6^{a}	2·6	2	21·0	6·0	50	10·9^{b}	0·6	44	10·4^{b}	0·5
FRUIT	12	169·4^{a}	6·6	21	65·1^{cd}	1·5	14	148·9^{b}	7·0	2	150·5	28·5	50	65·8^{c}	1·2	47	54·4^{d}	1·0
STH	13	32·2^{a}	1·1	22	29·1^{a}	1·0	15	29·0^{a}	1·0	2	37·4	5·4	50	27·9^{a}	0·7	47	15·8^{b}	0·5
NCAP	13	39·5^{a}	5·9	21	30·9^{ab}	3·7	15	46·7^{a}	9·1	2	44·0	34·0	50	29·6^{ab}	2·7	47	17·1^{b}	1·4
LRAY	14	2·77	0·17							3	1·97	0·17						
NACH	11	36·4^{ab}	7·1	22	53·8^{a}	2·5	15	27·9^{b}	7·3	3	29·7	13·4	49	36·7^{b}	2·1	46	38·5^{b}	1·7
NUNFO	11	41·6^{a}	7·3	22	8·7^{b}	2·0	15	46·5^{a}	7·2	3	41·3	16·3	49	12·6^{b}	1·5	46	6·7^{b}	1·3
NFLORET	11	78·0^{a}	4·1	22	62·5^{b}	1·6	15	74·3^{a}	1·8	3	71·0	3·8	49	49·2^{c}	1·1	46	45·2^{c}	1·1
REPRO	11	1119^{ab}	350	21	1763^{a}	264	15	647^{b}	155	2	450	60	49	1200^{ab}	172	46	675^{b}	60

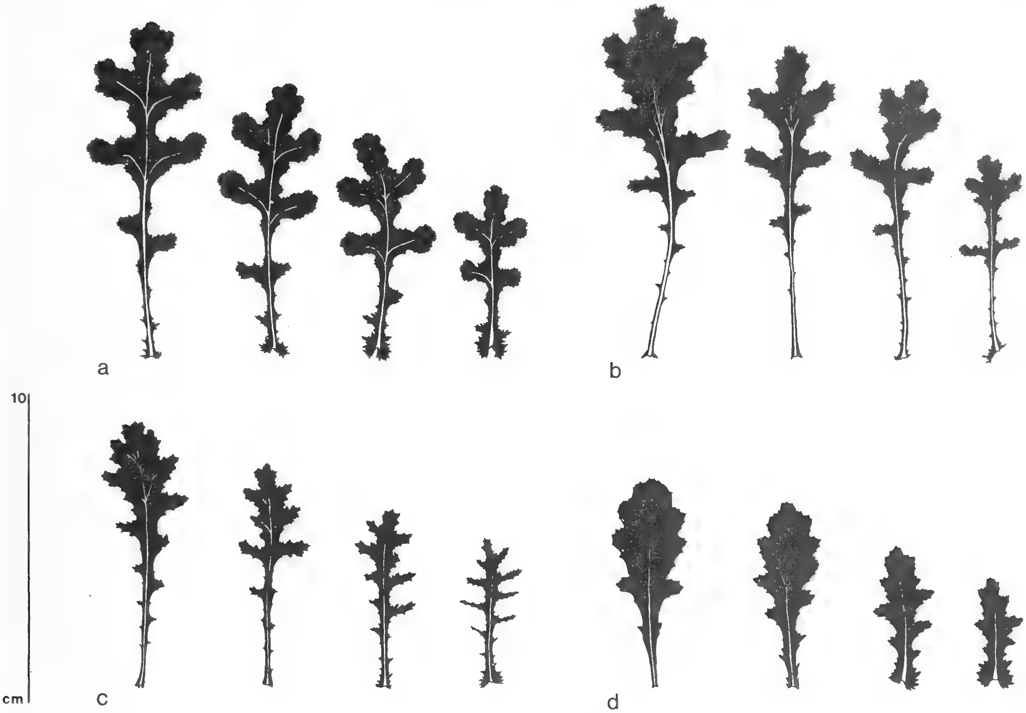


FIGURE 4. Silhouettes of representative middle and upper cauline leaves of cultivated progeny of: a. subsp. *denticulatus*, Les Quennevais (A4); b. putative hybrid, Les Quennevais (C1); c. var. *vulgaris*, Jersey (D1); and d. var. *vulgaris*, Germany (E2). Note that leaves of cultivated progeny of unidentified discoid plants B1, B2 and B7, and B3–B6 were similar to (c) and (a), respectively.

that may have been slight at the outset were 'strengthened' by the C.V.A., because this analysis seeks to maximize the separation between groups (Reyment 1991). It should be emphasized that the results of the C.V.A. were not used to investigate which characters contributed most to the separation between groups.

Fig. 5 shows a plot of the canonical variate scores for 137 out of 154 individuals projected on to the plane of the first two canonical axes. 17 individuals raised had missing values for some of the characters scored, and thus were not included in the analysis, which requires equal sample sizes for all characters (S.A.S. Institute Inc. 1988). The first two canonical variables were statistically significant (at $p<0.0001$), and accounted for 86% and 9% of the total variation, respectively.

The plot of the canonical variates illustrates that all plants derived from unidentified discoid parent individuals fall into two broad clusters. Progeny raised from individuals collected at L'Etacq (B1 and B2) and Ouaisné Common (B7) are nearly completely intermixed with var. *vulgaris* from La Tête du Nièr Côte and inland sites, and to a lesser extent associated with var. *vulgaris* from Germany. In contrast, offspring of four unidentified discoid plants from Les Quennevais (B3–B6) form a distinct cluster both with subsp. *denticulatus* from Les Quennevais (A1, A3 and A4) and from La Tête du Nièr Côte (A7), as well as with progeny of putative hybrids from Les Quennevais (C1 and C2). Rather interestingly, the C.V.A. shows at least moderate separation between both populations of var. *vulgaris* from Jersey and Germany.

Except for progeny of putative hybrids and unidentified discoid plants from Les Quennevais, canonical means of all six groups were significantly different according to Hotelling's multivariate T^2-test ($p<0.0001$). However, the picture outlined in Fig. 5 is clearly reflected by the Mahalanobis' distances (Table 7).

DISCUSSION

DISTRIBUTION, HABITAT AND ECOLOGY OF SUBSP. *DENTICULATUS* AND VAR. *VULGARIS* ON JERSEY

On Jersey, subsp. *denticulatus* is only known from the dune systems of the coastal plains on Ouaisné Common and St Ouen's Bay, where it is particularly common on Les Quennevais. The Quennevais area in the south of St Ouen's Bay was deliberately chosen for more detailed studies because it has long been known to harbour extensive populations of subsp. *denticulatus* (Babington 1839; Trimen 1871; Lester-Garland 1903; Le Sueur 1984), and because it has suffered relatively little from soil disturbance due to human activities in the past (Mrs F. Le Sueur, pers. comm., 1992). Thus, it can safely be taken as representing the specific ecological requirements of subsp. *denticulatus* in its natural maritime habitat. This dune system, which is obviously susceptible to various destructive and catastrophic agencies, e.g. salt-laden winds and severe winter storms, sand mobility, water shortage and grazing by rabbits, has mild temperatures in winter, high levels of insolation and even rainfall throughout the year (Ranwell 1976). Here, subsp. *denticulatus* most characteristically grows on mobile sand dunes or fixed calcareous dune grassland, where it is commonly associated with other winter-annuals and species of Mediterranean affinity (Table 4). It seems likely that subsp. *denticulatus* has gone unnoticed in the past as a member of the association *Tortuleto-Phleetum arenarii* of the calcareous dune communities, investigated in detail by Tüxen (1937) and Westhoff (1947). According to the latter author the main occurrence of this association is in S.W. Europe with its main period of growth in the winter. The obviously close phytosociological relationship of subsp. *denticulatus* to this association on Jersey is all the more interesting, as subsp. *denticulatus* has been postulated to have migrated from the Mediterranean northward along the coasts of W. Europe at the end of the latest glacial period (Kadereit 1984b). Similar to other community associates, it thus would seem to have colonized in the north of Europe one of the regions mildest in winter.

The results obtained from soil analyses (Table 3) do not provide any meaningful clue to the

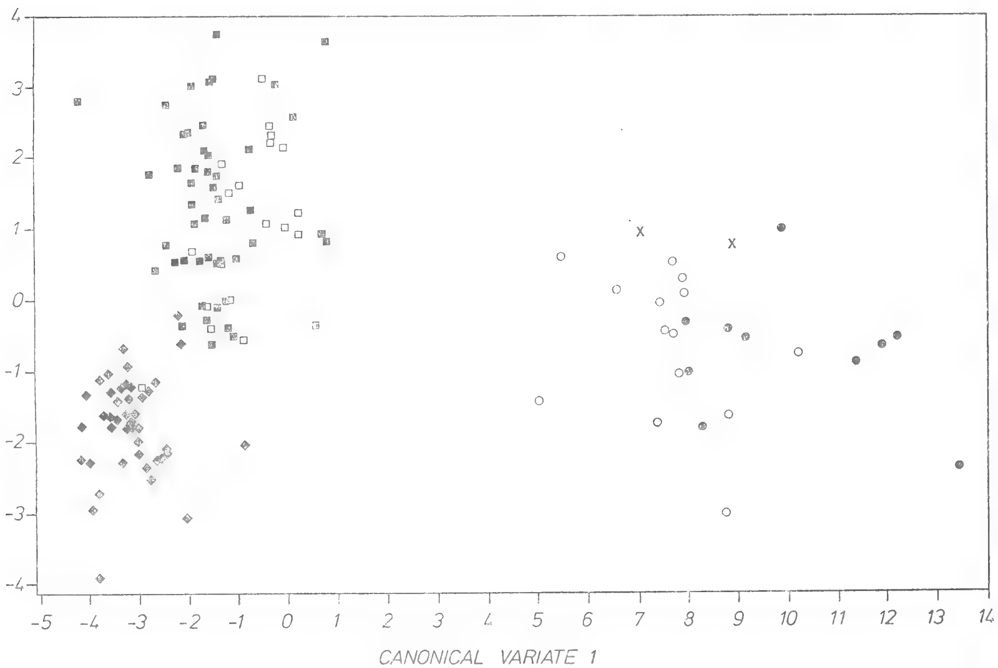


FIGURE 5. Canonical variate analysis for individual progeny plants of *Senecio vulgaris*. ● = subsp. *denticulatus* (A1, A3, A4, and A7), □ = unidentified discoid plants (B1, B2 and B7), ○ = unidentified discoid plants (B3–B6), × = putative hybrids (C1, C2), ■ = var. *vulgaris*, Jersey (D1–D8), ◆ = var. *vulgaris*, Germany (E1–E8). Analysis includes characters listed in Table 2 except LRAY (length of ray floret).

TABLE 7. MAHALANOBIS' SQUARED DISTANCES AMONG GROUPS ANALYSED IN THE CANONICAL VARIATE ANALYSIS OF PLANTS OF *SENECIO VULGARIS*

	Groups					
	1	2	3	4	5	6
1	–					
2	133.46***	–				
3	22·29***	83·23***	–			
4	16·71*	84·24***	10·11 N.S.	–		
5	144·42***	4·15***	90·81***	92·55***	–	
6	185·13***	15·12***	123·65***	134·27***	13·00***	–

Notes: See Table 6 for explanation of group numbers. F value significance: * $p \leq 0{\cdot}05$, ***$p < 0{\cdot}001$, N.S. = not significant.

unusual and disjunct distribution of subsp. *denticulatus* and several community associates (*Honkenya peploides*, *Phleum arenarium*, *Saxifraga tridactylites* and *Viola kitaibeliana*) within the Quennevais area, as detected in the present study (Fig. 2; Table 4). Böcher (1954) has recorded a pH value of 5·8 farther inland, thereby noting the disappearance of *Phleum arenarium*, *Koeleria macrantha* and *Tortula ruraliformis* (Besch.) Ingham, and Ranwell (1975) encountered both a low pH of 4.8, and a minimum value of carbonate content at a dune plain site c. 550 m inland from the shore. The present results, however, show neither a drop in carbonate nor in pH value at the landward dune plain (3), and the plateau scarp site (4). Taking account of both the close proximity of Ranwell's 550 m site to site 3, and the fact that the vegetation around these sites is characterized by *Cladonia rangiformis* Hoffm. (Table 4), a well-known acidophilous species (Böcher 1954), it seems reasonable to assume a rather patchy variation in edaphic composition in the region. Quite clearly, more fine-grained estimates of edaphic factors, especially pH, as well as availability of water and mineral nutrients, will be necessary to settle the problem of disjunct species distribution on Les Quennevais. Nevertheless, soil analysis does indicate that *Senecio vulgaris* subsp. *denticulatus* occurs on soils which have large amounts of carbonate, undoubtedly resulting from crushed mollusc shells, and low amounts of mineral nutrients, out of which nitrogen and phosphorus are considered to be of major significance (Grime 1988).

On Jersey, var. *vulgaris* can be found in man-disturbed inland and coastal localities throughout the island, such as on waste ground or along roadsides. Since subsp. *denticulatus* is virtually absent from ruderal interior sites, this might provide a first clue to the possibility that both taxa are also ecologically distinct in utilizing ephemeral resources to different degrees. It seems likely that due to human disturbance (e.g. roads and sand pits at St Ouen's Bay; building work at Ouaisné Common) the ruderal var. *vulgaris* has been recurrently introduced into the coastal habitat of subsp. *denticulatus*. Sympatry of the two taxa at St Ouen's Bay and Ouaisné Common thus might indicate that their ranges of ecological tolerance are not mutually exclusive. At St Ouen's Bay, however, it appears that preference for fertile and highly disturbed soils is a factor limiting the distribution of var. *vulgaris* to areas outside Les Quennevais, as larger numbers of var. *vulgaris* plants were only found growing in disturbed localities with soils characterized by relatively high amounts of organic matter and nitrogen, e.g. at Ville des Quennevais, St Brelade and L'Etacq (sites 8, 9 and 11; Table 3). Furthermore, during another visit made to Jersey in August 1992, some tall growing plants of var. *vulgaris* were also found on shingle in front of the seawall near L'Etacq, associated with the drift-laden portion of the beach, an extremely unstable habitat which undoubtedly is very rich in nitrogen from decaying organic matter (e.g. Chapman 1978).

POLLINATION STRATEGY OF SUBSP. *DENTICULATUS* AND VAR. *VULGARIS*

Although both taxa are self-compatible, there is a difference in pollination strategy between subsp. *denticulatus* and var. *vulgaris*. Visits of insects (flies and syrphid flies) to var. *vulgaris* have been reported (Abbott & Irwin 1988; Comes & Kadereit 1990), but this taxon normally appears to be an obligatory selfer with outcrossing rates seldom exceeding 1% under field conditions (Marshall & Abbott 1982, 1984). From the field observations presented above it seems that subsp. *denticulatus* is much more attractive to insects (mostly flies in this case) than either the discoid variant or the short ligulate hybrid. Thus, in direct analogy to the self-compatible and radiate var. *hibernicus* that shows outcrossing frequencies between 3 and 35% (Marshall & Abbott 1982, 1984), it is probable that subsp. *denticulatus* has a higher potential for outbreeding than var. *vulgaris* due to the possession of female ray florets which may outcross at a higher frequency than the hermaphrodite disc florets and convey a greater attractiveness of the radiate capitula to pollinators. The difference in pollination strategy between both taxa probably accounts for the fact that subsp. *denticulatus* consistently exhibits a greater amount of variation in the characters contained in Table 6 than var. *vulgaris*.

GREENHOUSE EXPERIMENTS

The present study has confirmed that, when grown under standard conditions in the greenhouse, subsp. *denticulatus* and var. *vulgaris* differ consistently in a number of morphological and life history characters, including leaf shape, degree of hairiness, germination behaviour and speed of development. Moreover, formal genetic (Trow 1912, 1916; Kadereit 1984a) and quantitative genetic studies (Comes 1994) involving subsp. *denticulatus* from Jersey have shown that the differences between both taxa are genetically based, and in general under multigenic control, except the presence/absence of both seed dormancy and ray florets (and probably also speed of development). However, at all loci assayed by standard protein electrophoretic techniques, Jersey subsp. *denticulatus* has an identical phenotype to British and German var. *vulgaris* (Ashton & Abbott 1992; Comes, unpublished results), whereas subsp. *denticulatus* from Ainsdale has unique alleles at the β EST-2 and β EST-3 loci (Ashton 1990; Ashton & Abbott 1992).

As regards the germination behaviour of the cultivated material investigated here, the amount of difference between both taxa does not conform entirely to experimental results obtained previously. Kadereit (1984a) found that subsp. *denticulatus* from Les Quennevais required a minimum time of 111 days after harvest for germination. Contrastingly, no pronounced seed dormancy of subsp. *denticulatus* derived from the same locality and two other sites (La Tête du Nièr Côte and Ouaisné Common) was found in this study (Fig. 3). Apart from different experimental conditions after sowing, these different findings may, in part, be attributable to different conditions experienced by achenes during formation and ripening on the mother plant, as Kadereit (1984a) used greenhouse-produced seeds in his experiment. These arguments do not rule out the possibility that phenotypic variability of germination behaviour in subsp. *denticulatus* could also be due to multiple allelism at the seed dormancy locus. However, the findings of the present study still indicate that subsp. *denticulatus* shows a markedly slower and less synchronized rate of germination than var. *vulgaris* (Fig. 3).

Also, in contrast to what was previously reported by Kadereit (1984a) from a study of Les Quennevais material of subsp. *denticulatus* and British var. *vulgaris*, no differences between both taxa were recorded for potential reproductive output in the cultivated material (Table 6). Kadereit's findings largely resulted from a significantly smaller average number of capitula and buds present at the time of maturity of the first capitulum in subsp. *denticulatus*. As plants were grown under different conditions and there was significant variation among families for this character (Kadereit 1984a), there is the possibility of both a great amount of genotypic variability and a considerable genotype × environment interaction for this feature.

Perhaps one of the most intriguing results of the progeny tests is that the pattern of germination behaviour (Fig. 3), the leaf shape characteristics (Fig. 4) and the canonical variate analysis (Fig. 5) clearly show that all discoid progenies that were raised from the unidentified discoid plants (B3–B6) from Les Quennevais were very similar to subsp. *denticulatus*. Although – with the exception of character AF (time from anthesis to first fruiting) – these variants are consistently associated with slightly lower values of all phenological characters (Table 6), the phenological differences are slight compared to those between discoid and radiate subsp. *denticulatus* on the one hand and Jersey var. *vulgaris* on the other. Thus, the present study has demonstrated that the presence of ray florets alone might be insufficient to identify subsp. *denticulatus* on Jersey. Evidently, when growing in drought-prone coastal sites, Jersey var. *vulgaris* may approach the discoid *denticulatus*-like variant in phenotype, and thus may impede identification in the field. Such a possibility has been demonstrated by the fact that, when collected, discoid seed parents from the fertile site at L'Etacq (B1 and B2) and the dune grassland on Ouaisné Common (B7) could not be assigned to either taxon using morphological criteria, but progeny analyses proved this material to be typical Jersey var. *vulgaris*. It is worth noting that two earlier records exist concerning the occurrence of discoid variants of subsp. *denticulatus* in coastal habitats, namely in the British Isles at Pevensey, Sussex (Wilmott 1925, 1949), and on Bornholm, Denmark (Lange 1851), but there is no evidence that these variants are of similar, i.e. hybridogenous, origin as those described here. This will be discussed in more detail below.

HYBRIDIZATION AT ST OUEN'S BAY

For the following discussion of hybridization at St Ouen's Bay it is irrelevant whether subsp. *denticulatus* represents a local ecotype or a population of a widely distributed monophyletic taxon. Evidence for the latter comes from the observation of pronounced seed dormancy and strongly elongated generation time in short ligulate material of *S. vulgaris* from S. Spain and Sicily (J. W. Kadereit, pers. comm., 1993).

All plants scored and collected as putative hybrids at St Ouen's Bay have been interpreted as such because of their intermediate ray floret length. However, direct evidence of their hybrid status is lacking because offspring individuals derived from two different short ligulate seed parents collected on Les Quennevais did not produce the expected intermediate phenotype but resembled subsp. *denticulatus* closely (Fig. 5). The fact that both individuals failed to segregate for capitulum type is not a strong argument against their hybrid status since lack of segregation could have reflected sampling error due to the very small number of progeny grown (N=3). Nevertheless, it appears reasonable to assume that the short ligulate plants, together with the discoid *denticulatus*-like variants described above, are the products of hybridization between subsp. *denticulatus* and var. *vulgaris*. Alternatively, they could reflect a polymorphism for capitulum type in populations of subsp. *denticulatus*, or even represent intermediate stages in the evolution of subsp. *vulgaris*. The hypothesis of their hybrid status is preferred, however, because: (i) subsp. *denticulatus* and var. *vulgaris* grow sympatrically at St Ouen's Bay; (ii) both taxa are visited by a similar set of putative pollinators; and (iii) fertile crosses can easily be obtained in the greenhouse (e.g. Gilmer & Kadereit 1989).

One morphological marker, absence of ray florets, that is fixed in var. *vulgaris* but – in general – absent from subsp. *denticulatus*, is regulated by an allele of a single gene that is only weakly linked to the gene(s) controlling speed of development (Comes 1994). If both taxa interact along an extensive hybrid zone (sensu Harrison & Rand 1989) at St Ouen's Bay, particularly in the man-disturbed area north of Les Quennevais, Mendelian segregation of this morphological marker in the resultant population is to be expected. The observation that the discoid variants tended to complete their life cycle somewhat earlier than typical subsp. *denticulatus* (see above) might be attributed to the weak linkage between the ray floret gene and the gene(s) controlling speed of development. Under the polymorphism hypothesis, however, this association remains unclear (excluding the highly unlikely possibility of pleiotropic or developmental effects of the ray floret gene on this phenological character), and under the intermediate hypothesis it is unclear why no truly intermediate or *vulgaris*-like individuals were found on Les Quennevais (Fig. 5).

Although the discoid and short ligulate *denticulatus*-like phenotypes thus might be considered as products of hybridization between subsp. *denticulatus* and var. *vulgaris*, their mode of origin remains obscure. It is possible that these phenotypes too are the products of many generations of introgression with the subsp. *denticulatus* population on Les Quennevais as the likely recipient population. Alternatively, they may be early recombinant segregants having arisen following self-fertilization of an F_1 hybrid. Evidence in favour of the latter possibility is offered by hybridization experiments between both taxa (Comes 1994). In these experiments, following spontaneous selfing of the F_1 hybrid (57% self seed set), several recombinant individuals occurred in the F_2 that were discoid (or short ligulate) but had phenological and morphometric features characteristic of subsp. *denticulatus*.

Irrespective of their mode of origin, it remains to be established why all discoid and short ligulate plants that were found on Les Quennevais showed characteristics typical of subsp. *denticulatus*. One likely explanation is that the hybridization boundary around this area is less permeable for genes regulating germination, phenological and morphological characters typical of var. *vulgaris* that are more likely to have ecological and adaptive significance, than for those determining capitulum type that is more likely to be influenced by random drift, especially in the presence of efficient self-fertilization and in the absence of tight linkage with other life history characters. Moreover, different mechanisms of mineral uptake and utilization could select for the *denticulatus* genotype in the Quennevais area. It seems likely that subsp. *denticulatus* is adapted to harvest and retain scarce resources under the poor nutrient-supplying power of this area in a similar way to well-known stress tolerators on calcareous soils, e.g. the associated *Saxifraga tridactylites* and *Myosotis ramosissima* (Grime *et al.* 1988). Under these circumstances, both a prolonged phase of vegetative growth and a delayed onset of reproduction in *Senecio vulgaris* subsp. *denticulatus* (Table 6) may be indicative of rather low rates of mineral nutrient capture and utilization (Grime 1988). If this is so, the need for early, rapid, and heavy resource allocation to reproduction in the ruderal var. *vulgaris* genotype will be incompatible with its survival or competitive ability on Les Quennevais. The potential of nutrient deprivation as a selective factor that might influence the establishment or spread of var. *vulgaris* has been demonstrated by Aarssen & Burton (1990). These authors reported evidence that maternal plants of var. *vulgaris* grown in nutrient-poor soils produced seeds with lower individual mass, seeds that germinated later, and seedling offspring that had significantly lower biomass and height than those individuals with high maternal soil nutrient level (but, unexpectedly, also seedling offspring that survived longer in the absence of external nutrients). Although it is tempting to attribute differential survival or competitive ability in the Quennevais area to different metabolic mechanisms, other edaphic or biotic factors on Les Quennevais could also select for the *denticulatus* genotype. For example, rabbit grazing and poor water supply might well be expected there, but not (or to a lesser extent) in the man-disturbed localities around this area, and this would also be likely to influence life history characters like speed of development.

Whatever its selective advantage on Les Quennevais, provided there is in situ selection, and given both an efficient self-pollination strategy and low levels of hybridization, subsp. *denticulatus* will be able to maintain its integrity there.

EPILOGUE

There is documentary evidence to suggest that subsp. *denticulatus* was once more widely distributed on Jersey. Populations of subsp. *denticulatus* may have existed on the coastal plains of St Aubin's Bay at least until the first half of the 19th century (Babington 1839), but since this locality was not referred to any more by Lester-Garland's account in 1903 (Lester-Garland 1903) it seems plausible that they were extinguished by the stabilizing of the dunes or the building of the sea walls towards the end of the 19th century. Equally, since Lester-Garland (1903) reported this taxon at St Brelade's Bay (including Ouaisné Common), the current population on Ouaisné Common appears to be a mere remnant of those populations that existed along St Brelade's Bay at the beginning of this century. Thus, even if it is not threatened by hybridization with or introgression from var. *vulgaris*, subsp. *denticulatus* might be seriously endangered from progressive destruction of its habitat by man.

ACKNOWLEDGMENTS

I am very grateful to Mrs F. Le Sueur for her invaluable advice during my field studies on Jersey and to Dr J. W. Kadereit (Mainz) and Mr C. D. Preston (Monks Wood) for critical discussion of the manuscript. I also should like to express my thanks to Dr Peter Kirby (Peterborough) for identifying the insect specimens and for his instructive comments on their biology, and to Anke Berg (Mainz) for help with the illustrations. The field studies on Jersey were supported by a Landesgraduierten-Förderungsgesetz (LGFG) grant of the Land Baden-Württemberg (Germany).

REFERENCES

Aarssen, L. W. & Burton, S. M. (1990). Maternal effects at four levels in *Senecio vulgaris* (Asteraceae) grown on a soil nutrient gradient. *American journal of botany* **77**: 1231–1240.

Abbott, R. J. (1992). Plant invasions, interspecific hybridization and the evolution of new plant taxa. *Trends in ecology and evolution* **12**: 401–405.

Abbott, R. J. & Irwin, A. J. (1988). Pollinator movements and the polymorphism for outcrossing rate at the ray floret locus in Groundsel, *Senecio vulgaris* L. *Heredity* **60**: 295–298.

Allen, D. E. (1967). The taxonomy and nomenclature of the radiate variants of *Senecio vulgaris* L. *Watsonia* **6**: 280–282.

Ashton, P. A. (1990). *Multiple origins of* Senecio cambrensis *Rosser, and related evolutionary studies in British* Senecio. Unpublished Ph.D. Thesis, University of St Andrews.

Ashton, P. A. & Abbott, R. J. (1992). Isozyme evidence and the origin of *Senecio vulgaris* L. (Compositae). *Plant systematics and evolution* **179**: 167–174.

Babington, C. C. (1839). *Primitiae florae Sarnicae.* Longman & Co., London.

Böcher, T. W. (1954). Studies on European calcareous fixed dune communities. *Vegetatio* **5–6**: 562–570.

Chapman, V. J. (1978). *Coastal vegetation*, 2nd ed. Pergamon Press, Oxford.

Comes, H. P. (1994). *Genetische Analyse phänologischer und morphologischer Unterschiede innerhalb des nahverwandten Sippenpaares* Senecio vulgaris *L. und* S. vernalis *Waldst. & Kit. (Asteraceae).* Unpublished Ph.D. Thesis, University of Heidelberg, Germany.

Comes, H. P. & Kadereit, J. W. (1990). Aspects of hybridization between the closely related *Senecio vulgaris* L. and *Senecio vernalis* Waldst. & Kit. *Flora* **184**: 381–388.

Gilmer, K. & Kadereit, J. W. (1989). The biology and affinities of *Senecio teneriffae* Schultz Bip., an annual endemic from the Canary Islands. *Botanische Jahrbücher* **111**: 263–273.

Grime, J. P. (1988). The C-S-R model of primary plant strategies – origins, implications and tests, in Gottlieb, L. D. & Jain, S. K., eds. *Plant evolutionary biology*, pp. 371–391. Chapman & Hall, London.

Grime, J. P., Hodgson, J. G. & Hunt, R. (1988). *Comparative plant ecology: a functional approach to common British species.* Unwin Hyman, London.

Harris, S. A. & Ingram, R. (1992). Molecular systematics of the genus *Senecio* L. II: The origin of *S. vulgaris. Heredity* **69**: 112–121.

Harrison, G. H. & Rand, D. M. (1989). Mosaic hybrid zones and the nature of species boundaries, in Otte, D. & Endler, J. A., eds. *Speciation and its consequences*, pp. 111–133. Sinauer Associates, Sunderland, Mass.

Kadereit, J. W. (1984a). Studies on the biology of *Senecio vulgaris* L. ssp. *denticulatus* (O. F. Muell.) P. D. Sell. *New phytologist* **97**: 681–689.

Kadereit, J. W. (1984b). The origin of *Senecio vulgaris* L. (Asteraceae). *Plant systematics and evolution* **145**: 135–153.

Lange, J. M. C. (1851). *Haandbog i den Danske Flora*, 1st ed. C. A. Reitzel, Copenhagen.

Lester-Garland, L. V. (1903). *A Flora of the Island of Jersey.* West, Newman & Co., London.

Le Sueur, F. (1976). *A natural history of Jersey.* Phillimore, London.

Le Sueur, F. (1984). *Flora of Jersey.* Société Jersiaise, Saint Helier.

Marshall, D. F. & Abbott, R. J. (1982). Polymorphism for outcrossing frequency at the ray floret locus in *Senecio vulgaris* L. I. Evidence. *Heredity* **48**: 227–235.

Marshall, D. F. & Abbott, R. J. (1984). Polymorphism for outcrossing frequency at the ray floret locus in *Senecio vulgaris* L. II. Confirmation. *Heredity* **52**: 331–336.

Perring, F. H. & Sell, P. D., eds. (1968). *Critical supplement to the atlas of the British flora*, T. Nelson & Sons, Ltd., London.

Ranwell, D. S. (1975). The dunes of St Ouen's Bay, Jersey: an ecological survey. Pt. I. History and plant communities least modified by human influences. *Annual bulletin of the Société Jersiaise* **21**: 381–391.

Ranwell, D. S. (1976). The dunes of St Ouen's Bay, Jersey: an ecological survey. Pt. II. Plant communities strongly modified by man, the whole flora and management implications. *Annual bulletin of the Société Jersiaise* **21**: 505–516.

Ren, Z. & Abbott, R. J. (1991). Seed dormancy in Mediterranean *Senecio vulgaris* L. *New phytologist* **117**: 673–678.

Reyment, R. A. (1991). *Multidimensional palaeobiology.* Pergamon Press, Oxford.

Reyment, R. A., Blackith, R. E. & Campbell, N. A. (1984). *Multivariate morphometrics*, 2nd ed. Academic Press, London.

SAS Institute Inc. (1988). *SAS/STAT user's guide.* SAS Institute Inc., Cary, North Carolina.

Sokal, R. R. & Rohlf, F. J. (1981). *Biometry*, 2nd ed. W. H. Freeman & Co., New York.

Stace, C. A. (1991). *New Flora of the British Isles.* Cambridge University Press, Cambridge.

Trimen, H. (1871). Notes in Jersey and Guernsey. *Journal of botany, London* **9**: 198–201.

Trow, A. H. (1912). On the inheritance of certain characters in the Common Groundsel – *Senecio vulgaris* Linn. – and its segregates. *Journal of genetics* **2**: 239–276.

Trow, A. H. (1916). On the number of nodes and their distribution along the main axis in *Senecio vulgaris* and its segregates. *Journal of genetics* **6**: 1–63.

Tüxen, R. (1937). Die Pflanzengesellschaften Nordwestdeutschlands. *Mitteilungen der floristisch-soziologischen Arbeitsgemeinschaft Niedersachsen, Hannover* **3**: 1–170.

Westhoff, V. (1947). *The vegetation of dunes and salt marshes on the Dutch Islands of Terschelling, Vlieland and Texel.* C. J. van der Horst, 's-Gravenhage.

Wilmott, A. J. (1925). The London Catalogue, 11th ed. *Journal of botany, London* **63**: 298–302.

Wilmott, A. J. (1949). Intraspecific categories of variation, in Wilmott, A. J. ed. *British flowering plants and modern systematic methods*, pp. 28–45. Botanical Society of the British Isles Conference Report No. 1, London.

(*Accepted April 1994*)

Rorippa islandica (Oeder ex Murray) Borbás (Brassicaceae) in Wales

A. O. CHATER

Windover, Penyrangor, Aberystwyth, Dyfed, SY23 1BJ

and

T. C. G. RICH

The Annex, Newgale Farm, Priory Road, Forest Row, East Sussex, RH18 5JD

ABSTRACT

Rorippa islandica (Oeder ex Murray) Borbás sensu stricto is reported from ten localities in Wales, a newly discovered stronghold for the species. An updated distribution map of the species in the British Isles is presented. The habitats of the species on the Afon Teifi are described, including depressions in the flood plain, a rock outcrop and waste ground. Possible dispersal mechanisms are discussed and the distribution of seeds both by water and by wildfowl is considered probable.

KEYWORDS: Distribution, habitat, dispersal, life cycle.

INTRODUCTION

On 17 July 1991, A. O. Chater found a *Rorippa* growing on rocks by the Afon Teifi at Cenarth, Cardiganshire (v.c. 46), which agreed with the description of *R. islandica*, Northern Yellowcress, in *Crucifers of Great Britain and Ireland* (Rich 1991). He returned to collect ripe fruits on 25 August 1991, and the material was determined as *R. islandica* by T. C. G. Rich, and later confirmed by B. Jonsell. The find was a surprise in two respects. First, this was the first confirmed record for Wales; old records for '*R. islandica*' have been treated as the generally commoner *R. palustris* (L.) Besser rather than *R. islandica* (Oeder ex Murray) Borbás sensu stricto (Rich 1991). The nearest known localities were in the Isle of Man 250 km to the north and western Ireland 250 km to the north west, so it was a considerable extension of range (subsequently in 1993, another locality was discovered in Kilkenny 200 km to the west north west). Second, the plant was growing on rocks beside a river rather than in its more usual habitat in north west Europe of muddy ponds, turloughs and lough margins.

In 1993, we re-surveyed known *Rorippa* localities along the Teifi and searched other sites in the area to determine the status of the plant. We have also examined the excellent regional collection held at the National Museum of Wales (**NMW**). In this paper we have documented the occurrence of *R. islandica* in Wales and presented an updated distribution map. As there is little ecological information available, we have also carried out studies on its habitats and vegetation on the Afon Teifi, and investigated possible dispersal mechanisms. Nomenclature follows Stace (1991).

DISTRIBUTION IN WALES

All Welsh records traced are listed below. As the widespread occurrence of *R. islandica* in south west Wales casts some doubt on unconfirmed records of *R. palustris* in Rich (1991), we have also included brief details of genuine *R. palustris* records seen in the field or verified from herbarium specimens. Fig. 1 shows the distribution of *R. islandica* in the British Isles as it is currently known, incorporating the Welsh records and many additional localities in Ireland (Goodwillie 1994).

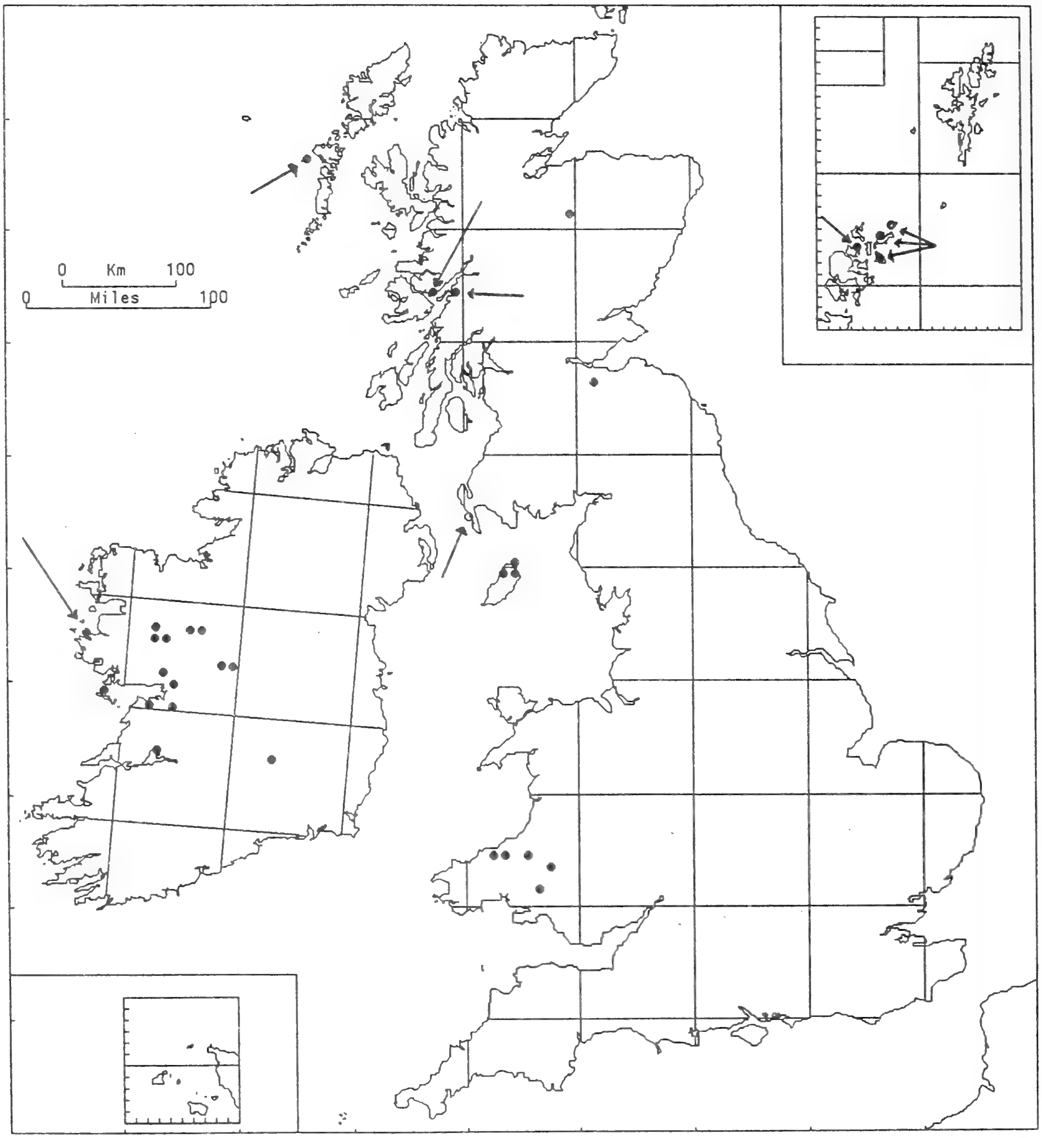


FIGURE 1. Distribution of *Rorippa islandica* in the British Isles, updated from Rich (1991). ● 1950–1993. ○ pre-1950.

Glamorgan, v.c. 41:

1. Garnswllt, near River Loughor (SN/62.10), 13 July 1981, *R. G. Ellis* (**NMW**). First v.c. record.

Carmarthen, v.c. 44:

2. 800 m E of Newcastle Emlyn castle (SN/319.408), muddy hollows in silage field south of river and N. of disused railway, 25 m a.s.l., c. 1000 plants, including many non-flowering rosettes, 23 August 1993, *A. O. Chater and T. C. G. Rich* (**NMW**).

3. Afon Bran, near bridge N. of Llandovery (SN/783.362), 11 September 1981, *R. D. Pryce* (**NMW**). Immature plants collected at Cwm Mynys Isaf, N.E. of Llanwrda (SN/726.340), August 1986, *H. J. Killick* (**NMW**), and on a rubbish tip at West Pwll (SN/4.0, tetrad Q), August 1982, *I. K.*

Morgan (**NMW**) may also be *R. islandica*. The former site was searched in 1993 by A. O. Chater but no suitable habitat for the plant was found.
Other material seen in **NMW**, including Pont Stephen, Felinfach (SN/5.4, tetrads T and Y) collected by A. O. Chater and R. D. Pryce in July 1982, is *R. palustris*.

Pembroke, v.c. 45:
4. 600 m E. of Llechryd Bridge, in silted-up bed of disused canal south of river and minor road (SN/223.434), 7 m a.s.l., c. 20 fruiting plants and many non-flowering rosettes (number uncertain because of presence of *Rorippa palustris* and consequent doubt about identity of vegetative rosettes), 23 August 1993, *A. O. Chater and T. C. G. Rich* (**NMW**). First v.c. record.
Plants from Castlemartin Corse (SR/9.9) are *R. palustris* (**NMW**).

Cardigan, v.c. 46:
5. 300 m W.S.W. of Llwynduris Farm, in and on banks of overgrown ditch in pasture and alongside hedge on N. side of river (SN/235.433), 5 m a.s.l., c. 35 plants, mostly fruiting, 23 August 1993, *A. O. Chater and T. C. G. Rich*, and 22 September 1993, *A. O. Chater* (**NMW**).
6. 50 m W. of Cenarth Bridge, on slightly sloping rock platform on north bank of river (SN/246.416), 10 m a.s.l., four plants of *R. islandica* in crevices in an area of 4 m × 5 m, prostrate and level with the surface of the rocks, 17 July 1991, *A. O. Chater* (**NMW**). Three plants with inflorescences and six non-flowering rosettes, 23 August 1993, A. O. Chater and T. C. G. Rich. No plants were found on the south bank in v.c. 44 in 1993. First found "by the Teifi, Cenarth" in August 1958, *Miss D. E. de Vesian* (**NMW**).
7. 200 m S. of Newcastle Emlyn castle, along c. 100 m length of silted-up ox-bow and around ox-bow pool on north side of river (SN/312.405), 25 m a.s.l., several thousand plants, including many non-flowering rosettes, 23 August 1993, *A. O. Chater and T. C. G. Rich* (**NMW**).
8. The Moat, 1 km E.S.E. of Llandyfriog, muddy depressions and carr in pastures between disused railway and river (SN/341.408), 30 m a.s.l., c. 1000 plants, including many non-flowering rosettes (number uncertain because of presence of *R. palustris* and consequent doubt about identity of vegetative rosettes), 23 August 1993, *A. O. Chater and T. C. G. Rich* (**NMW**).
9. Aberbachnog, 1·7 km E. of Henllan, by pond south of disused railway and in hollows in the pasture between here and river (SN/374.402), 40 m a.s.l., c. 300 plants, 24 August 1993, A. O. Chater and T. C. G. Rich. There is a specimen from the pond collected on 1 September 1979, *A. O. Chater* in **NMW**.
10. Lampeter, 500 m N. of the college, marsh by pool in waste ground and on adjacent soil tips (SN/579.488), 125 m a.s.l., c. 80 plants in marsh and c. 1500 plants on tips including many non-flowering rosettes, 4 September 1993, *A. O. Chater* (**NMW**). Some plants on the tipped soil were over 1m in diameter, and the ground beneath the prostrate stems was orange with the shed seed.

A number of other sites where it was felt that *R. islandica* might occur on the Teifi were visited in 1993 without success, and these are listed as grid references in Table 1. Although negative records are of lesser value, this information may help in any future survey of the species to indicate whether there has been any change in the distribution on the river.

TABLE 1. AFON TEIFI SITES SEARCHED WHERE *RORIPPA ISLANDICA* WAS NOT FOUND. (SITES WHICH SEEMED PARTICULARLY SUITABLE ARE INDICATED BY AN ASTERISK)

SN/154.484*	SN/454.401*
SN/182.443	SN/518.435* – 516.439
SN/184.449	SN/552.462* – 581.476*, many suitable sites
SN/225.432*	SN/597.484
SN/227.434	SN/606.495 – 616.499*
SN/235.414	SN/617.501
SN/256.416	SN/666.580*
SN/256.422*	SN/673.589*
SN/296.418*	SN/672.612
SN/391.396*	SN/683.626
SN/407.403 – 420.411	SN/709.664
SN/429.419* – 425.418	

Rorippa palustris was also found at three additional sites without *R. islandica* (voucher specimens in **NMW**). These sites were Pont Ceri (SN/296.418), 700 m E. of Dolaugwyrddon-Isaf (SN/564.465) and 400 m S.S.E. of Dolaugwyrddon-Isaf (SN/559.463).

Anglesey, v.c. 52:
Jonsell (1968) suggested that "a constant occurrence (1813–1890s) at a small lake in Anglesey (Griffith 1895) may be this species" but this was a result of a misunderstanding of Griffith's text; Davies and Griffith recorded the plant at different sites. Davies (1813) noted "*Sisymbrium terrestre* . . . In the clay pits, at Beaumaris, Cors Ddygai, not rare", and Griffith (1895) gives "**Nasturtium palustre** *DC*. . . . Very rare . . . On the margin of Llyn Frogwy, Bodforth!" R. H. Roberts looked for *R. islandica* in the 1970s without success (pers. comm., 1993), and another survey in 1993 by him of all known sites for *R. palustris* (including Llyn Frogwy) was equally unsuccessful. *R. islandica* has not yet been confirmed for Anglesey.

IDENTIFICATION AND LIFE CYCLE

The field work provided an opportunity to review the identification characters given in Rich (1991). Plants of *R. islandica* were often decumbent to ascending at the base, whilst *R. palustris* was usually more or less erect, but plants of either species in trampled places could be ascending. Leaf shape was quite variable, and it was impossible to identify vegetative rosettes with confidence. There was considerable overlap in flower size between both species, and the floral characters are not very reliable. The presence of a short-petalled clone of *R. sylvestris* (L.) Besser on the Teifi also caused some confusion, though the regularly pinnate leaves, long creeping rhizomes and linear ovaries of this species are otherwise distinctive.

The fruit and seed characters, however, proved a reliable means of distinguishing the plants, which could be done from several metres' distance with some experience. The most striking morphological feature of the *R. islandica* plants on the Teifi was that the fruits were secund and swept downwards so that the whole inflorescence was one-sided, and also quite dense due to the relatively shorter pedicels. How reliable this character is across the range of the species is unknown, but it appears diagnostic in Wales. In contrast, the fruits of *R. palustris* were arranged evenly around the stem and were not so densely crowded.

With practice, the fruit shapes could be seen to be quite different, with *R. islandica* having more rectangular, square-ended fruits. When seeds of both species were examined side by side, those of *R. palustris* were darker in colour, slightly larger and the epidermal cells could just be made out with a ×20 lens (the epidermis of *R. islandica* appearing comparatively featureless). Identification should always be confirmed from microscopical examination of ripe seeds and comparison with voucher material. The size of the epidermal cells is diagnostic, although it is difficult to quantify this because of variation on different parts of the seed.

Rorippa islandica and *R. palustris* have previously only rarely been found growing together in the same place (e.g. in Ireland, Goodwillie 1994). One plant was found at The Moat (Site 8) which was partially sterile (**NMW**), but this is more likely to be due to environmental factors than hybridisation since both species are habitually in-breeding. Jonsell (1968) failed to obtain any progeny from experimental crosses.

Rorippa islandica is usually considered an annual in the wild (e.g. Rich 1991), although Jonsell (1968) was able to keep some plants in cultivation for up to five years. In August and September 1993 we noticed that many plants (more than half the population at some sites) had not commenced flowering, and we assumed that these would flower later in the autumn. On revisiting these sites in early November 1993, there was still no sign of inflorescences on most of these rosettes, and they were still in the same condition in March 1994. Furthermore, many plants which had fruited in 1993 bore well-developed central rosettes through to March 1994. Several plants were also seen in November 1993 which had axillary rosettes of leaves on decaying fruiting stems which were about to break off from the parent plant to act as vegetative propagules (this phenomenon occurs occasionally in other crucifers, cf. Rich (1984), and Grime *et al.* (1988) for its occurrence in *R. palustris*). In its Teifi sites *R. islandica* therefore often behaves as a biennial, and possibly at least sometimes as a perennial, although further field studies with marked plants are needed to confirm the perennial habit. Goodwillie (1994) mentions phenological plasticity in *R. islandica* as probably fitting the plant for growth in turloughs where the unpredictability of the water level is the major environmental variable. The plasticity of life cycles in response to environmental conditions is well known in other crucifers (Rich 1991).

HABITATS OF *RORIPPA ISLANDICA* ON THE TEIFI

The Afon Teifi is about 115 km long and rises at 550 m a.s.l. in acidic moorland. When it has fallen to 160 m a.s.l., it meanders slowly for about 8 km through the extensive raised mire complex of Cors Caron, through beds of silts and clays. For much of the rest of its length, and especially in its lower half, the river is relatively fast-flowing and rocky. This is a reverse of the usual pattern, in which rivers have their faster, rocky section above the slower, meandering ones. The Teifi is also unusual in having no large tributaries. The Cors Caron stretch thus has an unexpectedly dominating effect on the rest of the river (Holmes 1983; Chater 1994). The underlying rocks of the whole river system are Ordovician and Silurian shales and mudstones and are largely acidic. Sites 4–9 are situated in the lower third of the river, and site 10 is three-fifths of the way up the river.

Six of the eight sites on the Teifi, nos. 2, 4, 5, 7, 8 and 9, are depressions in the floodplain, within 300 m of the river but separated from it. Four of these depressions originated as meanders or ox-bows which have become silted up and two still contain areas of more or less permanent open water adjacent to the *Rorippa* populations. Site 4 is a long-disused and largely silted-up canal, and site 8 is a meander anciently modified into a moat, half of which is now silted up. All six sites are regularly flooded, usually at least once a year and often for some days at a time, when the whole of the floodplain is inundated. These floods can occur at any time of the year, though rarely in summer. All six sites are on fine, silty, gley soils, probably mostly of the Conway series (Bradley 1980; Rudeforth *et al.* 1984) in situations where they form part of the Teme Association.

Soil pH was measured for each site from one fresh soil sample collected from the top 5 cm of the soil profile (i.e. the root zone). The samples were mixed with a similar volume of de-ionised water to form a paste and allowed to stand for about five minutes. pH was measured using a Piccolo ATC pH-meter (Hanna Instruments Inc.) with a HI 1280 amplified electrode. The soil pHs measured ranged from 5·2 to 6·6 (Table 2).

Site 6 seems to be unique for *R. islandica* in that it is a gently sloping platform of rock c. 1 m above normal water level in a rocky section of the river. The plants grow in crevices in the rock and are very dwarfed, and some are adjacent to patches of concrete placed to smooth the platform. It is frequently flooded, and the pH of the soil in the crevices is 6·9, possibly influenced by the concrete. The site used to be used for sheep-dipping and is now much used by fishermen and picnickers. Our initial impression that this habitat was unusual has thus been confirmed by further survey.

Site 10 is just west of a tributary, the Afon Dulas, 1·1 km above its confluence with the Teifi. Until about ten years ago it was a wood yard but is now marshy ground around a shallow pond. The ground is patchy and partly open and parts of it, including the area with *R. islandica*, are usually flooded for much of the winter. Flooding is due to poor drainage and the site, unlike the other seven, is not part of the Teifi floodplain although it is within the catchment. The pH here averaged 7·6, the substrate including timber, tarmac, stones and other imported material. Along the south side of the

TABLE 2. SOIL pH VALUES FROM *RORIPPA ISLANDICA* SITES IN THE TEIFI VALLEY, WALES

Site 2	pH 6·0
Site 4	pH 6·6
Site 5	pH 6·5
Site 6	pH 6·9
Site 7	pH 5·2
Site 8	pH 5·6
Site 9	pH 5·3
Site 10, marsh	pH 7·6
Site 10, tip	pH 8·2

marsh is a large area of soil and rubble of unknown origin, illegally tipped here in early 1992. The pH of this by the main colony of *R. islandica* here is 8·2. 100 m to the south-east is another equally recent soil tip, the material having come from excavation on the site; *R. islandica* is by far the most abundant plant on this tip. *R. islandica* must be a recent arrival at this site, as there was no vegetation on it until a decade or so ago. It is impossible to guess whether it arrived first in the marsh, where it could have been brought by birds (Mute Swans nest on the pond), or whether it arrived with the illegally dumped soil and spread from this to the adjacent tip and to the marsh. *R. islandica* has also been reported from rubbish tips in the Isle of Man (L. S. Garrad, pers. comm., 1989).

VEGETATION

Species associated with *R. islandica* at the eight Teifi sites are listed in Table 3 (at site 10 only the marsh part of the site is included). It should be understood that the species lists in Table 3 are not to be interpreted as floristic tables for the communities present, but are simply lists of species growing within 1 m of *R. islandica* plants. The most constant associates were *Persicaria hydropiper*, *Gnaphalium uliginosum* and *Callitriche brutia*, all also annuals of disturbed open, damp ground.

The vegetation of these sites falls into two main types which can be described in terms of *British plant communities* (Rodwell 1991, *et seq.*). The drier sites support *Agrostis stolonifera* – *Alopecurus geniculatus* grassland (MG13), which is characterised by constant *Agrostis stolonifera* and *Alopecurus geniculatus*, with *Ranunculus repens*, *Holcus lanatus*, *Poa trivialis*, *Juncus effusus* and *Glyceria fluitans*. It occurs in seasonally inundated places, on poorly drained, clayey soils, often in grazed and trampled conditions, and the sward is usually short and fairly open. It is not uncommon throughout most of lowland Britain. This was the most characteristic vegetation type for *R. islandica* which was very abundant in it at sites 2, 7, 8, and 9.

The *British plant communities* frequency table for *Agrostis stolonifera* – *Alopecurus geniculatus* grassland appears to underestimate the frequency of the annuals characteristic of these muddy, trampled sites (e.g. *Persicaria hydropiper, Gnaphalium uliginosum*), both in western Wales and elsewhere. An additional sub-community of the *Agrostis stolonifera* – *Alopecurus geniculatus* grassland, characterised by *Persicaria hydropiper*, might be justified.

The wetter sites support *Glyceria fluitans* swamp, *Alopecurus geniculatus* sub-community (S22c), which occurs in shallow, seasonally-inundated water on nutrient-rich soils, usually with a fine mineral substrate. It is often grazed and is frequent in ditches in fields, dry ditches and along the margins of small streams. It is dominated by *Glyceria fluitans* and *Alopecurus geniculatus*, with a few other frequent species such as *Rumex crispus* and *Poa trivialis*. It is widespread and common in the agricultural lowlands of Britain. *R. islandica* occurred in this vegetation type at sites 4, 5 and 8, and in the first two is at a much lower frequency than in the MG13 grasslands.

The Cenarth site (Site 6) supports sparse vegetation which is best treated as MG7 *Lolio-Plantaginion*, but can scarcely be considered a typical example of the vegetation.

The vegetation at site 10, disturbed and of recent origin, is probably best considered as M23 *Juncus effusus/acutiflorus* – *Galium palustre* rush-pasture, but the *R. islandica* grows in sparsely vegetated ground uncharacteristic of the community as a whole.

DISPERSAL

Rorippa islandica is easily overlooked, both because of its inconspicuous nature and because of the difficulties of identification, and, more than for many other species, absence of records should not be taken to indicate absence of the species. The earliest record from the Teifi is from Cenarth in 1958 (Site 6 or nearby), and the next is from Aberbachnog in 1979 (Site 9); it is still present at both of these sites. It was first found at the others in 1993. The only certain comment that can be made about the history of the populations is that the one at site 8 must be less than about a decade old. Sites 2 and 4–9, all in the lower half of the river, are on the floodplain where seeds could easily have been transported by regular flooding.

Unlike many other crucifers, the epidermal cells of the seeds of *R. palustris* and *R. islandica* do

TABLE 3. SPECIES GROWING IN THE SAME COMMUNITIES AS AND WITHIN 1 M OF *RORIPPA ISLANDICA* AT EIGHT SITES IN THE TEIFI VALLEY, WALES

	Site no.							
Associated species	2	4	5	6	7	8	9	10 (marsh)
Agrostis capillaris					+	+	+	
A. stolonifera					+	+	+	+
Alisma plantago-aquatica	+	+	+					
Alnus glutinosa						+		
Alopecurus geniculatus	+	+	+		+		+	
Apium nodiflorum			+					
Bidens cernua	+				+			
B. tripartita	+	+	+			+		
Callitriche brutia		+	+		+	+	+	
C. stagnalis			+		+			
Cardamine flexuosa			+			+		
C. pratensis			+				+	
Carex remota			+					
C. vesicaria						+		
Chenopodium rubrum	+							
Eleocharis palustris								+
Equisetum arvense			+					
E. palustre								+
Festuca rubra				+				
Filipendula ulmaria			+					
Galium palustre								+
Glyceria declinata		+						+
G. fluitans	+	+	+					
Gnaphalium uliginosum	+	+	+		+	+	+	
Juncus articulatus			+			+		+
J. bufonius		+			+		+	+
J. effusus	+		+		+	+		
J. kochii								+
Lemna minor			+				+	
Lysimachia nummularia			+			+		
Lythrum portula					+	+	+	+
L. salicaria	+	+	+		+			
Matricaria discoidea				+		+		
Myosotis laxa								+
M. scorpioides		+						
Oenanthe crocata			+	+				
Persicaria amphibia	+		+			+		
P. hydropiper	+	+	+		+	+	+	+
P. maculosa								+
Phalaris arundinacea	+	+	+	+				
Plantago major				+	+			
Poa annua				+			+	
Potentilla anserina			+				+	+
Ranunculus flammula			+					+
R. repens		+		+	+		+	+
R. sceleratus	+							
Rorippa islandica	+	+	+	+	+	+	+	+
R. palustris		+				+		
Rumex obtusifolius		+					+	
Sagina procumbens				+				
Salix cinerea				+		+		+
Sparganium erectum						+		
Stellaria media				+	+			
Taraxacum sp.				+				
Trifolium repens				+				
Typha latifolia	+							
Urtica dioica			+					
Veronica beccabunga						+		

not produce mucilage, but are hollow (Jonsell 1968). This may have the advantage of making the seeds buoyant, facilitating dispersal in water, and enabling the seeds to be drawn up in water films as, for instance, by birds as they leave the water. Ridley (1930) reported the presence of *R. palustris* in many places by the River Thames at Kew, where its seeds can only have been carried by water, and he also found that seeds put in water floated for 24 days. The possibility of dispersal of *R. islandica* in water was tested by a simple experiment.

FLOTATION EXPERIMENT

Seeds of *R. islandica* and *R. palustris* were collected from ripe fruits of plants in cultivation on 7 September 1993. Batches of 20 seeds were floated on 200 ml of tap water in glasses, and the numbers of seeds floating were counted at intervals for two months. The water was agitated once each day by shaking the glass enough to cause the seeds to dip below the surface. The influence of surface tension was tested by adding two drops of household detergent (Fairy Liquid). Seeds in water floated in a group in the middle of the glass, whilst those in detergent lined up around the margin of the glass, as would be expected from the shape of the water meniscus. Seeds in detergent initially sank after agitation, but rose to the surface again after a minute or so. The results are shown in Table 4, and indicate that seeds of both species are buoyant in water for substantial periods of time. In water with detergent, it is possible that the larger epidermal cells of *R. palustris* are more easily infiltrated with water thus reducing their buoyancy.

Transport of seeds of *R. islandica* down the river by floods (which often occur in autumn when the seeds are ripe) would thus seem a strong possibility, although ending up in an appropriate habitat is purely a matter of chance. The dispersal of plants such as *Impatiens glandulifera* along river corridors is well known, and *Claytonia sibirica* and *Rorippa austriaca* are currently spreading on the Afon Tywi and Afon Loughor respectively in v.c. 44 (G. Hutchinson, pers. comm., 1993).

Seeds floating on the surface of the water are easily drawn up in a film of water when an object (e.g. a finger) is immersed and lifted out. It is possible to imagine the same type of mechanism being involved with birds' feet or plumage as they leave water.

BIRD DISPERSAL

Jonsell (1968) suggests that dispersal of seeds by geese is possible for *R. islandica* and points out the connections between its distribution and the migration routes of geese. Similar ideas have been put forward for other species (e.g. Heslop-Harrison 1953; Gornall 1987), and evidence for long-distance dispersal of seeds in the digestive systems of geese to Britain is given by Welch (1993). He collected droppings from where skeins of Pink-footed Geese migrating from Iceland first landed, and placed them in a moderately heated greenhouse on sterile compost, some immediately and some after a few months storage in a deep freeze. Seedlings which germinated immediately often died, perhaps due to the toxic conditions of the droppings, but in subsequent years some seedlings were successfully raised. Seeds may also be dispersed by mud on birds, and Kerner (1903; see also Ridley 1930) reports finding seeds of *R. palustris* and many other species, in mud from the feet, beaks and feathers of Swallows, Snipe, Wagtails and Jackdaws.

Jonsell's suggestion is especially worth considering in the case of the *R. islandica* populations on

TABLE 4. NUMBERS OF *RORIPPA* SEEDS (OUT OF 20) REMAINING AFLOAT DURING A FLOTATION EXPERIMENT

Days from start of experiment	*R. islandica*		*R. palustris*	
	Water	Water + Detergent	Water	Water + Detergent
0	20	20	20	20
1	20	20	20	17
13	20	20	20	15
15	20	20	20	14
23	20	20	20	0
61	20	20	20	0

the Afon Teifi. The Greenland White-fronted Goose (*Anser albifrons flavirostris*) breeds in west Greenland, and winters exclusively in Ireland, west Scotland and Wales (Fox & Stroud 1985). A flock wintered on Cors Caron, the raised mire complex on the upper reaches of the Teifi, from at least the 1890s (when it probably consisted of c. 30 birds) until the 1960s. Numbers had risen to 250–300 by 1940, to 400 by 1957, and to 550–600 by 1962. A catastrophic decline followed, and the geese ceased to winter regularly there after 1967/8 (Fox & Stroud 1985). *R. islandica* does occur in west Greenland but is rare there, but of much greater significance is the fact that many of these geese break their autumn migration to the British Isles on the west and south coasts of Iceland (Cramp 1977). One of the two main areas for *R. islandica* in Iceland is in Arness Syslá in the south west (Jonsell 1968) and dispersal from here by migrating geese at a time when seed was ripe could explain how the seed came to be present in the Teifi river system. *R. islandica* has not yet, however, been found anywhere on the Teifi above site 10 at Lampeter, which is some 15 km below the former main wintering grounds of the geese.

Greenland White-fronted Geese also wintered further north in Cardiganshire throughout the first half of the present century, including Cors Fochno on the south side of the Dyfi estuary, and since the 1950s flocks of about 80–250 birds have been wintering regularly on this estuary. Neither *R. islandica* or *R. palustris* have been recorded from this area. Elsewhere in Wales the only regular wintering flocks that might have been expected to be involved in seed-dispersal direct from Iceland or Greenland have been in Montgomeryshire and perhaps Anglesey. Small flocks and casual records have been made in many places, including the lower Teifi, and on the Tywi in Carmarthenshire (Fox & Stroud 1985).

If Gornall's (1987) hypothesis that *Ranunculus reptans* is dispersed to the British Isles mainly by Pink-footed Geese, Mallard or Wigeon is correct, then one might predict that *R. islandica*, which grows in similar habitats and places to *Ranunculus reptans* at least in Iceland, might be expected to show some similarities in distribution in Britain. However, the distributions of *Rorippa islandica* and *Ranunculus reptans* in Britain do not overlap, and only *Rorippa palustris* (which is absent from Iceland) has been recorded from Loch Leven, the classic site for *Ranunculus reptans*.

DISCUSSION

The recent discoveries in Ireland (Goodwillie 1994) and the Welsh data presented here indicate that *R. islandica* has been widely overlooked, and it should be looked for elsewhere. It would be surprising if the species was not as widespread on the catchments of the Loughor and Bran/Tywi as it is along the Teifi. We would welcome further records supported by voucher specimens composed of a few ripe fruits.

The Afon Teifi and the Irish turloughs appear to be the major stronghold for the species in north west Europe. The Scottish localities are all scattered and isolated and support small populations. It is somewhat erratic in appearance in the Isle of Man. Whilst there is no definitive evidence, it is likely that *R. islandica* is not a new arrival in Wales. Its local abundance would seem to be associated with dispersal by water, and it is possible that the wider distribution is related to dispersal by geese.

The occurrence along a river system is also unusual. In Ireland it occurs in turloughs and ditches near the sea. In Scotland it occurs in small ponds, damp ground and loch margins. In Iceland it occurs around lakes and small bodies of water, moist soil and also around hot springs. In Greenland it occurs around small lakes and temporary ponds, as well as on or beside paths. In Norway it occurs in small coastal pools, ditches and potato fields. In central Europe it occurs on the shores of alpine lakes (Jonsell 1968).

ACKNOWLEDGMENTS

We are grateful to R. Gwynn Ellis and George Hutchinson, National Museum of Wales, for loan of specimens, Bengt Jonsell for confirming the Cenarth material, Dick Roberts for help with the Anglesey records, Richard Pryce and John Killick for help with the Carmarthen records, Roger Goodwillie for an advance copy of his paper, Lin Gander for telling us of the Lampeter site, and

Chris Preston and the Biological Records Centre for the updated distribution map and comments on the draft manuscript. We would also like to thank the local landowners for access.

REFERENCES

BRADLEY, R. I. (1980). *Soils in Dyfed. Sheet SN24 (Llechryd). Soil survey record no. 63.* Soil Survey of England and Wales, Harpenden.

CHATER, A. O. (1994). The higher plants and vegetation of Cardiganshire, in Jones, I. G., ed., *Cardiganshire county history 1.* University of Wales Press, Cardiff.

CRAMP, S., ed. (1977). *Handbook of the birds of Europe, the Middle East and North Africa: The birds of the Western Palearctic 1.* Oxford University Press, Oxford.

DAVIES, H. (1813). *Welsh botanology.* W. Marchant, London.

FOX, A. D. & STROUD, D. A. (1985). The Greenland White-fronted Goose in Wales. *Nature in Wales n.s.* **4**: 20–27.

GOODWILLIE, R. (1994, in press). Irish distribution of *Rorippa islandica* (Oeder ex Murray) Borbás. *Irish Naturalists' Journal* **24**.

GORNALL, R. J. (1987). Notes on a hybrid spearwort, *Ranunculus flammula* L. × *R. reptans* L. *Watsonia* **16**: 383–388.

GRIFFITH, J. E. (1895). *The flora of Anglesey and Carnarvonshire.* Nixon & Jarvis, Bangor.

GRIME, J. P., HODGSON, J. G. & HUNT, R. (1988). *Comparative plant ecology.* Unwin Hyman, London.

HESLOP-HARRISON, J. (1953). The North American and Lusitanian elements in the flora of the British Isles, in Lousley, J. E., ed. *The changing flora of Britain*, pp. 105–123. Botanical Society of the British Isles, London.

HOLMES, N. T. H. (1983). *Typing British rivers according to their flora. Focus on nature conservation* **4**. Nature Conservancy Council, Shrewsbury.

JONSELL, B. (1968). Studies in north-west European species of *Rorippa* s. str. *Symbolae botanicae Upsaliensis* **19**: 1–222.

KERNER VON MARILAUN, A. (1903). *The natural history of plants*, translated by Oliver, F. W. The Gresham Publishing Company, London.

RICH, T. C. G. (1984). Asexual reproduction of *Barbarea vulgaris* R. Br. in the British Isles. *Watsonia* **15**: 121–122.

RICH, T. C. G. (1991). *Crucifers of Great Britain and Ireland.* B.S.B.I. Handbook no. 6. Botanical Society of the British Isles, London.

RIDLEY, H. N. (1930). *The dispersal of plants throughout the world.* L. Reeve & Co., Ltd, Ashford, Kent.

RODWELL, J. S., ed. (1991 *et seq.*). *British plant communities.* Cambridge University Press, Cambridge.

RUDEFORTH, C. C., HARTNUP, R., LEA, J. W., THOMPSON, T. R. E. & WRIGHT, P. S. (1984). *Soils and their use in Wales. Soil survey of England and Wales Bulletin No. 11.* Soil Survey of England and Wales, Harpenden.

STACE, C. A. (1991). *New Flora of the British Isles.* Cambridge University Press, Cambridge.

WELCH, D. (1993). A check on the transmission to Britain of creeping spearwort by pink-footed geese. *B.S.B.I. Scottish Newsletter* **15**: 15–16.

(*Accepted April 1994*)

A biometric survey of *Limonium vulgare* Miller and *L. humile* Miller in the British Isles

H. J. DAWSON and M. J. INGROUILLE

Biology Department, Birkbeck College, Malet Street, London, WC1E 7HX

ABSTRACT

Limonium vulgare Miller and *L. humile* Miller (Plumbaginaceae) are closely related species that grow on saltmarshes around the coasts of northern Europe including the British Isles. They are often found together in the same marsh. Morphometric analyses were performed on plants collected from sites around the British Isles. This demonstrated the close relationship of these two species and provided strong evidence for hybridization and introgression in sites where both species were present.

KEYWORDS: hybridization, introgression, self-incompatibility, population, speciation.

INTRODUCTION

Limonium vulgare Miller and the closely related *L. humile* Miller, of the family Plumbaginaceae, are found in saltmarshes around the coast of Ireland and Britain northwards to southern Scotland. They have been recognised as distinct species from the time of Ray (1724) as *Limonium majus vulgatius* and *Limonium Anglicum minus, caulibus ramosioribus, floribus in spicis rarius sitis*. *L. vulgare* has short spikes with densely arranged spikelets and *L. humile* is more laxly branched with long spikes and spikelets distant from each other (Salmon 1905a & b). *L vulgare* does not occur on the coast of Ireland, where it is replaced by *L. humile*. Both occur on the coasts of north-western continental Europe. They grow mixed together in some marshes but *L. humile* is more frequent in the lower marsh than *L. vulgare* (Boorman 1966, 1967).

The difficulties of the identification of the two species have been discussed by Dawson (1988). The confusion in identification between *L. humile* and *L. vulgare* has led to misleading reports and records from some areas and may have obscured the true distribution of both species across the British Isles. This confusion has arisen because of the high degree of variability in *L. vulgare* which has, in the past, led to the description of a wide variety of forms and variants. The variability is not environmentally determined as was thought previously (Clapham 1987). Boorman (1966) used comparative cultivation and transplant experiments to demonstrate that some of the variation is genotypic in origin. Genotypic variation is emphasised in marshes because of the extent of clonal reproduction by rhizomatous spread in *L. vulgare*. Large homogeneous patches with distinct morphologies are found growing next to each other.

The species differ for the most part in chromosome number, *L. vulgare* is a tetraploid $2n = 36$ and *L. humile* a hexaploid $2n = 54$ (Dawson 1990a). There is aneuploid variation in *L. humile* and some plants have $2n = 36$, like *L. vulgare*.

The species possess different breeding systems; *L. vulgare* is an obligate outbreeder and *L. humile* is a facultative inbreeder. Outbreeding in *L. vulgare* is enforced by a self incompatibility system accompanied by dimorphism of pollen and stigmas, with either 'A' pollen (coarsely reticulate) and Cob stigma or 'B' pollen (finely reticulate) and Papillate stigma. The A/Cob morph is heterozygous (AC.ac) and the B/Papillate morph homozygous (ac.ac). *L. vulgare* is also slightly heterostylous, although this character is very variable. *L. humile* is a self-compatible homostylous monomorphic species with an 'A' Papillate morph with the stigma compatible to B pollen as well as A pollen ($Ac^1.Ac^1$). The monomorphic condition is found rarely elsewhere in the genus, and is also found in the related genus *Armeria* (Miller) Willd. and is always derived from the normal dimorphic system (Vekemans *et al.* 1990).

The two species, *L. vulgare* and *L. humile*, provide excellent material for the examination of speciation and the origins and outcomes of different breeding systems.

SAMPLING AND METHODS

Plants were sampled from 52 sites across Britain and Ireland (Fig. 1) some of which had populations of both species present. Details of sample sites are recorded in Dawson (1990b). Material was sampled from sites to represent the whole range of variation present. Some populations were either very small and/or uniform and could be effectively surveyed with a small sample. Different numbers

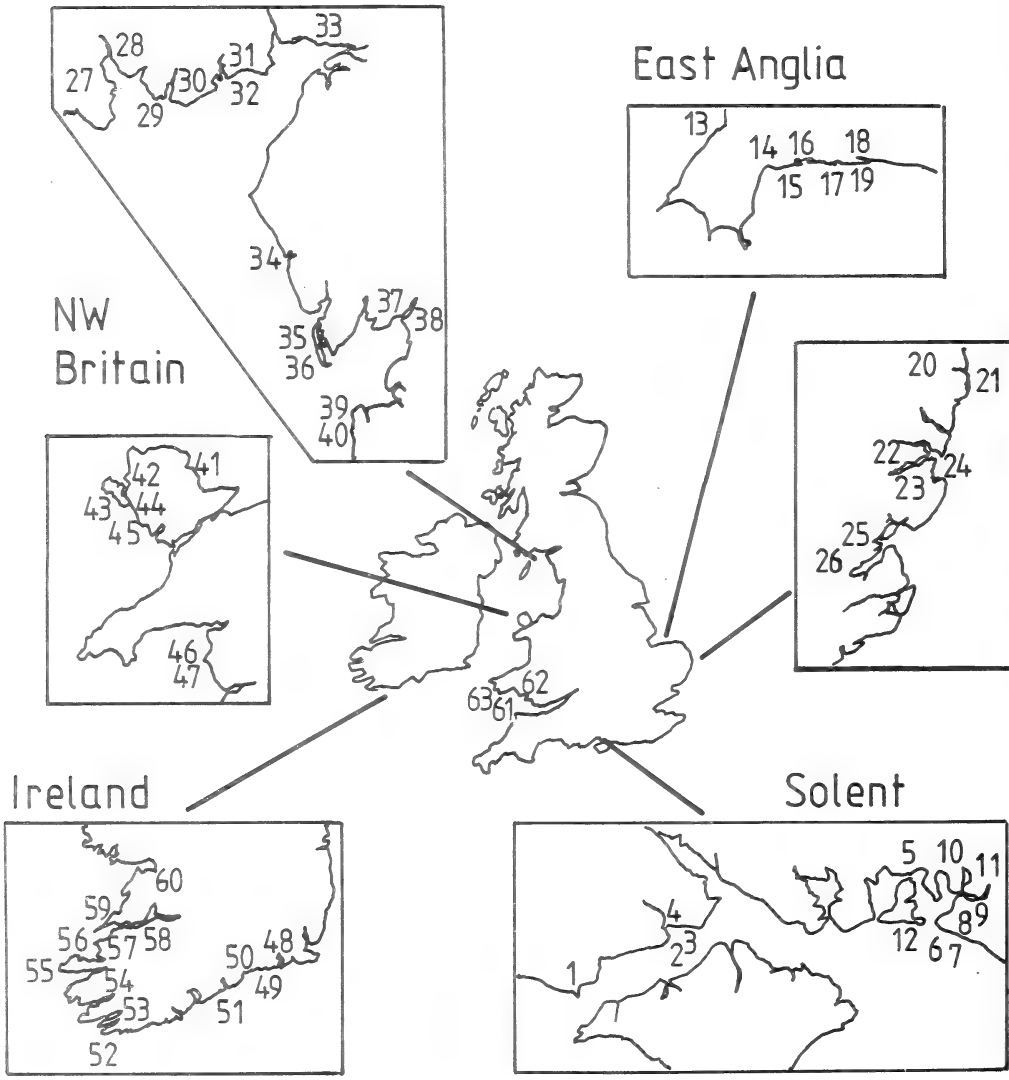


FIGURE 1. Geographical distribution of sampled sites of *Limonium* spp. (Population codes for British Isles as for O.T.U.s in Fig. 6).

of plants were collected at different sites. For the main survey of variation in the British Isles 580 plants were sampled and scored.

For the purpose of analysis, where a large number of populations were sampled, a number of geographical regions were circumscribed; Ireland, North West Britain (Scotland, Cumbria and Lancashire, North Wales), South Wales, the Solent Region, and East Anglia (Essex, Suffolk, Norfolk and Lincolnshire).

Plants from each site were first pressed and dried. Flowering spikes were removed from each plant on collection, labelled correspondingly and preserved separately in 70% ethanol.

The difference in pollen and stigma morph combination has been used to allocate plants to species in this work: A/Papillate = *L. humile*, A/Cob and B/Papillate = *L. vulgare*. This is however complicated by the mutated morphology of the Papillate stigma in *L. humile* plants, which is variable and somewhat intermediate between the Cob and Papillate morphology of the stigmas in *L. vulgare* (Dawson 1990b). There is also some variation in pollen morphology. Variation in stigma and pollen will be reported elsewhere. Pollen and stigma characters and those associated with heterostyly were not used in the multivariate analyses to investigate similarity.

An initial study was made on plants from two sites, chosen because they provided large, pure populations of each of the species: *L. vulgare* from Oxwich, Gower (v.c. 41, SS/514. 877) and *L. humile* from Dale, Dyfed (v.c. 45, SM/812.070). After this study an initial set of 33 scored characters was reduced to exclude those characters which proved difficult to measure accurately.

Following the methods described in Tabachnick & Fidell (1989) a number of characters were eliminated because of very high correlations with another character. Very high correlations may arise because of the logical correlation of characters. For example the length of secondary branches and the length of primary branches were very highly correlated ($r>0.90$) so that length of primary branches only has been included as a measure of branchiness. The length of secondary branches then becomes a superfluous character. In this situation the inclusion of superfluous characters can weight particular aspects of the morphology.

A set of characters which were highly correlated are branch length, spike length, number of spikelets and the distance between the lowest two spikelets. This is a general relationship perhaps relating to the potential to lengthen internodes. However in previous work it has been clear that *Limonium* species vary independently in these characters (Ingrouille 1984; Ingrouille & Stace 1985). For example, some species have an uneven distribution of spikelets on the spike with a relatively large distance between the first two spikelets. Others with a similar length of spike have an even distribution of spikelets on a spike.

Other high correlations between characters in the data set were between scape height and other vegetative measurements. It was clear that there was an overall size effect. Nevertheless scape height was clearly an important distinct character from overall size, one aspect of the ‘gestalt’ of the plant. A striking feature of variation on marshes is clones of markedly different ‘gestalt’, growing adjacent to each other (Dawson 1990b) and others with a similar ‘gestalt’ but differing in overall size. Scape height is only one aspect of the ‘gestalt’ but should nevertheless be included.

The inclusion of composite variables such as ratios between characters as well as the characters used to construct them may lead to inflated correlations (Tabachnick & Fidell 1989). In this work this has been avoided so that outer-bract length and outer bract width were included but not a ratio of outer-bract length to width. However this general rule has been relaxed in the analysis of ‘leaf shape’ which is a ratio of leaf length to leaf width. Leaf width, although significantly correlated to leaf shape, has also been included as a measure of maximum leaf size. In an examination of clones it was clear that leaf shape varied in two distinct ways: by the maximum size of leaf achieved by any clone and also by the relative narrowness of the leaf. Leaf length has not been included separately in the analysis.

Significant correlations between the characters remaining in the data set were the rule but it was neither possible nor desirable to try to abstract a set of characters which were not significantly correlated to each other. Significant correlations occur in a complex multidimensional way. In this large data set with just two species, significant correlations between characters were expected because particular sets of character measurements were associated with particular taxa or variants. It would not be desirable, in an analysis designed to measure the extent of relationship between taxa, a priori to limit the range of characters used on the basis of the presumed distinctiveness of those taxa.

It is not the level of statistical significance of correlations which is important but the actual level of the correlation. A data set with many very high correlations (say $r>0{\cdot}8$) lacks information content.

For the major survey 13 metric characters were used in the multivariate analysis. (Table 1, Fig. 2). There were no missing data. Correlations between these characters are reported in Table 2. The data were screened for the presence of outliers and non-normality and following the recommendations of Tabachnick & Fidell (1989) those characters which had high levels of skewness or kurtosis were transformed to their natural logarithmic value (Table 1). A few outliers were recoded as maximum or minimum values within the normal range. Characters were transformed to Z-scores.

Several different univariate and multivariate analyses were performed. Hierarchical analysis of variance of variables for plants within populations within regions was carried out to compare the patterns of variability in species. Multivariate analyses included discriminant function analysis,

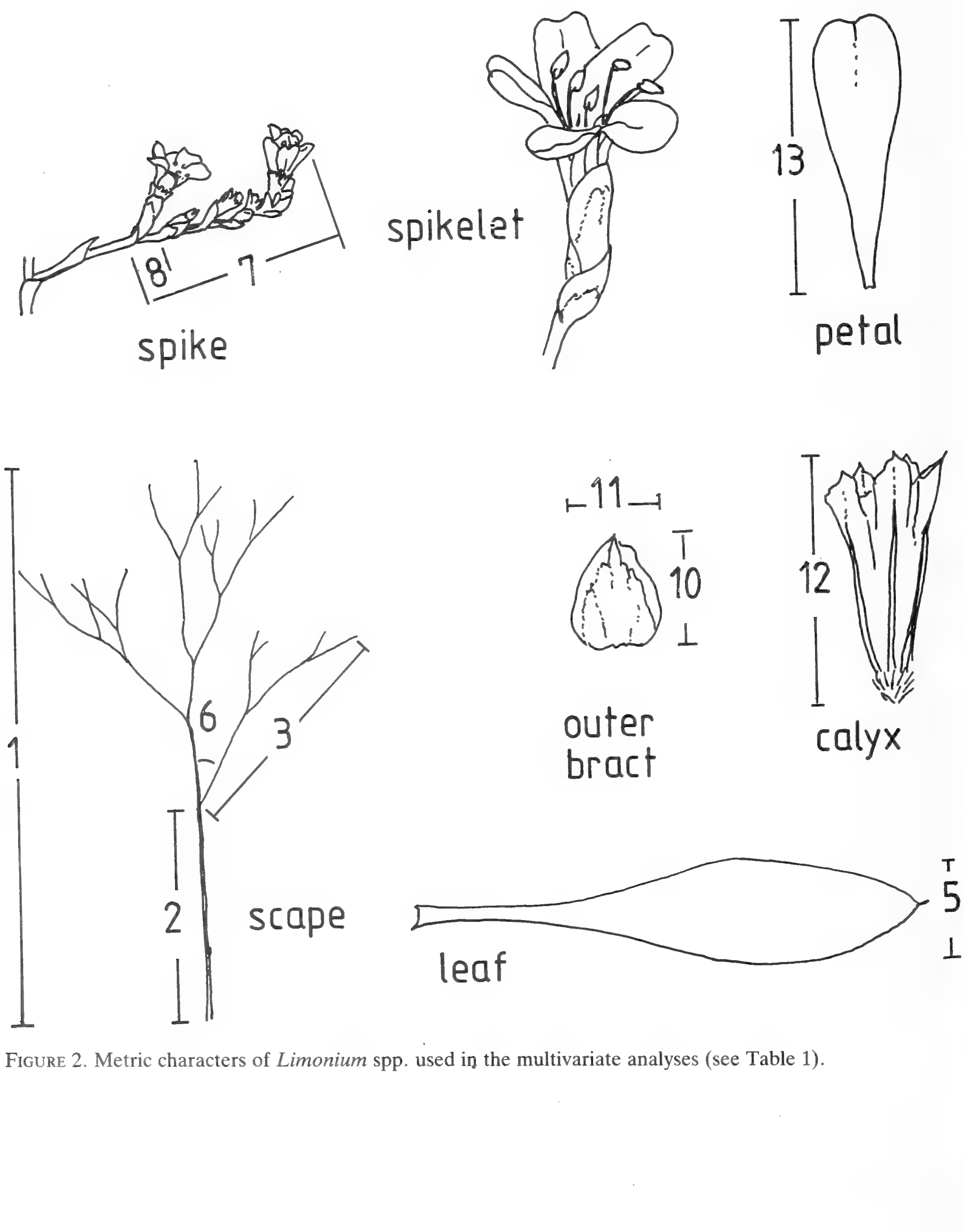


FIGURE 2. Metric characters of *Limonium* spp. used in the multivariate analyses (see Table 1).

TABLE 1. METRIC CHARACTERS OF *LIMONIUM* SPP. USED IN MULTIVARIATE ANALYSES

Character	Transformed (natural log)	No. of outliers* recoded of 580 cases
1. Scape height	yes	0
2. Height to first branching node	yes	6
3. Primary branch length	yes	1
4. Leaf shape	yes	0
5. Leaf width	yes	2
6. Branch angle	no	0
7. Spike length	yes	1
8. Spikelet distance	yes	2
9. Number of spikelets per spike	yes	1
10. Outer bract length	yes	2
11. Outer bract width	yes	1
12. Calyx length	no	0
13. Corolla length	no	2

* An outlier has a Z score >3.00.

TABLE 2. CORRELATION MATRIX BETWEEN CHARACTERS OF *LIMONIUM* SPP.
Probability in parentheses (n = 580)

	Characters 1	2	3	4	5	6	7	8	9	10	11	12
2	−0·00											
	(0·99)											
3	0·64	−0·10										
	(0·00)	(0·02)										
4	0·07	−0·15	0·12									
	(0·09)	(0·00)	(0·01)									
5	0·50	0·02	0·19	−0·09								
	(0·00)	(0·55)	(0·00)	(0·03)								
6	0·26	−0·02	0·17	0·08	−0·47							
	(0·00)	(0·69)	(0·00)	(0·05)	(0·00)							
7	0·21	−0·30	0·49	0·21	−0·11	0·16						
	(0·00)	(0·00)	(0·00)	(0·00)	(0·01)	(0·00)						
8	0·19	−0·12	0·08	−0·03	0·25	0·03	0·48					
	(0·00)	(0·00)	(0·07)	(0·53)	(0·00)	(0·49)	(0·00)					
9	0·19	−0·24	0·57	0·28	−0·25	0·18	0·80	0·02				
	(0·00)	(0·00)	(0·00)	(0·00)	(0·00)	(0·00)	(0·00)	(0·58)				
10	0·18	−0·04	0·29	0·06	0·08	0·01	0·41	0·22	0·36			
	(0·00)	(0·29)	(0·00)	(0·17)	(0·06)	(0·87)	(0·00)	(0·00)	(0·00)			
11	0·02	−0·11	0·24	0·20	−0·12	0·02	0·55	0·15	0·54	0·63		
	(0·64)	(0·01)	(0·00)	(0·00)	(0·01)	(0·56)	(0·00)	(0·00)	(0·00)	(0·00)		
12	0·10	−0·12	0·33	0·17	−0·04	−0·01	0·37	−0·12	0·47	0·45	0·43	
	(0·02)	(0·01)	(0·00)	(0·00)	(0·31)	(0·81)	(0·00)	(0·00)	(0·00)	(0·00)	(0·00)	
13	0·06	−0·03	0·01	−0·02	0·27	−0·17	−0·02	0·08	−0·10	0·20	0·07	0·28
	(0·15)	(0·44)	(0·88)	(0·63)	(0·00)	(0·00)	(0·00)	(0·55)	(0·05)	(0·02)	(0·08)	(0·00)

1=Scape height; 2=Height to first branching node; 3=Primary branch length; 4=Leaf shape; 5=Leaf width; 6=Branch angle; 7=Spike length; 8=Spikelet distance; 9=Number of spikelets per spike; 10=Outer bract length; 11=Outer bract width; 12=Calyx length; 13=Corolla length.

principal component analysis (P.C.A.) and cluster analysis on individuals and/or population means of British and Irish material. Cladistic methods were deemed unsuitable for the analysis of continuously varying characters.

Each multivariate method simplified the complex data set in different ways. Discriminant analysis was used to assess the level of intermediacy (hybridization/introgression) between species. P.C.A. and cluster analysis were used to detect patterns without any a priori allocation of plants to species. P.C.A. was carried out with VARIMAX rotation of the axes to maximise the interpretation of components in terms of the original characters. Cluster analysis was carried out on population means as O.T.U.s using both transformed character scores and also factor scores of factors with an eigenvalue greater than one. Several different measures of distance and clustering methods were tried including Ward's method of minimum variance clustering after the calculation of Squared Euclidean Distance.

Analyses were carried out using SPSSX (Norusis 1985) and NTSYS-pc (Rohlf 1990) statistical packages where appropriate.

RESULTS

Hierarchical analysis of variance of individual characters shows a contrasting pattern of variation in each species. An example is reported for the character corolla length in Table 3 and summarised in Table 4 for all 13 characters. *L. humile* is slightly more likely to have populations within regions more distinct than expected by chance from individual plant variation within populations, and *L. vulgare* is slightly more likely to have regions more distinct than expected by chance from variation between populations within regions. A comparison of amounts of variability which can be allocated to each source (Table 4) shows that within populations *L. vulgare* plants are significantly more variable than *L. humile* plants in seven characters. No characters are more variable for *L. humile* within populations.

No single character or pair of characters is effective for separating species. Character distributions of three important transformed characters are illustrated in Fig. 3.

Discriminant analysis using a combination of all characters is successful in identifying the two taxa (Table 5, Fig. 4). An analysis of variance of discriminant scores was highly significant. Characters highly weighted in the discriminant function include spike length and distance between the first two spikelets, previously used to identify species and also the outer bract width and calyx length. None of these characters, either individually or in combination effects a perfect separation of species (Fig. 3). Indeed even using all characters there is an overlap in discriminant scores, with 14 *L. humile* plants and 16 *L. vulgare* plants allocated incorrectly. Of the 16 mis-allocated *L. vulgare* eleven have the A/Cob pollen stigma combination. A statistically significant proportion (34) of the 50 *L. vulgare*

TABLE 3. HIERARCHICAL ANALYSIS OF VARIATION FOR COROLLA LENGTH IN *LIMONIUM* SPP.

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F-ratio
L. humile				
Between regions	7	966	138·00	1·53
Between populations within regions	34	3075	90·44	4·34*
Between plants within populations	268	5584	20·84	
Total	309	9625		
L. vulgare				
Between regions	8	2683	447·17	7·38*
Between populations within regions	27	1636	60·59	1·43
Between plants within populations	236	10005	42·39	
Total	271	14324		

* F-ratios significant at $p \leq 0{\cdot}05$.

TABLE 4. VARIABILITY OF *LIMONIUM VULGARE* AND *L. HUMILE* COMPARED; FREQUENCY OF SIGNIFICANT F-RATIOS (AT P≤0·05 LEVEL) IN 13 CHARACTERS

	No. of significant F-ratios (13 maximum)	
	L. humile	*L. vulgare*
F-ratio within species		
Between regions vs between populations within regions	6	8
Between populations within regions vs plants within populations	9	7
	L. humile/ *L. vulgare*	*L. vulgare*/ *L. humile*
F-ratio between species		
Regions	0	1
Populations within regions	3	1
Plants within populations	0	7

plants with the least discriminating scores (i.e. the 50 most similar to *L. humile*) are A/Cob (Table 6). Mis-allocated plants and plants with small discriminant scores are found almost entirely in mixed populations and concentrated in particular regions (Fig. 5).

Species distinctiveness differs markedly between regions (Table 7). Within species there are significant differences between regions for discriminant score (Table 8). The most distinct *L. humile* is found in the extreme north and west, in Ireland and Scotland. The most distinct *L. vulgare* is found in South Wales and East Anglia. In part this is related to the relative abundance of plants of each species in each region. It is most difficult to identify species in mixed populations in the Solent region, where in four mixed populations there are plants which are mis-allocated and in three of these marshes mean discriminant scores for different species are not or only just significantly different: probabilities of a significant difference are East Head $p \leq 0{\cdot}089$, Itchenor $p \leq 0{\cdot}050$, Chidham $p \leq 0{\cdot}134$. Elsewhere discriminant scores are significantly different even in mixed populations. The Solent Region has 66% of all mis-allocated plants in the discriminant analysis.

Within regions some populations are significantly different for discriminant score. Commonly this is related to whether the populations come from mixed sites or not. For example Cumbria/ Lancashire Ravenglass *L. humile* is distinct from the other populations of *L. humile* which are from mixed sites. Similarly the populations of *L. vulgare* found growing with *L. humile* in the Solent Region and Norfolk are statistically distinct from pure *L. vulgare* ones in the same regions. Elsewhere, occasional individual populations can be significantly distinct. Exceptionally *L. humile* plants from the far west of Ireland, where only pure *L. humile* populations are found have low discriminant scores. One *L. humile* plant from Poulnasherry Bay in County Clare was mis-allocated by discriminant analysis.

Cluster analysis of Squared Euclidean Distance by Ward's method proved most effective at clustering species separately. A small number of populations were clustered with populations of the other species, but often close to those from the same region. There were only minor differences between clustering using characters or factor scores. Clustering using character scores was slightly more successful than clustering factor scores; only five populations are mis-clustered compared to six using factor scores (Fig. 6). Only clustering using character scores is described in more detail here.

Mis-clustered *L. vulgare* populations are all from mixed sites. Itchenor and Needs Ore Point *L. vulgare* populations from the Solent are clustered in the major *L. humile* cluster in a small sub-cluster with the populations of *L. humile* also from the Solent. The Holme Island *L. vulgare* population clusters with the *L. humile* populations from its region of Lancashire and Cumbria. Two pure *L. humile* populations are mis-clustered: Treaddur Bay in North Wales and Rine Point in the far west of Ireland.

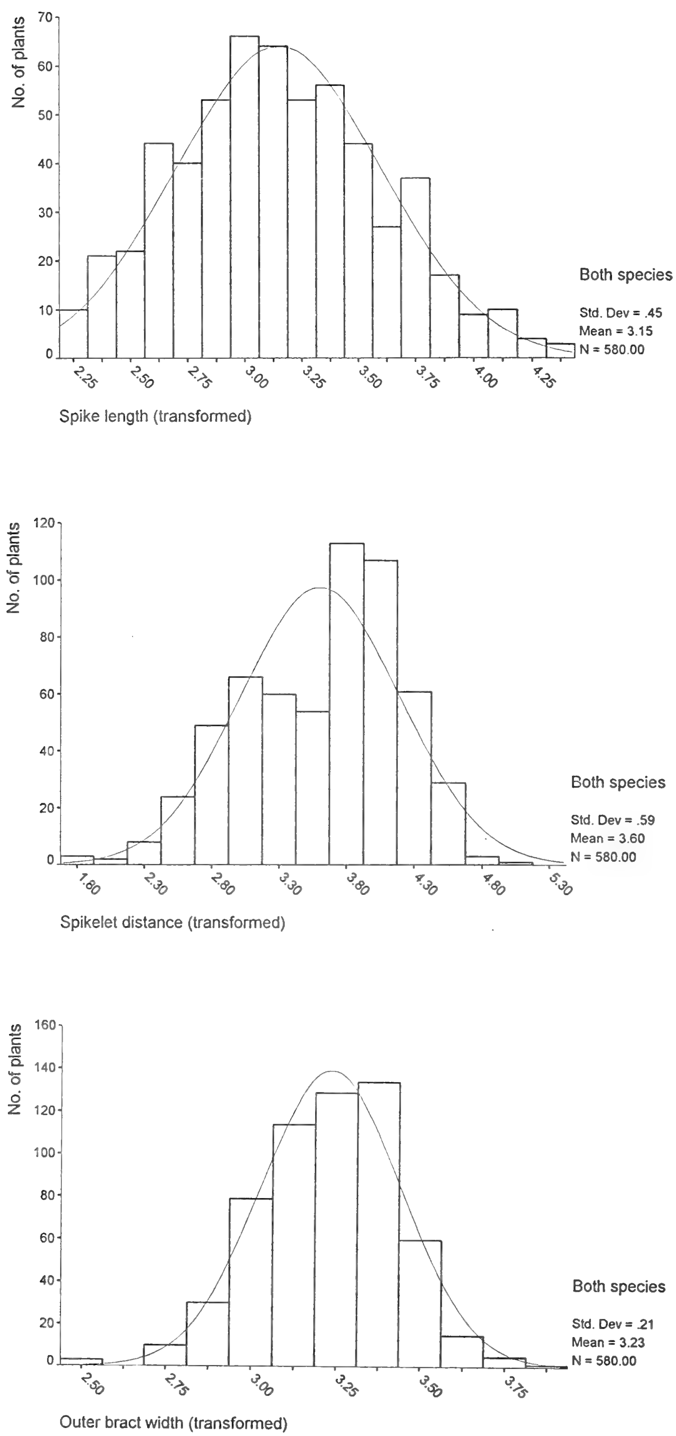


FIGURE 3. Histograms of transformed character measures of three characters: Spike length, Spikelet distance and Outer bract width of *Limonium* spp.

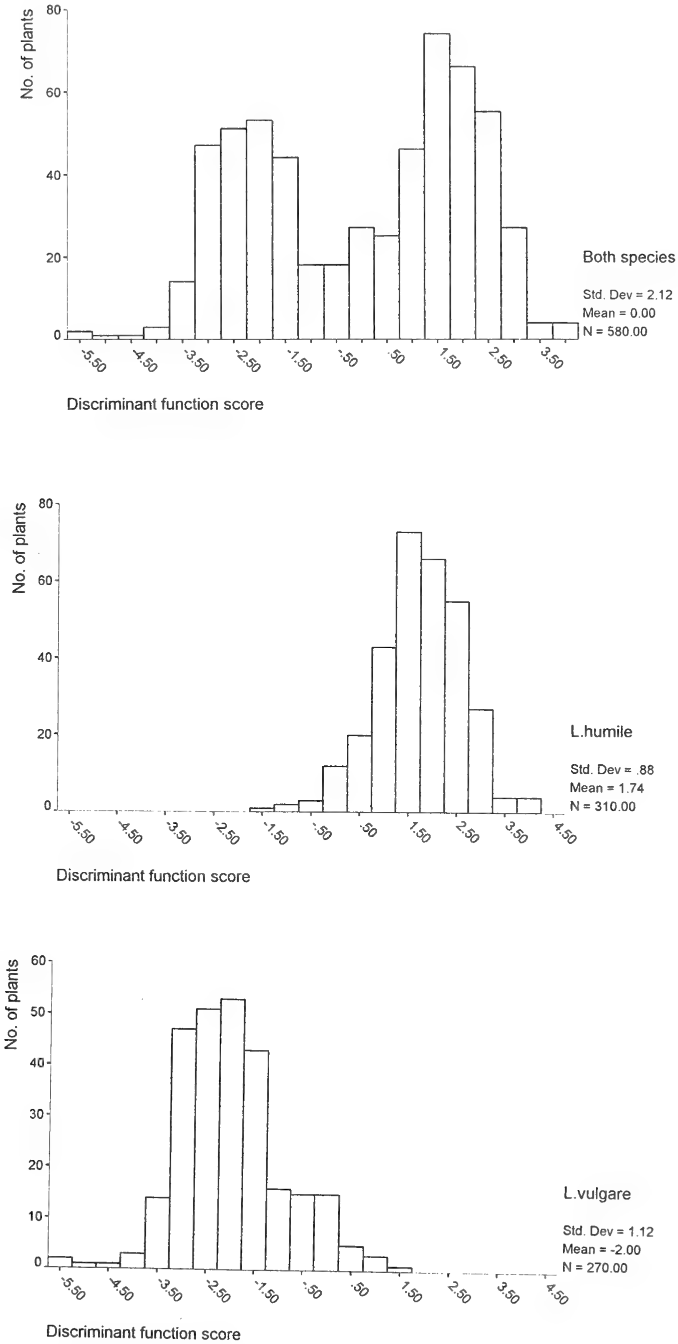


FIGURE 4. Histogram of discriminant scores for: all plants of both species, *Limonium humile* plants only and *L. vulgare* plants only.

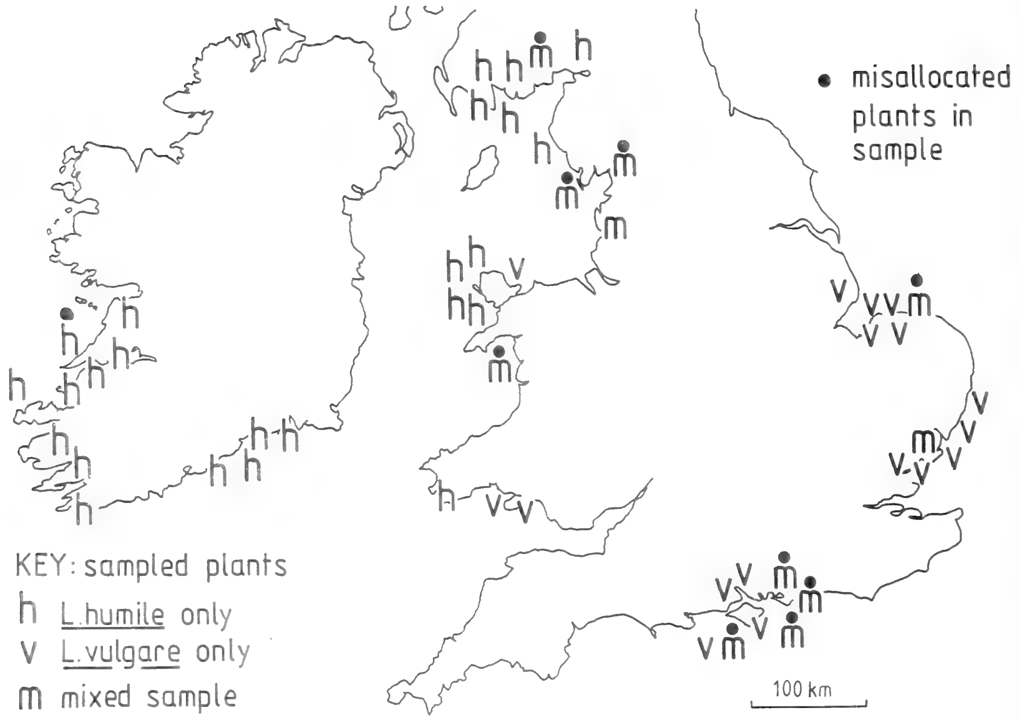


FIGURE 5. Summary of geographical origin of plants of *Limonium* spp. mis-allocated by the discriminant analysis.

TABLE 5. CHARACTERS OF *LIMONIUM* SPP. ORDERED BY CORRELATION WITHIN THE DISCRIMINANT ANALYSIS FUNCTION

Character	Pooled within groups correlations between characters and canonical discriminant functions
8. Spikelet distance	0·63
7. Spike length	0·34
11. Outer bract width	0·27
12. Calyx length	0·26
5. Leaf width	−0·24
3. Primary branch length	0·22
9. Number of spikelets per spike	−0·17
6. Branch angle	0·17
13. Corolla length	−0·14
10. Outer bract length	0·11
4. Leaf shape	0·09
2. Height to first branching node	−0·09
1. Scape height	−0·02

TABLE 6. ANALYSIS OF THE DISTRIBUTION OF STIGMA/POLLEN MORPHS IN THE MOST INTERMEDIATE *L. VULGARE* PLANTS

Stigma/pollen morph	Low Discriminant Scores	High Discriminant Scores	Totals
A/Cob	34	99	133
B/Papillate	16	121	137
Totals	50	220	270

Chi square = 8·62; $p \leq 0{\cdot}01$.

TABLE 7. DISCRIMINANT SCORES FOR *L. HUMILE* AND *L. VULGARE* IN DIFFERENT REGIONS

Region	Mean score *L. humile*	Mean score *L. vulgare*	Difference between means	Standard error of difference
1. Norfolk/Lincolnshire	1·49 (n=7)	−2·39 (n=61)	3·88	0·366 (df=66)
2. Suffolk/Essex	1·51 (n=7)	−2·22 (n=60)	3·73	0·356 (df=65)
3. Solent	0·89 (n=21)	−1·44 (n=62)	2·33	0·311 (df=81)
4. South Wales	1·53 (n=26)	−2·60 (n=38)	4·13	0·226 (df=62)
5. North Wales	1·68 (n=55)	−1·50 (n=23)	3·18	0·218 (df=76)
6. Cumbria/Lancashire	1·24 (n=24)	−1·74 (n=17)	2·98	0·307 (df=39)
7. Scotland	2·24 (n=40)	−0·90 (n=9)	3·14	0·317 (df=47)
8. Ireland	1·91 (n=130)			
Total	1·74 (n=310)	−2·00 (n=270)		

n = number of plants; df = degrees of freedom.
All differences significant at $p \leq 0{\cdot}01$.

TABLE 8. DIFFERENCES BETWEEN REGIONS FOR DISCRIMINANT SCORES OF *LIMONIUM HUMILE* AND *L. VULGARE*, REGIONS ORDERED BY SIZE OF DIFFERENCE

	Region							
L. humile	3	6	1	2	4	5	8	7
3. Solent								
6. Cumbria/Lancashire								
1. Norfolk/Lincolnshire								
2. Essex/Suffolk								
4. South Wales	★							
5. North Wales	★							
8. Ireland	★	★			★			
7. Scotland	★	★			★	★	★	

	Region						
L. vulgare	4	1	2	6	5	3	7
4. South Wales							
1. Norfolk/Lincolnshire							
2. Essex/Suffolk							
6. Cumbria/Lancashire	★	★					
5. North Wales	★	★	★				
3. Solent	★	★	★				
7. Scotland	★	★	★				

Duncan test, ★ = $p \leq 0{\cdot}05$.

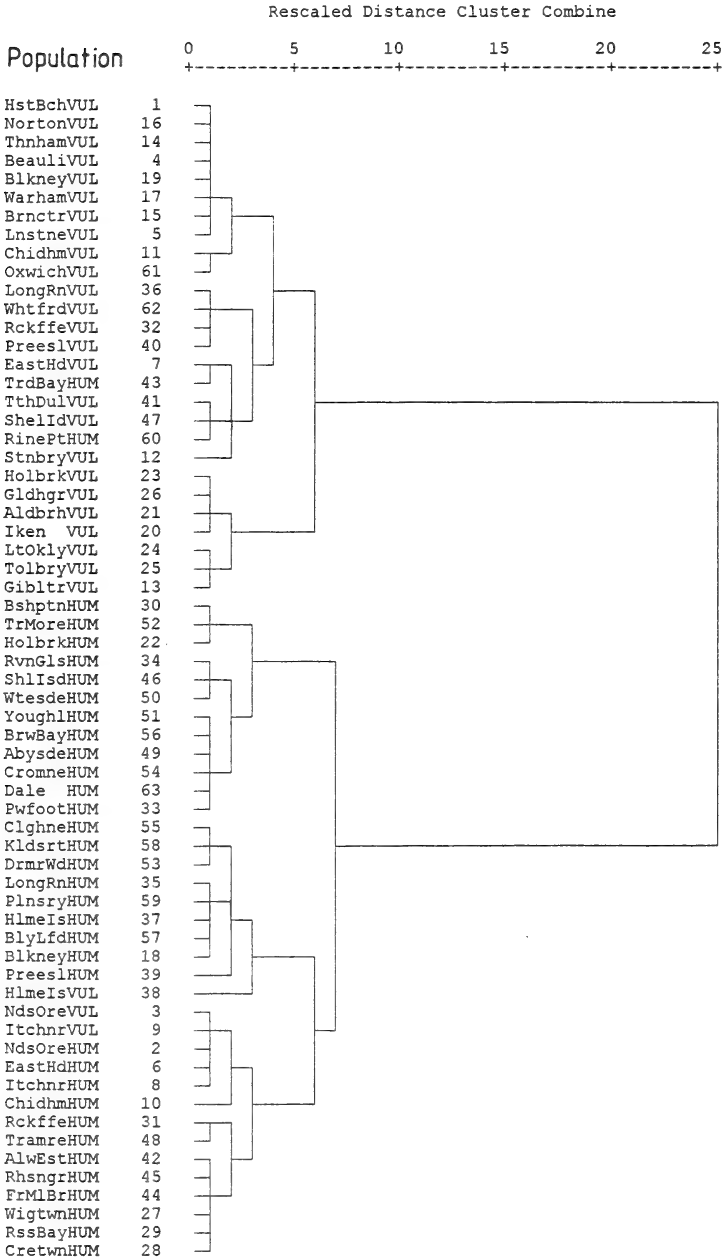


FIGURE 6. Phenogram of *Limonium vulgare* and *L. humile* populations from the British Isles. O.T.U. code numbers as in Fig. 1. (HUM = *L. humile*, VUL = *L. vulgare*.)

There is some clustering together of populations from the same region. For example, all six populations of *L. vulgare* from Essex and Suffolk cluster together with a population from Lincolnshire. All five *L. vulgare* populations from North Norfolk and four (of eight) from the Solent cluster together along with one from South Wales. Four (of six) *L. humile* populations from Scotland cluster with three others from North Wales and one from Ireland.

P.C.A. produces axes of variation which partially separate plants of different species. The first component was strongly correlated with the same characters discovered by discriminant analysis to be important discriminators. However multi-dimensional plots of factor scores do not effectively separate the two species but serve only to emphasise the overlap in species morphology. The second principal component was strongly correlated to overall size.

DISCUSSION

It is clear that *L. vulgare* and *L. humile* are morphologically very close. The ability to transform characters in a very simple way to produce near normal distributions of characters from the combined data set of both species is remarkable evidence for the continuity of variation between the two species. Of the best species discriminators only Spikelet Distance shows any trace of bimodality after transformation (Fig. 3b). No simple combination of easily measured characters can be used to identify species precisely. The best discriminating character is Spike Length but it is a character of debatable value; in eastern England and the Solent, Spike Length is plainly longer in *L. humile* than in *L. vulgare* but taxometric analyses of *L. humile* from several pure populations in Ireland show that here it is not necessarily significantly different from *L. vulgare* (Dawson 1990b).

The shape of the outer bract character given by Clapham (1987) is, in practice, unworkable. Although outer bract width is generally greater in *L. humile* there is very considerable overlap. Another character which has been used in keys is the degree of branching above or below the middle of the stem. This is one of the weakest discriminants.

Patterns of variation may be complicated by hybridization and introgression. Putative hybrid plants, intermediate plants as determined by discriminant analysis, are concentrated where both parental species are present in a marsh. This is strong evidence for hybridization, and it could have arisen because of the presence of intermediate habitats in these marshes. Nevertheless a concentration of intermediacy is the Solent region where a high degree of aneuploidy has also been detected. This is in plants with the *L. humile* stigma/pollen morph combination. *L. humile* is normally $2n=54$. Aneuploid plants are generally intermediate in gross morphology (Dawson 1990b). Intermediate *L. vulgare* plants have $2n=36$.

Intermediate/hybrid plants do have reduced pollen stainability though there is a broad range of values and some hybrids may be partly fertile. Those with the *L. humile* pollen/stigma morph have mean stainability of 68% (standard deviation = 18·9, n = 10) and those with the *L. vulgare* morphs have stainability of 84% (standard deviation = 14·4, n=15). This compares to stainabilities of 95% and 96% for the pure species *L. humile* and *L. vulgare* with little variation (Dawson 1990b).

Artificial hybrids are vigorous and at least partly fertile. The results of a small number of crossing experiments (Dawson 1990b) have shown that hybridization between the species is unidirectional and is only successful when *L. vulgare* is used as the male parent and *L. humile* as the female. This unidirectional inter-specific incompatibility is normal in other groups in crosses between a self-incompatible and self-compatible species; pollen from the parent with the intact self-incompatibility mechanism germinates successfully on the stigma of the self-compatible species but not the other way around.

However there is little evidence in nature that introgression is unilateral. Approximately equal numbers of intermediate plants are found in each species. Of the 40 plants mis-clustered in a cluster analysis of plants (Dawson 1990b) 17 were *L. humile* and 23 *L. vulgare*. Of the 30 plants misclassified by the discriminant analysis 14 were *L. humile* and 16 *L. vulgare* using their pollen/stigma combination.

There is a significant difference in the pollen/stigma morph of intermediate *L. vulgare* (Table 4). They more commonly have the A/Cob morph than the B/Papillate morph. This is expected because hybrids of a cross between an A/Cob *L. vulgare* plant (genotype AC/ac) and a *L. humile* plant (genotype Ac^1/Ac^1) produce A/Cob plants (genotype AC/Ac^1) and A/Papillate plants (genotype Ac^1/ac) in equal proportions.

It is unlikely that A/Cob intermediate plants can self-pollinate because they have a functioning Cob stigma gene. Nevertheless they may be able to act as males in backcrosses to either parental species: to *L. humile* because it has a mutated stigma gene and to *L. vulgare* because of the presence of B/Papillate plants. The consequences of having an unmutated stigma allele in intermediate A/

Papillate plants is not known. The A pollen could act in the same way as A pollen from the A/Cob intermediates. If selfing is possible it would give rise to a range of genotypes identical for pollen/stigma morph to pure B/Papillate *L. vulgare* or A/Papillate *L. humile* as well as hybrids, with genotypes in proportion 1 ac/ac(B/Cob):2 Ac^1/ac(hybrid A/Papillate):1 Ac^1/Ac^1 (A/Papillate *L. humile* type.

Another possibility is shown by *Armeria maritima* (Miller) Willd., which has an identical incompatibility system including some similar A/Papillate monomorphic populations. It also has some dimorphic populations, found on polluted soils, in which both A/Cob and B/Papillate morphs are partly self-compatible (Vekemans *et al*. 1990). In these populations it is the papillate morph which is the better selfer but the cob morph may also self effectively.

In *L. vulgare*/*L. humile* there is some evidence that introgression occurs in different directions in different regions. In North Wales and Scotland *L. vulgare* is the more intermediate in mixed populations. In East Anglia neither species has a high level of intermediacy in mixed populations. In Cumbria and Lancashire it is *L. humile* which is more intermediate in mixed populations. In the Solent Region both species have a high level of intermediacy in mixed populations.

The selective pressures that cause the breakdown of self-incompatibility systems are difficult to identify (Jain 1976) but are frequently associated with the colonization of marginal habitats (Stebbins 1950; Moore & Lewis 1965; Barrett 1988). In these circumstances the more assured production of seed shown by *L. humile* is an advantage. A generally lower position down the marsh may be for *Limonium* a more marginal position. *L. humile* is found in more open communities, often lower down the marsh than *L. vulgare*, where competition between species is lower. Its distribution is positively correlated with patches of bare mud (Boorman 1967, 1968, 1971).

Regional patterns of variation within each species are complicated by the different abundance of each species. The presence of both species within a marsh indicates a greater range of habitats, including intermediate habitats where plants with an intermediate morphology can grow successfully. There may have been selection within the gene pool of either species, enlarged or not by hybridization, for characteristics which allow them to grow within the ecological range of the other species. Different relative abundance also alters the potential for hybridization and introgression in different regions. *L. vulgare* is absent from Ireland and in Scotland and North Wales *L. humile* is the much commoner species. In East Anglia it is *L. vulgare* which is much more abundant.

Clear patterns of geographical variation in salt-marsh vegetation have been noted in Britain both on a broad geographical scale and more locally (Adam 1978). Part of this is clearly related to climate. For example, Scottish marshes are distinct because they are beyond the climatic limits of many important southern salt-marsh species. They are also more frequently subject to fresh-water run-off from the dry-land. Another important factor is the varying importance of grazing in marshes. Those around the Irish Sea are often very grassy as a result of grazing. They are also sometimes narrow or have a small altitudinal range over a large part of them. All these factors may influence the patterns of variation within and between regions. However apart from the continuum of variation between *L. vulgare* and *L. humile* there is no broad geographical pattern of variation, say from south-east to north-west. Differences in variation are more haphazard, but here too may reflect local variation between marshes. This kind of variation has been noted in *Salicornia* even in some of the same marshes sampled here (Ingrouille & Pearson 1987; Ingrouille *et al*. 1990).

It has been frequently suggested that inbreeding species and obligate outbreeders have contrasting patterns of variation (Loveless & Hamrick 1984). Inbreeders are homogeneous within populations but have distinct populations. Outbreeders are more variable within populations with less distinct populations. This pattern has been found in the *Limonium* species pair described here. Neighbouring individual plants of *L. vulgare* are more likely to be distinct than neighbouring plants of *L. humile* (Table 3). This observable difference is exaggerated because *L. vulgare* grows as large homogeneous clonal patches producing tens or hundreds of genetically identical flowering scapes. *L. humile* plants are smaller and more discrete with fewer scapes. This contrast is part of the differing strategies exhibited by the species. It will be described in detail elsewhere.

There are clearly two distinct species if one resorts to stigma and pollen morph to identify them. Since these are characters of considerable biological importance, relating to reproductive isolation, it is taxonomically worth maintaining two distinct species. However this kind of difference in *Armeria maritima* is not normally considered significant enough to merit specific recognition. Northern populations of *A. maritima* are monomorphic like *L. humile* with the A/Papillate morph.

There is considerable gross morphological variation within *A. maritima* which might be used to distinguish species in characters such as hairiness, calyx size and leaf shape for example (Lefebvre 1971; Philipp 1974). The monomorphic variant of *Armeria* is sometimes given specific rank as *A. sibirica* but is only one of several subspecies of *A. maritima* recorded in *Flora Europaea* (Gorentflot & Roux 1972; Pignatti 1972).

The correct identification of *L. vulgare* and *L. humile* can be fraught with difficulties for the non-expert even if pollen/stigma morph is used. This was graphically illustrated to M.J.I. when a class of final year B.Sc. students asked to identify the species from stigma and pollen morph routinely made an incorrect identification even with the aid of microscopes. Their difficulty was not a result of poor observation, but because stigma and pollen morphology is more variable than has been recognised previously. The stigma of *L. humile* is somewhat intermediate between the clearly contrasting Cob and Papillate morphs of *L. vulgare* (Dawson 1990b) and the 'A' pollen is variable.

Nevertheless, despite extensive hybridization where they grow together, *L. humile* and *L. vulgare* are distinct species, with different chromosome numbers and, perhaps related to this, some restriction on their ability to produce fully fertile hybrids.

ACKNOWLEDGMENT

H. J. Dawson acknowledges the financial support of the S.E.R.C. during the course of this work.

REFERENCES

Adams, P. (1978). Geographical variation in British saltmarsh vegetation. *Journal of ecology* **66**: 339–366.

Barrett, S. C. H. (1988). The evolution, maintenance and loss of self incompatibility systems, in Lovett-Doust, J. & Lovett-Doust, L., eds. *Plant reproductive ecology*, pp. 98–124. Oxford University Press, Oxford.

Boorman, L. A. (1966). *Experimental studies in the genus* Limonium. D. Phil. thesis, University of Oxford.

Boorman, L. A. (1967). *Limonium vulgare* Miller and *L. humile* Miller, in the Biological Flora of the British Isles. *Journal of ecology* **55**: 221–232.

Boorman, L. A. (1968). Some aspects of the reproductive biology of *Limonium vulgare* and *L. humile*. *Annals of botany* **32**: 803–807.

Boorman, L. A. (1971). Studies in salt marsh ecology with special reference to the genus *Limonium*. *Journal of ecology* **59**: 103–120.

Clapham, A. R. (1987). *Limonium* Miller, in Clapham, A. R., Tutin, T. G. & Moore, D. M., eds. *Flora of the British Isles*, 3rd ed. Cambridge University Press, Cambridge.

Dawson, H. J. (1988). *Limonium vulgare* Miller/*L. humile* Miller, in Rich, T. C. G. & Rich, M. D. B., eds. *Plant crib*, pp. 71–72. Botanical Society of the British Isles, London.

Dawson, H. J. (1990a). Chromosome numbers in two *Limonium* species. *Watsonia* **18**: 82–84.

Dawson, H. J. (1990b). *Variation and evolution in* Limonium vulgare *Miller and* L. humile *Mill. (Plumbaginaceae) in the British Isles*. Ph.D. thesis, University of London.

Gorentflot, R. & Roux, M. (1972). Traitement numérique de populations d'*Armeria maritima* (Mill.) Willd. d'Europe occidentale et centrale. *Revue générale de botanique* **79**: 341–56.

Ingrouille, M. J. (1984). A taxometric analysis of *Limonium* (Plumbaginaceae) in Western Europe. *Plant systematics and evolution* **147**: 103–118.

Ingrouille, M. J. & Stace, C. A. (1985). Pattern of variation of agamospermous *Limonium* (Plumbaginaceae) in the British Isles. *Nordic journal of botany* **5**: 113–125.

Ingrouille, M. J. & Pearson, J. P. (1987). The pattern of morphological variation in the *Salicornia europaea* L. aggregate (Chenopodiaceae). *Watsonia* **16**: 269–281.

Ingrouille, M. J., Pearson, J. P. & Havill, D. C. (1990). The pattern of variation in the *Salicornia dolichostachya* Moss group from different sites in southern England. *Acta botanica neerlandica* **39(3)**: 263–273.

Jain, S. K. (1976). The evolution of inbreeding in plants. *Annual review of ecology and systematics* **7**: 469–495.

Lefebvre, C. (1971). Populations naturelles et expérimentales d'*Armeria vulgaris* Willd. *Bulletin du Société Royale Botanique de Belgique* **104**: 71–78.

Loveless, M. D. & Hamrick, J. L. (1984). Ecological determinants of genetic structure in plant populations. *Annual review of ecology and systematics* **15**: 65–95.

Moore, D. M. & Lewis, H. (1965). The evolution of self pollination in *Clarkia xantiana*. *Evolution* **19**: 104–114.

Norusis, M. J. (1985). *SPSSX. Advanced statistics guide.* McGraw Hill, New York.
Philipp, M. (1974). Morphological and genetical studies in the *Armeria maritima* aggregate. *Botaniska tidskrift* **69**: 40–51.
Pignatti, S. (1972). *Armeria* Willd. and *Limonium* Miller, in Tutin, T. G. *et al.*, eds. *Flora Europaea* **3**: 30–50. Cambridge University Press, Cambridge.
Ray, J. (1724). *Synopsis methodica stirpium Britannicarum*, facsimile edition. Ray Society, London.
Rohlf, F. J. (1990). *NTSYS-pc, Numerical taxonomy and multivariate analysis system, version 1.60.* Exeter Software, Seatauket, New York.
Salmon, C. E. (1905a). Notes on *Limonium* III. *Limonium vulgare. Journal of botany, London* **43**: 5–14.
Salmon, C. E. (1905b). Notes on *Limonium* IV. *Limonium humile. Journal of botany, London* **43**: 54–59.
Stebbins, G. L. (1950). *Variation and evolution in plants*. Columbia University Press, New York.
Tabachnick, B. G. & Fidell, L. S. (1989). *Using multivariate statistics*, 2nd ed. Harper Collins, New York.
Vekemans, X., Lefebvre, C., Belalia, L. & Meerts, P. (1990). The evolution and breakdown of the heteromorphic incompatibility system of *Armeria maritima* revisited. *Evolutionary trends in plants* **4**: 15–23.

(*Accepted May 1994*)

Potamogeton × *schreberi* G. Fisch. (*P. natans* L. × *P. nodosus* Poir.) in Dorset, new to the British Isles

C. D. PRESTON

Institute of Terrestrial Ecology, Monks Wood, Abbots Ripton, Huntingdon, PE17 2LS

ABSTRACT

Potamogeton × *schreberi* G. Fisch. (*P. natans* L. × *P. nodosus* Poir., Potamogetonaceae) was discovered in 1992 in the River Stour, Dorset, the first record from the British Isles. Both *P. natans* and *P. nodosus* are recorded from the R. Stour, although neither has been found growing with *P.* × *schreberi*. The Dorset plant is described and compared with material from Germany and Switzerland. *P.* × *schreberi* differs from *P. natans* in having laminar submersed leaves and from *P. nodosus* in having phyllodes near the base of the stem and narrower submersed leaves which are entire rather than minutely denticulate. The differences between this hybrid and *P.* × *fluitans* Roth (*P. natans* × *P. lucens* L.) and *P.* × *sparganiifolius* Laest. ex Fr. (*P. natans* × *P. gramineus* L.) are discussed. *P.* × *schreberi* appears to be sterile, but is apparently able to persist and spread by vegetative reproduction.

KEYWORDS: hybrid, *Potamogeton* × *fluitans*, *P.* × *sparganiifolius*, vegetative reproduction, England.

INTRODUCTION

Potamogeton nodosus Poir. (Loddon Pondweed) has been known from the River Stour in Dorset since 1928, when it was first recorded (as *P. drucei* Fryer) by Druce (1929). In 1988–89 its distribution in the river was surveyed for the Nature Conservancy Council by Lady Rosemary FitzGerald, D. A. Pearman and other local botanists (FitzGerald 1990). The plant proved to be locally abundant in the river for about 9 km from immediately above Hayward Bridge at Child Okeford, grid reference ST/825.122, downstream to Blandford Bridge at Blandford Forum, ST/884.060 (see Fig. 1). All known herbarium specimens collected prior to this survey come from the same stretch of river. Most of them were collected at Hayward Bridge, the best known site for the species and the one where Druce was photographed examining it in 1931 (Allen 1986).

Although all the authenticated records of *P. nodosus* have been made at Hayward Bridge or downstream of it, there are a number of unconfirmed reports of the species at sites some distance upstream of Child Okeford. Good (1969) reported that *P. nodosus* "was found in considerable quantity, and flowering and fruiting well" during a Dorset Natural History and Archaeological Society excursion to West Mill, Stalbridge, on 27 July 1968. In 1981 the Rev. A. J. C. Beddow reported *P. nodosus* from Marnhull, and the distribution of the species was summarised by Good (1984) as "plentiful in the R. Stour between Marnhull Ham and Child Okeford". Both Marnhull and Stalbridge are more than 10 km upstream of Child Okeford. FitzGerald (1990) and her colleagues made determined searches for *P. nodosus* at West Mill and other localities upstream of Child Okeford, but failed to find it.

In 1992 Dr H. J. M. Bowen and Dr C. Turner reported that they had recently seen *P. nodosus* in quantity at Marnhull, in a stretch of river which had not been surveyed by FitzGerald (1990). This appeared to provide an opportunity of confirming the presence of the species upstream of Child Okeford. I visited the area on 14 October 1992 with D. A. Pearman, and we found the population Bowen and Turner had discovered. Examination of these plants showed that they were not *P. nodosus* but a hybrid between *P. natans* L. (Broad-leaved Pondweed) and a species with broad submersed leaves. At first I tentatively concluded that the other parent must be *P. lucens*. More detailed examination of the material, following a second visit to the site in July 1993, revealed characters which were inconsistent with this parentage, but could be explained if the broad-leaved parent was not *P. lucens* but *P. nodosus*. The putative hybrid between *P. natans* and *P. nodosus*

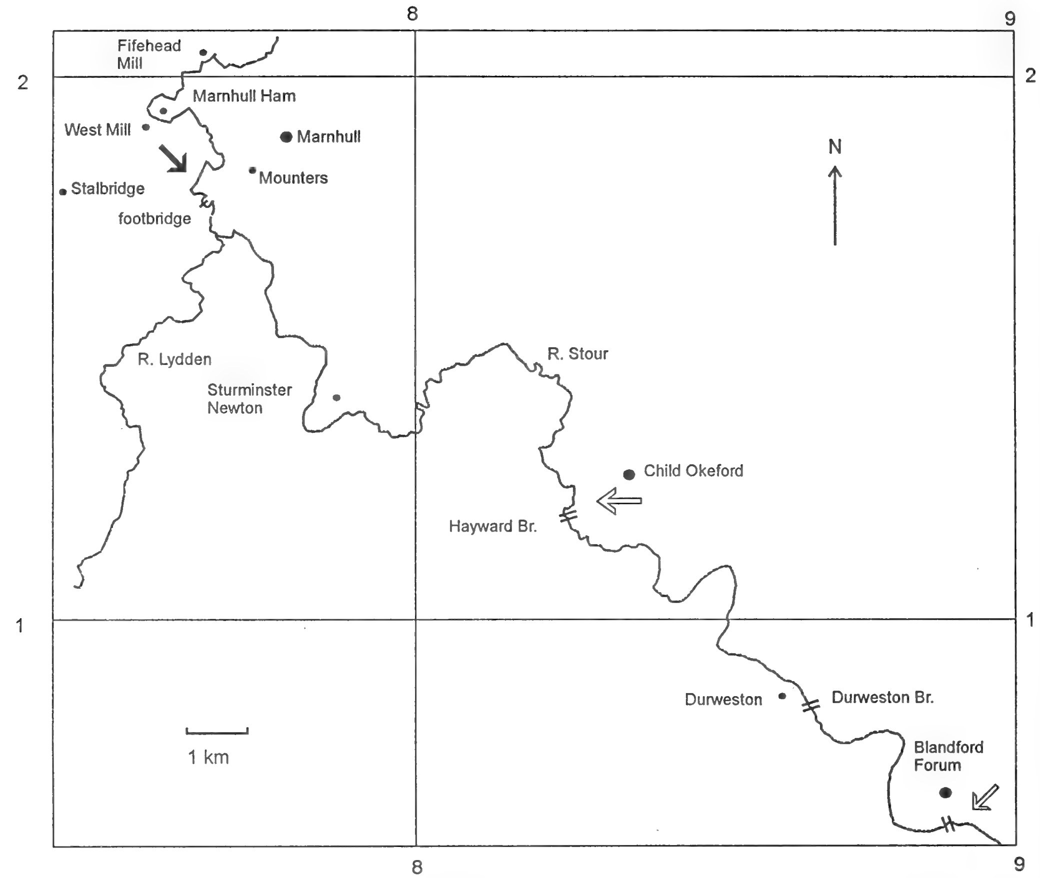


FIGURE 1. Map of the River Stour between Fifehead Mill and Blandford Forum, Dorset, showing the 10-km squares of the national grid and the place-names mentioned in the text. The stretch of river in which *P.* × *schreberi* is found is shown by a solid arrow. *P. nodosus* grows in the river between the open arrows. Details of the records of *P. natans* are given in the text.

(*P.* × *schreberi* G. Fisch.) has not hitherto been recorded in the British Isles, but is known from Germany and Switzerland. Comparison of the Dorset plant with continental material has shown that it is similar, and I have therefore concluded that it is indeed *P.* × *schreberi*.

A preliminary analysis of the isozymes of *P. nodosus* and the putative hybrid from the R. Stour and *P. natans* from the Moors River (v.c. 11, S. Hants) has added support to the hypothesis that the Stour hybrid is *P.* × *schreberi* (P. M. Hollingsworth 1993, unpublished data). *P. natans* and *P. nodosus* differed consistently in five enzyme systems, for all of which the hybrid showed a banding pattern which combined the bands of both putative parents. The remaining three enzyme systems produced banding patterns which were invariant across all three taxa.

More fieldwork is needed to establish the distribution of the hybrid and its putative parents in the R. Stour, but this paper has been written to document the occurrence of the plant in the British Isles prior to its inclusion in a forthcoming B.S.B.I. handbook.

DESCRIPTION

The following description is based on fresh material and pressed specimens collected from the R. Stour in Dorset.

Rhizome 2·5–4·2 mm in diameter. Stem 0·5–2·2 m long, 1·75–4·0 mm in diameter near the base, terete, unbranched. Phyllodes present at base of stem, 95–133 × 2·3–2·6 mm, 41–52 times as long as wide, opaque, green, slightly canaliculate, acute at the apex. Submersed leaves with lamina 56–182 × 2·5–14·5 mm, (6–)10–20(–31) times as long as wide, translucent, pale brown when young, green when mature, linear-elliptical, very gradually tapering into the petiole, acute at the apex, entire, the midrib bordered on each side by a band of lacunae up to 1 mm wide, the lateral veins 1–4 on each side of the midrib, the secondary veins transverse or ascending, rather irregular; petioles (60–)100–355 mm. Transitional leaves present between the submersed and the floating leaves. Floating leaves with laminae all pointing in the same direction on the surface of the water, 68–140 × 16–45 mm, 2·3–5·8 times as long as wide, opaque, subcoriaceous or coriaceous, rather flaccid, brown or brownish green when young, rather dark olive green when mature, elliptical to oblong-elliptical, tapering into the petiole, acute at the apex, entire, the lateral veins 5–10 on each side of the midrib, paler than the lamina when the living leaf is held up to the light, the secondary veins inconspicuous; petioles 89–180(–330) mm, without a distinct, discoloured section between the petiole and the lamina. Stipules 60–141 mm, rigid, translucent, brownish green, green, colourless with a greenish tinge or pale pink, with two slight or strong ridges along their length, obtuse to rounded and slightly hooded at the apex but appearing acute when rolled inwards. Inflorescences 22–28 × c. 6 mm; peduncles 46–79 mm, slightly compressed towards the base, similar in diameter from base to apex, spongy. Flowers 33–48, crowded together, with 4 carpels which protrude through the closed perianth segments; pollen apparently sterile. Fruits not developing.

IDENTIFICATION OF *P.* × *SCHREBERI*

Potamogeton × *schreberi* can be distinguished without difficulty from its putative parents. It has linear phyllodes at the base of the stem, but above these there are submersed leaves with a distinct lamina. These submersed leaves vary from leaves which resemble phyllodes but are expanded into a narrow, rather opaque lamina at the distal end, to leaves with a much more distinct, translucent lamina. *P. natans* has phyllodes but lacks laminar submersed leaves; *P. nodosus* lacks phyllodes but has laminar submersed leaves. The submersed leaves of *P. nodosus* are broader than those of *P.* × *schreberi* and are minutely denticulate (the teeth on fresh leaves can be seen in the field with a ×20 lens) whereas those of *P.* × *schreberi* are absolutely entire, even when examined at high power under the microscope. All three taxa produce floating leaves. The floating leaves of *P. natans* usually (but not invariably) have a discoloured, flexible section between the petiole and the lamina. This is not found in either the hybrid or *P. nodosus*. However, in some living leaves of *P.* × *schreberi* the petiole adjacent to the lamina is slightly browner than the green lamina or greenish brown petiole, and this may represent a vestige of the flexible section of *P. natans*. Because they lack this flexible section, the floating leaves of *P.* × *schreberi* tend to point to the same direction whereas those of *P. natans* do not.

At anthesis the flowers of the putative parents open, whereas the carpels of *P.* × *schreberi* protrude through closed perianth segments (as in some other sterile hybrids). *P. natans* fruits regularly. I have not seen any fruiting material of *P. nodosus* collected in Britain in the wild, although plants from the River Loddon cultivated by Fryer (1899) did develop some well-formed fruit (specimens in **BM**). Druce (1929) reported that the species was fruiting freely in the R. Stour in September 1928, but although he distributed specimens collected on this visit I have not yet seen any with fruits. The inflorescences of *P.* × *schreberi* in Dorset show no sign of developing fruit, and the pollen appears to be sterile (under the microscope the grains appear to be collapsed like a burst football).

Potamogeton × *schreberi* is more similar to two other hybrids than it is to its putative parents: *P.* × *fluitans* Roth (*P. natans* × *lucens*) and *P.* × *sparganiifolius* Laest. ex Fr. (*P. natans* × *gramineus* L.). Both of these (like *P.* × *schreberi*) are hybrids between *P. natans* and species with broad submersed leaves, and both have phyllodes at the base of the stem, laminar submersed leaves and possess the capacity to produce floating leaves. *P.* × *fluitans* is a variable hybrid, but all the populations I have examined have had stipules with two narrow wings at the base, extending for most of the length of the stipule. This character is derived from *P. lucens*, which has stipules winged for most of their length. The midrib of the submersed leaves of *P.* × *fluitans* lacks a border of lacunae and can be excurrent for up to 12 mm. Both the submersed and floating leaves of *P.* × *fluitans* have shorter petioles than those of *P.* × *schreberi*. *P.* × *sparganiifolius* is more difficult to distinguish from *P.* × *schreberi* but its submersed leaves can be much longer both in absolute terms and in relation to their width (especially in running water), and the fully developed submersed leaves have a shorter petiole than those of *P.* × *schreberi*. In both *P.* × *fluitans* and *P.* × *sparganiifolius* the lamina is usually longer than the petiole, whereas in *P.* × *schreberi* it is shorter than or only slightly exceeds the petiole. The shorter petioles of the submersed leaves of *P.* × *fluitans* and *P.* × *sparganiifolius* reflect the fact that the submersed leaves of *P. lucens* have a short petiole, and those of *P. gramineus* are sessile, whereas those of *P. nodosus* have a long petiole. When comparing the submersed leaves of these taxa the true submersed leaves should be considered, not leaves which are transitional between submersed and floating leaves.

The differences between *P. natans*, *P. nodosus*, *P.* × *fluitans*, *P.* × *sparganiifolius* and *P.* × *schreberi* are summarised in Table 1.

COMPARISON OF THE DORSET PLANT WITH CONTINENTAL MATERIAL

Potamogeton × *schreberi* is recorded from Germany and Switzerland (Dandy 1975). Fischer (1907) described the Bavarian plant in detail. I have seen specimens of *P.* × *schreberi* in **BM**, **CGE**, **E**, **M**, **MANCH**, **RNG**, **Z** and **ZT**; those in **M** (German plants) and **ZT** (Swiss) are most useful in showing the range of variation of continental plants. Specimens circulated by Koch (1933, 1934) to members of the Watson Botanical Exchange Club are typical of much Swiss material. Some characters of the German and Swiss plants are compared to those of the Dorset *P.* × *schreberi* and to related taxa in Table 1. Details of some of the specimens I have seen are listed at the end of this paper.

Fischer (1907) described the lowest 1–3 leaves on his material as "± aphyllis (phyllodis vel pseudo-phyllodis)". He described the floating leaves as variable in shape, some subcordate or rounded at the base, others tapering into the petiole. Examination of plants collected by Fischer (and of other Bavarian material) confirms that those submersed leaves which are present are of the type which resemble phyllodes with an expanded, distal lamina, and that floating leaves predominate. None of the floating leaves has a well-developed discoloured section between the petiole and the lamina, although some of them appear to have a slight discolouration in this area. Some of the floating leaves are broader in relation to their length than those of the Dorset plant, and have more lateral veins.

Swiss specimens of *P.* × *schreberi* show a full range of submersed leaves, from expanded phyllodes to leaves with a long petiole and a distinct, translucent lamina with a band of lacunae on each side of the midrib. The latter closely resemble the well-developed submersed leaves of the Dorset plant. On some Swiss plants the slight discolouration between the petiole and the lamina of the floating leaves is more apparent than on any material I have seen from Dorset or Bavaria, and is clearly derived from the strongly discoloured and (in herbarium specimens) shrunken section typical of *P. natans*. (One specimen in **ZT** determined as *P.* cf. *natans* × *nodosus* by W. Koch has such a section, but it has no submersed leaves and in my opinion it is probably *P. natans*.)

Fischer (1907) described the stipules of *P.* × *schreberi* as "nervosis 1–2 carinatis acutis"; both German and Swiss specimens usually have stipules with two distinct ridges along their length but these ridges are not winged.

Plants of *P.* × *schreberi* from Dorset, Bavaria and Switzerland are essentially similar. J. E. Dandy annotated the only Fischer specimen in **BM**, "apparently is *P. natans* × *nodosus* as G. Fischer thought". *P.* × *schreberi* shows some variation, with the German plants rather closer to *P. natans* than those from elsewhere.

DISTRIBUTION AND HABITAT

I have seen *P.* × *schreberi* at intervals in a stretch of the R. Stour some 1·5 km long. It is particularly frequent for about 0·5 km between ST/764.183 and ST/768.184, where there are extensive stands of

TABLE 1. A COMPARISON OF SOME CHARACTERS OF *POTAMOGETON NATANS*, *P. NODOSUS*, *P.* × *FLUITANS* (*P. NATANS* × *LUCENS*) AND *P.* × *SPARGANIIFOLIUS* (*P. NATANS* × *GRAMINEUS*) FROM THE BRITISH ISLES AND *P.* × *SCHREBERI* FROM DORSET, GERMANY (Ge) AND SWITZERLAND (He)

			P. × *schreberi*				
	P. natans	*P. nodosus*	Dorset	Ge	He	*P.* × *fluitans*	*P.* × *sparganiifolius*
Phyllodes	Present	Absent	Present	Present	Present	Present	Present
Submersed leaves	Absent						
Length of lamina (mm)		(70–)130–290	56–182	30–85	73–300	60–220	60–520
Breadth (mm)		13–38	2·5–14·5	2·0–4·5	2·5–13·0	8–33	1·8–11·5
Length:breadth ratio		4·7–7·5	(6–)10–20(–31)	20–34	14·3–40(–56)	4·3–20	16–72
No. of veins on each side of midrib		5–10	1–4	1–3	2–5	3–7	1–6
Margin		Denticulate	Entire	Entire	Entire	± Entire	± Entire
Petiole (mm)		40–210	(60–)100–355	100–205	95–425	25–70(–90)	0–55(–70)
Lamina:petiole ratio		1·4–2·9(–5·1)	0·5–1·3	(0·2–)0·3–0·8	0·4–1·2	1·3–10(–14·5)	(1·5–)7–∞
Floating leaves							
Petiole (mm)	50–150(–300)	30–210	89–180(–330)	(50–)80–220	56–300	25–70(–90)	30–250
Discoloured junction between petiole and lamina	Usually present	Absent	Absent	Absent	Absent or trace visible	Absent	Sometimes present
Base of stipules	Ridged	Ridged	Ridged	Ridged	Ridged	Winged	Ridged
Capacity to produce numerous well-formed fruits	Present	Present	Absent	Absent	Absent	Absent	Absent

the hybrid. Isolated patches occur downstream of this stretch as far as the footbridge at ST/764.176, which is the only point along this stretch of the river beside a public right-of-way. I have not searched other stretches of the river systematically, and *P.* × *schreberi* could well be more widespread.

The R. Stour in the vicinity of the *P.* × *schreberi* site flows through an area of Oxford Clay. The hybrid grows over a soft clay substrate in water from 0·2 m to at least 1 m deep. In those areas where it occurs it tends to be the most frequent macrophyte, and in places stands span the narrow river from bank to bank. Associated species include *Callitriche* sp., *Nuphar lutea*, *Potamogeton pectinatus*, *Sagittaria sagittifolia* and *Sparganium emersum*. There are well-developed stands of emergents (*Phalaris arundinacea*, *Phragmites australis*, *Schoenoplectus lacustris* and *Sparganium erectum*) along the sides of the river. According to Mr H. Cluett, whose farm lies along the stretch of the river where *P.* × *schreberi* is particularly frequent, the river was last dredged some 10–15 years ago.

I have not seen either of the putative parents of *P.* × *schreberi* growing with it. Both are, however, recorded in the R. Stour. *P. nodosus* is, as discussed above, locally abundant downstream of Hayward Bridge, some 10 km from the nearest recorded *P.* × *schreberi*. The stretch of the river with *P. nodosus* flows through a variety of geological formations including Upper Chalk, Lower Chalk and Upper Greensand. FitzGerald (1990) noted that *P. nodosus* grows over a gravelly substrate, and is never found where the bottom of the river is muddy. This suggests that *P.* × *schreberi* either has different ecological requirements from *P. nodosus*, or tolerates a wider range of substrate, as the hybrid grows over muddy clay at Marnhull. *P. natans* is apparently rarer than *P. nodosus* in the river. J. C. Mansel-Pleydell collected *P. natans* in the R. Stour at Durweston (May 1865, **DOR**) and in the R. Lydden between Stalbridge and Sturminster Newton (29 August 1883, **DOR**). Durweston lies on the stretch of the R. Stour where *P. nodosus* occurs; FitzGerald (1990) recorded *P. nodosus* both above and below Durweston Bridge. The R. Lydden is a tributary of the R. Stour which enters the R. Stour S.S.W. of Marnhull. There are no recent records of *P. natans* in the R. Stour supported by herbarium specimens, and the species was only recorded once during the 1988–89 survey of *P. nodosus*. FitzGerald and A. Horsfall recorded *P. natans* in the R. Stour at ST/764.202, downstream of Fifehead Mill, but they noted that the floating leaves were uncharacteristically elongated. It is possible that they actually saw *P.* × *schreberi*, which has been recorded a short distance downstream.

A detailed survey of the R. Stour would be required to establish the distribution of *P.* × *schreberi* and its relationship to that of its parents. The absence of both parents at Marnhull is not particularly surprising. The ability of *Potamogeton* hybrids to persist and spread vegetatively often leads to the presence of a hybrid in sites from which one or both parents are absent.

REPRODUCTIVE BIOLOGY

The one stand of *P.* × *schreberi* which I visited in July 1993 was flowering sparingly. There was no sign of developing fruit on these plants, and their pollen appeared to be sterile. The hybrid has, however, a robust rhizome and it is clearly able to persist and spread vegetatively. In addition, a specimen collected in October 1992 had a short shoot, terminated by a bud, arising from a node towards the base of a stem which had lost its lower leaves. This resembled similar shoots found in *P. nodosus* (Dandy & Taylor 1939) and other species, which can act as a means of dispersal downstream. It is possible that the population of *P.* × *schreberi* in the R. Stour represents one clone, which has spread vegetatively following the initial establishment of a single hybrid plant.

I have seen some inflorescences on both Swiss and German specimens. The young inflorescences are very compact, with closed perianth segments; some (perhaps more mature) inflorescences are more elongated with the flowers less closely spaced, but there is no sign of developing fruit. Koch (1934) noted, of Swiss material which he circulated, "plantu statu florendi rarissima". Fischer (1907) reported that Bavarian plants failed to fruit and material from Glattbrugg cultivated by Koch (**ZT**) also appears to be sterile. Nevertheless, the hybrid can persist in one site for a long period, as shown by the fact that it was first collected in the Seebach by J. C. D. von Schreber in 1775, and refound there by Fischer in 1904 (Fischer 1905, 1907).

NOMENCLATURE

G. Fischer first mentioned the possibility of a hybrid between *P. natans* and *P. nodosus* in 1903, when he suggested that a specimen collected by Schreber in the Seebach at Dechsendorf in 1775 was probably referable to this hybrid (Fischer 1903). In 1904 he rediscovered Schreber's plant in the Seebach, and decided that it was definitely the hybrid *P. natans* × *nodosus* (Fischer 1905). He applied the name *P.* × *schreberi* to the hybrid, and although he did not provide a formal description of the plant he included just enough morphological detail in his discussion to validate the name. Shortly afterwards he provided a full account of the hybrid, based on specimens from the Seebach and two other localities in Bavaria (Fischer 1907). In his publications Fischer used the name *P. fluitans* Roth for the fertile species which is called *P. nodosus* in this paper and the name *P. noltei* G. Fisch. for the hybrid *P. lucens* × *natans*.

The nomenclature of the hybrid is therefore:

Potamogeton × **schreberi** G. Fisch., *Mitteilungen der Bayerischen Botanischen Gesellschaft* **1**: 471 (1905) (*P. natans* L. × *P. nodosus* Poir.).

LIST OF SPECIMENS EXAMINED

The British specimens of *P.* × *schreberi* which I have collected, and some of the German and Swiss specimens which I have examined, are listed below. The characters of other taxa mentioned in the text are (unless stated) based on descriptions which I have prepared for the forthcoming B.S.B.I. handbook. These descriptions are based on living plants and herbarium specimens from Britain and Ireland.

BRITISH ISLES

England: Dorset, v.c. 9: River Stour by footbridge S. W. of Mounters, near Marnhull, ST/764.176, 14 October 1992, *D. A. Pearman & C. D. Preston (Preston 92/149)* (**BM**, **CGE**); —, 22 September 1993, *J. M. Croft, D. A. Pearman & C. D. Preston (Preston 93/84)* (**CGE**). River Stour W. of Mounters near Marnhull, ST/765.183, 14 October 1992, *D. A. Pearman & C. D. Preston (Preston 92/150)* (**CGE**). River Stour W. of Mounters near Marnhull, ST/767.182, 10 July 1993, *D. A. Pearman & C. D. Preston (Preston 93/30, 93/31)* (**BM**, **CGE**, **NMW**); —, 22 September 1993, *J. M. Croft, D. A. Pearman & C. D. Preston (Preston 93/85)* (**CGE**).

GERMANY

Bavaria: Im Seebach nahe dem Ausfluss, alt. 270 m, Oberfranken, July 1904–1905, *G. Fischer* (*Flora exsiccata Bavarica 997c*) (**E**, **M**). Seebach bei Erlangen, alt. 270–275 m, Oberfranken, June–September 1904–1905, *G. Fischer* (*Flora exsiccata Bavarica 997d*) (**E**, **M**). Im Seebach bei Möhrendorf (Erlangen), alt. 272 m, Oberfranken, July 1904, *G. Fischer* (*Flora exsiccata Bavaria 997a*) (**E**). Im Seebach a) bei Möhrendorf, b) bei dem altdeutschen Grabhügel, alt. 274 m, Oberfranken, July & September 1904 & 1905, *G. Fischer* (*Flora exsiccata Bavarica 997b*) (**E**, **M**). Möhrendorf, September 1916, *G. Fischer* (**BM**: conf. J. E. Dandy & G. Taylor, 1938). In der Vils ober- und unterhalb Hahnbach, alt. 385 m, August 1905, *W. Niebler* (det. G. Fischer) (*Flora exsiccata Bavaria 996*) (**E**, **M**). In der Vils bei Hahnbach, alt. 375 m, August 1906, *W. Niebler* (**MANCH**). B[ei] Hahnbach, Oberpfalz, 15 July 1946, *L. Oberneder 8230D* (**BM**: det. J. E. Dandy, 1962). Kanalisierter Vilslauf zwischen Neumühle und Amberg, Oberpfalz, 27 July 1946, *L. Oberneder 424* (**BM**).

SWITZERLAND

Schwyz: Im Rieselgiessen, Tuggen, 13 October 1918, *W. Koch* (**Z**, **ZT**). Im untern Rieselgiessen nahe der Mündung in die Spettlinth, Tuggen, 27 August 1919, *W. Koch* (**ZT**). Unter dem Sandsteinbrücklein über den Rieselgiessen im Stafelreit, 23 August 1920, *W. Koch* (**ZT**). In der Spettlinth unterhalb des Zusammenflusses mit dem Rieselgiessen, Tuggen, alt. 410 m, 31 August 1922, *W. Koch* (**ZT**).

St Gallen: Graben nahe Bahnhof, Rebstein, alt. 413 m, 28 September 1919, *W. Koch & E. S. Büel*

(**ZT**). Rheineck, Bodenseegebiet, August 1904, *C. S. Büel* (**ZT**). Neumühlekanal Rheineck, Bodenseegebiet, 2 November 1909, *C. S. Büel* (**ZT**: teste G. Fischer).
Zurich: Zurich, August 1847, *E. Müller* (**Z**). Dübendorf, July 1849, *C. Cramer* (**ZT**). In einem rasch fliessenden Bach an der Strasse zwischen Wallisellen (Station) und Düberndorf, June 1892, *F. v. Tavel* (**Z**). In der Glatt unterhalb Neugut, Wallisellen, 24 June 1917, *W. Koch* (**ZT**); —, 3 August 1931, *W. Koch* (**ZT**). In der Glatt beim [i.e. bei dem] Neugut, Wallisellen, 17 September 1917, *E. Baumann* (**ZT**: teste G. Fischer). In der Glatt bei Glattbrugg, alt. 425 m, 11 June 1932, *W. Koch* (**BM, CGE, E, RNG** (conf. J. E. Dandy & G. Taylor, 1938), **ZT**); —, 27 June 1933, *W. Koch* (**CGE, E, RNG** (conf. J. E. Dandy & G. Taylor, 1938), **ZT**).

ACKNOWLEDGMENTS

I am very grateful to D. A. Pearman for bringing the original record of the plant which proved to be *P.* × *schreberi* to my attention, for joining me for all my fieldwork and for much additional help. I also thank Mrs J. M. Croft for help with fieldwork and Mrs A. Pearman for hospitality in Dorset. P. M. Hollingsworth kindly provided preliminary details of his isozyme studies and Lady Rosemary FitzGerald, Dr T. Franke, Prof. J. W. Kadereit and Dr M. F. Watson helped in other ways. I am grateful to the herbaria cited for the loan of specimens, to English Nature for permission to cite FitzGerald (1990) and to A. O. Chater, P. T. Harding and P. D. Sell for commenting on a draft of this paper.

REFERENCES

Allen, D. E. (1986). *The botanists*, p. 135. St Paul's Bibliographies, Winchester.
Dandy, J. E. (1975). *Potamogeton* L., in Stace, C. A., ed. *Hybridization and the flora of the British Isles*, pp. 444–459. Academic Press, London.
Dandy, J. E. & Taylor, G. (1939). Studies of British Potamogetons – IV. The identity of *Potamogeton Drucei. Journal of botany, London* **77**: 56–62.
Druce, G. C. (1929). *Potamogeton Drucei* Fryer. *Report of the Botanical Society and Exchange Club of the British Isles* **8**: 928.
Fischer, G. (1903). Beitrag zur Kenntnis der bayerischen Potamogetoneen. III. *Mitteilungen der Bayerischen Botanischen Gesellschaft zur Erforschung der heimischen Flora* **1**: 301–306.
Fischer, G. (1905). Beitrag zur Kenntnis der bayerischen Potamogetoneen. V. *Mitteilungen der Bayerischen Botanischen Gesellschaft zur Erforschung der heimischen Flora* **1**: 471–476.
Fischer, G. (1907). Die bayerischen Potamogetoneen und Zannichellien. *Berichte der Bayerischen Botanischen Gesellschaft zur Erforschung der heimischen Flora* **11**: 20–162.
FitzGerald, R. (1990). *Rare plant survey of south-west England.* **4**, Dorset. Unpublished report (Nature Conservancy Council C.S.D. confidential report no. 1061).
Fryer, A. (1899). *Potamogeton Drucei* Fryer. *Journal of botany, London* **37**: 524.
Good, R. D'O. (1969). Botany. *Proceedings of the Dorset Natural History and Archaeological Society* **90**: 45–46.
Good, R. D'O. (1984). *A concise flora of Dorset*, p. 170. Dorset Natural History and Archaeological Society, Dorchester.
Koch, W. (1933). *Potamogeton natans* L. × *nodosus* Poir. (= *P. schreberi* Fischer). *Report of the Watson Botanical Exchange Club* **4**: 195.
Koch, W. (1934). *Potamogeton natans* L. × *nodosus* Poir. *Report of the Watson Botanical Exchange Club* **4**: 243.

(*Accepted July 1994*)

A new variety of Narrow-leaved Marsh-orchid in South Hampshire (v.c.11)

M. N. JENKINSON

Merriefield House, 21 St Clair Road, Canford Cliffs, Poole, Dorset, BH13 7JP

ABSTRACT

Morphometric study of a population of *Dactylorhiza majalis* (Rchb. fil.) P. F. Hunt & Summerh. subsp. *traunsteineri* (Saut. ex Rchb. fil.) H. Sund. (Orchidaceae) near Exbury, South Hants. (v.c. 11) reveals some distinct morphological differences from most other populations of the subspecies. These differences are considered sufficient to justify the proposal of a new variety, var. **bowmanii** M. N. Jenk., **var. nov.**, which is described. It is now known from three sites in v.c. 11 and one in Dorset (v.c. 9). Another study population, in North Hants. (v.c. 12), is determined as subsp. *traunsteineri* var. *traunsteineri*.

KEYWORDS: Orchidaceae, *Dactylorhiza*, morphometrics, multivariate analysis, Yorkshire, Berkshire, Anglesey, Hampshire.

INTRODUCTION

In 'Plant Records', *Watsonia* **19**: 152 (1992), the discovery in 1984 by R. P. Bowman of a new population of *Dactylorhiza traunsteineri* (Saut. ex Rchb. fil.) Soó (Orchidaceae) in S. Hants. (v.c. 11) was reported. The find was determined by Dr Francis Rose, and is a first record for the vice-county, this taxon having been previously recorded in Hampshire only from N. Hants. (v.c. 12).

For reasons outlined in detail elsewhere (Jenkinson 1992), related to morphological overlap between taxa (cf. Bateman & Denholm 1983), and the presence of morphological intermediates, particularly in Hampshire and Dorset populations, I regard this taxon as a subspecies of *D. majalis* (Rchb. fil.) P. F. Hunt & Summerh. Although strictly objective scientific data (in the form of compatible morphometric data) to justify merging this taxon with the continental *D. traunsteineri* (Saut. ex Rchb. fil.) Soó are actually still lacking, I am persuaded by the weight of informed opinion of experts who have seen both taxa in the field that they should be regarded as conspecific. The correct nomenclature for this taxon is therefore *Dactylorhiza majalis* (Rchb. fil.) P. F. Hunt & Summerh. subsp. *traunsteineri* (Saut. ex Rchb. fil.) H. Sund. (Sundermann 1980; R. M. Bateman, pers. comm., 1987; Bateman & Denholm 1989; Jenkinson 1992).

R. P. Bowman (pers. comm., 1985) drew my attention to the Exbury population as there appeared to be some particularly interesting features of some of the plants at the site. Growing in a flushed marshy clearing in the 10-km square SU/4.0, the population of Narrow-leaved Marsh-orchid (c. 200 plants) formed a small but distinct morphological population within a much larger mixed colony of *Dactylorhiza* spp., consisting predominantly of *D. majalis* subsp. *praetermissa* (Druce) D. M. Moore & Soó, *D. fuchsii* (Druce) Soó and hybrids between the two. There was also a small number of putative hybrids between *D. fuchsii* and *D. majalis* subsp. *traunsteineri*. The whole colony numbered c. 2000 plants at that time.

The site itself is a very wet flush in a clearing between a belt of old oak woodland and a coniferous plantation. The clearing was cut as a strip through the woodland in the early 1960s to enable a gas pipeline to be installed. The site was subjected to soil-test samples by R. M. Bateman in 1986, and the pH was found to be c. 6·6, slightly lower than that of most British and Irish sites for the taxon, which is widely regarded as being restricted to calcareous fens and basic flushes. Working on the assumption that the orchids were not present in the wood before the strip was cut, it would appear that the orchid colony could not have been more than 20 years old when it was first discovered. It may be felt that this is a rather short time for a site to acquire such a large and heterogeneous colony of *Dactylorhiza*. The oil pipeline from Wytch Farm, Dorset, to Fawley Refinery was also installed through the cut strip recently, to one side of the main concentration of orchids, without any apparent damage to the population of *D. majalis* subsp. *traunsteineri*, although on a recent visit (June 1993) it was found that much of the site had become overgrown with an umbellifer (?*Oenanthe crocata* L.) and Bracken (*Pteridium aquilinum* (L.) Kuhn), as a result of which the full extent of the mixed colony had declined somewhat.

A number of authors (e.g. Bateman & Denholm 1983; Foley 1990) have given recent detailed morphological descriptions of *D. majalis* subsp. *traunsteineri* (see Table 1). The Exbury plants are clearly distinct from *D. majalis* subsp. *praetermissa* at the site in many characters regarded as diagnostic of subsp. *traunsteineri*, such as small stature, thin stems, few narrow leaves, short lax few-flowered inflorescences, strongly reflexed lateral lobes to the labellum, and the presence (sometimes intense) of diffuse anthocyanins in upper stem and bracts. Certain other morphological features of these plants, however, are not typical of the subspecies. The most obvious of these in the field is the presence in the vast majority of plants of exceptionally deep sinuses and an unusually elongated central lobe to the labellum. In addition the labella are proportionately narrower in relation to their length than in most plants of this taxon, a feature that is exaggerated in the field by the strong reflexion of the lateral lobes. The flowers are also rather darker in base colour than those in most populations I have seen (with the exception of one Yorkshire population). The vegetative characteristics are generally more robust than most populations of the taxon (closer to some Irish populations – see Foley 1990), in some respects intermediate between this taxon and subsp. *praetermissa*. There are usually two non-sheathing leaves and three (but sometimes four) sheathing leaves, which are generally longer and broader than those of most populations of the taxon.

R. M. Bateman, having carried out a detailed morphometric comparison, expressed the opinion (pers. comm., 1986) that these plants were intermediate in overall morphology between subsp. *traunsteineri* (as epitomised by populations in Ireland and Anglesey) and subsp. *praetermissa*, but closer to, and therefore referable to, subsp. *traunsteineri*, thus concurring in essence with Rose.

It was clear, however, that whilst some vegetative characteristics could be described as 'intermediate', certain floral characters were even more extreme than most subsp. *traunsteineri*. I felt that the unusual morphology of these distinctive plants merited more detailed investigation. Accordingly in 1988 and 1989 morphometric data were obtained from recognised populations of subsp. *traunsteineri* in Oxfordshire (Berks., v.c. 22), Yorkshire (Mid-W. Yorks., v.c. 64) and Anglesey (v.c. 52), in order to incorporate the broadest possible spectrum of natural and normal variation within the taxon.

In addition, another taxonomically ambiguous colony of marsh-orchids, at Mapledurwell Fen near Basingstoke in N. Hants. (v.c. 12) in SU/6.5, was examined, as it has long been believed to contain a number of plants referable to subsp. *traunsteineri* (Doherty & Pilkington 1983), although Dr Francis Rose, in correspondence with R. P. Bowman (R. P. Bowman, pers. comm., 1984), expressed the view that it was "not quite pure" at the site, implying some introgression, presumably with *D. fuchsii* and/or *D. majalis* subsp. *praetermissa*, both of which are also present. In an attempt to resolve the status of these plants, they were incorporated into the current study.

I have since found three further smaller populations of plants similar in morphology to those at Exbury, all in the administrative county of Dorset, but two in v.c. 11 (S. Hants.) and one in v.c. 9 (Dorset). The largest population (c. 50 plants), discovered in 1988 at Avon Forest Park near Ringwood, in SU/1.0, was measured for this research. The other populations, six plants in 1992 at St Leonards near Ringwood in SU/1.0, and a single plant in 1993 on Studland Heath in SZ/0.8, were too small for significant statistical analysis. All three new populations differed from the original Exbury population in minor morphological features (Avon Forest Park, slightly more robust with slightly less deeply three-lobed lips; St Leonards, slightly paler in base colour; and Studland, with a slightly less deeply three lobed lip), but the overall similarity to the Exbury plants was such that there was no doubt that they were referable to the same taxon.

Details of the eight study populations from which data were obtained for the purpose of this research are listed on Table 2.

An interesting feature of all three recently discovered sites is that they are all in dry acid grassland. The plants are growing amongst Bracken (*Pteridium aquilinum*) and acid-soil indicators *Galium saxatile* L. and *Potentilla erecta* (L.) Raeusch. are present at all three sites. *Pteridium aquilinum* and *Potentilla erecta* are also present at Exbury. The dry grassland orchids *Orchis morio*

TABLE 1. RANGE OF VARIATION AND DESCRIPTION OF MAIN DISTINGUISHING CHARACTERS OF *DACTYLORHIZA MAJALIS* SUBSP. *TRAUNSTEINERI* AND SUBSP. *PRAETERMISSA*

Character	subsp. *traunsteineri*	subsp. *praetermissa*
1. Stem height	12–30 cm, only occasionally >30 cm	20–50 cm, often exceeding 30 cm
2. Stem width	<5 mm, flexuous	>5 mm, stout, erect
3. Sheathing leaves	Up to 3	3 or more
4. Non-sheathing leaves	0–1	2 or more
5. Length of longest leaf	Up to 12 cm, rarely more	Usually >12 cm
6. Width of widest leaf	Usually 8–12 mm, only occasionally >15 mm	Usually >15 mm
7. Leaf markings	Occasionally present, solid spots (except var. *eborensis*), 1–2 mm in diameter, round or transversely elongated, usually concentrated towards leaf-tips	Unmarked, except var. *junialis*
8. Inflorescence	Rarely >7 cm, 7–12 flowers	Usually >7 cm, usually >20 flowers
9. Peripheral bract cells mean size	60–115 μm, usually >80 μm in mean length, subacute to serrate	50–100 μm, but rarely >80 μm, rounded obtuse
10. Labellum size	>7·5 × 9·5 mm, usually broader than long, often broadest below middle, usually c.10 mm wide	>7·5 × 9·5 mm, usually broadest ± at middle, usually >10 mm wide
11. Labellum shape	Usually three-lobed, central lobe often elongated (>1 mm) well beyond laterals, lateral lobes usually markedly reflexed	Usually slightly three-lobed, rarely entire, central lobe only occasionally elongated well beyond laterals, laterals usually ± flat
12. Labellum markings	Dashes or flecks with loop markings, usually covering most of lip	Dots or dashes, more or less concentrated towards centre of lip
13. Labellum colour	Base colour variable from pale rose-pink to reddish-purple. Markings much darker, sometimes intensely so	Base colour usually pale rose-pink, rarely deeper rose-red. Markings slightly darker than base colour
14. Lateral outer perianth segments	Usually nearly vertical, rarely with annular markings	Usually more or less at 45°, unmarked
15. Spur	Occasionally <8·5 mm, usually tapering	Usually <8·5 mm, tapering
16. Anthocyanins	Stem/bract anthocyanins usually present, often intense	Stem/bract anthocyanins occasionally present, rarely intense

L. and *Spiranthes spiralis* (L.) Chevall. are present in quantity at the St Leonards site, as are *D. fuchsii* and *D. maculata* (L.) Soó. At Avon Forest Park, *D. majalis* subsp. *praetermissa* occurs in a damp hollow nearby, *Listera ovata* (L.) R. Br. and *Spiranthes spiralis* both occur occasionally with *D. majalis* subsp. *traunsteineri*, and *Orchis morio* occurs in some numbers in the vicinity. At the Studland site, the single plant occurred on a dry track verge amongst *Pteridium aquilinum* with no other orchids, although *D. majalis* subsp. *praetermissa* occurs in a damp patch of the same verge some 100 m away, and *D. incarnata* (L.) Soó subsp. *pulchella* (Druce) Soó occurs in the adjacent acid bog.

Long regarded as typically an inhabitant of wet calcareous fen or basic flushes (Heslop-Harrison 1953; Lacey 1955; Lacey & Roberts 1958; Tennant 1979; Kenneth & Tennant 1983; Bateman &

TABLE 2. STUDY POPULATIONS OF *DACTYLORHIZA* TAXA

Population	Grid Ref.	Habitat	No. plants	Accompanying *Dactylorhiza*
1. Wharfedale, Mid-W. Yorks., v.c. 64	SD/97.67	Basic flush	>200	*Dii*, *Df*, *Dm*, hybrids
2. Cothill, Berks., v.c. 22	SU/46.99	Fen	<10	*Df*
3. Parsonage Moor, Berks., v.c. 22	SU/46.99	Fen	<50	*Dmpr*, *Df*, hybrids
4. Rhos-y-Gad, Anglesey, v.c. 52	SH/51.79	Fen	>200	*Dmp*, *Dip*, *Dic*, *Df*, *Dm*, hybrids
5. Cors Erddreiniog, Anglesey, v.c. 52	SH/47.82	Fen	>1000	*Dmp*, *Dip*, *Dic*, *Df*, *Dm*, hybrids
6. Exbury, S. Hants., v.c. 11	SU/4–.0–	Neutral flush	>200	*Dmpr*, *Df*, hybrids
7. Avon Forest Park, S. Hants., v.c. 11	SU/1–.0–	Acid grassland	<50	*Dmpr*, *Df*, *Dm*
8. Mapledurwell Fen, N. Hants., v.c. 12	SU/67.52	Fen	<100	*Dmpr*, *Df*, hybrids

Key to accompanying *Dactylorhiza*: *Df* = *D. fuchsii*, *Dm* = *D. maculata*, *Dii* = *D. incarnata* subsp. *incarnata*, *Dip* = subsp. *pulchella*, *Dic* = subsp. *coccinea*, *Dmp* = *D. majalis* subsp. *purpurella*, *Dmpr* = subsp. *praetermissa*.

Note: Populations 2 and 3, as a result of county boundary changes, are now in the administrative county of Oxfordshire, and similarly, population 7 is now in the county of Dorset.

Denholm 1983; Kenneth, Lowe & Tennant 1988; Roberts 1988; Foley 1990), *D. majalis* subsp. *traunsteineri* has not hitherto been recorded, as far as is known, in any dry or markedly acid habitats in Britain, although some authorities (e.g. Davies, Davies & Huxley 1983) have cited *Sphagnum* bog as an occasional habitat for the taxon in continental Europe. It should be noted however that in the case of Davies, Davies & Huxley (1983) the authors express the cautionary opinion that this may be due to confusion between morphologically similar marsh-orchids.

Since the Narrow-leaved, Wicklow or Pugsley's Marsh-orchid was first described from Co. Wicklow in Ireland by H. W. Pugsley (Pugsley 1936), various authorities have sought to delimit the taxon more precisely. Arguably the best descriptions are those published by Bateman & Denholm (1983) and Foley (1990). These have been amalgamated and summarised in Table 1. In addition, for the purpose of comparison, a description of *D. majalis* subsp. *praetermissa* based on Bateman & Denholm (1983) and the present writer's own data has also been incorporated into Table 1.

MATERIALS AND METHODS

It was considered that in order to quantify accurately the similarities and dissimilarities of the proposed new variety with *D. majalis* subsp. *traunsteineri* as it is currently recognised in Britain, it was necessary to obtain morphometric data from a widely separated selection of well-known populations of the taxon, in order to incorporate as much as possible of the range of variation to be found, in what is a very variable taxon. 'Control samples' were therefore obtained from five populations (numbers 1–5 on Table 2) of the subspecies which have been the subject of previous morphometric research (Heslop-Harrison *et seq.* above), and which are widely recognised, well-determined sites for this taxon.

Morphometric data were obtained on a total of 59 characters for each of ten randomly selected plants of the target taxon in each population, according to criteria outlined by me elsewhere (Jenkinson 1992). These data were then subjected to the multivariate analysis described in that paper.

Two specimen plants (minus roots) were taken from the Exbury population in June 1989, and pressed and mounted. These are now conserved at **BM**. They were drawn prior to pressing, and that original drawing is reproduced as Fig. 1. The right-hand of the two plants is the holotype, the left-hand a paratype.

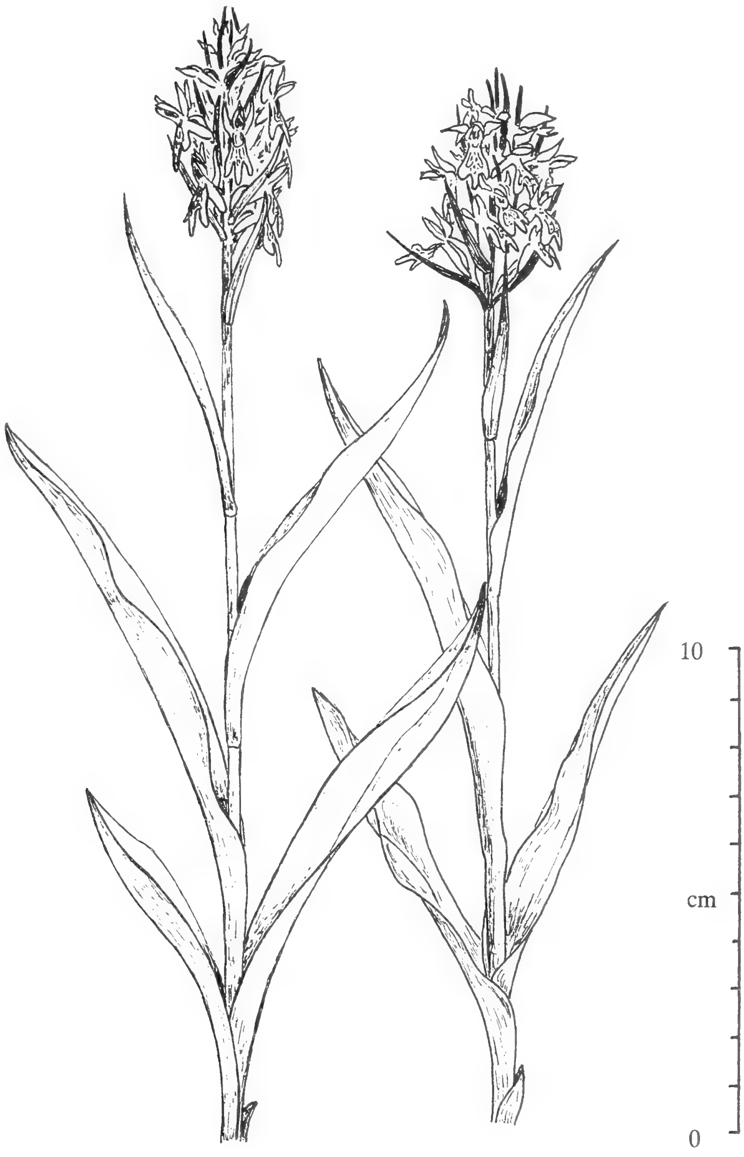


FIGURE 1. *Dactylorhiza majalis* subsp. *traunsteineri* var. *bowmanii* M. N. Jenkinson. Holotype (right hand plant): near Beaulieu, S. Hants. (v.c. 11), 13 June 1989. Paratype (left hand plant): as holotype. Drawn from specimens deposited in **BM**.

A separate sample of ten excised flowers was also obtained, mounted and forwarded to **BM** with the holotype. Drawings of the excised labella of that sample, and of the survey samples from Exbury and Avon Forest Park, are reproduced as Fig. 2.

RESULTS

Table 3 is a summary of population means, for the eight study populations, for those characters (listed in Table 1) regarded as 'diagnostic' for subsp. *traunsteineri*.

TABLE 3. POPULATION MEANS AND STANDARD DEVIATIONS (IN PARENTHESES) FOR SELECTED CHARACTERS OF STUDY POPULATIONS OF *DACTYLORHIZA*

Characters	Populations: 1. Wharfedale	2. Cothill	3. Parsonage Moor	4. Rhos-y-Gad	5. Cors Erddreiniog	6. Exbury	7. Avon Forest Park	8. Mapledurwell Fen
1. Plant height (cm)	16·16 (3·51)	20·64 (6·14)	17·99 (5·67)	14·68 (3·76)	16·80 (4·15)	27·12 (5·56)	18·30 (4·10)	19·40 (5·89)
2. Stem diameter (mm)	2·30 (0·63)	3·50 (0·87)	2·60 (1·02)	2·65 (0·47)	2·40 (0·39)	4·45 (0·72)	3·90 (1·33)	2·60 (0·74)
3. No. of sheathing leaves	2·60 (0·52)	2·20 (0·45)	2·80 (0·42)	2·70 (0·48)	2·60 (0·52)	3·00 (0·00)	3·50 (0·53)	3·00 (0·67)
4. No. of non-sheathing leaves	0·70 (0·48)	1·00 (0·00)	0·70 (0·48)	0·40 (0·52)	1·00 (0·47)	1·40 (0·52)	1·90 (0·74)	1·00 (0·47)
5. Length of longest leaf (cm)	6·59 (1·61)	10·02 (2·69)	8·25 (1·87)	6·50 (1·92)	7·55 (1·80)	12·81 (2·72)	10·51 (1·63)	9·99 (1·66)
6. Width of widest leaf (cm)	1·26 (0·29)	1·36 (0·32)	1·09 (0·23)	1·07 (0·15)	0·93 (0·11)	2·03 (0·28)	2·25 (0·70)	1·37 (0·22)
7. Leaf markings								
(a) Presence (yes: 1, no: 0)	0·60 (–)	0·00 (–)	0·50 (–)	0·30 (–)	0·20 (–)	0·00 (–)	0·00 (–)	0·70 (–)
(b) Distribution (1 = sparse at leaf tips)	0·60 (–)	0·00 (–)	0·70 (–)	0·30 (–)	0·30 (–)	0·00 (–)	0·00 (–)	0·40 (–)
(c) Type (1 = fine dots)	1·15 (–)	0·00 (–)	0·80 (–)	0·80 (–)	0·40 (–)	0·00 (–)	0·00 (–)	0·70 (–)
8. Inflorescence								
(a) Length (cm)	4·50 (1·39)	3·72 (0·77)	3·82 (0·95)	4·39 (1·30)	3·61 (0·79)	5·20 (1·10)	4·45 (1·37)	3·90 (0·99)
(b) Number of flowers	8·70 (3·74)	12·00 (5·57)	9·40 (3·86)	9·20 (4·34)	8·00 (3·13)	16·80 (4·96)	19·10 (8·97)	9·60 (4·33)
9. Mean length of peripheral bract cells (μm)	74·04 (5·29)	85·66 (9·46)	71·88 (9·64)	94·83 (23·44)	95·55 (13·97)	80·68 (12·92)	73·24 (6·86)	79·30 (10·44)
10. Labellum size and shape:								
(a) Length (mm)	7·83 (0·49)	7·90 (0·84)	8·35 (1·04)	7·90 (1·07)	7·53 (1·03)	8·53 (0·49)	7·93 (0·53)	9·20 (0·83)
(b) Width (mm)	9·85 (1·21)	9·70 (0·78)	9·50 (0·62)	10·60 (1·47)	9·30 (0·95)	9·55 (0·81)	9·60 (1·11)	10·30 (1·01)
(c) Reflexion lateral lobes (Scale 1–5)	3·70 (–)	3·40 (–)	2·80 (–)	4·10 (–)	3·50 (–)	3·90 (–)	3·40 (–)	3·70 (–)
(d) Length central lobe (mm)*	2·25 (0·44)	2·50 (0·79)	1·70 (0·54)	2·18 (0·80)	2·05 (0·86)	3·10 (0·67)	2·18 (0·43)	2·33 (0·82)

TABLE 3. *continued.*

Characters	Populations							
	1. Wharfedale	2. Cothill	3. Parsonage Moor	4. Rhos-y-Gad	5. Cors Erddreiniog	6. Exbury	7. Avon Forest Park	8. Mapledurwell Fen
11. Labellum markings:								
(a) Type (scale 1–5)**	4·50	4·20	4·00	4·90	4·80	4·40	3·50	4·20
	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)
(b) Coverage (scale 1–3)**	2·60	2·60	2·60	3·00	3·00	2·70	3·00	2·60
	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)
12. Labellum colour:								
(a) Base colour (scale 0–3)	2·90	2·20	2·30	3·00	1·70	2·80	3·00	2·40
	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)
(b) Markings (scale 0–3)	3·00	2·00	2·00	3·00	2·30	3·00	3·00	2·40
	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)
13. Lateral outer perianth segments								
(a) Position (scale 1–5)**	4·00	4·80	3·60	3·80	4·10	3·30	2·60	4·20
	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)
(b) Markings (scale 0–3)**	1·00	0·40	1·10	1·20	1·60	1·00	0·80	1·10
	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)
14. Spur: (a) Length (mm)***	7·58	8·75	7·88	8·05	8·30	7·60	6·65	7·98
	(1·48)	(1·10)	(0·94)	(1·01)	(1·25)	(1·17)	(0·77)	(1·23)
(b) Shape:	2·30	2·40	3·00	3·00	2·80	2·90	3·00	2·60
(3= conical/tapered)	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)
15. Anthocyanin intensity:								
(a) Upper part of stem (scale 0–3)	2·90	2·40	2·00	3·00	1·50	2·50	2·70	1·30
	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)
(b) Floral bracts: (scale 0–3)	3·00	2·80	2·70	3·00	2·50	2·90	3·00	2·40
	(–)	(–)	(–)	(–)	(–)	(–)	(–)	(–)

Notes: *Character 10(d) on this table does not equal part of Character 11 on Table 1, which indicates the degree of extension *beyond* the lateral lobes. Character 10(d) is the total length of the central lobe, measured from the base of the right-hand sinus. Nevertheless, in all plants measured, the central lobe extended more than 1 mm beyond the laterals. **See Jenkinson (1992) for more detailed clarification of numerical representation of qualitative character-states. ***See note below Table 4 re spur length: point of excision and method of measurement vary between workers, and are not therefore directly comparable.

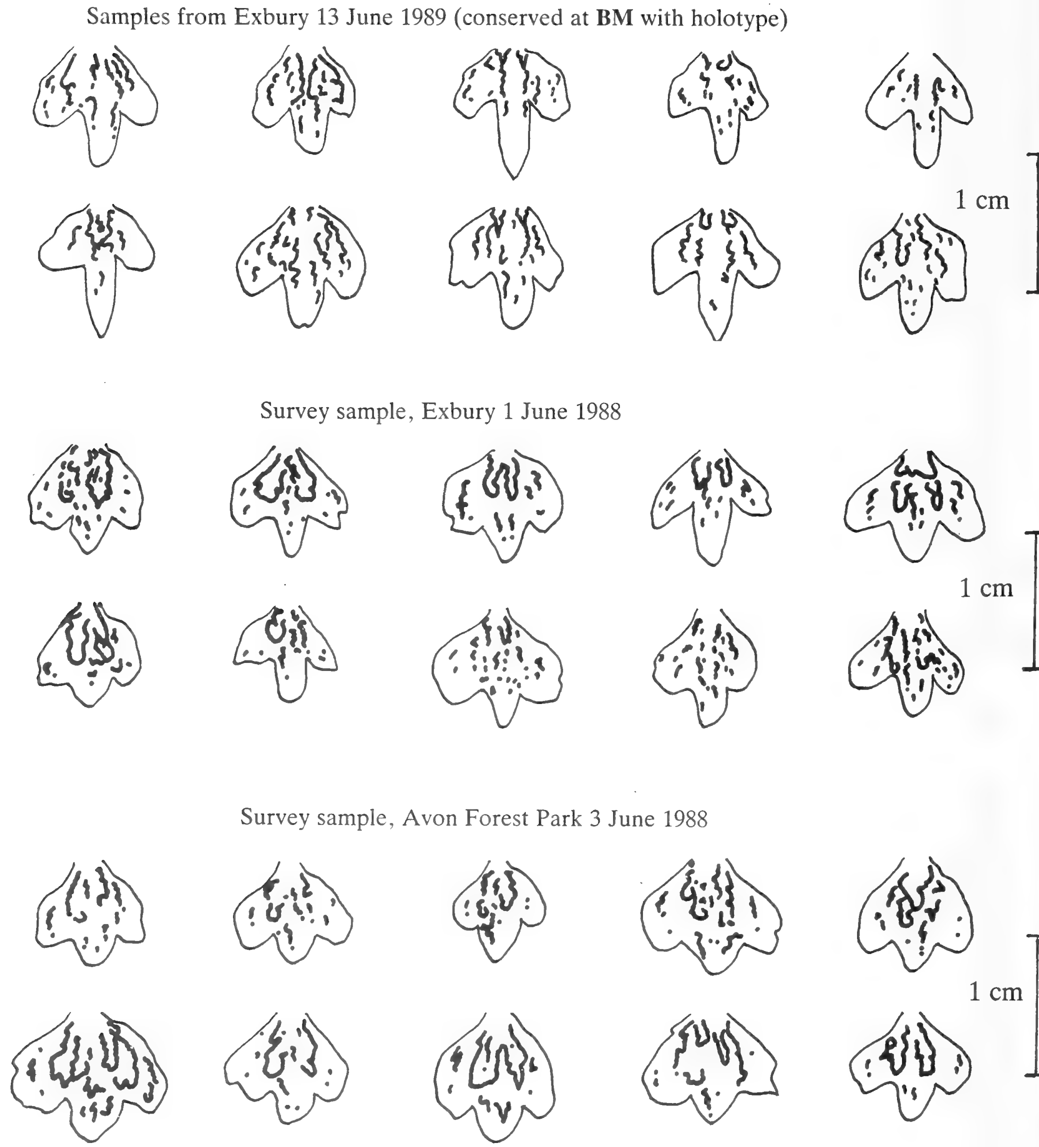


FIGURE 2. Drawings of 30 excised and mounted labella of *Dactylorhiza majalis* subsp. *traunsteineri* from Exbury (20) and Avon Forest Park (10).

It will be seen that for the vast majority of character-states, the three Hampshire populations from which data have been obtained fall within the parameters of subsp. *traunsteineri* according to accepted morphological criteria. The only difference from typical subsp. *traunsteineri* noted in the Mapledurwell Fen population was a relatively low mean density of stem anthocyanin. This is not considered significant. At Exbury and Avon Forest Park, however, certain clear distinctions in morphology become apparent. These are listed in Table 4, in which characters are numbered as in Table 1.

TABLE 4. MEAN VALUES (WITH RANGE IN PARENTHESES) FOR MAIN DISTINGUISHING CHARACTERS OF *D. MAJALIS* SUBSP. *TRAUNSTEINERI* VAR. *BOWMANII*

Character	Exbury	Avon Forest Park	Remarks
3. Sheathing leaves	3·0 (3·0)	3·5 (3·0–4·0)	Avon Forest Park more than most
4. Non-sheathing leaves	1·4 (1·0–2·0)	1·9 (1·0–3·0)	More than most
5. Length of longest leaf (cm)	12·81 (8·5–16·7)	10·51 (7·0–12·5)	Longer than most
6. Width of widest leaf (cm)	2·03 (1·6–2·45)	2·25 (1·6–3·4)	Broader than most
8. Number of flowers	16·8 (13–28)	19·1 (8–40)	More than most
11. Length of central lobe (mm)	3·1 (2·25–4·5) (survey sample)	2·18 (1·75–3·0)	Longer than most – to max. 7 mm at Exbury – very marked in the field
14. Lateral outer perianth	Both populations between 45° and vertical.		Lower than most
15. Length of spur (mm)*	7·60 (5·5–9·0)	6·65 (5·5–8·25)	Shorter than most – especially Avon Forest Park

* See Bateman & Denholm (1989) for their remarks re compatibility of measurements for length of spur. All measurements for this study, including those for the 'control sample' populations, are lower than those given by Bateman & Denholm (1983) for this character. It depends on the point of excision of the spur. Those at Avon Forest Park, however, were shorter than those of most plants measured in all populations.

DISCUSSION AND CONCLUSIONS

The absence of significant differences between the morphology of the plants measured at Mapledurwell Fen and that of the 'control' populations measured I consider to be sufficient evidence to support a firm determination of *D. majalis* subsp. *traunsteineri* (i.e. of the type variety, cf. Bateman & Denholm 1983) at this site. Furthermore, Dr Rose now takes the view (pers. comm., 1993) that there are some early-flowering plants at the site which are referable to *D. majalis* subsp. *traunsteineri* var. *traunsteineri*, although the situation is somewhat complicated later in the flowering season by the presence of hybrids and intermediates. There would therefore be no justification in separating these plants from var. *traunsteineri* merely on the basis of a few very minor morphological differences.

The situation at Exbury and Avon Forest Park, however, is somewhat different: the differences from typical subsp. *traunsteineri* var. *traunsteineri* at these sites (and in the few plants found at St Leonards and Studland) I consider to be of some importance. Whilst in the context of their overall morphology it is clear that they are sufficiently close to subsp. *traunsteineri* to warrant inclusion in that taxon, and indeed have been determined as such by both Rose and Bateman, it is my view that the differences identified and described above are comparable in magnitude to those that delimit the other two British named varieties of the subspecies (Roberts & Gilbert 1963; Bateman & Denholm 1983; Lowe, Tennant & Kenneth 1986), viz.:

var. *eborensis* (Godfery) R. M. Bateman & Denholm: short stem, leaves often marked with annular markings, small labellum, short spur;

var. *francis-drucei* (Wilmott) R. M. Bateman & Denholm: short stem, short unmarked leaves, few-flowered inflorescence, small labellum often longer than broad, elongated central lobe, short spur.

A new variety is therefore proposed to take account of the distinct morphological characteristics of plants at the four locations so far identified. It is named in honour of the finder of the Exbury population, R. Paul Bowman, B.S.B.I. recorder for many years for v.c. 11 (S. Hants.).

DESCRIPTION

Dactylorhiza majalis (Rchb. fil.) P. F. Hunt & Summerh. subsp. **traunsteineri** (Saut. ex Rchb. fil.) H. Sund. var. **bowmanii** M. N. Jenk., **var. nov.**

Caulis plerumque 15 cm (interdum 30 cm) altus superans, raro 5 mm diametro superans. Folia vaginantia 3–4, plerumque secus caulem ± aequaliter dispersa, folium longissimum plerumque secundum infimum, 8–16 cm longum, latissimum interdum secundum infimum, plerumque infimum, 1·6–3·4 cm latum; folia invaginantia plerumque 2, interdum 1; folia omnia immaculata. Inflorescentia plerumque minus quam 7 cm longa, plerumque 20% longitudinis caulis excedens, plerumque laxa, interdum plus quam 18-flora. Cellulae peripherales bractearum plerumque majores quam 70 μm longae. Labellum plerumque 7·5–9 × 8·5–10·5 mm, plerumque ± circa mediam partem latissimum; color basicus plerumque atrorubens, cum maculis lineatisque fuscioribus, labello incomplete obtecto; sinus semper praesentes atque profundi, lobus medianus plerumque longus (>2·5 mm), lobi laterales raro indentati, plerumque valde reflexi. Sepala lateralia plerumque plus verticalia quam horizontalia (>45°), modice sed non annulatim maculata. Calcar raro minus quam 6·5 mm longum, plerumque 7·5–8·5 mm, plerumque decrescens, raro cylindricum vel sacciforme.

Aestate florens (Junio, primam ad tertiam hebdomadem). Habitat in pascuis asperis udis vel aridis atque ± acidis; quattuor populationes in Anglia australi, tota distributio ignota; rarissima.

Holotypus: Exbury, near Beaulieu, S. Hants. (v.c. 11), England, very wet neutral flush, 13 June 1989, *M. N. Jenkinson* (holo. **BM**) (illustrated in Jenkinson (1991), Plates 62 & 63, p. 112).

Stem usually exceeding 15 cm, only occasionally exceeding 30 cm, rarely exceeding 5 mm in diameter. *Sheathing leaves 3–4*, usually ± evenly distributed along stem, *longest leaf* usually second lowest on stem, *8–16 cm long, widest leaf* occasionally second lowest, but usually lowest leaf, *1·6–3·4 cm in width, non-sheathing leaves usually 2, occasionally 1; leaf markings absent.* Inflorescence usually less than 7 cm long, usually more than 20% of stem length, usually lax, occasionally more than 18 flowers. *Mean length of peripheral bract cells usually exceeding 70 µm. Labellum* usually more than 7·5 × 8·5 mm, but *less than 9 × 10·5 mm*, usually broadest ± at middle; *base colour usually dark magenta, markings* usually darker dashes and loops, *less than complete coverage of labellum; sinuses always present, well-developed; central lobe usually long* (>2·5 mm); *lateral lobes* rarely indented, *usually strongly reflexed.* Lateral outer perianth segments usually nearer vertical than horizontal (>45°), usually lightly marked with solid, not annular, markings; *spur rarely less than 6·5 mm long, usually 7·5–8·5 mm*, usually tapering, rarely cylindrical or sac-like.

Flowering June (best weeks 1–3). *Habitat: damp or dry, neutral to slightly acidic rough grassland*; only four known populations in southern England, full distribution unknown. Very rare. (N.B. Italics in the English description follow the practice of Bateman & Denholm (1983) in order to emphasise those characters considered to be most diagnostic, but concentrate in this case on those which best distinguish the newly-described variety from the typical subspecies and the other named varieties.)

ACKNOWLEDGMENTS

I gratefully acknowledge the assistance of the following: Drs R. M. Bateman and I. Denholm, for advice and helpful discussion, permission to use the results (published and unpublished) of their own extensive research, and critical appraisal of this paper; R. P. Bowman, for much useful fieldwork, advice and discussion, on *Dactylorhiza* in particular, culminating in the discovery and investigation of the Exbury colony; F. Horsman, for guidance and assistance in the field in Yorkshire; Nicholas Jenkinson, for assistance with the fieldwork in North Hants., Oxfordshire and Yorkshire; Dr F. Rose, for helpful discussion with regard to the Mapledurwell Fen population; Dr R. J. White, for helpful advice and discussion, and invaluable assistance with the multivariate analysis on the computers of Southampton University; and F. A. Woodhead, for assistance with the Avon Forest Park colony, much helpful fieldwork, and the loan of her microscope for the peripheral bract cell measurements. In addition, my thanks go to the following individuals and organisations, who have variously assisted with site information, accompanied visits to sites, and the provision of permits: Berkshire, Buckinghamshire and Oxfordshire Naturalists' Trust (F. La Forte); Hampshire Wildlife Trust; the former Nature Conservancy Council (Berkshire, Dyfed-Powys and North Wales Regions); and the North Wales Wildlife Trust.

REFERENCES

Bateman, R. M. & Denholm, I. (1983). A reappraisal of the British and Irish dactylorchids, 1. The tetraploid marsh-orchids. *Watsonia* **14**: 347–376.

Bateman, R. M. & Denholm, I. (1989). Morphometric procedure, taxonomic objectivity, and marsh-orchid systematics. *Watsonia* **17**: 449–455.

Davies, P., Davies, J. & Huxley, A. (1983). *Wild orchids of Britain and Europe*. Chatto & Windus, London.

Doherty, J. & Pilkington, J. (1983). *Hampshire's countryside heritage: 3. Rivers and wetlands*. Hampshire County Council, Winchester.

Foley, M. J. Y. (1990). An assessment of populations of *Dactylorhiza traunsteineri* (Sauter) Soó in the British Isles and a comparison with others from Continental Europe. *Watsonia* **18**: 153–172.

Heslop-Harrison, J. (1953). Studies in *Orchis* L. II. *Orchis traunsteineri* Saut. in the British Isles. *Watsonia* **2**: 371–391.

Jenkinson, M. N. (1991). *Wild orchids of Dorset*. Orchid Sundries Ltd, Stour Provost, Gillingham, Dorset.

Jenkinson, M. N. (1992). The marsh orchids in Hampshire and Dorset: some recent research. *Proceedings of the Hampshire Field Club and Archaeological Society* **47**: 225–252.

Kenneth, A. G., Lowe, M. R. & Tennant, D. J. (1988). *Dactylorhiza lapponica* (Laest. ex Hartman) Soó in Scotland. *Watsonia* **17**: 37–41.

Kenneth, A. G. & Tennant, D. J. (1983). The Scottish records of *Dactylorhiza traunsteineri* (Sauter) Soó. *Watsonia* **14**: 415–417.

Lacey, W. S. (1955). *Orchis traunsteineri* (Saut.) in Wales. *Proceedings of the Botanical Society of the British Isles* **1**: 297–300.

Lacey, W. S. & Roberts, R. H. (1958). Further notes on *Dactylorhiza traunsteineri* (Saut.) Vermeul. in Wales. *Proceedings of the Botanical Society of the British Isles* **3**: 22–27.

Lowe, M. R., Tennant, D. J. & Kenneth, A. G. (1986). The status of *Orchis francis-drucei* Wilmott. *Watsonia* **16**: 178–180.

Pugsley, H. W. (1936). New British marsh orchids. *Proceedings of the Linnean Society of London* **148**: 121–125.

Roberts, R. H. (1988). The occurrence of *Dactylorhiza traunsteineri* (Sauter) Soó in Britain and Ireland. *Watsonia* **17**: 43–47.

Roberts, R. H. & Gilbert, O. L. (1963). The status of *Orchis latifolia* var. *eborensis* Godfery in Yorkshire. *Watsonia* **5**: 287–293.

Sundermann, H. (1980). *Europäischer und mediterrane Orchideen – eine Bestimmungsflora*, 3rd ed. Brucke-Verlag, Hildesheim.

Tennant, D. J. (1979). *Dactylorhiza traunsteineri* in Yorkshire. *Naturalist (Hull)* **104**: 9–13.

(*Accepted August 1994*)

Erica × *stuartii:* the authorship reconsidered

E. C. NELSON

National Botanic Gardens, Glasnevin, Dublin 9, Ireland

ABSTRACT

The author of the epithet *stuartii* for the naturally-occurring hybrid *Erica* × *stuartii* (*E. mackaiana* × *tetralix*) (Ericaceae) was J. Muirhead Macfarlane, and the combination at specific level was made by the editor of *The Gardeners' Chronicle*, Maxwell T. Masters; the binomial's correct form is *Erica* × *stuartii* (Macfarl.) Mast.

KEYWORDS: Ericaceae, Ireland, nomenclature.

INTRODUCTION

This paper does not propose a radical name-change for a plant that is relatively common in western Ireland (W. Galway (Connemara), W. Mayo and W. Donegal; v.cc. H16, H27, H35), and (as named cultivars) in gardens. Its purpose is to establish the authority for the established name *Erica* × *stuartii*.

An essential principle of the *International code of botanical nomenclature* (*I.C.B.N.*) is that a name is validly published when it is accompanied by a diagnosis that "in the opinion of its author distinguishes the taxon from others" (*I.C.B.N.* 1988; Art. 32.2). For nomenclatural precision, therefore, it is crucial that the first place of valid publication of a Latin name and the author's name are exactly established and clearly stated. After 1 January 1935, the diagnosis must be in Latin (*I.C.B.N.* 1988; Art. 36); before 1935 a diagnosis in any language is sufficient to validate a Latin name.

Even today plants grown in gardens may be dubbed with names which are not validly published – or not published at all. Sobriquets of this kind can seep into print through horticultural periodicals and nurserymen's catalogues. Such seepage has no consequences nowadays – after 1 January 1953 publication of names in trade catalogues and non-scientific newspapers does not constitute valid publication (*I.C.B.N.* 1988; Art. 29.4), and the inadvertent or unintentional printing of a name is not effective.

STUART'S HEATHER: DISCOVERY AND NAMING

Erica × *stuartii*, a naturally-occurring hybrid between *E. mackaiana* Bab. and *E. tetralix* L., is an example of a wild plant taken into cultivation, informally named by gardeners, and the garden sobriquet subsequently was effectively published in the horticultural press.

The principal modern accounts (e.g. McClintock 1979, 1980) report that this binomial was published by the Rev. E. F. Linton in *The annals of Scottish natural history* in July 1902. But Linton (1902a) was not the first author to publish a valid Latin name for this heather.

On 11 August 1890, Dr Charles Stuart, a Scottish naturalist of some renown who was visiting Connemara (Co. Galway, western Ireland, v.c. H16) with other members of the Scottish Alpine Botanical Club, collected an unusual heather with a strikingly coloured and constricted corolla (Nelson 1979) in the peatlands near Craiggamore. Other club members also gathered specimens, and some brought cuttings to Edinburgh, where, because several were skilful gardeners, this peculiar plant was soon established in cultivation including at the Royal Botanic Garden.

The heather's discovery was reported at a meeting of the Botanical Society of Edinburgh, chaired by Robert Lindsay, held on 11 December 1890. At that time Dr J. Muirhead Macfarlane agreed "to examine its microscopic structure with a view to assist in its identification" (Craig 1891), but already was inclined to the view that it was "no hybrid but only a form, like *E. Mackayi* [i.e. *E. mackaiana*], of *E. Tetralix*."

Macfarlane (1893), having examined Stuart's heather, decided that it was a subspecies of *E. tetralix* and that it deserved a name. Thus, in *Transactions and proceedings of the Botanical Society of Edinburgh*, he published the name *E. tetralix* subsp. *stuarti* accompanied by a good formal description to diagnose it from three other subspecies recognized by him. Macfarlane's name is valid, even though it is now considered that Stuart's heather represents a unique clone – in cultivation it may be deemed a cultivar.

SUBSEQUENT PUBLICATIONS

Eight years later, in *The gardeners' chronicle* of 13 July 1901, the editor noted that a Mr Lindsay – evidently Robert Lindsay, one of the Scottish Alpine Botanical Club members who had been on the Connemara tour – had sent specimens of *E. stuarti* (sic); the editorial ([Masters] 1901) included a precise description of the specimen. Under the *I.C.B.N.* this paragraph constitutes a valid publication of the binomial *E. stuarti*, even though the orthography is not in accord with modern practice. Who was the author; Robert Lindsay, or the editor of *The gardeners' chronicle* (Maxwell T. Masters)? And, was Masters publishing a new name or merely repeating Macfarlane's name at species level?

A few weeks later, on 7 September, a second notice of the plant appeared in *The gardeners' chronicle*, this one signed by R. Lindsay (Kaimes Lodge, Murrayfield, Midlothian) and retrospectively dated 4 July (Lindsay 1901).

In April 1902 an obituary of Dr Charles Stuart, who died on 12 February 1902, was published in *The annals of Scottish natural history*: Evans (1902) wrote that:

"*Aquilegia stuarti* [sic] commemorates his work in this direction [i.e., crossing species], as does *Erica tetralix stuarti* [sic] his discovery of a very distinct subspecies of heath in Connemara."

Other obituaries (e.g. in *The garden* (R. D. 1902)) also included explicit references to the heather.

Several months after Stuart's death, Linton (1902a) published his article, entitled '*Erica stuarti*, nov. hybr.' There is no sense in stretching the interpretation of the *I.C.B.N.* to confirm Linton's (1902a) paper as the original publication of a valid name for the plant found by Dr Stuart. Indeed, any attempt to promote such an argument would be in error because Linton's name then becomes an illegitimate homonym. Thus Linton's claim to authorship is spurious.

ERICA × *STUARTII*: AUTHORSHIP

To whom should the name be credited? I have no doubt that Scottish gardeners affectionately dubbed Dr Stuart's heath *Erica stuarti* soon after its discovery and propagation. Furthermore, I conclude that Macfarlane should be credited with publication of the epithet '*stuartii*' – the fact that he identified the plants as a subspecies of *E. tetralix* reflects only the general state of knowledge of indigenous heathers during the 1890s. The subsequent use of the epithet at species level – as *E. stuarti* – by M. T. Masters in *The gardeners' chronicle* does not indicate anything other than that the name was currently in use. To suggest, as one interpretation of the *I.C.B.N.* might require, that Masters's binomial is a distinct new name is unhelpful, but he did raise the epithet to specific level.

As noted above, Stuart's Connemara heather is now identified as a mutant clone of the hybrid between *E. tetralix* and *E. mackaiana*, also formerly called *E.* × *praegeri* Ostenf. 'Stuartii' (McClintock 1979) but correctly (following a change in the *I.C.B.N.*) *E.* × *stuartii* 'Stuartii' (and not, as recently proposed, *E.* × *stuartii* 'Charles Stuart' (Clarke 1988, [Coombes] 1991). Following is an expanded bibliographic summary:

Erica × stuartii (Macfarl.) Mast., *The gardeners' chronicle* **30** (ser. 3): 34 (13 July 1901).
Basionym: *Erica tetralix* L. subsp. *stuartii* ('stuarti') Macfarl., *Transactions and proceedings of the Botanical Society of Edinburgh* **19**: 63–64 (1893).

FIGURE 1. Type specimen of *Erica tetralix* L. subsp. *stuartii* Macfarl.; designated here as neotype of *Erica* × *stuartii* (Macfarl.) Mast. (Royal Botanic Garden, Edinburgh).

NEOTYPUS (here designated): "Erica sp. – Near Roundstone Connemara [Co. Galway v.c. H16] . . . E. Tetralix sub-sp. Stuarti, Macf. . . .", 9 August 1890, *anon.* (**E**).
Synonym: *Erica* × *praegeri* Ostenf., *New phytologist* **11**: 114–127 (1912).

ACKNOWLEDGMENTS

My thanks are due to the Curator of the Herbarium, Royal Botanic Garden Edinburgh, for a loan of specimens; to Gina Douglas, Librarian at the Linnean Society of London, for help in tracing bibliographic materials; to Dr R. K. Brummitt, Royal Botanic Gardens, Kew, for his guidance; and to David McClintock for his comments on an early draft of this paper.

REFERENCES

CLARKE, D. (1988). *W. J. Bean's Trees and shrubs hardy in the British Isles. Supplement.* J. Murray, London.

[COOMBES, A. J.] (1991). *The Hillier manual of trees and shrubs*, 6th ed. Hillier Nurseries (Winchester) Ltd, Romsey.

CRAIG, W. (1891). Excursion of the Scottish Alpine Botanic Club to Connemara, in August 1890. *Transactions and proceedings of the Botanical Society of Edinburgh* **19**: 15–25.
R.D. (1902). Dr Charles Stuart. *The garden* **61**: 132.
EVANS, A. H. (1902). The late Dr. Charles Stuart of Chirnside. *The annals of Scottish natural history* **11**: 65–66.
LINDSAY, R. (1901). *Erica stuarti. The gardeners' chronicle* **30** (ser. 3): 190.
LINTON, E. F. (1902a). *Erica stuarti*, nov. hybr. *The annals of Scottish natural history* **11**: 176–177.
LINTON, E. F. (1902b). A new *Erica* hybrid. *The Irish naturalist* **11**: 177–178.
MCCLINTOCK, D. (1979). The status of, and correct name for, *Erica* 'Stuartii'. *Watsonia* **12**: 249–252.
MCCLINTOCK, D. (1980). *Erica* × *stuartii* E. F. Linton – a correction. *Watsonia* **13**: 59.
MACFARLANE, J. M. (1893). An examination of some Ericas collected by the Scottish Alpine Botanical Club in Connemara during 1890. *Transactions and proceedings of the Botanical Society of Edinburgh* **19**: 58–64, plate 1.
[MASTERS, M. T.] (1901). *Erica stuarti. The gardeners' chronicle* **30** (ser. 3): 34.
NELSON, E. C. (1979). Historical records of the Irish Ericaceae, with particular reference to the discovery and naming of *Erica mackaiana* Bab. *Journal of the Society for the Bibliography of Natural History* **9**: 289–299.

(*Accepted August 1994*)

Notes

GENTIANELLA CILIATA (L.) BORKH. IN WILTSHIRE (V.C. 8)

While working on Gentianaceae at The Natural History Museum, London (**BM**) in 1992, T.N.H. found a previously unrecorded specimen of *Gentianella ciliata* (L.) Borkh. from South Wilts. (v.c. 8).

This species has only been recorded three times before in the British Isles, two records being from the same locality in Buckinghamshire (v.c. 24), where it was first collected in 1875 and rediscovered in 1982, with specimens of both collections being in **BM** (Knipe 1982; Stace 1991). The third record, from Surrey (v.c. 17), is supported by a specimen at **K**, but is considered to be of an alien, rather than a native, plant (Knipe 1982).

The recently found specimen was collected at Pitton, S. Wilts, "on Down at junction of chalk and Tertiary beds", by E. J. Tatum in September 1892, and was included in the herbarium of A. W. Bennett.

Edward John Tatum (1851–1929) was a solicitor who was active botanically from c.1880–c.1890. He is known to have been a diligent and meticulous worker who was responsible for several first records to the Wiltshire flora. It would appear that he was puzzled by his *Gentianella* and sent it to Bennett for comment, for it is one of the few Tatum specimens known to be in **BM**, the bulk of his herbarium being untraced (Kent & Allen 1984).

T.N.H. and her Chinese colleagues prefer to treat *Gentianella ciliata* as a member of the genus *Gentianopsis*. If they are followed the species is known as *Gentianopsis ciliata* (L.) Ma.

This interesting record of a very rare plant provides evidence to support Knipe's hypothesis that *G. ciliata* is native to southern England. It also shows that valuable 'new' records can be found even in comparatively well-known herbaria.

ACKNOWLEDGMENT

We wish to thank Miss A. Hutchinson, B.S.B.I. Recorder for v.c. 8, for information on E. J. Tatum.

REFERENCES

Kent, D. H. & Allen, D. E. (1984). *British and Irish herbaria.* Botanical Society of the British Isles, London.
Knipe, P. R. (1982). *Gentianella ciliata* (L.) Borkh. in Buckinghamshire. *Watsonia* **17**: 94.
Stace, C. A. (1991). *New Flora of the British Isles*. Cambridge University Press, Cambridge.

C. M. Dowlen
Department of Botany, The Natural History Museum, London, SW7 5BD
T. N. Ho
Northwest Plateau Institute of Biology, Academia Sinica,
78 Xiquan Street, Xining, Qinghai, People's Republic of China

A FORGOTTEN SHETLAND DANDELION

In 1907 W. H. Beeby discovered an unusual *Taraxacum* now classified in section *Spectabilia* (Dahlst.) Dahlst. near Lang Clodie Loch, North Mainland (GR HU/31.87), in the remote country north of Ronas Hill, Shetland (v.c. 112). Late-grown as the material was, it must have struck Beeby as different from any form of *T. faeroense* (Dahlst.) Dahlst. (which he knew as *T. spectabile* Dahlst.), the common dandelion of rocks, marshes, hillsides, etc., in Shetland. He not only preserved a specimen of this new dandelion but brought back a root to grow, and was so impressed by its differences that he described it as a new subspecies of *T. spectabile*, subsp. *geirhildae* Beeby (Beeby 1909).

Beeby was handicapped by making his Shetland visits at a time when most dandelions were past flowering and by having to base his knowledge of them largely on cultivated plants. His description was clearly drawn up from material, wild and cultivated, of the Lang Clodie Loch plant; but when he goes on to say that subsp. *geirhildae* grows not only near Lang Clodie Loch, but also in parts of Central Mainland, many miles to the south and with a quite different terrain, he was apparently confusing forms of *T. faeroense* with his taxon. At all events no recent botanist has seen the Lang Clodie Loch plant in Central Mainland, and Beeby's single specimen from this area (Burn of Quoys, 5 August 1908, **SLBI**), which is in leaf only, is merely *T. faeroense*. Beeby's epithet is romantic but, unfortunately, not very appropriate for a *Taraxacum* of North Mainland: it commemorates Geirhild (daughter of the Viking pioneering seafarer Floki Vilgerdarson), who is said to have been drowned in the Loch of Girlsta (Pálsson & Edwards 1972), a large loch in Central Mainland which Beeby believed (wrongly) to be a site of his new taxon. Druce (1922, p. 501) misinterpreted subsp. *geirhildae*, and the records of his own which he cites can only have referred to forms of *T. faeroense*. The confusion surrounding subsp. *geirhildae* may have contributed to the subsequent neglect of this taxon by British botanists. In 1980, however, its rediscovery by one of us (W.S.) in the type locality showed clearly that it was something quite distinct from any form of *T. faeroense*. Richards & Haworth (1984) at first referred it to the Scandinavian *T. ornatum* G. Hagl., and it appeared under that name in our Flora (Scott & Palmer 1987); but this identification, it now appears, was mistaken. It seems best to treat the Lang Clodie Loch plant as a new species of the section *Spectabilia* (Dahlst.) Dahlst., raising Beeby's subspecies to specific rank; a new combination is therefore called for.

Taraxacum geirhildae (Beeby) R. C. Palmer & W. Scott, **comb. et stat. nov.** (Fig. 1).
Basionym: *Taraxacum spectabile* Dahlst. subsp. *geirhildae* Beeby, *Annals of Scottish Natural History* **18**: 105 (1909).
LECTOTYPUS: "on the Kattarönis, e. of Lang Klödi Loch, Northmaven, Shetland", 28 August 1907, *W. H. Beeby 1669* (**SLBI**). (The specimen on the lower half of the sheet; the upper half contains material cultivated by Beeby, 1908.)

As Beeby characterised his taxon only very briefly, a fuller description might be helpful.

Plant medium-sized, robust. Leaves prostrate to widely spreading, typically broadly obovate, (60–)90–100(–140) mm × (22–)25–28(–30) mm, thick, rough above with very short stout hairs, yellowish-green to dark apple green, very sparingly and lightly spotted brownish-red, unlobed, with up to five teeth or small denticulations on either side of the proximal margin, midrib conspicuously reddish, typically very shortly petiolate, occasionally ± wanting. Scape to 18 cm, dull brownish-red. Exterior bracts adpressed, dark green, ovate-triangular, typically 7–8 × 3 mm, with narrow paler border. Capitulum deep yellow, 45–50 mm in diameter; ligules striped dark purplish-grey; styles discoloured (in fresh material); pollen present. Achene 4·3–4·6 mm long, straw-brown, shortly spinulose in apical quarter, otherwise ± smooth.

T. geirhildae resembles *T. faeroense* but, as Beeby noted, has markedly larger capitula of a darker yellow, and unlike *T. faeroense* is polliniferous. The very lightly spotted leaves are yellowish-green to dark apple green, firmer in texture than in *T. faeroense* and distinctly glossy (rather than dull); they also have shorter petioles and are somewhat different in shape, being obovate (sometimes broadly so) and never lobed in the wild. (Contrary to Beeby's statement, we find that in cultivation *T. geirhildae* sometimes produces weakly lobed leaves.) The ligule stripe may be best described as a dark purplish-grey (not pinkish-red as is usual in *T. faeroense*). In fresh material of *T. geirhildae* the styles are obviously discoloured; in *T. faeroense* the discoloration is less pronounced.

Flowering in early June, *T. geirhildae* is quite frequent in the type locality, on grassy ledges among rocky outcrops to the south-east of Lang Clodie Loch and towards the south end of Birka Water. This attractive dandelion appears to be an endemic Shetland species.

FIGURE 1. Lectotype of *Taraxacum spectabile* Dahlst. subsp. *geirhildae* Beeby (**SLBI**), basionym of *T. geirhildae* (Beeby) R. C. Palmer & W. Scott. As with most of the specimens in Beeby's North Isles Collection, the label giving all the details appears on the back of the sheet.

ACKNOWLEDGMENT

Thanks are due to Dr A. J. Richards for his help and encouragement.

REFERENCES

BEEBY, W. H. (1909). On the flora of Shetland. *Annals of Scottish natural history* **18**: 103–107.

DRUCE, G. C. (1922). Flora Zetlandica. *Report of the Botanical Society and Exchange Club of the British Isles* **6** (supplement): 457–546.

PÁLSSON, H. & EDWARDS, P., eds. (1972). *The book of settlements. Landnámabók*, p. 17. University of Manitoba Icelandic Studies, part 1.

RICHARDS, A. J. & HAWORTH, C. C. (1984). Further new species of *Taraxacum* from the British Isles. *Watsonia* **15**: 85–94.

SCOTT, W. & PALMER, R. [C.] (1987). *The flowering plants and ferns of the Shetland Islands*, p. 302. The Shetland Times Ltd, Lerwick.

R. C. PALMER
11 Fleet Way, Didcot, Oxon., OX11 8BZ
W. SCOTT
New Easterhoull, Castle Street, Scalloway, Shetland Islands, ZE1 0TP

A NEW SHETLAND *HIERACIUM* OF THE SECTION *ALPESTRIA* [FRIES] F. N. WILLIAMS

The *Hieracium* described below was first collected in 1952 by the late Professor D. H. N. Spence at West Burrafirth, West Mainland, Shetland (v.c. 112) (*Spence 417*, **STA**, two sheets), and was subsequently found by W. S. in various places in the West Burrafirth area and in the Norby and Bousta districts of Sandness, also in West Mainland. When describing *H. attenuatifolium* Sell & C. West from the mouth of the Laxo Burn, on the east coast of Mainland and some 20 km E.N.E. of West Burrafirth, Sell & West (1965) referred W.S.'s material from West Burrafirth and Bousta to their new species while recognising certain differences. In our Flora (Scott & Palmer 1987) we included the West Mainland plant under *H. attenuatifolium* without comment. Doubts as to whether it was really *H. attenuatifolium* were raised by R.C.P. after a visit to West Burrafirth in 1986, and these misgivings were endorsed by J. Bevan when he visited Shetland in 1987. Bevan (1988) later referred to the West Mainland plant as 'Taxon A', an undescribed species. Further careful study of the plant both in the wild and in cultivation has confirmed us in our view that the West Mainland plant is fully distinct from *H. attenuatifolium*; it appears to match no known species, and is therefore described as a new species.

Hieracium spenceanum W. Scott & R. C. Palmer, **sp. nov.**

Holotypus: common on steep brackeny slopes, head of West Burra Firth, West Mainland, Shetland Islands, v.c. 112, GR HU/257.567, 5 August 1986, *R. C. Palmer S1986/80* (**OXF**, sheet 1, left-hand specimen).

Caulis robustus, (10–)20–40(–80) cm altus, plerumque ubique rubellus sed interdum parte basali rubellus superne viridis, raro ubique viridis, modice ubique (praesertim inferne) pilosus, parcissime inferne densius superne floccosus, eglandulosus. Folia saturate viridia, subtus atque interdum supra purpureo-tincta, marginibus modice pilosis, rubellis. Folia basalia (0–)3–5(–7), saltem nonnulla florendi et fructificandi tempore paene semper praesentia, eis temporibus bene rosulata; folia primigenia parva, subrotunda, late elliptica vel ovato-elliptica, ± abrupte in petiolum alatum contracta, apice ± late rotundato, saepe minute apiculato, folia posteriora grandiora, alioquin similia; omnia subintegra vel minute denticulata, subtus parcissime floccosa parce pilosa (pilis simplicibus in costa numerosioribus), supra modice pilosa, efloccosa. Folia caulina 3–7, plerumque elliptica, 2·5-plo—3·5-plo longiora quam latiora, saepe in caule inferiore coacta, infima in petiolum alatum angustata, mediana et superiora ovato-elliptica, sessilia, semiamplexicaulia; omnia minute usque distincte et regulariter denticulata, interdum paucis vadosis dentibus utrinque praedita, apice minuto apiculo acuta, utraque pagina (praesertim subtus) pilis stellatis dispersis vestita, modice subtus (praesertim in costa) et parce supra pilis simplicibus induta, superiora glabrescentia. Anthela compacte cymosa, acladio brevi et capitulis (1–)2–6(–24), interdum (in plantis luxuriantibus locorum umbrosorum) ramos longos ex axillis foliorum superiorum emittens. Pedunculi modice floccosi, necnon pilis aliis simplicibus sparsis pallidis nigribasibus, aliis glanduliferis paucis obscuris inaequalibus induti. Capitula c. 35 mm diametro, basi subtruncata. Involucri squamae 10–11 mm longae, 2 mm latae, lineari-lanceolatae, ante anthesin incumbentes, apice obtuso, obscurae, parce floccosae, parce pilosae pilis pallidis nigribasibus, uberrime pilis glanduliferis obscuris valde inaequalibus vestitae. Ligulae flavae, apice glabro. Styli mediocriter lividi, id est mediocriter olivacei. Cypsela 4·5 mm longa, saturate fulva. Receptaculi alveoli margine dentati, dentibus projecturis brevibus filamentosis armatis.

Stem robust, (10–)20–40(–80) cm high, normally reddish throughout but sometimes reddish at base and green above, rarely green throughout, moderately pilose throughout (especially below), very sparingly floccose below but more densely floccose above, eglandular. Leaves deep green, suffused with purple beneath and sometimes also above, with moderately pilose reddish margins. Basal leaves (0–)3–5(–7), at least some nearly always present at flowering and fruiting and often forming a well-developed rosette at those times, the primordial small, subrotund, broadly elliptic or ovate-elliptic, ± rapidly contracted below to a winged petiole, apex ± broadly rounded, often minutely apiculate, the later basal leaves larger but otherwise similar. All basal leaves subentire or finely denticulate, very sparingly floccose beneath, sparingly pilose beneath (but pilose hairs more numerous on the midrib), moderately pilose and efloccose above. Stem-leaves 3–7, typically elliptic, 2·5–3·5 times longer than broad, often concentrated in the lower part of the stem, the lowest

TABLE 1. A COMPARISON OF THE CHIEF CHARACTERS OF *HIERACIUM SPENCEANUM*, *H. AUSTRALIUS* AND *H. ATTENUATIFOLIUM*

Character	*H. spenceanum*	*H. australius*	*H. attenuatifolium*
Presence or absence of lower leaves at flowering time	Present	Absent	Absent
Number of stem-leaves	3–7, concentrated towards base	5–10, ± evenly spaced	8–10, ± evenly spaced
Stem-leaf length/width ratio	2·5–3·5	2·5–4	3·25–3·75
Shape of stem-leaves	elliptic	elliptic	widest above middle
Diameter of capitula	35 mm	c. 35 mm	50 mm
Glandular hairs on phyllaries	markedly unequal in length	of ± uniform length	markedly unequal in length
Style colour	medium livid	dark livid	yellow
Cypsela length	4·5 mm	3·5 mm	c. 4 mm

narrowed to a winged petiole, the median and upper becoming ovate-elliptic, sessile and semiamplexicaul. All stem-leaves finely to distinctly and ± regularly denticulate, sometimes with a few shallow teeth on each side, apex acute with a minute apiculus, with scattered floccose hairs on both surfaces (especially beneath), moderately pilose beneath (especially on the midrib), sparingly pilose above, upper stem-leaves becoming glabrescent above. Inflorescence compactly cymose with short acladium and (1–)2–6(–24) capitula, sometimes with long branches from the upper leaf-axils in well-grown plants from sheltered sites. Peduncles moderately floccose with scattered, pale, dark-based pilose hairs and a few unequal dark glandular hairs. Capitula c. 35 mm diameter, subtruncate-based. Phyllaries incumbent in bud, 10–11 × 2 mm, linear-lanceolate, tip obtuse, dark, sparingly floccose, sparingly pilose (the hairs pale with dark bases), and with abundant very unequal dark glandular hairs. Ligules yellow, glabrous-tipped. Styles medium livid (medium olive-green). Cypsela 4·5 mm long, deep reddish-brown. Receptacle pits dentate, the teeth with short filamentous projections.

H. spenceanum is quite different from *H. attenuatifolium*; indeed, its affinities lie more with *H. australius* (Beeby) Pugsley. The chief characters of the three species are set out in Table 1.

H. attenuatifolium, as here delimited, seems restricted to the mouth of the Laxo Burn, where it has become almost extinct as a consequence of grazing pressure. All the other stations cited for *H. attenuatifolium* by us (Scott & Palmer 1987) in fact belong to *H. spenceanum*, which occurs in a handful of stations, usually in small numbers, in the West Burrafirth and Sandness areas, both on the northern coastal fringe of West Mainland. There is, fortunately, a particularly splendid colony of *H. spenceanum* in the type locality, on low rocky sea-banks and brackeny slopes near the head of West Burra Firth, which may well have been Spence's station. *H. spenceanum*, like *H. attenuatifolium*, is probably endemic to Shetland.

We have named *H. spenceanum* in honour of the late Professor David Spence of the University of St Andrews, in recognition of his pioneering work on the ecology of Shetland (in particular his studies of the serpentine and relict scrub sites), and also, on a more personal note, to record our appreciation for the help he gave us in many ways in our own studies of the Shetland flora.

ACKNOWLEDGMENTS

Grateful thanks are due to J. Bevan, whose stimulating observations encouraged us to look more closely at the West Mainland plant we had been calling *H. attenuatifolium.* Our thanks must also go to Professor M. B. Usher, who spurred us on to describe the present taxon as a new species.

REFERENCES

BEVAN, J. (1988). *A survey of* Hieracia (*Hawkweeds*) *in Shetland 1987*. Unpublished report to the Nature Conservancy Council, Peterborough.

SCOTT, W. & PALMER, R. C. (1987). *The flowering plants and ferns of the Shetland Islands*, p. 320. The Shetland Times Ltd, Lerwick.

SELL, P. D. & WEST, C. (1965). A revision of the British species of *Hieracium* Section *Alpestria* [Fries] F. N. Williams. *Watsonia* **6**: 85–105.

W. SCOTT
New Easterhoull, Castle Street, Scalloway, Shetland Islands, ZE1 0TP
R. C. PALMER
11 Fleet Way, Didcot, Oxon., OX11 8BZ

Plant Records

Records for publication must be submitted to the appropriate Vice-county Recorder (see *B.S.B.I. Year Book for 1995*), and *not* the Editors. The records must normally be of species, hybrids or subspecies of native or naturalized plants belonging to one or more of the following categories: 1st or 2nd v.c. record; 1st or 2nd post-1930 v.c. record; only extant v.c. locality, or 2nd such locality; a record of an extension of range by more than 100 km. Such records will also be accepted for the major islands in v.cc. 102–104 and 110. Only 1st records can normally be accepted for *Rubus*, *Hieracium* and hybrids. Records for subdivisions of vice-counties will not be treated separately; they must therefore be records for the vice-county as a whole. Records of *Taraxacum* are now being dealt with separately, by Dr A. J. Richards, and will be published at a later date.

Records are arranged in the order given in the *List of vascular plants of the British Isles* by D. H. Kent (1992), from which the species' numbers, taxonomy and nomenclature are taken. The B.S.B.I. has set up a procedure to register changes to this list, and a number of records of additional species have been held over until the new arrangements can take effect. The Ordnance Survey national grid reference follows the habitat and locality. With the exception of collectors' initials, herbarium abbreviations are those used in *British and Irish herbaria* by D. H. Kent & D. E. Allen (1984). Records are field records if no other source is stated.

Records from the following vice-counties are included in the text below: 1–6, 9, 11, 13, 14, 17, 22, 24–26, 28, 29, 35, 36, 38, 41, 43–51, 58, 59, 61, 64, 68–70, 72–75, 77–81, 83, 86, 89, 91–93, 96, 98, 99, 101, 104, 108.

The following signs are used:

* before the record: to indicate a new vice-county record.

† before the species number: to indicate that the plant is not a native species of the British Isles.

† before the record: to indicate a species which, though native in some parts of the British Isles, is not so in the locality recorded.

[] enclosing a previously published record: to indicate that the record should be deleted.

1/4.1. Diphasiastrum alpinum **83**, Midlothian: Moorland, Mauldslie Hill, NT/316.518. C. Dixon, 1992, **E**, det. D. R. McKean. 1st record since 1863.

4/1.1. Equisetum hyemale ***78**, Peebless.: Base-rich flushes, Medwyn Mains, NT/12.49. B. D. Wheeler, 1993, **E**, det. D. J. McCosh.

4/1.4 × 5. Equisetum fluviatile × E. arvense (E. × litorale) ***24**, Bucks.: Edge of lake, Great Linford Gravel Pits, SP/836.430. R. Maycock, 1989, det. C. N. Page.

4/1.4 × 8. Equisetum fluviatile × E. palustre (E. × dycei) ***104**, N. Ebudes: Abhainn a'Ghlinne, Dalavil, Skye, NG/60.05. M. Veit, 1991, **herb. M.V.**

4/1.5 × 8. Equisetum arvense × E. palustre (E. × rothmaleri) ***101**, Kintyre: Shore just above water level, Aucha Lochy, NR/726.228. C. D. Preston & N. F. Stewart, 1988, **E**, det. C. N. Page.

5/1.1. Ophioglossum vulgatum **73**, Kirkcudbrights.: Grassland, I.C.I. factory, Cargenbridge, NX/946.747. O. M. Stewart, 1993. 2nd extant locality.

†8/1.1. Pteris cretica ***5**, S. Somerset: Porlock Wood, Porlock, SS/877.467. P. Green, 1993. ***29**, Cambs.: Hole in brick wall, Market Passage, Cambridge, TL/449.585. C. D. Preston, 1993, **CGE**, conf. J. R. Akeroyd.

11/1.1 × 2. Polypodium vulgare × P. interjectum (P. × mantoniae) ***28**, W. Norfolk: Ditch-side, East Winch, TF/704.159. H. Williamson, 1993, **BM**, det. A. C. Jermy.

14/1.1. Thelypteris palustris **41**, Glam.: Fen meadow near Cefn Cribwr, SS/8.8. J. Woodman, 1993, **NMW**, det. G. Hutchinson. Only extant locality.

15/2.4. Asplenium marinum **81**, Berwicks.: Sandstone rocks near Ladykirk, NT/8.4. M. E. Braithwaite, 1993. Confirmation of an 1838 record at an inland site 14 km from sea.

15/2.5a. ASPLENIUM TRICHOMANES subsp. TRICHOMANES *50, Denbs.: River gorge, Ysbytty Ifan, SH/817.458. J. A. Green, 1993.

16/3.3. ATHYRIUM FLEXILE 92, S. Aberdeen: Near Derry Cairngorm, NO/0.9. D. J. McCosh, C. A. Stace & D. J. Tennant, 1993, **BM**, conf. A. C. Jermy & A. Paul. 2nd record.

16/4.2. GYMNOCARPIUM ROBERTIANUM *46, Cards.: Overgrown stoney mounds, Mynach Vale lead mine, SN/772.775. D. K. Reed, 1993, **NMW**.

†17/2.1. CYRTOMIUM FALCATUM *11, S. Hants.: Wall of dock, Portsmouth Naval Base, SU/628.003. D. E. Bulloch, 1992, **herb. R. P. Bowman**, det. E. J. Clement.

17/3.5. DRYOPTERIS AEMULA 41, Glam.: Sandstone cliff in oak woodland near Blackmill, Bridgend, SS/9.8. P. S. Jones, N. Ward & A. J. Williams, 1993, **NMW**, det. G. Hutchinson & Q. O. N. Kay. Only extant locality. *73, Kirkcudbrights.: Shaded rocks, Castramont Burn, NX/592.617. R. Tydewell, 1989, refound by P. Ripley & O. M. Stewart, 1993.

17/3.8 × 9. DRYOPTERIS CARTHUSIANA × D. DILATATA (D. × DEWEVERI) *50, Denbs.: Shore of Alwen Reservoir, SH/927.554. G. Battershall, 1993, det. A. C. Jermy.

†19/1.1. AZOLLA FILICULOIDES *46, Cards.: Ditch E. of Llangorwen church, SN/603.838. S. P. Chambers, 1993. Covering surface of fish pond, Llain-wen, SN/392.550. R. J. Williams, 1993, **NMW**. 1st and 2nd records.

27/1.1. CERATOPHYLLUM DEMERSUM *99, Dunbarton: Forth & Clyde Canal between Temple and Kelvindale, NS/55.69. K. J. Watson & K. J. Murphy, 1988.

†28/6.1 × var. ACONITUM NAPELLUS × A. VARIEGATUM (A. × CAMMARUM) *77, Lanarks.: Trackside, Craigend, NS/82.33. P. Macpherson, 1993, **herb. P.M.**

28/13.4. RANUNCULUS SARDOUS 38, Warks.: Edge of cereal crop, Wellesbourne, SP/286.542. M. J. Senior, 1992, **WAR**, det. J. M. Mullin. 1st post-1930 record. 50, Denbs.: Gravel near the sea, Foryd, Rhyl, SH/991.808. J. A. Green, 1993. 2nd extant locality. 75, Ayrs.: By muddy farm track, Standard Farm, Barrhill, NX/264.818. J. McCleary, 1993, **GLAM**, conf. A. McG. Stirling. 2nd, and 1st recent, record.

28/13.10. RANUNCULUS AURICOMUS 108, W. Sutherland: Deciduous woodland, Strath Beag, Loch Eriboll, NC/390.514. M. Barron, 1993. 2nd record.

28/15.1. MYOSURUS MINIMUS 3, S. Devon: Hundreds of plants on damp edge of green lane near Colyton, SY/23.95. L. J. Margetts, 1991. 1st post-1930 record.

28/17.3. THALICTRUM FLAVUM *45, Pembs.: *Phragmites australis*-dominated fen, Castlemartin Corse, SR/900.997. J. O. Mountford, 1984.

30/1.5b. PAPAVER DUBIUM subsp. LECOQII 46, Cards.: Vegetated waste ground, Penrhyn-coch, SN/638.839. S. P. Chambers, 1993. 2nd record.

30/1.6. PAPAVER HYBRIDUM 5, S. Somerset: Arable field, Kilton, Nether Stowey, ST/160.451. I. Green, 1993. 1st record since 1897.

30/5.1. CHELIDONIUM MAJUS †81, Berwicks.: Woodland edge by road near Lennel, NT/849.406. M. E. & P. F. Braithwaite, 1993. Only extant locality.

31/4.1. CERATOCAPNOS CLAVICULATA 104, N. Ebudes: Boulder scree N. of Eyre, Raasay, NG/577.351. S. J. Bungard, 1993, conf. C. W. Murray. Only extant locality on Raasay.

31/5.3. FUMARIA BASTARDII 79, Selkirks.: Disturbed ground, Boleside, Galashiels, NT/500.335. M. E. Braithwaite, 1992, **herb. R. W. M. Corner**, det. M. G. Baker. 2nd record, 1st since 1930.

31/5.8. FUMARIA DENSIFLORA 61, S.E. Yorks.: Arable field on chalk, Etton Wood, SE/945.433. J. Dews, 1993, det. M. G. Daker. Only extant locality and 1st record of a native population.

†40/2.2. ALNUS INCANA *77, Lanarks.: Marshy ground, Hamilton, NS/72.55. P. Macpherson, 1993, **herb. P.M.**

†43/1.3. CHENOPODIUM CAPITATUM *13, W. Sussex: Maize field S. of Coates Common, SU/998.172. H. W. Matcham & N. J. H. Sturt, 1993, det. J. M. Mullin.

43/1.6. CHENOPODIUM RUBRUM **46**, Cards.: Abundant on manure heap, Tygwyn, SH/523.647. A. O. Chater, 1993. 2nd post-1930 record.

43/3.2. ATRIPLEX PROSTRATA **81**, Berwicks.: Verge of A697 near Crook's Lodge, NT/815.405. M. E. Braithwaite, 1993, **herb. M.E.B.** 1st inland record.

43/3.2 × 4. ATRIPLEX PROSTRATA × A. LONGIPES (A. × GUSTAFSSONIANA) *46, Cards.: Bare disturbed mud in saltmarsh, W. bank of Afon Leri, Ynys-las, SN/616.934. A. O. Chater, 1993, **NMW**.

43/3.5. ATRIPLEX PRAECOX **104**, N. Ebudes: Seashore, Eilean Tigh, Raasay, NG/609.533. S. J. Bungard, 1990, **E**, det. D. R. McKean. 1st Raasay record.

43/3.6. ATRIPLEX LITTORALIS *35, Mons.: Margin of old sludge pond, Alpha Steel Works, Newport, ST/338.848. T. G. Evans & M. Jones, 1993, **NMW**. *46, Cards.: Bare disturbed mud in saltmarsh, W. bank of Afon Leri, Ynys-las, SN/616.934. A. O. Chater, 1993, **NMW**. Stoney ground at top of saltmarsh, E. side of Aberystwyth harbour, SN/582.811. A. O. Chater, 1993, **NMW**. 1st and 2nd records.

43/3.10. ATRIPLEX PORTULACOIDES †*46, Cards.: Edges of creeks in saltmarsh, Dyfi estuary, SN/641.941. A. O. Chater, 1993, **NMW**. Planted in 1950s by E. H. Chater, now naturalized over several hectares.

43/8.1. SALSOLA KALI **104**, N. Ebudes: Sandy shore, Laig, Eigg, NM/46.88. J. Bevan, P. F. Braithwaite & C. W. Murray, 1992. Only extant locality on Eigg.

46/1.1c. ARENARIA SERPYLLIFOLIA subsp. LEPTOCLADOS *81, Berwicks.: Ha-ha, The Hirsel, NT/828.409. M. E. Braithwaite, 1993, **herb. M.E.B.**, det. G. Halliday.

46/4.2. MINUARTIA VERNA †*41, Glam.: Site of abandoned experimental plots on smelter waste tips, Pentre-chwyth, Swansea, SS/669.953. S. J. Wainwright, 1993, conf. C. R. Hipkin. Probably a deliberate but unrecorded introduction.

46/7.7b. CERASTIUM FONTANUM subsp. HOLOSTEOIDES *73, Kirkcudbrights.: Damp rock ledge near Door of Cairnsmore of Fleet, NX/512.643. O. M. Stewart, 1993.

46/7.12. CERASTIUM SEMIDECANDRUM **79**, Selkirks.: Top of old wall, Newark Castle, Yarrow, NT/422.294. R. W. M. Corner, 1993, **herb. R.W.M.C.** 2nd record.

46/9.1. MOENCHIA ERECTA **44**, Carms.: Dry S.-facing rocky bank, Cwm Crychan, SN/820.390. I. K. Morgan, 1992. 2nd extant locality.

†46/18.1. LYCHNIS CORONARIA *46, Cards.: Vegetated ballast of long-disused railway, site of Llanfarian station, SN/591.778. S. P. Chambers, 1993. Well established and persistent.

†47/1.7. PERSICARIA AMPLEXICAULIS *77, Lanarks.: Rough grassy bank, Cessnock, Glasgow, NS/56.64. E. K. Lindsay & P. Macpherson, 1993, **herb. P.M.**

47/1.8. PERSICARIA VIVIPARA **73**, Kirkcudbrights.: In two flushes, Cairnsmore of Fleet, NX/512.653 & 517.644. D. Hawker, 1992. 2nd record.

†47/5.1 × 2. FALLOPIA JAPONICA × F. SACHALINENSIS (F. × BOHEMICA) *3, S. Devon: Edge of carpark, Trenchford Reservoir, SX/804.824. L. J. Margetts & W. H. Tucker, 1992, **herb. L.J.M.** *69, Westmorland: Beck Head, Witherslack, SD/446.846. T. C. G. Rich & M. Baecker, 1991, **LANC**, det. A. P. Conolly & J. P. Bailey.

47/4.6. POLYGONUM RURIVAGUM *68, Cheviot: Gravel by road near roundabout on A1, Berwick, NT/990.547. M. E. Braithwaite, 1992, **herb. G. A. Swan**, det. J. R. Akeroyd.

47/8.8 × 13. RUMEX LONGIFOLIUS × R. CRISPUS (R. × PROPINQUUS) *79, Selkirks.: With parents on waste ground, A7 3 km S. of Selkirk, NT/468.250. R. W. M. Corner, 1993, **herb. R.W.M.C.**, det. J. R. Akeroyd.

47/8.15 × 19. RUMEX SANGUINEUS × R. OBTUSIFOLIUS (R. × DUFFTII) *46, Cards.: With parents on waste ground, Glanyrafon Industrial Estate, Llanbadarn Fawr, SN/611.803. A. O. Chater, 1992, **NMW**, det. J. R. Akeroyd.

47/8.21. RUMEX MARITIMUS **81**, Berwicks.: Muddy edge of pool in fen, Lithtillum Loch, NT/80.40. M. E. Braithwaite, 1993. Only extant locality.

50/1.1. ELATINE HEXANDRA *96, Easterness: Loch Dochfour, NH/607.387. N.C.C. Loch Survey Team, 1988.

51/1.6 × 7. HYPERICUM PERFORATUM × H. MACULATUM subsp. OBTUSIUSCULUM (H. × DESETANGSII nothosubsp. DESETANGSII) *24, Bucks.: Calcareous bank of disused railway, Buckingham, SP/698.330. R. Maycock & A. Woods, 1989, det. N. K. B. Robson. *44, Carms.: Hay meadow, Pencarreg, SN/567.460. H. J. Killick, 1985, **NMW**. Roadside, farm above Goitre, SN/373.234. J. Bevan, H. J. Killick & M. E. Smith, 1992, **NMW**. 1st and 2nd records, both det. N. K. B. Robson.

52/1.1. TILIA PLATYPHYLLOS **50**, Denbs.: Hedgerow, Colwyn Bay, SH/835.809. G. Battershall, 1993. 2nd record.

†53/1.6. MALVA PUSILLA **4**, N. Devon: Recently disturbed area, Kenwith Nature Reserve, Bideford, SS/448.272. W. H. Tucker, 1993. 1st post-1930 record.

53/2.1. LAVATERA ARBOREA **50**, Denbs.: Hedgerow, Llysfaen, SH/899.784. G. Battershall, 1993. 2nd record. **51**, Flints.: Disturbed ground near dunes, Ffrith Beach, Prestatyn, SJ/047.833. J. Phillips, 1992. 1st post-1930 record.

53/2.2. LAVATERA CRETICA †*3, S. Devon: Waste ground, Topsham Quay, SX/966.877. L. J. Margetts, 1991, **BM**, det. N. K. B. Robson.

†54/1.1. SARRACENIA PURPUREA **98**, Main Argyll: In *Sphagnum* at margin of bog pools, Rannoch Moor, NN/3.4. J. Rees, 1992. 31 plants counted by G. P. Rothero & B. H. Thompson, 13 July 1993.

59/1.1. FRANKENIA LAEVIS †*3, S. Devon: Face of low cliff, Lympstone, SX/989.838. R. Lawrence, 1986.

61/2.5 × 9 × 11. SALIX PURPUREA × S. VIMINALIS × S. CINEREA (S. × FORBYANA) *77, Lanarks.: Shingle, Glengavel Water, NS/64.36. P. Macpherson, 1993, **herb. P.M.**, det. R. D. Meikle.

†61/2.6. SALIX DAPHNOIDES *77, Lanarks.: Grassy river-bank, Meadowside, NS/55.66. P. Macpherson, 1991, **herb. P.M.**, det. R. D. Meikle.

61/2.9 × 10. SALIX VIMINALIS × S. CAPREA (S. × SERICANS) *75, Ayrs.: Gailes Marsh, Irvine, NS/32.36. K. J. Watson, 1992.

61/2.9 × 16. SALIX VIMINALIS × S. REPENS (S. × FRIESIANA) *69, Westmorland: Sandy car-park, Sandscale, SD/200.757. P. Burton, 1993, **LANC**, det. R. D. Meikle. 3rd British record.

61/2.10b. SALIX CAPREA subsp. SPHACELATA *78, Peebless.: Steep hill slope, Talla Linns, NT/138.202. N. P. Ashmole, 1993, **E**, det. D. R. McKean & R. D. Meikle.

61/2.10 × 14. SALIX CAPREA × S. MYRSINIFOLIA (S. × LATIFOLIA) *104, N. Ebudes: Rocky outcrop below bridge over R. Lealt, Skye, NG/516.604. C. Westall, 1989, **E**, det. R. D. Meikle.

61/2.11 × 16. SALIX CINEREA × S. REPENS (S. × SUBSERICEA) *11, S. Hants.: Heathland, Whitten Bottom, SU/204.006. G. H. Forster, 1993, **herb. R. P. Bowman**, det. R. D. Meikle.

61/2.14 × 15. SALIX MYRSINIFOLIA × S. PHYLICIFOLIA (S. × TETRAPLA) *93, N. Aberdeen: Roadside by moorland, Glass, NJ/445.382. D. Welch, 1993, **ABD**, det. R. D. Meikle.

†62/1.6. SISYMBRIUM ORIENTALE *99, Dunbarton: Waste ground near river bank, Dumbarton Common, NS/39.76. A. McG. Stirling, 1993, **GLAM**.

†62/9.1. Malcolmia maritima *49, Caerns.: Marine embankment below Môr Hel Hotel, Criccieth, SH/498.377. R. E. Hughes, 1987, **NMW**.

62/10.1. Matthiola incana †46, Cards.: Well naturalized on vegetated shingle, Borth, SN/608.891. A. O. Chater, 1993, **NMW**. 2nd record, 1st since 1930.

62/12.3. Rorippa islandica *44, Carms.: River shingle, River Bran N. of Llandovery, SN/783.362. R. D. Pryce, 1981, **NMW**. Muddy hollow in silage field near Newcastle Emlyn Castle, SN/319.408. A. O. Chater & T. C. G. Rich, 1993, **NMW**. 1st and 2nd records, both det. T. C. G. Rich. **46**, Cards.: Muddy hollow in old ox-bow near Newcastle Emlyn Castle, SN/312.405. A. O. Chater & T. C. G. Rich, 1993, **NMW**, det. T. C. G. Rich. 2nd record.

62/12.5 × 6. Rorippa sylvestris × R. amphibia (R. × anceps) ***61**, S.E. Yorks.: Winter-flooded marshy grassland, Wheldrake Ings, SE/704.438. C. D. Preston, 1993, **CGE**.

†62/14.4. Cardamine raphanifolia **79**, Selkirks.: Edge of R. Yarrow below Newark Castle, NT/422.293. R. W. M. Corner, 1993, **herb. R.W.M.C.** 2nd record.

62/21.4. Draba muralis †**79**, Selkirks.: Old walls, Newark Castle, Yarrow, NT/422.294. R. W. M. Corner, 1993, **herb. R.W.M.C.** Introduced as seed 10 years ago. 1st record since 1875.

62/22.3. Erophila glabrescens **46**, Cards.: Rabbit-grazed sandy grassland, Penyrergyd dunes, SN/162.485. A. O. Chater, 1991, **NMW**, det. T. T. Elkington. 2nd record. ***73**, Kirkcudbrights.: Crevices in road and pavement, Black Water Bridge, NX/616.883. O. M. Stewart, 1993.

62/23.3. Cochlearia officinalis **81**, Berwicks.: Bank of A1, Bowshiel Wood, NT/794.670. M. E. & P. F. Braithwaite, 1993. 1st inland record.

62/23.5. Cochlearia danica **81**, Berwicks.: Verge of A1, Brockholes, NT/823.648. M. E. & P. F. Braithwaite, 1993. 1st inland record.

62/27.1. Teesdalia nudicaulis ***81**, Berwicks.: Near Gaitheugh, NT/5.3. A. Brotherston, 1877, **BM**.

62/31.1. Coronopus squamatus ***77**, Lanarks.: Rough bank, Coatbridge, NS/71.67. P. Macpherson, 1993, **herb. P.M.**

†62/34.4. Brassica juncea **41**, Glam.: Flower-bed, Hill's Street, The Hayes, Cardiff, ST/186.764. K. L. Davies, 1986, **NMW**, det. T. C. G. Rich. Still present in 1993. Only extant locality.

†62/37.1b. Coincya monensis subsp. recurvata ***58**, Cheshire: Waste ground, Bromborough Dock, SJ/346.854. V. Gordon & K. Watson, 1992, **herb. G. M. Kay**, det. T. C. G. Rich.

62/41.1. Crambe maritima **75**, Ayrs.: Shingle N. of Girvan Mains, NS/19.00. A. McG. Stirling *et al.*, 1993. 2nd extant locality.

65/10.2. Arctostaphylos alpinus **104**, N. Ebudes: Windswept ridge, Beinn Bhuidhe, Skye, NG/77.21. C. W. Murray, 1990, **herb. C.W.M.** 1st record since 1772 record from same area.

69/6.3. Anagallis minima **104**, N. Ebudes: Rubha na Cloiche, NG/565.337, & near Eyre, NG/572.339, Raasay. S. J. Bungard, 1993. 1st Raasay records.

†72/1.1. Escallonia macrantha ***46**, Cards.: Self-sown plants on cliff, E. side of Ystwyth estuary, Aberystwyth, SN/580.806. A. O. Chater, 1993, **NMW**.

73/1.1. Crassula tillaea ***13**, W. Sussex: Sandy arable field near Bignor Park Cottage, SU/990.169. M. Edwards, 1993, conf. M. Briggs.

†73/1.3. Crassula helmsii ***35**, Mons.: Edge of stream, Trethomas, ST/187.886. J. Woodman, 1992, **NMW**. Margin of borrow pit, Monmouth, SO/503.127. J. F. Harper, 1992, **NMW**. 1st and 2nd records, both conf. T. G. Evans. ***49**, Caerns.: Pond, Port Meirion village, SH/58.37. R. G. Ellis, 1993. ***91**, Kincardines.: Pool in rocks above high water-mark, Cove Bay, NJ/957.007. D. Welch, 1993, **ABD**. ***104**, N. Ebudes: Pond in grounds of Skeabost House Hotel, Skye, NG/413.487. C. W. Murray, C. D. Preston & N. F. Stewart, 1989, **herb. C.W.M.**

†73/5.8. Sedum stoloniferum *4, N. Devon: Roadside verge under trees, Ayshford, ST/045.160. L. J. Margetts & W. H. Tucker, 1990, det. H. J. M. Bowen.

†73/5.17. Sedum dasyphyllum **50**, Denbs.: Rhos-on-sea, SH/843.808. G. Battershall, 1993. 2nd extant locality.

†74/1.2. Astilbe rivularis ***98**, Main Argyll: Clearing in estate woodland N. of Inveraray Castle, NN/096.099. B. H. Thompson, 1993, **BM**, det. J. M. Mullin.

†74/5.8 × 9. Saxifraga umbrosa × S. spathularis (S. × urbium) **50**, Denbs.: Damp wood, Nant y Garth Pass, Ruthin, SJ/150.518. J. A. Green, 1993. Only extant locality.

†75/1.2. Sorbaria tomentosa ***29**, Cambs.: Old wall, Humberstone Road, Cambridge, TL/458.595. G. M. S. Easy, 1993, **herb. G.M.S.E.**

†75/4.1. Aruncus dioicus ***47**, Monts.: Meadow below Powis Castle, Welshpool, SJ/216.063. G. Hutchinson, 1989. 1st Welsh record.

75/8.14. Rubus arrheniiformis ***9**, Dorset: Common land, Lambert's Castle, SY/36.98. L. J. Margetts, 1991, **herb. L.J.M.**, det. A. Newton. ***28**, W. Norfolk: Wet heath and scrub, East Winch, TF/70.14. A. L. Bull, 1993, conf. A. Newton.

75/8.27. Rubus plicatus ***104**, N. Ebudes: Skeabost, Skye, NG/41.48. A. Newton, 1991, **herb. A.N.**

75/8.50. Rubus ebudensis ***104**, N. Ebudes: Side of B884, Colbost, Skye, NG/212.492. A. Newton, 1991, **herb. A.N.**

75/8.51. Rubus errabundus ***2**, E. Cornwall: Scrub on heathy hill, Kit Hill, SX/376.715. R. W. Gould, 1993, det. A. Newton.

†75/8.55. Rubus laciniatus ***75**, Ayrs.: Daljarrock, Colmonell, NX/1.8. R. C. L. Howitt, 1970, **GLAM**.

75/8.68. Rubus perdigitatus ***3**, S. Devon: Ride in forestry plantation, Trinity Hill, Axminster, SY/305.954. L. J. Margetts, 1992, **herb. L.J.M.**, det. A. Newton.

75/8.76. Rubus pyramidalis ***104**, N. Ebudes: Kyle Farm road, Skye, NG/74.25. A. Newton, 1991, **herb. A.N.**

75/8.82. Rubus silurum ***69**, Westmorland: Single large bush by side of farm road to Beckside Hall, Middleton, SD/628.882. G. Halliday, 1993, **LANC**, conf. A. Newton. Northernmost known locality.

75/8.90. Rubus amplificatus ***80**, Roxburghs.: Railway S. of Newcastletown, NY/4.8. C. W. Muirhead, 1969, **GLAM**, det. A. McG. Stirling.

75/8.92. Rubus boudiccae ***9**, Dorset: Woodbury Hill near Bere Regis, SY/85.94. M. Porter, 1991.

75/8.93. Rubus cardiophyllus ***2**, E. Cornwall: Scrub, Red Lake Reserve between Lostwithiel and Lerryn, SX/12.58. A. Newton, 1988.

†75/8.102. Rubus elegantispinosus ***69**, Westmorland: Hedge, Arrad Foot, Greenodd, SD/306.813. G. Halliday, 1993, **LANC**, det. A. Newton.

75/8.111. Rubus milfordensis ***11**, S. Hants.: Single bush by gateway by Dunwood near Romsey, SU/306.230. D. E. Allen, 1985, **BM**, conf. A. Newton.

75/8.116. Rubus pistoris ***9**, Dorset: Lightly wooded heath, Bewley Down, ST/28.06. L. J. Margetts, 1988, **herb. A. Newton**, det. A.N.

75/8.125. Rubus subinermoides ***104**, N. Ebudes: Portree, Skye, NG/47.43. A. Newton, 1991, **herb. A.N.**

†75/8.134. RUBUS ARMENIACUS *70, Cumberland: Verge of lane W. of Renwick, NY/575.440. G. Halliday, 1993, **LANC**, conf. A. Newton. *75, Ayrs.: Embankment of disused railway, Parkhouse Community Nature Reserve, Ardrossan, NS/23.42. A. McG. Stirling, 1993.

75/8.140. RUBUS ROSSENSIS *2, E. Cornwall: Path by Lower Tamar Lake, SS/294.110. W. H. Tucker, 1993, conf. A. Newton.

75/8.143. RUBUS WINTERI *3, S. Devon: Under roadside trees near Exmouth, SY/02.83. R. D. Randall, 1991, conf. A. Newton.

75/8.144. RUBUS ADSCITUS *9, Dorset: Hedgerow, Hawkchurch, SY/34.99. L. J. Margetts, 1988, **herb. A. Newton**, det. A.N.

75/8.159. RUBUS ORDOVICUM *50, Denbs.: Hedge, Capel Garmon, SH/812.582. G. Battershall, 1993, conf. A. Newton.

75/8.169. RUBUS FUSCICORTEX *50, Denbs.: Hedge, Capel Garmon, SH/812.582. G. Battershall, 1993, conf. A. Newton.

75/8.176. RUBUS AEQUALIDENS *3, S. Devon: W. of Dawlish, SX/93.76. R. D. Randall, 1991, **herb. R.D.R.**, conf. A. Newton.

75/8.188. RUBUS HETEROBELUS *3, S. Devon: Lympstone Common, SY/03.85. R. D. Randall, 1991, **herb. R.D.R.**, conf. A. Newton.

75/8.199. RUBUS RADULOIDES *70, Cumberland: Hedge by road W. of Rose Castle, Nether Welton, NY/363.464. G. Halliday, 1993, **LANC**, det. A. Newton.

75/8.239. RUBUS INSECTIFOLIUS *2, E. Cornwall: Scrub, Red Lake Reserve between Lostwithiel and Lerryn, SX/12.58. A. Newton, 1988.

75/8.242. RUBUS LONGITHYRSIGER *9, Dorset: Woodland, Bewley Down, ST/28.06. L. J. Margetts, 1988, **herb. A. Newton**, det. A.N.

75/8.243. RUBUS MALVERNICUS *3, S. Devon: Shady roadside, Venn Ottery, SY/064.915. R. Gould, L. J. Margetts & R. D. Randall, 1992, **herb. L.J.M.**, det. A. Newton.

75/8.253. RUBUS RUDIS *28, W. Norfolk: Conifer plantation, Shouldham Warren, TF/66.10. A. L. Bull, 1993, conf. A. Newton.

75/8.280. RUBUS PHAEOCARPUS *9, Dorset: Footpath across Warmwell Heath, SY/758.872. D. E. Allen, 1993, **BM**, conf. A. Newton.

75/8.286. RUBUS SCABRIPES *17, Surrey: One large bush on margin of woodland, Holmbury Hill, TQ/098.432. Surrey Flora Committee meeting, 1993, det. D. E. Allen & A. Newton.

75/8.312. RUBUS LATIFOLIUS *104, N. Ebudes: Roadside verge, Elgol, Skye, NG/528.146. M. Gregory, 1989, **herb. C. W. Murray**, det. A. Newton.

75/8.319. RUBUS TUBERCULATUS *77, Lanarks.: Grassy waste ground, Kenmuir, Glasgow, NS/66.62. P. Macpherson & A. McG. Stirling, 1993, **herb. P.M.**

†75/9.9. POTENTILLA NORVEGICA 80, Roxburghs.: Waste ground by the Slitrig, Whitlaw, Hawick, NT/499.134. R.W. M. Corner, 1992, **herb. R.W.M.C.** 2nd record.

75/9.13b. POTENTILLA ERECTA subsp. STRICTISSIMA *3, S. Devon: Gorse scrub, Hackpen Hill, Culmstock, ST/111.119. Gorse scrub, North Hill near Broadhembury, ST/096.065. Both L. J. Margetts, 1993, **NCE**, det. A. J. Richards. 1st and 2nd records. *4, N. Devon: Rough grassland, Marshall Farm estate, Woolfardisworthy, SS/310.185. M. Bristow & W. H. Tucker, 1993, **herb. L. J. Margetts**, conf. L.J.M. *5, S. Somerset: Foches Corner, West Buckland, ST/183.172. L. J. Margetts, 1993, det. A. J. Richards. *46, Cards.: With subsp. *erecta* in dense *Calluna vulgaris*/*Empetrum nigrum* heath, Draws Drum E. of Ponterwyd, SN/797.805. Bank in conifer forest, Myherin valley E. of Ysbyty Cynfyn, SN/772.790. Both A. O. Chater, 1991, **NMW**, conf. B. Harold. 1st and 2nd records.

75/9.14. POTENTILLA ANGLICA *93, N. Aberdeen: Grassland on abandoned railway, Ellon, NJ/947.305. D. Welch, 1993, **ABD**.

75/9.14 × 15. POTENTILLA ANGLICA × P. REPTANS (P. × MIXTA) *46, Cards.: Laneside grassy bank, Felin Ganol, Penparc, SN/199.487. A. O. Chater, 1991, **NMW**. Mown grassland, R.A.E. site, Aberporth, SN/241.522. A. O. Chater, 1992, **NMW**. 1st and 2nd records, both conf. B. Harold.

75/13.3. GEUM MACROPHYLLUM *46, Cards.: Abundant in wooded dingle and on roadside banks and verges, Cwmyrolchfa N. of Bronnant, SN/640.688. G. Jones, 1993, **NMW**, det. A. O. Chater. Known here to site owner for 40 years.

75/15.2. AGRIMONIA PROCERA **28**, W. Norfolk: Pasture, Larling, TL/963.903. J. Humphris, 1993. Only extant locality. †**104**, N. Ebudes: Edge of woodland path, Cuillin Hills estate, Portree, Skye, NG/48.43. J. E. Duncan & H. Lefevre, 1982, **herb. C. W. Murray**. 1st Skye record.

†75/18.1. ACAENA NOVAE-ZELANDIAE *46, Cards.: Shaley slopes under pines, U.C.W. Campus, Aberystwyth, SN/597.817. S. P. Chambers, 1993.

†75/19.5. ALCHEMILLA TYTTHANTHA *77, Lanarks.: Rough grassland, Cuningar Loop, Glasgow, NS/62.63. K. J. Watson, 1990, **GL**, conf. S. M. Walters.

†75/21.8. ROSA GLAUCA *17, Surrey: Self-sown in rough grass, Bagshot Heath, SU/903.632. S. Berrett & K. Page, 1993.

75/21.11 × 12. ROSA STYLOSA × R. CANINA (R. × ANDEGAVENSIS) *17, Surrey: Scrub around old farm pond, Dormansland, TQ/428.404. G. Fookes, 1993, det. A. L. Primavesi.

75/21.12 × 14. ROSA CANINA × R. OBTUSIFOLIA (R. × DUMETORUM) *25, E. Suffolk: Sea-wall, Buss Creek Marshes, Southwold, TM/495.761. C. D. Preston & S. E. Yates, 1992, det. A. L. Primavesi.

75/21.17. ROSA MOLLIS *75, Ayrs.: Garnock Floods, Irvine, NS/30.41. K. J. Watson, 1992. Sandy waste ground, I.C.I. Nobel Works site, Ardeer, NS/28.40. A. McG. Stirling, 1993. 1st and 2nd records.

75/21.19. ROSA MICRANTHA *26, W. Suffolk: Roadside verge near Mayday Farm, Brandon, TL/796.833. C. D. Preston, 1992, det. A. L. Primavesi. 1st post-1930 record.

†75/22.7. PRUNUS CERASUS **50**, Denbs.: Hedge, Cefn Berain, SH/979.687. J. A. Green, 1993. Only extant locality.

†75/22.13. PRUNUS LUSITANICA *49, Caerns.: Bird-sown plants in grassland, Brynian Farm near Llanbedr-y-Cennin, SH/785.719. R. Lewis, 1993, **NMW**.

75/28.24. SORBUS TORMINALIS **41**, Glam.: Carboniferous limestone cliff, Castell Coch woodlands, ST/128.828. G. M. Barter, 1992. 2nd extant locality.

†75/32.5. COTONEASTER AFFINIS *3, S. Devon: Edge of East Budleigh Common, SY/040.847. L. J. Margetts, 1991, **herb. L.J.M.**, det. J. Fryer & J. R. Palmer. *46, Cards.: Ty-rhos near Plwmp, SN/371.513. M. Evans, 1978, **NMW**, det. J. Fryer. Still present 1993, when dominant in roadside hedges and with abundant self-sown seedlings.

†75/32.10. COTONEASTER SALICIFOLIUS **41**, Glam.: Railway cutting, Gabalfa, ST/166.791. G. Hutchinson, 1986, **NMW**, det. J. Fryer. 2nd record. *47, Monts.: Scrub on limestone, Llanymynech Rocks, SJ/260.217. J. Pedlow & M. Wainwright, 1989, det. J. Fryer.

†75/32.11 × 18. COTONEASTER DAMMERI × C. CONSPICUUS (C. × SUECICUS) *41, Glam.: Waste ground, Bridgend Industrial Estate, SS/92.79. G. Hutchinson, 1990, **NMW**, det. J. Fryer.

†75/32.16. COTONEASTER INTEGRIFOLIUS *77, Lanarks.: Carrick Quay, Glasgow, NS/59.64. P. Macpherson, 1992, **herb. P.M.**, conf. J. Fryer.

†75/32.18. COTONEASTER CONSPICUUS *41, Glam.: Railway embankment, Gabalfa, ST/168.791. G. Hutchinson, 1986, **NMW**, det. J. Fryer. *49, Caerns.: Steep roadside slope between

Tyn-y-Groes and Talycafn Bridge, SH/785.719. R. Lewis, 1992, **NMW**, conf. J. Fryer. 1st Welsh records.

†75/32.21. COTONEASTER HORIZONTALIS *47, Monts.: Disused limestone quarry, Llanymynech Rocks, SJ/264.217. H. Webster, 1986. *73, Kirkcudbrights.: Amongst willows in quarry E. of Creetown, NX/500.585. O. M. Stewart, 1992. *75, Ayrs.: Embankment of disused railway, Parkhouse Community Nature Reserve, Ardrossan, NS/23.42. A. McG. Stirling, 1993.

†75/32.22. COTONEASTER HJELMQVISTII *41, Glam.: Railway embankment, Gabalfa, ST/168.791. G. Hutchinson, 1986, **NMW**, det. J. Fryer.

†75/32.34. COTONEASTER BULLATUS *25, E. Suffolk: Open woodland, The Dales, Ipswich, TM/155.462. M. A. Hyde, 1981. Ditch, Piper's Vale, Ipswich, TM/175.416. T. Hutton, 1993, det. E. M. Hyde. Both **herb. E. & M. Hyde**. 1st and 2nd records. *26, W. Suffolk: Roadside hedge, Harper's Hill, Nayland, TL/967.334. B. H. Harley, 1993, **IPS**, det. G. M. S. Easy. *47, Monts.: Limestone scree, Llanymynech Rocks, SJ/260.218. R. Dawes & I. C. Trueman, 1989, det. J. Fryer. *75, Ayrs.: Embankment of disused railway, Parkhouse Community Nature Reserve, Ardrossan, NS/23.42. A. McG. Stirling, 1993.

†75/32.35. COTONEASTER REHDERI *46, Cards.: Scrub below A487 S.W. of Ffos-y-ffin, SN/444.601. A. O. Chater, 1993, **NMW**. *49, Caerns.: Woodland, Bryn Maelgwyn S. E. of Llandudno, SH/797.805. R. Lewis, 1991, **NMW**, det. J. Fryer. Edge of woodland between Pontwgan and Roewen, SH/7.7. R. Lewis, 1993. 1st and 2nd records.

†75/32.37. COTONEASTER DIELSIANUS *47, Monts.: Woodland on limestone, Llanymynech Hill, SJ/266.217. M. Wainwright, 1989, det. J. Fryer.

†75/32.40. COTONEASTER STERNIANUS *4, N. Devon: Wall above river-bank, Hillsford Bridge, SS/742.478. W. H. Tucker, 1988, det. J. R. Palmer. Still present in 1993. *29, Cambs.: Bramble thickets on waste ground, Wisbech, TF/462.103. G. M. S. Easy, 1993, **herb. G.M.S.E.** *41, Glam.: Waste ground, Birchgrove, Cardiff, ST/165.804. A. D. Tipper, 1988, **NMW**, det. J. Fryer. *44, Carms.: Lane to Waungron Farm, S. of Llanybydder, SN/52.42. G. Hutchinson, 1991, **NMW**, det. J. Fryer. Stradey Woods, Llanelli, SN/495.014. I. K. Morgan, c.1969, **NMW**, det. G. Hutchinson.

77/4.2. ASTRAGALUS DANICUS *108, W. Sutherland: Sandy grassland, Bay of Clachtoll, NC/040.273. A. McG. Stirling & A. A. P. Slack, 1993.

†77/7.1d. ANTHYLLIS VULNERARIA subsp. CARPATICA *25, E. Suffolk: Verge of bridle-path and farm-track, Wherstead, TM/147.413. Ipswich District Natural History Society, 1993, **IPS**, det. J. R. Akeroyd.

77/14.12. VICIA LATHYROIDES 79, Selkirks.: Old wall top, Newark Castle, Yarrow, NT/422.294. D. J. Methven, 1993. 1st record since 1926 record in this locality.

77/14.13. VICIA LUTEA †58, Cheshire: Road bank, Tarvin, SJ/496.661. M. Stead, 1991, **herb. G. M. Kay**. 1st record since 1862.

77/15.2. LATHYRUS JAPONICUS 11, S. Hants.: Bare shingle, Hurst Castle Spit, SZ/319.898. G. D. Field, 1993, conf. R. P. Bowman. Only extant locality. *91, Kincardines.: Stoney beach just above high-water mark, Nigg, NJ/965.047. D. Bale, 1993, **herb. D. Welch**, conf. D.W.

†77/15.7. LATHYRUS GRANDIFLORUS *73, Kirkcudbrights: Ravenshall, NX/525.523. O. M. Stewart, 1993. Well naturalized on roadside and river-bank, Palnure, NX/455.631. O. M. Stewart, 1993. 1st and 2nd records.

77/15.12. LATHYRUS NISSOLIA †*44, Carms.: Roadside verge near Derwen Farm, Cae'r-bryn, SN/597.143. R. D. Pryce & K. Sanderson, 1993, **NMW**. Side of B4310 near Porthyrhyd, SN/521.166. G. Hutchinson, 1993, **NMW**. 1st and 2nd records.

77/18.5. MEDICAGO ARABICA †83, Midlothian: Waste ground, Granton, Edinburgh, NT/23.77. O. M. Stewart, 1990, **E**. Grassy bank, Warriston Road, Edinburgh, NT/253.754. S. Maxwell, 1993. 1st and 2nd post-1930 records.

77/19.5. TRIFOLIUM GLOMERATUM **5**, S. Somerset: Gadd's Bottom, Kingston St Mary, ST/230.297. I. Green, 1993. 1st record since 1916.

†77/25.1. GENISTA MONSPESSULANA ***5**, S. Somerset: Hedge bank, Luccombe, SS/913.443. J. Clarke, 1993.

78/1.1. HIPPOPHAE RHAMNOIDES †***77**, Lanarks.: Grassy waste ground, Cessnock, Glasgow, NS/56.64. P. Macpherson, 1991, **herb. P.M.** Still present in 1993.

†79/2.2. MYRIOPHYLLUM AQUATICUM ***46**, Cards.: In *Azolla filiculoides*-dominated pond, Llain-wen near Synod Inn, SN/392.550. A. O. Chater, 1993, **NMW**.

†80/1.1. GUNNERA TINCTORIA ***75**, Ayrs.: Waste ground near sea, Auchengarth, NS/190.643. A. McG. Stirling, 1993. ***99**, Dunbarton: Bank of A83 near Cameron House, Balloch, NS/37.83. A. McG. Stirling, 1993.

84/1.3 × 8. EPILOBIUM MONTANUM × E. CILIATUM ***104**, N. Ebudes: With both parents on waste ground, Park Lane, Portree, Skye, NG/48.43. G. Kitchener, 1991, **E.**

84/1.7. EPILOBIUM ROSEUM **73**, Kirkcudbrights.: Old Creetown station, NX/475.599. O. M. Stewart & A. White, 1993. Only extant locality.

†84/1.14. EPILOBIUM KOMAROVIANUM ***2**, E. Cornwall: China clay waste, Carvear Moor, SX/051.547. G. C. Matthews & R. J. Murphy, 1993. ***98**, Main Argyll: Roadside bank, grounds of County Hospital, Oban, NM/86.30. E. L. S. Macpherson, 1961, **herb. P. Macpherson**, conf. E. J. Clement.

†91/2.14 × wal. EUPHORBIA ESULA × E. WALDSTEINII (E. × PSEUDOVIRGATA) ***3**, S. Devon: By Exeter Canal, SX/92.91. L. M. Spalton, 1991, det. A. Radcliffe-Smith.

†100/1.1. RHUS HIRTA ***50**, Denbs.: Waste ground, Llandulas, SH/918.782. G. Battershall, 1993.

†102/1.6. OXALIS STRICTA ***50**, Denbs.: Weed in flowerbeds, Loggerheads, SJ/199.626. R. Maycock & A. Woods, 1993.

†102/1.10. OXALIS DEBILIS ***49**, Caerns.: Waste ground near railway halt, Dolgarrog, SH/784.669. R. Lewis, 1991, **NMW**.

†103/1.1 × 2. GERANIUM ENDRESSII × G. VERSICOLOR (G. × OXONIANUM) ***77**, Lanarks.: Wood, Thorntonhall, NS/58.54. P. Macpherson, 1989, **herb. P.M.** Still present and spreading, 1993.

†104/1.1. TROPAEOLUM SPECIOSUM ***75**, Ayrs.: Roadside hedge, Pinmore, Girvan, NX/20.91. A. E. White, 1993, conf. A. McG. Stirling.

105/1.1. IMPATIENS NOLI-TANGERE †***46**, Cards.: Gulley, Capel Bangor, SN/6.7. C. Morley, 1939, ms notebook in **IPS**.

†105/1.3. IMPATIENS PARVIFLORA ***93**, N. Aberdeen: Railway siding, Inverurie, NJ/776.219. D. Welch, 1992, **ABD**.

†107/32.1. AMMI MAJUS ***38**, Warks.: Churchyard, Birmingham, SP/070.871. A. D. Grenfell, 1983. Roadside, Coventry, SP/356.786. M. J. Senior, 1992, det. J. C. Bowra. 1st and 2nd records.

108/3.2. CENTAURIUM ERYTHRAEA **80**, Roxburghs.: Steep bank, Bowden Burn, Newtown St Boswells, NT/56.30. J. Blane, 1992. 2nd extant locality.

108/4.1. BLACKSTONIA PERFOLIATA ***28**, W. Norfolk: Bank of New Cut by Whitedyke Farm, Feltwell, TL/69.89. J. Secker, 1992.

108/5.2. GENTIANELLA CAMPESTRIS **50**, Denbs.: Limestone turf, Maeshafn, SJ/200.615. R. Maycock & R. Woods, 1993. 2nd post-1930 record.

108/5.4a. GENTIANELLA AMARELLA subsp. AMARELLA **1**, W. Cornwall: Dune grassland, Rushy Green near Crantock, SW/787.608. H. Meredith, 1993, conf. L. J. Margetts. 1st record since 1912.

109/1.herb. VINCA HERBACEA [**81**, Berwicks.: Delete record published in *The botanist in Berwickshire* by M. E. Braithwaite & D. G. Long (1990), which is based on a form of *V. minor*, fide M. E. Braithwaite.]

110/3.1. ATROPA BELLADONNA **75**, Ayrs.: Sandy waste ground, I.C.I. Nobel Works site, Ardeer, NS/28.40. A. McG. Stirling & E. Millar, 1993. 1st record this century.

111/3.2b. CALYSTEGIA SEPIUM subsp. ROSEATA ***45**, Pembs.: Behind shingle ridge, Newgale, SM/849.218. S. B. Evans, 1987, **NMW**.

111/3.2 × 4. CALYSTEGIA SEPIUM × C. SYLVATICA (C. × LUCANA) ***73**, Kirkcudbrights.: With both parents on hedgebank, Eldingham industrial estate near Dalbeattie, NX/838.626. O. M. Stewart, 1993.

113/2.1. NYMPHOIDES PELTATA †***68**, Cheviot: Edge of R. Tweed N.E. of Union Bridge, NT/934.512. J. M. Croft & C. D. Preston, 1991, **CGE**. Still present in 1994.

116/1.2. LITHOSPERMUM OFFICINALE **46**, Cards.: Weedy vegetation on sandy slope between road and beach N.W. of Nantyferwig, Gwbert, SN/165.484. A. O. Chater, 1993, **NMW**. 1st record since 1929, when recorded in this area by J. H. Salter.

116/4.3. SYMPHYTUM TUBEROSUM [**47**, Monts.: Delete record published in *Watsonia* **19**: 288 (1993); specimen in **NMW** is *S. grandiflorum*, det. F. H. Perring.]

†116/4.4. SYMPHYTUM GRANDIFLORUM ***47**, Monts.: Churchyard, Penstrowed, SO/070.915. C. A. Small, 1992, **NMW**, det. F. H. Perring. ***73**, Kirkcudbrights.: Wood edge E. of Kirkcudbright, NX/691.507. O. M. Stewart & A. White, 1992.

†116/4.6. SYMPHYTUM ORIENTALE ***50**, Denbs.: Roadside, Eglwysbach, SH/804.716. W. McCarthy, 1993, **NMW**. 1st Welsh record.

†116/4.8. SYMPHYTUM BULBOSUM ***6**, N. Somerset: Edge of path, Butleigh, Street, ST/520.338. P. Green, 1993, det. F. H. Perring.

†116/5.1. BRUNNERA MACROPHYLLA ***64**, Mid-W. Yorks.: Roadside, Marston Moor, SE/499.525. P. P. Abbott, 1993.

116/15.1 × 4. MYOSOTIS SCORPIOIDES × M. LAXA (M. × SUZAE) ***46**, Cards.: Poached, muddy margin of pond, The Moat, Llandyfriog, SN/342.408. A. O. Chater, 1993, **NMW**, det. P. M. Benoit.

116/15.9. MYOSOTIS RAMOSISSIMA **73**, Kirkcudbrights.: Short turf near shore, Fauldbog Bay, NX/643.441. O. M. Stewart, 1992. 2nd extant locality.

†118/4.1a. LAMIASTRUM GALEOBDOLON subsp. ARGENTATUM ***25**, E. Suffolk: By wall alongside watercourse, Walberswick, TM/499.746. G. Kitchener, 1992. Off Dunwich road, Westleton, TM/445.693. G. Kitchener, 1992. 1st and 2nd records.

†118/13. rac. × nep. NEPETA RACEMOSA × N. NEPETELLA (N. × FAASSENII) ***46**, Cards.: Dune by caravan site, The Patch, Penyrergyd, SN/162.485. A. O. Chater, 1993, **NMW**.

118/22.1. LYCOPUS EUROPAEUS **104**, N. Ebudes: In *Sphagnum* and running water under *Salix aurita*, N. of Lochan Gun Ghrunnd, Raasay, NG/613.519. S. J. Bungard, 1991. 1st Raasay record.

118/23.†3 × 4. MENTHA SPICATA × M. SUAVEOLENS (M. × VILLOSA) ***24**, Bucks.: Disused orchard, Ravenstone, SP/849.507. R. Maycock & A. Woods, 1989, det. R. M. Harley as var. *alopecuroides*.

118/23.4. MENTHA SUAVEOLENS ***83**, Midlothian: Waste ground by sea, Granton, Edinburgh, NT/23.77. O. M. Stewart, 1988, **E**, det. R. M. Harley. 1st confirmed record.

118/25.3. SALVIA PRATENSIS ***13**, W. Sussex: Grazed chalk grassland, Anchor Bottom S. of Upper Beeding, TQ/205.095. G. Hart, 1992, **herb. P. Harmes**, det. A. C. Leslie. 1st confirmed record.

121/1.3b. PLANTAGO MAJOR subsp. INTERMEDIA ***25**, E. Suffolk: Side of ditch, Shipmeadow, TM/389.905. C.D. Preston & N. F. Stewart, 1989, **CGE**. ***46**, Cards.: Margin of potato field N.

of Ty-gwyn, Mwnt, SN/197.521. J. R. Akeroyd, A. O. Chater & C. D. Preston, 1987. Recently reconstructed bank of A44, Lovesgrow, SN/636.810. S. P. Chambers, 1992. 1st and 2nd records.

†123/1.sus. × vir. FORSYTHIA SUSPENSA × F. VIRIDISSIMA (F. × INTERMEDIA) ***35**, Mons.: Bank of R. Ebbw, Risca, ST/2.9. J. Harper, 1992.

124/1.2. VERBASCUM VIRGATUM †***35**, Mons.: Rail ballast, old shunting lines, Undy, ST/447.875. T. G. Evans, 1993, **herb. T.G.E.**

124/2.2. SCROPHULARIA AURICULATA **104**, N. Ebudes: S. of Eaglais Breige, Raasay, NG/58.43. S. J. Bungard, 1990, **herb. C. W. Murray**, det. D. R. McKean. 1st Raasay and 2nd v.c. record.

124/8.2. CHAENORHINUM MINUS ***93**, N. Aberdeen: Cess by railway, Gartly, NJ/527.314. D. Welch, 1993, **ABD**.

†124/16.23. VERONICA FILIFORMIS **104**, N. Ebudes: Inverarish, Raasay, NG/555.357. S. J. Bungard, 1993. 1st Raasay record.

†124/17.1. HEBE SALICIFOLIA ***50**, Denbs.: Woods, Pwllycrochan, SH/842.785. G. Battershall, 1993.

124/20.1 × 9. EUPHRASIA ROSTKOVIANA subsp. ROSTKOVIANA × E. CONFUSA ***44**, Carms.: Acidic, sheep-grazed turf above Pont Clydach, Mynydd Du, SN/740.195. R. D. Pryce, 1982, **NMW**, det. A. J. Silverside. 2nd Welsh record.

124/20.3 × 7. EUPHRASIA ANGLICA × E. NEMOROSA ***44**, Carms.: Rough pasture, Cefn Parcin, Llanybydder, SN/54.42. I. M. Vaughan, 1972, **NMW**, det. A. J. Silverside. 3rd Welsh record.

124/20.5 × 9. EUPHRASIA ARCTICA subsp. BOREALIS × E. CONFUSA ***44**, Carms.: Disturbed ground on recolonised ash-tip, Machynys, Llanelli, SS/51.98. R. D. Pryce, 1986, **NMW**, det. A. J. Silverside. 2nd Welsh record. ***46**, Cards.: Leadmine, Llwynmalus, Tyn-y-graig, SN/690.679. S. P. Chambers, 1992, det A. J. Silverside.

124/20.5 × 19. EUPHRASIA ARCTICA subsp. BOREALIS × E. SCOTTICA ***44**, Carms.: Heathy roadside E.N.E. of Llidiadnenog, SN/553.367. R. D. Pryce, 1986, **NMW**, det. A. J. Silverside. 1st Welsh record.

124/20.6 × 9. EUPHRASIA CONFUSA × E. TETRAQUETRA ***2**, E. Cornwall: Short turf by the sea, Tintagel, SX/05.89. G. G. & P. S. Graham, 1983, **SUN**, det. A. J. Silverside.

124/20.20. EUPHRASIA HESLOP-HARRISONII **104**, N. Ebudes: Saltmarsh turf, Ardnish, Skye, NG/679.242, and Kensaleyre, Skye, NG/418.518. A. J. Silverside, 1982, **herb. A.J.S.** 1st and 2nd Skye records.

124/23.1. PARENTUCELLIA VISCOSA †***5**, S. Somerset: Edge of newly made pond, Fitzhead, Wiveliscombe, ST/109.299. P. Green, 1993. †**64**, Mid-W. Yorks.: Old quarry, West Bradford, SD/731.471. K. A. Crowther, 1992. 2nd record. Limestone grassland below slag heap, Micklefield, SE/433.324. Leeds Naturalists' Club excursion, 1993. 2nd extant locality.

124/25.2b. PEDICULARIS SYLVATICA subsp. HIBERNICA ***41**, Glam.: *Molinia caerulea* bog, Broad Pool, Gower, SS/51.91. E. Nic Lughadha *et al.*, 1993, **NMW**. Coastal heath, Overton Cliff, SS/454.849. T. C. G. Rich *et al.*, 1993. 1st and 2nd records. ***46**, Cards.: With subsp. *sylvatica* in *Molinia caerulea*-dominated heathy pasture, N. of Nanthen-foel, Pont Creuddyn, SN/542.521. A. O. Chater & D. Glyn Jones, 1993, **NMW**. With subsp. *sylvatica* in flush, Cefnyresgair-fawr, E.S.E. of Tregaron, SN/707.581. A. O. Chater, 1993. 1st and 2nd records.

†125/1.2. LATHRAEA CLANDESTINA ***48**, Merioneth: Woodland, W. bank of Afon Dulas near Esgair-geiliog, N. of Machynlleth, SH/7.0. S. Grasse & A. Morton, 1990, **NMW**. Open *Salix* scrub, Dwyryd estuary, SH/5.3. R. E. Hughes, 1993, **NMW**. Introduced c.30 years ago and now well naturalized. 1st and 2nd Welsh records.

125/2.2. OROBANCHE RAPUM-GENISTAE **4**, N. Devon: On *Cytisus scoparius* subsp. *maritimus* on steep rock face above landing beach, Lundy, SS/142.439. L. Farrell & R. Key, 1993. 1st post-1930 record for Lundy.

†129/1.4. CAMPANULA PERSICIFOLIA *46, Cards.: Overgrown bank of Afon Einion, Eglwys Fach, SN/684.958. A. O. Chater, 1993, **NMW**.

130/6.7. GALIUM MOLLUGO 79, Selkirks.: Field on S.E. side of Selkirk, NT/476.284. J. Muscott, 1992. 2nd record.

130/6.7b. GALIUM MOLLUGO subsp. ERECTUM *50, Denbs.: Edge of lane, Eryris, SJ/209.571. J. A. Green, 1993.

130/6.9. GALIUM STERNERI **81**, Berwicks.: Rock outcrop, Gaitheugh, Gledswood, NT/59.34. M. E. Braithwaite, 1993, **herb. M.E.B.** 1st record since J. H. Balfour's 1852 record in this locality.

†131/1.1. SAMBUCUS RACEMOSA *6, N. Somerset: Postlebury Wood, Trudoxhill, ST/739.427. G. Read, 1993.

†131/2.3. VIBURNUM TINUS ***50**, Denbs.: Woodland, N. side of Bryn Euryn, Colwyn Bay, SH/83.80. and bank of A470 N.E. of Talycafn Bridge, SH/79.72. R. Lewis, 1993. 1st and 2nd records.

131/6.4. LONICERA XYLOSTEUM †***75**, Ayrs.: Sourlie Wood, Irvine, NS/34.41. K. J. Watson, 1993.

133/1.1. VALERIANELLA LOCUSTA ***96**, Easterness: Dunes, Nairn, NH/896.574. M. Barron, 1993.

133/1.2. VALERIANELLA CARINATA **50**, Denbs.: Colwyn Bay, SH/833.802. G. Battershall, 1993. 2nd post-1930 record.

†133/1.5. VALERIANELLA ERIOCARPA ***11**, S. Hants.: Base of cliffs below Royal Bath Hotel, Bournemouth, SZ/091.908. R. M. Walls, 1993, **herb. R.M.W.**, conf. R. P. Bowman.

135/11.1. CENTAUREA SCABIOSA **81**, Berwicks.: Railway cutting, Lamberton, NT/96.59. J. O. Mountford & C. Sargent, 1980. 2nd record.

†135/11.2. CENTAUREA MONTANA **50**, Denbs.: Mynydd Llanelian, SH/850.744. G. Battershall, 1993. 2nd record.

135/17.1. PICRIS ECHIOIDES †***98**, Main Argyll: Edge of estate track near Loch Craignish, Lunga, NM/797.070. B. H. Thompson, 1993, **herb. B.H.T.**, conf. C. D. Preston.

135/22.1. LACTUCA SERRIOLA ***43**, Rads.: Recently excavated ground, Presteigne by-pass, SO/321.634. D. R. Humphries, 1993. ***51**, Flints.: Roadside bank in industrial estate, Sandycroft, SJ/328.667. T. Edmondson, 1992.

135/22.2. LACTUCA VIROSA ***5**, S. Somerset: Waste ground, Minehead, SS/974.462. I. Green, 1993.

†135/27.5a. PILOSELLA CAESPITOSA subsp. COLLINIFORMIS ***77**, Lanarks.: Rough grassland near Stevenston, NS/76.59. P. Macpherson, 1993, **herb. P.M.**

135/28.4. HIERACIUM SALTICOLA ***99**, Dumbarton: Waste ground, Dumbarton Common, NS/39.76. A. McG. Stirling, 1993.

135/28.5. HIERACIUM VAGUM ***75**, Ayrs.: R. Stinchar, Ballantrae, NX/0.8. A. Somerville, 1902, **LCN**, det. P. D. Sell & C. West.

135/28.10. HIERACIUM SUBUMBELLATIFORME ***91**, Kincardines.: Rocky riverside, Banchory, NO/687.957. D. Welch, 1993, **ABD**, det. D. J. McCosh.

135/28.94. HIERACIUM SUBHIRTUM ***75**, Ayrs.: Rocky streamside, Cross Burn, Kirriereoch, NX/40.87. O. M. Stewart & A. McG. Stirling, 1988, **E**, det. D. J. McCosh.

135/28.116. HIERACIUM DURICEPS ***80**, Roxburghs.: Calcareous streamside rocks, Green Needles, Kielderstone, NT/64.01. B.S.B.I. field meeting, 1993, det. A. McG. Stirling.

135/28.140. HIERACIUM EXOTERICUM ***91**, Kincardines.: Old Red Sandstone outcrop in river gorge, The Burn, Edzell, NO/599.710. D. Welch, 1993, **herb. D.W.**, det. D. J. McCosh.

135/28.147. HIERACIUM CALEDONICUM *91, Kincardines.: Rock outcrop, Slack of Birnie, NO/ 672.807. D. Welch, 1993, **herb. D.W.**, det. D. J. McCosh.

135/28.176. HIERACIUM DICELLA *75, Ayrs.: Sea cliffs S. of the castle, Dunure, NS/24.15. R. Mackechnie, 1936, **GLAM**, det. D. J. McCosh. Still there in 1993.

135/28.209. HIERACIUM VENNICONTIUM *104, N. Ebudes: Cliff above Old Man of Storr, Skye, NG/49.54. O. M. Stewart, 1987, **E**, det. P. D. Sell.

135/28.236. HIERACIUM GLOBOSIFLORUM *104, N. Ebudes: Rocky outcrops, Beinn na Greine, Skye, NG/74.22. C. W. Murray, 1989, **herb. C.W.M.**, det. J. Bevan as 'dark-styled form'.

135/28.248. HIERACIUM HOLOSERICEUM *104, N. Ebudes: Rough gravelly ground, Beinn na Greine, Skye, NG/74.22. R. M. & C. W. Murray & A. A. P. Slack, 1986, **herb. C.W.M.**, det. J. Bevan.

135/30.4. FILAGO MINIMA **46**, Cards.: Disturbed sandy soil, Penparc sand quarries, SN/ 199.484. A. O. Chater & C. D. Preston, 1993, **NMW**. Only extant locality.

†135/41.3 × 4. ASTER LAEVIS × A. NOVI-BELGII (A. × VERSICOLOR) ***46**, Cards.: Long grass at tidal limit of Afon Cletwr, Craigypenrhyn, SN/653.929. A. O. Chater, 1992, **CGE**, det. P. F. Yeo.

†135/43.4. ERIGERON KARVINSKIANUS **50**, Denbs.: Crags above woodland, W. side of Bryn Euryn, Colwyn Bay, SH/83.79. R. Lewis, 1993, det. Mrs R. Lewis.

135/62.†1 × 10. SENECIO CINEREA × S. JACOBAEA (S. × ALBESCENS) ***59**, S. Lancs.: Disused cinder track, Fazakerley, SJ/380.978. B.S.B.I. meeting, 1993. ***75**, Ayrs.: Waste ground in industrial estate, Cambuslea Road, Newton-upon-Ayr, NS/35.23. A. McG. Stirling, 1993.

†135/71.3. PETASITES ALBUS **46**, Cards.: Extensive colony in scrub and woodland, Falcondale grounds, SN/565.491. A. O. Chater, 1993. 2nd record.

†138/4.2. ELODEA NUTTALLII ***61**, S.E. Yorks.: Barmston Drain, Beverley, TA/05.40. J. Dews, 1993. Slowly flowing ditch, Wheldrake Ings, SE/703.433. C. D. Preston, 1993. 1st and 2nd records. **73**, Kirkcudbrights.: Carsfad Loch, NX/605.858. O. M. Stewart, 1993. 2nd record.

142/1.8. POTAMOGETON PRAELONGUS **29**, Cambs.: Wicken Lode, Wicken Fen, TL/56.70. N. F. Stewart, 1992. 2nd extant locality.

142/1.14. POTAMOGETON OBTUSIFOLIUS **46**, Cards.: Mesotrophic lake, Llyn Maesllyn, SN/ 693.627. A. O. Chater & C. Moscrop, 1993, **NMW**. 2nd record.

142/1.16. POTAMOGETON TRICHOIDES *3, S. Devon: Drainage ditch, Exminster Marshes, SX/ 9.8. M. C. F. Proctor, 1969, **BM**, det. J. E. Dandy. ***61**, S.E. Yorks.: Pond and slowly flowing ditch, Wheldrake Ings, SE/704.434. & 703.433. C. D. Preston, 1993, **CGE**.

142/2.1. GROENLANDIA DENSA †***104**, N. Ebudes: Pond in hotel grounds, Skeabost House Hotel, Skye, NG/413.487. C. W. Murray, C. D. Preston & N. F. Stewart, 1989, **herb C.W.M.** Perhaps introduced unintentionally with plants from Derbyshire.

148/2.2 LEMNA MINOR ***108**, W. Sutherland: Recently re-excavated peaty ditch near Elphin school, NC/215.119. I. M. Evans, 1993.

†148/2.4. LEMNA MINUTA ***38**, Warks.: Pond, Solihull, SP/164.817. J. W. Partridge, 1989, **WAR**, det. A. C. Leslie. R. Leam near Leamington Spa, SP/333.655. J. W. Partridge, 1991, det. J. C. Bowra. 1st and 2nd records.

†151/1.2. JUNCUS TENUIS ***79**, Selkirks.: Track, Thirlestane Tower, Ettrick, NT/281.154. R. W. M. Corner, 1993, **herb. R.W.M.C.**

151/1.6. JUNCUS FOLIOSUS ***73**, Kirkcudbrights.: Edge of damp, shingley burn, glen N. of Corse of Slakes road, NX/54.58. O. M. Stewart, 1993. ***86**, Stirlings.: Sandy shore of Loch Lomond, Balmaha, NS/42.90. A. & D. A. Pearman & C. D. Preston, 1993, **CGE**.

152/3.2. ELEOCHARIS AUSTRIACA ***59**, S. Lancs.: Silty mound in bed of River Ribble 2·5 km N.N.E. of Clitheroe Castle, SD/752.441. P. Jepson, 1993, det. S. M. Walters.

152/7.2. SCHOENOPLECTUS TABERNAEMONTANI *81, Berwicks.: Pond, Morningbank, Swinton, NT/833.477. M. E. Braithwaite, 1993, **herb. M.E.B.**

152/12.1. SCHOENUS NIGRICANS *48, Merioneth: With *Juncus maritimus* in upper saltmarsh near Pennal, SN/6.9. R. Squires, 1993, **NMW**. 1st confirmed record.

152/16.1. CAREX PANICULATA *86, Stirlings.: Mugdock Wood, Milngavie, NS/545.763. A. McG. Stirling, 1950, **BM**, det. R. W. David.

152/16.1 × 3. CAREX PANICULATA × C. DIANDRA (C. × BECKMANNII) *98, Main Argyll: Loch Ederline, Ford, NM/865.021. A. McG. Stirling & B. H. Thompson, 1992, **BM**, det. R. W. David.

152/16.3. CAREX DIANDRA *78, Peebless.: Bridgehouse, NT/1.5. No collector, 1865, **BM**.

152/16.5. CAREX OTRUBAE **104**, N. Ebudes: Shore rocks, Rubha na Leac, Raasay, NG/598.381. S. J. Bungard, 1993. 1st confirmed Raasay record.

152/16.7. CAREX SPICATA *74, Wigtowns.: Port Castle Bay, Whithorn, NX/425.357. A. Rutherford & A. McG. Stirling, 1985, **BM**, det. R. W. David.

152/16.8b. CAREX MURICATA subsp. LAMPROCARPA *89, E. Perth: Stenton, Dunkeld, NO/07.40. J. H. Penson, 1961, **BM**, det. R. W. David.

152/16.11. CAREX DISTICHA *93, N. Aberdeen: Marsh by flooded brick-pit, Cruden Bay, NK/08.36. M. Innes, 1992.

152/16.27. CAREX PSEUDOCYPERUS **46**, Cards.: Large pond dug out from swampy, wooded hollow in 1992, Cwmsaeson, Oakford, SN/453.585. A. O. Chater & D. Glyn Jones, 1993. 2nd record.

152/16.47. CAREX PALLESCENS **83**, Midlothian: Upland grassland, Moorfoot Hills S.W. of Hirendean Castle, NT/294.501. C. Dixon, 1993, **E**, conf. D. R. McKean. Upland heath, Linhouse Water E. of Murieston, NT/075.649. S. Maxwell, 1993. 1st and 2nd post-1930 records.

152/16.49. CAREX ORNITHOPODA **64**, Mid-W. Yorks.: Grassy areas amongst limestone pavement at 380 m, Twistleton Scars, SD/715.764. B.S.B.I. meeting, 1992, det. G. M. Kay. 2nd record, 1st this century.

152/16.59. CAREX MAGELLANICA *46, Cards.: Fringing pool and in nearby wet mire, E. of Drybedd, Dyffryn Castle, SN/779.832. A. O. Chater, 1993, **NMW**.

152/16.68. CAREX ELATA **36**, Herefs.: Pondside, Wallbrook Wood, Allensmore, SO/440.360. J. Port, 1993, det. A. O. Chater. 1st confirmed record this century.

153/11.1. MILIUM EFFUSUM **81**, Berwicks.: Policy woodland, Swinton House, NT/813.473. M. E. Braithwaite, 1993, **herb. M.E.B.** 2nd extant locality.

†153/12.7g. FESTUCA RUBRA subsp. MEGASTACHYS **25**, E. Suffolk: Edges of garden lawn, Shottisham, TM/31.44. A. Morgan, 1992, det. P. J. O. Trist. 2nd record.

153/12.9. FESTUCA VIVIPARA **83**, Midlothian: Disturbed ground, Emly Bank, Moorfoot Hills, NT/293.474. C. Dixon, 1993, **E**, det. D. R. McKean. 2nd post-1930 record.

153/12.12. FESTUCA HUONII *3, S. Devon: Rock outcrop near Prawle Point, SX/767.361. R. Takagi-Arigho, 1992, **herb. R.T.-A.**, det. T. A. Cope. 1st record for British Isles outside Channel Islands.

153/18.1. POA INFIRMA *9, Dorset: Cliffs, Bournemouth, SZ/12.91. R. M. Walls, 1993.

153/18.6. POA ANGUSTIFOLIA *81, Berwicks.: Sandstone wall top, side of R. Tweed below Ladykirk House, NT/886.455. M. E. Braithwaite, 1993, **herb. M.E.B.**, det. J. R. Edmondson.

153/20.1. CATABROSA AQUATICA **78**, Peebless.: peaty ditch, Kippit Farm, Dolphinton, NT/11.47. D. J. McCosh, 1993, **herb. D.J.M.** 1st post-1930 record.

153/24.1. GLYCERIA MAXIMA **81**, Berwicks.: Side of R. Tweed, Ladykirk, NT/896.464. M. E. Braithwaite, 1993, **herb. M.E.B.** 2nd record.

†153/28.3. AVENA FATUA **79**, Selkirks.: Waste ground, Clovenfords, NT/451.367. R. W. M. Corner, 1991, **herb. R.W.M.C.** 1st post-1930 record.

†153/29.1. GAUDINIA FRAGILIS ***11**, S. Hants.: Old grassland in meadow, Curdridge, SU/52.13. J. Rowe, 1993, **HCMS**, det. F. Rose.

153/32.1b. DESCHAMPSIA CESPITOSA subsp. PARVIFLORA ***35**, Mons.: Shady cliff top near Lover's Leap, Piercefield Park, ST/523.969. T. G. Evans, 1988, **herb. T.G.E.** Shady bank of River Honddu N.N.W. of Cwmyoy, SO/291.249. T. G. Evans, 1993, **herb. T.G.E.** 1st and 2nd records.

153/31.2. KOELERIA MACRANTHA **79**, Selkirks.: Basic grassland, Selkirk Hill, NT/481.284. J. Muscott, 1992, **herb. R. W. M. Corner**. 2nd extant locality.

†153/38.5. PHALARIS PARADOXA ***14**, E. Sussex: Arable field near Wilmington East, TQ/539.053. P. A. Harmes, 1989, **herb. P.A.H.**, det. E. J. Clement. Established in quantity; still present in 1993.

†153/39.3. AGROSTIS CASTELLANA ***3**, S. Devon: Waste ground, The Maer, Exmouth, SY/011.800. R. Takagi-Arigho, 1990, **RAMM**. ***58**, Cheshire: New road verge, Ringway, SJ/807.858. D. Shaw, 1992, **herb. G. M. Kay**, det. R. M. Payne.

†153/39.9. AGROSTIS SCABRA **83**, Midlothian: Boggy area of disused railway, Edinburgh, NT/763.251. D. R. McKean & U. L. Moorhead, 1993, **E**. 1st record since 1915.

153/40.2. CALAMAGROSTIS CANESCENS ***24**, Bucks.: Edge of woodland ride by hazel coppice, Leckhampstead Wood, SP/727.403. R. J. Hornby, L. M. Jones-Walters & J. Spencer, 1989.

153/44.1. APERA SPICA-VENTI **13**, W. Sussex: Arable set-aside on chalk downland, Thundersbarrow Hill, TQ/22.09. H. Matcham & A. Spiers, 1993, **herb. P. A. Harmes**. Sandy set-aside field E. of Coates Castle, SU/996.177. A. Spiers, 1993. 1st and 2nd records since 1909.

153/45.1. MIBORA MINIMA †***9**, Dorset: Dune-slack, Studland Heath, SZ/033.838. F. Woodhead, 1993, **RNG**.

†153/51.4. BROMOPSIS INERMIS ***69**, Westmorland: S. side of Kaber-Barras road, NY/815.116. J. Atkins, 1993, **LANC**, det. G. Halliday.

†153/52.1. ANISANDRA DIANDRA **38**, Warks.: Side of bridle path, Pillerton Priors, SP/292.486. J. C. Bowra, 1993, **WAR**, det. P. J. Copson. 2nd record, 1st this century.

†153/53.1. CERATOCHLOA CATHARTICA **11**, S. Hants.: Side of farm track near Sandy Lane, Shedfield, SU/556.147. E. A. Pratt, 1992, det. E. J. Clement. By footpath along Danes Stream, Milford on Sea, SZ/292.917. V. Scott, 1992, det. P. J. O. Trist. 1st records since 1925.

†153/53.2. CERATOCHLOA MARGINATA ***22**, Berks.: Field track, Pusey House, Southover, SU/3.9. T. C. G. Rich, 1993, **RNG**.

153/56.1 × 2. ELYTRIGIA REPENS × E. ATHERICA (E. × OLIVERI) ***3**, S. Devon: Waste ground, The Maer, Exmouth, SY/009.800. R. Takagi-Arigho, 1989.

153/57.1. LEYMUS ARENARIUS **104**, N. Ebudes: Rocky skerry S. of Oskaig Point, Raasay, NG/544.377. J. Bungard, 1992, conf. S. J. Bungard. 1st Raasay record.

153/63.1b. MOLINIA CAERULEA subsp. ARUNDINACEA ***44**, Carms.: Damp grassy area N.E. of Witchett Pool, Laugharne Burrows, SN/283.077. G. Hutchinson & I. K. Morgan, 1992, **NMW**.

†153/68.1. ECHINOCHLOA CRUS-GALLI ***46**, Cards.: Abundantly naturalized in marsh by pond N. of Lampeter College, SN/579.488. A. O. Chater, 1993, **NMW**.

†153/71.1. DIGITARIA ISCHAEMUM ***3**, S. Devon: Derelict sidings, Exeter, SX/917.916. D. Bolton, 1989, **RAMM**, det. R. Takagi-Arigho. Waste ground, Exmouth, SX/992.807. R. Takagi-Arigho, 1989, **RAMM**. 1st and 2nd records.

154/1.4. SPARGANIUM NATANS ***5**, S. Somerset: Pinkworthy Pond, SS/723.423. C. Giddens & P. Green, 1993, det. C. D. K. Cook.

155/1.2. TYPHA ANGUSTIFOLIA **35**, Mons.: Galvanised tank, sludge bed pond, Alpha Steel Works, Newport, ST/33.84. T. G. Evans & M. Jones, 1993. 2nd record.

†157/1.1. PONTEDERIA CORDATA *__59__, S. Lancs.: Disused canal, White Gate, Oldham, SD/895.034. G. M. Kay & P. D. Stanley, 1993.

158/7.1. COLCHICUM AUTUMNALE **41**, Glam.: Damp grassland near Lakston, Bridgend, SS/8.7. C. Lindley, 1993. Only extant locality.

158/11.1. FRITILLARIA MELEAGRIS †*__58__, Cheshire: Sloping wet pasture, Hassal Green, SJ/779.579. S. Jones, 1993.

†158/23.1. MUSCARI NEGLECTUM *__83__, Midlothian: Wood, Bowshank near Stow, NT/45.41. M. Little, 1984.

†158/23.2. MUSCARI ARMENIACUM *__83__, Midlothian: Under birch trees on old railway line, Warriston, Edinburgh, NT/25.75. D. R. McKean, 1986. Still present in 1994.

†158/24.5. ALLIUM SUBHIRSUTUM *__17__, Surrey: Roadside, Purley, TQ/326.538. G. Fookes, 1993.

158/24.14. ALLIUM SCORODOPRASUM *__98__, Main Argyll: Grassland between beach and fields, Toward Point, NS/130.675. C. Gibson, 1991, conf. G. P. Rothero.

158/24.16. ALLIUM VINEALE *__104__, N. Ebudes: Rock ledges S. of Sithean Mor, Raasay, NG/599.475. S. J. Bungard, 1991, **herb. C. W. Murray**.

†158/33.3a. NARCISSUS POETICUS subsp. POETICUS *__49__, Caerns.: Grassy bank at top of rock outcrop, Tyn-y-Groes, SH/775.718. R. Lewis, 1993, **NMW**.

†159/4.1. HERMODACTYLUS TUBEROSUS **6**, N. Somerset: Sandy bank, Brean, ST/297.557. P. Green, 1993. 2nd record.

162/3.1. EPIPACTIS PALUSTRIS **2**, E. Cornwall: Marshy area in dunes, Rock Dunes, SW/934.766. T. J. Dingle & M. G. C. Atkinson, 1993. 2nd record.

162/3.4. EPIPACTIS HELLEBORINE **72**, Dumfriess.: Above Liddel Water, Penton Bridge, NY/433.774. M. S. Porter, 1991. 2nd record this century.

162/8.1. GOODYERA REPENS **81**, Berwicks.: Pinewood near Hirsel Law, NT/83.42. M. E. Braithwaite, 1993. Only extant locality.

162/13.2. PLATANTHERA BIFOLIA *__79__, Selkirks.: Hill pasture, Selkirk Hill, NT/4.2. G. French, 1993.

162/16.1 × 18.1. GYMNADENIA CONOPSEA × DACTYLORHIZA FUCHSII (× DACTYLODENIA ST-QUINTINII) *__104__, N. Ebudes: Grassland, Harris area, Rum, NM/3.9. C. W. Murray, 1984, det. M. Bates & S. J. Clarke.

162/17.1. COELOGLOSSUM VIRIDE **46**, Cards.: Unimproved pasture, Tynygwndwn, S.S.E. of Llanfair Clydogau, SN/6.4. A. O. Chater & L. Gander, 1993. 2nd extant locality.

162/18.3 × 5. DACTYLORHIZA INCARNATA × D. PURPURELLA (D. × LATIRELLA) *__81__, Berwicks.: Old quarry, Grantshouse, NT/827.645. Lady Margaret Elliot, 1993, **E**, det. S. Clarke.

162/18.8. DACTYLORHIZA LAPPONICA *__104__, N. Ebudes: Damp flush, Dibidil, Rum, NM/4.9. B. & J. Allan, 1989, **E** (photographs), det. D. J. Tennant.

162/20.4. ORCHIS USTULATA *__41__, Glam.: Limestone grassland, Llanmadog, SS/43.93. N. Benson, 1993, conf. D. Painter. 1st certain Welsh record.

Book Reviews

Exkursionsflora von Österreich. W. Adler, K. Oswald & R. Fischer; edited by M. A. Fischer. Pp. 1180, 510 figures. Eugen Ulmer, Stuttgart & Vienna. 1994. Price DM 78 (ISBN 3–8001–3461–6).

Although Austria has long been a favourite holiday destination for those in search of Alpine plants, the only pocket-sized Flora in the language of that country which was available until now was the 1973 reprint of K. Fritsch's *Exkursionsflora für Österreich*, first published in 1897. French-speaking visitors are well served by books centred on Switzerland: see, for example, the review of Aeschimann & Burdet's *Flore de la Suisse* (1989) in *Watsonia* **18**: 229, 1990. For the monoglot English visitor, the Swiss Alpine Club's *Our Alpine Flora* (1989) by E. Landolt & K. M. Urbanska is available in English, and there are many other popular guides to Alpine plants available in English, French, German and Italian.

The appearance of *Exkursionsflora von Österreich* is doubly welcome, as it effectively replaces as well as updates Janchen's rather inadequate account of Austria's flowering plants in *Catalogus florae Austriae*, edited by K. Hafler & F. Knoll. This was published in four parts from 1956–60 with four supplements from 1963–67. Within a concise format, the new Excursion Flora provides (to quote its subtitle) an identification book for all vascular plants growing in the wild in Austria as well as the most important cultivated plants, together with information on their ecology and distribution. Compiled by three main authors with major contributions from eleven others and smaller treatments and corrections from a further 26, the book was edited by Manfred Fischer. Illustrations of critical parts are mainly by Gabriele Hofer-Sabek and Anton Igersheim, together with seven other artists; in contrast to Aeschimann & Burdet, the figures are included within the keys.

As is usual with key-based Floras, most of the descriptive matter is presented within the terminal couplet of the keys, including notes on the economic uses of the plant. Diagnostic features are underlined. Introduced taxa are treated in a smaller font than native taxa, as are keys to infraspecific taxa, a distinction which is unlikely to help users in the field. It also contains a 16-page summary of the literature, and a very detailed 50-page glossary which includes an analysis of the Latin geographical epithets of the scientific names of plants.

A considerable degree of detail is provided in the taxonomic treatments of some of the more critical genera. The account of *Alchemilla*, for instance, occupies 22 pages; the more cursory treatment of *Rubus*, by contrast, still covers 13 pages. Even under familiar taxa there are some critical observations, such as the possibility that *Potentilla crantzii* subsp. *serpentini* is more deserving of varietal status.

A useful aspect of the book is its attention to synonymy. The second edition of *Flora Europaea* vol. 1 appeared (in 1993) too late for detailed consultation; thankfully, the Green Spleenwort here appears with its more familiar scientific name, *Asplenium viride*. Although the great majority of accepted names follow those given in W. Gutermann *et al.*'s *Liste der Gefäßpflanzen Mitteleuropas* (1973), the exceptions are shown by placing the synonym in bold italic font; other synonyms, including deviations from *Flora Europaea*, are given in medium italic font. In a similar way, standard vernacular names of plants are given in bold font, followed in some cases by alternative names in medium font, both being abbreviated wherever feasible. These conventions are easier to read than to explain.

Most botanists visiting Austria will wish to know the distribution of a particular plant within the country, and this is shown partly by means of a summary of occurrences within each of the eleven Länder (provinces) or, for commoner species, a list of provinces from which it is absent. Where infraspecies are included, this information is given at subspecific level. A summary of the distribution of each species outside Austria is also given, except for endemics; for these, a more detailed statement of distribution within Austria is provided. Geographical information is given in highly compressed form; the front end papers include not only a map of Austria and its provinces, principal rivers, lakes and mountain ranges, but also a key to the abbreviations of places shown on the map which greatly aids legibility. This map also solves the problem, for German speakers at least, of what to call the new Czech and Slovak republics: 'Tschechien' and 'Slowakei'. These, together with another recently established country, 'Slowenien' (Slovenia), not to be confused with Slovakia, form three of the eight countries now sharing a border with Austria.

It is evident from a glance at the bibliography that local floristic studies are being actively pursued in Austria, and I would expect that the appearance of this new Flora will be welcomed enthusiastically by Austrian botanists as well as by visitors. Although its format is more complex, its practicality and comprehensiveness is on a par with Stace's *New Flora of the British Isles* (1991). Thanks to the extensive use of abbreviations, even users whose knowledge of German is patchy would find it eminently usable if a translation into English of the abbreviated terms listed on pp. 21–24 were to be provided in a future edition.

Students of botany will find the detailed chapter on "Morphology and Phytography" (pp. 38–91) interesting, and the summary data on endemics and near-endemics on pp. 114–116 will be convenient both for Flora-writers and conservationists. One must also mention the short chapter on the history of botanical studies of the flora of Austria (pp. 157–163) which ranges from Clusius to Janchen and ends with a sketch of a bulging plant press. At a price of around £33 at mid-1994 prices, this closely printed and meticulously edited book represents good value for money and may soon become the preferred German-language field Flora for much of central Europe as well as for Austria itself.

J. R. EDMONDSON

Illustrated Flora of Mallorca. E. Beckett. Pp. 223, with 96 colour plates and an illustrated glossary. Editorial Moll, Palma de Mallorca. 1993. Price Pta. 5500 (ISBN 84–273–0714–4).

This excellent illustrated guide to the flora of Mallorca, in a carefully and well edited format, follows the model of *The concise British Flora in Colour* of W. Keble Martin (1965). The most important part of the book is the inclusion of 96 plates, each one containing between five and 19 plants (the majority 10–14) drawn in pen and ink and watercolours. They represent both the commonest plants of the Mallorcan flora, those which the visitor sees most frequently, and also some of the rarer ones. The drawings were made by the author during repeated visits to Mallorca since 1976, the majority being from living specimens or photographs. In some cases, clearly indicated in the text, the drawings were made from non-Mallorcan plants. In a few cases the latter include some plants whose presence in Mallorca needs to be confirmed, such as *Carduncellus pinnatus*, or which have been recently deleted from the Balearic flora, like *Ranunculus monspeliacus*. The drawings include diagnostic details and, with rare exceptions (we could mention *Helianthemum salicifolium* and *Cistus clusii* as examples of those which have an unusual appearance) are very accurate reproductions of the form, appearance and true colour of the plants. Many of the drawings are really excellent; however some of the white-flowered Umbelliferae are on plates which also have a white background, and while they are not themselves of poor quality they have not printed well. The monocotyledons, with the exception of *Urginea maritima* (= *Drimia maritima*), have been drawn without the basal parts, doubtless to avoid having to uproot the plants.

To compile the list of Mallorcan plants, the author has used not only the first edition of *Flora Europaea* and an unpublished catalogue by Professor Llorens, a Mallorcan botanist, but also the general Floras and catalogues currently in use for the Balearic islands, as well as some specialised works about particular genera which are grouped within the bibliography. It is surprising that the most recent Floras of Spain which included the Balearic islands in their circumscription have not been included: Bolòs & Vigo, *Flora dels Països Catalans* (vol. 1, 1984; vol. 2, 1990), and Castroviejo *et al.* (eds), *Flora Iberica* (four vols, 1986–). To have consulted them would have resolved some doubts expressed in the book such as the presence or absence in Mallorca of plants like *Asarum europaeum* or the previously mentioned *Ranunculus monspeliacus*.

The plants are ordered systematically, from the ferns to the monocotyledons, following the order of *Flora Europaea*. The information on each species includes the Latin name, the English name (where it exists), a short description based on *Flora Europaea*, the flowering period and indications of ecological preference and degree of rarity. *Flora Europaea* has also been followed for the nomenclature, except in some cases where she uses names given in *Med-Checklist* by Greuter, Burdet & Long or in the previously mentioned Llorens catalogue. In these cases the name used in *Flora Europaea* is cited as a synonym. On occasion, this has led to the unnecessary inclusion of synonymous names older than the accepted ones, such as *Quercus humilis* Mill. (1768) vs *Q. lusitanica* Lam. (1785), *Gagea iberica* Terracc. (1804) vs *G. nevadensis* (1838) or *Asparagus stipularis* Forsk. (1775) vs *A. horridus* L. in Murray, 1774; L. f., 1781; this error has already been noted in *Flora Europaea*. This is a slightly embarrassing feature for a professional botanist, but it is probably unimportant for the majority of potential users of the book. The nomenclatural or taxonomic deviations from *Flora Europaea* are not always accurate; this is the case with the previously mentioned *Gagea iberica*, which actually has the correct name *G. durieui* Parl. ex Batt. & Trab. (1895) or in the case of *Teucrium balearicum* (Pau) Castrov. & Bayón, which scarcely differs from *T. subspinosum* and according to a recent publication (*Candollea* **46**: 47–51 (1991)) must be included within *T. màrum* L.

The work includes a preface, notes on the flora and vegetation of Mallorca, an illustrated glossary and an index of plates, and concludes with an index of Latin familial and generic names. The format of the book is not ideally suited to being taken into the field, but because of its very solid covers it can be handled without reducing its ease of use.

The book fills a large gap, in spectacular fashion, in the existing coverage of Mallorcan and Balearic Floras. I expect that it will be welcomed enthusiastically not only by the many nature lovers who visit Mallorca and the other Balearic islands each year, but also by the many Mallorcans with an interest in botany.

G. López

The art of botanical illustration. W. Blunt & W. T. Stearn. New edition, revised and enlarged. Pp. 368, illustrated. Antique Collectors' Club, Woodbridge in association with The Royal Botanic Gardens, Kew. 1994. Price £29.95 (ISBN 1–85149–177–5).

A new edition of such a familiar and treasured book is cause for excitement. There have been several recent histories of botanical illustration but 'Blunt' has earned a respect and devotion that deserves to be maintained. In the introduction to the new version we learn that, when the book was first mooted in 1946, two of the original editors of Collins' *New Naturalist* series separately asked Blunt and Stearn to write it! That situation surely highlights one of the difficulties of writing a history of this subject – whether to treat it as a branch of the history of art or of botany. Plants occupied a significant place in the whole canvas of subjects chosen for artistic depiction long before the needs of descriptive botany tailored that specially disciplined representation that we understand as 'botanical illustration'. So perhaps it was more fitting that Blunt, a student and teacher of the art and history of drawing, should have been the eventual choice as author of this history. A measure of his success is the classic status according to this history in the four decades since its publication and the fact that two other publishers have brazenly 'borrowed' his title for more recent histories of their own – sincere flattery one hopes!

Stearn's contribution to the original work, which Blunt graciously acknowledged, obviously amounted to an essential improvement in the specialised botanical view of the subject. Blunt had more feeling for the poetry of drawing, and the aesthetics of media, syntax, rhythm, texture, light and shade, perspective, etc., – but always with sensitivity for the 'personality' of the plant. Stearn's interest was more concerned with the importance of botanical illustration as one of the tools developed by descriptive botanists of the classical period and its significance as a visual information resource. Long before his death in 1987, Blunt had declined to undertake a full revision of the book, his view being that his history should stand as a product of its day. However, now that revision is possible, we are indeed fortunate to have the authority of knowledge of Blunt's original collaborator to perform that task.

In fact, although the outward appearance is radically altered, the internal structure of Blunt's work is not, and the text is mostly the same. Stearn has lightly revised it – altering outdated facts, inserting significant comments to strengthen botanical emphasis, adding biographical dates, and supplying or enlarging footnotes that direct the reader's attention to more recent literature. Blunt's text has been slightly modernized here and there but, despite the title-page statement of dual authorship of this edition, those who knew him will still hear Blunt's unmistakable deep and cultured voice coming off the page and will appreciate his personal expressions of unashamed pleasure at the loveliness of some illustrations or the repellence of others!

It is not until Chapter 23 "The Twentieth Century" that we really hear Stearn's voice. He has extended the densely packed account of contemporary artists, giving emphasis to British, Greek, South African and Australian work, and has included thematic passages on the illustration of comparative plant morphology and orchids. It must be said that Stearn's selection of contemporary artists for mention is a very personal one that only hints at the number of talented artists that have emerged since 1950. A notable trend of botanical art during the post-war period has been a broadening of the range of styles and the introduction of entirely new media, some of which have achieved general acceptance. Unfortunately for the reader, Stearn barely mentions the 32 year-old Hunt Institute for Botanical Documentation and its collection of over 30,000 examples of botanical art that includes a fully representative share of post-war artwork, merely alluding to its exhibitions on pages 12 & 13 of the Introduction, and does not touch on the prestigious 24 year-old Guild of Natural Science Illustrators and its informative *Handbook of scientific illustration* (1989). Also omitted is any mention of the famous Broughton Collection of some 119 flower paintings, 38 albums and almost 900 mounted drawings, a collection distinguished for the excellence of its examples from the classical period of European flower painting and botanical art. Given to the Fitzwilliam Museum, Cambridge between 1966 and 1973, it is probably Britain's most important collection of fine botanical art.

The authors had expressed disappointment at the distinctly poor quality of the illustrations in the original edition. The present publishers clearly decided that the visual element of the original should be radically enlarged and improved using much more colour. To achieve this they replaced the modest octavo format of the *New naturalist* series with a 27 × 21 cm quarto. In keeping with contemporary fashion in book-design, illustrations are variously placed about the pages within the discipline of the designer's invisible 'grid'; one, two or three illustrations may occupy the full width of a page, some are full-page. The column of text is fitted into this grid system leaving outer margins of 4.5 cm throughout the book, most of which are blank.

Most of the original choice of 55 colour images have been retained, not always in the same size, but some are much improved by re-photography with a wider field of view. Omissions from the original selection are usually filled with alternative illustrations from the same sources. The number of examples is increased making a new total of 125 colour illustrations and, of these, just over a dozen are devoted to post-1950 artwork. Of the original 47 monochrome plates, most are retained and ten more are added. Unfortunately, some plates that Blunt intentionally juxtaposed are now separated (e.g. Plates 8 & 13, now six pages apart), and several are reduced in size. The 61 figures, which were generally poor in the 1950 printing, are all repeated but with virtually no improvement in quality, and five more have been added. Three early intaglio illustrations are so badly reproduced as to obscure all fine detail (Figs 41, 45 & 46). Two others (Plates 32 & 33) are reproduced in half-tone but in such reduced size that they look like tonal drawings, the linear quality of the engraving being virtually obscured. This is doubly unfortunate because Blunt describes them as a "landmark in botanical illustration", a special feature of which was that plants were engraved *life size*.

Many illustrations are chosen from rare, sometimes unique, originals that most readers may never chance to see. Those who are fortunate enough to know and handle these source works may not need to be told, for example, that the 9 × 6 cm Colour Plate 44 illustrates an original painting of some 53 × 36·5 cm in the Victoria & Albert Museum. But what size is the drawing reproduced in Plate 24 at 8·5 × 4·5 cm, one of a thousand paintings in what Blunt calls "five noble volumes" in far-away St Mark's Library, Venice? Three colour reproductions from Thornton's famous *Temple of Flora* are presented in different sizes (Colour Plates 81–83). In short, the reader, however knowledgable, seriously needs statements of the sizes of the original images.

A few textual errors deserve mention: on p. 171, the three-colour printing process is that of J. C. Le Blon (1667–1741), not to be confused with A. Le Blond (1819–1894), a colour-printer by the Baxter process; it was that same Baxter process that Wm. Dickes (1815–1892), a Baxter licensee, employed to print Anne Pratt's illustrations, and not chromolithography as stated on p. 276; the co-author of the *Nature-printed British seaweeds*, mentioned on p. 158, is not A. Crumb but actually

Alexander Croall (1809–1885); the "Hunt Botanical Collection", on p. 347, should read Hunt Botanical Library.

The accurate colour reproduction of artwork is still difficult even today. Films, lighting and colour-printing techniques have all improved but many modern colour reproductions of artwork on paper still show disturbingly odd background tints: the present work is no exception. Generally, though, the colour work is good and quite acceptable for the price. What one gets for one's money is a much nicer version of Blunt but without a great deal of new information. It remains a selective outline of the development of a rich segment of specialised art, elegantly chronicled in a personal style, and providing a very reliable platform from which to launch into a broad range of specialised studies.

G. D. R. BRIDSON

Dictionary of British & Irish botanists and horticulturists, including plant collectors, flower painters and garden designers, revised edition. R. Desmond, assisted by C. Ellwood. Pp. xl + 825. Taylor & Francis and the Natural History Museum, London. 1994. Price £120.00 (ISBN 0–85066–843–3).

Ray Desmond's *Dictionary*, which was published in 1977, has since that time been the standard reference work of biographical data of British and Irish botanists and horticulturists. The author has now produced a new edition which is even bigger and better than the original volume, xl + 825 against xxvi + 747 pages, with an enlarged format which permits more entries per page, and with many more references in the bibliography. As well as providing data on a further 3000+ botanists, gardeners and nurserymen, the scope of the book has been extended to include flower painters, botanical artists and garden designers.

The book follows the arrangement of the earlier edition with dates and places of birth and death of each of the individuals, followed by a concise biography. A further paragraph provides data on books and papers written by the individual, and a final paragraph gives details of sources of further information. The rearrangement of the different categories into separate paragraphs adds greatly to the clarity of the work.

Eight years' scanning of periodicals and books was undertaken in the production of the new edition, but it is a pity that the termination date for periodicals was as early as December 1990 as this excludes entries for such worthies as John Codrington (1898–1991), John George Dony (1899–1991), Ronald d'Oyley Good (1896–1992), Mary Patricia Happer Kertland (1902–1991), William Arthur Sledge (1904–1991) and Bryan Thomas Styles (1934–1992). There appear to be few omissions, though Richard Pearse Libbey (1911–1987), a Norfolk botanist who studied *Oxalis* and Poaceae and whose herbarium is now at the University of Leicester (**LTR**) is not mentioned, nor are Clara Winsome Muirhead (1915–1985), an authority on the flora of Cumberland who worked at the Royal Botanic Garden, Edinburgh, and whose plants are at Carlisle Museum (**CLE**) and Plymouth (**PLH**), or Effie Moira Rosser (1923–1987), author of *Senecio cambrensis*, whose types and other plants are at Manchester Museum (**MANCH**).

Errors, as are to be expected in a work of this high standard, appear to be remarkably few, but John Blackstone's plants (p. 77) were donated to the British Museum (Natural History), London (**BM**) by Ripon Museum as long ago as 1947, Frederick J. Hutchison died in 1891, not 1981, and Barbara Welch's maiden name (p. 728) was Gullick not Gullicky.

Ray Desmond is again to be congratulated on a fine revision of his most useful reference work, which despite its high price should be in the hands of all those who are seriously interested in the history of Irish- and British-born botanists and gardeners.

D. H. KENT

Field guide to wild flowers of Britain and Northern Europe. R. Gibbons & P. Davies. Pp. 330, illustrated. The Crowood Press, Marlborough. 1994. Price £9.99 (ISBN 1–85223–784–8).
Field guide to trees of Britain, Europe and North America. A. Cleave. Pp. 320, illustrated. The Crowood Press, Marlborough. 1994. Price £10.99 (ISBN 1–85223–801–1).

The field guide market is a crowded one and some people feel it is in danger of being overwhelmed by a flood of clonal works offering little more than recycled information packaged in slightly different ways. As an author of field guides myself I have been told that no new works of this genre should be written. Obviously I disagree with this extreme sentiment. Nomenclature changes over the years if nothing else, and even favourite references eventually become outdated or too worn to be risked in the field, so it is worth perusing new works with an eye to finding suitable replacements, preferably ones offering a little extra – a greater coverage (in terms of species or area) than is already available, new information or easier access, better illustrations or some other significant improvement.

How, then, do these latest offerings from the Crowood Press measure up? They are genuinely pocket-sized, well-bound with attractive covers and modestly priced for books illustrated with over 720 colour photographs. Descriptions are brief and avoid jargon, those for wild flowers being very succinct while the guide to trees uses a more discursive style. The two books are clearly meant to form part of a series but beyond the points mentioned, the similarities diminish. The *Field guide to wildflowers* embraces Britain and Northern Europe (i.e. the British Isles and northern France eastwards to Germany, Denmark and the southern tips of Norway and Sweden). The usefulness of the concept of Northern Europe is at best questionable and in my view usually denotes a publisher's ruse to encourage take up of foreign editions while maintaining a British market, rather than an attempt to add real value to the book. Another sure sign that the Northern European factor has been added simply to increase sales potential is the giving of separate distributions of species for Britain and for the continent, as is done here. Like almost all modern flower guides, this one contains only a selection of the flora of the area and its claim to be comprehensive is somewhat tongue-in-cheek. However, with a species list exceeding 1400, it compares favourably with other works. While there are many good photographs the overall quality is patchy. I found this surprising since the authors are experts who normally produce a consistently high level of work.

The *Field guide to trees* fares better. The much smaller total number of tree species allows a better coverage in the book and, while its usefulness as a reference for North America in doubtful, it does include most of the common introductions from that continent encountered in Europe. The overall quality of the photographs is also better and many species are represented by several shots to illustrate the different features of the tree. The descriptions are followed by comments giving additional characters and snippets of interesting information.

My biggest single complaint about these books (and many similar ones) is how to get into them. There are no keys in either book, with Gibbons & Davies claiming these "demand a level of detail . . . finer than most people will want". Fair enough, though I find the reluctance of authors to tempt inexperienced users with simple, usable keys regrettable. In photoguides of this kind, especially for wild flowers where lack of space restricts species to a single photograph, many species will be inadequately portrayed for rapid identification and some bear little resemblance to the plants as they would be seen in the field. Can less experienced botanists (presumably the main target audience) expect to 'get a result' simply by skimming the pages and 'picture spotting' before checking descriptions, as Gibbons & Davies suggest? I think the answer frequently must be no. Without any alternative means of entry, potentially useful and attractively packaged books of this kind remain less accessible than they need be. Experienced botanists, on the other hand, will find the books little different from many already available. On balance then, *Field guide to wildflowers* falls into the 'clone' category, while *Field guide to trees*, by virtue of the extra information, escapes – just.

J. R. PRESS

Index of garden plants. M. Griffiths. Pp. lxi + 1234; 16 figs. Macmillan, London. 1994. Price £35.00 (ISBN 0–333–59149–6).

This is not so much an index to the *Royal Horticultural Society Dictionary of Gardening*, rather than a condensed version of it compiled by Mark Griffiths with unfortunately only a cursory acknowledgment to some 250 contributors to the original book whose work it mainly is. In order to reduce the four volumes to one, the general entries, biographies and the many pages of plates (except those which illustrate the glossary) have been lost. Family entries have been reduced to a list of included genera, which is quite useful unless one is looking at Fumariaceae. This family is now often included in Papaveraceae and this seems to have been the fate of *Corydalis* while related genera such as *Dicentra* remain in Fumariaceae. Descriptions have been cut to the bare essentials, with no information on cultivation, but room is found for number of species, hardiness and distribution details. One particularly important piece of information which seems to have been lost is reference to the poisonous nature of any of the plants listed.

In several ways I prefer the layout to that used in the original. Common names are incorporated into the alphabetical list, and synonyms, instead of being relegated to the end of each genus, are incorporated into the list of accepted names. One problem I am sure some will have, is the size of the text which is very small and may test the eyes of those with less than perfect sight.

Although the introduction has been much reduced, the comprehensive illustrated glossary is retained and incorporates a glossary of plant taxonomy. A useful section is included on the naming of plants. Examples show how names are applied to the various ranks of cultivated plants, and how different terminations are used. These are often a cause of considerable confusion, for while the example *Crinodendron hookeranum* is given, the epithet is correctly cited as *hookerianum* in the main body of the text.

Confusion also seems to have arisen over the designation of hybrids, with x used in the examples but × used in the text. While both are acceptable, usage should be consistent within one work. When a multiplication sign is used it should always be lower case; however, in the main text (but not in the examples, where the letter x is used) upper case multiplication signs are used for intergeneric hybrids, except for × *Pyracomeles* where a combination can be found. Another confusing and annoying typographical error is the consistent placing of the multiplication sign immediately before the name of the second parent in a hybrid formula as if it were an intergeneric hybrid.

The *R.H.S. Dictionary* itself has been heavily criticised for its numerous spelling mistakes and other errors. Although some of these have been corrected (for example the cultivars incorrectly assigned to *Buxus harlandii* are now correctly placed under *B. microphylla*) others have not. *Ilex* × *altaclerensis* is still in as *altaclarensis* although its correct spelling has long been settled. *Acer palmatum* 'Senkaki' is still incorrect, *A. platanoides* 'Crimson King' now appears twice, once as 'Crimson king', and *Helichrysum italicum* still grows to 50 m. I could go on.

Although brief, the individual descriptions in most cases give enough information to be useful but it could be argued that describing the leaves of *Pieris japonica* 'Pygmaea' as "blade-like" says little about this very distinct form. Works such as this often fall short on their inclusion of cultivars but we are told that out of more than 60,000 names, some 30,000 are cultivars. Some inconsistencies do arise, however, when hybrid cultivars are treated. These are occasionally (as in *Ceanothus*) given individual entries, or (as in *Pieris*) listed under one of the parents, or (as in *Diascia*) listed at the end of the entry where (as in the original *Dictionary*) only very scanty information is given.

The list of entries appears to contain most of those in the *Dictionary* itself except for "the vast array of cultivars of *Rosa* or *Rhododendron* or those of economic plants". Indeed I have come across several additions the inclusion of which seems to have been prompted by works published too late to influence the *Dictionary* itself. These include *Colutea buhsei* (as "*bushei*") and *C. multiflora*, both unfortunately with incorrect author citations.

While this work will undoubtedly appeal to gardeners and students of cultivated plants, its use to those interested in the British flora is less obvious. It is certainly a valuable guide to plants in cultivation but it is unlikely that many of these will escape and naturalise in this country. Those that do will not be easy to identify from this work with no illustrations and no keys. I find it hard to believe, for example, that many of the species of *Cotoneaster* naturalised here will be easy to name from the descriptions (apart from the fact that not all naturalised species are included), and one species prominent by its absence, because it is rarely cultivated, is the only native member of the genus, *C. cambricus*.

In spite of its far from minor defects, this will be a useful book and it has, in addition to its extensive coverage, a major factor in its favour, the price. At £35 it is a bargain, and one that I have no hesitation in recommending.

A. J. Coombes

Index Kewensis on CD-ROM. Compiled by Royal Botanic Gardens, Kew. One Compact Disk and spiral-bound manual. Oxford University Press, Oxford. 1993. Price £995.00 + VAT (ISBN 0–19–268003–X); additional manuals £7.50 (ISBN 0–19–268004–8).

Index Kewensis, that wonderful work that is treasured, cursed, and used daily in almost any herbarium, is now available on Compact Disk. The books have been like old friends to us – over the years they have become tattered and sometimes slightly unglued, the pages darkened from the touch of thousands of fingers over many decades, the edges rounded from wear. Many of us have copies that have been cut up and pasted back together, and the publication of each Supplement has required another round of this. Those of us who don't cut and paste are familiar with the long slow crawl through each Supplement. *Index Kewensis on CD-ROM* brings this enormous amount of data into one easily searchable place.

Charles Darwin believed it would be useful to have an updated version of Steudel's *Nomenclature* (1840–1841). *Index Kewensis* was begun in January 1882 and funded at first by a provision in Darwin's will. *Index Kewensis* today is a list of plant names with bibliographic references to the place of first publication and the geographic distribution reported in the original publication. It is compiled by a team of people at the Royal Botanic Gardens, Kew, and is one of the many useful references produced by that institution.

The *Index Kewensis on CD-ROM* provides the information from the original publication plus all 19 Supplements, cleaned up and standardized somewhat, in a form that allows a wide variety of searches and report generation. This was done by electronically scanning the text using an optical character reader. The project was started some years ago, when scanners were not as smart as they are now, and a great deal of time and effort has had to be invested in cleaning up errors in misreading text due to changes in and peculiarities of type-faces over the years. The addenda to the original two volumes and to Supplements I and II were not read by the optical character reader, but those addenda that could be interpreted have been added to the CD-ROM files.

When one purchases *Index Kewensis on CD-ROM*, one receives a floppy diskette, the CD-ROM itself, and a spiral-bound manual which also describes how the software can be installed on a network. The manual is extremely useful not only because it leads one step-by-step in the use of the CD–ROM but also because it gives a very clear history of *Index Kewensis*, including an explanation of conventions that have been used. To use *Index Kewensis on CD-ROM* one requires, at a minimum, an IBM AT or PS/2 or compatible equipped with a hard-disk drive; 2 Mb of free hard-disk space; 640 Kb of RAM with 420 Kb free; and DOS version 3·0 or higher. One also needs a CD-ROM drive and MS-DOS CD-ROM extensions version 2·0 or higher.

It is possible to search seven lists or fields using one of two search methods. The lists include family, infrafamily, genus, infragenus, species, infraspecies and full author names (data for the 'infra' categories only after 1971). Three additional files can be searched using a text search: publication, notes and author. A few notes on specific files may be useful: the manual warns that familial and generic concepts have changed over the years. Considerable effort has been made to standardize author names on Brummitt and Powell's *Authors of plant names* (1992), and a search on the full name will pull up records regardless of the abbreviation used in the original *Index Kewensis* entry.

Searches can be done using wild cards and Boolean operators, and one can move from field to field using a mouse or a combination of keys or arrow keys. At any point one can click on a field and see a display of the item. One can display or download full records for any taxon or author name, or one can list names of taxa with publication information or notes. Distribution information is contained in notes and searches on distribution need to be carefully constructed. It is really a treat to be able to list all names published in a certain journal, or described by a given individual, or described over a specified period of years.

Inevitably there are some problems, but considering the magnitude of this project, they are few. Firstly, the quality of the data of the CD-ROM is not much better than it was in the original book (except for the author files), and many errors have crept in as a result of the optical scanning exercise. The folks at Kew welcome corrections. To prevent users from simply absorbing all the data into their own databases, there is an upper limit on records that can be downloaded at one time. Names of families and genera are in upper case letters. The infraspecific rank is not displayed in lists. Searches using many wild cards, or wild cards at the beginning rather than at the end of a complete search with many wild cards may seem to take forever, and I know that some searches have been terminated after failing to be completed overnight.

These problems are minor, however, compared with the overall utility of *Index Kewensis on CD-ROM*, and I think every herbarium that uses the books regularly, and most libraries that might be reluctant to buy the books but that have patrons who need to look up names of plants, will want to invest in it. Updates will be issued regularly on subscription; the first is due in 1995 and thereafter the publishers plan to issue them on a yearly basis.

N. R. Morin

Trees of Ireland, native and naturalized. E. C. Nelson & W. F. Walsh. Pp. 247, with 30 coloured plates and 30 black and white vignettes. The Lilliput Press, Dublin. 1993. Price IR£17.99 (paperbound) and IR£35.00 (cloth bound) (ISBN 1–874675–24–4).
Irish trees and shrubs. P. Wyse Jackson. Pp. 72, with 32 coloured plates. Appletree Press, Belfast. 1994. Price £3.99 (ISBN 0–86281–420–0).

The nearly simultaneous appearance of two illustrated books on Irish trees suggests, at first sight, either bad planning or bad luck. This is not so, however, as the books are of very different type, and aimed at different markets. Nelson & Walsh is an archetypal coffee-table book, and will be bought by most purchasers mainly with the illustrations in mind. Wyse Jackson's book is a cheap pocket manual designed for day-to-day reference.

Nelson & Walsh deal only with trees; their delimitation from shrubs is fully discussed. It is all the more surprising to find *Rhamnus catharticus* and *Frangula alnus* included. I will not deny that they *can* attain tree size, but in sixty years' botanizing in Ireland I have never seen a specimen approximating to tree dimensions. It makes me wonder whether the text may have been written to fit a pre-existing set of illustrations. Mrs Walsh's illustrations, amounting to 30 full-page plates, each with three or four detailed paintings in colour, and a pencil sketch to show the general form of the tree, have the attractive elegance and botanical accuracy characteristic of her work. In particular she must be congratulated on the remarkable accuracy of the colour throughout. It is a pity, accordingly, that a few plates show one of her characteristic defects – a poor choice of specimen. It is impossible, for example, to deduce from these pictures what is the shape of a horse-chestnut leaf, or how many leaflets there are normally on the leaf of an elder.

Nelson's text contains the necessary minimum of botanical description, but the greater part consists of a mixture of history, folk-lore and poetry, the last-named often rather thinly linked to the plant in question. Folk-lore is a legitimate field of serious study, but I think it a mistake to mix in odd snippets of it with botanical facts; the borderline between fact and fancy is too easily blurred. Nelson has done some very good work in Irish botanical history, but his enthusiasm sometimes runs away with him, and there are rather too many quotations from Dr Rutty.

The scope of the book is restricted to native and naturalized trees, and excludes those that are merely planted. It is rather surprising that *Pyrus pyraster* should be included; the tree is extremely rare in Ireland, and I believe that most of the trees alleged to be naturalized have been, in fact, planted. It could, with advantage, have yielded place to *Sorbus intermedia*, which is abundantly naturalized in some districts. Equally eccentric is his treatment of the genus *Betula*. After a needless mockery of the methods of distinguishing the two species (fairly difficult, but by no means impossible), he decides that the only method is to count the chromosomes, and flies in the face of the virtually unanimous opinion of European botanists by proclaiming that there is only one species, *B. alba* L. There are quite a few interesting and reliable pieces of information to be picked out of Nelson's *causeries*, but on the whole one is forced to the conclusion that Mrs Walsh's illustrations deserve a less self-indulgent text.

Peter Wyse Jackson's book is very different. It slips easily into the hip-pocket; it includes shrubs as well as trees; and it covers a few planted conifers, which are all too often treated as pariahs. In fact it includes all the woody plants one is apt to see when wandering round the country. The only serious omission is *Populus* × *canadensis*, which is by far the commonest poplar in most of Ireland, and is recognizable from afar. *Pinus radiata* could have been sacrificed to allow for its inclusion. In other respects, however, the choice is sensible. Each species is given about 200 words of text and a half-page (75 cm^2) of illustration. The text is practical and down-to-earth, with a minimum of folk-lore, though even Jackson cannot resist telling us that the carrying of a hazel-nut in the pocket "was said" (more honest than the usual 'is said') to keep away rheumatism. The illustrations are variable in quality; many are entirely satisfactory, but some (*Rhododendron* and *Escallonia*, for example) are misleading in their colour, and a few others have faults in design. In most of the willows and a few others the leaves appear too glossy. Nevertheless, with only a few exceptions they will serve well enough as aids to identification.

If Jackson has a tendency to political correctness it is to be found in the 'Food for free' syndrome. His assessment of the gastronomic value of the various 'wines' and other products which he cites as derivable from the trees and shrubs of the countryside is often too enthusiastic. He even tries to make us eat ash-fruits: "its fruits can be eaten if picked very young, boiled and pickled in vinegar". 'Can', I think, is the operative word.

D. A. WEBB

Sedges and their allies in Dorset. An atlas of the distribution of the family Cyperaceae in Dorset. D. A. Pearman. Pp. 108. Dorset Environmental Records Centre, Dorchester. 1994. Price £5.00 (ISBN 0–9511394–4–4).

Having been brought up to believe that Scotland was the place to visit to see sedges, I was surprised to learn that Dorset contained 69 species of Cyperaceae, probably more than in any other county and almost 70% of all the British species. For this reason among many others the *Atlas* under review is of much more than local interest. It covers modern administrative Dorset, chiefly v.c. 9 and a part of v.c. 11, and includes maps on a 1-km square grid for all species and subspecies, post-1980 records being distinguished from pre-1980 ones (what has happened to the 1980 records is not made clear). The text for each taxon is full of interesting information on the Dorset habitats for the plants, associations with other sedges, hints on separation from other similar species, the distribution in Dorset with lists of sites for the rarer species and a note on the British distribution.

There is a great emphasis on historical records and on changes in abundance or distribution. Several of the larger waterside species seem to have disappeared from most of their former sites, and changes in grazing regimes, lowering of water-tables and spread of *Phragmites australis* (because of increase in nutrients) are suggested as possible causes. Lack of grazing and consequent overgrowth of many of the sites for other species seems another major reason for losses. Much use has been made of the uniquely detailed survey of Dorset by Professor R. d'O. Good in the 1930s, when he made species lists for over 7,000 vegetation stands. I was sorry to learn from the *Atlas* that the forthcoming new *Flora of Dorset* will not have space for similar discursiveness on historical changes. It is ironic that whilst one of the most frequently cited justifications for producing local Floras is to document changes, this aspect is so often given short shrift when it comes to the crunch. The present *Atlas* is a most welcome attempt to draw conclusions and not just to add yet more undigested information.

There is a most interesting introductory chapter on habitats, including discussions of the historical changes, species to be found in each type and a selection of accessible representative sites. The few drawings by Robin Walls scattered through the book are so expressive of the characters of the species depicted that I wish there had been room for more. The Latin nomenclature follows Stace (1991) and Kent (1992). Among the English names used are several that are new to me. Whether they are of local or personal origin is not made clear, but I hope that one of them at least, Gingerbread Sedge for *Carex elongata*, will become popular. Errors seem few, but a couple could seriously mislead: *Isolepis cernua* is said to be "easily told from *I. setacea* by the wrinkled seed", but it is the latter that has the longitudinally ribbed nut; and the male glumes of *Carex acutiformis* cannot be described as "ovate or truncate" for they are oblong-lanceolate and subacute or obtuse. The subspecific epithet of what used to be *Carex demissa* is several times mis-spelled, perhaps reflecting the author's stated difficulty in accepting the taxonomy. An odd omission is any mention of the subspecies of *Eleocharis palustris*. Subsp. *palustris* is shown in the *Critical supplement to the* *atlas of the British flora* for two 10-km squares (SZ/1.9 and SU/1.0) that are partly covered by the *Dorset Atlas*, so it would have been helpful to have made clear whether any of the Dorset plants are this or whether they are all subsp. *vulgaris*.

Anyone interested in sedges should learn a lot from this work. As Clive Jermy says in his preface, it illustrates how plant recording on a local level can, when properly written up, contribute to conservation and academic understanding in a wider context. The author and the Dorset Environmental Records Centre (which only last year produced its *County red data book*) are to be congratulated on producing this work and on making it available in such an attractive format and at such a reasonable price. The rest of us must look to our laurels.

A. O. CHATER

Wild and garden plants. S. M. Walters. Pp. 200 with 16 pp. of colour plates. HarperCollins Publishers, London. 1993. Price £27.50 (ISBN 0–00219376–0).

How far are the English passions for gardening and 'wild nature' linked and how far are they opposed? Max Walters poses these questions in his foreword and explicitly makes the answering of them the underlying theme of this volume, the 80th, in 'The New Naturalist Library'.

Wild and garden plants is divided into three parts, each comprising four chapters. The first quartet explores general topics under these headings: 'The sources of wild and garden plants', 'The kinds of plants', 'The variation of plants' and 'Hybridisation and sterility'. The author's emphasis is on basic botanical matters including, for example, the definition of a species and a genus, the application of Latin names, plant ecology and the variability of plant populations, the history of the native flora, and the recognition of a 'native' plant. Dr Walters also pursues briefly such topics as hardiness, and the impoverished flora of "what we now call the British Isles". The second part, headed 'Life forms and adaptations', explores another four subjects, broadly defined groupings of plants: native and exotic trees, shrubs and shrubberies, some 'special' life forms including parasites, carnivores, succulents and epiphytes, and in a chapter on 'Herbs, 'Flowers' and 'Grasses'' Dr Walters expatiates on the different meanings that the word 'herb' has for pedantic botanists and common-or-garden folk. The last set of four chapters is headed 'Botany and horticulture as modern hobbies': the individual chapters are entitled 'The science of genetics and horticultural practice', 'Botanists, gardeners and social change', 'The rise of ecology' and 'Late twentieth century attitudes'. The final chapter includes a diversity of subjects from the work of the N.C.C.P.G. (National Council for the Conservation of Plants and Gardens), to the *European garden Flora* project, and the spread of alien plants of garden origin.

The book is illustrated with black and white photographs, a variety of line drawings and 39 colour plates.

'The New Naturalist Library' is an estimable and collectable series of natural history books. The aim of these monographs remains, as the editors affirm in their preface, to make up-to-date information and ideas accessible to all with an interest in the countryside and its wildlife. To this end, previous volumes have had excellent, comprehensive bibliographies. The bibliography in *Wild and garden plants* is restricted to three pages, albeit set in double columns, which is parsimonious compared with as many as 30 pages in former volumes.

The flora of gardens within our lands is immeasurably rich in exotic species and those plants of various origins, called cultivars, that have been deliberately selected and are deliberately maintained merely to beautify and exhilarate gardeners. Max Walters' book provides some insights into the biological background to the garden flora, and interweaves fascinating details about the less bountiful native flora and the naturalized plants that inhabit the envelope of countryside beyond garden hedges.

With such phrases as "the green English countryside" or "the two ancient Universities" sprinkled liberally throughout, indeed from the first sentence, this is very much an England-centred book, which is a pity for surely the other nations that share the Celtic Archipelago possess equally interesting wild floras, and their people have as much of a passion for gardening and wilderness and have contributed as significantly to the creation, maintenance and embellishment of fascinating gardens. Indeed, the repeated use of the adjective 'English' becomes irritating when it was inexactly juxtaposed with statements or illustrations referring obviously to a wider context (for example, a discussion of epiphytes in 'English' woodlands illustrated by a photograph of ivy (*Hedera helix*) and polypody (*Polypodium vulgare*) on a tree in Anglesey). The author and his editors might have taken more care to ensure that this book served a wider context than eastern England.

Gardening is an intensely personal activity and many gardeners are eccentrics with contagious enthusiasm, yet there were very few people in this book. Plants also have characters – colours, scents, textures, extraordinary habits – but they are rarely described with enough enthusiasm to ignite the reader's mind to paint enticing pictures in the mind's eye. I tried hard to discover that passion for gardening and wilderness presaged in the foreword. The English attitude towards gardens and wild nature is strangely impersonal and muted when envisioned through *Wild and garden plants*.

Wild and garden plants is an erudite book, informed by the author's life as a botanist and director of the University of Cambridge Botanic Garden, but its pages failed to enthrall me.

E. C. Nelson

Flora of the Christchurch area. F. Woodhead. Pp. 120, ten figures, four colour plates. Privately published, Bournemouth. 1994. Price £7.95 (ISBN 0–9522857–0–3). Available from 28 Hungerford Road, Bournemouth, BH8 0EH, price £9.00 including postage and packing.

This new Flora, on a 1-km square basis, covers much of Britain's fastest growing urban area, most of which is on the acid Tertiary soils which extend west towards Dorchester and east to the New Forest and beyond. E. F. Linton, in his *Flora of Bournemouth*, covered this area too, but that was 80 years ago. There is tremendous pressure here from roads, housing, airports, and from leisure activities, but there are some superb remaining sites sandwiched in between, such as Christchurch harbour, the lower Avon valley, the heaths around Hurn, and the Bournemouth cliffs themselves, where many 'Red Data' and 'Scarce' species have been found.

This work covers an area of v.c. 11, South Hampshire, which was absorbed into Dorset in 1974, with the addition of a small part of modern Bournemouth from v.c. 9, Dorset. Thus although it has no natural boundary, it is a whole in itself. The same area will be covered by the long-awaited new *Flora of Hampshire*, but that work will be on a tetrad basis and will, I understand, cover records from the 1960s onwards, whereas this volume incorporates records from 1981 to 1993. The proposed new *Flora of Dorset* might await developments from the boundary commissioners before covering the same area again! Incidentally the part of Bournemouth that is most densely urban is not actually covered in this work. Perhaps it should have been for completeness.

The introductory chapters are concise but comprehensive, with clear maps and explanations. Figure 4 shows the extent of the conurbation, and reinforces one's surprise that eight S.S.S.I.s are found within the survey area. The records are all made by the author, and incorporate a few pointed out by others and subsequently verified. It is this aspect that would be the basis of the only reservation I feel about the book. By all means check anything rare, or critical or unlikely, but to eschew all records of others seems slightly surprising, and is certainly at variance with almost every other recent county Flora. Perhaps the very smallness of the survey area – 122 1-km squares – is an excuse for this approach.

Overall the 1-km square grid coverage works well indeed. I often feel most dubious about what tetrad maps actually show, other than a generalised demonstration of surface geology. Site surveys seem far more preferable, and their incorporation into maps at least serves two useful purposes. The 1-km square grid is intermediate between the two methods and is fine enough to convey some of the benefit of a site approach. The maps are clear, and of course, are far better interwoven with the text than in a separate section at the end. I feel it is carrying secrecy too far to omit maps of *Osmunda regalis*, *Orchis morio* and all dactylorchids; there are enough real threats without inventing more. The commentary is to the point, and places the records within the context of the historical position and that of the rest of Dorset (but not Hampshire).

The book is spaciously and pleasingly laid out. As with many recent county Floras there are the obligatory colour photographs, presumably for the benefit of a 'wider public'. I like very much the idea of a 'local' Flora, especially of a definite area. Whilst this particular area might not have the immediate appeal of the Lizard or the Avon Gorge, perusal of the contents reveals a wealth of rare plants and it can only be a timely contribution to conservation by its presentation of hard facts on a threatened area.

D. A. PEARMAN

Flora of Flintshire. G. Wynne. Pp. 400, with 25 colour and three black and white plates. Gee & Son, Denbigh. 1993. Price £25.00 (ISBN 0–7074–0224–7).

Flintshire can now be crossed off the decreasing list of counties that has never had a county Flora thanks to this work by Goronwy Wynne. Although no longer existing as an administrative unit, being amalgamated with Denbighshire to form Clywd in 1974, Flintshire covers the Watsonian v.c. 51. This makes a compact recording unit some 38 km × 16 km forming the north-east corner of Wales, every part of which is within half an hour's drive of the author's home. It is 30 years since the death of Arthur Dallman who, although he never published his *Flora of Flintshire*, left extensive botanical notes covering the first half of this century and indeed a draft manuscript for his projected Flora. These are housed in the Botany Department at the National Museum and Galleries on Merseyside. This current *Flora*, which draws heavily on Dallman's work and for which fieldwork started in the early 1970s, therefore spans virtually the entire 20th Century. It is apparent that Goronwy Wynne's surveys are no less meticulous than those of Arthur Dallman before him.

The *Flora* is divided into three sections. Part I deals with the description of the county and includes sections on botanical exploration and a guide to some of the best botanical localities (omitting some sensitive sites). The climatic data are well presented and demonstrate that even in such a relatively small area as Flintshire, climatic variations do occur. The effect of climatic variation on species distribution within the County is dealt with in Part II.

Part II explains the survey techniques and analyses the results. Species recording is at the tetrad level, in common with the majority of recent county Floras. There are 172 tetrads in Flintshire. In order to attempt to explain patterns of plant distribution in Flintshire, a total of 119 environmental attributes were identified and assigned to each tetrad. These environmental attributes range from soil type to altitude and include land use such as golf courses, railways and built up areas. By using the TWINSPAN ordination technique on these environmental attributes, eleven different land classes were identified in Flintshire. It could be argued that the 2-km square is rather large for such a technique, but it appears that a series of clearly defined units has been produced.

The species records were also subjected to TWINSPAN ordination and produced 13 different floristic classes. Clearly one test of whether such techniques is valid is to see if there is any correlation between the land and floristic classes. Although statistically tested (using DECOR-ANA) it is also visually apparent that there is such a correlation. Geographical elements, floristic gains and losses as well as individual habitat studies are also included in Part II.

Part III is concerned with the details of individual species occurring in Flintshire. This is comprehensively and clearly presented. Of great value are the tetrad distribution maps for every species with more than one record. Many of these additionally have a small graph attached showing the species' position on the first two axes of the DECORANA ordination.

The tri-lingual index is rather lengthy. It might have been more manageable to index Latin names separately from Welsh and English ones. A similar problem occurs with the gazetteer. All the places named in the *Flora* are listed in the gazetteer with a 4-figure grid reference. Their inclusion on a map is therefore superfluous, especially as this necessitates the use of very small print.

Presentation of the *Flora* is most attractive and the text is well laid-out, although not without the occasional typographical error (such as the addition of a 't' in rainfall on page 81). The excellent colour plates are a welcome addition. Both colour photographs and plant portraits by Margaret Gillison Todd and Jean Hughes are included. Their presence in such a competitively-priced book is due to sponsorship of individual plates by organisations such as the Countryside Council for Wales and the Liverpool Botanical Society. Whilst admittedly the Wood Horsetail (*Equisetum sylvaticum*) is perhaps no great botanical art subject, its black and white photograph along with three other uncommon Flintshire plants (*Pyrola rotundifolia*, *Epipactis phyllanthes* and *E. helleborine*), is unfortunately lifeless in comparison to the colour plates in the book.

The *Flora of Flintshire* goes a long way to satisfying a wide readership. It has a high scientific content, but at the same time is very readable and will be of value to land managers and conservationists as well as botanists.

B. D. Greenwood

Obituaries

ERIC SMOOTHEY EDEES
(1907—1993)

Eric Edees was born at Runcorn, Cheshire, on 5 June 1907 and died on 14 October 1993. He was the son of Isaac Edees, a Methodist minister, and Eric himself was for many years a lay preacher in the Methodist church. The family moved to Manchester, where he was educated at Manchester Grammar School, and went on to read Classics at Manchester University. In 1930 he moved to Stoke-on-Trent as a history teacher, and from that time Staffordshire was his adopted county.

He joined the North Staffordshire Field Club in 1938 and was elected Chairman of their Botany Section in 1941 on the retirement of W. T. Boydon Ridge. He held this post until his death and was a most active and distinguished member of the Field Club. He joined our Society, then the Botanical Exchange Club, in 1943. Eric's long-term study of Staffordshire plants resulted in his *Flora of Staffordshire*, published in 1972. He was a founder member of the Staffordshire Wildlife Trust.

Eric Edees' important contributions to British field botany were recognised by the award of the North Staffordshire Field Club's Spanton Medal (1948) and Robert Garner Silver Medal (1955), the Linnean Society of London's H. H. Bloomer Silver Medal (1975) and a Master of Science degree by Keele University. He was elected an Honorary member of the B.S.B.I.

He was a quiet and courteous man, but held strong opinions. He was a natural teacher with a wide knowledge of plants, who would patiently explain in the field the diagnostic characters of his beloved *Rubus* to everyone interested. His wife Margaret, who gave him much support and help with the *Flora*, predeceased him, but he is survived by two brothers and a sister.

B. R. Fowler

ERIC EDEES' CONTRIBUTION TO BRITISH BATOLOGY

I first met Eric at a Breckland field meeting in 1965, but it was not until 1967, when I needed to make progress with *Rubus* for the Cheshire Flora, that a closer relationship developed. I had sent a few specimens for his determination, but had omitted to ensure that the pressings retained the essential characters of the plants. They were cursorily returned unnamed, but he invited me to meet him on our county march to inspect the local brambles on both sides of the line. Thus began a 20-year period of fruitful cooperation in bramble study.

Eric first came to grips with *Rubus* in 1936 when he submitted local gatherings to W. C. Barton. Later he turned to Francis Rilstone for enlightenment and assistance in naming specimens. Unfortunately, Rilstone's detailed knowledge was mainly of the Cornish bramble flora, but nevertheless he was able to name the more widespread Staffordshire plants satisfactorily. This early collaboration, conducted energetically on both sides, culminated in the joint publication of a local Staffordshire bramble as *Rubus daltrii* in 1945.

Thereafter, specimens were submitted to William Watson, then the Botanical Exchange Club's referee for *Rubus*. Eventually, in 1950, Watson visited Staffordshire to examine growing bushes which he could not name satisfactorily in the dried state. Eric was not impressed by the initial hesitation on encountering the plants, followed later by pronouncement of an obscure name exhumed from the recesses of Sudre's *Rubi Europae*. Watson's view at that time apparently was that inability to ascribe a name amounted to a stain on his reputation, an attitude completely at variance with Eric's careful, methodical, and above all cautious approach to the determination of *Rubus* specimens.

Following Watson's death in 1954, Eric became the B.S.B.I.'s referee for *Rubus* and published the first of his 'county' articles, on the brambles of Staffordshire, in 1955. These consisted of a list of species, with notes on the features, taxonomic history and distribution of each. As referee, he was approached for help by several county Flora writers, which resulted in accounts for Derbyshire in 1959 and Lincolnshire in 1966. While these, together with visits to Cheshire in support of my own 1971 Flora, were a natural development of his Staffordshire experience, receipt of gatherings from Scottish and Welsh botanists, in particular Miss U.K. Duncan, Miss M. McCallum Webster and T. A. W. Davis, reinforced his developing conviction that a number of taxa lacked descriptions in the literature and could not be satisfactorily named from either Rogers' or Watson's handbooks. His outlook on methodology is well set out in 'The difficulties of a *Rubus* referee' (*Proceedings of the Botanical Society of the British Isles* **3**: 281–282, 1959). Visits were made further afield during summer to Scotland, Mid-Wales, Cumbria, Norfolk (at regular intervals), Suffolk, Hampshire and Cornwall.

B. A. Miles had, from 1961 onwards, set himself the task of refinding Watson's and J. E. Woodhead's collecting sites, amassing much definitive material of taxa described in Watson's *Handbook*. Based in south-eastern England and applying himself to the task with vigour, he built up a detailed knowledge of the brambles of the Home Counties, both in field and herbarium, as well as a burgeoning distrust of Watson's taxonomy. Eric was pleased to find a batologist familiar with the South-East to complement his own mainly Midland and Northern experience. Specimens were exchanged, problems ventilated and provisional conclusions reached about many of the conundrums discussed in a lively correspondence. A few tentative proposals were made, e.g. to embark on regional reviews of bramble taxonomy and nomenclature. Eric visited Miles in 1968, when specimens were examined and cooperation within spheres of influence mooted. No definitive plan of action had, however, been agreed before Miles' untimely death in January 1970.

I had already decided to publish some of the unnamed Cheshire brambles for inclusion in my Flora (virtually my batological apprenticeship). Fortunately our contiguous counties allowed frequent Saturday visits to Eric's house at Newcastle-under-Lyme for reviews at first of **MANCH** specimens, then of our own collections, as well as parcels from enthusiasts, who now included Messrs Kenneth and Stirling from Scotland and Messrs Ironside-Wood and Bull from eastern England. Eric had been given a number of Rilstone's specimens (including continental sheets) by Woodhead and also a selection of Watson's herbarium. This material, together with his own expanding gatherings, became the reference point for comparison and discussion.

When I broached the subject of possible publications, including a revision of *Rubus* in Britain, he was lukewarm on anything other than staged regional accounts, insisting that our knowledge was inadequate. It was clear that, if the British *Rubi* were to be better understood, syntype material of British and Continental authors must be critically examined.

In 1972 I determined to collect together the relevant material for study, no easy task as it is scattered across the herbaria of Europe. I was fortunate to enlist the support of the late David Valentine, then Professor of Botany at Manchester University, in gaining access to the biggest and best British collection, the Barton and Riddelsdell herbarium (**BM**). Barton's photographs and notes, the fruit of 25 years' study, including discussion of Muller's and Focke's taxa, as well as the whole of Sudre's *Batotheca Europaea*, were sent on loan to Manchester Museum, where Charles Bailey's *Rubi* were also made available. These, together with sheets loaned from Kew, the South London Botanical Institute and Lausanne, with Rogers' **BM** syntypes, enabled me to assemble groups of associated specimens. Referring to the literature passim, I began to review the *Rubus* list: as assessment was completed, I took the groups of specimens to Eric for his independent opinion. We then compared notes and found that in most cases our views coincided. It became clear that it was sensible for each of us to concentrate on our adopted fields of interest. I began to compile articles for publication, and after some hesitation, Eric followed suit, not however until I had faced him with the thought that a chance encounter with a bus could render his hard-won expertise abortive: his published contribution was vital if progress was to be made.

Two developments in the mid-1970s served to advance British batological aspirations. First, our growing contacts with the Continent, particularly H. Weber in Germany and H. Vannerom in Belgium, enabled concepts to be challenged or confirmed and elucidation of the N. W. European bramble flora to reach an advanced state. Second, there was the launch of a projected 'Flora of Great Britain and Ireland', for which Eric and I committed ourselves to write *Rubus* for Volume 2.

This task filled almost four years and required a disciplined, systematic approach. Eric concentrated on descriptions and keys, while my contribution embraced the geography, ecology and nomenclature. There was, of course, regular discussion on problems in both spheres. Joint meetings were held in the field and once in the Cambridge University Herbarium, where the profusion and diversity of material readily available, along with library facilities, provided a major stimulus for research.

Unfortunately the Flora project was becalmed by the ill-health of two of the three editors and our *Rubus* account languished until, in 1985, I approached the Ray Society with a view to publishing our work as a monograph. By this time Eric had retired from active batology and compilation of the introductory material fell to my lot, as well as the assembly of supporting features and liaison with our stalwart editor, D. H. Kent. Eric's eagle eye, was, however, cast fruitfully over the final draft and he was quietly pleased and proud to look through the finished product in July 1988.

Through the years of our collaboration, his steadfast adherence to defined objectives, sound judgement based on meticulous attention to detail, with discussion lightened by bluff, occasionally quirky humour, made for a congenial relationship which I shall always cherish.

A. NEWTON

ERIC EDEES, NORFOLK AND NORFOLK BRAMBLES

Eric Edees' wife, Margaret, was born in the village of Necton, near Swaffham, Norfolk, and her family were still living there a few years ago, and probably still do. As a result, many holidays were spent at Necton, in the course of which Eric collected sufficient material to produce a short MS entitled 'The Flora of the Swaffham district'. It was never published, but his efforts were not wasted, as the MS was passed on to Eric Swann, co-author of *The Flora of Norfolk*, in which the use of Edees' work is acknowledged. Eric (Edees) told me on one occasion that, when the family went to the sea for the day, either to Blakeney or to the Wells/Holkham area of the North Norfolk coast, he would go with them, then turn round and walk the 30 or so miles back to Necton, botanising all the way.

I first met him at the end of the 1960s. In the previous two seasons I had been struggling unsuccessfully to come to terms with *Rubus*, using W. C. R. Watson's *Handbook*, and sending a small package of wildly inaccurately identified specimens to Eric for 'confirmation'. The only one I ever got right at that stage was *R. ulmifolius*! In 1970 I wrote and asked if I might impose on his goodwill again and send another parcel, to which he replied that he would be visiting his wife's relatives during October, and if I cared to wait until then, he would call and name them. Then, if I had a site nearby with a number of species in that we could walk round, he would name those that he could so late in the season. I could mark them, and examine them during the summer of the following year, and I would then have a basis on which to build.

We lived at Foxley at the time, with the large area of ancient woodland, Foxley Wood, just 1 km away, which I had permission to visit. The day duly arrived, and so did Eric and Margaret Edees, my gatherings were named, and he expressed himself surprised at one or two of my discoveries. We spent an hour walking around the wood and I had 14 named species to collect next season – indeed the basis for all my subsequent work on *Rubus*. Within a year or two, it became obvious that in Norfolk, as in most other counties, there were brambles that did not have names, and two stood out as being widespread and locally abundant.

In 1977, Eric came to stay with us for a week, and we visited many sites in Norfolk and Suffolk. From gatherings made on this visit, the names *R. boudiccae* and *R. norvicensis* were both subsequently published. Since then, both have been discovered to have a much wider distribution than East Anglia, with the former here and there across central and southern England, and a number of sites in southern Ireland, and the latter as far south and west as Hampshire and Guernsey.

I felt sometimes that Eric's fascination for brambles was something of a 'love-hate' relationship, which was borne home to me whilst investigating *R. norvicensis* in depth. We stood in a large woodland clearing with a seemingly endless mix of plants all around, some of which were nameable, several others not. Turning slowly through 180°, glaring silently all around as he did so, he suddenly exclaimed: "I hate blackberries!". We all feel like that from time-to-time, but 25 years of study of them has given me a deal of satisfaction – a satisfaction which I should not have had, had Eric not gone some distance out of his way to help a beginner.

A. Bull

RICHARD WILLIAM ('DICK') DAVID
(1912—1993)

To his large circle of friends and colleagues, Richard David, who died on 25 April 1993, will always be known and remembered as 'Dick'. It is some indication of the breadth of his interests and the attractive qualities of his personality that very many botanical friends had little or no knowledge of his considerable academic achievements as a Shakespearean scholar or his professional career in learned publishing as University Publisher and Secretary to the Syndics of Cambridge University Press.

Dick David was born on 28 January 1912 in Winchester, where his father, the Rev. F. P. David, was a Housemaster at the College, and Dick went there as a Scholar. His academic career was smoothly brilliant, and he entered Corpus Christi College to read first Classics and then English in 1931. After graduating, followed by a year's research in Paris, he wrote a Prize Essay on Shakespeare's dramatic poetry, which was published by Cambridge University Press in 1935 when the author was only 23. In the following year he joined the Press as assistant secretary. This publishing career was interrupted by wartime service in the Royal Navy, in which he rose to be a Lieutenant-Commander, and after the war Dick returned to the Press and rose steadily to his leading position among academic publishing, a service recognised by his C.B.E. in 1967.

Whilst English literature and Shakespearean studies were Dick's main academic interest, and publishing his professional expertise, he was keenly interested in the countryside and in field botany in particular, having acquired at an early age his mother's love of flowers. Dick's own delightful account of how he was given the "Bentham & Hooker Illustrations on his fourth birthday and encouraged by his mother to paint in the daisy and the dandelion" can be found in his 1980 Presidential Address to the B.S.B.I., "Gentlemen and Players" (*Watsonia* **13**: 173–179, 1981). Throughout his career, the family holiday home at Polzeath on the beautiful Camel estuary in Cornwall drew Dick most summers, and immersed him in a very different botanical world from that provided by Cambridge; and his friendship with John and Faith Raven, together with his enthusiasm for fly-fishing, also made him a regular holiday visitor to Ardtornish on the marvellous Morvern peninsula in Argyll, again a totally contrasting botanical scene.

Dick's Presidential Address reminds us that his own contribution to botany can be taken as a model of the value of that close link between amateur and professional which is undoubtedly one of the main reasons why the Botanical Society of the British Isles continues to serve the science of taxonomy so well. With long service on the Society's Publications and Records Committees, and following an established tradition of alternation between amateur and professional in the post, Dick became President of the B.S.B.I. for the customary two-year stint from 1979 to 1981, and in that position made his unique contribution. It was a time of continuing change in the B.S.B.I., which needed to address important questions of orientation and policy, especially in the field of the conservation of the natural environment. The Society's pioneer role in the Distribution Maps Scheme in the 1950s and 1960s had firmly established the value of systematic recording of the British flora in determining policies for nature conservation, and Dick put much effort into liaison with both official and voluntary conservation bodies to shape the way ahead. He had, as early as 1955, become the B.S.B.I.'s Recorder for East Cornwall (v.c. 2), and later in 1961 took on the post for West Cornwall (v.c. 1) as well. From these interests developed his friendship with Len Margetts, with whom he collaborated to produce the *Review of the Cornish Flora, 1980* in 1981. Len recalls (in Davies (1994)) how "his quiet humour, modesty and expertise made him an ideal companion, and our shared fascination for the lesser critical groups – *Euphrasia* (eyebrights) and *Fumaria* (fumitories) in particular – ensured a succession of Cornish venues."

What of the sedges, the botanical passion of Dick's later years? In his account of his own friendship with Dick, Clive Jermy (in Davies 1994) reminds us how it all began: "In 1968 the Botanical Society of the British Isles published a little book aimed at helping botanists identify British and Irish sedges. It had been written by myself, together with my former tutor, Tom Tutin, under whom I had researched the group at Leicester University. As with all books, we as authors had a few copies to give to those friends who had helped, and when those were satisfied I had one left. Tom said "I think you should send that to Dick David at the Cambridge University Press. I think he likes sedges!"

Tom Tutin's pithy sentence was proved to be a monumental understatement, for, in his retirement, Dick became devoted to the British sedges and obviously found, in his careful, planned survey of the surviving field populations in the British Isles of many of the rarer *Carex* species, a perfectly satisfying way of combining his zeal and expertise in field botany with his deep enjoyment of the 'wild places' of the British and Irish countryside. In this he was following an honourable tradition of gifted amateurs. He did much more than mere recording, however; stimulated by his growing friendship with two outstanding professional botanists, Arthur Chater and Clive Jermy, he tackled the notorious 'critical' sedge groups of *Carex muricata* and *C. flava*, and the fruits of their joint labours are available to all to appreciate in the second edition of the Society's Handbook, entitled *Sedges of the British Isles* (Jermy, A. C., Chater, A. O. & David, R. W., 1982) – a book, incidentally, that is much appreciated and used by many Continental European botanists as providing an up-to-date and definitive survey of an important European genus.

In his attitude to that other great traditional British hobby, gardening, Dick differed significantly from many of his fellow-botanists in having a foot in both camps. He could search for hours for an insignificant rare alpine sedge of no conceivable interest to gardeners, but he also developed a parallel passion for that very attractive horticultural genus, *Crocus*, which provided him with occasions for field trips abroad in the winter and early spring when the sedges were 'lying low'. In part, the stimulus to take up the study of *Crocus* was provided by his association with the University Botanic Garden in Cambridge, an institution for which he developed a deep affection, especially after he and his wife Nora moved to a house nearby. A frequent visitor to the Botanic Garden, especially to the rock garden and alpine house in early spring, Dick served as a Manager of the Cory Fund, which administers the important Reginald Cory bequest to the Garden, from 1979 to 1982. During my time as Director (1973–83) Dick began to use the facilities of the Experimental and Research Area of the Garden to grow wild-origin stocks of his critical sedges under comparable conditions, and it is pleasant to record that we still have plants derived from these stocks in cultivation in the Garden on the Systematic Beds.

No picture of Dick would be remotely adequate without some reference to his happy marriage and family life. In 1935 he married Nora Blakesley, a graduate of Newnham College who shared Dick's interests in the countryside, travel and the theatre in particular, but whose own career took her into local and national Labour Party politics, culminating in a life peerage in 1978. It was a constant source of admiration to their many friends that Dick and Nora happily pursued their separate careers from a firm and affectionate family basis with shared pleasure in the careers of their four children, Dick coping with amused tolerance with the unusual social problem of being plain 'Mr David' to Nora's 'Lady David'.

Dick was active to the end. He died in Corsica on a field excursion to see the lovely *Crocus*. We all feel a great loss, not least because the modern world seems to produce fewer selfless 'gentlemen' of Dick's calibre, but we realise that increasing incapacity in old age would have been difficult for Dick to tolerate, and the end was appropriate. Our sympathies go out to Nora and the family.

I am personally indebted to Nora and others concerned for permission to use and to quote from draft texts of some contributions to a volume of essays, *Dick David remembered by his friends*, covering the many facets of Dick's life. This volume, edited by Dick's son-in-law Tony Davies (1994), contains inter alia a bibliography of Dick's published works, including the botanical ones (available from L. A. Davies, 50 Clarence Road, Birmingham, B13 9UH).

S. M. WALTERS

KATHLEEN MARGARET HOLLICK
(1913—1993)

Kathleen was a keen plantswoman and an able artist. Her garden at the Old House at Ashbourne, a shadow of its former self, is sadly neglected since she tragically lost all her mental powers – she was in a nursing home for some years before death released her on 6 December 1993. But her drawings will not die.

She was born on 26 October 1913, the only daughter of a much respected G.P. of the town, where she lived all her life. She was educated by a governess, Miss Orme, who kindled her life-long absorption in plants.

She was B.S.B.I. Recorder for Derbyshire (v.c. 57) for 36 years up to 1985. Professor A. R. Clapham wrote in his *Flora of Derbyshire*, which came out in 1961, that he was "very deeply indebted" to her. She was the mainspring of the two Supplements to the *Flora* in 1974 and 1979, which she produced with Susan Patrick of the Derby Museum. She knew her county very well, its landscapes, people, history and all, her travelling done by bicycle, bus or train. She had close connections with the lovely parish church next door to her really old house, and she wrote its history. She helped her father plant the daffodils in the local churchyard, and it is due to her insistence that the grass should not be mown until the flowering was over and the foliage had died down, that they are still the magnificent show they are today.

We are told that when the steeple was being repaired, she went up the steeple-jack's ladder to the top – she was then over 60. This was typical of her 'go' and dauntless spirit, in all weathers too.

Her garden was open to the public on occasions for charity, with good plants which she would talk interestingly about. Several of them had been sent her for drawing, to ensure she had fresh material.

She made scores and scores of drawings of wild flowers. The first were for Dr R. W. Butcher's two-volume *New Illustrated British Flora* of 1961, no fewer than 359 of them. She also did many for the sadly never-finished *British Alien Flora*, originally conceived as Volume 3 of Butcher's work.

Her interests included local history (her notes on early tiles are in the Derbyshire County Records Office), birds, regular duck counts, and being a member of the Conservation Committee of the Derby Wildlife Trust; and she was no sleeping Fellow of the Linnean Society of London.

Our happy memories of her go back over 50 (D.McC.) and over 20 (A.B.) years, as always a welcoming, lively and inspiriting companion and friend. Her herbarium and drawings are in the Museum at Derby. Her private collection of paintings has been kept within the family.

We are grateful to her niece Mrs Joanna Neal for help with details of her life.

D. McClintock & A. Burns

KENNETH GUY MESSENGER
(1920—1993)

All who knew him were shocked and saddened at the news of the sudden death of Guy Messenger in November 1993, especially as some were expecting to meet him at the B.S.B.I. Annual Exhibition Meeting to be held on the following day, and at which Guy had been intending to mount an exhibit.

Kenneth Guy Messenger was born on 26 February 1920 at Hampstead, London. His father was a dentist, and Lecturer and Consultant at Guy's Hospital; his mother had been a nurse at Guy's. He had one brother and one sister. His childhood was spent at Hendon. He was educated at Grove Park Preparatory School and Felsted School, Essex, at the latter as a scholar. In 1937 he began the course of Medical Studies at Guy's Hospital, but he abandoned this in 1939 when he went up to Emmanuel College, Cambridge to read for the Natural Sciences Tripos in Chemistry, Zoology and Botany. This course was interrupted by military service, most of which he spent in India and Ceylon in the Royal Corps of Signals. After the Second World War he returned to Cambridge, and graduated with Second Class Honours in 1949.

At first he thought of specializing in Marine Biology, but decided on a career as a teacher. He was appointed Senior Biology Master at Uppingham School in September 1949, and taught there for 31 years, retiring in 1980. He had read Zoology for the second part of his Tripos, and claimed to have been somewhat shaky on the Botany at the beginning of his teaching career. However, he acknowledged his debt to Humphrey Gilbert Carter at Cambridge and the stimulus provided by acquaintance with other botanists such as Max Walters and Paul Richards. In 1957, at the instigation of John H. Chandler of Stamford and Franklyn Perring, he joined the B.S.B.I. and began recording for the Atlas Distribution Maps Scheme. In the Preface to his *Flora of Rutland* Guy expresses amazement at his own temerity in undertaking a 10-km square for this survey in the state he considered his own botanical knowledge to be, but he had the cooperation of a very competent botanist in John Chandler. His efforts for the Distribution Maps Scheme provided some of the groundwork for a complete survey of the county of Rutland on a tetrad basis, with the assistance of John Chandler and an enthusiastic team of Uppingham schoolboys. The outcome of this survey was Guy's *Flora of Rutland*, published in 1972.

I first became acquainted with Guy Messenger when he joined the Leicestershire Flora Committee at its inauguration in 1967. His experience on the Rutland *Flora* was invaluable, and he was also a very useful committee member with a shrewd capacity for cutting Gordian knots and breaking vicious circles. He and I made several 'square-bashing' excursions together, sometimes in my area and at others in the large area of Leicestershire adjacent to Rutland for which he had assumed the responsibility. My friendship with him really matured after 1974 when he undertook the specialist work on the critical groups *Ulmus*, *Rubus*, *Hieracium* and *Taraxacum*, and I took on the work for *Rosa*. Together we covered the greater part of Leicestershire, Guy recording elms and I roses. Our conversations during these forays would have amused an outside observer, consisting as they did of monologues on *Rosa* and *Ulmus*, delivered almost simultaneously with little mutual comprehension. Later I spent some days with him at Uppingham, helping him to make a complete survey of the Rutland roses for the supplement to the *Flora of Rutland* which, alas, he did not live to complete.

Guy's interest in the genus *Ulmus* began with his Rutland survey, and was enhanced by the survey of Leicestershire, during which he was working against time, because the ravages of Dutch Elm Disease were rapidly destroying nearly all the adult elm trees in the county. He had two long sessions with R. H. Richens at Cambridge on *Ulmus*, and the study of the genus became one of the two absorbing interests during his retirement. His object was to devise a practicable scheme which would reconcile the two violently opposed current taxonomic views of the treatment of the genus. He accumulated a vast quantity of data, but had not arrived at a workable solution to the problem. He was not, I think, a very systematic worker, and was also a perfectionist who would not dream of publishing anything until he was absolutely sure of his facts. He was probably, too, diffident of setting himself up as an authority against the eminent people who have studied the genus. It is to be hoped that the notes he has left can be effectively used by others in the future, and that all his work will not have been wasted.

Guy never married, and after the death of his mother lived a solitary life with only his Siamese cat for company. Nevertheless he was a sociable person and was good company, with a wry and sometimes slightly bawdy sense of humour. He derived great pleasure from classical music, and played the double bass in the Uppingham School orchestra. His second main absorbing interest besides *Ulmus*, and of longer standing, was in cartobibliography. He amassed a collection of more than 5000 Ordnance Survey maps, and published a monograph on the 1-inch maps. He was also a leader in the Brathay Exploration Group, and was one of the authors of the *Flora of Foula*. He contributed several articles to the B.S.B.I.'s journals, and his interest in maps and mapping no doubt inspired him to contribute the topographical and botanical gazeteers for his own *Flora of Rutland* and the *Flora of Leicestershire*. He was elected a fellow of the Linnean Society of London in 1974.

All in all, Guy was a warm-hearted man with a keen mind, wide interests, and sound views on all subjects. He will no doubt be remembered with affection by many of his former Uppingham School pupils. He certainly made a name for himself in botanical circles, and will be sadly missed by his many friends.

A. L. Primavesi

SIR GEORGE TAYLOR
(1904—1993)

Sir George Taylor, Keeper of Botany at the British Museum (Natural History) 1950–1956, Director of the Royal Botanic Gardens, Kew, 1956–1971, and a Life Member of the Botanical Society of the British Isles, which he joined in 1933, died at Dunbar, Lothian, on 12 November 1993, in his ninetieth year. He was born in Edinburgh on 15 February 1904, the only son (though he had three sisters) of William Taylor and Jane Sloan, and was educated at George Heriot's School, where, it is said, encouraged by a housemaster, George Scott, he developed a keen interest in field botany, cycling extensively around the countryside in search of rare plants. Although remembered chiefly as a botanical and horticultural administrator, he had a sound knowledge of British plants, with a particular fondness for, and interest in, the Scottish flora. Indeed his attachment to Edinburgh, Scotland and things Scottish, persisted throughout a lifetime spent largely in the south of England. He was proud of his 'Scottishness', and to the end of his life retained, almost unmodified, his Scottish accent.

On leaving school he went to Edinburgh University, where he had a distinguished academic career, graduating in 1926 with first class honours in Botany, and being awarded the Vans Dunlop Scholarship. After a collecting trip to South Africa, in company with Reginald Cory, he joined the staff of the Botany Department of the British Museum (Natural History) in 1928, where – apart from wartime secondment to the Air Ministry – he remained until 1956, becoming Deputy to the easy-going John Ramsbottom in 1946, and succeeding him as Keeper of Botany in 1950. Those of us who first became acquainted with the B.M. Botany Department in the immediate post-war years, may remember the occasion as a somewhat intimidating one, with the choleric A. J. Wilmott ruling like one of the less predictable Roman Emperors over the European section of the herbarium, while those who ventured into exotic botany risked the sharp-tongued derision of the disputatious J. E. Dandy. It was not a place for the weak-nerved; in such company, George Taylor, formidable though he could be, seemed the very model of normality.

George Taylor had developed a special interest in the botany of the Himalayan region during his Edinburgh days, and this enthusiasm remained with him throughout his life. In 1934 he published an excellent monograph of the genus *Meconopsis*, for which he was awarded a doctorate, and in 1938, just before the outbreak of the Second World War, he accompanied Frank Ludlow and George Sherriff on what was to prove for him a memorable collecting trip to Bhutan and S. E. Tibet.

Early in his career at the B.M. he had begun to take an interest in *Potamogeton* (pondweeds), and working with J. E. Dandy, published a series of critical revisions of the species and hybrids in *Journal of Botany* and *Watsonia*. Along with Dandy he was for many years a B.S.B.I. referee for this difficult genus. For most of his career he was a leading authority on the family *Podostemaceae*, a remarkable group, many of the species superficially resembling bryophytes rather than flowering plants.

In 1956, on the retirement of Sir Edward Salisbury, George Taylor was appointed Director of the Royal Botanic Gardens, Kew, a post for which he was eminently well qualified. He already knew most of the Kew botanical staff; he had served as Botanical Secretary of the Linnean Society from 1951 to 1956, and as a member of the Royal Horticultural Society's Council from 1951. Furthermore he was a keen practical gardener, very proud of the rarities he had successfully established in his garden at Rickmansworth.

Kew in 1956 was still recovering from the effects of the war years and the austerities of the early post-war period; considerable areas of the Gardens had changed little since the beginning of the century, and there were uninviting expanses of dull, commonplace evergreens, by this time aged and often overgrown. These the new Director replaced with rhododendrons, camellias and other flowering trees and shrubs. A Heath Garden provided colour at a season when there was little else to catch the eye. Waste ground at the back of Kew Palace (which the Duke of Edinburgh had accurately described as "a bit of a dump") was transformed into the popular Queen's Garden. A new Jodrell Laboratory was built, and a new wing added to the Herbarium; Kew took over control of the fine gardens at Wakehurst Place, Ardingly, Sussex. Looking back, one wonders how so much was accomplished in a relatively short time. But George Taylor was a vigorous and determined man, always ready to push ahead where a project met with his approval, and no less ready to reject any proposal which he reckoned unsound. Naturally such a decisive personality made enemies, but all except the most irreconcilable of these would have had to admit that he was a most effective administrator. Certainly, under his Directorship, botanical research at Kew rapidly extended beyond the traditional taxonomy and anatomy into cytology, physiology and phytochemistry, and he would, I am sure, be very gratified to note the many recent advances and developments in these and other disciplines. In one respect he might not see eye-to-eye with the current programme: he once told me emphatically that he did not want Kew to be actively involved in educating the general public. He wanted it to be a fine garden and research centre, where the intellectually curious could add to their knowledge, and the others simply enjoy themselves.

He received many honours, amongst them the Victoria Medal of the R.H.S. (1956) and a knighthood (1962), and was elected a Fellow of the Royal Society in 1968. He is commemorated in the genus *Tayloriophyton* M. P. Nayar, and in no fewer than 14 species, including one British plant, the very rare willow hybrid, *Salix* × *taylorii* Rechinger f.

On retirement from Kew in 1971, Sir George became the first director of the Stanley Smith Horticultural Trust, with its headquarters at Belhaven House near Dunbar. He was back in Scotland, not far from Edinburgh, and settled in a fine house in a good garden, where he was to enjoy many happy years, still in touch with many of his friends and former colleagues, and still able, through the Trust, to play an active role in assisting a wide range of horticultural and botanical projects.

Until his final illness he remained the same Sir George, restless, forthright and pungently humorous – an original character and, to me, an engaging one.

R. D. Meikle

SIR GEORGE TAYLOR'S STUDIES OF THE GENUS *POTAMOGETON*

Although George Taylor was best known as a botanical and horticultural administrator, it is for his studies of the genus *Potamogeton* that he will be remembered by field botanists in Britain and Ireland. This work was carried out with J. E. Dandy, in a remarkable and perhaps unique partnership which lasted until Taylor's promotion to administrative posts meant that the work had to be continued by Dandy alone.

When asked towards the end of his life when he first became interested in aquatic plants, Taylor replied that he had 'paddled in water' for as long as he could remember. The first specimens of *Potamogeton* collected by Taylor which are recorded in Dandy's card index were gathered in Scotland in 1926, and the fact that he found at least eleven taxa that year (including the rare hybrid *P.* × *olivaceus*) suggests that he already had some knowledge of the genus, or immediately discovered that he had an affinity with it. If Taylor collected much material in the next few years it has not survived, but he collected extensively in both England and Scotland in 1932. These collections included the very rare *P.* × *griffithii* from Loch na Creige Duibhe, Argyll; this population had been described as *P. macvicarii* by Arthur Bennett in 1907 but Taylor was the first to attempt to refind the plant. The specimen was submitted to the acknowledged expert in the genus, W. H. Pearsall, who misidentified it as *P. alpinus*; Dandy and Taylor themselves were later to sort out the taxonomy of this hybrid.

J. E. Dandy became interested in *Potamogeton* when he worked up some specimens collected by Taylor on an expedition to Africa in 1934–35. These included some species which also occurred in Britain, and while working on them Dandy and Taylor resolved to write a monograph of the genus in Britain and Ireland. Eighteen preliminary papers were published in the series "Studies of British Potamogetons" between 1938 and 1942. These established the correct application of the name *Potamogeton pusillus* and clarified the taxonomy and British distribution of numerous species and hybrids. A 19th paper in the series, on *P.* × *sudermanicus*, was at an advanced stage of preparation when the *Journal of Botany* ceased publication in 1942, a calamity which Taylor attributed to the laziness of the editor, J. Ramsbottom. After he moved to Kew, in 1956, Taylor was unable to continue his work on *Potamogeton*. The projected monograph had by then been drafted but it was never submitted for publication: the demise of the *Journal of Botany* and Taylor's move to Kew may have been partly responsible, but the main reason was probably the reluctance of Dandy, a notorious perfectionist, to commit himself to print. Taylor did not undertake any serious work on the genus after his retirement, but he collected one or two specimens: it gave him particular pleasure to discover *P. polygonifolius* in East Lothian in 1982, as he had searched for the species in the county for many years.

Taylor's contribution to the partnership with Dandy included extensive fieldwork (see below). During his collecting trips Taylor spent many hours in the evenings floating out specimens, usually in a bath in the hotel in which he stayed. His specimens are lodged in **BM**, with duplicates in numerous other collections. They are of outstanding quality, usually displaying entire plants from root to apex, but are not accompanied by ecological notes. During his fieldwork Taylor made the first (and, so far, the only) British collections of *P.* × *lanceolatifolius*, and also discovered the rare *P.* × *cognatus* in Scotland. Some of Taylor's wartime Yorkshire collections which appeared in the field to be *P. pectinatus* turned out on detailed examination to be *P.* × *suecicus* (*P. filiformis* × *pectinatus*), and thus established the presence of this hybrid south of the current limit of the rarer parent, *P. filiformis*. In addition to these discoveries, Taylor made a point of visiting sites where other rare hybrids had been discovered, and collecting representative material for the herbarium. He visited the Outer Hebrides in 1951 and Colonsay in 1953, for example, to follow up records made by J. W. Heslop-Harrison and his team. In addition to the fieldwork, Taylor was responsible for dissecting the stipules of many of the linear-leaved specimens determined by Dandy and Taylor, including the type specimen of *P. pusillus* in the Linnaean herbarium. The publications were, in Taylor's words, 'polished' by Dandy and therefore bear the imprint of Dandy's personality.

In his old age Taylor was justly proud of his work on *Potamogeton*. He was delighted by a chronological printout of his collections which I gave to him, and asked repeatedly whether it qualified him for an appearance in the *Guinness Book of Records*! His only regret was that the monograph which he and Dandy had planned had never materialised.

Dandy once remarked to W. T. Stearn that "George does the collecting and I do the thinking", a caustic comment which doubtless contains an element of truth. However, it is perhaps fairer to conclude with Taylor's view that theirs was a true partnership in which it was difficult and perhaps undesirable to assess their individual contributions. Certainly, Taylor's own hard work and his determination to publish must have been partly responsible for the stream of papers on the genus *Potamogeton* which appeared in the period when they were working together, a series of publications which must constitute one of the most critical and scholarly contributions made this century to the taxonomic study of the British flora.

The years in which Taylor is known to have collected *Groenlandia* and *Potamogeton* specimens are listed below, with the vice-counties in which he gathered them. I hope to publish a full bibliography of the work of Dandy and Taylor on the British and Irish *Potamogeton* taxa in a forthcoming B.S.B.I. Handbook.

1926: 83, 88, 101.
1928: 88.
1932: 8, 17, 20, 21, 24, 62, 83, 88, 97.
1933: 9, 75, 80, 81, 83, 87–90, 95, 97, 106.
1934: 62, 65, 66, 69, 73, 74, 77, 79, 81, 86, 92.
1935: 78, 80, 83, 85, 86, 88, 89, 95, 96.
1936: 57, 89, 105.
1937: 20, 21, 30, 39, 55–57, 69, 79, 80, 83–86, 88–90, 97, 98, 105.
1938: 22.
1939: 7, 8, 17, 20–22, 24, 30, 31, 63, 64, 68, 72–74, 76, 78, 81–86, 92, 93, 95, 96.
1940: 7, 20, 21, 58, 59, 61–65.
1941: 32, 53–57, 61–65, 67, 78, 80, 82–84.
1942: 32, 53, 54, 56, 62–64, 68, 77, 81, 83, 84.
1943: 23, 59, 64, 77, 85, 86, 90.
1944: 54, 56, 61–67, 86, 90.
1945: 30, 56, 59, 61–67, 77, 78, 83, 85, 86.
1946: 7–9, 11, 16, 20–22, 24, 30, 31, 56, 62, 64, 68, 77, 78, 80–83, 85, 88, 91, 92, 95, 96, 108.
1947: 21, 23, 25, 27, 28, 32, 38, 54, 56, 58, 60, 62–65, 68, 73, 75, 77, 82, 86, 90.
1948: 14, 16, 20–23, 32–34, 36, 38, 43, 80, 86, 87, 90, 108.
1949: 6, 17, 31, 32, 34, 38, 47, 50, 54, 64, 65, 67, 68, 75, 77.
1951: 110.
1952: 25, H9, H38, H39.
1953: 18, 19, 31, 48, 55, 56, 72–74, 79, 80, 85, 86, 90, 92, 96, 102.
1954: 73, 74.
1955: 31, 101.
1956: 84.
1979: 80.
1982: 82.
1984: 78.

C. D. PRESTON

Report

ANNUAL GENERAL MEETING, 14 MAY 1994

The Annual General Meeting of the Society was held at the University of Oxford, in the Department of Plant Sciences by kind permission of Professor C. J. Leaver, Sibthorpian Professor of Botany, at 11.45 a.m. Dr F. Perring, President, took the Chair and 161 members were present.

Apologies for absence were read and Minutes of the 1993 Annual General Meeting, published in *Watsonia* **20**: 85–87 (1994), were approved.

REPORT OF COUNCIL

The Chairman took members through the Report of Council, commenting first on the number of members who had died in 1993, not only the quantity but the quality of those members who would be hard to replace. At the request of the Chairman all stood in silence for a minute to their memory. The Report had been circulated to members, and with the 1993 A.G.M. attendance figure corrected to 80, the adoption of the Report was proposed by Miss E. Young, seconded by Mrs M. Lindop and accepted unanimously.

HON. TREASURER'S REPORT AND ACCOUNTS

Mr M. Walpole, Hon. Treasurer, taking members through the Accounts, invited queries. There being none, the adoption of his Report and the Accounts was proposed by Mr D. A. Pearman, seconded by Mr R. G. Ellis and accepted unanimously.

ELECTION OF PRESIDENT-ELECT

The President stated that it was a pleasant duty to propose Council's nomination of Mr. D. A. Pearman, who had worked with dedication on the Society's projects during the past years. The nomination was endorsed by the meeting, and Mr Pearman was elected with applause.

RE-ELECTION OF HON. GENERAL SECRETARY AND HON. TREASURER

Proposing the re-election of these Officers from the Chair, the President thanked Mrs M. Briggs for ensuring that the administration of the Society synchronised as clockwork, and Mr M. Walpole for competent management of our finances which had ensured our peace of mind. Dr Perring commented that he could not have managed this year without these officers, and they were re-elected with applause and a presentation.

ELECTION OF COUNCIL MEMBERS

In accordance with Rule 11 nominations had been received for Mrs M. Lindop, Professor C. A. Stace and Mr R. M. Walls. Profiles had been published, and these members were elected unanimously by the meeting.

ELECTION OF HONORARY MEMBERS

Council had nominated three members: proposing Dr D. E. Allen, Professor W. T. Stearn highly commended him for his scholarly publications, including *The Botanists – A history of the Botanical Society of the British Isles through 150 years*.

Proposing Dr R. J. Gornall, Dr J. R. Akeroyd, in writing, referred to him as a past Honorary Receiving Editor of *Watsonia*, who had enhanced the quality and prestige of the Society's journal, and now, as a teacher and researcher at the University of Leicester, was furthering our traditional links with the wider taxonomic community.

Proposing Mr D. McClintock, Mr R. S. R. Fitter described him as a major player on the botanical scene since the 1950s when the *Pocket guide to wild flowers*, McClintock & Fitter, 1956, was the first in the series of modern field guides to wild flowers in Britain.

The elections of Dr D. E. Allen, Dr R. J. Gornall and Mr D. McClintock were unanimous, and with applause.

RE-ELECTION OF HONORARY AUDITORS

The Hon. Treasurer, proposing the re-election of Grant Thornton, West Walk, Leicester, reported that they were willing to continue as Hon. Auditors. Their re-election was seconded by Mrs J. Robertson and passed unanimously with appreciation and applause.

ANY OTHER BUSINESS

The President thanked all the Secretaries and Editors who had contributed to the projects and activities of the Society during the year, particularly mentioning Mrs E. Wiltshire, Hon. Field Secretary and all the Regional Secretaries who had together produced an excellent programme of field meetings in all parts of the British Isles. Also he thanked Mr C. D. Preston, retiring member of Council not eligible for immediate re-election, for his considerable and constructive help with recording projects and liaison for these.

Finally, on behalf of all present, the President thanked Dr Q. C. B. Cronk, local organiser for this Annual General Meeting in Oxford and his team of helpers, for the excellent arrangements and interesting programme provided for the weekend.

There being no other business, the meeting closed at 12.22 p.m.

MARY BRIGGS

INSTRUCTIONS TO CONTRIBUTORS

Scope. Authors are invited to submit Papers and Notes concerning British and Irish vascular plants, their taxonomy, biosystematics, ecology, distribution and conservation, as well as topics of a more general or historical nature.

Manuscripts must be submitted *in duplicate*, typewritten on one side of the paper, with wide margins and double-spaced throughout.

Format should follow that used in recent issues of *Watsonia*. Underline where italics are required. Names of periodicals should be given in full, and herbaria abbreviated as in *British and Irish herbaria* (Kent & Allen 1984). The Latin names and English names of plants should follow the *New Flora of the British Isles* (Stace 1991). Further details on format can be obtained from the Hon. Receiving Editor.

Tables, figure legends & appendices should be typed on separate sheets and attached at the end of the manuscript.

Figures should be drawn in black ink and identified in pencil on the back with their number and the author's name. They should be drawn no more than three times final size, bearing in mind they will normally be reduced to occupy the full width of a page. Scale-bars are essential on plant illustrations and maps. Lettering should be done with transfers or high-quality stencilling, although graph axes and other more extensive labelling are best done in pencil and left to the printer. Black and white photographs can be accepted if they assist in the understanding of the article.

Contributors are advised to consult the editors before submission in cases of doubt. Twenty-five offprints are given free to authors of Papers and Notes; further copies may be purchased in multiples of 25 at the current price. The Society takes no responsibility for the views expressed by authors of Papers, Notes, Book Reviews or Obituaries.

Submission of manuscripts

Papers and Notes: Dr B. S. Rushton, School of Applied Biological and Chemical Sciences, University of Ulster, Coleraine, Co. Londonderry, N. Ireland, BT52 1SA.

Books for Review: C. D. Preston, Biological Records Centre, Monks Wood Experimental Station, Abbots Ripton, Huntingdon, PE17 2LS.

Plant Records: the appropriate vice-county recorder, who should then send them to C. D. Preston, Biological Records Centre, Monks Wood Experimental Station, Abbots Ripton. Huntingdon, PE17 2LS.

Obituaries: Dr J. R. Akeroyd, Lawn Cottage, Fonthill Gifford, Tisbury, Wiltshire, SP3 6SG.

Back issues of Watsonia are handled by Dawson UK Limited, Cannon House, Folkestone, Kent, CT19 5EE to whom orders for all issues prior to Volume 20 part 1 should be sent.

Recent issues (Vol. 20 part 1 onwards) are available from the Hon. Treasurer of the B.S.B.I., 68 Outwoods Road, Loughborough, Leicestershire, LE11 3LY.

Watsonia

February 1995 Volume twenty Part three

Contents

Published by the Botanical Society of the British Isles

UK ISSN 0043-1532

Filmset by
WILMASET LTD, BIRKENHEAD, MERSEYSIDE
Printed in Great Britain by
EATON PRESS LIMITED, WESTFIELD ROAD, WALLASEY, MERSEYSIDE

WATSONIA

Journal of the Botanical Society
of the British Isles

Volume 20 Part 4 August 1995

Editors: J. R. Akeroyd, J. R. Edmondson,
R. R. Mill, E. C. Nelson, C. D. Preston,
B. S. Rushton

ISSN: 0043-1532

Botanical Society of the British Isles

Patron: Her Majesty Queen Elizabeth the Queen Mother

Applications for membership should be addressed to the Hon. General Secretary, c/o Department of Botany, The Natural History Museum, Cromwell Road, London, SW7 5BD, from whom copies of the Society's Prospectus may be obtained.

Officers for 1995-96

President, Mr D. A. Pearman

Vice-Presidents, Mr A. O. Chater, Mr. R. G. Ellis, Mr C. D. Preston

Honorary General Secretary, Mrs M. Briggs

Honorary Treasurer, Mr M. Walpole

Editors of *Watsonia*

Papers and Notes, J. R. Edmondson, R. R. Mill, E. C. Nelson, B. S. Rushton*

Plant Records, C. D. Preston

Book Reviews, C. D. Preston

Obituaries, J. R. Akeroyd

*Receiving editor, to whom all MSS should be sent (see inside back cover).

DNA fingerprinting and biometry can solve some taxonomic problems in apomictic blackberries (*Rubus* subgen. *Rubus*)

T. KRAFT

Department of Systematic Botany, University of Lund, Östra Vallgatan 18, S-223 61 Lund, Sweden

and

H. NYBOM*

Balsgård-Department of Horticultural Plant Breeding, Swedish University of Agricultural Sciences, Fjälkestadsvägen 123-1, S-291 94 Kristianstad, Sweden

ABSTRACT

The feasibility of using DNA fingerprinting and biometry in apomictic blackberries (*Rubus* subgen. *Rubus*) was investigated on five sets of material, chosen to represent various taxonomic problems: 1. Four similar but according to biometrical results distinct species were compared: the Swedish *R. pseudopallidus* and *R. hartmanii*, and the German *R. fuscus* and *R. pallidus*. Surprisingly, *R. hartmanii* and *R. fuscus* exhibited identical DNA fingerprints, whereas the other taxa in this group could be clearly distinguished; 2. *R. insularis* and *R. septentrionalis*, both from Sweden, were rather similar but still well separated by each of the two methods; 3. Samples of *R. infestus* from Sweden and Germany were almost identical with DNA fingerprinting and did not differ appreciably with biometry; 4. Samples of *R. polyanthemus* from Sweden and Germany were completely identical with DNA fingerprinting and deviated only slightly with biometry; and 5. *R. scheutzii* from Sweden and *R. muenteri* from Germany could not be separated with either method.

Keywords: Taxonomy, microspecies, apomixis, DNA analysis, M13 probe, (AC)/(TG) probe, Rosaceae.

INTRODUCTION

Taxonomists have for a long time struggled with the notorious blackberries, *Rubus* subgen. *Rubus* (Rosaceae). These perennial, bushy plants are characterized by vigorous vegetative reproduction, either through root suckering or through tip rooting. Thus a genetically homogeneous clone, consisting of several ramets, may spread over a substantial area. The taxonomic problems are, however, caused primarily by the system for seed reproduction. Most species in this group are polyploid and pseudogamous, i.e. the egg cell is not fertilized but pollination is still necessary to trigger embryo development. The few existing diploid species instead appear to be sexual (Gustafsson 1930). Crossing experiments between polyploid species have demonstrated that apomixis is not complete since at least a minor proportion of the resulting offspring carry some paternal traits and thus emanate from sexual seed set (Lidforss 1905; Nybom 1988). Moreover, many of these interspecific hybrids in their turn appear to have reverted to sexuality (Lidforss 1905; Nybom 1995).

In Europe, Sudre (1908–1913) recognized over 100 blackberry species, many of which were split into units of lower rank. The fact that his index contains more than 3000 names is, however, also caused by a vast number of synonyms. At the beginning of this century, a considerable number of botanists – often non-professionals – were occupied with *Rubus* taxonomy but activity eventually dwindled. A new boost was delivered by the work of Weber (1972) on the *Rubus*-flora in northern Germany and the Nordic countries, and a comprehensive treatise of the British brambles published

* Corresponding author.

by Edees & Newton (1988). In a later study, Weber (1985) arranged the *Rubus* taxa into four different taxonomic categories: 1. widespread species with a distribution of more than 500 km in diameter; 2. regional species with a distribution of 20–250 km in diameter; 3. local species with a distribution of less than 20 km in diameter; and 4. individual species consisting of a few vegetatively derived plants. Only the first two categories were thought to merit taxonomic interest.

Phenotypic variation in *Rubus* is to a large extent associated with environmental factors, thus rendering identification of isolated populations very difficult. At the end of the last century, several Swedish *Rubus* species with a restricted distribution were described as new species. Later, many of these were lumped with previously described species, often of British or German origin. In some cases, this led to a rather intense debate among *Rubus* taxonomists.

Rubus taxonomy has always emphasized morphological characters, and the different species have been defined as morphologically uniform groups of plants. Often a major part of the taxonomic work has been based on subjective evaluation of dried herbarium specimens. In other apomictic genera, morphological data have sometimes been subjected to more sophisticated biometrical treatments, e.g. in *Crataegus* (Dickinson & Phipps 1985; Dickinson 1986). Also allozyme electrophoresis has yielded valuable results in apomicts, e.g. in *Antennaria* (Bayer 1989) and *Taraxacum* (Van Oostrum *et al.* 1985). Recently, the very sensitive method of DNA fingerprinting has provided an efficient means to identify genotypes and to separate clones in, for example, *Taraxacum* (Van Heusden *et al.* 1991) and *Rubus* (Nybom & Schaal 1990; Antonius & Nybom 1994). To what extent DNA fingerprinting could be considered a generally useful tool for taxonomy in apomicts is, however, not yet investigated. In this study we therefore attempt to solve some taxonomic problems in *Rubus* subgen. *Rubus* using two different approaches: DNA fingerprinting and biometry.

1. *R. pseudopallidus* (C. E. Gustafsson) Å. Gustafsson is a species endemic to a restricted area on the Swedish east coast. When first described, suggestions were made that this could be a subspecies of *R. hartmanii* Gandoger (Lund 1877), which also occurs on the Swedish east coast and, very rarely, in Great Britain (Edees & Newton 1988). Areschoug (1886), however, treated it as identical to *R. pallidus* Weihe, whereas several other botanists regarded it as *R. fuscus* Weihe & Nees (Hylander 1941; Oredsson 1970; Weber 1972). Both *R. pallidus* and *R. fuscus* are widespread in N.W. Europe but do not otherwise occur in Sweden (Weber 1972). Thus, does *R. pseudopallidus* merit species rank, or should it be synonymized with any one of *R. fuscus*, *R. pallidus* or *R. hartmanii*?

2. *R. septentrionalis* Watson occurs in a very restricted area on the Swedish west coast, in southern Norway, in northern Denmark and in Great Britain (Weber 1984; Edees & Newton 1988). Sometimes this taxon has been considered a subspecies of *R. insularis* F. Aresch. (Areschoug 1886; Weber 1972). This latter species occurs in the southernmost part of Sweden, in Denmark and in the eastern parts of Germany (Pederson & Schou 1989). Therefore, should *R. septentrionalis* and *R. insularis* be treated as separate species?

3. The endemic species *R. taeniarum* Lindeberg has been described from a restricted area on the Swedish west coast (Lindeberg 1858). However, it was soon afterwards synonymized with *R. infestus* Weihe & Nees (Focke 1877), a species which occurs in Great Britain, Germany and Denmark (Weber 1972; Edees & Newton 1988). Should *R. taeniarum* and *R. infestus* be treated as separate species?

4. *R. polyanthemus* Lindeberg was first described from Sweden where it occurs in a very restricted area on the southwestern coast (Lindeberg 1883). Since then, it has also been reported from Ireland, Great Britain, Denmark and Germany (Weber 1985; Pedersen & Schou 1989). Can the Swedish and German populations of *R. polyanthemus* be treated as conspecific?

5. It has been suggested that *R. scheutzii* Lindeberg, endemic to the Swedish east coast, is identical to *R. muenteri* Marsson, a species that only occurs in Germany (Areschoug 1886; Weber 1985). Are *R. scheutzii* and *R. muenteri* separate species?

MATERIALS AND METHODS

Nomenclature is according to Weber (1972), except in two cases: the Swedish *Rubus* population which Weber regarded as *R. fuscus* in 1972, is here called *R. pseudopallidus* (as suggested by Weber, pers. comm., 1992); and *R. insularis* subsp. *confinis* in Weber (1972) is here called *R. septentrionalis* in accordance with Weber (1984).

DNA FINGERPRINTING

Recently hypervariable regions of genomic DNA have been detected, which can be used to yield genotype-specific 'DNA fingerprints' in various organisms (Jeffreys *et al.* 1985; Nybom 1991, 1993). This so called minisatellite-DNA consists of a number of tandem repeats of a core sequence with c. 10–60 base pairs. Restriction enzymes will usually cut the DNA at either end of a series of tandem repeats. The length of the resulting DNA-fragment is therefore proportional to the number of repeats. Hybridization of sample DNA to a minisatellite DNA probe allows us to analyze a considerable number of such DNA fragments simultaneously.

Fresh *Rubus* leaves were collected in Sweden and Germany (Table 1, Fig. 1). Plants were considered from different localities if collected at least 1 km apart. Voucher specimens are deposited at **LD**. Determinations of the German plants have been verified by Prof. Dr Dr H. E. Weber.

DNA was extracted from fresh or frozen leaf material and subsequently digested with the restriction enzyme *Hae*III. The resulting DNA fragments were size-separated by electrophoresis in an agarose gel, denatured and transferred to a nylon filter by Southern blotting. These nylon filters were hybridized to a ^{32}P-labelled minisatellite DNA probe derived from the M13 bacteriophage (Vassart *et al.* 1987). Autoradiography was carried out for 2–12 days at −80°C with intensifying screens. Residual probe was stripped off and filters rehybridized, this time to a synthetic (AC)/(TG)

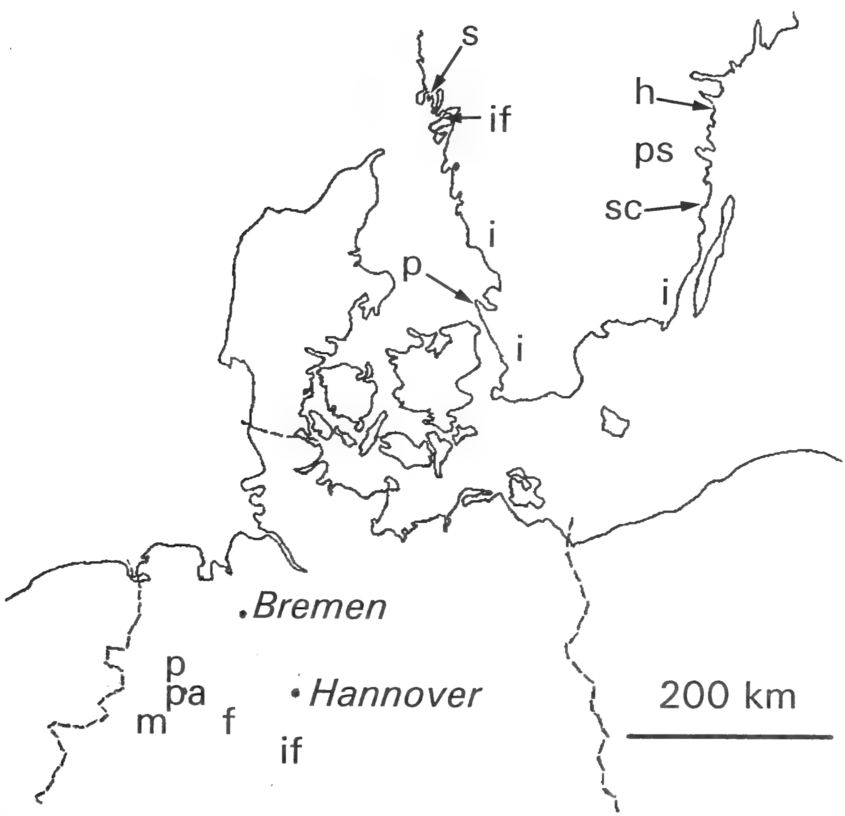


FIGURE 1. Map of southern Sweden, Denmark and northern Germany showing where material of *Rubus* spp. was collected for the DNA fingerprinting. f = *R. fuscus*, h = *R. hartmanii*, i = *R. insularis*, if = *R. infestus*, m = *R. muenteri*, p = *R. polyanthemus*, pa = *R. pallidus*, ps = *R. pseudopallidus*, s = *R. septentrionalis*, sc = *R. scheutzii*. Some letters represent several closely situated localities.

TABLE 1. ORIGINS OF THE *RUBUS* MATERIAL USED FOR DNA FINGERPRINTING AND THE DISTANCE BETWEEN THE TWO MOST DISTANT LOCALITIES

	Sweden			Germany		
Species	Number of localities	Number of shrubs	Maximum distance (km)	Number of localities	Number of shrubs	Maximum distance (km)
R. fuscus	0	0	–	1	1	–
R. hartmanii	7	8	7	0	0	–
R. infestus	4	11	21	1	2	–
R. insularis	5	6	180	0	0	–
R. muenteri	0	0	–	2	3	7
R. pallidus	0	0	–	1	1	–
R. polyanthemus	2	2	2	1	1	–
R. pseudopallidus	4	6	5	0	0	–
R. scheutzii	6	10	20	0	0	–
R. septentrionalis	2	4	7	0	0	–

polydinucleotide (Lönn *et al.* 1992). For a more detailed description of DNA isolation and hybridization with the M13 probe, see Nybom & Schaal (1990). Labelling and hybridization with the (AC)/(TG) probe was performed in the same way as with the M13 probe except that the final washes were in 0.2× SSC instead of 2×.

DNA fragment patterns were scored manually for presence or absence of individual bands. A bandsharing value was calculated for each pairwise comparison between two different plants: D = 2 × number of shared fragments/(number of fragments in plant A + number of fragments in plant B). For a more detailed description of DNA fingerprint evaluation, see Nybom & Rogstad (1990).

BIOMETRY

We have chosen morphological characters for the biometrical investigation according to two criteria: they should be easy to measure on dried material as well as considered generally useful for species identification within *Rubus*. Distribution of prickles on the stem and in the inflorescence is an important character. Some species have prickles of more or less even size, whereas others have a characteristic mixture of both large and small prickles. Thus we noted the frequency of prickles occurring in three different length-classes. Lengths of the petiolules and the shape of the terminal leaflet of the three-, five-, or seven-foliated leaves are often employed to separate species. Number of glands and hairs on the stem and in the inflorescence are also commonly used characters. For the present investigation we ultimately decided on the following measurements: length/width ratio of the terminal leaflet (A/B, Fig. 2); lengths of leaf petiolules (C,D,E, Fig. 2); distance from petiolule base of the middle leaflets (leaf centre) to the point of attachment for the lower leaflet petiolule (F, Fig. 2); length of petiole (G, Fig. 2); number and size distribution of prickles on 5 cm of the stem; number of hairs on 1 cm of the stem; distance from inflorescence apex down to the base of the uppermost inflorescence leaf; number of prickles and glands on the pedicel; number of hairs on the pistils; and number of hairs on the anthers.

Measurements were taken on herbarium specimens in **LD** (Table 2, Fig. 3). The herbarium sheets have been marked with 'TK' and a number from 1 to 212. For each species–country combination we selected 20 specimens that were as complete as possible. We also used plants from our own collections as well as some herbarium specimens in **C** of *R. muenteri* and *R. polyanthemus* from Germany. Still, only five specimens of each of these two species–country combinations were available.

All comparisons were performed between plants of similar stem diameter to correct for variation caused by differences in plant vigour. F-tests were calculated, for each character separately, to determine the level of variation between taxa as compared to within. Multivariate F-tests, including all of the above-mentioned characters, were also performed utilizing the Hotelling-Lawley trace statistic (Morrison 1976). All calculations were performed with SYSTAT for Windows (1992). When necessary, logarithmic transformations were used to adjust for inequality of variances.

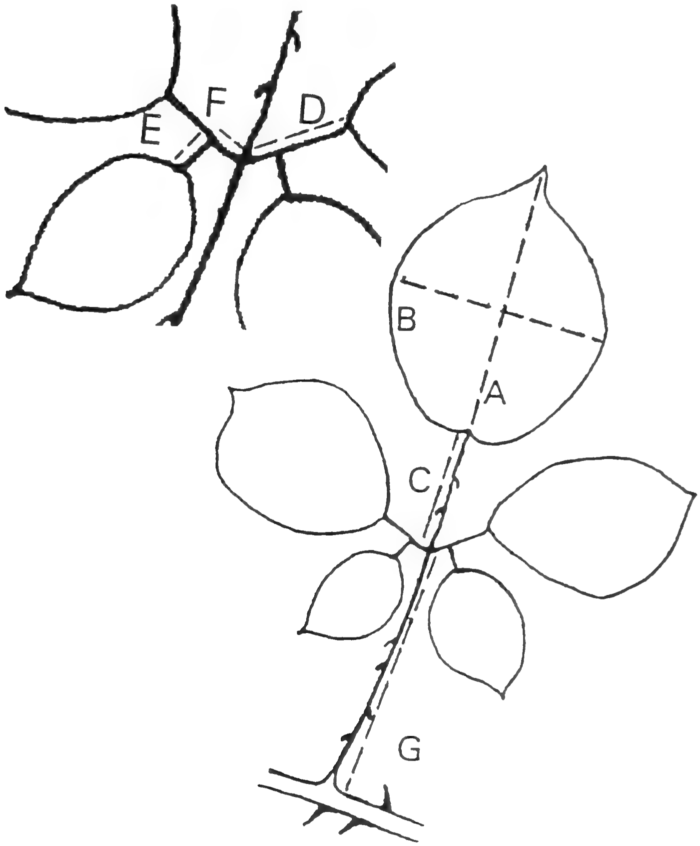


FIGURE 2. Leaf of blackberry (*Rubus* sp.) and enlarged portion of the centre of the leaf with some of the characters used for the biometrical analysis: length/width-ratio of the terminal leaflet (A/B); length of the petiolule of the terminal leaflet (C), middle leaflet (D) and lower leaflet (E); distance from petiolule base of the middle leaflets (leaf centre) to the point of attachment for the lower leaflet petiolules (F), and length of the petiole (G).

TABLE 2. ORIGINS OF THE *RUBUS* MATERIAL USED FOR BIOMETRY AND THE DISTANCE BETWEEN THE TWO MOST DISTANT LOCALITIES

	Sweden			Germany		
Species	Number of localities	Number of shrubs	Maximum distance (km)	Number of localities	Number of shrubs	Maximum distance (km)
R. fuscus	0	0	–	5	17	190
R. hartmanii	10	20	20	0	0	–
R. infestus	13	30	30	5	20	160
R. insularis	12	21	180	0	0	–
R. muenteri	0	0	–	4	5	380
R. pallidus	0	0	–	12	15	150
R. polyanthemus	2	20	5	3	5	300
R. pseudopallidus	5	19	10	0	0	–
R. scheutzii	6	20	25	0	0	–
R. septentrionalis	6	20	5	0	0	–

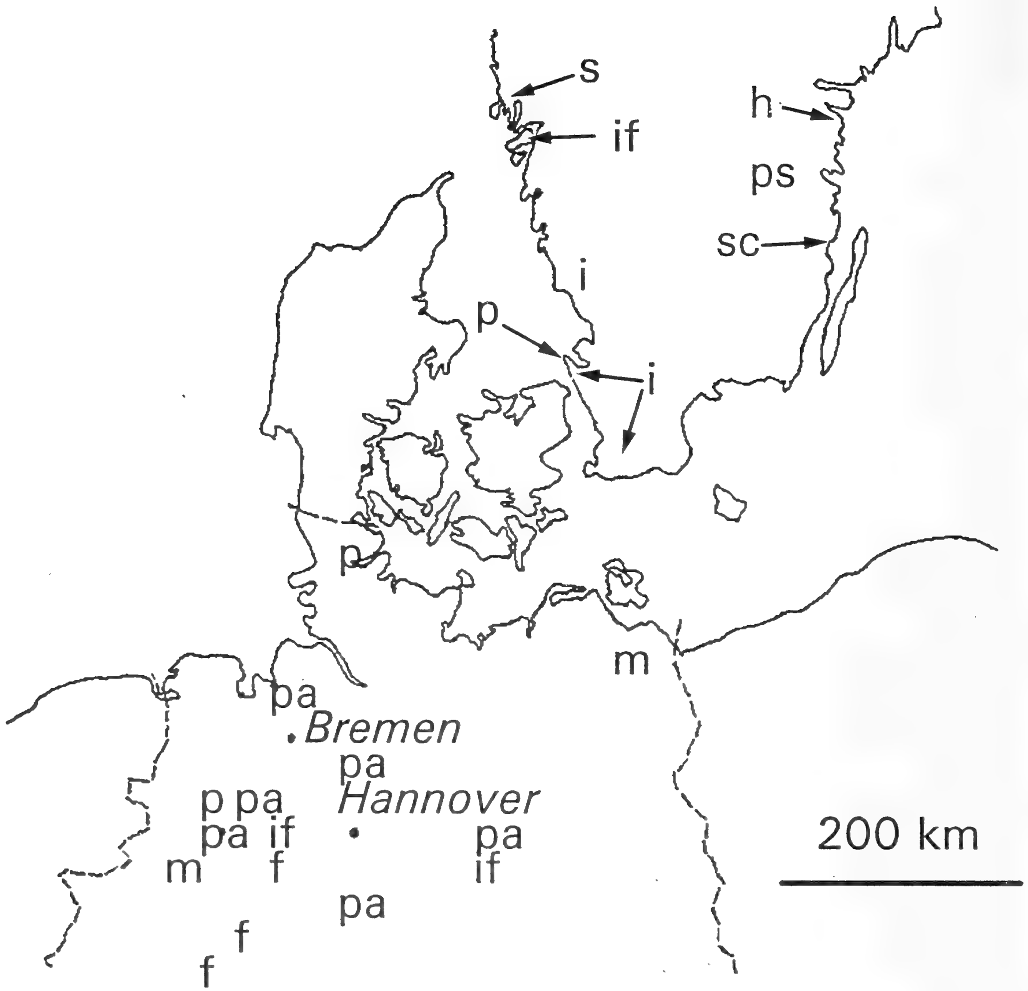


FIGURE 3. Map of southern Sweden, Denmark and northern Germany showing where material of *Rubus* spp. was collected for the biometrical analysis, f = *R. fuscus*, h = *R. hartmanii*, i = *R. insularis*, if = *R. infestus*, m = *R. muenteri*, p = *R. polyanthemus*, pa = *R. pallidus*, ps = *R. pseudopallidus*, s = *R. septentrionalis*, sc = *R. scheutzii*. Some letters represent several closely situated localities.

RESULTS

R. PSEUDOPALLIDUS

Does *R. pseudopallidus* merit species rank, or should it be synonymized with any one of *R. fuscus*, *R. pallidus* or *R. hartmanii*? Quite surprisingly, the German *R. fuscus* and the Swedish *R. hartmanii* exhibited identical DNA fingerprints with both DNA probes (Table 3, Fig. 4). Barring minor mutations, which do not manifest themselves in DNA fingerprinting, these two species appear to have essentially the same genotype. By contrast, the DNA fingerprint of *R. pallidus* differed considerably from those of *R. pseudopallidus* and *R. fuscus/R. hartmanii*. *R. pseudopallidus* was more similar to *R. fuscus/R. hartmanii* than to *R. pallidus* (Table 3). Nine fragments could be scored with the M13 probe in *R. fuscus/R. hartmanii*, eight in *R. pseudopallidus* and seven in *R. pallidus*. With the (AC)/(TG)-probe 13 fragments could be scored in *R. fuscus/R. hartmanii*, 15 in *R. pseudopallidus* and eleven in *R. pallidus*. Intraspecific variation was not encountered.

A multivariate F-test on the biometrical data showed a significant difference between *R.*

TABLE 3. AMOUNT OF BANDSHARING (D-VALUES) AS OBTAINED IN DNA FINGERPRINTING, FOR PAIRWISE COMPARISONS AMONG *RUBUS* SPP.

Results from hybridization with the (AC)/(TG) probe in the upper right half, and from hybridization with the M13 probe in the lower left half.

Species	*R. pseudopallidus*	*R. fuscus*	*R. hartmanii*	*R. pallidus*
R. pseudopallidus	–	0·79	0·79	0·54
R. fuscus	0·82	–	1·00	0·67
R. hartmanii	0·82	1·00	–	0·67
R. pallidus	0·53	0·62	0·62	–

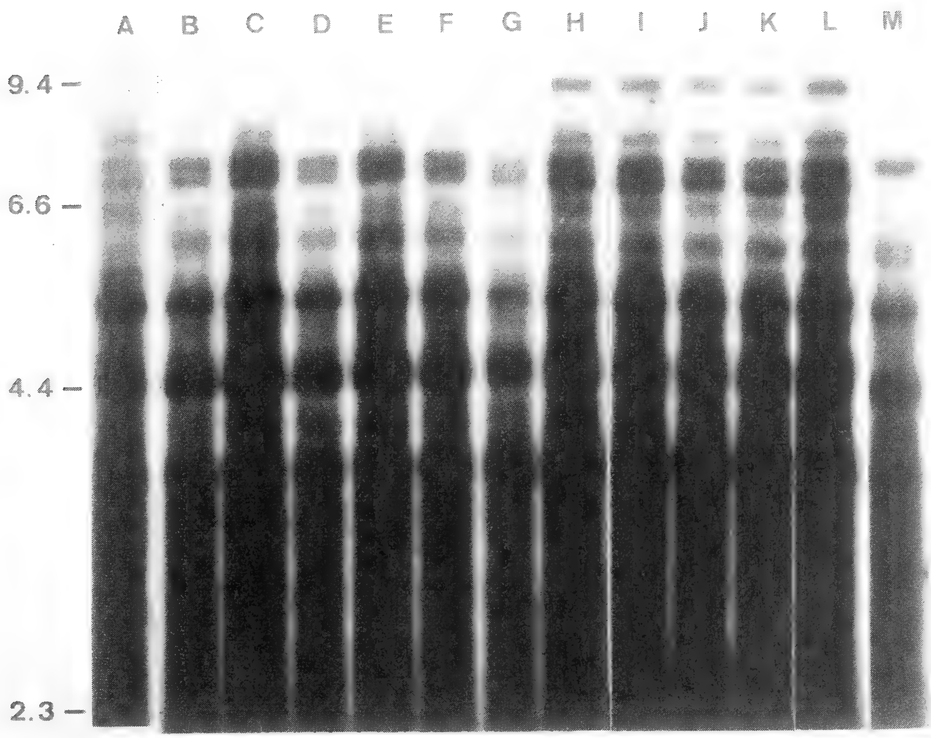


FIGURE 4. DNA samples from leaves of *Rubus fuscus* (A), *R. pseudopallidus* (B–F), *R. hartmanii* (G–L) and *R. pallidus* (M) digested with *Hae*III and hybridized with the M13 probe. Size markers (kb) were obtained by digestion of λ DNA with *Hin*dIII.

pseudopallidus and *R. fuscus* ($F=3{\cdot}25$, $p=0{\cdot}007$), between *R. pseudopallidus* and *R. hartmanii* ($F=6{\cdot}98$, $p<0{\cdot}001$), and between *R. pseudopallidus* and *R. pallidus* ($F=9{\cdot}46$, $p<0{\cdot}001$). Single-variate F-tests for the same interspecific comparisons showed significant variation ($p<0{\cdot}05$) for five, six and seven characters, respectively (Table 4). There was a significant difference with the multivariate F-test also between *R. fuscus* and *R. hartmanii* ($F=7{\cdot}28$, $p=<0{\cdot}001$), whereas six characters differed significantly with the single-variate F-tests. *R. fuscus* was also well separated from *R. pallidus* with the multivariate F-test ($F=6{\cdot}93$, $p<0{\cdot}001$), and yielded significant differences in six characters with the single-variate F-tests. The last pair of species to compare in this group, *R. hartmanii* and *R. pallidus*, differed considerably both with the multivariate F-test ($F=25{\cdot}77$, $p<0{\cdot}001$) and with the single-variate F-tests, yielding seven significantly different characters.

TABLE 4. BIOMETRICAL CHARACTERS OF *RUBUS* WHICH SHOWED A SIGNIFICANT VARIATION (P<0·05) WHEN SPECIES WERE COMPARED TO EACH OTHER

Variable	Species					
	fus-pse	*har-pse*	*pal-pse*	*har-fus*	*pal-fus*	*har-pal*
Length of the terminal petiolule	–	–	–	+	0	+
Length of the middle petiolule	0	0	0	+	0	0
Length of the lower petiolule	0	0	0	+	–	0
Length of the petiole	–	0	–	+	0	+
Length/width ratio of the terminal leaflet	0	–	+	0	+	–
Placement of the lower leaflets on the petiolules of the middle leaflets	0	+	0	+	0	+
No. of prickles <1·5 mm	+	+	+	0	+	–
No. of prickles 1·5–3 mm	+	+	+	0	+	0
No. of prickles >3 mm	–	0	0	+	–	+
Distance from inflorescence apex to base of the uppermost leaf in the inflorescence	0	+	+	0	0	–
No. of prickles on the pedicel	0	0	0	0	+	0
No. of hairs on pistils	0	0	–	0	0	0

+ denotes a significantly higher value for the first species, – denotes a significantly lower value for the first species, and 0 no significant difference. Species: *fus, R. fuscus; pse, R. pseudopallidus; har, R. hartmanii; pal, R. pallidus*.

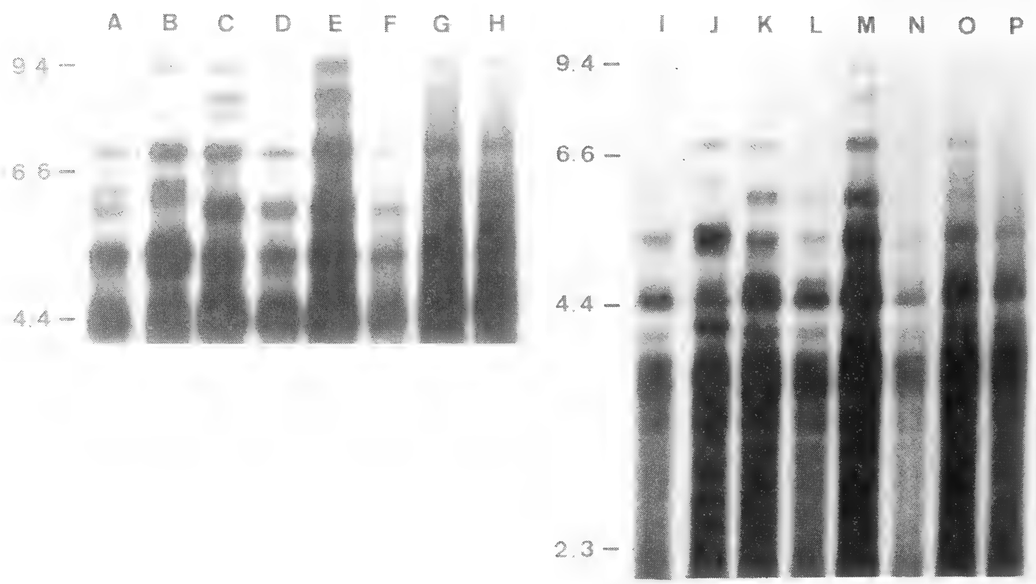


FIGURE 5. DNA samples from leaves of *Rubus insularis* (A, B, G–J, O, P) and *R. septentrionalis* (C–F, K–N) digested with *Hae*III and hybridized with the M13 probe. I–P are identical to A–H except for a different exposure time, A, G–I, O and P represent a genotype, '*R. insularis* II', which differs somewhat from the standard genotype, '*R. insularis* I'. Size markers (kb) were obtained by digestion of λ DNA with *Hin*dIII.

R. SEPTENTRIONALIS

Should *R. septentrionalis* and *R. insularis* be treated as separate species? Hybridization with the M13 probe demonstrated the existence of two similar but not identical genotypes of *R. insularis* in our material, '*R. insularis* I' and '*R. insularis* II', differing in two bands (Fig. 5). A comparison of these two genotypes resulted in a D-value of 0·89. The (AC)/(TG) probe, on the other hand, yielded no intraspecific variation. '*R. insularis* I' comprises all plants from Scania in southernmost Sweden and from the Swedish east coast, whereas '*R. insularis* II' comprises material from two close localities on the Swedish west coast. Intraspecific DNA variation was not encountered in *R. septentrionalis*. This species was, however, quite different from *R. insularis*, with a D-value of 0·56 with the M13 probe for comparisons to both '*R. insularis* I' and '*R. insularis* II', and 0·73 with the (AC)/(TG) probe. All genotypes investigated had nine fragments that could be scored with the M13 probe. With the (AC)/(TG) probe 17 fragments could be scored in *R. insularis* and 16 in *R. septentrionalis*.

The multivariate F-test showed a significant difference between *R. insularis* and *R. septentrionalis* ($F=9{\cdot}30$, $p<0{\cdot}001$). According to the single-variate F-tests, three characters showed significant ($p<0{\cdot}05$) variation between taxa: *R. insularis* had fewer prickles in two of the length classes, namely <4 mm and 4–6 mm and the lower leaflets were attached further up on the petiolules of the middle leaflets.

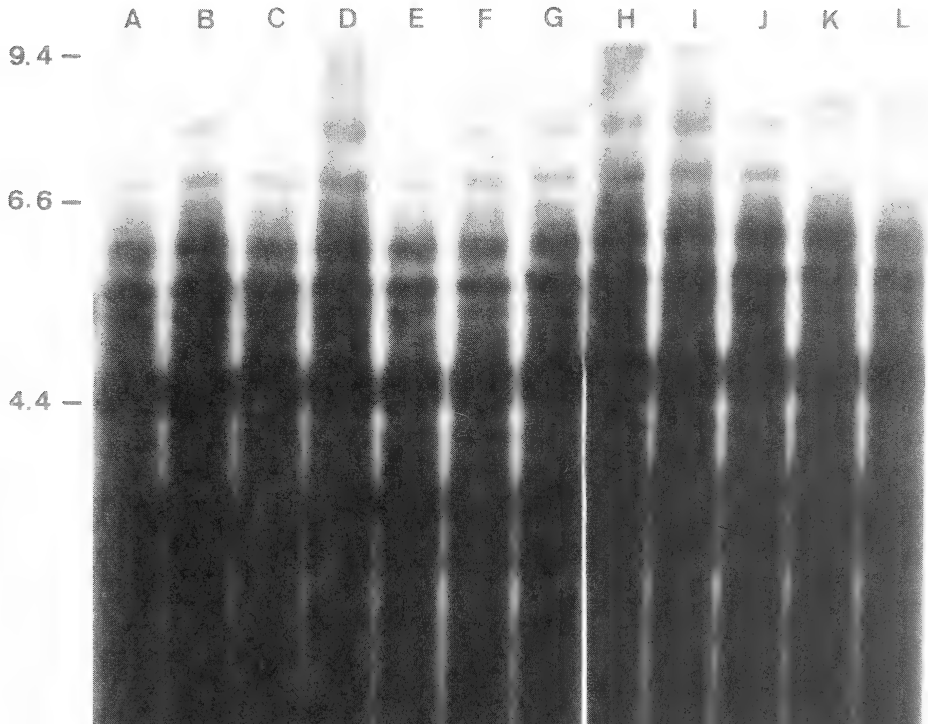


FIGURE 6. DNA samples from leaves of *Rubus infestus* from Sweden (A–J) and Germany (K–L) digested with *Hae*III and hybridized with the M13 probe. Size markers (kb) were obtained by digestion of λ DNA with *Hin*dIII.

R. INFESTUS

Should *R. taeniarum* and *R. infestus* be treated as separate species? Both DNA fingerprinting probes showed the Swedish collections of *R. taeniarum* to be homogeneous as were also the German collections of *R. infestus* (Fig. 6). Moreover, comparison of (AC)/(TG)-hybridized samples from the two countries yielded identical DNA fingerprints. Somewhat different fragment profiles were, however, obtained after M13 hybridization resulting in a D-value of 0·90, which indicates that genotypes differ somewhat between the two countries. Ten fragments could be scored in both sets of material with the M13 probe and 16 with the (AC)/(TG) probe.

The multivariate F-test showed a barely significant difference between the Swedish and the German material ($F=2{\cdot}71$, $p=0{\cdot}038$). Only one character showed significant ($p<0{\cdot}05$) variation with the single variate F-test: the petiolules of the middle leaflets were longer on the German material.

R. POLYANTHEMUS

Should the Swedish and the German populations of *R. polyanthemus* be treated as conspecific? German and Swedish populations of *R. polyanthemus* had identical DNA-fingerprints with both probes (Fig. 7). Nine fragments could be scored with the M13 probe and 18 with the (AC)/(TG) probe.

By contrast, the biometrical data showed a significant difference between the two sets of material with the multivariate F-test ($F=5{\cdot}29$, $p=0{\cdot}005$). According to the single-variate F-tests, three characters showed significant ($p<0{\cdot}05$) variation between Swedish and German plants: the petiolules of the lower and middle leaflets were significantly longer on the German plants and the lower leaflets were attached further up on the petiolules of the middle leaflets.

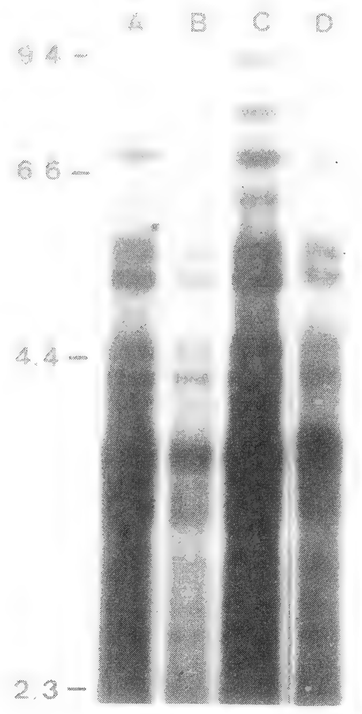


FIGURE 7. DNA samples from leaves of *Rubus polyanthemus* from Germany (A, D) and Sweden (B, C) digested with *Hae*III and hybridized with the M13 probe. Size markers (kb) were obtained by digestion of λ DNA with *Hin*dIII.

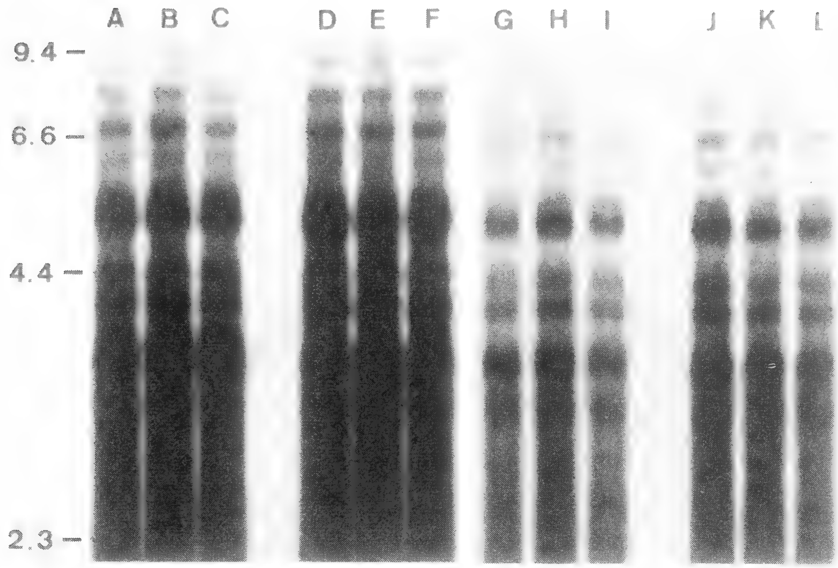


FIGURE 8. DNA samples from leaves of *Rubus scheutzii* (A–C, G–I) and *R. muenteri* (D–F, J–L) digested with *Hae*III and hybridized with the M13 probe. G–L are identical to A–F except for a different exposure time. Size markers (kb) were obtained by digestion of λ DNA with *Hin*dIII.

R. SCHEUTZII

Should *R. scheutzii* and *R. muenteri* be treated as separate species? *R. muenteri* and *R. scheutzii* had identical DNA fingerprints with both probes (Fig. 8). Nine fragments could be scored with the M13 probe and 15 with the (AC)/(TG) probe.

The biometrical data did not show any significant difference between *R. muenteri* and *R. scheutzii*, neither with multivariate (F=1·019, p=0·481) nor with single-variate F-tests.

DISCUSSION

R. PSEUDOPALLIDUS

In 1877 Lund described a new blackberry species from the Swedish east coast, *R. mitigatus*. However, he suggested even then that it could perhaps more appropriately be treated as a subspecies of *R. hartmanii*, which occurs about 50 km from the new taxon. According to Lund, *R. mitigatus* deviates from *R. hartmanii* by its thinner leaves that are always green underneath, differently shaped terminal leaflets and inflorescences, and fewer and smaller prickles on the stem. Areschoug (1886) considered the new taxon to be identical to *R. pallidus*, Hylander (1941) regarded it as *R. fuscus*, and in Gustafsson's opinion (1935) it is instead most similar to *R. menkei* Weihe & Nees. *R. pallidus*, *R. fuscus* and *R. menkei* all occur in Germany and/or Denmark. Since the name *R. mitigatus* had already been used for another species, Gustafsson renamed it as *R. menkei* var. *pseudopallidus*. At first Weber (1972) synonymized this taxon with *R. fuscus*, but later changed his mind and now regards it as an endemic species, *R. pseudopallidus* (Weber, pers. comm., 1992).

Surprisingly, *R. hartmanii* has DNA fingerprints identical to *R. fuscus* in spite of a significant biometrical variation between these two species. This discrepancy is probably due to environmentally induced morphological variation, and perhaps also to the occurrence of genetic variation which affects parts of the genome not screened by the DNA fingerprint probes. The inability of DNA fingerprinting to detect somatic mutations has been reported previously in cultivated apple (Nybom 1990). By contrast, genetic recombination between cross-pollinating genotypes results in easily detected fingerprint variation (Nybom 1991). Thus *R. hartmanii* and *R. fuscus* probably deviate from each other in somatic mutations only.

Our study shows that *R. pseudopallidus* can be distinguished from *R. fuscus*/*R. hartmanii* as well as from *R. pallidus* by both DNA fingerprint and biometrical data. However, DNA fingerprint studies in some other *Rubus* species indicate that intraspecific variation is more common in German material than in Swedish (Kraft *et al.*, manuscript submitted). Therefore, it appears necessary to obtain much more data on the variability of *R. fuscus* in Germany before finally defining this species. In the meantime, we believe that *R. hartmanii* and perhaps also *R. pseudopallidus* are best treated as synonyms of *R. fuscus*. *R. pallidus*, on the contrary, appears to be more dissimilar according both to morphology and to DNA fingerprint data, and should for the time being retain its status as a separate species.

R. SEPTENTRIONALIS

In 1883, *R. confinis* Lindeberg was described from Bro on the Swedish west coast but in 1886 it was demoted to a subspecies of *R. insularis* (Areschoug 1886). Watson (1946, 1958) claimed that there are two different species in the vicinity of Bro; *R. septentrionalis*, regarded as identical to *R. confinis*, with a west European distribution and *R. broensis* Watson which also occurs sporadically in England. Weber (1972) at first agreed with Areschoug on *R. insularis* subsp. *confinis* and mentioned both *R. septentrionalis* and *R. broensis* as synonyms of this subspecies. Characteristic for subsp. *confinis* in comparison to subsp. *insularis* is, according to Weber, the smaller stature, increased number of prickles on the stem, more rounded terminal leaflet, narrower inflorescence, white petals and green pistils. *R. broensis* is thought to be only a shade form of subsp. *confinis*. Later Weber (1984) gave *R. septentrionalis* species status, and included the plants from Bro in this species, which also occurs in southern Norway, northern Denmark and Great Britain.

Our study clearly suggests that *R. insularis* and *R. septentrionalis* should be treated as two separate species since they are well distinguished both biometrically and with DNA fingerprinting. Interestingly, *R. insularis* is the only taxon to show intraspecific variation within Sweden with DNA fingerprinting. These differences are, however, quite limited and appeared only after hybridization with the M13 probe. The genotype '*R. insularis* II' was collected from two localities on the Swedish west coast, 13 km apart. These localities are isolated by 160–180 km from the remainder of the Swedish distribution of *R. insularis*.

R. INFESTUS

Lindeberg (1858) described *R. taeniarum* as a new species from central Bohuslän on the Swedish west coast, where it is fairly common in a small area (Oredsson 1974). Both Focke (1877) and Areschoug (1886) instead treated these populations as identical to *R. infestus*, although Lindeberg (1887) never agreed. Thirty years later, Neuman (1915) came to the conclusion that *R. taeniarum* is well separated from *R. infestus*. Gustafsson (1938) also argued that *R. taeniarum* should be regarded as a species. Weber (1972), on the other hand, treated *R. taeniarum* as a synonym of *R. infestus*. Apart from a larger stem diameter in German plants, these were almost identical to the Swedish material in our study, with both biometrical and DNA fingerprint data. It seems likely that the few recorded differences are due only to environmental influences and/or somatic mutations, and therefore we conclude that the Swedish populations should be treated as *R. infestus*.

R. POLYANTHEMUS

R. polyanthemus was described by Lindeberg (1883) from southern Sweden. This species has also been called *R. pulcherrimus* Neuman and *R. neumanii* Focke but these synonyms were due to differing opinions about nomenclature rather than about the taxonomy. The DNA fingerprints were identical for the Swedish and German plants investigated, whereas biometrical data showed some significant differences. We believe that this, still rather restricted, morphological variation can be explained by differences in growing conditions and/or somatic mutations. In either case, the two populations must be very closely related and should be treated as a single species.

R. SCHEUTZII

Lindeberg described *R. scheutzii* as a new species in his exsiccata *Herbarium Ruborum Scandinaviae* in 1885. This species is fairly common in a small area on the Swedish east coast (Oredsson 1974). Areschoug (1886) regarded it as identical to the Central European *R. muenteri*, but Gustafsson (1924) claimed that they are well separated with *R. muenteri* being overall more delicate.

Since we obtained no variation between the two species with biometrical or DNA fingerprint data, there appears to be no reason to separate *R. muenteri* and *R. scheutzii*. This is in agreement with the most recent taxonomic treatments, where the Swedish populations are included under *R. muenteri* (Weber 1985; Pedersen & Schou 1989).

CONCLUSIONS

Blackberry taxonomy is usually based almost exclusively on the subjective evaluation of various morphological characters. Published descriptions have mentioned how species differ or are identical for certain characters without any explanation of the basis for these statements. No serious attempts have been made to investigate the extent to which these characters might be prone to environmentally induced variation. Recently, more objective interpretations of morphological data have proven useful for the separation of species in critical groups like the apomictic *Crataegus* (Dickinson & Phipps 1985). Multivariate statistical methods applied to flowers, fruits and leaves of *Crataegus* sect. *Crus-galli* L. yielded results in close accord with previous classifications. However, comparison of widespread plants, as in the present study, may be greatly confounded by environmental influences on the phenotype. Nevertheless, we chose to work exclusively with dried herbarium specimens in order to determine how valid are these types of data. For future taxonomic work, we strongly recommend that measurements are taken instead on plants grown in a randomized design in an experimental garden to circumvent the problem of phenotypic plasticity. Unfortunately this approach is very time-consuming and expensive.

The recent development of molecular methodology has greatly improved the tools at our disposal. Estimates of genetic variability can nowadays be obtained that are completely independent of where the plants were grown. So far, the most sensitive of these methods in distinguishing different plant genotypes is DNA fingerprinting by hybridization of DNA samples to minisatellite DNA probes (reviews in Nybom 1991, 1993). DNA fragment profiles are individual-specific in cross-pollinated plants, as demonstrated for example in the dioecious North American box elder, *Acer negundo* L. (Nybom & Rogstad 1990). Clones may also be identified and delimited as in North American quaking aspen, *Populus tremuloides* Michx. (Rogstad *et al.* 1991). In population studies of *Rubus*, varying levels of genetic variation have been encountered, which are closely associated with the reproductive system in these species (Nybom & Schaal 1990; Antonius & Nybom 1994).

DNA fingerprinting has also yielded results that appear promising for taxonomic applications in apomictic plant groups. Thus Van Heusden *et al.* (1991) collected plants of several apomictic species of *Taraxacum* from the Netherlands, France and Czechoslovakia. In one species they found the same DNA fingerprint in material from France and Czechoslovakia and only a slight deviation in material from the Netherlands. Another DNA fingerprint was found to be identical in material from three, supposedly different species in the Netherlands. These taxa could be separated on minor morphological characters, possibly due to mutations within a clonal line or by recombination between very closely related genotypes.

In our study, intraspecific DNA variation was extremely low. Complete DNA fingerprint homogeneity in material collected from large parts of the distributional area in Sweden has been encountered also in other blackberry species like *R. nessensis* W. Hall, *R. grabowskii* Weihe ex Günther *et al.* and *R. pedemontanus* Pinkwart (Kraft *et al.* 1995; Kraft *et al.*, manuscript submitted). Apparently, the Swedish populations of each of these species are derived from a single recombinational event. The resulting genotypes have subsequently spread over large areas, presumedly by a combination of vegetative reproduction and dispersal of apomictic seed. In some cases, like *R. hartmanii*/*R. fuscus*, morphological variation occurs in spite of identical DNA fingerprints. Most likely, this variation is caused by environmental influences and/or somatic mutations. A series of studies on some closely occurring stands of *R. nessensis* similarly yielded identical DNA fingerprints in spite of substantial differences in plant demography and flowering phenology (Kraft *et al.*, manuscript submitted). We believe that variability in morphological characters caused by somatic mutations is, in most cases, not prominent and consistent enough to merit species rank for the resulting variants. Plant populations that have identical DNA fingerprints should, therefore, in general be regarded as conspecific. On the other hand, different DNA fingerprints may be encountered within what is commonly accepted as a species. As long as this species is morphologically well defined, we see no practical reason to split it into several taxa.

Biometrical analysis and DNA fingerprinting yielded consistent results in three of our five case studies. In the remaining two cases, taxa with identical DNA fingerprints differed in morphological characters. The additional heterogeneity recorded with biometrical data is probably to a large extent due to environmental influences. Distinct genetic variation is instead more easily detected by DNA fingerprinting, as demonstrated by the two deviating plants of *R. insularis* from the Swedish west coast. However, DNA fingerprinting is relatively expensive and time-consuming and cannot, therefore, be used for large series of material. Ideally, a combination of DNA fingerprinting and biometry should be applied in studies of taxonomic problems in apomictic genera. Such studies would also increase our understanding of the genetic structure and evolution of these intriguing plant groups.

ACKNOWLEDGMENTS

Practical help in the field and the herbarium as well as valuable comments on the manuscript were given by A. Oredsson and H. Weber. Financial support was granted to T. Kraft by Enander's Fund and to H. Nybom from the Swedish Natural Science Research Council.

REFERENCES

Antonius, K. & Nybom, H. (1994). DNA fingerprinting reveals significant amounts of genetic variation in a wild raspberry (*Rubus idaeus*) population. *Molecular ecology* **3**: 177–180.

Areschoug, F. W. C. (1886). Litteraturgenomgång. *Botaniska notiser* **39**: 33–39.

Bayer, R. J. (1989). Patterns of isozyme variation in the *Antennaria rosea* (Asteraceae: Inuleae) polyploid agamic complex. *Systematic botany* **14**: 389–397.

Dickinson, T. A. (1986). Topodeme differentiation in Ontario taxa of *Crataegus*: Leaf morphometric evidence. *Canadian journal of botany* **64**: 2738–2747.

Dickinson, T. A. & Phipps, B. J. (1985). Studies in *Crataegus* L. XIII. Degree and pattern of phenotypic variation in *Crataegus* sect. *Crus-galli* in Ontario. *Systematic botany* **10**: 322–337.

Edees, E. S. & Newton, A. (1988). *Brambles of the British Isles*. The Ray Society, London.

Focke, W. O. (1877). *Synopsis Ruborum Germaniae*. C. Ed. Müllers Verlagsbuchhandlung, Bremen.

Gustafsson, Å. (1930). Kastrierungen und Pseudogamie bei *Rubus*. *Botaniska notiser* **83**: 477–494.

Gustafsson, C. E. (1924). Strödda Rubusanteckningar. *Botaniska notiser* **77**: 251–259.

Gustafsson, C. E. (1935). *Rubus menkei* Wh. & N. *Svensk botanisk tidskrift* **29**: 410–412.

Gustafsson, C. E. (1938). Skandinaviens Rubusflora. *Botaniska notiser* **91**: 378–420.

Hylander, N. (1941). *Förteckning över Skandinaviens växter*, 3rd ed. C. W. K. Gleerups Förlag, Lund.

Jeffreys, A. J., Wilson, V. & Thein, S. L. (1985). Individual-specific 'fingerprints' of human DNA. *Nature* **316**: 76–79.

Kraft, T., Nybom, H. & Werlemark, G. (1995). *Rubus vestervicensis* (Rosaceae) – its hybrid origin revealed by DNA fingerprinting. *Nordic journal of botany*, in press.

Kraft, T., Nybom, H. & Werlemark, G. DNA fingerprint variation in some blackberry species (*Rubus* subgen. *Rubus*). Manuscript submitted.

Lidforss, B. (1905). Studier öfver artbildningen hos slägtet *Rubus*. *Arkiv för botanik* **4(6)**: 1–41.

Lindeberg, C. J. (1858). *Novitae Florae Scandinaviae I*. D. F. Bonnier, Göteborg.

Lindeberg, C. J. (1883). *Herbarium Ruborum Scandinaviae* n. 12. Fasc. 1. Göteborg.

Lindeberg, C. J. (1887). Genmäle. *Botaniska notiser* **40**: 69–78.

Lönn, M., Tegelström, H. & Prentice, H. C. (1992). The synthetic $(TG)_n$ polydinucleotide: a probe for gene flow and paternity studies in wild populations? *Nucleic acids research* **20**: 1153.

Lund, A. A. W. (1877). Om Westervikstraktens björnhallonarter. *Årsberättelse vid Westerviks på reallinien högre elementarläroverk den 8 och 9 juni 1877:* 1–22.

Morrison, D. F. (1976). *Multivariate statistical methods*. McGraw-Hill, New York.

Neuman, L. M. (1915). Är *Rubus taeniarum* Lindeberg identisk med *R. infestus* Weihe, och hvad är F. Areschougs *R. infestus*. *Botaniska notiser* **68**: 85–91.

Nybom, H. (1988). Apomixis versus sexuality in blackberries (*Rubus* subgen. *Rubus*, Rosaceae). *Plant systematics and evolution* **160**: 207–218.

Nybom, H. (1990). DNA fingerprints in sports of 'Red Delicious' apples. *HortScience* **25**: 1641–1642.

NYBOM, H. (1991). Applications of DNA fingerprinting in plant breeding, in BURKE, T., DOLF, G., JEFFREYS, A. J. & WOLFF, R., eds. *DNA fingerprinting: Approaches and applications*, pp. 294–311. Birkhäuser, Basel.

NYBOM, H. (1993). Applications of DNA fingerprinting in plant population studies, in PENA, S. D. J., CHAKRABORTY, R., EPPLEN, J. T. & JEFFREYS, A. J., eds. *DNA fingerprinting: State of the science*, pp. 293–309. Birkhäuser, Basel.

NYBOM, H. (1995). Evaluation of interspecific crossing experiments in facultatively apomictic blackberries (*Rubus* subgen. *Rubus*) using DNA fingerprinting. *Hereditas*: in press.

NYBOM, H. & ROGSTAD, S. H. (1990). DNA "fingerprints" detect genetic variation in *Acer negundo*. *Plant systematics and evolution* **173**: 49–56.

NYBOM, H. & SCHAAL, B. A. (1990). DNA "fingerprints" reveals genotypic distributions in natural populations of blackberries and raspberries (*Rubus*, Rosaceae). *American journal of botany* **77**: 883–888.

OREDSSON, A. (1970). Drawings of Scandinavian plants 17–44, *Rubus* L. subgen. *Rubus*. *Botaniska notiser* **123**: 447–454.

OREDSSON, A. (1974). Frequency mapping of blackberry species (*Rubus* L. subgen. *Rubus*) in Sweden. II. Distributional patterns. *Botaniska notiser* **127**: 44–68.

PEDERSEN, A. & SCHOU, J. C. (1989). *Nordiske brombaer* (Rubus *sect.* Rubus, *sect.* Corylifolii *og sect.* Caesii). Aarhus University Reports, No. 21, University of Aarhus.

ROGSTAD, S. H., NYBOM, H. & SCHAAL, B. A. (1991). The tetrapod DNA fingerprinting M13 repeat probe reveals genetic diversity and clonal growth in quaking aspen (*Populus tremuloides*, Salicaceae). *Plant systematics and evolution* **175**: 115–123.

SUDRE, H. (1908–13). *Rubi Europae vel monographia iconibus illustrata Ruborum Europae*. Librairie des Sciences Naturelles, Paris.

SYSTAT (1992). Statistics for Windows. Version 5 Edition. Systat Inc., Evanston.

VAN HEUSDEN, A. W., ROUPPE VAN DER VOORT, J. & BACHMANN, K. (1991). Oligo-(GATA) fingerprints identify clones in asexual dandelions (*Taraxacum*, Asteraceae). *Fingerprint news* **3(2)**: 13–15.

VAN OOSTRUM, H., STERK, A. A. & WIJSMAN, H. J. W. (1985). Genetic variation in agamospermous microspecies of *Taraxacum* sect. *Erythrosperma* and sect. *Obliqua*. *Heredity* **55**: 223–228.

VASSART, G., GEORGES, M., MONSIEUR, R., BROCAS, H., LEQUARRÉ, A.-S. & CHRISTOPHE, D. (1987). A sequence in M13 phage detects hypervariable minisatellites in human and animal DNA. *Science* **235**: 683–684.

WATSON, W. C. R. (1946). Appendix 1. Checklist of British species of *Rubus*, and key to sections, subsections and series of *Eubatus*. *Journal of ecology* **33**: 337–344.

WATSON, W. C. R. (1958). *Handbook of the Rubi of Great Britain and Ireland*. Cambridge University Press, Cambridge.

WEBER, H. E. (1972). *Die Gattung* Rubus (*Rosaceae*) *im nordwestlichen Europa*. J. Cramer, Lehre.

WEBER, H. E. (1984). Zur Kenntnis des *Rubus gracilis* J. & C. Presl und nahestehender Sippen. *Feddes repertorium* **95**: 601–620.

WEBER, H. E. (1985). Rubi Westfalici. *Abhandlungen Westfalischer Museum für Naturkunde*, No. 47.

(*Accepted November 1994*)

Rubus edeesii H. E. Weber & A. L. Bull (Rosaceae), a new bramble species from Britain and Germany

H. E. WEBER

University of Osnabrück, Dept. Vechta, Driverstrasse 22, D-49364 Vechta, Germany

and

A. L. BULL

Hillcrest, East Tuddenham, Dereham, Norfolk, NR20 3JJ

ABSTRACT

Rubus edeesii H. E. Weber & A. L. Bull is described and illustrated as a new species of subgen. *Rubus* sect. *Rubus* ser. *Sylvatici*, recorded in Lincolnshire and Westphalia (Germany) and named after the British batologist E. S. Edees.

KEYWORDS: Apomictic species, *Rubus* L., ser. *Sylvatici*, distribution, bird dispersal.

INTRODUCTION

During the exploration of the vegetation of hedges (Wittig 1975) and the *Rubus* flora in Westphalia (Weber 1985) a distinct bramble was found around Münster. Because its distribution area seemed to be very local, the plant was not treated taxonomically and, like other local or individual morphotypes, arranged merely under a provisional name and omitted from a book on the Westphalian bramble flora (Weber 1985). In December 1993, A.L.B. sent to H.E.W. for examination some sheets with provisionally named brambles gathered in Norfolk and Lincolnshire, and one of these specimens was easily recognised as the plant collected also in Westphalia. Its distribution area seems to be very disjunct, like that of other bird-sown bramble species such as *Rubus drejeri* Jensen ex Lange and *R. tuberculatus* Bab.

DESCRIPTION

Rubus edeesii H. E. Weber & A. L. Bull **sp. nov.** (Figs 1 & 2)
Turio alte arcuatus, viridulus vel parce vinosus, (obtuse) angulatus faciebus planis, pilis plerumque fasciculatis (vulgo (5–)10–30 ad 1 cm) pilosus. Aculei 4–8 per 5 cm, flavescentes, aequales, e basis 6–8 mm dilatata paulo reclinati, rarius leviter curvati, 7–8(–8·5) mm longi.

Folia 5-nata (singuli raro 6–7 nata), digitata, supra pilis 15–25 ad cm^2, subtus viridia, pilis ad tactum non vel paulo perceptibilibus pilis stellulatis nullis instructa. Foliolum terminale mediocriter usque sat longe petiolulatum (longitudo petioluli plerumque 33–41 per centum longitudinis laminulae), e basi leviter cordata (rarius rotundata) ellipticum vel parce obovatum, apice 15–23 mm longe acuminatum, dentibus cuspidatis dentibusque principalibus longioribus (non recurvatis) 3–5 mm alte grosse et irregulariter serratum, interdum paulo lobatum. Foliola infima 2–3 mm petiolulata. Petiolus pilosus, aculeis curvatis 9–13 munitus. Stipulae subfiliformes usque ad 1 mm latae, margine glandulis (sub)sessilibus instructae.

Inflorescentia ampla, late cylindrica, 3–15 cm infra apicem aphylla, cetera foliis 1–3-nata, instructa, ramis usque 70–80° divaricatis plerumque supra mediam earum ramosis. Rachis pilis minutis fasciculatis pilisque longioribus dense obtecta, glandulis sessilibus multis instructa, aculeis

FIGURE 1. Holotype of *Rubus edeesii* H. E. Weber & A. L. Bull (**MANCH**).

sat gracilibus, parce reclinatis, plerumque leviter curvatis, 6–7 mm longis 3–5 per 5 cm armata. Pedicelli pro maxima parte 10–15 mm longi, pilis usque 0·6–0·8 mm longis hirsuti, glandulis stipitati 0–2 usque 0·3 mm longis instructi, aculeis 3–7, saepe inaequalibus, rectis vel parce reclinatis,

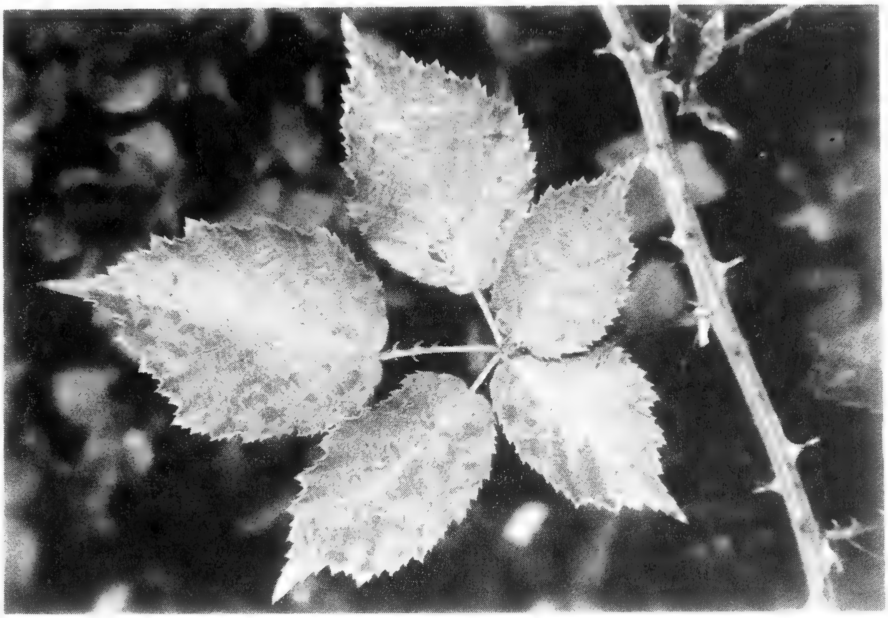


FIGURE 2. *Rubus edeesii* at the locus typicus (Germany, Westphalia).

usque (1–2(–3) mm longis muniti. Bracteolae vulgo glandulis breviter stipitatis instructae. Sepala canoviridia, plerumque inermia, post anthesin reflexa. Petala alba, obovata, unguiculata, apice parce emarginata vel crenata, 10–15 mm longa. Stamina alba stylos virescentes superantia. Antherae glabrae. Ovaria glabra. Receptaculum parce pilosum. Fructus bene evoluti. Floret (VI–) VII (–VIII).

Rubus e sect. *Rubus* ser. *Sylvatici* (P. J. Müller) Focke, honore clarissimi batologii Eric S. Edees (1907–1993), egregie meritis exploratione generis Ruborum in Britannia, nominatus. Crescit in Britannia (Lincolnshire) et Germania (Westfalia).

TYPUS: Germany, Westphalia: Margin of wood on the road S.W. of the airfield S. of Telgte, "Im Berdell", 12 August 1994, *H. E. Weber no. 94.812.4* (**MANCH**, holotypus; **herb. A.L.B., herb. H.E.W.**, isotypi).

Stem high arching, greenish or somewhat reddish, sharply to bluntly angled, with flat sides, each with (5–)10–30 mostly tufted hairs per 1 cm. Prickles 4–8 per 5 cm, slightly yellowish, equal, slenderly declining or more rarely slightly curved, 7–8 (–8·5) mm long with a 6–8 mm broad base.

Leaves 5-nate, digitate (exceptionally and rarely some 6–7-nate), dull green above with 15–25 hairs per cm^2, green beneath, moderately hairy with simple hairs usually not or hardly to be felt by touch. Terminal leaflet elliptical or elliptical-obovate, with a slightly cordate (rarely rounded) base and a distinct acuminate 15–23 mm long apex and with a petiolule 33–41% as long as the lamina. Serration coarse, up to 3–5 mm deep, irregular with moderately cuspidate teeth and longer (not recurved) main teeth. Basal leaflets 2–3 mm, stalked. Petiole hairy, with 9–13 curved prickles. Stipules nearly filiform, up to 1 mm broad, with subsessile to very shortly stalked glands at the margin.

Inflorescence large, broadly cylindrical with a broad apex, the upper 3–15 cm leafless, otherwise with 1–3-nate leaves, with spreading (70–80°) branches divaricately branched in their upper half. Rachis densely covered with small tufted and also longer hairs and with many sessile glands, prickles 3–5 per 5 cm, slender, slightly declining or a little curved, 6–7 mm long. Pedicels chiefly 10–15 mm long, with dense small tufted hairs and hirsute with simple hairs up to 0·6–0·8 mm long, stalked glands 0–2, up to 0·3 mm long, prickles 3–7, often unequal, patent or a little declining, 1–2(–3) mm long. Bracteoles usually with short-stalked glands. Sepals greyish-green, usually without prickles, reflexed. Petals white, obovate, mostly notched at the apex, 10–15 mm long. Stamens white, exceeding greenish styles. Anthers and ovaries glabrous, receptacle with few hairs. Fruits well developed. Flowering time (June–) July (–August).

The plant belongs to subgen. *Rubus* sect. *Rubus* ser. *Sylvatici* (P. J. Müller) Focke. Because of the yellowish prickles and with some respect also to the leaves it reminds one a little of *Rubus platyacanthus* P. J. Müller, but differs much from that species mainly by the panicle which is similar to that of *Rubus gratus* Focke. The plant is named after the well known British batologist E. S. Edees (1907–1993) who published together with A. Newton the monograph *Brambles of the British Isles* in 1988.

In 1907 the Rev. Augustin Ley collected a bramble at Apley, Lincolnshire, which he named *Rubus silvaticus* Weihe & Nees (Ley 1908), a specimen of which is now in the herbarium at Lincoln Museum. This was seen around 1936 by W. C. R. Watson who redetermined it as *Rubus macrophylloides* Genevier. Edees (1966) saw the specimen in 1965 and stated that "it is unlikely that this determination will stand". He subsequently referred to the Lincolnshire plant as "false *macrophylloides*" (A. Newton, pers. comm.). Edees stated that he had seen it in the field at Stainton Wood, Short Wood and Great West Wood (the latter two sites being at Apley) where it was abundant.

ECOLOGY AND DISTRIBUTION

Hedgebanks, wood margins, shrubberies, clearings, road margins on medium, siliceous (not calcareous) soils. In Germany it occurs in Westphalia in the plain district around Münster, chiefly between Telgte and Altenberge, growing mainly together with *Rubus gratus* Focke, *R. plicatus* Weihe & Nees, *R. vigorosus* P. J. Müller & Wirtgen, *R. pyramidalis* Kaltenb., *R. silvaticus* Weihe & Nees, *R. rudis* Weihe and *R. calvus* H. E. Weber. In Britain in the ancient *Tilia cordata* woods now known as Bardney Forest, which includes Apley, to the E. of Lincoln, *Rubus edeesii* is associated with *R. mucronatoides* Ley ex Rogers, *R. calvatus* Lee ex Bloxam, *R. gratus* Focke, *R. vestitus* Weihe and *R. lindleianus* Lees. To the S.W. and S.E. of Lincoln, it grows on acid sands and gravels in the area between Woodhall Spa and Newark, in contrast to the boulder clay of Bardney, and here the associated species include *R. gratus*, *R. nemoralis* P. J. Müller, *R. lindleianus*, *R. vestitus* Weihe, *R. hylocharis* W. C. R. Watson, *R. polyanthemus* Lindeb., *R. pyramidalis* and *R. platyacanthus* P. J. Müller & Lef.

The great distance between the British and German distribution areas is due to seed transport by birds (Whitethroats, *Sylvia communis*, and others) which are able to carry these by non-stop flights directly from one place to another over distances up to 500 km (Berthold in Weber 1987), thus often forming discontinuous distribution patterns, or spots (each resulting from a single bird-sown bramble) along the flight paths of migrating birds. By subsequent continuous spreading such spots usually later spread to greater distribution areas (Weber 1987). Like other brambles (*Rubus dasyphyllus* (Rog.) Marsh., *R. tuberculatus* Bab.), *R. edeesii* seems probably to have originated in Britain and was spread to continental Europe.

REPRESENTATIVE EXSICCATAE

England:

v.c. 53, S. Lincolnshire: Northon Disney, 3 August 1993, SK/88.59, *A.L. Bull* (**herb. A.L.B., herb. H.E.W.**). Stapleford Wood, 3 August 1993, SK/88.56, *A.L. Bull* (**herb. A.L.B.**).

v.c. 54, N. Lincolnshire: Ostler's Plantation, Woodhall Spa, 29 July 1993, TF/21.62, *A.L. Bull*. Stainton Wood, 29 July 1993, TF/07.78, *A.L. Bull* (**herb. A.L.B.**).

v.c. 56, Nottinghamshire: Crowood Farm Belt, Thorney, 3 August 1994, SK/87.73, *A.L. Bull*. Wigsley Wood, 3 August 1994, SK/84.70, *A.L. Bull* (**herb. A.L.B.**).

Germany (Westphalia):

(Localities quoted as given on the sheets and arranged according to the grid system used for mapping in Germany.)

4012.14: Kasewinkel südlich Handorf bei Münster, 12 August 1994, *H.E. Weber no. 94.812.7*. Nordwestlich Haus Möllenbeck bei Telgte, July 1975, *R. Wittig no. R113* (**herb. H.E.W.**).

4012.41: "Im Berdel" zwischen Münster und Telgte, 15 July 1975, *E. Foerster no. 750715.4.* Flugplatz Telgte bei Münster, 15 July 1975, *E. Foerster no. 750715.06* (**herb. Foerster, herb. H.E.W.**). Wallhecke nördlich Wolbeck, c. 500 m nördlich Böckmann, July 1975, *R. Wittig no. R98* (**herb. H.E.W.**).
4012.42: 1 km östlich Flugplatz bei Telgte, July 1975, *R. Wittig no. R120* (**herb. H.E.W.**).
4108.13: NSG Schwarzes Venn nordwestlich Groß Reken, July 1975, *R. Wittig s. n.* (**herb. H.E.W.**).
4111.1: Viehstraße in der Ventruper Heide bei Münster, July 1976, *R. Wittig s. n.* (**herb. H.E.W.**).

REFERENCES

EDEES, E. S. (1966). Brambles of Lincolnshire. *Proceedings of the Botanical Society of the British Isles* **6**: 209–214.

LEY, A. (1908). Some Lincolnshire Rubi. *Journal of Botany* **46**: 53.

WEBER, H. E. (1985). *Rubi Westfalici*. Münster.

WEBER, H. E. (1987). Typen ornithochorer Arealentwicklung, dargestellt an Beispielen der Gattung *Rubus* L. (*Rosaceae*) in Europa. *Botanischer Jahrbücher für Systematik* **108**: 525–535.

WITTIG, R. (1975). Die Gebüsch- und Saumgesellschaften der Wallhecken in der Westfälischen Bucht. *Abhandlungen aus dem Landesmuseum für Naturkunde zu Münster in Westfalen* **38(3)**: 1–78.

(*Accepted February 1995*)

Eleven new British species of *Hieracium* L. section *Alpina* (Fries) F. N. Williams

P. D. SELL, C. WEST

The Herbarium, Department of Plant Sciences, Downing Street, The University, Cambridge, CB2 3EA

and

D. J. TENNANT

Marhead Grange, Arkendale, Knaresborough, North Yorkshire, HG5 0RG

ABSTRACT

Eleven new species of section *Alpina* (Fries) F. N. Williams of *Hieracium* L. (Asteraceae), **Hieracium calvum** P. D. Sell & D. J. Tennant, **sp. nov.**, **H. completum** P. D. Sell & C. West, **sp. nov.**, **H. kennethii** P. D. Sell & D. J. Tennant, **sp. nov.**, **H. leptodon** P. D. Sell & D. J. Tennant, **sp. nov.**, **H. milesii** P. D. Sell & C. West, **sp. nov.**, **H. mundum** P. D. Sell & C. West, **sp. nov.**, **H. optimum** P. D. Sell & C. West, **sp. nov.**, **H. pensum** P. D. Sell & C. West, **sp. nov.**, **H. perscitum** P. D. Sell & C. West, **sp. nov.**, **H. probum** P. D. Sell & C. West, **sp. nov.** and **H. subglobosum** P. D. Sell & C. West, **sp. nov.** and three new forms, **H. hanburyi** forma **pusillum** P. D. Sell & D. J. Tennant, **forma nova**, **H. insigne** forma **celsum** P. D. Sell & D. J. Tennant, **forma nova** and **H. marginatum** forma **chaetocephalum** P. D. Sell & C. West, **forma nova**, are described and their distributions given. In addition, a new status is given to two taxa, **H. eximium** forma **tenellum** (Backh.) P. D. Sell & C. West, **stat. nov.** and **H. hanburyi** forma **atraticeps** (Pugsley) P. D. Sell & D. J. Tennant, **stat. nov.**

KEYWORDS: hawkweeds, Scotland.

INTRODUCTION

Section *Alpina* (Fries) F. N. Williams is probably the most difficult group of species of the genus *Hieracium* L. occurring in the British Isles. During the 1970s, P.D.S. and C.W. attempted a revision of the group, based particularly on the fine series of specimens in **CGE** collected by A. G. Kenneth and by B. A. Miles. They discovered a number of new species and prepared descriptions of them. The retirement from active work of C.W. in 1980, followed by his death in 1986, and long periods of ill-health for P.D.S. since 1981 have delayed publication of the new species. This has been beneficial in that D.J.T., who has long made a special study of the group, has been able to revise and add to the descriptions. Alone or with A. G. Kenneth, he has seen all the species in the field, and he has grown them all side by side in his garden. In the course of his work three more new species have been discovered.

This paper gives only the Latin diagnoses and descriptions, in order to validate the species. A second paper will follow in which comparable English descriptions of all the species in section *Alpina* found in the British Isles will be given. The distinction of the species in this section is so critical that the diagnosis should be taken only as a guide; the detailed description should always be checked for certain identification. The chromosome counts given in this paper are derived from Stace *et al.* (1995).

Most of the taxa described in this paper are rare plants, some populations being restricted to only a few specimens. In the interests of their conservation, therefore, it is important that they are not collected without expert knowledge.

DESCRIPTIONS OF NEW SPECIES AND FORMS

Hieracium calvum P. D. Sell & D. J. Tennant, **sp. nov.**
HOLOTYPUS: Rock-ledges in east-facing coire of Carn Crom on the west side of Glen Derry, South Aberdeen, v.c. 92, GR NO/02.95, 6 August 1978, *D. J. Tennant no. D1/78* (**CGE**).

Ab *Hieracio larigensi* (Pugsley) P. D. Sell & C. West et *H. globosifloro* Pugsley et *H. graniticola* W. R. Linton folio caulino infimo plerumque grandiore, involucro angustiore, involucri squamis paulo latioribus, caule pilis stellatis paucioribus in parte superiore ornato differt; ab *H. backhousei* F. J. Hanb. foliis basalibus integrioribus, folii caulini infimi margine pilis simplicibus densioribus longioribusque vestito, involucro angustiore villosiore, involucri squamis acutioribus distinguitur; ab *H. milesii* P.D. Sell & C. West et *H. hanburyi* Pugsley involucro pilis glanduliferis brevioribus sparsioribusque vestito differt; a speciebus ceteris britannicis Sectionis *Alpinorum* stylis flavis ornatis foliis suis basalibus in pagina superiore plerumque glabris distinguitur.

Planta phyllopoda. *Caulis* 13–20(–27) cm altus, interdum 2 vel aliquot, gracilis vel subrobustus, saepe flexuosus, ad basin interdum rubriusculoviolaceus; in parte inferiore pilis simplicibus eglanduliferis paucis vel numerosis mediocribus longisque sinuosis albis nigricantibasibus (basin versus densioribus longissimisque), pilis glanduliferis paucis vel aliquot perbrevissimis flaviusculis, pilis stellatis paucis vel nullis vestitus; in parte superiore pilis simplicibus eglanduliferis numerosis mediocribus longisque (vel in parte suprema longissimis) pallidis vel griseiusculis ad bases crassas nigris, pilis glanduliferis dispersis brevissimis obscuris, pilis stellatis aliquot vel numerosis sed non densis vestitus. *Folia* pallidiuscule vel mediocriter vel raro intensiuscule viridia, interiora in pagina superiore plerumque nitida, in pagina marginibusque interdum rubriusculoviolaceotincta, in pagina inferiore pallidiora, in pagina tota superiore plerumque glabra, sed ad margines petiolumque pilis simplicibus eglanduliferis numerosis vel densis longis vel longissimis sinuosis albis nigricantibasibus, in pagina inferiore pilis simplicibus eglanduliferis dispersis vel numerosis pallidis vel nigricantibasibus, in pagina inferiore et ad margines pilis glanduliferis paucis perbrevissimis flaviusculis, ad margines interdum pilis stellatis paucis vestita; folia basalia pauca vel numerosa, exteriora 10–45 mm longa, 6–26 mm lata, plerumque late elliptica vel ovata, ad apicem late rotundo-obtusa vel subacuta vel interdum apiculata, integra vel denticulata, ad basin cuneata vel breviter contracta, interiora 30–90 mm longa, 5–22 mm lata, rigida et coriacea, saepe canaliculata, elliptica vel anguste elliptica vel oblanceolata, ad apicem saepe tortum plerumque acuta saepe acuminata aliquando subacuta, plerumque integra interdum undulata vel serratodentata, dentibus paucis haud profundis vel anguste mammiformibus, ad basin longe attenuata vel aliquando breviter angustata; petioli magis minusve (saepe late) alati, basin versus saepe rubriusculoviolaceotincti; folia caulina 1–2(–3), infimum 10–110 mm longum, 1·5–12 mm latum, semipatens, lineari-oblanceolatum vel anguste ellipticum, ad apicem acutum vel acuminatum vel raro obtusum, integrum, ad basin attenuatum, sessile vel petiolatum, in pagina superiore glabrum, sed in marginibus et pagina inferiore pilis simplicibus eglanduliferis numerosis longiusculis et pilis stellatis aliquot vestitum, cetera folia caulina plerumque linearia acuta integra vel interdum bracteiformia, unum raro gemma rudimentali in axilla praeditum. *Capitulum* plerumque solitarium, interdum 2, vel 2 vel plura a caulibus e rosula basali exorientibus portata, 40–50 mm diametro; involucrum facie obscure viridiusculogrisea vel viridiuscula, anguste campanulatum, ad basin breviter angustatum vel rotundatum; pedunculi (si adsunt) cauli superiori similiter vestiti. *Involucri squamae* ante anthesin incumbentes, atriusculovirides, interiores marginibus pallidius viridiusculis; omnes pilis simplicibus eglanduliferis longis sinuosissimis albis vel aliquantum griseiusculis nigricantibasibus inaequaliter distributis (nonnusquam sparsis sed ad basin semper numerosis crispissimis saepe perlongis), pilis glanduliferis numerosis brevissimis vel brevibus pallidis vel obscuris, a pilis simplicibus eglanduliferis partim modo tectis, vestitae, sine pilis stellatis, interiores ad apicem pilis simplicibus nonnullis brevissimis ornatae; squamae interiores 10–15 mm longae, 1–2 mm latae, appressae vel laxe appressae, lineari-lancolatae, ad apicem acutissimae vel abrupte acutae vel acuminatae, interdum violaceotinctae; squamae exteriores breviores, ad apicem subacutae vel acutae. *Ligulae* mediocriter flavae; exteriores ad 4(–4·6 cult.) mm latae, ad apicem magis minusve discretae et saepe profunde dentatae, haud profunde concavae, in pagina inferiore pilis simplicibus eglanduliferis paucissimis vel aliquot breviusculis pallidis vel obscuriusculis vestitae, ad apicum pilis talibus brevissimis vel brevibus paucis vel nullis ultra dentium margines protrudentibus. *Styli* flavi vel flaviusculi, in sicco saepe obscuriusculi. *Receptaculi alveoli* margine breviter dentati. *Cypselae* 3·8–4·1 mm longae, purpureiusculonigrae. 2n = 36.

Extremely local and very scarce in crevices and on ledges of shelving coarse-grained granite rocks and boulders, between 800 and 980 m: on Carn Crom and Derry Cairngorm on the west side of Glen Derry in South Aberdeen (v.c. 92), and on the east side of Cairngorm in Easterness (v.c. 96). Endemic.

Hieracium completum P. D. Sell & C. West. **sp. nov.**
HOLOTYPUS: East-facing cliffs, c. 808 m, Coire Etchachan, South Aberdeen, v.c. 92, GR NO/017.997, 3 August 1966, *R. W. Jones & B. A. Miles no. 66/147* (**CGE**).

A plerisque Sectionis *Alpinorum* speciebus britannicis maculis suis fusciusculoviolaceis in pagina superiore foliorum basalium dispersis distinguitur. Ab *Hieracio probo* P. D. Sell & C. West foliis basalibus clarioribus nitidioribus plerisque ovatis praecipue differt.

Planta phyllopoda. *Caulis* 13–30 cm altus, diametro mediocri, interdum robustus et ad basin lignosus, plerumque infra involucrum incrassatus, striatus, plerumque ad basin rubriusculoviolaceus et interdum in porcis in parte inferiore guttatus, pilis simplicibus eglanduliferis paucis vel numerosis pallidis nigricantibasibus (basin versus et ad petiolos plerumque multis longis, in parte superiore brevioribus sed longius nigricantibasibus), pilis glanduliferis paucis vel numerosis brevissimis pallidis obscurisque, pilis stellatis nonnullis (utrisque in parte superiore numerosioribus) vestitus. *Folia* pallidiuscule vel mediocriter clare viridia, plerumque subnitida raro hebetata, plerumque per totam paginam superiorem obscure fusciusculoviolaceomaculata vel marmorata, in pagina inferiore saepe pallidiora, costa rubriusculoviolaceotincta; folia basalia plerumque numerosa, aliquando coriacea, pleraque in pagina superiore et ad margines pilis simplicibus eglanduliferis paucis vel numerosis magis minusve uniformiter dispersis brevibus mediocribusque longiusculisque graciliusculis subrigidis sinuosis vel ad apicem curvatis albis plerumque pallidibasibus, in pagina inferiore pilis simplicibus eglanduliferis numerosis brevibus vel mediocribus gracilibus mollioribus sinuosis, in utraque pagina et in marginibus pilis glanduliferis paucis brevissimis flaviusculis vestita, exteriora 5–45 mm longa, 3–35 mm lata, subrotunda vel ovata vel elliptica vel raro obovata, ad apicem rotundo-obtusa vel obtusa saepe mucronulata, denticulata, ad basin plerumque late cuneata interdum truncata, interiora 10–70(–100) mm longa, 4–30 mm lata, plerumque ovata interdum late elliptica vel late lanceolata, ad apicem late acuta vel subacuta raro obtusa plerumque mucronata vel apiculata, interdum convoluta, magis minusve ordinate serratodentata, dentibus anguste mammiformibus acutis, interdum denticulata, ad basin cuneata vel attenuata; petioli breves vel longi, plerumque rubriusculoviolaceotincti praecipue ad basin, pilis simplicibus eglanduliferis paucis vel numerosis mediocribus vel longis interdum appressis vestiti; folia caulina 1–3(–4), infimum 1–60 mm longum, 20–30 mm latum, basalia interiora saepe simulans, lanceolatum vel ellipticum vel anguste ovatum, ad apicem acutomucronatum vel acuminatum, denticulatum vel irregulariter serratodentatum, dentibus paucis angustis acutis, ad basin saepe cuneatum et perspicue petiolatum, cetera linearia acuta vel magis minusve bracteiformia erecta, summum filamentosum, omnia folia caulina pilis simplicibus eglanduliferis numerosis, pilis glanduliferis nonnullis minutis, saepe in pagina inferiore pilis stellatis nonnullis vestita. *Capitulum* plerumque solitarium, interdum 2–3, 35–50 mm diametro; involucrum facie atriuscula vel obscure viridiusculogrisea, late campanulatum, ad basin valde constrictum; pedunculi (si adsunt) cauli superiori similiter vestiti. *Involucri squamae* ante anthesin incumbentes, viridiusculoatrae, interiores marginibus indistinctis viridiusculis; omnes pilis simplicibus eglanduliferis densiusculis mediocribus vel longis (ad 3 mm) gracilibus pallidis vel griseiusculis ad bases longas incrassatas nigris, pilis glanduliferis numerosis brevissimis vel brevibus flaviusculis obscurisque, a pilis simplicibus eglanduliferis partim modo tectis, vestitae, sine pilis stellatis sed interiores ad apicem pilorum ramosorum simpliciumque brevium caespite ornatae; squamae interiores 11–15(–18) mm longae, 1·2–1·8(–2·0) mm latae, inaequales, valde appressae, magis minusve late lineari-lanceolatae, ad apicem abrupte acutae vel subacutae; squamae exteriores breviores erectae, ad apicem magis minusve obtusae. *Ligulae* clare intensiuscule vel raro mediocriter flavae; exteriores latiusculae (ad 4·5 mm), ad apicem magis minusve discretae et profunde dentatae, concavae apicemque versus valde ascendentes, in pagina inferiore pilis simplicibus eglanduliferis paucis brevissimis vel brevibus pallidis vestitae vel nullis, ad apicem pilis talibus aliquot perbrevissimis ultra dentium margines protrudentibus. *Styli* uniformiter obscurissimi (griseiusculi). *Receptaculi alveoli* margine breviter dentati. *Cypselae* 3·6–4·5 mm longae, purpureiusculonigrae. 2n = 36.

Rock-ledges, dry gullies and stream-banks on both schist and granite between 600 and 1200 m: on the Cairnwell in East Perth (v.c. 89); in several localities in and around the heads of Glen Clova and Glen Isla in Angus (v.c. 90); in Glen Callater, on Lochnagar and at Dubh-loch in South Aberdeen (v.c. 92); in the Cairngorm Range on Creag an Dail Bheag [Little Craigandail] and in Coire Etchachan (both in v.c. 92) and on many of the mountains bordering both sides of the Lairig Ghru Pass (v.cc. 92 and 96); in Glen Einich and Coire Garbhlach in the Cairngorm mountains and on the adjacent Monadhliath Hills, Easterness (v.c. 96). Endemic.

This species was mistakenly known to F. J. Hanbury, E. F. and W. R. Linton, E. S. Marshall and other earlier botanists as *H. curvatum* Elfstrand, a species now considered not to occur in the British Isles. Most of the specimens later referred to *H. pseudocurvatum* (Zahn) Pugsley (1948) belong to *H. completum*. *H. pseudocurvatum* is in fact restricted to two localities on the Cairngorms.

Hieracium eximium Backh., *Monogr. Brit. Hier.* 20 (1856).
Forma **eximium**.
Styli viridiusculogrisei vel obscurissime grisei. 2n = 36.
Forma **tenellum** (Backh.) P. D. Sell & C. West, **stat. nov.**
Basionym: *H. eximium* var. *tenellum* Backh., *Monogr. Brit. Hier.* 21 (1856).
Styli flavi vel aliquantum sordide flavi. 2n = 36.

Other than style colour there is little to distinguish these two forms, but forma *eximium* shows a preference for schistose rock and forma *tenellum* for granite.

Hieracium hanburyi Pugsley in *J. Bot. (London)* **79**: 178 (1941).
Forma **pusillum** P. D. Sell & D. J. Tennant, **forma nova**
Holotypus: Rock-ledge on schistose rock, c. 760 m, at head of Canness Glen, Glen Isla, Forfar [Angus], v.c. 90, GR NO/20.77, 12 July 1982, *D. J. Tennant, no. C1/82* (**CGE**).

Planta parva; *folia* subintegra vel haud profunde dentata; *involucri squamae* abrupte acutae vel subacutae vel obtusae, pilis glanduliferis et simplicibus eglanduliferis numerosis ornatae; *styli* obscuri. 2n = 36.

Forma **hanburyi**
Synonym: *H. hanburyi* var. *humile* Pugsley in *J. Linn. Soc. London (Bot.)* **54**: 52 (1948).
Planta saepe major; *folia* magis dentata; *involucri squamae* anguste acutae, pilis glanduliferis et simplicibus eglanduliferis numerosis ornatae; *styli* flavi vel aliquantum discolores. 2n = 36.

Forma **atraticeps** (Pugsley) P. D. Sell & D. J. Tennant, **stat. nov.**
Basionym: *H. hanburyi* var. *atraticeps* Pugsley in *J. Linn. Soc. London (Bot.)* **54**: 51 (1948).

Planta saepe magna; *folia* magis minusve dentata; *involucri squamae* anguste acutae, pilis glanduliferis densis, pilis simplicibus eglanduliferis nullis vel sparsis ornatae; *styli* magis minusve flavi. 2n = 36.

Hieracium hanburyi is a very variable species whose limits are difficult to define. We recognise the three most distinct variants as forms. P.D.S. and C.W. once recognised forma *atraticeps* as a distinct species because of the characteristic clothing of the heads, but it grows with forma *hanburyi* and intermediates occur. Forma *pusillum* is known only from the Glen Isla and the Clova Mountains, Angus (v.c. 90). *H. perscitum* and *H. hanburyi* can easily be confused on herbarium sheets, but they look very different in the field.

Hieracium insigne Backh. in *Phytologist (Newman)*, Series 2, **4**: 806 (1853).
Lectotypus: Near Loch Ceanndin, Aberdeenshire, v.c. 92, August 1852, *J. Backhouse jun.* (**CGE**).
Forma **insigne**
Capitulum solitarium, 45–65 mm diametro; *involucri squamae* 13–20 mm longae, 0·7–1·5 mm latae, laxiores, apicibus angustissimis. 2n = 36.
Forma **celsum** P. D. Sell & D. J. Tennant, **forma nova**
Holotypus: Schistose cliffs, c. 2400 ft [720 m], south side of Coire Garbhlach, Glen Feshie, Easterness, v.c. 96, GR NN/880.941, 12 August 1966, *R. W. Jones & B. A. Miles no. 66/216* (**CGE**).

Capitula 1–3, 25–50 mm diametro; *involucri squamae* 10–17 mm longae, 1·0–1·5 mm latae, appressae, apicibus interdum minus angustis. 2n = 27, 36.

Forma *insigne* is known only from cliffs above Loch Kander (Loch Ceanndin) in Glen Callater, South Aberdeen (v.c. 92). Forma *celsum* occurs in Coire an Lochaine Uaine, Cairntoul, in South Aberdeen (v.c. 92), in Coire Garbhlach, in Glen Feshie and on Creag an Leth-choin in the Lairig Ghru Pass, both in Easterness (v.c. 96), and in several places on Beinn na Socaich, Glen Spean, Westerness (v.c. 97). Endemic.

Hieracium kennethii P. D. Sell & D. J. Tennant, **sp. nov.**
HOLOTYPUS: An Teallach, West Ross, v.c. 105, GR NH/055.865, c. 650 m, 1984, *A. G. Kenneth no. 5184* (**CGE**).

Ab *Hieracio perscito* P. D. Sell & C. West foliis coraceis nitidis, folio caulino infimo magis petiolato pilisque stellatis paucis vestito, involucri squamis pilis glanduliferis manifestis multo paucioribus vestitis; ab *H. subgloboso* P. D. Sell & C. West foliis basalibus exterioribus ad basin magis truncatis plerumque clarius viridibus, folio caulino infimo majore saepe dentato, involucri squamis minus acutis, ligulis intensius flavis; ab *H. mundo* P. D. Sell & C. West foliis basalibus latioribus clarioribus nitidioribus, exterioribus saepe magis truncatis et dentibus latis obtusis instructis, folio caulino infimo sine dentibus spinulosis, involucri squamis saepe acutioribus; ab *H. penso* P. D. Sell & C. West foliis coriaceis nitidis claris plerumque in pagina superiore uniformiter pilosis, involucri ad basin angustiore, squamis magis appressis, ligulis intensius flavis distinguitur. Ab omnibus aliis Sectionis *Alpinorum* speciebus britannicis aut stylis suis obscuris aut separatione geographica distinguitur.

Planta phyllopoda. *Caulis* 10–24 cm altus, gracilis vel mediocris, interdum flexuosus, aliquando ad basin rubriusculoviolaceotinctus, in parte inferiore pilis simplicibus eglanduliferis paucissimis vel paucis vel numerosis mediocribus vel longis (ad 3 mm) saepe gracillimis sinuosis albis nigricantibasibus, pilis glanduliferis dispersis brevissimis flaviusculis, pilis stellatis paucissimis vel dispersis vestitus, in parte superiore pilis simplicibus eglanduliferis paucis vel numerosis mediocribus et longis (ad 2 mm) pallidis vel griseiusculis nigricantibasibus, pilis glanduliferis numerosis vel numerosissimis brevissimis vel brevibus vel mediocribus (ad 1·0 mm) obscuris, pilis stellatis numerosis vel densis vestitus. *Folia* mediocriter vel intensiuscule clare viridia, supra subtusque nitida, in pagina inferiore paulo modo pallidiora, in pagina superiore marginibusque pilis simplicibus eglanduliferis numerosis vel densis magis minusve uniformiter dispersis mediocribus et longis (ad 2 mm) gracilibus subrigidis albis pallidibasibus (folia exteriora saepe pilis paucis circa costam vestita), in pagina inferiore pilis simplicibus eglanduliferis paucis vel numerosis vel numerosissimis, in paginis marginibusque pilis glanduliferis paucis brevissimis flaviusculis, interdum in utraque pagina circa costam pilis stellatis paucis vestita; folia basalia aliquot vel numerosa, exteriora 5–35 mm longa, 4–30 mm lata, subrotunda vel late ovata vel obovata, saepe asymmetrica, ad apicem late rotundo-obtusa interdum retusa vel apiculata, denticulata vel magis minusve sinuatodentata, dentibus aliquot irregularissimis et interdum dentibus paucis retrorsis late mammiformibus (aliquando angustioribus), ad basin late cuneata vel truncata, interiora 6–45 mm longa, 4–25 mm lata, subcoriacea, ovata vel elliptica, ad apicem late acuta apiculataque vel obtusa, sparse denticulata vel irregulariter serratodentata, dentibus mediocribus vel angustis patentibus mammiformibus, ad basin late cuneata vel breviter contracta raro attenuata; petioli breves vel longiusculi, pilis simplicibus eglanduliferis longis albis dense vestiti; folia caulina 1–5, infimum 13–60 mm longum, 2–16 mm latum, semipatens, oblanceolatum, aliquando ellipticum, interdum fere ad basin caulis positum et basalia interiora simulans, ad apicem acutum vel obtusum interdum acuminatum vel cuspidatum, integrum vel dentibus aliquot irregularibus acutis serratodentatum, ad basin in petiolum plerumque angustiusculum attenuatum vel anguste contractum, in utraque pagina et ad margines pilis simplicibus eglanduliferis paucis vel magis minusve irregulariter dispersis pallidis (in petiolo densioribus, in pagina inferiore nigricantibasibus), in utraque pagina aliquando pilis stellatis aliquot (praesertim in costa) vestitum, cetera folia caulina parva magis minusve acuta integra vel bracteiformia. *Capitulum* plerumque solitarium, interdum 2, 30–48 mm diametro; involucrum facie griseiusculoviridi vel viridiusculoatra, campanulatum, ad basin angustatum; pedunculi (si adsunt) cauli superiori similiter vestiti. *Involucri squamae* ante anthesin incumbentes, atriusculovirides vel virides; omnes pilis simplicibus eglanduliferis numerosis mediocribus longisque (ad 3 mm) gracilibus sinuosis pallidis vel griseiusculis nigricantibasibus, pilis glanduliferis numerosis brevibus brevissimisque atriusculis (a pilis simplicibus eglanduliferis pro parte majore tectis) vestitae, sine pilis stellatis sed interiores ad apicem pilorum brevium caespite manifesto ornatae; squamae interiores 11–15 mm longae, 1·2–1·8 mm latae, inaequales, strictim appressae, lineari-lanceolatae, ad apicem plerumque abrupte acutae interdum subacutae vel obtusae; squamae exteriores breviores erectae semiappressae. *Ligulae* uniformiter intensiuscule flavae vel aliquando mediocriter flavae; exteriores 3–4 mm latae, ad apicem aliquantum discretae et magis minusve profunde dentatae, fere rectae vel aliquantum concavae, in pagina inferiore pilis simplicibus eglanduliferis paucissimis vel aliquot brevissimis pallidis vestitae, ad apicem pilis nullis talibus vel aliquot perbrevissimis vel aliquando paucis brevissimis ultra dentium margines protrudentibus. *Styli* magis minusve uniformiter obscure viridiusculogrisei. *Receptaculi alveoli* margine dentati. *Cypselae* 3.9–4.3 mm longae, purpureiusculonigrae. 2n = 36.

Rocky knolls and steep grassy slopes from c. 600 to 700 m on Torridonian Sandstone on Mac is Mathair and elsewhere, rather locally, on the north-eastern and north-western sides of the An Teallach Range. Dundonnell, in West Ross (v.c. 105); also on Cnoc na Creige, near Glen Coùl, from c. 450 to 550 m, West Sutherland (v.c. 108). Endemic.

Named after Archibald Graham Kenneth (1915–1989), in recognition of his fine work over many years on the hawkweeds of western Scotland.

Hieracium leptodon P. D. Sell & D. J. Tennant, **sp. nov.**
HOLOTYPUS: North-east corrie, Ben More, Mid Perth, v.c. 88, August 1978, *D. J. Tennant* (**CGE**).

Hieracio calendulifloro Backh., *H. eximio* Backh. et *H. notabili* P. D. Sell & C. West simile, sed folio caulino infimo conspicuo, in plantis bene effectis dentibus multis longissimis gracillimis acutis prorsum curvatis ornato distinguitur.

Planta phyllopoda. *Caulis* 12–30 cm altus, medius vel gracilis, interdum flexuosus, ad basin plerumque rubriusculoviolaceotinctus, in parte inferiore pilis simplicibus eglanduliferis dispersis vel numerosis mediocribus vel longis vel longissimis (ad 5 mm) gracilibus tenuibus sinuosis pallidis nigricantibasibus, pilis glanduliferis paucis perbrevissimis vel brevissimis pallidis vel obscurioribus, pilis stellatis paucis, in parte superiore pilis simplicibus eglanduliferis numerosis longe nigricantibasibus, pilis glanduliferis aliquot vel densis brevissimis vel brevibus nigriusculis, pilis stellatis aliquot vel numerosis sed non densis vestitus. *Folia* pallidiuscule vel mediocriter viridia, pruinam levem caeruleogriseam ferentia, in pagina superiore hebetata vel paulo modo nitida, saepe rubriusculoviolaceotincta praecipue in marginibus, in pagina inferiore pallidiora; folia basalia numerosa, exteriora 8–50 mm longa, 5–25 mm lata, late elliptica vel ovata, ad apicem rotundo-obtusa raro retusa interdum apiculata, denticulata vel subintegra, interdum dentibus aliquot mammiformibus, ad basin rotundata vel cuneata vel breviter angustata interdum attenuata, interiora 25–90 mm longa, 9–22 mm lata, anguste vel late elliptica raro oblanceolata, ad apicem interdum tortum obtusa vel acuta saepe apiculata, denticulata vel dentata vel serratodentata, interdum undulata, dentibus regularibus vel irregularibus saepe ascendentibus anguste vel raro late mammiformibus ad apices longe rotundoapiculatis, in triente superiore saepe integra, ad basin breviter angustata vel attenuata, omnia pilis simplicibus eglanduliferis numerosis brevibus mediocribusque longisque (ad 3 mm) albis pallidibasibus vel nigricantibasibus (in paginis ambabus plerumque uniformiter distributis et in marginibus longis densis), pilis glanduliferis dispersis brevissimis flaviusculis vestita; petioli plerumque breves, alati, pilis simplicibus eglanduliferis densiusculis longissimis sinuosis vestiti, subtus saepe rubriusculoviolaceotincti; folia caulina 2–4(–5), infimum 10–90 mm longum, 2–20 mm latum, semipatens, anguste ellipticum vel elliptico-oblongum, ad apicem acutum vel subacutum, saepe serratodentatum vel serratum, dentibus irregularibus longissimis (ad 10 mm) angustis saepe prorsum curvatis apiculatis saepe spinulosis ornatum, ad basin angustatum sessile vel semiamplexicaule vel subpetiolatum, folium a basi secundum saepe dentibus paucis acutis angustis ornatum vel integrum, cetera linearia acuta integra vel bracteiformia vel filamentosa erecta. *Capitula* 1–3(–4), 35–50 mm diametro: involucrum facie viridiusculogrisea, cylindricum vel campanulatum, ad basin rotundatum vel truncatum; pedunculi longi graciles, cauli superiori similiter vestiti. *Involucri squamae* ante anthesin incumbentes, atriusculovirides; interiores 12–16 mm longae, 0·8–1·0 mm latae, appressae, lineari-lanceolatae, ad apicem plerumque gradatim acutae vel acutissimae interdum abrupte acutae, intimae interdum filamentosae; exteriores multo breviores semilaxae erectae, ad apicem subacutae; omnes pilis simplicibus eglanduliferis numerosis vel densis mediocribus vel longis (ad 3 mm) pallidis vel griseiusculis nigricantibasibus, pilis glanduliferis numerosis brevissimis obscuris, a pilis simplicibus eglanduliferis plerumque omnino tectis, sine pilis stellatis, interiores ad apicem pilis paucis brevissimis vestitae. *Ligulae* pallide clare vel raro mediocriter flavae; exteriores numerosae, aliquantum angustae (ad 4 mm), ad apicem plerumque profunde et irregulariter dentatum magis minusve discretae, concavae supraque ascendentes, in pagina inferiore pilis simplicibus eglanduliferis numerosis vel densis brevissimis pallidis vestitae, ad apicem pilis talibus numerosis brevissimis nonnullisque brevibus ultra dentium margines protrudentibus. *Styli* intense viridiusculogrisei. *Receptaculi alveoli* margine breviter dentati. *Cypselae* 3·5–4·0 mm longae, purpureiusculonigrae. 2n = 36.

Cliff-ledges and crevices in large boulders on muscovite-albite pelitic schist and other hard mica-schist rocks at 710–890 m in the north-east corrie of Ben More, Mid Perth (v.c. 88). Endemic.

Hieracium marginatum P. D. Sell & C. West in *Watsonia* **6**: 304 (1967).
Forma **marginatum**
Involucri squamae pilis simplicibus eglanduliferis numerosis vel densis, ad 2·5 mm longis, ornatae. 2n = 36.
Forma **chaetocephalum** P. D. Sell & C. West, **forma nova**
HOLOTYPUS: Summit corrie of Ben Dearg, East Ross, v.c. 106, 1976, *A. G. Kenneth no. 9076* (**CGE**).

A forma *marginato* involucri squamis pilis simplicibus eglanduliferis densis, ad 4 mm longis, ornatis distinguitur. 2n = 36.

These two forms have the same area of distribution – Westerness (v.c. 97), Ross (v.cc. 105 and 106) and Sutherland (v.cc. 107 and 108) – but the single character in which they differ, the woolliness of the head, is so striking that it is worth distinguishing them by separate names.

Hieracium milesii P. D. Sell & C. West, **sp. nov.**
HOLOTYPUS: Cliff-ledges, c. 880 m, due south of Loch Kander, Glen Callater, South Aberdeen, v.c. 92, GR NO/190.807, 6 August 1966, *R. W. Jones & B. A. Miles no. 66/162* (**CGE**).

Ab *Hieracio tenuifronti* P. D. Sell & C. West foliis caulinis saepe magis effectis, involucri squamis laxioribus pilisque glanduliferis manifestis ornatis, stigmatibus flaviusculis distinguitur.

Planta phyllopoda. *Caulis* singularis vel duplicatus, 8–20(–28) cm altus, gracilis vel robustus, saepe flexuosus, ad basin interdum rubriusculoviolaceus, ubique pilis simplicibus eglanduliferis paucis vel numerosis brevibus mediocribusque longisque gracilibus sinuosis albis vel griseiusculis ad bases incrassatas nigricantibus (in parte inferiore modice vestitus, in parte superiore pilis numerosis brevibus vel mediocribus saepe griseiusculis), pilis glanduliferis aliquot vel numerosis brevissimis pallidis obscurisque (in parte superiore numerosis vel densis longioribus, ad 1·0 mm), pilis stellatis multis (in parte superiore densiusculis) vestitus. *Folia* pallidiuscule vel intensiuscule viridia aliquando glauciviridia, in pagina superiore hebetata vel nitida, in pagina inferiore pallidiora, saepe rubriusculoviolaceotincta: folia basalia pauca vel numerosa, exteriora 6–40 mm longa, 5–26 mm lata, ovata vel obovata vel late elliptica, interdum asymmetrica, saepe undulata vel convoluta, ad apicem late rotundo-obtusa, subintegra, denticulata vel serratodentata, dentibus aliquot haud profundis vel anguste mammiformibus plerumque ad marginum trientes duas inferiores limitatis, ad basin cuneata vel abrupte contracta, in pagina superiore pilis simplicibus eglanduliferis aliquot brevibus mediocribusque longisque uniformiter distributis vel aliquando ad margines limitatis, in pagina inferiore pilis talibus aliquantum brevioribus mollioribusque dispersis vel nullis, in utraque pagina et in marginibus pilis glanduliferis aliquot perbrevissimis flaviusculis, in marginibus interdum pilis ramosis paucis brevissimis vestita, interiora 15–75 mm longa, 3–30 mm lata, rigidiuscula et subcoriacea, anguste vel late elliptica, ad apicem late acuta saepe apiculata aliquando obtusa, subintegra vel irregulariter sinuatodentata vel dentibus magnis anguste vel late mammiformibus interdum cuspidatis, ad marginum trientes duas inferiores limitatis, ornata, ad basin cuneata vel attenuata vel raro subtruncata, in utraque pagina pilis simplicibus eglanduliferis plerumque numerosis brevibus mediocribusque longisque subrigidis ad bases plerumque bulbosas pallidis vel discoloribus vel aliquando nigriusculis uniformiter distributis vel prope et ad margines restrictis, pilis glanduliferis et interdum ramosis foliis exterioribus similiter vestita; petioli breviusculi vel longi, magis minusve graciles, ad basin saepe valde rubriusculoviolacei, pilis simplicibus eglanduliferis paucis vel densiusculis mediocribus vel longis subrigidis pallidis vestiti; folia caulina (1–)2–4 (–5), infimum 10–60(–90) mm longum, 2–18 mm latum, rigide semierectum vel patens, interdum undulatum, lineari-oblanceolatum vel anguste ellipticum, ad apicem acutum vel raro rotundo-obtusum, plerumque integrum, ad basin attenuatum, plerumque valde petiolatum, interdum aliquantum alatum et semiamplexicaule, in pagina superiore pilis simplicibus eglanduliferis saepe nigricantibasibus paucis vel nullis, in marginibus et aliquando in pagina inferiore et in paginae superioris costa pilis talibus aliquot brevibus vel mediocribus, pilis glanduliferis brevissimis pallidis, pilis stellatis paucis vel numerosis vestitum, folium a basi secundum minus (ad 45 mm longum, 4 mm latum) sed simile, interdum semipatens, cetera minora linearia bracteiformis semierecta vel ad caulem appressa. *Capitulum* solitarium, raro 2(–3), aliquando cum altero a secundo caule e basi exoriente portato, 25–40 mm diametro, interdum nutans; involucrum facie saturate viridiusculogrisea vel viridiusculonigra, campanulatum vel late campanulatum, ad basin rotundatum; pedunculi (si adsunt) cauli superiori similiter vestiti. *Involucri squamae* ante anthesin incumbentes, atriusculovirides, marginibus pallidioribus; omnes pilis simplicibus eglanduliferis densiusculis mediocribus et longis (ad 3 mm) gracilibus sinuosis griseiusculis vel intense griseis nigricantibasibus, pilis glanduliferis numerosis brevissimis brevibusque mediocribusque obscuris, a pilis simplicibus eglanduliferis plerumque leviter modo tectis, vestitae, sine pilis stellatis sed interiores ad apicem pilorum brevium pallidorum caespite definitissimo ornatae; squamae interiores 10–17 mm longae, 1·1–1·8 mm latae, late lineari-lanceolatae, ad apicem abrupte acutae saepe acuminatae interdum subacutae aliquando convolutae, aliquantum appressae vel sublaxae; squamae exteriores paulo breviores, interdum laxae, erectae, ad apicem subacutae. *Ligulae* pallide vel mediocriter flavae; interiores densae; exteriores mediae vel latiusculae (ad 4·5 mm latae), ad apicem magis minusve discretae et profunde dentatae dentibus magis minusve gracilibus, rectae vel haud profunde concavae, in pagina inferiore pilis simplicibus eglanduliferis paucis vel multis brevissimis vel brevibus pallidis (saepe aliquot aliquantum griseiusculis) vestitae vel nullis, ad apicem pilis talibus aliquot vel multis perbrevissimis (aliquando cum paucis brevissimis vel brevibus) ultra dentium margines protrudentibus. *Styli* flavi vel sordide viridiusculoflavi; stigmata flaviuscula. *Receptaculi alveoli* margine breviter dentati. *Cypselae* 3·2–4·0 mm longae, purpureiusculonigrae. 2n = 36.

Cliff-ledges and rock-crevices on granite, quartz porphyry and quartz-biotite mica-schist from 740 to 1010 m: local and scarce in East Perth (v.c. 89), on Carn nan Sac and Glas Tulaichean near Glenshee; in Angus (v.c. 90), above Loch Wharral, near Braedownie, at the head of Glen Fee and in Coire Sharrock, all in Glen Clova, at the heads of Caenlochan and Canness Glens in Glen Isla, and in Glen Prosen; in South Aberdeen (v.c. 92), not uncommon in the north-east coire of Lochnagar and in several localities above Loch Kander in Glen Callater, but local and very scarce in the Cairngorm Mountains in the Lairig Ghru Pass and Glen Geusachan at the southern and south-eastern foot of Cairntoul and on Creag an Dail Bheag [Little Craigandail]. Endemic.

Named after Beverley Allan Miles (1937–1970) in recognition of his fine set of alpine hawkweeds collected in the Scottish mountains.

Hieracium mundum P. D. Sell & C. West, **sp. nov.**
HOLOTYPUS: On flat rocks at c. 580 m, south-east of Loch a' Choire Ghranda, Beinn Dearg, East Ross, v.c. 106, GR NH/273.893, 27 July 1967, *R. W. Jones & B. A. Miles no. 67/86* (**CGE**).

Ab *Hieracio leptodonti* P. D. Sell & D. J. Tennant (quod facie simulat) facie ubique generaliter minus dense pilosa, foliis minus pruinosis, involucri squamis minus acutis pilisque glanduliferis aliquot manifestis vestitis, ligulis intensius flavis; ab *H. perscito* P. D. Sell & C. West foliis basalibus angustioribus coriaceioribus ellipticis, exterioribus ad basin minus late cuneatis, folio caulino infimo dentibus longioribus spinulatis ornato, involucri squamis pilis glanduliferis paucis manifestis vestitis, pilis brevissimis aliquot vel multis ad ligularum apices protrudentibus; ab *H. subgloboso* P. D. Sell & C. West foliis basalibus angustioribus, folio caulino infimo majore latiore spinulatoserrato, involucri squamis obtusioribus, ligulis intensius flavis pilosioribusque; ab *H. eximio* Backh. planta tota valde rubriusculoviolaceotincta, foliis coriaceioribus minus dense pilosis, folio caulino infimo spinulatoserrato, involucri squamis obtusioribus pilisque glanduliferis manifestis vestitis, ligulis intensius flavis distinguitur.

Planta phyllopoda. *Caulis* 7–24(–30) cm altus, graciliusculus vel subrobustus, saepe flexuosus, ad basin valde rubriusculoviolaceotinctus, ubique pilis simplicibus eglanduliferis paucis vel numerosis brevibus mediocribusque longisque gracilibus sinuosis albis vel aliquantum griseiusculis ad bases incrassatas nigriusculis (in parte inferiore saepe densis longissimis sinuosissimis interdum retrorsis, in parte superiore minus densis mediocribus vel longis patentibus), in parte inferiore pilis glanduliferis paucissimis brevissimis obscuris, in parte superiore numerosis vel densis, ubique pilis stellatis numerosis, in parte superiore saepe densis. *Folia* aliquantum triste mediocriter vel intensiuscule viridia, in pagina superiore hebetata vel paulo modo nitida, in pagina inferiore pallidiora plerumque valde rubriusculoviolaceotincta vel maculata, praecipue in costa marginibusque dentibusque; folia basalia pauca vel numerosa, exteriora 6–55 mm longa, 4–23 mm lata, pleraque subrotunda vel elliptica, ad apicem rotundo-obtusa, plerumque denticulata, interdum dentata, ad basin cuneata, interiora 20–80 mm longa, 6–20 mm lata, rigidiuscula et subcoriacea, saepe subcanaliculata, aliquantum undulata, lanceolata vel oblanceolata vel anguste elliptica, ad apicem magis minusve obtusa (vel intima acuta), serratodentata vel incisa, dentibus magis minusve regularibus vel irregularibus angustis saepe apiculatis, ad basin attenuata, omnia folia basalia in pagina superiore pilis simplicibus eglanduliferis numerosis mediocribus vel longis gracilibus subrigidis ad bases bulbosas pallidis vel discoloribus (in foliis exterioribus plerumque sparsis, in interioribus magis minusve densis) uniformiter dispersis vel versus et ad margines restrictis, in pagina inferiore pilis talibus paucis vel numerosis magis minusve uniformiter distributis brevibus vel mediocribus saepe nigricantibasibus, in utraque pagina et in marginibus pilis glanduliferis aliquot perbrevissimis flaviusculis et saepe pilis stellatis paucis vestita; petioli plerumque breviusculi, raro longi, rigidi, magis minusve alati, rubriusculoviolaceotincti; folia caulina (2–)3–6(–7), infimum 10–75 mm longum, 1–14 mm latum, basalibus interioribus saepe simile (in plantis robustis saepe usque ad 4 folia grandia, fere ad basin caulis sita), patens, saepe undulatum, lineare vel lineari-lanceolatum, ad apicem acutum vel subacutum, serratum vel ordinate spinulatoserratum, dentibus longis angustis rubriusculoviolaceotinctis, rarissime integrum, ad basin attenuatum, in pagina inferiore marginibusque pilis simplicibus eglanduliferis densis mediocribus vel longis gracilibus sinuosis nigricantibasibus, in pagina superiore plerumque nullis, in utraque pagina pilis stellatis aliquot (praecipue in costa) vestitum; petiolus alatus magis minusve amplexicaulis, pilis simplicibus eglanduliferis (basin versus densissimis) vestitus; folia caulina superiora parva acuta vel magis minusve bracteiformia. *Capitulum* plerumque solitarium, interdum ad 3, 25–40(–47) mm diametro; involucrum facie obscurissime viridiusculogrisea vel nigriusculogrisea, campanulatum, ad basin rotundatum; pedunculi (si adsunt) cauli superiori similiter vestiti. *Involucri squamae* ante anthesin incumbentes, atriusculovirides vel rubrotinctae vel brunneotinctae; omnes pilis simplicibus eglanduliferis numerosis brevissimis vel brevibus vel longis (ad 2·5 mm) gracilibus sinuosis albis vel aliquantum griseiusculis nigricantibasibus, pilis glanduliferis numerosis brevissimis vel brevibus (ad 0·8 mm) obscuris, a pilis simplicibus eglanduliferis partim modo tectis, vestitae, sine pilis stellatis sed interiores ad apicem pilorum brevium caespite manifesto ornatae; squamae interiores 11–15 mm longae, 1·0–1·5 mm latae, magis minusve appressae, lineari-lanceolatae, ad apicem pleraeque subacutae vel nonnullae obtusoapiculatae, intimae abrupte acutae; squamae exteriores multo breviores, erectae, ad apicem obtusae. *Ligulae* uniformiter mediocriter vel intensiuscule flavae; exteriores latiusculae (ad 4·3 mm), ad apicem discretae et aliquantum vel profunde dentatae, haud profunde concavae, in pagina inferiore pilis simplicibus eglanduliferis paucissimis vel numerosis brevissimis vel brevibus pallidis vel aliquantum discoloribus vestitae, ad apicem pilis talibus aliquot vel multis brevissimis ultra dentium margines protrudentibus. *Styli* magis minusve uniformiter obscure viridiusculogrisei. *Receptaculi alveoli* margine breviter dentati. *Cypselae* 3–4 longae, purpureiusculonigrae. 2n = 36.

Rocky knolls, detritus and crevices in shelving rocks, less frequently cliff-ledges, on fine-grained quartz-biotite and other rock, between 425 and 760 m: on Fannich Forest hills, Braemore, and Beinn Dearg Range in West and East Ross (v.cc. 105 and 106); on Carn Dearg in East Sutherland (v.c. 107); on Foinaven, on Ben Hope and near Glen Coul in West Sutherland (v.c. 108). Endemic.

Hieracium optimum P. D. Sell & C. West. **sp. nov.**
HOLOTYPUS: Beinn a' Chreachain, Argyll, v.c. 98, 9 July 1976, *A. G. Kenneth no. 1276* (**CGE**).

Ab *Hieracio grovesii* Pugsley foliis basalibus minus dentatis et in pagina superiore pilis stellatis numerosissimis (sed in pagina inferiore aliquantum paucioribus) vestitis, folio caulino infimo saepe majore, involucro obscuriore, stylis obscuris differt. Ab omnibus aliis Sectionis *Alpinorum* speciebus britannicis pilis stellatis densissimis in utraque foliorum basalium pagina distinguitur.

Planta phyllopoda. *Caulis* 15–30 cm altus, striatus, ad basin saepe rubriusculoviolaceus, in parte inferiore pilis simplicibus eglanduliferis sparsis brevibus vel longis albiusculis nigricantibasibus, pilis glanduliferis sparsis brevissimis flaviusculis, pilis stellatis paucis, in parte superiore pilis simplicibus eglanduliferis numerosis brevibus vel longis aliquantum griseiusculis nigricantibasibus, pilis glanduliferis numerosis brevissimis et aliquot brevibus flaviusculis et obscuris, pilis stellatis numerosis vestitus. *Folia* tristiuscule mediocriter vel intensiuscule viridia, saepe partim triste rubriusculoviolaceotincta vel suffusa; folia basalia exteriora 5–60 mm longa, 5–2·5 mm lata, subrotunda vel late ovata, ad apicem obtusomucronata, integra vel denticulata vel dentibus paucis haud profundis instructa, ad basin magis minusve cuneata, interiora 25–70 mm longa, 5–25 mm lata, plerumque late vel anguste elliptica, raro oblanceolata vel obovata, ad apicem obtusomucronata vel subacuta, integra vel denticulata vel dentibus paucis haud profundis acutis instructa, ad basin attenuata, in utraque pagina et in marginibus pilis simplicibus eglanduliferis brevibus vel mediocribus albis pallidibasibus vel nigricantibasibus (in paginis sparsis, in marginibus densioribus), pilis glanduliferis paucis vel multis brevissimis flaviusculis, pilis stellatis numerosissimis vel densis vestita; petioli interdum longi, pilis simplicibus eglanduliferis numerosis mediocribus vel longis albis vestiti; folia caulina 1–2(–3), infimum 10–70 mm longum, 4–10(–20) mm latum, oblanceolatum vel lanceolatum, ad apicem obtusum vel acutum, integrum, ad basin attenuatum, pilis simplicibus eglanduliferis pilisque glanduliferis brevissimis nonnullis, pilis stellatis numerosis (praecipue in pagina inferiore) vestitum, petiolo brevi instructum, cetera magis minusve bracteiformia et similiter vestita, unum saepe gemma rudimentali in axilla praeditum. *Capitulum* plerumque solitarium, interdum 2, circa 30–50 mm diametro; involucrum facie atriusculoviridi, campanulatum, ad basin late rotundatum, supra basin constrictum; pedunculi (si adsunt) cauli superiori similiter vestiti. *Involucri squamae* ante anthesin incumbentes, atriusculovirides; omnes pilis simplicibus eglanduliferis densis longis (ad 5 mm) sinuosis albis vel griseiusculis nigricantibasibus, pilis glanduliferis numerosis brevibus nigriusculistipitatis flavicapitatis, a pilis simplicibus eglanduliferis magis minusve omnino tectis, vestitae, sine pilis stellatis sed interiores ad apicem pilis ramosis brevibus nonnullis ornatae; squamae interiores 15–17 mm longae, 1·5–2·0 mm latae, appressae, latiuscule lineari-lanceolatae, ad apicem acutissimum magis minusve gradatim protractae; squamae exteriores breviores. *Ligulae* clare mediocriter vel intensiuscule flavae; exteriores ad apicem magis minusve discretae et profunde irregulariterque dentatae, concavae, in pagina inferiore pilis simplicibus eglanduliferis paucis vel multis brevissimis vel brevibus pallidis vestitae, ad apicem pilis aliquot brevibus ultra dentium margines protrudentibus. *Styli* obscuri. *Receptaculi alveoli* margine breviter dentati. *Cypselae* 3·5–4·0 mm longae, purpureiusculonigrae.

Rock-ledges on Dalradian mica-schist from 700 to 820 m, on Meall Buidhe and Beinn a' Chreachain in Argyll (v.c. 98). Endemic.

Hieracium pensum P. D. Sell & C. West, **sp. nov.**

HOLOTYPUS: East-facing cliffs of Coire Ghranda, Beinn Dearg, East Ross, v.c. 106, GR NH/ 267.806, 27 July 1967, *R. W. Jones & B. A. Miles no. 67/84* (**CGE**).

Ab *Hieracio mundo* P. D. Sell & C. West foliis minus rigidis minus coriaceis minus pilosis, capitulo saepe majore pilisque glanduliferis manifestioribus ornato; ab *H. perscito* P. D. Sell & C. West capitulo multo majore pilisque glanduliferis manifestis multo paucioribus ornato; ab *H. subgloboso* P. D. Sell & C. West statura robustiore, involucro majore; ab *H. kennethii* P. D. Sell & D. J. Tennant foliorum pagina superiore glabra differt. A ceteris Sectionis *Alpinorum* speciebus britannicis aut distributione geographica aut stylis obscuris distinguitur.

Planta phyllopoda. *Caulis* 10–30 cm altus, mediocris vel robustus, saepe flexuosus, ad basin interdum rubriusculopurpureotinctus; in parte inferiore pilis simplicibus eglanduliferis numerosis vel aliquantum densis mediocribus vel longis gracilibus sinuosis albis nigricantibasibus, pilis glanduliferis paucis brevissimis plerumque pallidis, pilis stellatis aliquantum sparsis vestitus; in parte superiore pilis simplicibus eglanduliferis aliquot vel multis longis gracilibus griseiusculis nigricantibasibus, pilis glanduliferis numerosis brevissimis vel brevibus obscuris, pilis stellatis densis vestitus. *Folia* pallidiuscule vel mediocriter viridia, pruinam dilute caesiam ferentia, hebetata vel paulo modo nitida, venis conspicuis ornata, in marginibus et ad apicem interdum leviter rubriusculoviolaceotincta; folia basalia satis numerosa, exteriora 10–50 mm longa, 8–27 mm lata, subrotunda vel obovata vel elliptica, ad apicem rotundo-obtusa, acute denticulata vel dentibus paucis haud profundis vel anguste mammiformibus instructa, ad basin cuneata, interiora 20–80 mm long, 8–30 mm lata, oblanceolata vel obovata vel elliptica raro ovata, non coriacea, plana vel paulo canaliculata, raro leviter undulata, ad apicem interdum tortum obtusa perspicueque mucronata vel subacuta cuspidataque, serrata, dentibus irregularibus patentibus vel retrorsis anguste mammiformibus interdum cuspidatis (aliquando in petiolum descendentibus), ad basin cuneata vel attenuata, omnia in marginibus pilis simplicibus eglanduliferis numerosis vel densis mediocribus vel longis vel longissimis gracilibus subrigidis sinuosis pallidibasibus vestita, pleraque in pagina superiore sine pilis simplicibus eglanduliferis praeter intima (quae interdum uniformiter vestiuntur), in pagina inferiore pilis simplicibus eglanduliferis brevibus vel longis sinuosissimis interdum nigricantibasibus modice et uniformiter vel in costa densius vestita, in pagina inferiore marginibusque pilis glanduliferis aliquot minutis flaviusculis vestita; petioli mediocres vel sublongi graciles alati, interdum dentibus paucis instructi, plerumque pilis simplicibus eglanduliferis densis longis sinuosis patentibus vel retrorsis vestiti; folia caulina (2–)3–5(–7), infimum 10–55(–110) mm longum, 2–20 mm latum, interdum prope caulis basin situm, magis minusve patens, interdum undulatum, oblanceolatum vel anguste ellipticum, ad apicem anguste acutum, saepe dentibus parvis angustis nonnullis instructum vel denticulatum, ad basin attenuatum saepe petiolatum, in marginibus pilis simplicibus eglanduliferis densis longis nigricantibasibus (ad basin densissimis longissimis sinuosis), in pagina superiore pilis talibus paucis vel nullis, in pagina inferiore pilis talibus dispersis, in costa marginibusque pilis stellatis paucis vel nullis vestitum, cetera folia caulina anguste elliptica vel linearia integra, vel summum bracteiforme, unum interdum gemma rudimentali in axilla praeditum. *Capitulum* plerumque solitarium, aliquando 2 vel plura vel cum altero a secundo caule e basi exoriente portato, 35–58 mm diametro; involucrum facie obscure viridiusculogrisea vel viridusculonigra, campanulatum, ad basin late rotundatum; pedunculi (si adsunt) cauli superiori similiter vestiti. *Involucri squamae* ante anthesin incumbentes, viridiusculoatrae; omnes pilis simplicibus eglanduliferis densis longis (ad 3·5 mm) albis vel aliquantum griseiusculis nigricantibasibus, pilis glanduliferis numerosis brevissimis vel brevibus et paucis mediocribus (ad 1·0 mm) obscuris, a pilis simplicibus eglanduliferis partim modo tectis, vestitae, sine pilis stellatis, interiores ad apicem pilorum brevium caespite ornatae; squamae interiores 12–20 mm longae, 1·1–1·8 mm latae, aliquantum laxae paulo curvatae lineari-lanceolatae, ad apicem plerumque acutissimae; squamae exteriores laxae erectae aliquantum breviores, ad apicem abrupte acutae. *Ligulae* pallidiuscule vel mediocriter flavae; exteriores latae (ad 4·7 mm), ad apicem semidiscretae et profunde et saepe irregulariter dentatae, fere rectae, in pagina inferiore pilis simplicibus eglanduliferis paucis brevissimis pallidis vestitae vel nullis, ad apicem pilis talibus paucis vel aliquot brevissimis (et interdum paucis brevibus) ultra dentium margines protrudentibus. *Styli* uniformiter obscure viridiusculogrisei. *Receptaculi alveoli* margine breviter dentati. *Cypselae* 3·5–4·0 mm longae, purpureiusculonigrae. 2n = 36.

Cliff-ledges and large rocks, infrequently rock detritus, on quartz-biotite mica-schist and weathered microgranite between 520 and 915 m: on Beinn Dearg, Seana Bhraigh and Fannich Forest and Braemore Forest hills in West and East Ross (v.cc. 105 and 106). Endemic.

Hieracium perscitum P. D. Sell & C. West, **sp. nov.**

Holotypus: Rocky knoll, c. 530 m, An Teallach, West Ross, v.c. 105, GR NH/082.864, 29 July 1978, *A. G. Kenneth & P. D. Sell no. 78/337* (**CGE**).

Hieracio hanburyi Pugsley simillimum, a quo foliis basalibus ovatis vel lanceolatis plerumque dentibus minoribus regularioribus ornatis, folio caulino infimo patente, involucris minoribus angustioribusque et pilis eglanduliferis multo longioribus quam pilis glanduliferis vestitis, stylis valde obscurioribus distinguitur.

Planta phyllopoda. *Caulis* 10–27 cm, plerumque gracilis, saepe flexuosus, infra pallide violaceotinctus, basin versus pilis simplicibus eglanduliferis plus minusve numerosis vel densis mediocribus et longis vel longissimis gracilibus sinuosis albis plerumque nigricantibasibus, in parte superiore pilis talibus dispersis vel sparsis brevibus vel longis gracillimis sinuosissimis, in parte inferiore pilis glanduliferis dispersis brevissimis pallidis, in parte superiore pilis talibus numerosioribus brevissimis vel brevibus obscuris, in parte inferiore pilis stellatis dispersis, in parte superiore pilis talibus numerosioribus vestitus. *Folia* pallidiuscule vel clariuscule mediocriter viridia vel intensius triste glauciusculoviridia, dilute nitida vel hebetata, in utraque pagina et in marginibus plerumque sordidoviolaceotincta vel notata (vel in pagina inferiore pallidiora); folia basalia pauca vel aliquot, exteriora 5–40 mm longa, 8–25 mm lata, subrotunda vel late ovata vel late elliptica, ad apicem late rotundo-obtusa, integra vel denticulata vel haud profunde sinuatodentata, ad basin cuneata vel rotundata, interiora 15–50 mm longa, 6–20 mm lata, interdum leviter undulata, subrigida sed non (vel leviter modo) coriacea, ovata vel ovatolanceolata vel elliptica, ad apicem rotundo-obtusa vel subacuta vel acuta saepe apiculata, remote denticulata vel irregulariter serratodentata, dentibus angustis vel latis saepe ascendentibus rubriusculoviolaceis mammiformibus, ad basin cuneata vel aliquando attenuata, folia basalia omnia pilis simplicibus eglanduliferis dispersis vel satis densis brevibus et mediocribus et aliquando longis gracilibus mollibus vel subrigidis sinuosis albis ad bases bulbosas pallidis vel obscuris (in foliorum interiorum pagina superiore saepe uniformiter distributis, in marginibus densis sinuosissimisque, in pagina inferiore aliquantum paucioribus sed in costa saepe densis; in foliis exterioribus sparsius distributis), in utraque pagina et in marginibus pilis glanduliferis paucis perbrevissimis flaviusculis vestita; petioli plerumque breviusculi, graciles, ad basin saturate rubriusculoviolaceotincti, pilis simplicibus eglanduliferis numerosis vel densis longis vestiti; folia caulina (0–)1–3(–5), infimum 10–50(–70) mm longum, 2–15(–20) mm latum, rigide patens, saepe undulatum, ad trientem vel dimidium inter caulis basin et apicem positum, plerumque lanceolatum, aliquando anguste ovatum, saepe folia basalia intima simulans, ad apicem gradatim acutum vel acuminatum vel magis minusve cuspidatum, denticulatum vel irregulariter serratum, dentibus paucis acutis vel anguste mammiformibus, ad basin saepe sessilem aliquando petiolatam semiamplexicaulem cuneatum vel attenuatum, in pagina superiore pilis simplicibus eglanduliferis sparsis interdum nigricantibasibus, in pagina inferiore marginibusque pilis talibus densioribus, in pagina inferiore pilis stellatis nonnullis vestitum, folium a basi secundum semipatens lineare vel lineari-lanceolatum integrum sessile, vel bracteiforme, in pagina superiore glabrum, in pagina inferiore pilis stellatis densis vestitum, cetera folia caulina (si adsunt) perminuta filamentosa acuta appressa vel semipatentia, unum interdum gemma rudimentali in axilla praeditum. *Capitula* 1–2, 23–42 mm diametro; involucrum facie viridiusculonigra vel nigriuscula, anguste campanulatum, ad basin rotundatum vel subtruncatum; pedunculi (si adsunt) cauli superiori similiter vestiti. *Involucri squamae* ante anthesin incumbentes, atriusculovirides, interiores marginibus aliquantum pallidioribus; omnes pilis simplicibus eglanduliferis numerosis mediocribus vel longis (ad 2 mm) gracilibus aliquantum griseiusculis nigricantibasibus, pilis glanduliferis numerosis brevissimis brevibusque obscuris (quorum pauci a pilis simplicibus eglanduliferis teguntur), pilis stellatis paucis vel nullis vestitae sed interiores ad apicem pilorum brevium caespite ornatae; squamae interiores 10–13 mm longae, 1·2–1·7 mm latae, arcte appressae, latiuscule lineari-lanceolatae, ad apicem pleraeque obtusae nonnullae subacutae; squamae exteriores breviores, magis minusve appressae. *Ligulae* clare mediocriter flavae; exteriores ad apicem magis minusve discretae et profunde dentatae vel laciniatodentatae, rectae vel aliquantum concavae, in pagina inferiore pilis simplicibus eglanduliferis paucis vel nullis pallidis vestitae, ad apicem pilis talibus brevissimis paucis vel nullis ultra dentium margines protrudentibus. *Styli* obscure viridiusculogrisei. *Receptaculi alveoli* margine interdum fimbriatodentati. *Cypselae* 3·9–4·7 mm longae, purpureiusculonigrae. 2n = 36.

Rocky knolls, from 530 to 760 m, on Torridonian Sandstone and Moine Schist: An Teallach Range, Ben More Coigach, Braemore Forest and Fannich Forest hills in West and East Ross (v.cc. 105 and 106). Endemic.

Hieracium probum P. D. Sell & C. West, **sp. nov.**
HOLOTYPUS: Cliffs at north-west side of Coire Ardair, near Loch Laggan, Westerness, v.c. 97, GR NN/430.884, 25 July 1966, *R. W. Jones & B. A. Miles no. 66/68* (**CGE**).

A speciebus omnibus britannicis *Hieracii* Sectionis *Alpinorum* stylis obscuris ornatis (praeter quasdam geographice disjunctas) caulibus foliisque suis sparsius pilosis, involucri squamis minus acutis minusque sericeis, ligulis saturate flavis distinguitur.

Planta phyllopoda. *Caulis* 13–35 cm altus, singularis vel interdum plures, gracilis vel robustus, saepe flexuosus, valde striatus, in parte inferiore pilis simplicibus eglanduliferis pilisque glanduliferis pilisque stellatis sparsissimis, in parte superiore pilis simplicibus eglanduliferis paucis vel multis brevibus vel longis gracilibus sinuosis albiusculis ad bases longas aliquantum tumidas nigris, pilis glanduliferis plus minusve numerosis brevissimis vel brevibus (ad 0·5 mm) nigriusculis, pilis stellatis sparsis vel densis vestitus. *Folia* pallidiuscule vel saturate tristiuscule viridia, subnitida vel hebetata, interdum subcoriacea, raro rubriusculoviolaceomaculata; folia basalia numerosa (8–14), exteriora 10–30 mm longa, 7–25 mm lata, interdum undulata, obovata vel subrotunda vel elliptica, ad apicem rotundo-obtusa interdum apiculata raro retusa, integra vel denticulata, ad basin attenuata vel cuneata vel subtruncata, interiora 35–70 mm longa, 13–25 mm lata, undulata, obovata vel oblanceolata vel elliptica, ad apicem saepe obtusa interdum subacuta plerumque apiculata leviterque torta, denticulata vel incisodentata vel serratodentata, dentibus irregularibus late vel anguste mammiformibus vel aquilinomammiformibus, ad basin cuneata vel attenuata, omnia in pagina superiore (vel modo ad vel prope margines) pilis simplicibus eglanduliferis paucis vel multis mediocribus vel longis (ad 2 mm) subrigidis sinuosis albis ad bases bulbosas pallidiusculis, in pagina inferiore pilis talibus paucis vel multis brevioribus magis minusve uniformiter distributis, in utraque pagina et in marginibus pilis glanduliferis paucis brevissimis gracilibus flaviusculis vestita; petioli aliquantum graciles, longi (ad 7 cm), late alati, interdum dentibus paucis instructi, ad basin rubriusculoviolacei, in marginibus pilis simplicibus eglanduliferis paucis vel multis mediocribus vel longiusculis interdum appressis vestiti vel fere glabri; folia caulina 1–3(–5), infimum 10–60 mm longum, 2–12 mm latum, erectum appressumque vel patens, interdum undulatum, anguste ellipticum vel lineari-oblanceolatum, ad apicem abupte acutum vel obtusum saepe tortum, subintegrum vel dentatum dentibus paucis, ad basin breviter cuneatum vel attenuatum interdum magis minusve petiolatum saepe alatum, in pagina superiore (saepe modo margines versus) pilis simplicibus eglanduliferis multis mediocribus pallidis, in pagina inferiore interdum pilis stellatis paucis vestitum, cetera folia caulina linearia abrupte acuta vel bracteiformia vel filamentosa erecta. *Capitulum* plerumque solitarium, interdum 2(–5), circa 35–45 mm diametro; involucrum facie obscure viridiusculogrisea vel viridiusculonigra, campanulatum vel late campanulatum; pedunculi (si adsunt) cauli superiori similiter vestiti. *Involucri squamae* ante anthesin incumbentes, atriusculovirides, interiores marginibus indistinctis pallidioribus; omnes pilis simplicibus eglanduliferis mediocribus vel longis (ad 3 mm) gracilibus pallidis vel aliquantum griseiusculis ad bases longas incrassatas nigris, pilis glanduliferis aliquot vel numerosis manifestis brevissimis vel brevibus (ad 0·4 mm) obscuris vestitae, sine pilis stellatis sed interiores ad apicem pilorum ramulosorum simpliciumque caespite definito ornatae; squamae interiores 15–17 mm longae, 1·0–1·7 mm latae, inaequales appressae linearilanceolatae, ad apicem interdum incurvatum plerumque abrupte acutae vel subacutae interdum obtusae vel acuminatae vel mucronatae, intimae saepe angustae acutae; squamae exteriores breviores appressae vel semilaxae. *Ligulae* saturate tristiuscule flavae; interiores densae; exteriores ad 4·2 mm latae, ad apicem discretae vel valde discretae, aliquantum concavae vel ad apicem profunde dentatum perspicue concavae, raro non evolutae (ad apicem convexe involutae), in paginae inferioris parte superiore pilis simplicibus eglanduliferis paucis pallidis vestitae vel nullis, pilis talibus paucis perbrevissimis vel brevibus ultra dentium margines protrudentibus. *Styli* obscure viridiusculogrisei; stigmata aliquantum pallidiora. *Receptaculi alveoli* margine breviter dentati. *Cypselae* 3·2–4·2 mm longae, purpureiusculonigrae. 2n = 36.

Rocks and ledges between 550 and 915 m: on hard mica-schist on Creagan Liatha, Stob Binnein and An Caisteal in West Perth (v.c. 87), on Cruach Ardrain in (?) Mid Perth (v.c. 88), and in Moy Corrie and Coire Ardair, both on Creag Meagaidh, and in the adjacent Coire nan Gall, Westerness (v.c. 97); on granitic rock on Aonach Mor and Aonach Beg, Westerness (v.c. 97); on Bidean nam Bian, Glen Coe, in Main Argyll (v.c. 98). Endemic.

Hieracium subglobosum P. D. Sell & C. West, **sp. nov.**

Holotypus: Cliff-ledges, c. 640 m, south of lochan in north-east corrie of Ben Hope, West Sutherland, v.c. 108, GR NC/484.503, 22 July 1966, *R. W. Jones & B. A. Miles no. 66/40* (**CGE**).

Ab *Hieracio globosifloro* Pugsley (quod est facie simillimum) statura saepe minore, foliis clarius viridibus, ligulis minus densis, stylis obscuris differt.

Planta phyllopoda. *Caulis* 6–20(–30) cm altus, gracilis vel mediocris, saepe flexuosus, ad basin rubriusculoviolaceus, ubique pilis simplicibus eglanduliferis paucis vel multis brevibus mediocribusque longisque gracilibus sinuosis albis vel griseiusculis ad bases incrassatas nigriusculis, in parte inferiore pilis talibus dispersis pallidis interdum retrorsis, in parte superiore pilis talibus aliquot vel multis mediocribus vel longis (ad 4 mm) patentibus saepe griseiusculis ad bases longas nigris, in parte inferiore pilis glanduliferis dispersis brevissimis flaviusculis, in parte superiore pilis talibus numerosis vel densis brevibus mediocribusque (ad 1·0 mm) nigriusculis, in parte inferiore pilis stellatis dispersis, in parte superiore pilis talibus numerosis vel densis vestitus. *Folia* mediocriter saepe clare viridia, in pagina superiore nitida, in pagina inferiore pallidiora, saepe triste rubriusculoviolaceotincta (praecipue in pagina dentium marginumque superiore et in costa subtus); folia basalia aliquantum pauca vel numerosa, saepe parva, in foliorum satis regularium rosula, exteriora 3–50 mm longa, 3–25 mm lata, subrotunda vel ovata vel obovata, ad apicem late rotundo-obtusa, integra vel denticulata, ad basin cuneata, interiora 15–90 mm longa, 2–30 mm lata, aliquantum tenuia vel coriacea, aliquando canaliculata, anguste vel late elliptica vel obovato-lanceolata, ad apicem acuta vel obtusa saepe apiculata, subintegra vel denticulata interdum undulata vel irregulariter serratodentata vel incisa, dentibus aliquando magnis irregularissimis patentibus vel ascendentibus anguste mammiformibus vel aquilinomammiformibus, ad basin cuneata vel breviter attenuata, folia interiora in pagina superiore plerumque fere glabra sed versus et ad margines pilis simplicibus eglanduliferis aliquot vel numerosis mediocribus vel longis subrigidis albis ad bases bulbosas saepe discoloribus vel nigris (in foliis intimis pilis longioribus densioribusque), folia omnia in pagina inferiore pilis talibus dispersis mollioribus (in costa densis), in utraque pagina pilis glanduliferis paucis brevissimis flaviusculis (in marginibus nonnullis) pilisque ramosis paucissimis brevissimis vestita; petioli breves vel longi, graciles, saepe basin versus rubriusculoviolaceotincti, in marginibus interdum dentibus paucis pilisque simplicibus eglanduliferis dispersis vel densis (praecipue basin versus) mediocribus vel longis subrigidis interdum sinuosis ornati; folia caulina (0–)1–3(–5), infimum 6–60 mm longum, 1–7 mm latum, semipatens vel erectum, lineari-ellipticum, ad apicem attenuatoacutum vel rarissime obtusum, plerumque integrum raro remote denticulatum vel dentibus paucis acutis ornatum, ad basin attenuatum, in pagina superiore glabrum, in marginibus et pagina inferiore pilis simplicibus eglanduliferis mediocribus subrigidis saepe nigricantibasibus (basin versus longis saepe densis) pilisque stellatis dispersis vestitum, cetera folia caulina parva acuta vel filamentosa vel bracteiformia appressa. *Capitulum* solitarium, saepe parvum, raro 2, 25–40 mm diametro; involucrum facie nigriuscula vel raro obscure viridiusculogrisea, campanulatum vel anguste campanulatum, in pedunculum decrescens, sed ad basin rotundatum, supra basin constrictum; pedunculi (si adsunt) cauli superiori similiter vestiti. *Involucri squamae* ante anthesin incumbentes, atriusculovirides, interiorum nonnullae marginibus inconspicuis viridiusculis; omnes pilis simplicibus eglanduliferis aliquot vel densis mediocribus vel longiusculis (ad 4 mm) patentibus sinuosis albis vel frequentius griseiusculis ad bases longissimas incrassatas nigris, pilis glanduliferis numerosis brevissimis pallidis et brevibus nigriusculis, a pilis simplicibus eglanduliferis partim modo tectis, sine pilis stellatis sed ad apicem pilis ramosis nonnullis brevibus vestitae; squamae interiores 9–16 mm longae, 0·9–1·7 mm latae, inaequales, saepe curvatae, raro numerosissimae, satis arcte appressae, lineari-lanceolatae, intimae angustissimae, ad apicem acutissimum vel acuminatum attenuatae, raro subacutae vel obtusae; squamae exteriores breviusculae, erectae, ad apicem acutae. *Ligulae* clare pallide flavae, raro mediocriter flavae; exteriores ad apicem saepe valde discretae et profunde interdumque irregulariter dentatae, rectae vel haud profunde concavae, sine pilis vel interdum pilis simplicibus eglanduliferis paucissimis brevibus pallidis in pagina inferiore vestitae et aliquando pilis talibus paucis brevissimis magis minusve griseiusculis ultra dentium margines protrudentibus. *Styli* magis minusve uniformiter obscurissime grisei vel mediocriter viridiusculogrisei. *Receptaculi alveoli* margine breviter dentati. *Cypselae* 3·5–4·2 mm longae, purpureiusculonigrae. 2n = 27.

Mainly on gentle rocky slopes or rocky knolls, occasionally on rock-ledges, on Moine and other schists, quartzite, microgranite and Torridonian Sandstone, usually between 550 and 850 m, but descending to 350 m just south of Cape Wrath. Widespread in the north-western Highlands, but often local in its individual localities: near Loch Cluanie and in Glen Affric and Glen Cannich near the western border of Easterness (v.c. 96), and on several hills in the northern part of Westerness (v.c. 97); on numerous hills in West Ross (v.c. 105) and several in East Ross (v.c. 106) including Seana Bhraigh and Beinn Dearg and in Glen Carron (Achnasheen); on hills south and east of Loch More in East Sutherland (v.c. 107) and many hills throughout West Sutherland (v.c. 108). Endemic.

ACKNOWLEDGMENTS

We are greatly indebted to Philip Oswald not only for correcting the Latin grammar but also for making the descriptions more lucid. We thank Clive Stace for allowing us to include the chromosome numbers counted at the School of Biological Sciences of the University of Leicester.

REFERENCES

Pugsley, H. W. (1948). A prodromus of the British Hieracia. *Journal of the Linnean Society of London (Botany)* **54**: 1–356.

Stace, C. A., Gornall, R. J., Squirrell, J. & Shi, Y. (1995). Chromosome numbers in *Hieracium* L. section *Alpina* (Fries) F. N. Williams. *Watsonia* **20**: 367–377.

(*Accepted March 1995*)

Chromosome numbers in *Hieracium* L. section *Alpina* (Fries) F. N. Williams

C. A. STACE, R. J. GORNALL, J. SQUIRRELL and Y. SHI

Department of Botany, University of Leicester, Leicester, LE1 7RH

ABSTRACT

Cytological study of 34 of the 35 named British taxa of *Hieracium* section *Alpina*, plus two un-named taxa, showed that 24 are tetraploids (2n = 36), six are triploids (2n = 27), one is a pentaploid (2n = 45), one (*H. macrocarpum*) is a tetraploid or hypertetraploid (2n = 36 or 37), and four occur as both triploids and tetraploids. Of the latter four, *H. tenuifrons* is represented by a western tetraploid, a central triploid and an eastern tetraploid race; *H. insigne* f. *celsum* is represented by a triploid western and a tetraploid eastern race (but only one plant of the former was counted); and material of the other two taxa was insufficient to draw any firm conclusions. The pentaploid taxon (un-named, from An Teallach, W. Ross, v.c. 105) appears to be the first count for any taxon of *Hieracium* sensu stricto above the level of tetraploid.

KEYWORDS: apomixis, hawkweeds, polyploidy, Britain.

INTRODUCTION

TAXONOMY

The genus *Hieracium* L. (Asteraceae) is well known as one in which apomixis is widespread, giving rise to a very large number of variants that have been described as species and to a lesser extent at other ranks. In the older literature the genus was divided into subgenus *Hieracium* and subgenus *Pilosella* (Hill) Gray, but most modern works now treat the latter as the separate genus *Pilosella* Hill. This separation is based on a range of morphological, biochemical, cytological and genetical characteristics. Nevertheless, in most of the literature the generic name *Hieracium* remains ambiguous; it might or might not include *Pilosella*, or indeed concern *Pilosella* alone. An idea of the number of taxa in these two genera is provided by the fact that under *Hieracium* and *Pilosella* there are 11,827 entries in *Index Kewensis* (CD-ROM version, 1993).

British hieraciologists have traditionally divided *Hieracium* sensu stricto into up to 16 sections. The latest work (Kent 1992) recognized twelve, which follows the views of Sell & West (1968). Section *Alpina* (Fries) F. N. Williams is relatively easily recognized by its short scapose stems bearing usually only a single terminal capitulum. The species in Britain mostly occur in rock crevices and on rock ledges and other rather bare rocky places at over 600 m altitude. Sell & West (1976), in their account of *Hieracium* (incl. *Pilosella*) for *Flora Europaea*, did not divide the genus into sections, but instead recognized 260 main taxa at the level of species or species groups. Section *Alpina* in the sense of British authors corresponds with Sell & West's '*H. alpinum* group' and '*H. nigrescens* group' (nos. 158 and 159).

Kent (1992) listed 19 microspecies within section *Alpina*, to which must be added the eleven new species and five extra formae described by Sell *et al.* (1995). There still remain about half a dozen other variants in Scotland that merit names (D. J. Tennant, pers. comm., 1994). The 35 named taxa are distributed as follows: 28 are endemic to Scotland; *H. subgracilentipes* is endemic to the English Lake District; five species (*H. alpinum*, *H. calenduliflorum*, *H. eximium*, *H. globosiflorum* and *H. tenuifrons*) occur in Scotland and European mountains, the first-named extending to Greenland; and *H. holosericeum* occurs in Scotland, the English Lake District, Snowdonia and the European mountains.

TABLE 1. SUMMARY OF CHROMOSOME COUNTS OF SPECIES OF *HIERACIUM* AND *PILOSELLA*

Ploidy Level		No. of Taxa
Diploid	(2n = 2x = 18)	83
Triploid	(2n = 3x = 27)	110
Tetraploid	(2n = 4x = 36)	66
Pentaploid	(2n = 5x = 45)	21
Hexaploid	(2n = 6x = 54)	6
Heptaploid	(2n = 7x = 63)	4
Octoploid	(2n = 8x = 72)	1
Nonaploid	(2n = 9x = 81)	1
Decaploid	(2n = 10x = 90)	2

See text for sources. Aneuploid counts have been rounded off to the nearest euploid level.

CHROMOSOME NUMBERS

We have carried out a literature survey of the chromosome numbers of the genera *Hieracium* and *Pilosella* reported in the standard abstracting references, covering the years up to 1989, to which we have added relevant data in *The cytological catalogue of the British and Irish flora* (Bailey & Gornall ined.). The results are summarized in Table 1. The total number of taxa cannot be obtained by summing the totals, because some occur at more than one ploidy level. Species of both *Hieracium* and *Pilosella* contribute to the diploid, triploid and tetraploid totals, but we have been unable to separate the totals for these two genera. However, in the pentaploid and higher levels all reports but one refer to the genus *Pilosella*. The single exception is actually somewhat spurious, since it refers to the presence of 54 chromosomes in certain pollen mother cells of a plant of *H. umbellatum* with 2n = 27 (Rosenberg 1927b). It is thus the case to date that all known chromosome numbers of *Hieracium* sensu stricto are diploid, triploid or tetraploid (with some aneuploids). As far as we are aware, the diploids represent sexual and the triploids and tetraploids apomictic plants (Rosenberg 1927a).

There have been relatively few chromosome studies of British or Irish *Hieracium* sensu stricto. Mills & Stace (1974) reported counts for 21 and Morton (1974) for twelve taxa, only one being common to the two lists. We know of British counts for only two other species (Bailey & Gornall ined.). These 34 taxa cover eleven of the twelve sections of the genus. Eleven of the species are tetraploid and 21 triploid; the other two taxa (*H. umbellatum* L. subsp. *umbellatum* and subsp. *bichlorophyllum* (Druce & Zahn) Sell & C. West) exist as both diploid and triploid cytotypes. Hence in the British Isles only the two subspecies of *H. umbellatum* are known to be sexual.

In section *Alpina* there have hitherto been only two British counts. Mills & Stace (1974) found *H. hanburyi* to be tetraploid (2n = 36) and Morton (1974) reported the same for *H. calenduliflorum*. Elsewhere there are counts for *H. alpinum* (2n = 27 for material from Greenland, Iceland, Fennoscandia, Komi ASSR, Siberian Arctic, Poland, Slovakia and Switzerland) and for the non-British *H. nigrescens* Willd. (2n = 27 from Komi ASSR).

As part of a molecular genetic investigation of section *Alpina*, we have made a detailed cytological investigation of our material. Here we report the chromosome numbers of 152 plants (34 of the 35 named taxa, plus two un-named ones and four 'intermediates') and discuss their significance.

MATERIALS AND METHODS

Mr D. J. Tennant has made a detailed study of *Hieracium* section *Alpina* over the past 25 years. Uniquely, he has seen all the taxa in their native situation, and has grown them all in his Yorkshire garden. Most of his collection (c. 150 pots), including all but two of the 35 taxa, was transferred to Leicester in 1993 and 1994 for safe-keeping, propagation and study. This has been supplemented by some of our own collections, plants having been grown from wild-collected seed, and by F_1 plants grown from seed produced by Mr Tennant's plants. The collection now contains all the 35 named taxa except *H. optimum* Sell & C. West, as well as six other problematical un-named taxa (Table 2). All determinations have been made by Mr D. J. Tennant. At present the vouchers are the living plants, which are too valuable to press. However, F_1 plants are being grown as vouchers.

Plants are kept in an unheated greenhouse, being grown in 12·5 cm pots containing equal parts of potting compost and terrace gravel (derived from granite) collected in the Cairngorms, Scotland. Seed is germinated on 1% agar after two weeks in tap-water at 4°C. Plants are transferred to pots in compost as soon as they are large enough to move from the agar, and potted on into the compost-gravel mixture when they are fully established.

Cytological studies were made on the pot-grown plants. Actively growing roots were placed into a pretreatment solution of 0.002M 8-hydroxyquinoline and kept at 4°C for 24 hours. Subsequently the pre-treatment solution was replaced by fixative (3 parts absolute ethyl alcohol: 1 part glacial acetic acid). Roots were hydrolysed for 10 minutes at room temperature in 5M HCl, which was then removed and replaced by 70% IMS (industrial methylated spirit).

Dissection of the root was carried out in a drop of 40% acetic acid on a microscope slide. The removed root tip was then transferred into a drop of 2% certified aceto-orcein. Epidermal tissue was removed and discarded thus revealing the meristematic regions, which were then macerated and finally squashed.

The resultant slides were viewed under a high power microscope for suitable, countable metaphases. Chromosome counts were made from at least three root tips for each accession.

RESULTS

The chromosome counts made for 152 plants are listed in Table 2. These cover 34 named taxa, plus:

1. Plants apparently intermediate between *H. eximium* and *H. calenduliflorum*, now thought by Mr Tennant to be a variant of *H. leptodon* (EXI/CLD-1);
2. Plants apparently intermediate between *H. eximium* and *H. memorabile* (EXI/MEM-51, 52 & 53);
3. Plants apparently intermediate between *H. hanburyi* and *H. tenuifrons* (HAN/TNF-1 & 2);
4. Plants apparently intermediate between *H. tenuifrons* and *H. memorabile* (TNF/MEM-51);
5. An un-named, probably new, taxon from Ben Dearg, E. Ross, v.c. 106 (XYZ-2); and
6. An un-named, probably new, taxon from An Teallach, W. Ross, v.c. 105 (XYZ-1).

The first five of these are tetraploids (2n = 36), the last a pentaploid (2n = 45).

Of the 34 named taxa, six are triploids (2n = 27), 24 are tetraploids (2n = 36), and the other four gave both triploid and tetraploid counts. Two plants of *H. macrocarpum* (MAC-24 & 25) were found to be hypertetraploids (2n = 4x + 1 = 37); otherwise all the plants were euploids.

DISCUSSION

The marked prevalence of tetraploid over triploid counts for British species of section *Alpina* (28:10) is in strong contrast to the previously published figures for *Hieracium* (including some *Pilosella* species) overall world-wide (66:110, see Table 1) or for *Hieracium* sensu stricto in Britain alone (13:23). This is particularly surprising since all the previous counts (c. 12) for non-British plants of section *Alpina* (involving two species, *H. alpinum* and *H. nigrescens*) were triploid. Our counts of British *H. alpinum* are also triploid (Fig. 1a).

The existence of a pentaploid (XYZ-1 from An Teallach, W. Ross) is unique (Fig. 1d); we have been able to discover no previous counts for plants of *Hieracium* sensu stricto above the level of tetraploid.

There are many reports of aneuploid counts in the literature. In Table 1 these figures were subsumed into the nearest euploid level. Without detailed population and karyotypic studies it is difficult to be sure of the significance of aneuploids. They could refer to odd individual plants, odd cells of euploid individuals, or simply to errors. On the other hand they might represent whole 'populations' of plants, or whole taxa. Examples of all of these situations are well known in apomicts. For example, most taxa of the *Limonium binervosum* (G. E. Sm.) Salmon aggregate are

TABLE 2. CHROMOSOME NUMBERS IN *HIERACIUM* SECTION *ALPINA*

H. alpinum L.
ALP-1. V.c. 92, S. Aberdeen: Glen Derry, NO/0.9. 2n = 27.
ALP-22. V.c. 92, S. Aberdeen: Glen Derry, NO/0.9. 2n = 27.
ALP-23. V.c. 88, Mid Perth: Ben More, Crianlarich, NN/4.2. 2n = 27.

H. backhousei F. Hanb.
BAC-1. V.c. 90, Angus: Glen South Esk, above Glen Clova, NO/2.7. 2n = 36.
BAC-4. V.c. 92, S. Aberdeen: Allt an Dubh Loch, above Glen Muick, Ballater, NO/2.8. 2n = 36.

H. calenduliflorum J. Backh.
CLD-1. V.c. 97, Westerness: Ben na' Socaich, Glen Spean, NN/2.7. 2n = 36.
CLD-2. V.c. 92, S. Aberdeen: Lochnagar, above Glen Muick, Ballater, NO/2.8. 2n = 36.
CLD-8. V.c. 92, S. Aberdeen: Allt an Dubh Loch, above Glen Muick, Ballater, NO/2.8. 2n = 36.
CLD-13. V.c. 92, S. Aberdeen: Allt an Dubh Loch, above Glen Muick, Ballater, NO/2.8. 2n = 36.
CLD-30. V.c. 92, S. Aberdeen: Allt an Dubh Loch, above Glen Muick, Ballater, NO/2.8. 2n = 36.
CLD-48. V.c. 92, S. Aberdeen: Allt an Dubh Loch, above Glen Muick, Ballater, NO/2.8. 2n = 36.
CLD-65. V.c. 92, S. Aberdeen: Allt an Dubh Loch, above Glen Muick, Ballater, NO/2.8. 2n = 36.
CLD-86. V.c. 92, S. Aberdeen: Allt an Dubh Loch, above Glen Muick, Ballater, NO/2.8. 2n = 36.
CLD-150. V.c. 97, Westerness: Ben na' Socaich, Glen Spean, NN/2.7. 2n = 36.
CLD-151. V.c. 90, Angus: Craig of Gowal, head of Glen South Esk, above Glen Clova, NO/2.8. 2n = 36.
CLD-152. V.c. 97, Westerness: Ben na' Socaich, Glen Spean, NN/2.7. 2n = 36.
CLD-153. V.c. 90, Angus: Bachnagairn, head of Glen South Esk, above Glen Clova, NO/2.7. 2n = 36.
CLD-154. V.c. 90, Angus: Loch Brandy, Glen Clova, NO/3.7. 2n = 36.
CLD-155. V.c. 97, Westerness: Ben na' Socaich, Glen Spean, NN/2.7. 2n = 36.
CLD-158. V.c. 97, Westerness: Aonach Mor, Ben Nevis range, above Glen Spean, NN/1.7. 2n = 36.

H. calvum Sell & D. Tenn.
CLV-1. V.c. 92, S. Aberdeen: Glen Derry, NO/0.9. 2n = 36.
CLV-2. V.c. 92, S. Aberdeen: Glen Derry, NO/0.9. 2n = 36.
CLV-3. V.c. 92, S. Aberdeen: Falls, Coire an Lochain Uaine, Derry Cairngorm, Glen Derry, NO/0.9. 2n = 36.
CLV-4. V.c. 92, S. Aberdeen: Glen Derry, NO/0.9. 2n = 36.
CLV-5. V.c. 92, S. Aberdeen: Glen Derry, NO/0.9. 2n = 36.
CLV-6. V.c. 92, S. Aberdeen: Glen Derry, NO/0.9. 2n = 36.
CLV-7. V.c. 96, Easterness: East side of Cairn Gorm, NJ/0.0. 2n = 36.
CLV-8. V.c. 92, S. Aberdeen: Glen Derry, NO/0.9. 2n = 36.
CLV-9. V.c. 96, Easterness: East side of Cairn Gorm, NJ/0.0. 2n = 36.
CLV-10. V.c. 96, Easterness: East side of Cairn Gorm, NJ/0.0. 2n = 36.
CLV-11. V.c. 96, Easterness: East side of Cairn Gorm, NJ/0.0. 2n = 36.
CLV-12. V.c. 96, Easterness: East side of Cairn Gorm, NJ/0.0. 2n = 36.

H. completum Sell & C. West
COM-1. V.c. 92, S. Aberdeen: Coire Etchachan, NO/0.9. 2n = 36.
COM-25. V.c. 92, S. Aberdeen: Coire Etchachan, NO/0.9. 2n = 36.
COM-35. V.c. 92, S. Aberdeen: Coire Etchachan, NO/0.9. 2n = 36.
COM-36. V.c. 92, S. Aberdeen: Coire Etchachan, NO/0.9. 2n = 36.
COM-37. V.c. 92, S. Aberdeen: Coire Etchachan, NO/0.9. 2n = 36.

H. eximium J. Backh.
EXI-24. V.c. 92, S. Aberdeen: Coire Etchachan, NO/0.9. 2n = 36.
EXI-54. V.c. 92, S. Aberdeen: Creag an Dail Bheag, Cairngorms, NO/1.9. 2n = 36.
EXI-55. V.c. 90, Angus: Glen Doll, Glen Clova, NO/2.7. 2n = 36. An F_1 plant.
EXI-56. V.c. 90, Angus: Glen Doll, Glen Clova, NO/2.7. 2n = 36. An F_1 plant.

H. eximium f. *tenellum* (J. Backh.) Sell & C. West
TNE-1. V.c. 92, S. Aberdeen: Creag an Dail Bheag, Cairngorms, NO/1.9. 2n = 36. Three F_1 plants.
TNE-2. V.c. 92, S. Aberdeen: Creag an Dail Bheag, Cairngorms, NO/1.9. 2n = 36.

H. eximium/*H. calenduliflorum* intermediate
EXI/CLD-1. V.c. 98, Main Argyll: Allt nan Giubhas, Meall a' Bhuiridh, Glencoe, NN/2.5. 2n = 36.

TABLE 2. *continued*

H. eximium/H. memorabile intermediate
EXI/MEM-51. V.c. 92, S. Aberdeen: Coire an Lochain Uaine, Derry Cairngorm, Glen Derry, NO/0.9. 2n = 36.
EXI/MEM-52. V.c. 92, S. Aberdeen: Coire an Lochain Uaine, Derry Cairngorm, Glen Derry, NO/0.9. 2n = 36.
EXI/MEM-53. V.c. 92, S. Aberdeen: Coire an Lochain Uaine, Derry Cairngorm, Glen Derry, NO/0.9. 2n = 36.

H. globosiflorum Pugsley
GLO-1. V.c. 92, S. Aberdeen: Coire an Lochain Uaine, Cairn Toul, Cairngorms, NN/9.9. 2n = 27.
GLO-19. V.c. 92, S. Aberdeen: Creag an Dail Bheag, Cairngorms, NO/1.9. 2n = 27.

H. graniticola W. R. Linton
GRA-1. V.c. 92, S. Aberdeen: Coire Etchachan, NO/0.9. 2n = 27. Also an F_1 plant.
GRA-3. V.c. 92, S. Aberdeen: Coire Etchachan, NO/0.9. 2n = 27.
GRA-4. V.c. 92, S. Aberdeen: Coire Etchachan, NO/0.9. 2n = 27.
GRA-5. V.c. 92, S. Aberdeen: Coire Etchachan, NO/0.9. 2n = 27.

H. grovesii Pugsley
GRO-1. V.c. 92, S. Aberdeen: Beinn a' Bhuird, Cairngorms, NO/0.9. 2n = 36. Also an F_1 plant.

H. hanburyi Pugsley
HAN-1. V.c. 88, Mid Perth: Ben More, Crianlarich, NN/4.2. 2n = 36.
HAN-23. V.c. 90, Angus: Head of Glen Fee, Glen Clova, NO/2.7. 2n = 36.
HAN-26. V.c. 90, Angus: Head of Glen Fee, Glen Clova, NO/2.7. 2n = 36.

H. hanburyi f. *atraticeps* (Pugsley) Sell & D. Tenn.
ATR-1. V.c. 90, Angus: Head of Glen Fee, Glen Clova, NO/2.7. 2n = 36. Also three F_1 plants.
ATR-2. V.c. 90, Angus: Above lowest falls, Glen Fee, Glen Clova, NO/2.7. 2n = 36.
ATR-3. V.c. 90, Angus: Head of Glen Fee, Glen Clova, NO/2.7. 2n = 36.
ATR-4. V.c. 90, Angus: Glen Fee falls, Glen Clova, NO/2.7. 2n = 36.
ATR-5. V.c. 90, Angus: Head of Glen Fee, Glen Clova, NO/2.7. 2n = 36.
ATR-6. V.c. 90, Angus: Head of Glen Fee, Glen Clova, NO/2.7. 2n = 36.
ATR-7. V.c. 90, Angus: Head of Glen Fee, Glen Clova, NO/2.7. 2n = 36.
ATR-8. V.c. 90, Angus: Upper falls, Glen Fee, Glen Clova, NO/2.7. 2n = 36.

H. hanburyi f. *pusillum* Sell & D. Tenn.
PUS-2. V.c. 90, Angus: Canness Glen, Glen Isla, NO/2.7. 2n = 36.
PUS-24. V.c. 90, Angus: Canness Glen, Glen Isla, NO/2.7. 2n = 36.
PUS-25. V.c. 90, Angus: Boustie Ley, Glen Clova, NO/3.7. 2n = 36.

H. hanburyi/H. tenuifrons intermediate
HAN/TNF-1. V.c. 96, Easterness: Glen Einich, Cairngorms, NN/9.9. 2n = 36.
HAN/TNF-2. V.c. 96, Easterness: Glen Einich, Cairngorms, NN/9.9. 2n = 36.

H. holosericeum J. Backh.
HOL-13. V.c. 92, S. Aberdeen: Allt an Dubh Loch, above Glen Muick, Ballater, NO/2.8. 2n = 27.
HOL-33. V.c. 97, Westerness: Aonach Mor, Ben Nevis range, above Glen Spean, NN/1.7. 2n = 27.
HOL-36. V.c. 96, Easterness: Bynack More, Strath Nethy, Cairngorms, NJ/0.0. 2n = 36.
HOL-47. V.c. 49, Caernarvonshire: Summit of Craig yr Ysfa, south-east of Carnedd Llywelyn, SH/3.6. 2n = 27.

H. insigne J. Backh.
INS-1. V.c. 92, S. Aberdeen: Coire Kander, head of Glen Callater, NO/1.8. 2n = 36.
INS-3. V.c. 92, S. Aberdeen: Coire Kander, head of Glen Callater, NO/1.8. 2n = 36.
INS-4. V.c. 92, S. Aberdeen: Coire Kander, head of Glen Callater, NO/1.8. 2n = 36.

H. insigne f. *celsum* Sell & D. Tenn.
CEL-1. V.c. 96, Easterness: Creag an Lethchoin, Lairig Ghru, NH/9.0. 2n = 36.
CEL-2. V.c. 97, Westerness: Ben na' Socaich, Glen Spean, NN/2.7. 2n = 27.
CEL-3. V.c. 92, S. Aberdeen: Coire an Lochain Uaine, Cairn Toul, Cairngorms, NN/9.9. 2n = 36.
CEL-4. V.c. 96, Easterness: Creag an Lethchoin, Lairig Ghru, NH/9.0. 2n = 36.
CEL-5. V.c. 96, Easterness: Coire Garbhlach, Glen Feshie, Cairngorms, NN/8.9. 2n = 36.

TABLE 2. *continued*

H. kennethii Sell & D. Tenn.
KEN-1. V.c. 105, W. Ross: An Teallach, Dundonnell, NH/0.8. 2n = 36.
KEN-3. V.c. 105, W. Ross: An Teallach, Dundonnell, NH/0.8. 2n = 36.
KEN-4. V.c. 105, W. Ross: An Teallach, Dundonnell, NH/0.8. 2n = 36.

H. larigense (Pugsley) Sell & C. West
LAR-1. V.c. 96, Easterness: Creag an Lethchoin, Lairig Ghru, NH/9.0. 2n = 36. An F_1 plant.
LAR-2. V.c. 96, Easterness: Creag an Lethchoin, Lairig Ghru, NH/9.0. 2n = 27.

H. leptodon Sell & D. Tenn.
TND-1. V.c. 88, Mid Perth: Ben More, Crianlarich, NN/4.2. 2n = 36. An F_1 plant.
TND-2. V.c. 88, Mid Perth: Ben More, Crianlarich, NN/4.2. 2n = 36. Also an F_1 plant.
TND-3. V.c. 88, Mid Perth: Ben More, Crianlarich, NN/4.2. 2n = 36.
TND-5. V.c. 88, Mid Perth: Ben More, Crianlarich, NN/4.2. 2n = 36.

H. macrocarpum Pugsley
MAC-1. V.c. 92, S. Aberdeen: Creag an Dail Bheag, Cairngorms, NO/1.9. 2n = 36. Six F_1 plants.
MAC-19. V.c. 106, E. Ross: Carn Liath, Strath Carron, NH/1.5. 2n = 36.
MAC-21. V.c. 92, S. Aberdeen: Coire an t-Saighdeir, Cairn Toul, Cairngorms, NN/9.9. 2n = 36.
MAC-22. V.c. 96, Easterness: Coire Chuirn, south of Dalwhinnie, NN/6.7. 2n = 36.
MAC-23. V.c. 96, Easterness: Coire Chuirn, south of Dalwhinnie, NN/6.7. 2n = 36.
MAC-24. V.c. 96, Easterness: Coire Chuirn, south of Dalwhinnie, NN/6.7. 2n = 37.
MAC-25. V.c. 96, Easterness: Coire Chuirn, south of Dalwhinnie, NN/6.7. 2n = 37.
MAC-27. V.c. 96, Easterness: Outflow shingle, N. end of Loch Einich, NN/9.9. 2n = 36.

H. marginatum Pugsley
MAR-2. V.c. 106, E. Ross: Coire Ghranda, Ben Dearg, NH/2.8. 2n = 36. Also an F_1 plant.
MAR-4. V.c. 105, W. Ross: Meall Doire Faid, Braemore, NH/2.7. 2n = 36.
MAR-5. V.c. 106, E. Ross: Coire Ghranda, Ben Dearg, NH/2.8. 2n = 36.

H. marginatum f. *chaetocephalum* Sell & C. West
CHA-1. V.c. 97, Westerness: Coire Ardair, Craig Meagaidh, Loch Laggan, NN/4.8. 2n = 36. Also three F_1 plants.

H. memorabile Sell & C. West
MEM-6. V.c. 97, Westerness: Aonach Mor, Ben Nevis range, above Glen Spean, NN/1.7. 2n = 36. An F_1 plant.
MEM-10. V.c. 92, S. Aberdeen: Head of Glen Callater, NJ/1.7. 2n = 36.
MEM-11. V.c. 96, Easterness: Coire Garbhlach, Glen Feshie, Cairngorms, NN/8.9. 2n = 36.
MEM-13. V.c. 92, S. Aberdeen: Head of Glen Callater, NO/1.8. 2n = 36.
MEM-14. V.c. 96, Easterness: Coire Garbhlach, Glen Feshie, Cairngorms, NN/8.9. 2n = 36.
MEM-15. V.c. 96, Easterness: Creag an Lethchoin, Lairig Ghru, NH/9.0. 2n = 36.

H. milesii Sell & C. West
MIL-1. V.c. 90, Angus: Canness Glen, Glen Isla, NO/2.7. 2n = 36.
MIL-2. V.c. 90, Angus: Caenlochan, NJ/1.7. 2n = 36.
MIL-3. V.c. 92, S. Aberdeen: Loch Kander, head of Glen Callater, NO/1.8. 2n = 36.
MIL-5. V.c. 90, Angus: Caenlochan, NJ/1.7. 2n = 36.
MIL-6. V.c. 90, Angus: Caenlochan, NJ/1.7. 2n = 36.

H. mundum Sell & C. West
MUN-1. V.c. 106, E. Ross: Coire Ghranda, Ben Dearg, NH/2.8. 2n = 36.

H. notabile Sell & C. West
NOT-1. V.c. 97, Westerness: Coire Ardair, Craig Meagaidh, Loch Laggan, NN/4.8. 2n = 36. Three F_1 plants.
NOT-3. V.c. 97, Westerness: Coire Ardair, Craig Meagaidh, Loch Laggan, NN/4.8. 2n = 36.

H. pensum Sell & C. West
PEN-1. V.c. 106, E. Ross: Coire Ghranda, Ben Dearg, NH/2.8. 2n = 36. Also two F_1 plants.

TABLE 2. *continued*

H. perscitum Sell & C. West
PER-1. V.c. 105, W. Ross: An Teallach, Dundonnell, NH/0.8. 2n = 36. Also an F_1 plant.
PER-2. V.c. 105, W. Ross: An Teallach, Dundonnell, NH/0.8. 2n = 36.
PER-5. V.c. 105, W. Ross: An Teallach, Dundonnell, NH/0.8. 2n = 36.
PER-7. V.c. 105, W. Ross: An Teallach, Dundonnell, NH/0.8. 2n = 36.

H. probum Sell & C. West
PRO-2. V.c. 97, Westerness: Aonach Mor, Ben Nevis range, above Glen Spean, NN/1.7. 2n = 36.
PRO-24. V.c. 87, W. Perth: Stob Binnein, Crianlarich, NN/4.2. 2n = 36.
PRO-25. V.c. 87, W. Perth: Stob Binnein, Crianlarich, NN/4.2. 2n = 36.

H. pseudocurvatum (Zahn) Pugsley
PCU-1. V.c. 92, S. Aberdeen: Creag an Dail Bheag, Cairngorms, NO/1.9. 2n = 27.
PCU-2. V.c. 92, S. Aberdeen: Creag an Dail Bheag, Cairngorms, NO/1.9. 2n = 27.
PCU-3. V.c. 92, S. Aberdeen: Creag an Dail Bheag, Cairngorms, NO/1.9. 2n = 27.

H. pseudopetiolatum (Zahn) Roffey
PPE-1. V.c. 92, S. Aberdeen: Coire Etchachan, NO/0.9. 2n = 27.
PPE-17. V.c. 97, Westerness: Coire Ardair, Craig Meagaidh, Loch Laggan, NN/4.8. 2n = 27.
PPE-18. V.c. 97, Westerness: Coire Ardair, Craig Meagaidh, Loch Laggan, NN/4.8. 2n = 27.

H. subglobosum Sell & C. West
SGL-1. V.c. 106, E. Ross: Coire Ghranda, Ben Dearg, NH/2.8. 2n = 27. Also two F_1 plants.
SGL-2. V.c. 106, E. Ross: Coire Ghranda, Ben Dearg, NH/2.8. 2n = 27.

H. subgracilentipes (Zahn) Roffey
SGR-1. V.c. 69, Westmorland: Dollywaggon, Helvellyn, NY/3.1. 2n = 36.
SGR-8. V.c. 69, Westmorland: Rampsgill Head, above Haweswater, NY/4.1. 2n = 36.
SGR-11. V.c. 69, Westmorland: Dollywaggon, Helvellyn, NY/3.1. 2n = 36.

H. tenuifrons Sell & C. West
TNF-1. V.c. 98, Main Argyll: Allt nan Giubhas, Meall a' Bhuiridh, Glencoe, NN/2.5. 2n = 36.
TNF-2. V.c. 88, Mid Perth: Creag Roro, Ben Lawers, Glen Lyon, NN/6.4. 2n = 27. Also an F_1 plant.
TNF-4. V.c. 92, S. Aberdeen: Coire Etchachan, NO/0.9. 2n = 36.
TNF-44. V.c. 97, Westerness: Coire Ardair, Craig Meagaidh, Loch Laggan, NN/4.8. 2n = 27.
TNF-45. V.c. 97, Westerness: Coire Ardair, Craig Meagaidh, Loch Laggan, NN/4.8. 2n = 27.
TNF-46. V.c. 88, Mid Perth: Creag Roro, Ben Lawers, Glen Lyon, NN/6.4. 2n = 27.
TNF-47. V.c. 97, Westerness: Coire Ardair, Craig Meagaidh, Loch Laggan, NN/4.8. 2n = 27.
TNF-48. V.c. 98, Main Argyll: Allt nan Giubhas, Meall a' Bhuiridh, Glencoe, NN/2.5. 2n = 36.
TNF-49. V.c. 92, S. Aberdeen: Coire Etchachan, NO/0.9. 2n = 36.
TNF-50. V.c. 92, S. Aberdeen: Coire Etchachan, NO/0.9. 2n = 36.
TNF-52. V.c. 88, Mid Perth: Ben Heasgarnich, Glen Lyon, NN/4.3. 2n = 36. Two F_1 plants.
TNF-53. V.c. 92, S. Aberdeen: Coire Etchachan, NO/0.9. 2n = 36.
TNF-54. V.c. 97, Westerness: Coire Ardair, Craig Meagaidh, Loch Laggan, NN/4.8. 2n = 27.

H. tenuifrons/H. memorabile intermediate
TNF/MEM-51. V.c. 96, Easterness: Coire Garbhlach, Glen Feshie, Cairngorms, NN/8.9. 2n = 36.

Un-named new taxa
XYZ-1. V.c. 105, W. Ross: An Teallach, Dundonnell, NN/0.8. 2n = 45.
XYZ-2. V.c. 106, E. Ross: Summit coire, Ben Dearg, NH/2.8. 2n = 36.

hypotetraploids ($2n = 4x - 1 = 35$) (Ingrouille & Stace 1986). One previous count of *H. alpinum* from the Siberian Arctic (Sokolovskaya & Strelkova 1960) is a hypotriploid ($2n = 3x - 1 = 26$), but must be viewed in the light of the above comments. In the present study two plants of *H. macrocarpum* (MAC-24 & 25) from Coire Chuirn, Easterness, were found to be hypertetraploids ($2n = 4x + 1 = 37$) (Fig. 1c). Two other plants (MAC-22 & 23) from the same locality were tetraploids (2n = 36).

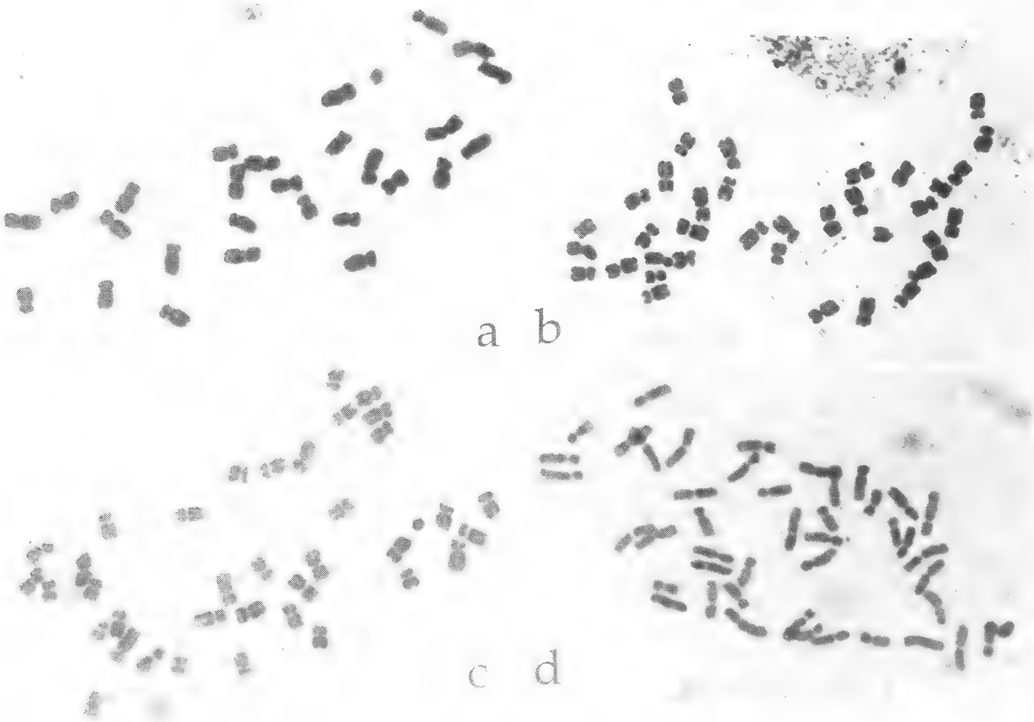


FIGURE 1. Root-tip squashes of (a) *Hieracium alpinum* (ALP-22) from Glen Derry, S. Aberdeen, 2n = 3x = 27; (b) *H. calenduliflorum* (CLD-152) from Ben na' Socaich, Westerness, 2n = 4x = 36; (c) *H. macrocarpum* (MAC-24) from Coire Chuirn, Easterness, 2n = 4x + 1 = 37; and (d) Un-named new taxon (XYZ-1) from An Teallach, W. Ross, 2n = 5x = 45. All × 1250.

The caveats concerning the interpretation of aneuploid counts mentioned above must be repeated when considering taxa in which two ploidy levels have been found. However, in such a highly critical group as *Hieracium* sect. *Alpina*, there are two taxonomic problems as well. Firstly, it is possible that in fact the two cytotypes should be recognized as different taxa, not one. Secondly, pots might have become mislabelled due to clerical or horticultural errors or due to misidentification. The last is a real possibility even when identification has been made by the acknowledged experts in the group, since several of the microspecies are very difficult to distinguish if one or two characters (e.g. style colour) are missing. In section *Alpina* this problem is exacerbated because frequently several (sometimes more than ten) species grow in one locality, and in any one locality only a small proportion of the plants flower in any given year.

Apart from the case of *H. macrocarpum* mentioned above, four taxa were found with two chromosome numbers:

a. *H. tenuifrons*. D. J. Tennant has for long recognized three non-overlapping regional races within this species: a western race found in Westerness (v.c. 97) , Main Argyll (v.c. 98) and just into Mid Perth (v.c. 88); a central race found in W., Mid and E. Perth (v.cc. 87–89) and just into Westerness; and an eastern race found in the Cairngorms (S. Aberdeen and Easterness: v.cc. 92, 96). The chromosome numbers of these three races are 2n = 36 (three plants), 27 (six plants) and 36 (four plants) respectively. In terms of gross morphology, the western race (which includes the type) is far more distinct from the other two than the latter two are from each other (D. J. Tennant, pers. comm., 1994). Although the cytological data do not fully support the morphological data, the two together do provide evidence that the three races of *H. tenuifrons* are distinct entities. Whether they are worth recognizing taxonomically, and if so at what ranks, are moot points.

Chromosome numbers throw no light on the identity of the *H. hanburyi*/*H. tenuifrons*

'intermediate' (HAN/TNF-1 & 2), since it, *H. hanburyi* and the eastern race of *H. tenuifrons* are all tetraploids. The same is true of the *H. tenuifrons/H. memorabile* 'intermediate' (TNF/MEM-51).
b. *H. insigne* f. *celsum*. The single triploid (CEL-2) comes from the western area (Glen Spean, Westerness, v.c. 97), while the four tetraploids are from the eastern area (S. Aberdeen, v.c. 92 and Easterness, v.c. 96). These five plants come from four localities which represent much of the total range of this rare taxon. The different chromosome number of the western plant clearly requires further investigation.
c. *H. larigense*. Both plants are from the area of the type locality (Lairig Ghru, Easterness, v.c. 96) and the existence of two ploidy levels in *H. larigense* from this area requires confirmation. A misidentification is one possible explanation, which will be investigated the next time the plants flower at Leicester and by molecular studies.
d. *H. holosericeum*. Although this is the most widespread British species, and is often common in Scottish localities, it is one of the most difficult to keep healthy in cultivation. The single tetraploid and two of the triploid plants come from three rather widely separated Scottish localities. The single Welsh count was also triploid. Clarification of the cytological pattern in this species must await more counts from the same and other localities in Scotland as well as from the Lake District, but clearly the Easterness plant might be misidentified. This will be checked by molecular studies.

Comments on some of the other taxa are also desirable.

H. calenduliflorum is a somewhat variable species. D. J. Tennant recognises two races – a western one from Westerness (v.c. 97) and Main Argyll (v.c. 98), which shows some resemblances to *H. notabile*; and an eastern one from Angus (v.c. 90) and S. Aberdeen (v.c. 92). In addition to this, CLD-151 is an unusually highly pubescent plant, and CLD-158 an unusually small, narrow-leaved plant. All these plants are tetraploids (Fig. 1b), as was the previously counted plant from Lochnagar, S. Aberdeen (Morton 1974). Preliminary results from molecular analyses of the two races have, however, revealed some differences.

The *H. eximium/H. calenduliflorum* 'intermediate' plant (EXI/CLD-1) is, like the two species, tetraploid, as is *H. leptodon*, to which D. J. Tennant now refers it. The same is true of the *H. eximium/H. memorabile* 'intermediate' (EXI/MEM-51, 52 & 53).

The three plants of *H. eximium* (EXI-51, 52 & 53) from Derry Cairngorm, S. Aberdeen, might represent a distinct taxon, having more coriaceous leaves and being more obviously glandular (D. J. Tennant, pers. comm., 1994), but all have the same chromosome number.

Our plants of *H. hanburyi* are tetraploids, as was the previously counted plant from River Eidart, Easterness (Mills & Stace 1974). The *H. hanburyi/H. tenuifrons* 'intermediate' has been commented upon already.

H. macrocarpum is virtually confined to the Cairngorms except for the distant locality in E. Ross, where the plants (MAC-19) differ in some respects from those in the Cairngorms and might represent a different taxon. The chromosome numbers, however, do not differ.

The two plants of *H. pseudopetiolatum* from Westerness differ slightly from that from Coire Etchachan, but not in chromosome number.

Since there are in the main only two ploidy levels involved, it is not surprising that they throw rather little light on taxonomic problems. However, all the five formae newly recognized by Sell *et al.* (1995) have the same chromosome number as the respective type formae, and none of the other variants mentioned above differs in chromosome number from the respective typical species. This indicates that there is in fact rather little (if any) variation in chromosome number within each microspecies as delimited by traditional taxonomists. A corollary of this conclusion is, therefore, that those cases where both triploid and tetraploid counts are found in one microspecies constitute evidence that the two cytological races do, in fact, represent different taxa. This is clearly true of *H. tenuifrons* and perhaps of *H. celsum*. Moreover, it suggests that the pentaploid un-named plant from An Teallach (XYZ-1) is indeed a new species.

The use of chromosome numbers as taxonomic evidence in this way is justifiable in an obligately apomictic group, but much less so in a sexual or facultatively apomictic one. Without the existence of sexual reproduction (i.e. meiosis followed by fertilization) the evolution of a triploid from a tetraploid, or vice versa, although conceivable, is a most unlikely event. It would involve the chance inclusion of 27 chromosomes in a cell destined to become an embryo from a plant with 36 chromosomes, or vice versa. If such an event is at all likely (i.e. if the requisite mechanisms exist), it is surely unlikely that the only new chromosome numbers to arise would be euploids; one would expect aneuploids to be formed at least as frequently (perhaps much more frequently) than euploids. There is no evidence that this occurs; only two of 152 plants so far counted are aneuploids, and none of the F_1 progeny of these 152 plants differed from their parent in chromosome number. A far more likely cause of the existence of both triploids and tetraploids (and higher euploid levels) is their independent origins from sexual events. The only exceptions to this hypothesis would be chromosome number doubling (e.g. triploids giving rise to hexaploids) or the occasional origin of aneuploids, both of which are possible by unexceptional mitotic events.

The published lists used to compile Table 1 show several examples of species represented by more than one ploidy level. Many of these, however, are members of the genus *Pilosella*, in which sexual diploids, tetraploids and hexaploids exist and where mechanisms for the production of plants of different ploidy level (up to decaploid) are well known (Gadella 1991). Of the species of *Hieracium* sensu stricto in which two or more polyploid levels have been recorded, some (e.g. *H. umbellatum* L.) exist as sexual diploids as well and others may well be cases of misidentification (e.g. *H. pulmonarioides* Villars) or varied use of the same name (e.g. *H. murorum* L. and *H. villosum* Jacq.).

Sell & West (1976), in *Flora Europaea*, segregated British *Hieracium* into two species groups (*H. alpinum* group and *H. nigrescens* group), giving chromosome numbers of 2n = 27 and 2n = 36 respectively. The former was based upon the [Continental] counts for *H. alpinum* and the latter upon the British counts for *H. hanburyi* and *H. calenduliflorum* (Moore 1982). The only British species included in the *H. alpinum* group were *H. alpinum* and *H. holosericeum* (both with triploid counts in Britain), while the other 15 British species mentioned were all placed in the *H. nigrescens* group. Besides the special case of *H. tenuifrons* four of these are triploids, and recent counts of *H. nigrescens* from Komi ASSR are also triploid (Lavrenko et al. 1988). Furthermore, one of our three counts of *H. holosericeum* is tetraploid. Hence there is no chromosome number difference between the two species groups, whose descriptions in *Flora Europaea* differ only by few relatively trivial features (viz. leaf width and three characters all prefixed by "often"). Moreover, although Pugsley's (1948) definition of the two species groups was very similar, he placed five of the species that Sell & West included in the *H. nigrescens* group in the *H. alpinum* group (*H. grovesii*, *H. eximium*, *H. calenduliflorum*, *H. macrocarpum* and *H. graniticola*), the first four of these five being tetraploids.

We are carrying out further chromosome studies of *Hieracium* section *Alpina*, including karyotype analyses, in parallel with molecular (DNA and enzyme) methods.

ACKNOWLEDGMENTS

We are greatly indebted to Mr David Tennant for providing us with most of the material, for guiding and tutoring two of us (Y.S. and C.A.S.) on a trip to the Scottish Highlands in 1993, and for sharing much of his unparalleled knowledge with us. We are also grateful to Rebecca Smith, Jacqueline Clayton, Peter Hollingsworth and Lisa Page for making some of the chromosome counts, to Dr John Bailey for help with cytological techniques, and to Mr Jim Bevan for putting us in touch with Mr Tennant in the first place.

REFERENCES

Bailey, J. P. & Gornall, R. J. (ined.) *Cytological catalogue of the British and Irish flora.*

Gadella, T. W. J. (1991). Variation, hybridization and reproductive biology of *Hieracium pilosella* L. *Proceedings, Koninklijke Nederlandse Akademie van Wetenschappen* **94**: 455–488.

Ingrouille, M. J. & Stace, C. A. (1986). The *Limonium binervosum* aggregate (Plumbaginaceae) in the British Isles. *Botanical journal of the Linnean Society* **92**: 177–217.

Kent, D. H. (1992). *List of vascular plants of the British Isles.* B.S.B.I., London.

Lavrenko, A. N., Serditov, N. P. & Ulle, Z. G. (1988). Chromosome numbers in some species of Asparagaceae, Asteraceae and Ranunculaceae from the north Urals (Komi ASSR). *Botaničeskij žurnal* **73**: 605–607.

Mills, J. N. & Stace, C. A. (1974). Chromosome numbers of British plants, 2. *Watsonia* **10**: 167–168.

Moore, D. M. (1982). *Flora Europaea check-list and chromosome index.* Cambridge University Press, Cambridge.

Morton, J. K. (1974). Chromosome numbers of British plants, 3. *Watsonia* **10**: 169.

Pugsley, H. W. (1948). A prodromus of the British *Hieracia*. *Journal of the Linnean Society of London (Botany)* **54**: 1–356.

Rosenberg, O. (1927a). Die semiheterotypische Teilung und ihre Bedeutung für die Entstehung verdoppelter Chromosomenzahlen. *Hereditas* **8**: 305–338.

Rosenberg, O. (1927b). Homoeotypic division in uninucleate pollen mother cells. *Hereditas* **9**: 285–288.

Sell, P. D. & West, C. (1968). *Hieracium*, in Perring, F. H. & Sell, P. D., eds. *Critical supplement to the Atlas of the British flora*, pp. 75–131. E. P. Publishing Ltd, London.

Sell, P. D. & West, C. (1976). *Hieracium*, in Tutin, T. G. *et al.*, eds. *Flora Europaea* **4**: 358–410. Cambridge University Press, Cambridge.

Sell, P. D., West, C. & Tennant, D. J. (1995). Eleven new British species of *Hieracium* L. section *Alpina* (Fries) F. N. Williams. Watsonia **20**: 351–365.

Sokolovskaya, A. P. & Strelkova, O. S. (1960). Geographical distribution of polyploid plant species in Eurasian arctic. *Botaničeskij žurnal* **45**: 370–381.

(*Accepted March 1995*)

NOTE ADDED IN PROOF

Recent work on sect. *Alpina* by J. Chrtek jun. in eastern Europe (*Folia geobotanica et phytotaxonomica Bohemoslavaca, Praha* **29**: 91–100 (1994), and unpublished) has shown that:

1. *Hieracium alpinum* sensu stricto from Czechoslovakia, Poland and the Ukraine exists mostly as triploid (2n = 27) but also as diploid (2n = 18) cytotypes. This is the first diploid count for sect. *Alpina*.
2. All the other (non-British) taxa in sect. *Alpina* from these areas are triploids or tetraploids.
3. Continental material named *H. calenduliflorum* and *H. eximium* does not belong to these species but to non-British taxa. It is possible that *H. alpinim* itself is in fact the only British species that is not endemic.

We are grateful to Dr Chrtek for these data.

Sorbus domestica L., new to Wales and the British Isles

M. HAMPTON

9 Adenfield Way, Rhoose, South Glamorgan, CF62 3EA

and

Q. O. N. KAY

School of Biological Sciences, University of Wales, Swansea, SA2 8PP

ABSTRACT

The discovery of two native or long-established populations of the mainly southern European tree *Sorbus domestica* L. (Rosaceae) in sea-cliff sites on the coast of southern Wales is reported. The True Service-tree had not been previously known as a native species or persistent introduction in Britain, with the exception of a single tree that formerly grew in the Wyre Forest in central England. Identification characters, including previously undescribed epidermal features, isozyme variation, and its ecology and associates at the two sites are described. Its occurrence and possible history in Britain are briefly discussed.

KEYWORDS: *Sorbus aucuparia*, isozyme analysis, ecology, distribution, disjunction.

INTRODUCTION

In May 1983 Marc Hampton observed a number of wind-stunted trees of a *Sorbus* L. species (Rosaceae) with pinnate leaves, resembling *Sorbus aucuparia* L. but apparently distinct from that species, growing on inaccessible ledges on a south-facing limestone sea-cliff in southern Glamorgan, Wales (v.c. 41). The site is in an area which had been well studied botanically and it seemed unlikely that any long-established but undiscovered species of tree could occur there. During subsequent brief visits to the site he observed several distinctive features of the trees, all consistent with the possibility that they might be *S. domestica* L., notably their strikingly silvery young leaves in early spring and, in some years, their display of flowers 16–18 mm in diameter, larger and more conspicuous than in *S. aucuparia* and with pink-flushed petals. In addition, the branches of the inflorescence, especially the final pedicels, were comparatively lax and straight rather than curved as in *S. aucuparia*, forming a more or less pyramidal inflorescence which differed in shape from the flat-topped corymbs of *S. aucuparia*, and the inflorescences enlarged simultaneously with the leaves, not after them as in *S. aucuparia*. The limestone cliff habitat, with strongly basic soil, would be a most unusual one for *S. aucuparia*, but was similar to the cliff refuges of other *Sorbus* species. It was not possible for M.H. to make a closer study of the population until early 1993, when his searches of similar cliffs in the area revealed another, rather larger population of the same taxon on higher cliffs about 4 km to the east of the first site, again growing on inaccessible ledges, and again apparently overlooked in an area with an even longer history of botanical study. The precise localities of the two sites are here deliberately withheld in order to prevent damage to the sites, but they have been confidentially notified to the relevant vice-county recorders and to the regional and national officers of the Countryside Council for Wales with responsibility for species conservation.

IDENTIFICATION, MORPHOLOGY AND VARIATION

Confirmation of the identity of the taxon forming the Glamorgan cliff populations presented considerable problems. *Sorbus domestica* is similar to *S. aucuparia* in many vegetative characters.

Although several morphological characters of the Glamorgan cliff taxon strongly suggested from the outset that it might be *S. domestica*, this species had not previously been found either in natural habitats or as a persistent introduction in Britain, with the exception of a single ancient tree that formerly grew in the Wyre Forest in Worcestershire (Lees 1867; Amphlett & Rea 1909). The largest trees in the Glamorgan cliff populations are evidently of considerable age (ring-counts suggest possible ages of several hundred years for the larger trunks), but are wind-trimmed, partly prostrate and only c. 3–5 m high. Immature fruits, pyriform and pubescent rather than globose and glabrescent as in *S. aucuparia*, are formed in some years, and a single green, pyriform, mature but seedless fruit was seen on one of the western trees in the autumn of 1991, but full fruiting has not yet been observed and probably takes place only in exceptionally favourable years, if at all. A similar shrub-like habit, with fruiting rare or absent, has been reported for populations of *S. domestica* growing on dry, warm slopes at the northern limit of the range of the species in mainland Europe, which lies in southern Germany (Gerstberger 1980).

In contrast, the Wyre Forest tree was tall and apparently fruited freely before it became decrepit (it was locally known as the 'Witty Pear'). It was first described in 1678, became decrepit during the mid-nineteenth century and was finally destroyed by fire in 1862 (Lees 1867; Amphlett & Rea 1909). Although it grew in a remote part of the Wyre Forest it was regarded as a probable introduction (e.g. Clapham, Tutin & Warburg 1962). It has left descendants including one of the two tall (17 m and 24 m, Bean 1980) and free-fruiting trees of *S. domestica* cultivated since the mid-nineteenth century in the Oxford Botanic Garden (T. Walker *in litt.*), and could, like similar *S. domestica* trees cultivated in modern arboreta in Britain, have been descended from cultivars grown in mediaeval orchards. Apart from the very obvious distinction provided by the fruits (c. 2–2·5 cm in diameter, greenish-brown and pear- or less often apple-shaped with numerous stone-cells in *S. domestica*, 0·6–0·9 cm in diameter, globose, bright red and soft-fleshed when mature in *S. aucuparia*), the other characters given in Floras for distinguishing the two species are inconsistent and potentially unreliable (Gerstberger 1980), especially for trees growing in exposed habitats. Consequently, non-fruiting trees cannot be certainly identified from the keys published in major Floras.

As fruits were not available, a range of other characters, including previously uninvestigated micromorphological and isozyme characters, were investigated in the Glamorgan cliff taxon and compared with cultivated material of *S. domestica* and with wild and cultivated material of *S. aucuparia* during the summer of 1993 (Table 1). This comparison confirmed that the Glamorgan cliff taxon is undoubtedly *S. domestica*. Isozyme comparisons were made by Rosemary John and Sarah Martin. Five of the six trees from which leaf samples were taken, all from the western population, were isozymically identical to one another at the nine loci that were investigated (GOT-1 and 2, G6PDH, IDH, MDH, PGI-1 and 2, PGM, SOD); the sixth was less well characterised, but may have differed at one locus (GOT-1). All were clearly distinct from *S. aucuparia* at several loci.

TABLE 1. CHARACTERS USED TO DISTINGUISH *SORBUS DOMESTICA* FROM *S. AUCUPARIA*

Sorbus domestica (Glamorgan cliff taxon)	*Sorbus aucuparia*
Styles 5–(6)[1]	Styles 3–4[1]
Stipules 6–14 mm, forked at or below half-way, soon falling, with little green tissue[2]	Stipules 4–8 mm, simple or fan-shaped, persistent and green on long shoots[2]
Epidermal cells around stomata on lower leaf epidermis with sinuous median ridges but lacking papillae; stoma with 'collar' ridge[3]	Epidermal cells around stomata on lower leaf epidermis with central papillae flanked by radiating ridges, so that 5–6 papillae surround each stoma; no conspicuous 'collar' ridge[3] around stoma.
Buds glabrous and viscid[4], green or pale brown[1]	Buds tomentose[4], brown
Bark on trunk and older branches deeply and narrowly fissured[5], flaking[1]	Bark on trunk and older branches remaining smooth[1] or with fissures at wide intervals

All characters were determined in fresh material and compared with fresh material of known identity. The Glamorgan cliff taxon agreed with *S. domestica* in all characters that were investigated. Additional characters are described in the first paragraph of this paper. References: [1]Warburg & Kárpáti 1968; [2]Gerstberger 1980; [3]Kay unpublished; [4]Burnat 1899; [5]Stace 1991.

Isozyme comparisons with fresh leaf material of cultivated *S. domestica* trees from Oxford Botanic Garden (single trees of the apple-fruited and pear-fruited varieties) and Mount Pleasant Trees of Berkeley, Gloucestershire (two cultivars, one from a long-established local garden) showed polymorphism within the species at all loci except MDH; the Glamorgan cliff taxon differed from the Oxford trees in PGI and SOD, and from the Gloucestershire garden cultivars in PGI, SOD and GOT-1; PGI alleles differed amongst the cultivars. In practice the leaf epidermis characters (apparently previously unobserved) and (when still present) the stipule characters (Table 1), combined with the bud characters in fresh material, are likely to be most useful for the separation of vegetative material of *S. domestica* from *S. aucuparia*.

ECOLOGY AND HISTORY

At the first (western) Glamorgan site, *S. domestica* grows as scattered small trees, branching from the base and up to about 3·5 m in height, on a vertical sea-cliff of horizontally bedded Lias limestone c. 25 m high, with a S.S.W. aspect. The trees are rooted into softer beds of marly calcareous shale which form recessed ledges between harder, projecting limestone strata; 13–14 separate trees can be counted, most on the higher inaccessible ledges. The three westernmost *S. domestica* trees grow in dense cliff-scrub with *Prunus spinosa*, *Hedera helix*, *Clematis vitalba*, *Rubus ulmifolius* and *Crataegus monogyna** forming a thicket 2–2·5 m deep, but most of the other trees grow in more open sites, often with the lower part of the trunk prostrate and appressed to the cliff surface. Trunk diameters at the base of the tree ranged from 10 cm to 23 cm in four accessible trees, with similar dimensions estimated for the trees on the higher inaccessible ledges. Conspicuously fissured, flaking bark (a characteristic of *S. domestica*, illustrated photographically by Step (1905)) covers the lower parts of the older trunks. Several trees show the remains of dead older trunks or branches embedded in the base of the present trunk, suggesting that the living trunks may have arisen as basal shoots from older trunks that are now dead. A section of one of these older dead trunks 6 cm in diameter examined by M.H. showed 85–90 annual rings, indicating an age of about 300–400 years for the largest living trunks. Bean (1980) states that there is little doubt that trees of *Sorbus domestica* can live for 500–600 years. If the trees in the Glamorgan cliff populations have periodically regrown from basal shoots or from suckers after the death and decay of an older main trunk, considerably greater ages seem possible. A pH of 7·55 was found for the stony calcareous marl into which one of the westernmost trees was rooted. Associated species are listed in Table 2. No introduced species grow in association with the *S. domestica* population here, although a number of weedy species grow on or near the cliff-top and on the nearby maritime drift-line. The population extends along about 100 m of cliff-face, bounded to the east by cliffs that are probably now too exposed to salt spray for *S. domestica* to survive and to the west by sloping degraded cliffs covered by denser, largely closed woodland and scrub.

At the second site, 4 km east of the first, *S. domestica* again grows as scattered small trees and shrubs, on the upper, open, vertical or near-vertical part of a south-facing horizontally bedded Lias limestone sea-cliff about 50 m high, with softer strata, into which *S. domestica* is probably rooted, alternating with projecting ledges of harder limestone. The lower part of the cliff here is steeply sloping and fairly densely wooded, with ash, elm and some yew. The largest *S. domestica* trees here are about 5 m high, but most are smaller, spreading along horizontal ledges, and with many apparent saplings or small sucker shoots growing in unshaded and largely unvegetated open vertical areas. A total number of about 70 apparently separate *S. domestica* trees, shrubs and saplings or sucker shoots was estimated, extending along about 230 m of cliff; as at the western site, the population is bounded to the west by denser, closed woodland on less steeply sloping cliffs, and to the east by more exposed and unstable vertical cliffs. The cliffs on which *S. domestica* grows here are entirely inaccessible or, at best, extremely hazardous; voucher specimens could be obtained only from a few trees at the edge of the population. At this second site, the introduced species *Quercus ilex* was present nearby but was not seen growing with *S. domestica* (Table 2).

The south-facing Lias limestone cliffs and valley-slopes of southern Glamorgan provide favourable microhabitats for thermophilous calcicole species, a number of which are at or near the

* All nomenclature follows Stace (1991), except where stated otherwise.

TABLE 2. ABUNDANCE OF SPECIES ASSOCIATED WITH *SORBUS DOMESTICA* AT CLIFF SITES IN SOUTHERN GLAMORGAN, WALES

Species	Site: Western site	Site: Eastern site
Sorbus domestica	5	la
Adiantum capillus-veneris	x	x
Brachypodium sylvaticum	1·3	lf
Brassica nigra	1·3	–
Centaurea scabiosa	–	o
Clematis vitalba	1·4	lf
Cornus sanguinea	–	o
Crataegus monogyna	1·4	lf
Dactylis glomerata	1·3	–
Daucus carota	–	o
Festuca rubra	1·5	lf
Fraxinus excelsior	–	la
Hedera helix	1·5–8	la
Helianthemum nummularium	–	o
Inula conyzae	–	o
Iris foetidissima	x	x
Ligustrum vulgare	x	o
Lithospermum purpurocaeruleum	x	x
Ononis repens	–	o
Origanum vulgare	–	o
Parietaria judaica	1	–
Pilosella officinarum	–	o
Pimpinella saxifraga	–	o
Plantago lanceolata	–	o
Prunus spinosa	1·5	o
Quercus ilex	–	x
Q. robur	–	x
Rosa canina agg.	1·4	r
Rubia peregrina	4	lf
Rubus ulmifolius	1·4–5	o
Sambucus nigra	–	o
Sanguisorba minor	–	o
Senecio erucifolius	–	o
S. jacobaea	–	o
Taxus baccata	–	x
Teucrium scorodonia	–	o
Ulmus sp.	–	x
Viburnum lantana	1	o

The lists are composite estimates for the areas in which *S. domestica* grows. Because of the inaccessibility of the greater part of both populations, some less conspicuous species are likely to have been missed. At the eastern site, frequencies of the species growing on vertical cliffs were estimated from a range of c.80–200 m using binoculars. The figures for the western site show Domin cover-abundance scores. Letter abbreviations: la, locally abundant; lf, locally frequent; o, occasional; r, rare; x, present nearby but not seen with or under *S. domestica*.

limits of their European ranges, for example *Adiantum capillus-veneris*, *Campanula glomerata*, *Cirsium eriophorum*, *C. acaule* and *Lithospermum purpurocaeruleum*. Elsewhere in the Bristol Channel area, the hard Carboniferous Limestone cliffs of the Gower Peninsula in western Glamorgan and of the Avon Gorge, Brean Down and the southern Mendip Hills in Somerset have acted as refuges for a greater number of calcicole species, including the vast majority of the British apomictic *Sorbus* microspecies (Proctor & Groenhof 1992; Stace 1991). However, the friable, marly calcareous shales which are interbedded with the Lias limestone strata provide special cliff microhabitats, which do not occur in these Carboniferous Limestone districts, and the Lias limestone itself is relatively soft, maintaining a higher pH in the soils of cliff-tops and valley-slopes than on Carboniferous Limestone. The warm, south-facing ledges on which *S. domestica* grows are an exceptionally favourable environment for a thermophilous calcicole species at the northern limit of its range; the Mediterranean species *Adiantum capillus-veneris* grows as an undoubted native on the same ledges, in places where water seepages emerge from the permeable calcareous marl.

It seems quite possible that *S. domestica* may be native in the Glamorgan sites. Ring-counts indicate that the oldest trees at both sites are a minimum of several hundred years old, and introduced species are absent from the cliff refuges on which *S. domestica* grows, with the exception of *Quercus ilex* at the eastern site, where it was not seen with *S. domestica* (Table 2). There are no records of past cultivation or planting of *S. domestica* in southern Wales. Similar disjunctions between Continental and British populations occur in the European ranges of other calcicole species with outlying localities in the Bristol Channel area, for example *Arabis scabra*, *Draba aizoides* and *Koeleria vallesiana*. The full extent of the native distribution of *S. domestica* in Europe is hard to determine, because it has been widely cultivated for its fruits in the past, especially in Germany and France, and often occurs as scattered, isolated trees which seem likely to be descended from cultivated trees (e.g. Burnat 1899; Hegi 1922). It typically grows on calcareous soils. Wild populations are apparently widespread in southern Europe from Spain to the Balkans (Hegi 1922; Warburg & Kárpáti 1968), and also in Turkey (Davis 1972), extending northwards to southern Germany, where *S. domestica* is an indicator species of thermophilous mixed-oak woodland (*Quercetalia pubescenti-petraeae*) on dry slopes (Gerstberger 1980). In France, *S. domestica* is often of doubtful spontaneity, but occurs in possibly native populations in woods and hedgerows and calcareous soils in the Midi and in central and western France as far north as Morbihan (Coste 1901). The discovery of *S. domestica* in Glamorgan suggests that it could have been similarly overlooked or confused with *S. aucuparia* at other possible refuge sites in southern Britain and perhaps elsewhere in north-western Europe. The close superficial vegetative similarity between *S. domestica* and *S. aucuparia* has apparently not been realised by most botanists working in the British Isles, and non-fruiting populations of pinnate-leaved *Sorbus* on south-facing calcareous cliffs or open limestone slopes, if found, should be critically examined.

ACKNOWLEDGMENTS

We are very grateful to the University of Liverpool Botanic Garden at Ness, the University of Oxford Botanic Garden, and Mount Pleasant Trees of Berkeley, Gloucestershire for generously providing fresh material of cultivated *S. domestica*, to Gwynn Ellis and George Hutchinson of the National Museum of Wales and to Philip Nethercott for their taxonomic advice and assistance, to Colin Pascoe for historical research, to Rosemary John and Sarah Martin for expertly carrying out isozyme analyses, and to Peter Jones for his help in the field.

REFERENCES

AMPHLETT, J. & REA, C. (1909). *The botany of Worcestershire*. Cornish Brothers Ltd, Birmingham.

BEAN, W. J. (1980). *Trees and shrubs hardy in the British Isles*, ed. 8. John Murray, London, (4 vols. & supplement. *Sorbus*, vol. 4, 1980, pp. 399–464).

BURNAT, E. (1899). *Flora des Alpes Maritimes*, **3** (1). H. Georg, Genève, Bâle & Lyon.

CLAPHAM, A. R., TUTIN, T. G. & WARBURG, E. F. (1962). *Flora of the British Isles*. Cambridge University Press, Cambridge.

COSTE, H. J. (1901). *Flore descriptive et illustrée de la France, de la Corse et des contrées limitrophes*, **2** (1). Paul Klincksieck, Paris.

DAVIS, P. H., ed. (1972). *Flora of Turkey and the East Aegean Islands*, **4** (Rosaceae to Dipsacaceae). Edinburgh University Press, Edinburgh.

GERSTBERGER, P. (1980). Neue Merkmale zur Unterscheidung von *Sorbus domestica* L. und *Sorbus aucuparia* L. *Göttinger floristische Rundbriefe* **14**: 1–5.

HEGI, G. (1922). *Illustrierte Flora von Mittel-Europa*, **4** (2). J. F. Lehmanns Verlag, München.

LEES, E. (1867). *The botany of Worcestershire*. Worcestershire Naturalists' Club, Worcester.

Proctor, M. C. F. & Groenhof, A. C. (1992). Peroxidase isoenzyme and morphological variation in *Sorbus* L. in South Wales and adjacent areas, with particular reference to *S. porrigentiformis* E. F. Warb. *Watsonia* **19**: 21–37.

Stace, C. A. (1991). *New flora of the British Isles*. Cambridge University Press, Cambridge.

Step, E. (1905). *Wayside and woodland trees*. Frederick Warne & Co., London.

Warburg, E. F. & Kárpáti, Z. E. (1968). *Sorbus* L., in Tutin, T. G. *et al.*, eds., *Flora Europaea* **2**: 67–71. Cambridge University Press, Cambridge.

(*Accepted February 1995*)

Elytrigia repens (L.) Desv. ex Nevski subsp. *arenosa* (Spenner) A. Löve (Poaceae) in north-western Europe

P. J. O. TRIST

Glovers, 28 High Street, Balsham, Cambridge CB1 6DJ

ABSTRACT

Elytrigia repens subsp. *arenosa* differs from subsp. *repens* in being a much smaller plant with shorter ribbed cauline leaves and shorter panicles and spikes. It is recorded from the east, south and south west coasts of England and the Channel Islands on maritime sand. Its nomenclature is summarised, specimens seen are listed and the north western European distribution is given and mapped.

KEYWORDS: nomenclature, European specimens, distribution, maritime sands, sandy heaths.

INTRODUCTION

Elytrigia repens (L.) Desv. ex Nevski subsp. *arenosa* (Spenner) A. Löve has had a chequered history. It is an undistinguished grass which has had little attention. It was first recognised by Koch & Ziz (1814) in Germany, later by Jansen & Wachter (1933) in the Netherlands and by Holmberg (1926) and Hylander (1953) in Denmark, Finland and Sweden. Korneck (1966) and Hecker (1987) both record it in studies on the Mainz sands in Germany. In Britain it was not recorded in Bentham & Hooker (1858) or subsequently. As far as I know, Melderis (1980) was the first to report this taxon from Britain. It is likely that Stace (1991) carried its first description in a British Flora. Of this taxon he says "its distribution and taxonomic status are very uncertain". I here attempt to clarify this uncertainty.

The late C. E. Hubbard had early knowledge of subsp. *arenosa* and had been alerted by a specimen he collected in 1936 from reclaimed land near The Wash, W. Norfolk, v.c. 28. The specimen is in **K**, labelled "*Agropyron repens* var.?". I have examined it and consider it to be *Elytrigia repens* subsp. *arenosa*. Further evidence of his early interest in this taxon comes from a sheet recently found at **NWH**. The label records "*Agropyron maritimum* (*Triticum maritimum*) Koch & Ziz, sea bank, Burnham Overy Staithe, Norfolk, 28 July 1967: collected by C. E. Hubbard and E. L. Swann". I have seen this specimen and agree the determination with the nomenclature updated to *Elytrigia repens* subsp. *arenosa*. Swann also annotates the sheet "like *A. repens* but glaucous with glabrous leaves, convolute when dry, with stout smooth ribs, spikelets small". This agrees with my own description.

Hubbard (in litt. 1972) informed me "I have a living plant of the plant originally named *Triticum repens* var. *maritimum* by Koch & Ziz in Germany". He had also received six sheets of specimens of var. *maritimum* from K. Watermann of Ingelheim which were collected from the type locality on the Mainz sands in Germany; these were later incorporated at **K**. Of these sheets, Hubbard also commented "these I hope to pass to Melderis for study". Hubbard's health intervened and Melderis never received the sheets. When the latter included *Elymus repens* subsp. *arenosus* in *Flora Europaea* (Melderis 1980) I was interested to see a specimen. In 1986 I asked Melderis if he had a list of British localities for this taxon. He did not reply to my question but said that the inclusion of this taxon in Melderis & McClintock (1983) "was simply on the authority of C. E. Hubbard". He said he would shortly go to Kew and study the Watermann specimens of *E. repens* var. *maritimum* and later let me have a report. However, this intention, written into his last letter which was addressed to me and in his pocket at the time of his death, was never realised. Melderis had also referred (in litt. 1986) to specimens at **BM**, but in my subsequent researches I found no annotations on any sheets referring to *Elymus repens* subsp. *arenosus*. From these events it seems clear that Melderis was unable to complete his proposed study and had accepted Hubbard's opinion in the listing of subsp. *arenosus*. It is not known which of the two proposed the rank of subspecies.

The specimens at **K** from the Mainz area of Germany subsequently proved of guidance to me in the primary field identification. In 1986 on coastal dunes on L'Ancresse Common, Guernsey I found my first living specimens of subsp. *arenosa*. Subsequent searches at **CGE** and **LTR** yielded several British specimens which matched those I had taken in Guernsey. I then made further successful searches on the east coast of England and was satisfied that this taxon could be included in the British list and its description could be improved.

NOMENCLATURE

The original description of this taxon was made under *Triticum repens* var. *maritimum* Koch & Ziz in 1814. It will later be shown that this name is unacceptable. Smith (1800) in recording *Triticum repens* var. γ did not give a description of the plant but as his authority he cited Ray and Withering and referred to material in **herb. Lightfoot**. Roth (1802) validly published a description of Smith's plant under *Triticum repens* var. *maritimum* Sm. ex Roth. It is evident that the name var. *maritimum* Koch & Ziz published in 1814 was not based on var. *maritimum* Sm. ex Roth (1802), but was a later homonym and a nom. illeg.

It is likely that the Smith plant was based on British material and the Koch & Ziz plant was probably based on a different type as the authors were accounting for plants on the Continent and published in *Catalogus plantarum Palatinatus*.

The synonym *Triticum repens* var. *maritimum* Koch & Ziz non Sm. ex Roth is retained in the summary of the nomenclature and confirms that the plant *Triticum repens* var. *maritimum* Sm. ex Roth (1802) was unrelated to *Triticum repens* var. *maritimum* Koch & Ziz published in 1814.

The first valid and legitimate name for our plant is *Triticum repens* var. *arenosum* Spenner published in 1825. This latter was elevated to *Elymus repens* subsp. *arenosus* by Melderis in 1978 although he used a later publication of the epithet by Petif (1830) as the basis for his new combination (Melderis 1978).

Stace (1991) has corrected the nomenclature and returned the species to *Elytrigia*.

The following summarises the nomenclature.

Elytrigia repens (L.) Desv. ex Nevski subsp. **arenosa** (Spenner) Á. Löve in *Taxon* **29**: 351 (1980).

Triticum repens L. var. *maritimum* Koch & Ziz, *Catalogus plantarum quas in ditione florae Palatinatus legerunt* **5**: 17 (1814) nom. illeg., non Smith ex Roth (1802).

Triticum repens var. *arenosum* Spenner, *Florae Friburgensis* **1**: 162 (1825).

Triticum repens var. *arenosum* Petif, *Enumeratio plantarum in ditione florae Palatinatu sponte crescentium* **5**: 16 (1830).

Triticum maritimum Jansen & Wachter in *Nederlandsch kruidkundig archief* **43**: 178 (1933), non L. (1762).

Agropyron maritimum Jansen & Wachter, *Flora Neerlandica* **1** (2): 116 (1951), non (L.) P. Beauv. (1812).

Elytrigia repens var. *maritima* N. Hylander in *Botaniska notiser*: 357 (1953).

Elymus repens subsp. *arenosus* (Petif) Melderis in *Botanical journal of the Linnean Society* **76**: 379 (1978).

DESCRIPTION OF *ELYTRIGIA REPENS* SUBSP. *ARENOSA*

Perennial, usually forming small patches but sometimes as a single-culmed plant, with rhizomes; whole plant glaucous-green. Culms (16–)28–65 cm high, 0·4–1·0(–1·6) mm wide below the spike, erect, slender, sometimes geniculate at or near the base; nodes 2–3, light to dark pink. Sheaths glabrous, rounded on the back with well developed auricles; ligules less than 0·5 mm. Lower leaves few, (4–)7–14(–20) cm × 2–4 mm, rigid, finely pointed at apex. All leaves with prominently raised, broad, whitish or green veins c. 0·15–0·2 mm wide on the adaxial surface, glabrous or with a few scattered hairs, with margins sometimes minutely scabrid, all leaves involute or quickly becoming so on drying. Upper cauline leaves 1·5–6(–9·5) cm × 1–2(–3·4) mm, long-acuminate at apex. Spikes

(2·5–)4–9 cm long, erect, short and narrow, rhachis strap-shaped, with scabrid margins. Spikelets few, (7–)9–14 mm long, sessile, 2–6 flowered. Glumes (4·4–)6–9(–10) mm long, lanceolate to lanceolate-oblong, strongly keeled, scabrid, slightly unequal, blunt or mucronate and sometimes with awns (0·2–)1·0–2·3 mm at apex; veins 3(–7). Lower lemmas (5·5–)7–10(–12) mm long, lanceolate-oblong, blunt or mucronate at apex, sometimes with an awn (0·3–)1·8–2·8(–4·6) mm. In both glumes and lemma the awn is an extension of the central nerve and is sometimes scabrid distally. Palea shorter than the lemma, with ciliate margins. Anthers 4·0–5·3 mm.

The incidence of awns on subsp. *arenosa* is variable. On British material I found 22 spikes awned and 25 awnless. All 26 spikes of Swedish specimens were awned but only two out of 23 in German material. Those from Finland and Spain were awned but in French specimens the incidence was only two out of ten. The incidence of hairs on the adaxial leaf surfaces on subsp. *arenosa* is of little help in effecting determination. Four specimens of 50 British plants had leaf hairs, one in 26 of German and 15 of 18 in Swedish material. The occasional presence of hairs on subsp. *arenosa* leaves should not lead one to confuse the leaves with those of subsp. *repens*, as in the latter the leaf surface is flat and the leaf is flaccid and longer than in subsp. *arenosa*. Another possible confusion in determination may arise from the rare occurrence of cilia on the sheath margin of *Elytrigia repens* subsp. *arenosa* which is a character of *Elytrigia atherica* (Link) Kerguélen ex Carreras Mart. and its hybrids. Where a specimen with sheath cilia also has narrow and stiff leaves with involute margins and raised veins, it should be determined as *Elytrigia repens* subsp. *arenosa*.

An examination of a wide range of European specimens has enabled me to expand and modify the previous descriptions given by Melderis (1978, 1980) and Stace (1991). As examples I consider that all leaf margins of subsp. *arenosa* are involute or become so soon after collection; that geniculation at lowest nodes is infrequent; that leaves are found with either flat or round topped ribs and that none have been found more than 4 mm wide; and that lemmas are sometimes awned.

A comparison of the two subspecies is given in Table 1.

TABLE 1. A COMPARISON OF *ELYTRIGIA REPENS* SUBSP. *REPENS* AND SUBSP. *ARENOSA*

	Elytrigia repens subsp. *repens*	*Elytrigia repens* subsp. *arenosa*
Culm length	30–120 cm	(16–)28–65 cm
Culm geniculation	Sometimes at or near the base	Infrequent
Culm nodes	Light to dark brown	Light to dark pink
Leaves	Generally flat and flaccid, veins narrow; usually with dispersed hairs on adaxial surface	Thick, rigid; margins involute, veins broad, rounded or flat, 0·15–0·2 mm wide; usually glabrous
Upper leaves	8–16(–25) cm × 2–8·5 mm	1·5–6(–9·5) cm × 1–2(–3·4) mm
Basal leaves	8–30 cm × 3–10 mm	(4–)7–14(–20) cm × 2–4 mm
Spike length	5–20(–30) cm	(2·5–)4–9 cm
Spike habit	Erect to nodding with up to c. 25 spikelets	Short and strict often with <10 spikelets
Spikelet length	10–20 mm	(7–)9–14 mm
Number of florets	3–8	2–6
Glume length	7–12 mm	(4·4–)6–9(–10) mm
Glume: no. of veins	3–7	3(–7)
Glume awns	Sometimes mucronate and rarely awned in British specimens	(0·2–)1·0–2·3 mm
Lemma length	8–13 mm	(5·5–)7–10(–12) mm
Lemma awns	Usually absent in British material but in var. *aristatum* are thin and weak up to 15 mm long	Thick, straight and rigid, (0·3–)1·8–2·8 (–4·6) mm long. Where the lemma is mucronate, the tip is corneous and often scabrous
Anthers	3·5–6 mm	4–5·3 mm

HABITAT

Elytrigia repens subsp. *arenosa* occurs on maritime sand and dunes and can be seen within 30 m of the tide but is more often at least 70 m from the sea. It is also found at the rear of partially colonized sand beaches where infrequent tidal overflows encourage the growth of a salt tolerant flora. More observations and sampling for salinity are necessary before an opinion can be given on the salt tolerance of subsp. *arenosa*. The pH of the sands examined ranges from 6 to 7.

To the east of Caen, Normandy, it is seen on high dunes of mobile fine sand which are partially colonized with *Ammophila arenaria* (L.) Link, *Ononis repens* L. and *Tamarix gallica* L. At Sizewell E. Suffolk (v.c. 25) it grows on similar dunes with *Elytrigia atherica, Rumex crispus* L. and *Carex arenaria* L. At both of these sites subsp. *arenosa* only colonizes the perimeter of the associated vegetation. At L'Ancresse Common, Guernsey it grows as single-culmed plants widely spaced in semi-open consolidated dunes with *Agrostis stolonifera* L., *Cynosurus cristatus* L., *Gaudinia fragilis* (L.) P. Beauv. and *Vulpia bromoides* (L.) Gray.

In the vicinity of the Old Dunwich River at Walberswick, E. Suffolk (v.c. 25) it is found on consolidated sand subject to occasional tidal overflow, the soil of which is a mixture of fine sand and undecomposed organic matter derived from plant remains of *Festuca rubra* L., *Glaux maritima* L., *Atriplex portulacoides* L. and *Spergularia marina* (L.) Griseb. indicating a low salinity. On the beach at Thorpness, E. Suffolk (v.c. 25) it is found in small shingle and coarse sand with *Silene uniflora* Roth, *Senecio vulgaris* L. and *Ononis repens* L. On the same coast at Dunwich it is sparingly seen in small isolated colonies in sandy areas in large shingle on the back of the sea defences with *Lathyrus japonicus* Willd. It is recorded from the sand banks of the tidal estuary of the River Parret, S. Somerset (v.c. 5).

In Germany subsp. *arenosa* occurs on sandy heaths and in sandy arable land in the Mainz area c. 400km inland (Korneck 1966; Hecker 1987). The protologue of this taxon by Koch & Ziz (1814) reads "*Triticum repens maritimum* in sabulosis prope Moguntiam (Mainz) cum aliis plantis salinis copiose occurit". Hecker (1987) lists 217 taxa on the Mainz sands, and 159 of these are also found on the sands in the West Suffolk Breckland. Subsp. *arenosa* has not yet been reported from the latter, but it could well occur there. Recalling the above "plantis salinis copiose occurit", the Breckland sands support some maritime taxa including *Corynephorus canescens* (L.) P. Beauv., *Carex arenaria* L., *Phleum arenarium* L., *Trifolium scabrum* L. and *T. suffocatum* L.; the area is today c. 40 km from the tidal bay of The Wash. The inland stations of *Elytrigia repens* subsp. *arenosa* in the Rhine locality of Mainz suggests that it requires open sandy habitats rather than specifically maritime ones. It may well be a taxon like *Hippophaë rhamnoides* L. which was once more widespread and now occurs predominantly on the coast of Britain as its former inland sand habitats have been eroded (Godwin 1975). Both subsp. *arenosa* and *H. rhamnoides* are included in Hecker's (1987) list.

DISTRIBUTION OF *ELYTRIGIA REPENS* SUBSP. *ARENOSA* IN NORTH-WESTERN EUROPE

The distribution of *Elytrigia repens* subsp. *arenosa* in north-western Europe is shown in Fig. 1.

ENGLAND

S. Somerset, v.c. 5. Banks of River Parret between Stert Point and Combwich, 1907, *E. S. Marshall* (**CGE**, **OXF**).

W. Sussex, v.c. 13. Sea shore at Pagham, 1875, *H. E. Fox* (**OXF**).

S. Essex, v.c. 18. Foot of sea wall, Sandbeach Farm, Bradwell Juxta Mare, TM/030.053, 1986, *P. J. O. Trist* (**herb. P.J.O.T.**).

E. Suffolk, v.c. 25. The Dunes, Walberswick, 1950, *E. K. Horwood* (**LTR**); near the Old Dunwich River, The Flats, Walberswick, TM/501.749, 1989, *P. J. O. Trist* (**herb. P.J.O.T.**); sand erosion from shingle sea defence, Corporation Marshes, Walberswick, TM/495.740, 1991, *P. J. O. Trist* (**herb. P.J.O.T.**); foot of shingle bank sea defences, Dunwich, TM/479.707, 1989, *P. J. O. Trist* (**herb. P.J.O.T.**); fixed dunes, Sizewell beach, TM/475.629, 1989, *P. J. O. Trist* (**herb. P.J.O.T.**); sand and shingle beach, N. of Haven House, Thorpness, TM/470.589, 1989, *P. J. O. Trist* (**herb. P.J.O.T.**).

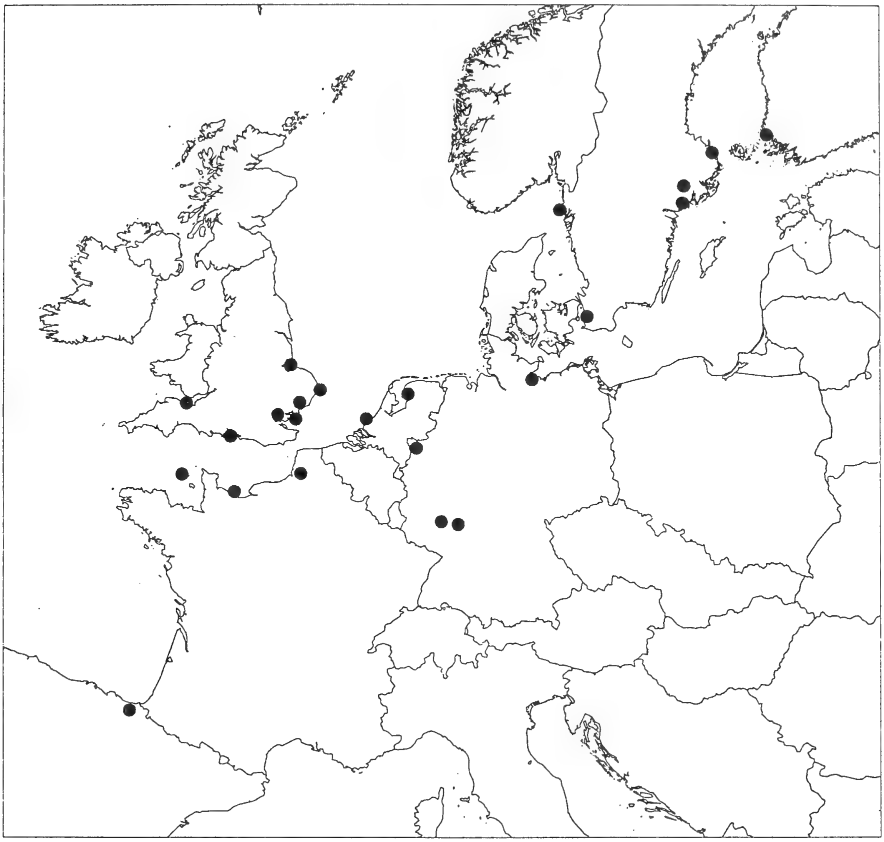


FIGURE 1. European distribution of *Elytrigia repens* subsp. *arenosa*.

E. Norfolk, v.c. 27. Sandy waste, Gt Yarmouth, 1953, *B. A. Poulton* (**E**).

W. Norfolk, v.c. 28. Hunstanton, 1935, *T. G. Tutin* (**LTR**); near the river by the paper mill, West Newton, 1936, *C. E. Hubbard* (**K**); sea defence bank, Burnham Overy Staithe, 1967, *C. E. Hubbard & E. L. Swann* (**herb. E.L.S.** in **NWH**).

Channel Islands v.c. S. Consolidated dunes by the Doyle Rock, L'Ancresse Common, Guernsey, WV/348.834, 1986, *P. J. O. Trist* (**herb. P.J.O.T.**); coastal sand dunes, Port Soif, Guernsey, WV/304.818, 1991, *Patience Ryan* (det. P.J.O.T.).

SPAIN

San Sebastian, 1895, *M. Gandoger* (**E**).

FRANCE

Dyke bank on sea shore, west of St Valery-sur-Somme, 1959, *D. P. Young* (**BM**); sand dunes at rear of beach, E. of Le Hôme, West of Cabourg, Calvados, Normandy, 1989, *P. J. O. Trist* (**herb. P.J.O.T.**); high sand dunes at rear of beach, N.E. of Merville-Franceville, Calvados, Normandy, 1989, *P. J. O. Trist* (**herb. P.J.O.T.**).

THE NETHERLANDS

Oostvoorne, 1914, *A. W. Kloos & J. W. Henrard* (**L**); Oostvoorne, 1917, *J. T. Henrard* (**L**); Hook of Holland, 1910, *P. Jansen & W. H. Wachter* (**L**); Noordwolde, Hemelumer Oldeferd, 1929, *A. N. Koopmans* (**L**).

GERMANY

Sandy area near Cleves, E.S.E. of Nijmegen, 1866, Florae rhenanae Fasc. 6 (**BM**); Offenbach am Main, undated, *C. B. Lehmann* (**K**); heathland on 'Mainzer sand', Mainz, 1971, *Kurt Watermann* (**K**); sandy arable field, Weilersberg near Mainz, 1969, 1971, *Kurt Watermann* (**K**); Priwall, near Travemünde, N.E. of Lubeck, 1845, *G. R. Haecker* (**E**).

FINLAND

Upper part of the sea shore meadow, west of Kuljunmaa in the Tirkkale group, off Lokalahti, 1973, *Sakari Hinneri* (**E**).

SWEDEN

Nyköping, Sodermanland, 1921, *Carl Blom* (**K**); sandy shore south of Kristineberg, Skaftö, Bohuslän, 1947, *K. H. Mattesson* (**NMW**); Norrvreda, Singö, Upplandia, 1928, *G. A. Ringselle* (**NMW**); Tranvik, Singö, Upplandia, 1928, *G. A. Ringselle* (**NMW**); Lund, Skäne, 1901, *O. R. Holmberg* (**BM**); Rundskär, Nyköping archipelago, 1882, *Hugo Samzelius* (**E**).

I have been unable to identify any specimens from collections sent from Trondheim (**TRH**) and Tromso (**TROM**) in Norway and it is likely that these areas are too far north for subsp. *arenosa* to occur. Dr Sivertsen of Trondheim suggests that this taxon might be found on the sands around Lista and in the Jaeren district in the south of Norway. I was surprised to find no specimens of subsp. *arenosa* in a large collection from Copenhagen (**C**).

ACKNOWLEDGMENTS

I thank the curators of **BM**, **C**, **CGE**, **E**, **K**, **L**, **LTR**, **NMW**, **NWH**, **OXF**, **RNG**, **TRH** and **TROM** for search and loan of specimens. I am also indebted to Mrs G. Beckett, A. O. Chater, Dr T. A. Cope, the late R. W. David, R. J. Driscoll, R. G. Ellis, Dr P. Grubb, D. R. McKean, C. D. Preston, Mrs P. Ryan, P. D. Sell, Professor C. A. Stace, Dr S. M. Walters and Dr P. Yeo for various assistance and guidance. I am particularly grateful to Dr C. E. Jarvis and D. H. Kent for search and guidance with nomenclature. I also acknowledge the help received from Dr U. Hecker, Dr D. Korneck, Dr R. van der Meijden, Dr M. Morkved, J. Reiersen, Dr S. Sivertsen and Dr J. F. Veldkamp.

REFERENCES

GODWIN, H. (1975). *Hippophaë rhamnoides*, in *History of the British flora*, p. 208. Cambridge University Press, Cambridge.

HECKER, U. (1987). *Agropyron maritimum*, in Die Farn-und Blütenpflanzen des Mainzer Sandes. *Mainzer naturwissenschaftliche archiev* **25**: 85–133.

HOLMBERG, O. R. (1926). *Scandinavian Flora* **2**: 274. Stockholm.

HYLANDER, N. (1955). *List of plants of north west Europe*. 1. *Vascular plants*, 26. Lund.

KOCH, W. D. J. & ZIZ, J. B. (1814) *Triticum repens* var. *maritimum*, in *Catalogus plantarum quas in ditione florae Palatinatus legerunt* **5**: 17. Mainz.

KORNECK, D. (1966). *Agropyron repens* var. *maritimum*, in Wiederfund von *Kochia arenaria* Roth im Naturschutzgebeit 'Mainzer Sand'. *Hessische Floristische Briefe* **178**: 49–56.

MELDERIS, A. (1978). Taxonomic notes on the tribe *Triticeae* (Gramineae), with special reference to the genera *Elymus* L. *sensu lato*, and *Agropyron* Gaertner *sensu lato*. *Botanical journal of the Linnean Society* **76**: 369–384.

MELDERIS, A. (1980). *Elymus* L., in TUTIN, T. G. *et al.*, eds. *Flora Europaea* **5**: 196. Cambridge University Press, Cambridge.

MELDERIS, A. & MCCLINTOCK, D. (1983). The genera *Elymus* L. and *Leymus* Hochst. in Britain. *Watsonia* **14**: 391–395.

PETIF, C. (1830). *Triticum repens* var. *arenosum*. *Enumeratio plantarum in ditione florae palatinatu sponte crescentium* **5**: 16. Zweibrucken.

ROTH, A. W. (1802). *Triticum repens* var. *maritimum* Smith ex Roth. in *Neue Beiträge zur Botanik*, 136–137. Frankfurt.

SMITH, J. E. (1800). *Triticum repens* var. γ. *Flora Britannica* **1**: 158. London.

STACE, C. A. (1991). *Elytrigia repens* (L.) Desv. ex Nevski subsp. *arenosa* (Spenner) A. Löve in *New Flora of the British Isles*, p. 1066. Cambridge University Press, Cambridge.

(*Accepted November 1994*)

Watsonia **20**: 391–396 (1995)

Puccinellia distans (Jacq.) Parl. subsp. *borealis* (O. Holmb.) W. E. Hughes (Poaceae) in mainland Scotland and the Outer Isles

P. J. O. TRIST

Glovers, High St, Balsham, Cambridge, CB1 6DJ

and

J. K. BUTLER

Seaside Cottage, Thurso East, Caithness, KW14 8NH

ABSTRACT

Puccinellia distans subsp. *borealis* (Northern Saltmarsh Grass) is distinguished from subsp. *distans* by its shorter culms and narrower leaves and in its native habitat the culms of the former are frequently procumbent. It has mostly contracted, dense and narrow panicles as opposed to the open character of the panicles of subsp. *distans*. Reflexed branches are frequent in subsp. *distans* but infrequent in subsp. *borealis*. The lemmas of subsp. *distans* are marginally smaller. The predominant natural habitat is identified as cracked seashore pavement of Old Red Sandstone rock and the importance of the man-made habitat on harbour and slipway stone structures is emphasised. The latter habitat probably controls the distribution of the plant. It is only rarely found in the saltmarsh habitat.

KEYWORDS: taxonomy, habitat, phenology, distribution.

INTRODUCTION

It is considered that the first British collection of *Puccinellia distans* subsp. *borealis* was made by Ralph Tate under the name of *Sclerochloa distans* from Balta Voe, Unst, Shetland in 1865 (**BM**). E. S. Marshall collected it as *Glyceria distans* Wahl. on "cliffs c. half a mile south of Wick, Caithness" and also at Melvich, West Sutherland, both sheets of 1886 in **BM** and **CGE**. In 1888 W. H. Beeby collected it as *Glyceria distans* Wahl. "on the stoney shores of Hildasay Is., Shetland" (**BM**) and in E. S. Marshall's collection in **CGE** a sheet is labelled "comm. W. H. Beeby leg. 1888, E. S. Marshall". Further collections were made by F. J. Hanbury at Uyeasound, Unst, Shetland, 1894, who also gave a sheet to Marshall (**CGE**). One of us (P.J.O.T.) has considered these specimens and is satisfied that they are all the same taxon, namely *Puccinellia distans* subsp. *borealis*. In Hubbard & Milne-Redhead (1968) the title "A *Puccinellia* new to Britain" is misleading. Credit can be given to Beeby for publishing a short account under *Glyceria distans* var. *prostrata* in 1895 but he was not the first to collect the taxon. He had noted the prostrate growth in his first collection and later obtained plants from F. J. Hanbury from which he took seed. From his plants in cultivation Beeby (1895) recorded "the prostrate habit is not so pronounced as in the wild specimens". Nevertheless he mistakenly published *Glyceria distans* var. *prostrata* Beeby.

Subsp. *borealis* was not included in Hubbard (1954) and first appeared under *Puccinellia capillaris* (Liljebl.) Jansen in Hubbard (1968). He was first alerted to this taxon in 1955 when he received specimens from the Isle of May off the coast of Fife (v.c. 85). In 1962 Elaine Bullard sent a specimen from Sule Skerry, Orkney to Hubbard who identified it as *Puccinellia capillaris*. Subsequently Bullard (1968) found the same taxon on the coast of all Orkney Islands. Hubbard & Milne-Redhead (1968) reported it from the coasts of Caithness, West Sutherland, Banff and Moray.

DESCRIPTION OF *PUCCINELLIA DISTANS* SUBSP. *BOREALIS*, NORTHERN SALTMARSH GRASS

A loose to compact perennial. Culms spreading, procumbent or erect, 2–40 cm long, 2–4 noded, smooth. In natural habitats the culms seldom exceed 28 cm long. Leaves grey-green, glabrous, sheaths smooth, slightly inflated, striate; ligules 0·4–2·2 mm long, membranous; blades blunt-tipped, 3–12 cm long, seldom flat and mostly plicate, 1–2 mm wide but width in small plants is <1·0 mm. Panicles mostly contracted, erect and dense throughout, 2–12 cm long; when panicles exert, the branches at the lower nodes are patent; pedicels 0·8–4·8 mm long, scabrid.

Spikelets oblong, 2·5–9 mm × 1·5–2 mm, 2–8 flowered. Glumes slightly unequal, ovate to elliptic; lower 0·5–2 mm long, 1-nerved; upper 1·3–2·8 mm long, 3-nerved. Lower lemmas oblong to elliptic, blunt, (1·8–)2·2–2·8 mm long, minutely hairy at the base. Paleas about as long as lemma, hairy on the keels. Anthers 0·4–1 mm long.

The following summarises the nomenclature:

Puccinellia distans (Jacq.) Parl. subsp. **borealis** (O. Holmb.) W. E. Hughes in *Botanical journal of the Linnean Society* **76**: 363 (1978).

Glyceria distans var. *prostrata* Beeby in *Journal of botany (London)* **33**: 315–316 (1895).

Poa retroflexa Curtis subsp. *borealis* O. Holmb. in *Botaniska notiser* **26**: 182 (1926).

Puccinellia distans var. *prostrata* (Beeby) Jansen & Wachter in *Nederlandsch kruidkundig archief* **40**: 248 (1930).

Puccinellia capillaris (Liljebl.) Jansen in *Flora Neerlandica* **1**: 2, 69 (1951).

Puccinellia borealis (O. Holmb.) Á. Löve & D. Löve in *Botaniska notiser* **128**: 498 (1976).

HABITAT

THE NATURAL HABITAT

The most convincing natural habitat of *Puccinellia distans* subsp. *borealis* is at a low level on a rocky seashore platform. On the British mainland it occurs around the coast of Caithness (v.c. 109), having a specific preference for the flagstone pavement of the Old Red Sandstone. This fine-grained sedimentary rock forms gently sloping flat surfaces fractured at intervals by long fissures typically a few mm wide.

This grass occupies these fissures (as shown in Fig. 1) at the lowest level on the shore capable of accommodating higher plants, i.e. 4 m above Ordnance Datum. Here there is a sparse community in which the constant species are *Armeria maritima* (Miller) Willd., *Plantago maritima* L., *Puccinellia distans* subsp. *borealis* and *Sagina maritima* G. Don. Occasional associates are *Aster tripolium* L. and *Plantago coronopus* L. This community occupies about 1 m of vertical height and gives way at higher levels to a similar but richer community in which the dominant grass is *Festuca rubra* subsp. *juncea* (Hackel) K. Richter which is responsible for some displacement of the *P. distans*. In this higher zone *Agrostis stolonifera* L. and *Tripleurospermum maritimum* (L.) Koch occur in addition to *Carex distans* L. and *Euphrasia foulaensis* F. Towns. ex Wettst. at the top of the zone some 7 m above Ordnance Datum level.

On the Scottish mainland good examples of this community in platform cracks were found at Proudfoot ND/383.510 (see Fig. 2) and at Thurso East ND/143.701 (both v.c. 109, Caithness); such communities occur all round the coast from Reay in north-west Caithness to Helmsdale on the east coast of Sutherland wherever the exacting conditions of sloping pavement at the correct intertidal height occur. It is also the dominant natural habitat on seashores in Orkney.

Subsp. *borealis* is also to be found in saltmarshes but its occurrence in this habitat is uncommon. Saltmarsh itself is rare due to the combination of a rocky wave-exposed shore and the prevalence of coarse sand on the sea bottom. On this account subsp. *borealis* is seldom found in association with *Puccinellia maritima* (Hudson) Parl.; where it does occur on Orkney the former has a hazardous chance of withstanding the competition of a close sward created by the stolons of *P. maritima*. This association in saltmarsh is known in Orkney and Shetland. It is reported by Bullard (pers. comm., 1987) "in saltmarsh with open areas of bare mud" at Westayre Loch, Sanday, 1966; "in muddy saltmarsh at the edge of a small loch", Sandsend, Shapinsay, 1966 with *Juncus bufonius* L. and *Spergularia marina* (L.) Griseb.; and on saltmarsh at Sebay Mill, Tankerness, 1966. In 1982 Bullard sent specimens (now in **herb. P.J.O.T.**) of subsp. *borealis* from "open areas of saltmarsh on

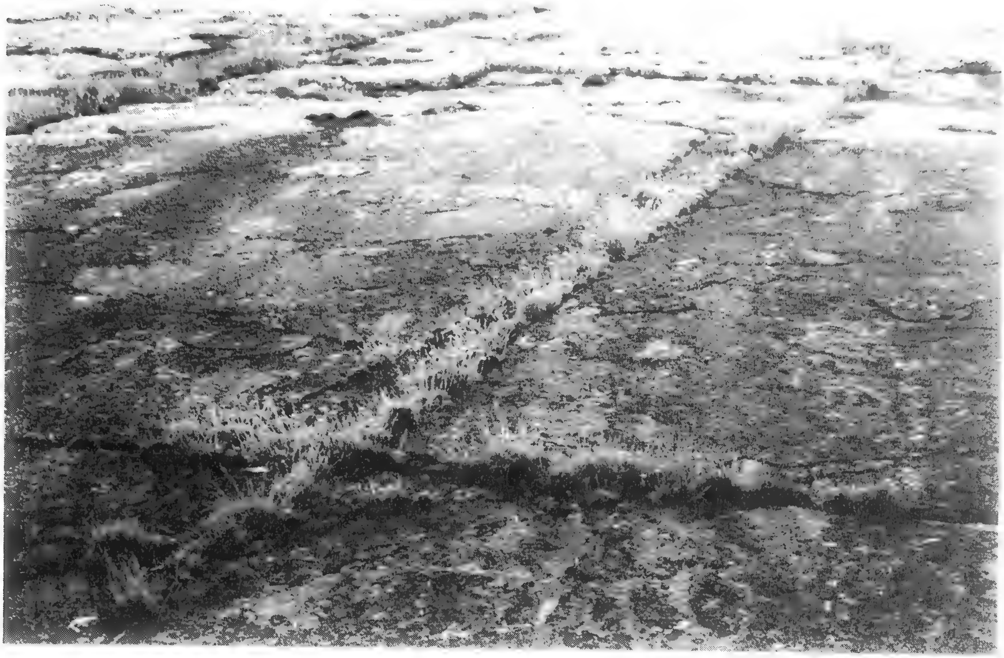


FIGURE 1. *Puccinellia distans* subsp. *borealis* in association with *Armeria maritima* in the cracks of Old Red Sandstone natural paving at Proudfoot, Wick.

FIGURE 2. Individual plants of *Puccinellia distans* subsp. *borealis* in crevices. The rock is partly coated with tar.

the east side of Cata Sound, Orkney" which were associated with *Agrostis capillaris* L., *Armeria maritima*, *Juncus gerardii* Loisel., *Plantago maritima* and *Puccinellia maritima*.

This uncommon association between the two species of *Puccinellia* is also recorded by Scott & Palmer (1987) "about the tiny brackish pool behind the jetty at Grutness", Shetland and by Gilbert & Holligan (1979) on Rona, North Ebudes, v.c. 104.

Subsp. *borealis* is less common on sand and fine stones, but does occur on such substrates, for example on the sloping banks of the tidal River Halladale at Bighouse, West Sutherland NC/890.649. E. S. Marshall also records finding occasional plants "on muddy decomposed boulder clay" south of Wick in 1886 (**CGE**) and also "in mud among stones at the rivermouth at Dunbeath" ND/165.295, both in Caithness. It also occurs on the stony shore on the western side of Loch Eriboll, v.c. 108, W. Sutherland. There are two examples, at Janetstown and Lybster on the east coast of Caithness of the plant being found among larger (c. 150 mm) waveworn boulders which did not have a matrix of silt or other fine material; this situation is, however, uncommon.

MAN-MADE HABITAT

The natural habitat occurs around 1 m above mid tide level, which is also the level at which the top of a harbour quay is constructed. This proves to be a very good habitat for *Puccinellia distans* subsp. *borealis*. There are many records from small quays, slipways and stonework on larger harbour walls. The quay top is often a stone pavement and the pattern of local distribution suggests that the seed is carried by waves flooding over the quay. Plants are to be found mainly in the crevices of the pavement and also on tracks and rough ground within reach of the swell. Bullard (pers. comm., 1987) found the plant in two locations amongst *Leymus arenarius* (L.) Hochst. in coastal dunes some distance from the swell region. The plant may occasionally act as a short-lived ruderal when carried by vehicle tyres from a harbour area.

In the quay top community which is on the horizontal, the plant association is richer than in the natural sloping pavement habitat. *Armeria maritima*, *Plantago maritima* and *Sagina maritima* are the constant associates but *Aster tripolium*, *Cochlearia anglica* L., *Matricaria discoidea* DC., *Plantago coronopus*, *Potentilla anserina* L., *Spergularia marina* and *Tripleurospermum maritimum* typically occur. In this habitat the *Puccinellia distans* subsp. *borealis* is able to survive alongside *Festuca rubra* subsp. *juncea*, whereas in the natural habitat of the sloping rock platform they tend to occupy different levels. A good example of a rich community is the harbour quay at Keiss in Caithness ND/351.609 where thousands of plants of subsp. *borealis* were seen in July 1993.

A comparison of the vertical distribution of the plants in the natural and man-made habitats shows that the horizontal surface of a quay allows the species a better foothold at higher elevation above mid-tide.

The success of the man-made habitat is clear. It can be said that almost every quay and slipway on the far north and east coast of the mainland and on Orkney and Shetland are candidate sites for at least a few plants of subsp. *borealis*. This habitat is the main source of new seed and probably the basis of the present distribution. Numerically the distribution seems to be centred on north-east Caithness, Orkney and Shetland where the population is sufficiently dense to provide seaborne seed for wider distribution.

PHENOLOGY

Davis (1983) records that in species of *Puccinellia* "growth and flowering are continuous throughout the summer and simultaneous among varied microhabitats within populations". The various maritime habitats in which subsp. *borealis* is found shows its ability to adapt to environmental variability.

The sea shore by the harbour at Lybster, Caithness, v.c. 109 has a man-made earth-stone boat slipway. A single plant of subsp. *borealis* collected on 16 July 1982 was 20 cm high overall with 17 fresh green panicles. All culms were erect and panicles were in varying stages of development from first break of sheath to open panicles. Within a few metres five plants of 4–8 cm high had 1–3 panicles per plant, all of which had one or more dead panicles and others in stages of dying or development. In another collection taken the same day at Janetstown on the east coast of Caithness, where the large-shingle beach was similar, subsp. *borealis* was found between stones on a bank above and on the harbour wall. Four plants of 6–10 cm in height were taken and three had single dead panicles and leaves; on the other plant there were two dead panicles and three panicles in stages of dying. These records illustrate the continuous growth of individual plants of subsp. *borealis* which may be seen from mid-June to mid-August in all the types of maritime habitats.

Davis (1983) also discusses the periods of moisture stress which arise from varying frequencies of tidal wash. In addition there are variations in salt stress on plants where salt is retained in crevices as opposed to direct drainage through shingle and sand beaches at river mouths. There may also be a difference in salt retention in natural platform crevices compared to quay top crevices because the latter lie on a rubble base.

Procumbent growth is noticeable on beach habitats subject to tidal flow and this appears as a reaction to the tidal thrust over the rocks. Plants out of reach of seawater flush, but within the spray and swell of high tides, frequently have erect growth.

Davis (1983) also records that species of *Puccinellia* "are patchily distributed due to the discontinuous and restricted occurrence of suitable habitats". This is demonstrated on the north coast of the Scottish mainland. Between Loch Eriboll in West Sutherland and Reay in Caithness the rocks are from the Moine Succession or igneous intrusions related to it. Here, *Puccinellia* spp. are very sparse. Between Reay and Scrabster the shore is mostly vertical cliff. But between Scrabster and John o'Groats there is an almost continuous occurrence of flat rocky platforms of Old Red Sandstone where subsp. *borealis* can be found whenever these platforms have the preferred intertidal height. On the east coast of Caithness from John o'Groats to Dunbeath there are many stretches of vertical cliff but any occurrence of suitable rocky platforms is likely to have some specimens of the plant. South of Dunbeath there are few suitable natural habitats since cliff, boulder beach or fine sand prevail.

DISTRIBUTION

Puccinellia distans subsp. *borealis* is reported from the north of the Outer Hebrides, v.c. 110 on the Butt of Lewis, Uig and at Stornoway, but there are no records for the North Ebudes, v.c. 104 or the west coast of Scotland. It occurs frequently on the coasts of the Orkney Isles (v.c. 111), on North Rona (v.c. 110) to their west, on Fair Isle, Foula and Shetland (v.c. 112). On the north coast of Scotland it is found on the shores of Loch Eriboll and then eastward at intervals to Bighouse (v.c. 108) almost at the western boundary of Caithness. It is seen at Brimsness and Scrabster. Eastward from Scrabster it is locally plentiful along to John o'Groats. South from John o'Groats it occurs at intervals, being plentiful around Wick and occurring at Lybster, Dunbeath, Helmsdale and as far as Golspie. Then again it can be found at Hopeman and Peterhead on the coast of Banff (v.c. 93, N. Aberdeen) and at intervals down to Fife (v.c. 85), where it occurs frequently between Crail and Pittenweem and on the Isle of May to the east. It is recorded from Rosyth, Fife and at Leith Docks, (v.c. 83, Midlothian), also on the Bass Rock in the Firth of Forth and at Tyninghame, East Lothian (v.c. 82).

The plant is known from the Faeroes, Iceland, Greenland, Norway and on the coast of the Netherlands.

The hybrid between *Puccinellia distans* (Jacq.) Parl. subsp. *borealis* (O. Holmb.) W. E. Hughes and *P. maritima* (Huds.) Parl., named *Puccinellia* × *mixta* O. Holmb., has been found on the Fianuis peninsula on North Rona, Outer Hebrides, v.c. 110 by Gilbert & Holligan (1979). It is also recorded from Denmark, Holland, Iceland, Norway and Sweden (Jones & Stace 1975).

ACKNOWLEDGMENTS

We are grateful to the curators of **BM** and **CGE** for access to specimens and information. We thank D. H. Kent for assistance with nomenclature and Elaine Bullard for field notes and discussions and also Elizabeth Norman for help with field work over several years. Charles Turner kindly commented on the manuscript.

REFERENCES

BEEBY, W. H. (1895). *Glyceria distans* var. *prostrata* Beeby. *Journal of botany (London)* **33**: 315–316.

BULLARD, E. R. (1968). Notes on the occurrence of *Puccinellia capillaris* (Liljebl.) Jansen. *Bulletin of Orkney Field Club* **4**: 5.

DAVIS, J. J. (1983). Phenotypic plasticity and the selection of taxonomic characters in *Puccinellia* (Poaceae). *Systematic botany* **8**: 341–353.

GILBERT, O. L. & HOLLIGAN, P. M. (1979). *Puccinellia capillaris* (Liljebl.) Jansen × *P. maritima* (Huds.) Parl. on North Rona, Outer Hebrides. *Watsonia* **12**: 338–339.

HUBBARD, C. E. (1954). *Grasses*, 1st ed. Penguin, Harmondsworth.

HUBBARD, C. E. (1968). *Grasses*, 2nd ed., p. 199. Penguin, Harmondsworth.

HUBBARD, C. E. & MILNE-REDHEAD, E. (1968). A *Puccinellia* new to Britain. *Proceedings of the Botanical Society of the British Isles* **7**: 507.

JONES, B. M. G. & STACE, C. A. (1975). *Puccinellia capillaris* (Liljebl.) Jans. × *P. maritima* (Huds.) Parl. = *P.* × *mixta* Holmberg in STACE, C. A. ed. *Hybridisation and the flora of the British Isles*, p. 559. Academic Press, London.

SCOTT, W. & PALMER, R. C. (1987). *Puccinellia distans* (Jacq.) Parl. subsp. *borealis* (O. Holmb.) W. E. Hughes in SCOTT, W. & PALMER, R. C. *The flowering plants and ferns of the Shetland Islands*, p. 357. The Shetland Times, Lerwick.

(*Accepted September 1994*)

A graphical analysis of the characters of *Calamagrostis stricta* (Timm) Koeler, *C. canescens* (Wigg.) Roth and their hybrid populations in S. E. Yorks., v.c. 61, northern England

F. E. CRACKLES

143 Holmgarth Drive, Bellfield Avenue, Hull, HU8 9DX

ABSTRACT

Population samples of *Calamagrostis stricta* (Timm) Koeler, *C. canescens* (Wigg.) Roth and the hybrids *C. canescens* × *C. stricta* (Poaceae), 2n = 28 and 2n = 56, as well as a strongly introgressant *C. canescens* population along Leven Canal, S.E. Yorks., v.c. 61 are described using methods of polygraphic analysis: pictorial scatter diagram, hybrid index analysis and polygonal graphs. A polygonal graph is also given for a recombinant represented by a single plant. The overall intermediate nature of the hybrids is demonstrated as well as the loose non-random association of characters. The nature of the hybrids, the effect of polyploidy and the relative merits and limitations of the different methods of polygraphic analysis used are discussed. Evidence for a *C. canescens* population being strongly introgressed is assembled.

KEYWORDS: Poaceae, introgression, multivariate analysis.

INTRODUCTION

In an earlier paper (Crackles 1994) I described a diverse group of *Calamagrostis* populations along the Leven Canal in S.E. Yorkshire (v.c. 61) and showed that these could be assigned to six 'taxa': *C. canescens* (Wigg.) Roth, *C. stricta* (Timm) Koeler, *C. canescens* × *C. stricta* 2n = 56 (H_1 population), *C. canescens* × *C. stricta* 2n = 28 (H_2 population), a recombinant individual plant (H_3) and an introgressed *C. canescens* (I_1 population). These could all be identified in the field.

To explore in more detail the relationship between these various populations and the characters by which they differed, I undertook a comparison of population samples by graphical methods of analysis – using pictorial scatter diagrams, hybrid index analysis (Anderson 1949) and polygonal graphs. The results provide some further insights into the relationships of the Leven *Calamagrostis* populations, as well as illustrating the continuing value of these relatively simple graphical methods and indicating their relative weaknesses and strengths.

METHOD OF STUDY

25 shoots of *C. stricta*, *C. canescens* and the putative hybrid populations H_1 and H_2 and 20 shoots of the I_1 population (Crackles 1994) were collected at random. Material was collected at the end of July or in early August 1970, when the panicles were in their after-flowering condition so that comparison of the maximum number of floret characters could be made. The range of measurements, the mean and the standard deviation for various characters are given in the previous paper (Crackles 1994).

As axes for each scatter diagram (Figs 1 & 2), the ratio of bract length to bract width was plotted against the ratio of panicle length to length of basal branch of panicle. Ratios were used to minimise the possible effect of varying environmental conditions on lengths of structures. Other information was added to the scatter diagram to produce metroglyphs.

In the case of the ratio of glume length to glume width, and awn length, the intermediate range was calculated by dividing the range between the standard deviations for the two species by four and taking the median two quarters as the intermediate range.

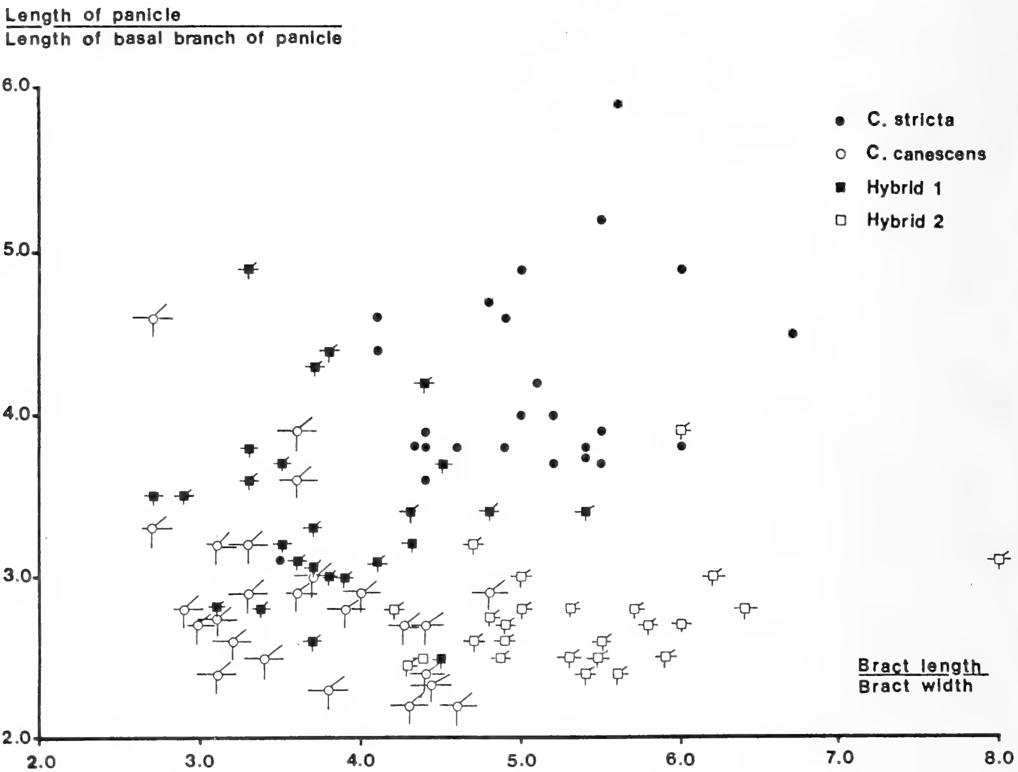


FIGURE 1. Scatter diagram for population samples of *Calamagrostis stricta*, *C. canescens* and *C. canescens* × *C. stricta*, Hybrid 1 and Hybrid 2 (H_1 and H_2 populations).
Callus hairs: shorter than lemma ●; ± equal to lemma ●; longer than lemma ●.
Awn insertion from: bottom 37·5% of lemma ●; 37·5%–85·0% way up lemma ●; near tip of lemma ●.
Awn length: >1·7 mm ●; 0·9–1·7 mm ●; <0·9 mm ●.
Glume length/glume width: <4·5 ●; 4·5–6·0 ●; >6·0 ●.

A more arbitrary method had to be used to determine the intermediate range for the position of awn insertion on the lemma. It was known from observation that the awn is inserted just below the middle of the lemma in the hybrid, *C. canescens* × *C. stricta*. In *C. canescens* the awn is almost apical, while in *C. stricta* it is inserted 25%–35% along the length of the lemma from its base. The intermediate range was defined by dividing the range 25%–50% into two and taking the lower half as *C. stricta* and the upper half as intermediate.

The hairs surrounding the floret (callus hairs) are generally at least 0·7 mm longer than the lemma in *C. canescens* and substantially shorter than the lemma in *C. stricta.* Callus hair length between 0.4 mm longer and 0.4 mm shorter than the lemma was taken to be an intermediate character.

The method of hybrid index analysis is described by Anderson (1949) and consists of selecting a number of characters with respect to which the species differ, and recording each character of each plant as identical with that of one of the species or as intermediate between them. Each character is then assigned an arbitrary value. When each of the characters of the plant listed has received a score, the total index score of the plant is obtained by summing the scores of all its characters.

In selecting characters the following principles were borne in mind:

1. in obtaining an index score for an individual plant or a population it is essential that as many characters as possible are taken into account;
2. an index score for each character used must be obtainable for each population analysed;
3. characters which can be observed with the naked eye or with a hand lens and structures which can

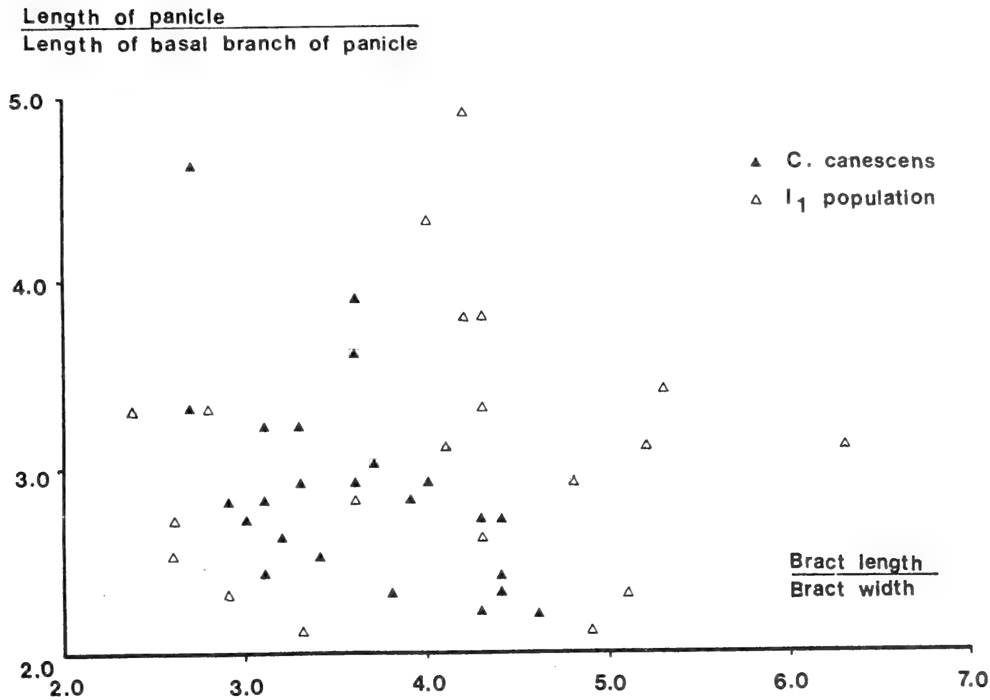


FIGURE 2. Scatter diagram for population samples of *Calamagrostis canescens* and a suspected *C. canescens* introgressant (I_1 population).

be measured without the use of a microscope are most useful and were used whenever possible; and

4. floret characters were included in order to achieve coverage of important features although measurements had to be made using a binocular microscope.

TABLE 1. METHOD OF SCORING THE HYBRID INDEX FOR *CALAMAGROSTIS* TAXA

Character	*C. stricta* Score 0	Intermediate Score 1	*C. canescens* Score 2
Panicle length (cm)	<14·0	14·0–15·5	>15·5
Panicle width (in fruit) (cm)	<1·6	1·6–2·5	>2·5
Length of basal branch of panicle (cm)	<4·0	4·0–5·1	>5·1
Culm rough near panicle	+		–*
Culm width at 2nd node (mm)	<1·6	1·6–2·0	>2·0
Bottom leaf sheath hairy	+		–*
Glume length (mm)	<4·0	4·0–4·5	>4·5
Glume width (mm)	>0·90	0·55–0·90	0·60–0·70
Glume length/glume width	<4·5	4·5–6·0	>6·0
Callus hairs	<floret	± = floret	>floret
Awn length (mm)	>1·7	0·9–1·7	<0·9
Awn insertion**	<37·5%	37·5%–85·0%	>85%
Ligule length (mm)	<3·0	3·0–3·6	>3·6

* scored as 1.

** awn insertion measured from base of floret as % of floret height.

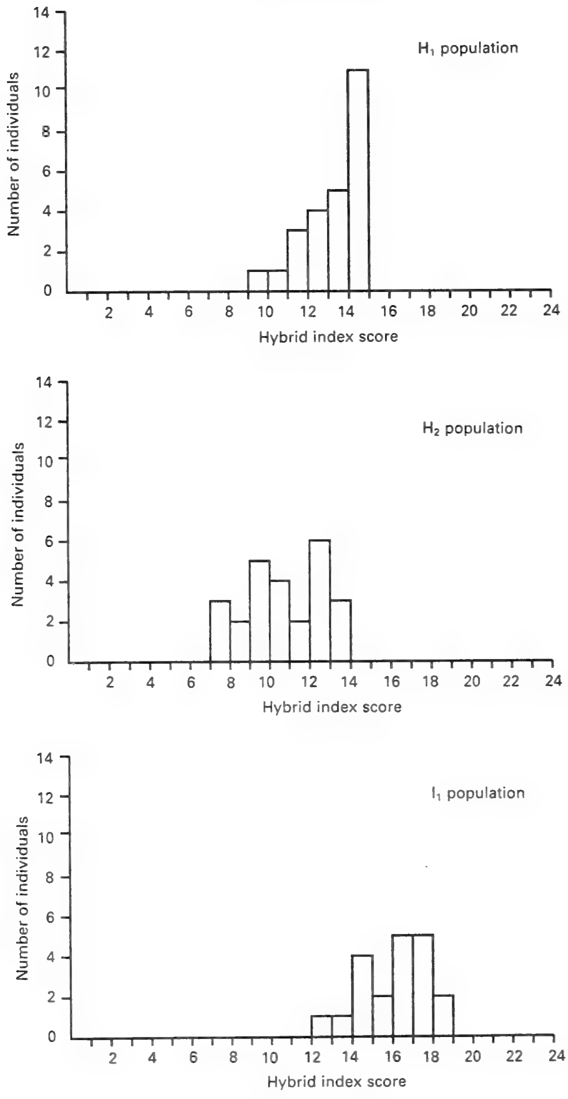


FIGURE 3. Hybrid index scores for Leven *Calamagrostis canescens* × *C. stricta*, H_1 and H_2, and the *C. canescens* I_1 population samples.

A list of characters used and the method of scoring are given in Table 1. The intermediate range for each character was determined in the same way as for the scatter diagrams. The frequency distribution of hybrid index scores for the H_1, H_2 and I_1 populations are shown in Fig. 3.

A polygonal graph was constructed for each of the Leven *Calamagrostis* populations studied and for a single plant, the only one of its kind found, H_3 (Fig. 4) The method of scoring is given in Table 2. In using this method, characters in which a hybrid shows a range of measurements which is not intermediate between those of the parents can be included and I have selected lemma length as one of the eight characters. The lemma of individuals of the H_1 population is longer than that of both parents (Crackles 1994).

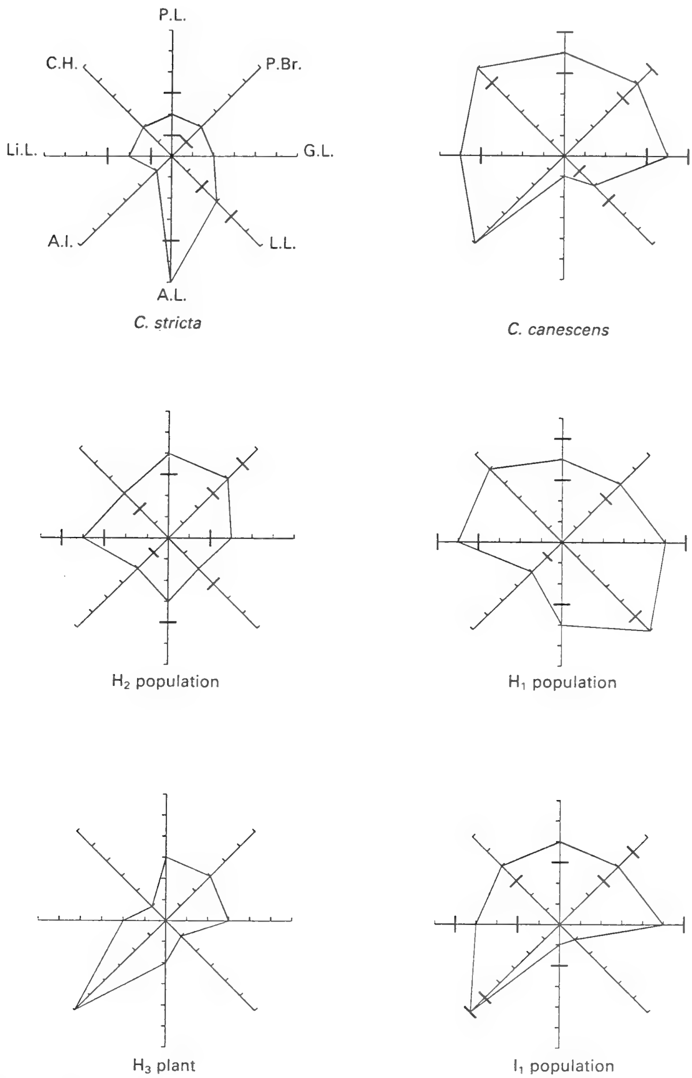


FIGURE 4. Variation in eight characters of the Leven *Calamagrostis* taxa. Each radius has six divisions (see Table 2). In the case of each Leven *Calamagrostis* population sample, except the H_3, the polygonal graph was drawn using the mean of the measurements for each character; standard deviations are shown along each axis. The polygonal graph for the H_3 was drawn using measurements for one plant only. Abbreviations are given in Table 2.

RESULTS

The overall intermediate morphological nature of the H_1 and H_2 populations between that of the two species is demonstrated by the intermediate shape of the polygonal graphs for the two hybrids (Fig. 4) and by the range of hybrid scores for both hybrid populations (Fig. 3).

The tendency of intermediate characters of the H_1 and H_2 populations to be inherited together, but not invariably so, is shown for four characters by the use of intermediate length arms attached to dots on the scatter diagram (Fig. 1). By examining these four characters, a pair at a time (Table 3), it is seen that such intermediate characters have a strong tendency to remain together, but that the

TABLE 2. METHOD OF SCORING FOR POLYGONAL GRAPHS OF *CALAMAGROSTIS* TAXA

	Radius division from the centre of a circle*					
Character	0	1	2	3	4	5
Panicle length (P.L.) (cm)	5·9–8·9	9·0–12·0	12·1–15·1	15·2–18·2	18·3–21·3	21·4–24·4
Length of basal branch of panicle (P.Br.) (cm)	1·2–2·4	2·5–3·7	3·8–5·0	5·1–6·3	6·4–7·6	7·7–8·9
Glume length (G.L.) (mm)	2·6–3·1	3·2–3·7	3·8–4·3	4·4–4·9	5·0–5·5	5·6–6·1
Lemma length (L.L.) (mm)	2·5–2·6	2·7–2·8	2·9–3·0	3·1–3·2	3·3–3·4	3·5–3·6
Awn length (A.L.) (mm)	0·3–0·6	0·7–1·0	1·1–1·4	1·5–1·8	1·9–2·2	2·3–2·6
Awn insertion** (A.I.)	27%–38%	39%–50%	51%–62%	63%–74%	75%–86%	87%–98%
Ligule length (Li.L.) (mm)	1·3–1·8	1·9–2·4	2·5–3·0	3·1–3·6	3·7–4·2	4·3–4·8
Callus hairs (C.H.) (mm)	1·9–2·1	2·2–2·5	2·6–2·9	3·0–3·3	3·4–3·7	3·8–4·1

*see Fig. 4.
** measured from the base of the floret as a % of floret height.

TABLE 3. THE FREQUENCY OF ASSOCIATION OF CHARACTERS WITHIN TWO POPULATIONS (H_1 AND H_2) OF *CALAMAGROSTIS*, EXAMINED TWO AT A TIME

	Percentage association*		
Associated character pair	H_1	H_2	H_1 and H_2
Callus hairs and awn length	80	84	82
Awn length and awn insertion	64	84	74
Callus hairs and awn insertion	72	72	72
Glume ratio and awn insertion	76	60	68
Glume ratio and awn length	80	64	72
Callus hairs and glume ratio	96	60	78

* percentages calculated using the number of short 'arms', representing intermediate states, on the scatter diagram shown in Fig. 1.

strength of the affinity between these varies not only from one pair of characters to another, but also usually from one hybrid population to the other.

The H_1 and H_2 populations were found to be morphologically distinct (Crackles 1994). Differences between these two populations are further demonstrated by:

a. the fact that most individuals of the H_2 population appear in a different part of the scatter diagram from those of the H_1 population (Fig. 1); and
b. differences between the polygonal graphs for the two populations.

The differences between the polygonal graphs for the hybrid populations H_1 and H_2 is mainly one of size, there being a general similarity of shape except for the difference caused by the much greater lemma length in the H_1 population.

Morphological evidence has already been given to support the view that the *C. canescens* I_1 population is introgressed (Crackles 1994). Further evidence of this view is provided by graphical analysis:

a. over half of the individuals of the population occur outside the area occupied by typical *C. canescens* individuals on the scatter diagram (Fig. 2);
b. a hybrid index range of 13–19 was obtained for the I_1 population where *C. stricta* = 0 and *C. canescens* = 23; and
c. a polygonal graph for the I_1 population (Fig. 4) while of the same shape as that for typical *C. canescens* shows a shift towards the hybrid range for some characters.

The polygonal graph for the Leven H_3, represented by a single plant, confirms that this is a recombinant. The position of awn insertion was as in *C. canescens* and the awn length as in some *C. canescens* I_1 individuals while the panicle and ligule length were as in *C. stricta*. The basal branch of the panicle and the glume were intermediate in length, being within the range for these characters in the *C. canescens* × *C. stricta* H_2 population. The callus hairs tended to be shorter than in *C. stricta*.

DISCUSSION

The loose non-random association of characters in both the H_1 and H_2 populations demonstrated by the scatter diagrams (see Table 3) is considered by Anderson (1949) to be critical evidence of hybridization. This evidence together with the intermediate nature of many characters of these taxa (Crackles 1994) and their overall intermediacy demonstrated by the polygonal graphs and their hybrid index range, (H_1 10–15, mode = 15; H_2 8–14, mode = 13; *C. stricta* = 0, *C. canescens* = 23), as well as the fact that they occur in the same locality as both parental species, leave no doubt that both the H_1 and H_2 populations are the hybrid *C. canescens* × *C. stricta*.

Comparison of the polygonal graphs for the H_1 and H_2 populations suggest that the main difference between the two taxa is one of size of several characters.

The chromosome number of the Leven *C. stricta*, *C. canescens* and the H_2 *C. canescens* × *C. stricta* populations is 2n = 28 (Crackles 1994), a number Nygren (1946) found to be constant for the two species. The chromosome number for the Leven H_1 *C. canescens* × *C. stricta* is, however, 2n = 56 so that this taxon is an octoploid (Crackles 1994).

The question of the likely effects of polyploidy on characters of the H_1 population thus arises and whether such effects may be the full explanation of differences between the H_1 and H_2 populations. Stebbins (1971) drew attention to the varying effects of polyploidy in different genotypes and also to the fact that gigas effects are seen most often and most strongly in organs with a determinate type of growth. It would seem that polyploidy is the explanation of increased lemma length which is greater than in either parent. It is also the probable explanation of the longer and wider glumes while an intermediate shape is retained and of greater callus hair length which approaches that of *C. canescens* while remaining more or less the same length as the lemma as in other hybrid individuals. A tendency to greater plant height, greater panicle length and greater awn length would also seem to be due to polyploidy. Features frequently resulting from polyploidy and not occurring in the H_1 population are later flowering and reduction of branching (Stebbins 1971). The H_1 *C. canescens* × *C. stricta* individuals have a branching culm as does *C. canescens* and the flowering time is intermediate between that of the two species while the H_2 population flowers later, only slightly earlier than *C. canescens* or at the same time (Crackles 1994). The H_1 population is vegetatively vigorous and this is thought to be a result of polyploidy as the H_2 population is not notable in this respect.

There is some overlap of *C. canescens* × *C. stricta* H_1 and *C. canescens* individuals on the scatter diagram (Fig. 1) and this might be taken to indicate some backcrossing to *C. canescens*, but the hybrid index scores point to the strictly intermediate nature of this taxon.

The position of most individuals of the H_2 population on the scatter diagram mainly away from individuals of other *Calamagrostis* taxa sampled is of considerable interest, although the significance of this is obscure. This positioning of H_2 individuals on the scatter diagram results partly from the fact that their bract shape resembles that of *C. stricta* while H_1 individuals may resemble *C. canescens* in this respect. The ratio of panicle length to length of basal branch of panicle in the H_2 individuals is similar to that for most *C. canescens* individuals while H_1 individuals tend to be intermediate in this respect. The low figure for this ratio in H_2 individuals is mainly due to a tendency for the basal branch of the panicle to be markedly longer than in H_1 individuals and a possible explanation of this is that the *C. canescens* parent had an exceptionally long lowest branch to the panicle. The scatter diagram proved to be a powerful tool in separating individuals of the two species and most of those of the two hybrids.

It is a limitation of hybrid index analysis that individuals with the same hybrid score may have different genetic constitutions and that this is true both for members of the same population and for those of different populations. However the hybrid index range in this study is important in pointing to the overall intermediacy of the two hybrids. The slightly higher hybrid score for H_1 compared with H_2 individuals is likely to be due to polyploidy.

The polygonal graph describes a population as a characteristic shape which the eye can take in at a glance. By comparing different polygonal graphs differences between taxa with regard to a fixed and limited number of characters can be seen at the same time. Polygonal graphs in this study were particularly important in demonstrating the effect of polyploidy in the H_1 population.

ACKNOWLEDGMENT

I am indebted to Dr D. W. Shimwell for advice and encouragement during the early stages of the research.

REFERENCES

ANDERSON, E. (1949). *Introgressive hybridisation*. Wiley, London and New York.

CRACKLES, F. E. (1994). *Calamagrostis stricta* (Timm) Koeler, *C. canescens* (Wigg.) Roth and their hybrids in S.E. Yorks., v.c. 61, northern England. *Watsonia* **20**: 51–60.

NYGREN, A. (1946). The genesis of some Scandinavian species of *Calamagrostis*. *Hereditas* **32**: 131–262.

STEBBINS, G. L. (1971). *Chromosomal evolution in higher plants*. Arnold, London.

(*Accepted January 1995*)

Notes

PETRORHAGIA PROLIFERA (L.) P. W. BALL & HEYWOOD (CARYOPHYLLACEAE), AN OVERLOOKED NATIVE SPECIES IN EASTERN ENGLAND

Recent years have seen several additions to the native flora of Britain, either as a result of new geographical records or the elucidation of taxonomic problems. *Petrorhagia prolifera* (L.) P. W. Ball & Heywood, Proliferous Pink, reported here as a native species, represents a mixture of both. Floras published before 1962 recorded *P. prolifera*, under the names *Dianthus prolifer* L., *Tunica prolifera* (L.) Scop. or *Kohlrauschia prolifera* (L.) Kunth, as a native plant, at least on the south coast.

However, plants on coastal shingle beaches from Hampshire to Kent have been shown subsequently to belong to the closely related *P. nanteuilii* (Burnat) P. W. Ball & Heywood, Childing Pink (Ball & Heywood 1962). This species is now restricted in Britain to W. Sussex (v.c. 13). *P. nanteuilii* can be distinguished from *P. prolifera* by several small but constant morphological features, notably the tuberculate rather than reticulate seed testa, and by a chromosome number of 2n = 60 as opposed to 2n = 30 (Ball & Heywood 1962, 1964).

Evidence derived from morphological, cytological and geographical data and from hybridization experiments suggests strongly that *P. nanteuilii* is an allotetraploid derived from *P. prolifera* and another diploid species, *P. velutina* (L.) P. W. Ball & Heywood (Akeroyd 1975; Thomas 1983). *P. velutina*, which has smaller, echinate seeds and a chromosome number of 2n = 30, is widespread in the Mediterranean region and southern Europe, but does not occur in Britain. Two other closely related species are endemic to the Balkan Peninsula. The most recent revision of the genus (Ball & Heywood 1964) and the second edition of *Flora Europaea* Volume 1 (Ball & Akeroyd 1993) include these five annual species within *Petrorhagia*, as section *Kohlrauschia*. However, some continental botanists retain *Kohlrauschia* as a distinct genus.

It has recently become clear that two species of *Petrorhagia* section *Kohlrauschia* are present in Britain. Each of us had concluded independently, together with Dony & Dony (1986), that a *Petrorhagia* species is native inland in eastern England. Beckett (1992) reported on the status of an extant population of *P. nanteuilii* in West Norfolk (v.c. 28), suggesting that it was native. The plant had been reported, as *Tunica prolifera* (L.) Scop., by Trimmer (1866) from between Stanhoe and Bircham and from Fincham in the same part of the county, and was familiar to Norfolk botanists up until 1950, although not seen again until 1985. Examination by J.R.A. of collections of *Petrorhagia* in the herbaria of the Universities of Cambridge (**CGE**) and Reading (**RNG**), the Natural History Museum, London (**BM**) and the Castle Museum, Norwich (**NWH**), including a comparison of seed testas with a sample collected by G.B. in Norfolk in 1992, has confirmed that the Norfolk plant is indeed *P. prolifera*. A preliminary note of these observations has been published elsewhere (Akeroyd 1993).

P. prolifera, recorded mostly in eastern England, had long been regarded as a casual or locally as an established alien. The species, now apparently reduced in Britain to two populations, has its British headquarters in a few adjacent parishes in the Breckland of West Norfolk (v.c. 28). *P. prolifera* is a species with a central to south-eastern European distribution, extending northwards to Denmark and the Swedish Baltic islands of Öland and Gotland. Its presence in eastern England is therefore not unexpected, especially in the Breckland, famous for its native flora of species of central European affinity (Trist 1979). A second population in Bedfordshire (v.c. 30) is less convincingly native, but may derive from one or more extinct populations, or from seed introduced from Norfolk.

P. nanteuilii has a western Mediterranean and Lusitanian distribution, reaching its northernmost limit in the Channel Islands and on the southern coast of England. A further station recently reported from a railway embankment in Glamorgan (v.c. 41) probably represents an introduction via Cardiff Docks, where the species has occurred as a casual (Dawson 1988).

The habitats of both species in Britain, as on the continent, are dry, open or stony places and dry grasslands. At Pagham Harbour, Sussex (fide J.R.A.), *P. nanteuilii* grows in sparse, open plant communities on stabilized shingle. In Norfolk *P. prolifera* grows in dry, rather sparse grassland on a sandy soil; in Bedfordshire on open ground on sand and railway ballast.

We have seen the following putative native specimens of *P. prolifera* from Britain:

W. Norfolk (v.c. 28): Cockford Heath, 30 September 1835, *K. Trimmer*, **CGE**; Northwold, gravel pit, *W. J. Cross*, 9 August 1889, **BM**; Stoke Ferry, *W. J. Cross*, July 1890, August 1891, **BM**; nr Northwold, *J. E. Little*, 19 September 1927, **BM**, **CGE**, det. P. W. Ball; Cranwich, 'ground reverting to breck', *E. L. Swann 2127*, 28 July 1950, **NWH**. There is a record from Mundford, reported by Mrs Gomershall in her 1951 Wildflower Society Diary (fide G.B.); also, probably in v.c. 27 (E. Norfolk), from 'nr Norwich, *Dr. Smith*' [Sir J. E. Smith (1759–1828)], **BM**.

Beds. (v.c. 30): Potton, abundant for over 0·5 mile (1 km) by disused railway, *J. E. Lousley*, 4 September 1974, **RNG**; Potton, south-facing bank and track of dismantled railway, *J. G. & C. M. Dony*, **LTN** (Dony & Dony 1986); Potton (TL/210.489), old railway, on cinders and heaps of ballast, *G. Crompton*, 23 July 1980, **CGE**. This population has been extensively damaged by sand extraction (C. R. Boon, pers. comm., 1994).

The **BM** specimens from Norfolk were cited, as casuals, by Petch & Swann (1968). Two of them had been determined as *P. nanteuilii* by P. W. Ball (in litt. to E. L. Swann, fide G.B.), but examination of the seed testa by J.R.A. confirmed that they do indeed belong to *P. prolifera*. *P. prolifera* was rediscovered in the county in 1985 by J. E. Gaffney at Cranwich, where 70 plants were counted in 1992. The Bedfordshire population was observed until 1991 by C. M. and J. G. Dony, who also regarded it as a probable British native (Dony & Dony 1986). The plants are inconspicuous, of slender habit and with only one or two flowers within each inflorescence out at a time, so may survive elsewhere undetected.

P. prolifera has also undoubtedly been introduced into Britain from time to time, behaving as a casual, for example in railway sidings at Richborough, E. Kent (*J. E. Lousley*, 16 August 1936, **RNG**). Herbarium specimens from Galashiels, Selkirk (*M. McC. Webster 14263*, 1970, **CGE**) and Blackmoor, Hants. (e.g. *J. E. Lousley*, 5 October 1968, **RNG**) are all *P. nanteuilii*. These were probably alien plants – part of the wool shoddy flora for which Blackmoor was famous during the 1960s to early 1970s (Ryves 1974, 1988).

P. nanteuilii is included on Schedule 8 of the Wildlife and Countryside Act 1981, which gives it full protection in Britain. *P. prolifera* at present has no legal protection.

ACKNOWLEDGMENTS

We are grateful to Chris Boon, Mrs Chris Dony, the late Dr John Dony and Mrs Jean Gaffney for providing data on *P. prolifera*. We also thank the curators of **BM**, **CGE**, **RNG** and **NWH** for allowing us access to herbarium material of *Petrorhagia*. Chris Boon and Chris Preston kindly commented on a draft of the manuscript.

REFERENCES

Akeroyd, J. R. (1975). *The possible allopolyploid origin of* Petrorhagia nanteuilii (*Burnat*) *P. W. Ball & Heywood*. Pp. 26. Unpublished B.Sc. Thesis, University of St Andrews.

Akeroyd, J. R. (1993). Wildlife Reports. Flowering Plants. *British wildlife* **4**: 261.

Ball, P. W. & Akeroyd, J. R. (1993). *Petrorhagia* (Ser. ex DC.) Link., in Tutin, T. G. *et al.*, eds. *Flora Europaea* **1** (2nd ed.): 224–227.

Ball, P. W. & Heywood, V. H. (1962). The taxonomic separation of the cytological races of *Kohlrauschia prolifera* (L.) Kunth sensu lato. *Watsonia* **5**: 113–116.

Ball, P. W. & Heywood, V. H. (1964). A revision of the genus *Petrorhagia*. *Bulletin of the British Museum (Natural History). Botany* **3**: 121–172.

Beckett, G. (1992). Childing Pink, a Norfolk plant. *B.S.B.I. News* **62**: 20–21.

DAWSON, H. (1986). *Petrorhagia nanteuilii* (Burnat) P. W. Ball & Heywood in Mid-Glamorgan. *Watsonia* **16**: 174–175.
DONY, J. G. & DONY, C. M. (1986). Further notes on the flora of Bedfordshire. *Watsonia* **16**: 163–172.
PETCH, C. & SWANN, E. L. (1968). *The flora of Norfolk*. Jarrolds, Norwich.
RYVES, T. B. (1974). An interim list of the wool-alien grasses from Blackmoor, North Hants., 1969–1972. *Watsonia* **10**: 35–48.
RYVES, T. B. (1988). Supplementary list of wool-alien grasses recorded from Blackmoor, North Hants., 1959–1976. *Watsonia* **17**: 73–79.
THOMAS, S. M. (1983). A taxonomic clarification of *Petrorhagia* section *Kohlrauschia* (Caryophyllaceae). *Botanical journal of the Linnean Society* **87**: 55–75.
TRIMMER, K. (1866). *Flora of Norfolk*. London.
TRIST, P. J. O., ed. (1979). *An ecological Flora of Breckland*. E.P. Publishing, Wakefield.

J. R. AKEROYD
Lawn Cottage, Fonthill Gifford, Tisbury, Wilts., SP3 6SG
G. BECKETT
Bramley Cottage, Stanhoe, King's Lynn, Norfolk, PE31 8QF

RUBUS PERCRISPUS D. E. ALLEN & R. D. RANDALL (ROSACEAE) IN DORSET (V.C. 9)

After the paper describing this new species (Allen 1994) had gone to press, it was discovered that records of various *Rubus* taxa from one locality in the far east of v.c. 9 (Dorset) – "near Foxholes Wood" – all relate to *R. percrispus* too, thus adding a ninth vice-county to its known British Isles range.

When first collected there, by E. F. Linton in 1890 (**BM**), it was labelled "*R. radula* near type", a determination subsequently confirmed by Rogers in 1903. In 1891 and 1892 R. P. Murray revisited the locality, probably following directions given to him by Linton (and improving on the latter's data by identifying the habitat as a roadside). After deciding that the plant was *R. anglosaxonicus* Gelert (a species now known as *R. micans* Godron), he distributed material under that name in the second of those years through the Botanical Exchange Club (B.E.C.), only to have Rogers pronounce this intermediate between *R. anglosaxonicus* and *R. raduloides* (Rogers) Sudre but nearer the latter. Two examples of the B.E.C. gathering later passed into **herb. Barton & Riddelsdell** as their nos. 7376 and 10385 (now in **BM**), one of which was redetermined by Barton as *R. anglosaxonicus* × *R. echinatus* Lindley and later still by Watson as *R. aspericaulis* Lef. & P. J. Mueller (a species not now accepted as British). Another example of the same B.E.C. gathering in **LIV** has been referred to *R. raduloides* pure and simple.

In 1936, this time from a spot yet more precisely identified as a hedge to the north of the wood, N. Douglas Simpson collected (no. 36.1030, now in **BM**) in company with Watson a specimen which the latter considered a white-flowered form of *R. radula* Weihe ex Boenn. Watson had apparently collected this on his own there some years earlier, for he had recorded (Watson 1932) sowing seeds of it in order to test whether the flower colour in this species is independent of soil influences. Subsequently, however, he must have had second thoughts, for he was to omit *R. radula* from the list of all v.c. 9 *Rubus* species that he compiled for Good (1949).

With the aid of Simpson's more precise localization I succeeded in July 1994 in refinding what proved to be just a single clump under the east hedge of the A350 road just to the north of the wood (SY/950.984). R. D. Randall concurs with my determination of this, as well as all the other specimens referred to above, as *R. percrispus*.

R. radula has never seemed very likely to occur in Dorset and the sole evidence of its occurrence is thus now shown to be ill-founded. *R. raduloides*, in turn, now has its supposed Dorset localities cut back to a single wood near Sturminster Newton, in the far north of the county (where many batologists have collected it from 1889 onwards), which is more in line with the rest of its range in Wessex. Given the known preference of that species for basic soils, its presence in the neighbourhood of a wood renowned for *Rubus* species characteristic of acid soils appeared additionally anomalous. Foxholes Wood, near Wimborne, in the south-east of v.c. 9, constitutes a natural extension, rather, of the chain of localities for *R. percrispus* already known along the coastal hinterland of the western half of South Hampshire, v.c. 11. The discrimination of this new species has thus had the happy effect in this particular instance of enabling a whole cluster of long-standing puzzles and anomalies to be resolved.

REFERENCES

ALLEN, D. E. (1994). Four new Anglo-Sarnian species of *Rubus* L. (Rosaceae). *Watsonia* **20**: 143–151.
GOOD, R. (1949). *A geographical handbook of the Dorset flora*. Dorchester.
WATSON, W. C. R. (1932). *Report of the Botanical Society and Exchange Club of the British Isles* **9**: 826.

D. E. ALLEN
Lesney Cottage, Middle Road, Winchester, Hampshire, SO22 5EJ

TYPIFICATION OF *RUBUS PULLIFOLIUS* W. C. R. WATSON (ROSACEAE)

It has been apparent for some time that the holotype of this species (in **BM**) is not as it should be. The inflorescence and one of the two stem-pieces accompanying it on the same sheet patently belong to some other species of *Rubus*. That that is *R. oxyanchus* Sudre is better revealed by a specimen (no. 36.1013) collected by N. Douglas Simpson on the same occasion, doubtless under Watson's guidance, which is now in **BM** also. That species occurs in some quantity in the type locality, Southampton Common, S. Hants., v.c. 11, especially in its east section, from the central part of which ("near the Tram Depôt") the greater precision of Simpson's label shows that at least the latter's specimen came. Watson evidently did not know very well *R. oxyanchus*, a deceptively variable species mainly confined in Britain to the Bournemouth area, as suggested by his later erroneous determination of shade-grown Dorset material of that (in **BM** and **SLBI**) as a non-British species, *R. majusculus* Sudre. But it was in any case rash of him to have collected on Southampton Common, a locality apparently unknown to him till then and one exceptionally rich in *Rubus* species, on a date as late in the season as 8 September. Southampton has one of the hottest summer climates in Britain and at least in most years brambles there have virtually all wholly shed their petals by mid-August. In the circumstances it is consequently not surprising that he mixed up two species. The fact that he noted the petals on the inflorescence that he clipped as "pinkish" ought, however, to have given him pause, if only in subsequent years, for the petals of *R. pullifolius* are liable to be that colour only on first opening, before turning to pure white.

The second stem-piece on the sheet could well be that of *R. pullifolius*, however. Although the main range of this similarly Bournemouth area species does not extend eastwards further than Lymington, there have been one or two outlying finds of it in and around Southampton and one bush was seen on the Common there in 1974 – though repeated subsequent searches, especially on the site of the former tram depot, have failed to turn up more. Rather than dislodge a well-established name, the best course would seem to be to give the stem-piece the benefit of the doubt, and I accordingly here designate it as the lectotype.

It is desirable in a case such as this that the name be reinforced by the designation of an epitype. Fortunately there is a specimen in **BM** (Alum Chine, Bournemouth, S. Hants., v.c. 11, 27 July 1907, *W. Moyle Rogers* s.n., as *R. leucandrus*) which bears a label in Watson's handwriting showing that he determined it in 1948 as *R. pullifolius*, a name which he does on the whole appear to have applied consistently. As that specimen can conveniently be filed alongside the sheet bearing the lectotype, I accordingly here select it for this purpose.

ACKNOWLEDGMENTS

I wish to thank Dr C. E. Jarvis for nomenclatural advice and A. Newton for a helpful critique of a preliminary review of the problem.

D. E. ALLEN
Lesney Cottage, Middle Road, Winchester, Hampshire, SO22 5EJ

ADDITIONAL SETS OF CONTINENTAL *RUBUS* EXSICCATAE IN BRITISH HERBARIA

The recent monograph of *Rubus* in the British Isles by Edees & Newton (1988) most usefully includes an appendix listing the principal sets of relevant exsiccatae and the British institutions in which these are to be found.

Since that list was published several additional sets have come to light, and the location of these seems worth placing on record:

BAENITZ, *Herbarium Europaeum*. **MANCH**; **OXF**.

BRAUN, *Herbarium ruborum Germanicorum*. Also **SLBI**.

FRIDERICHSEN & GELERT, *Rubi exsiccati Daniae et Slesvigiae*. Also **BM**.

SUDRE, *Batotheca Europaea*. **BM** possesses two sets.

WIRTGEN, *Herbarium ruborum Rhenanarum*. Portions also in **BM** and **SLBI**.

The following *Rubus* sets not listed by Edees & Newton are also represented in British herbaria at least in part:

BILLOT, *Flora Galliae et Germaniae exsiccata*. **OXF** (via herb. F. Stratton); **SLBI** (via herb. F. Townsend).

LETENDRE, *Rubus de la Seine-Inférieure*. **MANCH**.

SCHULTZ, *Herbarium normale*. **OXF**; **SLBI**.

WIRTGEN, *Herbarium plantarum selectarum florae Rhenanae*. Ed. 2. **OXF** (a few only).

REFERENCE

Edees, E. S. & Newton, A. (1988). *Brambles of the British Isles*. Ray Society, London.

D. E. Allen
Lesney Cottage, Middle Road, Winchester, Hampshire, SO22 5EJ

LECTOTYPIFICATION OF *ROSA ROTHSCHILDII* DRUCE (ROSACEAE)

George Claridge Druce (1850–1932) was an enthusiastic, if uncritical, rhodologist who named four taxa in the genus, but only one (*Rosa rothschildii*) at specific rank. Of the six collections labelled *R. rothschildii* in the Oxford herbarium (**OXF**), only one is suitable to be considered as a lectotype (*Druce 4821*, September 1910). Firstly, it matches the protologue, both morphologically and geographically. Druce's mention of resinous scent implies that the subfoliar glands are not of the *R. rubiginosa* type, and the protologue suggests that he was particularly basing the species on the plants seen while botanizing with the Hon. N. Charles Rothschild at Ashton (Druce 1924; Rothschild 1983: 174). Secondly, the specimen has Druce's own protologue attached. It is therefore likely that he made the most use of this specimen in drawing up his description. The only other specimen that might be considered a candidate (*Druce s.n.*, June 1911) has no protologue appended and is too immature to have been of much assistance in drawing up the description.

Subsequent to the lectotypification, the six specimens were identified critically by A. L. Primavesi and G. G. Graham. The lectotype is *R. canina* × *R. sherardii*. It is clear that Druce, and later authors, intended the epithet *rothschildii* to apply also to certain nothomorphs of *R. canina* × *rubiginosa* (*R.* × *nitidula* of Besser (1815) has priority for hybrids of this parentage (Kent 1992)), and the other specimens labelled *R. rothschildii* fall broadly into this category. However, the lectotypification of *Rosa rothschildii* (and the fact that Druce based part of his description on material that is unambiguously *R. canina* × *sherardii*) allows us to resurrect the name from obscurity to be used for this hybrid, a practice already adopted in Graham & Primavesi (1993). *R.* × *rothschildii* combines the habit of *R. canina* with the stipitate glands and resinous scent of *R. sherardii*. The word "acicles", in both the Latin and English parts of the protologue, is clearly intended by Druce to refer to stipitate glands. These are abundant on the lectotype specimen, but there are no acicles in the conventional sense of small slender prickles. It is extraordinary that Wolley-Dod should have linked *R. rothschildii* to *R. obtusifolia* Desv. (= *R. tomentella* Lem.;

R. borreri Woods) as none of the specimens in **OXF** (except possibly that of A. Ley which is inadequate for determination) has any relationship to this taxon.

Rosa × rothschildii Druce, *Rep. B.E.C.* **3**: 157–158 (1913), emend. Graham & Primavesi, *Roses of Great Br. and Ireland*: 98 (1993). Hybrid formula: *R. canina* L. × *R. sherardii* Davies.
Synonyms: *R. tomentella* Lem. var. *rothschildii* (Druce) W.-Dod, *Roses of Britain*: 71 (1924); *R. obtusifolia* Desv. var. *rothschildii* (Druce) W.-Dod, *Revis. Brit. roses* (*Suppl. J. Bot.*): 73 (1931).
Misapplied names: *R. verticillacantha* sensu Druce p.p., *Journal of botany* **42**: 6 (1880), *J. Northants nat. Hist. Soc.* **1**: 273 (1881); *R. caryophyllacea* sensu Druce p.p., *B.E.C. Rep.* [1911]: 87 (1912), W.-Dod, *List Brit. roses*: 37 (1911). [The synonyms and misapplied names probably refer to extended elements of the taxon.]
Protologue (extract): "740 (2). Rosa Rothschildii, Druce . . . 2–3 m. Rami aculeis falcatis horrentes. Caules floriferi aciculati, aciculis infra inflorescentiam numerosis . . . glandulis subfoliaribus sat numerosis . . . Odor foliorum ei gregis *Mollissimae* similis, et odor florum ei gregis *Caninae* similis. Habitat: Northamptonshire – Dane's Camp, 1878, 1896; Farthinghoe; Ashton, near Oundle, 1910, G. C. Druce; Geddington Chase, Waddenhoe, Ley teste Wolley-Dod; Hunts. – Catsworth, Ellington, Ley teste Wolley-Dod; Surrey – Coombe (No. 786); Malden (No. 838), C. E. Britton, 1912. The Surrey plants have fruits slightly more spherical, and leaflets somewhat shorter and broader, but the acicular branches and glandular foliage bring them under *Rothschildii* . . . In the seventies I found a rose on Hunsbury Hill – the Dane's camp – near Northampton . . . However in August 1910 when staying at Ashton, I saw a rose in the very luxuriant hedgerows bordering the road leading to the Hon. N. Charles Rothschild's house, which at once reminded me of the Hunsbury Hill plant . . . In June 1911 I went to Ashton again in order to obtain flowering specimens when I found the rose in several places in the vicinity . . . The plant forms tall handsome bushes with conspicuous flowers of a brighter pink than normal *canina*, while the acicular branches, naked fruit, the very glandular, nearly glabrous leaves, the acicular petioles and peduncles are distinguishing characters which separate it from its allies. I have associated the plant with the name of my friend on whose estate it grows: and who has done so much to forward the study of Natural Science."
Specimens in **OXF**: *Druce* no. 4821, Ashton Wold, Northants, August 1910. [*R. canina* L. (foem.) × *R. sherardii* Davies (masc.)], LECTOTYPUS, hic desig.
Excluded specimens at **OXF**: *Druce*, Danes Camp, Northants, September 1889 [*R. rubiginosa* hybrid indet.]; *Druce*, Ashton, Northants, June 1911 [too young for determination but not the same as 4821]; *A. Ley* [B.E.C. 596], hedges, Wadenhoe, Northants, July 1910 [as *R. borreri* Woods var.] [inadequate for determination]; *C. E. Britton*, open ground, Malden, Surrey, 5 September 1911 [*R. canina × rubiginosa*]; *C. E. Britton* [B.E.C. 838], open ground, Malden, Surrey, 19 August 1912 [*R. canina × rubiginosa*]; *J. P. M. Brenan 6950*, rough pasture v.c. 23, near Woodeaton by the road to Marston, Oxon, 27 August 1943 (fruits), 11 June 1944 (flowers) [*R. canina* with some introgression with *R. rubiginosa* or *micrantha*].

REFERENCES

Druce, G. C. (1924). Obituary. The Hon. N. Charles Rothschild. *Journal of the Northamptonshire Natural History Society* **22**: 135–141.
Druce, G. C. (1930). *The Flora of Northamptonshire*. T. Buncle & Co., Arbroath.
Kent, D. H. (1992). *List of vascular plants of the British Isles*. Botanical Society of the British Isles, London.
Graham, G. G. & Primavesi, A. L. (1993). *Roses of Great Britain and Ireland*, Botanical Society of the British Isles, Handbook no. 7, London.
Rothschild, M. (1983). *Dear Lord Rothschild*. Philadelphia & London.

Q. C. B. Cronk, S. K. Marner
Department of Plant Sciences, University of Oxford, South Parks Road, Oxford, OX1 3RB
A. L. Primavesi
Ratcliffe College, Fosse Way, Ratcliffe-on-the-Wreake, Leicester, LE7 4SG

FURTHER DRUCE *ROSA* TAXA (ROSACEAE)

Eponymy: *Rosa* × *drucei* W.-Dod, *Journal of Botany* **62**: 205 (1924), as *R. canina* × *rubiginosa*, later suppressed by Wolley-Dod (1931) under *R. canina* var. *latebrosa* (Déséglise) N. E. Br. *R.* × *nitidula* Besser is an earlier name for the hybrid combination.

Druce's infraspecific taxa have been typified as follows and the types and associated specimens critically examined by G. G. Graham and A. L. Primavesi. All the taxa are probably best suppressed, although *R. arvensis* var. *suberecta* is likely to be the valid name for "cristate" *R. arvensis* (probably deriving from introgression with *R. canina*), in the (perhaps unlikely) event of any botanist wishing to use a name for this phenotype.

Rosa arvensis Huds. var. **suberecta** Druce, *B.E.C. Rep.* **5**: 559 (1920) [*R. a.* var. *cristata* Druce, *Fl. Berks*: 206 (1897), as "?var. cristata", nomen confusum; *R. a.* var. *subcristata* Druce ined.].
Protologue: "923. Rosa arvensis Huds., var. suberecta mihi. This differs from the type in the erect, persistent sepals. Greenham, Berks, 1893, G. C. Druce. see *Fl. Berks* 206, 1897".
Notes: Not recognised by Wolley-Dod and probably not worthy of recognition above the level of form. Druce (1897) contends that although Crépin considers it only an accidental condition, he himself noticed it for four consecutive years in "these localities" (apparently "By the Emborne [Enborne] Stream near Greenham Common and near Sandleford"). This variant ("with ascending and semipersistent sepals") has also been recorded from three localities in Hertfordshire (Purchas & Ley 1889). The sepal character is likely to be under genetic control and provides a parallel to the subcristate forms of *R. canina*.
Specimen in **OXF**: *Druce*, var. *subcristata*, Greenham, Berks, September 1893 [HOLOTYPE].

Rosa eglanteria L. var. **corstorphinae** Druce, *B.E.C. Rep.* **4**: 195 (1916) [*Rosa rubiginosa* L. f. *corstorphinae* (Druce) W.-Dod, *Roses Br.*: 92 (1924)].
Protologue (extract): "937. Rosa Eglanteria L., var. Corstorphinae mihi. Bush tall, stem prickles distant, long based, uncinate, of the flowering shoots crowded, nearly straight, 2–3 mm. long, of the peduncles crowded, straight slender. Leaves broadly ovate, densely glandular above and below, biserrate. Flowers in dense umbellate clusters, 8–10, dark rose-red, fragrant, very showy . . . Near Duninald, Forfar, in plenty. Shown me by Mrs Corstorphine . . . This handsome and very distinct-looking plant is quite new to me. I saw nothing in its vicinity which could suggest a hybrid origin, but the bushes were remarkably constant. Major Wolley-Dod, too, says he has seen nothing like it. If a hybrid, it is almost certainly *R. Eglanteria* × *gallica*, the armature recalling that of the latter species. G. C. Druce."
Notes: Wolley-Dod (1924) wrote that he could "see nothing in this but a very luxuriant form of the type", and that since its discovery in Forfar he had seen similar specimens from W. Kent and E. & W. Ross. We agree with Wolley-Dod that Druce's specimens are straightforward *R. rubiginosa*. The variety is not worth recognizing even at *forma* level. The Glassford specimens, distributed as f. *corstorphinae*, are hybrids.
Specimens in **OXF**: *Druce* (B.E.C. 937), Dunninald, Angus, August 1915 [HOLOTYPE]; *Druce* (B.E.C. 937), near Dunning, Perth, August 1916; *Druce* (BEC 937), near Montrose, Forfar, August 1916; *Druce*, inter Montrose and Arbroath, Forfar.
Excluded specimens in **OXF**: *J. G. Glassford*, Aberfeldy, mid-Perth, 20 August 1928 (three specimens ex herb. Wolley-Dod as *R. rubiginosa* f. *corstorphinae* W.-Dod); *J. G. Glassford*, Aberfeldy Mid-Perth, 20 August 1928 (ex B.E.C.) (both specimens are *R. rubiginosa* × *pimpinellifolia*).

Rosa mollissima Willd. f. **alba** Druce, *Journal of Botany* **40**: 184 (1902), *nomen nudum*.
Protologue: "*Rosa mollissima* Willd., (*R. tomentosa* Sm.) f. *alba*. Near Llanerchymedd, Anglesey."
Notes: although this appears to be a Druce name, he did not append his name to it or provide a description. No specimen has been found in **OXF**.

REFERENCES

Druce, G. C. (1897). *The Flora of Berkshire*. Oxford.
Purchas, W. H. & Ley, A. (1889). *A Flora of Herefordshire*. Hereford.

Wolley-Dod, A. H. (1924). *The roses of Britain*. London.
Wolley-Dod, A. H. (1931). Revision of British roses. *Journal of botany* (suppl.): 43–44.

Q. C. B. Cronk
Department of Plant Sciences, University of Oxford, South Parks Road, Oxford, OX1 3RB
A. L. Primavesi
Ratcliffe College, Fosse Way, Ratcliffe-on-the-Wreake, Leicester, LE7 4SG

TWO SUBSPECIES OF *FESTUCA RUBRA* L. NEW TO ENGLAND

While preparing the Poaceae account for the *Flora of Cumbria*, 42 collections of *Festuca rubra* s.l. were submitted to Dr A. K. Al-Bermani and Prof. C. A. Stace for identification. The material was not representative as half the specimens were from coastal sites and a quarter from the Lake District and Pennine hills.

Three of the specimens proved to be *F. arenaria* Osbeck, a species largely restricted to the east coast of Britain and not previously recorded in the west further north than south Lancashire. It was collected from St Bees Head, Cumberland (v.c. 70, GR NX/9.1, *C. W. Muirhead*, 1949, **PLYP**) and the Duddon estuary, Westmorland (v.c. 69, Sandscale Haws, SD/1.7, 1992; Askam-in-Furness, SD/2.7, 1991, both *P. Burton*, **LANC**).

The remaining specimens included all seven subspecies of *F. rubra* L. currently recognised as occurring in the British Isles. The commonest was subsp. *juncea*, which appears to be frequent around the entire coast.

Of particular interest are the records of the montane subspecies *arctica* and *scotica*, both new to England. The former was previously known south of the Scottish Highlands only from Snowdonia. The Cumbrian records are from rock ledges in the Lake District: near Fleetwith Pike (v.c. 70, NY/2.1), Hart Crag, Fairfield and Dollywaggon Pike (v.c. 69, NY/3.1), Red Screes (v.c. 69, NY/3.0) and High Street (v.c. 69, NY/4.1), four sites in the Pennines: two around Cross Fell (v.c. 70, NY/6.3) and others on limestone scars in upper Teesdale almost on the Durham border (v.c. 70, NY/7.3) and at High Cup Nick (v.c. 69, NY/7.2), and one from a lane in the upper Eden valley (v.c. 69, SD/7.9). The earliest record for Cumberland is that from near Fleetwith Pike (*C. W. Muirhead*, 1952, **PLYP**) and for Westmorland that from Hart Crag (*G. Halliday*, 1981, **LANC**). This subspecies will probably prove to be quite widely distributed in the Lake District and the Pennines.

The only records of subsp. *scotica* are from Cumberland, from limestone at 610 m on the north side of Crowdundle Beck, Cross Fell (NY/6.3, *C. W. Muirhead*, 1949, **PLYP**), in the Pennines, and in the Lake District from the north-east slopes of Pillar at 730 m (NY/1.1, *G. Halliday*, 1993, **LANC**). It was formerly unknown south of Argyllshire.

ACKNOWLEDGMENTS

I am grateful to Dr A. K. Al-Bermani and Prof. C. A. Stace for identification of the material.

G. Halliday
Department of Biological Sciences, The University, Lancaster, LA1 4YQ

RUMEX FRUTESCENS THOUARS × *R. OBTUSIFOLIUS* L. (POLYGONACEAE), A PREVIOUSLY UNDESCRIBED HYBRID DOCK, AND NEW RECORDS OF *R.* × *WRIGHTII* LOUSLEY IN WEST CORNWALL (V.C. 1)

Argentine Dock, *Rumex frutescens* Thouars, has been established at Phillack Towans, W. Cornwall (v.c. 1, SW/56.39), since at least 1921 (Thurston & Vigurs 1922; Margetts & David 1981; Margetts & Spurgin 1991). In late August 1994 it was locally plentiful there, with many hundreds of plants, some of which formed large patches. These were growing on calcareous dune-sand at the edges of a sand quarry and on banks and in grassland nearby.

Other species of dock found in the same area were *Rumex crispus* L. subsp. *crispus* (plentiful), *R. obtusifolius* L. subsp. *obtusifolius* (plentiful), *R. conglomeratus* Murray (locally plentiful), *R. sanguineus* L. (four plants) and the hybrid *R. crispus* × *R. obtusifolius* (*R.* × *pratensis* Mert. & Koch, four plants). A few plants of *R. pulcher* L. were found 300 m away.

In addition to these, a number of plants that were sterile and intermediate between *R. frutescens* and *R. obtusifolius* (nine plants) and *R. conglomeratus* (two plants) were presumed to be hybrids. This note describes *R. frutescens* × *R. obtusifolius*, a hybrid which has not been reported before, and gives details of *R. frutescens* × *R. conglomeratus* (*R.* × *wrightii* Lousley), which has been reported only once before (Lousley 1953; Lousley & Kent 1981).

Rumex × cornubiensis D. T. Holyoak, **hybr. nov.**
(*Rumex frutescens* Thouars × *R. obtusifolius* L. subsp. *obtusifolius*)

Hybrida inter *Rumex frutescens* Thouars et *R. obtusifolius* L. subsp. *obtusifolius* genita, characteribus variabilis et inter parentes media (Fig. 1), ab ambobus fructibus abortivis differt.

A hybrid between *R. frutescens* and *R. obtusifolius* L. subsp. *obtusifolius*, found within a few metres of colonies of the parent species. Although rather variable, it is intermediate between them in most characters (Fig. 1) and almost, if not completely, infertile.

A robust creeping perennial, spreading by underground rhizomes (mostly shorter than the far-creeping rhizomes of *R. frutescens*), so that it forms more spreading clumps than those of *R. obtusifolius*. Shoots arise from the rhizomes at intervals and attain a maximum height of 105 cm (nearly as tall as *R. obtusifolius* at this site, and distinctly taller than the maximum of 70 cm reached by *R. frutescens*). Lower leaves with lamina up to 16 × 6.7 cm, thicker than that of *R. obtusifolius*, but not as thick and leathery in texture as that of *R. frutescens*. Lamina often broader than in *R. frutescens*, with its greatest width around the middle and the base mostly truncate to weakly cordate; resembling *R. frutescens* in having the leaf-margin more or less crenulate, but the back of the midrib and main veins weakly scabrid with small papillae as in *R. obtusifolius*. Stem leaves much smaller, narrower and with more acute apices.

Panicle with branches arising at c. 40° from the main stem. Branches more numerous than is usual in *R. frutescens*, but fewer than in well-grown plants of *R. obtusifolius*. Whole inflorescence often with conspicuous deep red coloration. Whorls of inflorescence often less congested than in *R. frutescens*, but typically closer to each other than in *R. obtusifolius*. Pedicels mostly 2–5 mm (0·3–2 × length of inner perianth-segments when in fruit), most of these being distinctly longer than in *R. frutescens* but shorter and thicker than in *R. obtusifolius*. Inner perianth-segments up to 6 mm in length when fruits form, but mostly shorter and withering where fruits fail to develop. Well-formed inner perianth-segments varying in shape from narrowly ovate-triangular with rather acute apex (as in *R. frutescens*) to broader, triangular, with obtuse apex (as in *R. obtusifolius*); many with 2 or 3 short teeth, less than one-quarter of width of segment, on each margin at widest, basal part. When well-formed, all three inner perianth-segments with a prominent tubercle along the mid-vein, although the tubercle is typically larger and longer on one perianth-segment (tubercles with punctulate surface in fresh material). All of the few nutlets found were shrunken when dried and apparently infertile, 2–3·5 mm long, ovoid, and trigonous, brown, glossy, with acute angles.

Holotypus: W. Cornwall, v.c. 1, Phillack Towans (SW/568.392), edge of sand quarry, 21 August 1994, *D. T. Holyoak* (**RNG**).

The largest patch of *R.* × *cornubiensis* covers an area of some 12 × 9 m on top of a low bank. Elsewhere, a single plant has spread to form a roughly circular patch 2 m diameter. Hence it is likely that this hybrid has been established and spreading vegetatively at Phillack Towans for some years.

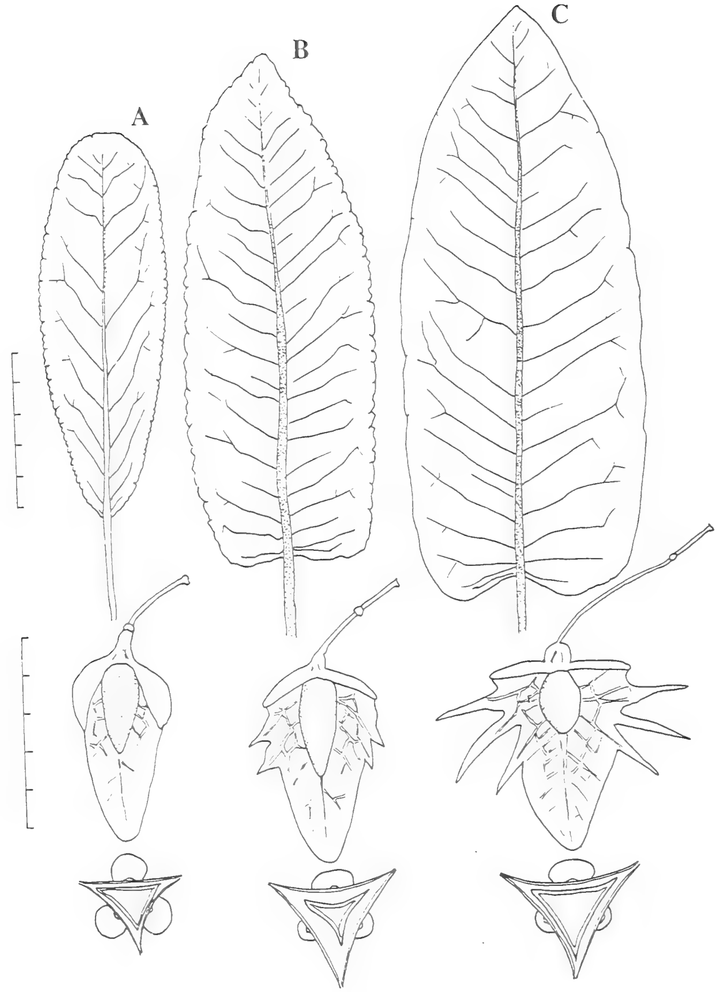


FIGURE 1. Representative lower leaves (underside) and fruits (side view and t.s) of *Rumex* from Phillack Towans, W. Cornwall. A. *R. frutescens*, B. *R.* × *cornubiensis*, C. *R. obtusifolius* subsp. *obtusifolius*. Scale lines are marked at intervals of 1 cm (leaves) or 1 mm (fruits).

Rumex × wrightii Lousley
(*R. conglomeratus* Murray × *R. obtusifolius* L. subsp. *obtusifolius*)

Two plants were found in grassland, close to populations of both parents (specimens lodged at **RNG**). One had five groups of stems close together and linked by underground rhizomes, implying that this hybrid is a long-lived perennial that can spread vegetatively. Both plants were short, not exceeding 30 cm in height, with a rather untidy appearance due to numerous short, leafy branches and the infertile inflorescences. Most branches were at angles of c. 30° to the main stem, but a large branch on one specimen was at c. 80° to the main stem. Some of the larger leaves were obovate and thicker than those of *R. conglomeratus*, with crenate margins and truncate or subcordate bases. The whorls of the inflorescence are mostly remote and the lower whorls are subtended by bracts. Both plants appeared to be completely infertile, with only a minority of the inner perianth-segments enlarging as fruits began to develop. These enlarged inner perianth-segments are narrowly ovate and up to 5 mm in length, all three segments with a long tubercle. On one specimen the pedicels are short (mainly 1–2 mm) on the other longer (up to 4·5 mm).

This hybrid has been reported only once before, from Braunton Burrows, N. Devon (v.c. 4), in 1952 (Lousley 1953; Lousley & Kent 1981). Descriptions of the Devon plants indicate that they are similar to those at Phillack Towans, although somewhat taller, up to 40 cm.

R. crispus is abundant close to the colonies of *R. frutescens* at Phillack Towans, but no hybrids between these species have been found, despite an extensive search. However, *R. crispus* there probably flowers earlier than *R. frutescens*, since by 21–31 August 1994 many of the *R. crispus* plants had ripe nutlets, whereas those of *R. frutescens* were either flowering or had mainly unripe nutlets and those of *R. conglomeratus* and *R. obtusifolius* mostly had ripening nutlets.

ACKNOWLEDGMENTS

Thanks are due to Paul Gainey, Geraldine Griffiths and Rose Murphy for helpful discussions in the field and to Dr John Akeroyd for commenting on specimens and a draft of this note.

REFERENCES

Lousley, J. E. (1953). *Rumex cuneifolius* and a new hybrid. *Watsonia* **2**: 394–397.
Lousley, J. E. & Kent, D. H. (1981). *Docks and knotweeds of the British Isles*. B.S.B.I., London.
Margetts, L. J. & David, R. W. (1981). *A review of the Cornish flora 1980*. Institute of Cornish Studies, Pool, Cornwall.
Margetts, L. J. & Spurgin, K. L. (1991). *The Cornish Flora supplement 1981–1990*. Trendrine Press, Zennor, Cornwall.
Thurston, E. & Vigurs, C. C. (1922). *A supplement to F. Hamilton Davey's Flora of Cornwall*. Truro.

D. T. Holyoak
8 Edward Street, Tuckingmill, Camborne, Cornwall, TR14 8PA

POTAMOGETON × *COGNATUS* ASCH. & GRAEBN. AT LOCH BORRALIE, WEST SUTHERLAND (V.C. 108), SCOTLAND

Potamogeton × *cognatus* Asch. & Graebn. (*P. perfoliatus* L. × *P. praelongus* Wulfen) (Potamogetonaceae) was originally described from Germany. It was discovered in Britain by J. M. Taylor, who found it in drains at Belton and Crowle, N. Lincolnshire (v.c. 54), in 1943. Both parents grew in the vicinity. An illustrated account of the Lincolnshire plant (which was the first flowering example of this hybrid to be discovered anywhere) was provided by Taylor & Sledge (1944). I am not aware of any records of the hybrid from Lincolnshire after Taylor's collections, which were made in 1943 and 1944, and I was unable to find either *P. praelongus* or *P.* × *cognatus* when I visited the area with Mrs I. Weston and others in 1989.

The only other locality for the hybrid in the British Isles is Loch Borralie, a loch on the Durness limestone of W. Sutherland, where it was collected by Sir George Taylor in 1948, Mrs B. Welch in 1951 and D. Dupree in 1970 (specimens in **BM**; records also in J. E. Dandy's card index at **BM**). The locality was published by Dandy (1975). In a detailed survey of Loch Borralie, Spence *et al.* (1984) refound all the aquatic plants previously recorded from the loch except this hybrid. Similarly, the hybrid was not recorded by the Nature Conservancy Council's Scottish Loch Survey team when they visited Loch Borralie on 29 June 1988. On 21 August 1993 I visited Loch Borralie with I. M. & Mrs P. A. Evans and D. A. & Mrs A. Pearman in an attempt to refind *P.* × *cognatus*. To my surprise, we found it at two places in the loch.

In view of the lack of published information on the hybrid at Loch Borralie, and the fact that some crucial characters are difficult to interpret on herbarium specimens, notes on its morphology and habitat are provided below. Voucher specimens of *P.* × *cognatus* and its putative parents (*Preston 93/51–56*) will be deposited in **CGE** and **E**.

MORPHOLOGY

The following description is based on fresh material of *P.* × *cognatus* collected at Loch Borralie.

Stems to 1·2 m, 2·2–3·5 mm in diameter, terete. Submerged leaves 45–80 × 14–23 mm, 2·6–4·0 times as long as wide, translucent, green, often with a brownish tinge on the upper leaves and becoming brown with age, ovate-oblong, sessile, clasping the stems at the base for more than half the diameter of the stem but with a broad gap between the two edges of the leaf on the far side of the stem, tapering to a slightly hooded apex, denticulate and plane or undulate at the margin, the teeth 10(–25) μm long and 250–500 μm apart towards the leaf apex, just visible with a ×20 lens, more distant further from the apex and very distant towards the base, consisting of a single cell with an obtuse apex; midrib bordered on each side by a narrow band of lacunae, the lateral veins 6–9 on each side, 1–3 of which are more strongly developed than the others, the secondary veins transverse or ascending between the midrib and the inner lateral veins, more or less transverse elsewhere, all the veins with a dark tinge so that the leaf has a net-like appearance. Floating leaves absent. Stipules 12·5–18 mm, flexible, translucent with a milky or a slight pinkish tinge, rounded at the apex, persisting for several nodes behind the apex, two of the veins slightly more prominent than the others but not forming distinct ridges. Inflorescences 8–11 × 4·5–6·5 mm; peduncles 62–254 mm, 2·2–3·5 mm in diameter, of uniform diameter throughout their length, terete. Flowers 16–24, usually with 4 carpels (single flowers seen with 1, 3 and 5), the dark brown stigmas protruding from tightly closed green tepals.

When fresh material of *P.* × *cognatus* and its putative parents was compared side by side, the hybrid was clearly intermediate in vegetative characters (Table 1). It differed from both parents in its short inflorescences with closed tepals. A comparison of the Loch Borralie *P.* × *cognatus* with the published description of the Lincolnshire plant (Taylor & Sledge 1944) suggests that they are essentially similar. The main difference lies in the length of the peduncles, 45–75 mm in Lincolnshire compared to 62–254 mm at Loch Borralie. The long peduncles of the Borralie plant probably reflect the fact that the water was high following a wet season, and are unlikely to indicate a genetic difference between the plants. The fact that both the Lincolnshire and the Borralie plants had denticulate leaf margins is interesting: the original material of *P.* × *cognatus* had toothed margins (Ascherson & Graebner 1897) but Hagström (1916) described plants with entire leaves from a lake in Denmark.

HABITAT

A detailed description of Loch Borralie is given by Spence *et al.* (1984). It is 1·2 km long and 0·2–0·5 km wide, with an area of 36 hectares. It lies in a shallow basin in the Cambrian Durness limestone,

TABLE 1. CHARACTERS OF *POTAMOGETON PERFOLIATUS*, *P.* × *COGNATUS* AND *P. PRAELONGUS* FROM LOCH BORRALIE

	P. perfoliatus	*P.* × *cognatus*	*P. praelongus*
Length of main stem leaves (mm)	25–48	45–80	125–155
Leaf length: breadth ratio	1·3–2·5	2·6–4·0	6·7–7·4
Leaf base	Clasping stem with edges on far side almost meeting or overlapping	Clasping stem with broad gap between edges on far side	Slightly clasping stem
Leaf margin	Denticulate	Denticulate	Entire
Leaf apex	Scarcely hooded	Slightly hooded	Markedly hooded
Stipules	Fugacious	Persisting on upper nodes	Persistent
Inflorescence length (mm)	12–16	8–11	37–40
Tepals	Open	Closed	Open

All observations based on small samples collected on 21 August 1993. The quantitative characters show the difference between the taxa at Loch Borralie, but should not be used to identify plants from other sites.

and has a small catchment of 154 hectares. The water of the loch is calcareous (pH 8.5) and remarkably clear, with low levels of nitrogen and available phosphorus and very low plankton densities. The shallow water at the edge of the lake has an open plant community in which the main species are *Chara aspera* and *Littorella uniflora*, with *Potamogeton filiformis* and *Myriophyllum alterniflorum*. In deeper water the vegetation is dense, and is dominated by *Hippuris vulgaris*, *Myriophyllum spicatum*, *Potamogeton natans*, *P. pectinatus*, *P. perfoliatus* and *P. praelongus*. Below 4·5 m there is a deep-water charophyte sward dominated by *Chara globularis*.

Around much of the edge of Loch Borralie the water shelves gradually, and the *Potamogeton*-dominated community is inaccessible to the observer on the shore, especially when the water level is high. We detected the hybrid at two points where the water shelves much more steeply, and where the dense macrophyte-dominated community was visible from the shore or could be sampled by grapnelling. At the N.W. side of the loch, grid reference NC/382.673, *P.* × *cognatus*, *P. perfoliatus* and *P. praelongus* were dredged up together. At the S.E. side of the loch the hybrid was visible just offshore at a point where the limestone outcrops at the edge of the loch, grid reference NC/383.668. It grew in vegetation dominated by the submerged shoots of *Hippuris vulgaris*, in water c.1.5 m deep. The other species growing here were *P. perfoliatus* and *P. praelongus*. The presence of the hybrid in two localities 0·6 km apart suggests that it may be widespread in the vegetation in which its parents occur. The Lincolnshire population of *P.* × *cognatus* reproduced vegetatively by buds at the end of short stolons which arose at the nodes of the non-flowering shoots (Taylor & Sledge 1944).

Potamogeton perfoliatus and *P. praelongus* may be closely related (Haynes 1985). Their hybrid, *P.* × *cognatus*, has been recorded from only a few localities in northern Europe. The rarity of the hybrid has been commented on by Hagström (1916), who suggested that the earlier flowering time of *P. praelongus* restricted the opportunities for hybridisation. He contrasted the rarity of *P.* × *cognatus* with the frequency of *P.* × *nitens*, the hybrid between *P. perfoliatus* and *P. gramineus*. Although *P. gramineus* is morphologically dissimilar to *P. perfoliatus*, the two species 'scarcely can grow together without producing crosses'. The presence of *P.* × *cognatus* in Loch Borralie adds to the interest of this remarkable site, which is classified as an area of international importance in the *Nature Conservation Review* (Ratcliffe 1977).

ACKNOWLEDGMENTS

I am very grateful to D. A. and Mrs A. Pearman for joining me on the trip to Scotland, and to I. M. and Mrs P. A. Evans for meeting us at Loch Borralie. Scottish Natural Heritage kindly provided copies of the records from the 1988 visit of the Scottish Loch Survey. A. O. Chater and P. T. Harding kindly commented on a draft of this note.

REFERENCES

Ascherson, P. & Graebner, P. (1897). *Synopsis der Mitteleuropäischen Flora*, **1**. Wilhelm Engelmann, Leipzig.

Dandy, J. E. (1975). *Potamogeton* L., in Stace, C. A., ed., *Hybridization and the flora of the British Isles*, pp. 444–459. Academic Press, London.

Hagström, J. O. (1916). Critical researches on the Potamogetons. *Kongliga Svenska Vetenskapsakademiens Handlingar n.s.* **55(5)**: 1–281.

Haynes, R. R. (1985). A revision of the clasping-leaved *Potamogeton* (Potamogetonaceae). *Sida* **11**: 173–188.

Ratcliffe, D. A. (1977). *A nature conservation review*. 2 vols. Cambridge University Press, Cambridge.

Spence, D. H. N., Barclay, A. M. & Allen, E. D. (1984). Limnology and macrophyte vegetation of a deep, clear limestone lake, Loch Borralie. *Transactions of the Botanical Society of Edinburgh* **44**: 187–204.

Taylor, J. M. & Sledge, W. A. (1944). × *Potamogeton cognatus* Asch. and Graeb. in Britain. *The Naturalist* **1944**: 121–123.

C. D. Preston
I.T.E., Monks Wood, Abbots Ripton, Huntingdon, Cambs., PE17 2LS

AN EARLY SCOTTISH RECORD OF *RUBUS ARCTICUS* L. (ROSACEAE)

The small Northern bramble *Rubus arcticus* L. is considered to have become extinct in Britain in the mid-nineteenth century (Harley 1956). In the previous hundred years there were several reported occurrences, and several specimens were collected from widely separated localities (Harley 1956; Edees & Newton 1988). Some of the occurrences possibly resulted from seeds brought in by migrant birds or from cultivation in gardens (Harley 1956), and unfortunately no wild colony was regularly recorded, the localities of specimens being imprecise so that later botanists could not refind the populations.

Rubus arcticus was listed in the "Catalogue of British Plants in Dr Hope's Hortus Siccus, 1768" (Balfour 1907). However the entry is marked with a sign denoting "plant not yet found in Scotland, and that the specimen I had from England", and the source of the entry is given as "from Mr Gordon".

John Hope was Regius Keeper of the Royal Botanic Garden in Edinburgh from 1760 to 1786 (Balfour 1907) and corresponded with Dr David Skene, an Aberdeen medical practitioner and botanist (Welch 1989, 1993); much of this correspondence concerned new species being found in Scotland and exchanges of specimens. In a letter to Dr Skene dated 31 August 1765 (Skene MS 38*) Dr Hope wrote ". . . Mr Freer has added 4 score Plants to his collection, the last plants were the *Rubus arcticus* and *Osmunda crispa*. A list of them shall be sent you . . . Mr Freer I imagine may be ready again next spring to publish his list . . ."

Clearly this statement is in contradiction to the 1768 catalogue entry, and I suspect that errors occurred in its compilation or transcription. For some species two or more localities are given by Hope, so mention of Freer was not precluded by the Gordon source. Moreover two of the entries originating from information supplied by David Skene are dubious viz. the source of *Arenaria laricifolia* (sic) (= *Minuartia verna* (L.) Hiern) is given as "near Tongue, Aberdeenshire Dr Skene", and the source of *Chelidonium majus* is "at Revelston in Aberdeenshire Dr D. Skene". Places named Tongue and Revelston do not occur in Aberdeenshire, and we know that the *Minuartia* grows only on serpentine rocks in a very restricted district around Cabrach (Welch 1993); David Skene in an undated list (MS 482 p. 11*) accurately gave its locality as "Betwixt Clova & Craig".

According to Kent & Allen (1984) 40 of Adam Freer's specimens passed to Dr Hope, but Hope's herbarium is believed to have been destroyed around 1840, so there is little chance of finding the locality from which Freer obtained *Rubus arcticus*.

REFERENCES

BALFOUR, L. B. (1907). Eighteenth century records of British plants. *Notes from the Royal Botanic Garden, Edinburgh* **18**: 123–190.

EDEES, E. S. & NEWTON, A. (1988). *Brambles of the British Isles*. Ray Society, London.

HARLEY, R. M. (1956). *Rubus arcticus* L. in Britain. *Watsonia* **3**: 237–238.

KENT, D. H. & ALLEN, D. E. (1984). *British and Irish Herbaria*. Botanical Society of the British Isles, London.

WELCH, D. (1989). Dr Skene's botanical writings c. 1760–1770. *B.S.B.I. Scottish Newsletter* **11**: 12.

WELCH, D. (1993). *Flora of North Aberdeenshire*. Banchory.

D. WELCH

East Fernbank, Woodside Road, Banchory, Kincardineshire, AB31 3XL

* These numbers are from the catalogue of David Skene's papers held in the Aberdeen University Library (Special Collections).

Plant Records

Records for publication must be submitted to the appropriate Vice-county Recorder (see *B.S.B.I. Year Book for 1995*), and *not* the Editors. The records must normally be of species, hybrids or subspecies of native or naturalized plants belonging to one or more of the following categories: 1st or 2nd v.c. record; 1st post-1930 v.c. record; only extant v.c. locality, or 2nd such locality; a record of an extension of range by more than 100 km. Such records will also be accepted for the major islands in v.cc. 102–104 and 110. Only 1st records can normally be accepted for *Rubus*, *Hieracium* and hybrids. Records for subdivisions of vice-counties will not be treated separately; they must therefore be records for the vice-county as a whole. Records of *Taraxacum* are now being dealt with separately, by Dr A. J. Richards, and will be published at a later date.

Records are arranged in the order given in the *List of vascular plants of the British Isles* by D. H. Kent (1992), from which the species' numbers, taxonomy and nomenclature are taken. The Ordnance Survey national grid reference follows the habitat and locality. With the exception of collectors' initials, herbarium abbreviations are those used in *British and Irish herbaria* by D. H. Kent & D. E. Allen (1984). Records are field records if no other source is stated.

Records from the following vice-counties are included in the text below: 1–4, 9–14, 17–19, 25–27, 29, 35, 38–44, 46–50, 52, 53, 57–59, 64, 67–70, 73, 75, 77–81, 91, 93, 94, 98–100, 102, 108, 110.

The following signs are used:

* before the record: to indicate a new vice-county record.

† before the species number: to indicate that the plant is not a native species of the British Isles.

† before the record: to indicate a species which, though native in some parts of the British Isles, is not so in the locality recorded.

[] enclosing a previously published record: to indicate that the record should be deleted.

1/2.1. Lycopodiella inundata **70**, Cumberland: Wasdale, NY/1.0. J. Hooson, 1994. 2nd extant locality.

1/3.1. Lycopodium clavatum **58**, Cheshire: Peaty bank, Coombes Clough, Crowden, SK/053.994. G. M. Kay, 1994, **herb. G.M.K.** Only extant locality.

1/3.2. Lycopodium annotinum ***108**, W. Sutherland: W. of Gobernuisgach Lodge, NC/4.4. D. C. Lang, R. McBeath & G. P. Rothero, 1988. Ungrazed tall herb community on ledge just above water level, Loch Bealach a'Bhuirich, NC/262.280. G. P. Rothero, 1994. 1st and 2nd records.

4/1.1. Equisetum hyemale ***2**, E. Cornwall: Marshy corner of field, Portquin, SW/973.804. C. H. Watts, 1994.

11/1.3. Polypodium cambricum **98**, Main Argyll: Base of cliff in woodland between Port Kilcheran and Lochan Treshtil, Lismore, NM/822.382. A. McG. Stirling & B. H. Thompson, 1994. 2nd record.

14/1.1. Thelypteris palustris ***57**, Derbys.: Near Baslow, SK/2.7. I. D. Rotherham & P. A. Ardron, 1991. **69**, Westmorland: Storth, Arnside, SD/4.7. F. W. Grayson, 1994, **LANC**. 2nd extant locality.

17/1.1. Polystichum setiferum ***91**, Kincardines.: Den of Fenella, NO/77.66. C. H. Gimingham, 1947, **ABD**, det. C. N. Page. Deciduous woodland in den, Morphie, NO/708.645. D. Welch, 1994, **ABD**. 1st and 2nd records.

17/1.1 × 2. Polystichum setiferum × P. aculeatum (P. × bicknellii) ***46**, Cards.: With both parents on wall of ruined leadmine, Esgair Hir, SN/727.910. S. P. Chambers, 1993, **herb. S.P.C.**, det. A. M. Paul.

17/1.2. Polystichum aculeatum **2**, E. Cornwall: Walls of old mine buildings, Phoenix United Mine near Minions, SX/267.720. M. C. G. & A. A. Atkinson, 1994, conf. A. C. Jermy. 1st authenticated record since 1868.

†20/5.2. Larix kaempferi ***77**, Lanarks.: Caldercruix, NS/825.666. P. Macpherson, 1993, **herb. P.M.**, det. J. R. Akeroyd.

†28/4.1. ERANTHIS HYEMALIS *46, Cards.: Well established in lawns, Welsh Agricultural College, Llanbadarn Fawr, SN/602.811. S. P. Chambers, 1994.

28/9.1. ANEMONE NEMOROSA **102**, S. Ebudes: Oronsay, NR/3.8. A. Walker, 1992. Under *Gunnera*, Colonsay House Woods, Colonsay, NR/394.966. R. L. Gulliver, 1994. 1st Oronsay and Colonsay records.

28/13.11. RANUNCULUS SCELERATUS **102**, S. Ebudes: Flush above shore, Port Mor, Colonsay, NR/361.949. M. C. Gulliver, 1993. 1st post-1930 Colonsay record.

28/13.20. RANUNCULUS TRIPARTITUS **41**, Glam.: Trampled mud in shallow pool, Pitton Cross Moor, SS/434.880. Q. O. N. Kay & R. Wright, 1994, det. Q.O.N.K. & R. John. Only extant locality.

28/13.25b. RANUNCULUS PENICILLATUS subsp. PSEUDOFLUITANS **46**, Cards.: Shallow stream in pasture, Afon Dulas at Ffynnon Wen, Llangybi, SN/605.528. A. O. Chater, 1993, **NMW**, det. S. D. Webster as var. *pseudofluitans*. 2nd record.

28/17.4. THALICTRUM MINUS *78, Peebless.: Old dyke by road S. of Newhall, NT/317.320. A. McG. Stirling & B. H. Thompson, 1994.

†29/1.9. BERBERIS DARWINII *50, Denbs.: Roadside, Capel Garmon, SH/80.56. W. McCarthy, 1994. *77, Lanarks.: Craigton, NS/53.64. P. Macpherson & E. K. Lindsay, 1994, **herb. P.M.**, det. D. R. McKean.

†30/1.1. PAPAVER ORIENTALE *58, Cheshire: Spreading on dunes, Hoylake, SJ/208.875. G. M. Kay & P. D. Stanley, 1994.

†30/1.2. PAPAVER ATLANTICUM *58, Cheshire: Wall to canal, Higher Poynton, SJ/944.831. G. M. Kay, 1994.

31/5.1. FUMARIA CAPREOLATA *81, Berwicks.: Ayton, NT/92.60. F. M. Norman, 1878, **herb. Berwickshire High School, Duns**, det. M. E. Braithwaite.

31/5.6. FUMARIA PURPUREA *100, Clyde Is.: Rubbish tip, Brodick, Arran, NS/02.35. M. McCallum Webster, 1969, **E**, det. M. Lidén.

†36/3.1. SOLEIROLIA SOLEIROLII **26**, W. Suffolk: Old wall, Brandon Country Park, TL/785.852. E. M. Hyde, 1981. 2nd record. *77, Lanarks.: Walls and paths, Botanic Gardens, Glasgow, NS/56.67. P. Macpherson & A. McG. Stirling, 1994, **herb. P.M.**

†40/2.2. ALNUS INCANA *26, W. Suffolk: Verge of A45, Exning, TL/62.65. Verge of A45 E. of bridge over River Kennett, TL/704.672. Both M. D. Crewe, 1993. 1st and 2nd records. *77, Lanarks.: Damp ground by ponds, Hamilton, NS/72.55. P. Macpherson, 1993, **herb. P.M.** Bare waste ground, Glasgow, NS/56.65. P. Macpherson & E. K. Lindsay, 1993, **herb. P.M.**, det J. R. Akeroyd. 1st and 2nd records.

†40/2.3. ALNUS CORDATA *58, Cheshire: Edge of wood, High Lane, Disley, SJ/950.849. G. M. Kay, 1994.

43/1.13. CHENOPODIUM FICIFOLIUM **46**, Cards.: Disturbed refuse tip, Pendinas, Aberystwyth, SN/585.799. J. P. Woodman & A. O. Chater, 1994, **NMW**. 2nd record.

†43/3.1. ATRIPLEX HORTENSIS *38, Warks.: Side of lane, Farnborough, SP/435.498. P. J. Copson, 1984, **WAR**, det. J. C. Bowra. Heaps of topsoil, Long Itchington, SP/404.668. J. W. Partridge, 1987, det. J. C. Bowra. 1st and 2nd records.

43/3.4. ATRIPLEX LONGIPES *46, Cards.: Top of salt marsh, S. side of Dyfi estuary E. of mouth of Afon Leri, SN/620.936. A. O. Chater, 1993, **NMW**, det. J. R. Akeroyd.

†46/1.4. ARENARIA BALEARICA **40**, Salop: Bank, Church Stretton, SO/456.951. J. Warren, 1990. 2nd record.

46/5.5. STELLARIA HOLOSTEA **102**, S. Ebudes: Edge of bracken stand, Scallasaig, Colonsay, NR/394.943. R. L. Gulliver, 1994. 1st post-1930 Colonsay record.

46/7.11. Cerastium pumilum **49**, Caerns.: Limestone grassland, Nant y Gamar, Llandudno, SH/80.81. G. Battershall, 1992. Only extant locality.

46/8.1. Myosoton aquaticum †***49**, Caerns.: Flower beds, Llandudno, SH/780.827. W. McCarthy, 1994, **NMW**.

46/9.1. Moenchia erecta **46**, Cards.: Dry slope below coastal footpath W. of Banc, Llanrhystud, SN/534.703. J. Turner & J. Woodman, 1994. Only extant locality.

46/10.3. Sagina subulata **42**, Brecs.: Tirabad Cross, Cefngorwydd, SN/8.4. R. G. Woods, 1994. 2nd record.

46/10.8. Sagina maritima **81**, Berwicks.: Concrete by sea, Burnmouth harbour, NT/959.608. M. E. Braithwaite, 1994, **herb. M.E.B.** 2nd record, 1st since 1896. Concrete by sea, Glensgreen, Eyemouth, NT/946.645. M. E. Braithwaite, 1994, **herb. M.E.B.** 2nd extant locality.

46/11.2. Scleranthus annuus **99**, Dunbarton: Shandon, NS/25.86. J. H. Penson, 1971. 1st record since 1886. Abandoned sand quarry, Callendoun Quarry, Dumfin, NS/33.84. K. Futter, 1994. 2nd post-1930 record.

†46/18.1. Lychnis coronaria ***12**, N. Hants.: Well naturalized in rough grassland E. of Blackbushe, SU/812.594. C. R. Hall, 1992. **46**, Cards.: Rough ground by St Mary's College, Bryn Road, Aberystwyth, SN/586.823. S. P. Chambers, 1994. 2nd record. **69**, Westmorland: Coal yard, Arnside, SD/461.789. M. Baecker, 1993. 2nd record.

†46/20.9a × 10. Silene latifolia subsp. alba × S. dioica (S. × hampeana) ***73**, Kirkcudbrights.: With both parents on embankment of disused railway, Summerville, Dumfries, NX/95.76. O. M. Stewart, 1994.

46/20.12. Silene conica †***40**, Salop: New bank by Oswestry Bypass, SJ/295.272. M. Wainwright, 1987, det. P. M. Benoit.

†47/1.2. Persicaria campanulata ***12**, N. Hants.: Towpath, Basingstoke Canal, Pondtail, SU/82.53. C. R. Hall, 1986, det. A. R. G. Mundell.

47/4.2a. Polygonum oxyspermum subsp. raii ***102**, S. Ebudes: Rocky shore just above strand line, Kiloran Bay, Colonsay, NR/396.979. R. L. & M. C. Gulliver, 1993. 1st localized record.

47/4.3. Polygonum arenastrum **102**, S. Ebudes: Disturbed ground in croftyard, Colonsay, NR/372.954. R. L. & M. C. Gulliver, 1991. 1st Colonsay record.

47/4.5. Polygonum boreale **73**, Kirkcudbrights.: Mound of earth, Southerness, NX/975.542. O. M. Stewart, 1994. 2nd record.

†47/5.1 × 2. Fallopia japonica × F. sachalinensis (F. × bohemica) ***38**, Warks.: Riverside scrub, Leamington Spa, SP/308.656. J. W. Partridge, 1993, **WAR**, det. J. C. Bowra.

47/5.4. Fallopia convolvulus **102**, S. Ebudes: Barley field W. of road to Kiloran Bay, Colonsay, NR/397.976. R. L. Gulliver, 1992. 1st post-1930 Colonsay record.

47/8.8. Rumex longifolius **81**, Berwicks.: Verge of A6089 N. of Gordon, NT/629.451. R. W. M. Corner, 1994. 2nd extant locality. ***100**, Clyde Is.: Strandline, Lamlash, Arran, NS/028.311. R. W. M. Corner, 1989, **herb. R.W.M.C.**, det. J. R. Akeroyd.

†47/8.11. Rumex cristatus ***12**, N. Hants.: Growing through tarmac on side of B3011, Heckfield, SU/733.608. D. L. Brookman, 1993, **herb. Lady A. Brewis**.

†47/8.12. Rumex patientia ***12**, N. Hants.: Station yard, Aldershot, SU/86.50. A. C. Leslie, 1983, **herb. Lady A. Brewis.**

50/1.1. Elatine hexandra ***42**, Brecs.: Margin of reservoir emptied for repair, Dolymynach Reservoir, SN/907.617. C. Mosscroft, 1994.

†51/1.1. Hypericum calycinum ***77**, Lanarks.: Wood, Cambuslang, NS/63.60. P. Macpherson, 1993, **herb. P.M.**, det. N. K. B. Robson. 1st record of established population.

†51/1.6 × 7. HYPERICUM PERFORATUM × H. MACULATUM (H. × DESETANGSII) ***98**, Main Argyll: By gravel track at head of Loch Feochan, NM/876.246. B. H. Thompson, 1994, det. N. K. B. Robson as probably nothovar. *carinthiacum*.

51/1.14. HYPERICUM HIRSUTUM *__2__, E. Cornwall: Open scrub on disused railway embankment S. of Bagbury Farm near Bude, SS/213.051. T. J. Dingle, 1994.

†53/1.6. MALVA PUSILLA **40**, Salop: Garden weed, Wentnor, SO/383.926. S. Kingsbury, 1991. 2nd record.

†52/2.3. LAVATERA OLBIA ***35**, Mons.: Rough vegetation at side of woodland track, Ifton Great Wood, ST/460.895. T. G. Evans, 1994, **NMW**.

57/1.9b. VIOLA PALUSTRIS subsp. JURESSI ***46**, Cards.: Alder carr, Rhos Pil-bach D.W.T. Reserve, Plwmp, SN/367.529. A. O. Chater & S. P. Chambers, 1994.

†57/1.10. VIOLA CORNUTA **44**, Carms.: Roadside hedgebank, Blaendyfnant near Llanfyrnach, SN/236.294. G. Hutchinson & R. D. Pryce, 1994, **NMW**. 3rd Welsh record.

61/1.†1 × 2. POPULUS ALBA × P. TREMULA (P. × CANESCENS) ***77**, Lanarks.: Rubbly waste ground, Dalmarnock, Glasgow, NS/61.63. P. Macpherson, 1993, **herb. P.M.**, det. R. D. Meikle. 1st record of established population.

61/1.3a. POPULUS NIGRA subsp. BETULIFOLIA ***46**, Cards.: Bank of Afon Llanfihangel, Llanfihangel-y-Creuddyn, SN/658.762. A. O. Chater, 1992, **NMW**, det. E. Milne-Redhead. Wooded bank of dry gulley, Penparc, SN/212.485. A. O. Chater, 1994, **NMW**. 1st and 2nd records of native trees.

†61/1.4. POPULUS TRICHOCARPA ***58**, Cheshire: Canal bank, Wolverham, SJ/41.75. G. M. Kay, 1994. Suckering freely. ***77**, Lanarks.: Old quay, Glasgow, NS/57.64. P. Macpherson, 1994, **herb. P.M.**, det. R. D. Meikle.

61/2.12 × 16. SALIX AURITA × S. REPENS (S. × AMBIGUA) ***80**, Roxburghs.: Mire, Blind Moss, Ashkirk, NT/458.185. R. W. M. Corner, 1994, **herb. R.W.M.C.**, det. R. D. Meikle.

62/11.1. BARBAREA VULGARIS ***100**, Clyde Is.: Streamside, Torrylinn Shore, Kilmory, Arran, NR/957.207. T. Smith, 1988, det. T. C. G. Rich.

†62/11.3. BARBAREA INTERMEDIA ***78**, Peebless.: Roadside near Walkerburn, NT/351.374. Mrs Grant, 1981, **herb. M. E. Braithwaite**, det. M.E.B. Still present in Walkerburn in 1994. Near foot of Holm's Water, Rachan, NT/12.34. D. J. McCosh, 1994. 1st and 2nd records.

62/12.3. RORIPPA ISLANDICA ***41**, Glam.: Near River Loughor, Garnswllt, SN/62.10. R. G. Ellis, 1981, **NMW**, det. T. C. G. Rich.

62/12.5. RORIPPA SYLVESTRIS ***91**, Kincardines.: By River Dee, Banchory, NO/795.957. D. Welch, 1978.

†62/15.5. ARABIS CAUCASICA ***39**, Staffs.: Road verge under hedge, Yewtree Lane, Tettenhall, SJ/871.003. B. R. Fowler, 1994, **herb. B.R.F.**

62/15.6. ARABIS HIRSUTA **102**, S. Ebudes: Balnahard Dunes, NR/427.999. R. L. & M. C. Gulliver, 1993. 1st post-1930 Colonsay record.

†62/18.2. ALYSSUM SAXATILE ***42**, Brecs.: River bank N.W. of Gilwern, SO/242.154. M. Porter, 1992.

62/22.1. EROPHILA MAJUSCULA ***38**, Warks.: Garden weed, Warwick, SP/281.657. K. Davies, 1987, **WAR**, det. T. T. Elkington.

62/22.3. EROPHILA GLABRESCENS ***12**, N. Hants.: Sandy forest land, Longmoor Inclosure, Woolmer, SU/783.294. Sandy verge, N. of Woolmer Road E. of Greatham, SU/789.313. Both F. Rose, 1992, **herb. Lady A. Brewis**, det. T. T. Elkington. 1st and 2nd records. ***38**, Warks.: Quarry, Alderminster, SP/255.505. Car park, Leamington Spa, SP/327.645. Both J. W. Partridge, 1987, **WAR**, det. T. T. Elkington. 1st and 2nd records. ***43**, Rads.: Bank of rocky track, Cascob, SO/234.669. D. R. Humphreys, 1994, conf. R. G. Woods. *52, Anglesey: Sand dunes, Aberffraw, SH/35.68. J. Lowell, 1994. *77, Lanarks.: Rocky streamside, Daer Water, NS/ 97.09. P. Macpherson, 1994, **herb. P.M.**, conf. T. T. Elkington. *98, Main Argyll: Pathside, Dunstaffnage Castle, NM/88.34. P. Macpherson, 1957, **herb. P.M.**, det. T. T. Elkington.

62/23.5. Cochlearia danica †*42, Brecs.: Roadside N.W. of Erwood, SO/075.444. R. G. Woods, 1994.

62/30.3. Lepidium heterophyllum 26, W. Suffolk: Meadow near River Lark, Bury St Edmunds, TL/858.650. N. Gibbons, 1993, conf. G. Beckett. 2nd extant locality.

62/30.5. Lepidium ruderale *26, W. Suffolk: Verge of slip road at junction of A45 and A142, Newmarket, TL/633.659. M. D. Crewe, 1993. 40, Salop: Festival Square, Oswestry, SJ/ 282.294. E. Roberts, 1989. 1st post-1930 record.

62/30.6. Lepidium latifolium †*40, Salop: Near River Onny at Craven Arms, SO/437.826. W. Prestwood, 1989. Oswestry, SJ/294.299. E. Townsend, 1993. 1st and 2nd records.

62/31.1. Coronopus squamatus 81, Berwicks.: Path through arable field, Barefoots, Eyemouth, NT/941.648. M. E. Braithwaite, 1994, **herb. M.E.B.** Path through arable field above Hallydown shore, NT/927.653. M. E. Braithwaite, 1994. 1st and 2nd post-1930 records.

†62/34.4. Brassica juncea 25, E. Suffolk: Waste land alongside railway, Nacton, TM/ 217.406. E. M. Hyde, 1993, conf. T. C. G. Rich. 2nd record.

†62/36.1. Erucastrum gallicum *49, Caerns.: Tarmac on promenade, Llandudno, SH/ 792.821. W. McCarthy, 1994.

†62/40.1. Rapistrum rugosum *50, Denbs.: New roadside by car park, Ysbytty Ifan, SH/ 842.488. W. McCarthy, 1994, **NMW**. Field edge, Glan Conwy, SH/802.766. W. McCarthy, 1994. 1st and 2nd records.

†62/42.1a. Raphanus raphanistrum 102, S. Ebudes: Kale field, Uragaig, Colonsay, NR/ 388.981. R. L. Gulliver, 1994. 1st post-1930 Colonsay record.

64/1.1a. Empetrum nigrum subsp. nigrum 52, Anglesey: Maritime heath, Ynys Llanddwyn, SH/3.6. M. & L. Howe, 1994. 2nd record.

†65/8.1. Gaultheria shallon *46, Cards.: Well naturalized in woodland, Furnace, SN/ 684.952. A. O. Chater, 1993. Extensive thickets in woodland and scrub, Glandyfi Castle, SN/ 692.965. A. O. Chater & W. M. Condry, 1994. 1st and 2nd records.

†65/8.3. Gaultheria mucronata 58, Cheshire: Heath, Caldy Hill, SJ/224.858. D. P. & J. B. Earl, 1994. 2nd record.

69/1.1 × 3. Primula vulgaris × P. veris (P. × polyantha) *73, Kirkcudbrights.: Wood near shore, St Mary's Isle, NX/671.850. O. M. Stewart, 1994.

†69/1.9. Primula japonica *77, Lanarks.: Damp wood, Busby, NS/58.55. P. Macpherson, 1989, **herb. E. J. Clement**, det. E.J.C. as 'Postford White'. Still present in 1994.

69/2.1. Hottonia palustris †*77, Lanarks.: Abundant in pond, Hamilton, NS/724.566. K. Watson, 1993, **GL**.

†69/3.2. Cyclamen coum *14, E. Sussex: Naturalized in churchyard, Balcombe, TQ/307.309. A. G. Hoare, 1994, conf. P. A. Harmes.

69/6.3. Anagallis minima *40, Salop: Wimper Hill Wood, Wyre Forest, SO/732.763. J. Bingham, 1991.

†71/1.1. Philadelphus coronarius *38, Warks.: Railway embankment, Warwick, SP/ 294.654. J. C. Bowra, 1983, **WAR**, det. P. J. Copson. Still present in 1993.

†71/1.1 × mic. × pub. PHILADELPHUS CORONARIUS × P. MICROPHYLLUS × P. PUBESCENS (P. × VIRGINALIS) *77, Lanarks.: edge of rough grassland, Burnside, Glasgow, NS/61.59. P. Macpherson, 1994, **herb. P.M.**

72/2.6. RIBES ALPINUM †**58**, Cheshire: Hedgerow in green lane, Disley, SJ/986.846. G. M. Kay, 1994. 1st record this century, from site where species was recorded last century. †**73**, Kirkcudbrights.: Embankment of A75, Ramscale Bridge, NX/792.665. O. M. Stewart & A. White, 1994. 1st record since 1887.

73/1.1. CRASSULA TILLAEA *19, N. Essex: Floor of gravel pit, Alphamstone, TL/872.353. T. Tarpey, 1994.

†73/1.3. CRASSULA HELMSII *26, W. Suffolk: Farm pond, Long Melford, TL/879.445. D. Casey, 1983. *40, Salop: Pool, Haughton, Shawbury, SJ/554.165. W. Prestwood, 1988, det. C. A. Sinker. Brown Moss, SJ/563.394. I. C. Trueman, 1990. 1st and 2nd records.

†73/5.4. SEDUM SPECTABILE *25, E. Suffolk: Grassy strip between houses and shingle beach, Shingle Street, TM/367.426. M. D. Crewe, 1993.

†73/5.7. SEDUM SPURIUM *58, Cheshire: Wasteland, Brinnington, Stockport, SJ/916.929. E. Kearns, 1993, det. G. M. Kay.

†74/4.1. DARMERA PELTATA *98, Main Argyll: Roadside near Invereck, Kilmun, NS/142.830. A. McG. Stirling, 1983.

†74/5.6. SAXIFRAGA ROTUNDIFOLIA *77, Lanarks.: Well established on river shingle, Kelvinside, NS/56.67. A. Walker *et al.*, 1986, **GL**, still present in 1994. River shingle, Kelvindale, NS/56.66. K. Watson, 1991. 1st and 2nd records.

74/5.16. SAXIFRAGA HYPNOIDES **50**, Denbs.: Wet cliffs, Craig Berwyn, SJ/076.333. J. A. Green, 1994, **NMW**. Only extant locality.

†74/7.1. TOLMIEA MENZIESII **46**, Cards.: Frequent dense patches in woodland, Cwm Wyre E. of Llanrhystud, SN/556.698. J. Davies, 1993, det. A. O. Chater. 2nd record.

†74/8.1. TELLIMA GRANDIFLORA **79**, Selkirks.: Side of River Yarrow, Bowhill, NT/432.281. R. W. M. Corner, 1994, **herb. R.W.M.C.** 2nd record.

†75/3.1 × 2. SPIRAEA SALICIFOLIA × S. ALBA (S. × ROSALBA) *50, Denbs.: Alwen Reservoir, SH/953.534. A. P. Jones, 1994, **NMW**.

†75/3.1 × 3. SPIRAEA SALICIFOLIA × S. DOUGLASII (S. × PSEUDOSALICIFOLIA) *50, Denbs.: Cadney Moss, SJ/469.348. K. Watson, 1994.

†75/5.1. HOLODISCUS DISCOLOR *73, Kirkcudbrights.: By River Nith, Maxwelltown, NX/967.760. O. M. Stewart & A. White, 1993.

†75/8.5 × 6. RUBUS ODORATUS × R. PARVIFLORUS **13**, W. Sussex: Traffic island S.E. of Chichester, SU/878.041. A. C. Leslie, G. H. Foster, P. A. Harmes *et al.*, 1985, det. A. C. Leslie. Still present in 1994.

75/8.51. RUBUS ERRABUNDUS *64, Mid-W. Yorks.: Riverside, Dunsop Bridge, SD/659.503. D. P. Earl, 1993. *79, Selkirks.: Roadside, Yarrow Kirk, NT/35.27. A. Newton, 1993, **herb. A.N.**

†75/8.55. RUBUS LACINIATUS *42, Brecs.: Woodland, Llangynidr, SO/164.200. M. Porter & L. Kellaway, 1994. *44, Carms.: Base of wall, lane N. of Cedric Street, Llanelli, SN/512.001. I. K. Morgan, 1994, **NMW**, det. G. Hutchinson.

75/8.81. RUBUS SCIOCHARIS *14, E. Sussex: Heath, 'Gills Lap', Ashdown Forest, TQ/46.31. A. Bull & A. Newton, 1994.

75/8.92. RUBUS BOUDICCAE *53, S. Lincs.: Roadside, Doddington, SK/9.7. L. Cumming & A. Ley, 1907, **OXF**, det. D. E. Allen.

†75/8.102. Rubus elegantispinosus *13, W. Sussex: Roadside, Stoneleigh Forest near Emsworth, SU/748.087. D. E. Allen, 1993, **BM**, conf. A. Newton.

75/8.105. Rubus incurvatiformis *49, Caerns.: Hedgerow, Ty'n-y-Groes, SH/78.71. G. Battershall, 1993, det. A. Newton. *50, Denbs.: Hedge, Bryn y Maen, SH/836.765. G. Battershall, 1993, det. A. Newton.

75/8.109. Rubus lindebergii *79, Selkirks.: Roadside, Foulshiels, Yarrow, NT/42.29. A. Newton, 1993, **herb. A.N.**

75/8.111. Rubus milfordensis *11, S. Hants.: Gateway by Dunwood near Romsey, SU/306.230. D. E. Allen, 1985, **BM**, conf. A. Newton.

75/8.132. Rubus sprengelii *44, Carms.: Edge of forestry plantation, Forestry Picnic Site near Cenarth, SN/262.408. B.S.B.I. meeting, 1994, **NMW**, det. A. Newton.

75/8.134. Rubus armeniacus *52, Anglesey: Car park, Beaumaris, SH/60.76. D. P. Earl, 1994.

75/8.140. Rubus rossensis *1, W. Cornwall: Scrub, Tregarne Beacon, The Lizard, SW/78.23. L. J. Margetts, 1983, det. A. Newton.

75/8.143. Rubus winteri *10, Wight: Chalk scrub, Tennyson Down, SZ/332.857. D. E. Allen, 1993, **BM**, conf. A. Newton.

75/8.144. Rubus adscitus *44, Carms.: Field hedge, Springfield Road, Carmarthen, SN/412.212. B.S.B.I. meeting, 1994, **NMW**, det. A. Newton.

75/8.174. Rubus wirralensis *64, Mid-W. Yorks.: Laneside, Great Mitton, SD/712.415. D. P. Earl, 1994.

75/8.176. Rubus aequalidens *9, Dorset: Heathy hill slopes, Pilsdon Pen, Broadwindsor, ST/41.01. D. E. Allen, 1994, **BM**, det. A. Newton.

75/8.180. Rubus diversus *12, N. Hants.: Old planted-over common, Fox Plantation, Tangley, SU/33.52. D. E. Allen, 1993, **BM**, conf. A. Newton.

75/8.193. Rubus melanodermis *44, Carms.: Roadside hedge, Cwm Cathan, Garnswllt, SN/628.099. B.S.B.I. meeting, 1994, det. A. Newton.

75/8.194. Rubus micans *35, Mons.: Trackside in Hale Wood, ST/412.974. T. G. Evans, 1994, **herb. T.G.E.**, det. A. Newton.

75/8.200. Rubus trichodes *10, Wight: Rough ground, Tennyson Down, SZ/332.857. D. E. Allen, 1993, **BM**, det A. Newton.

75/8.214. Rubus formidabilis *11, S. Hants.: Rides, Parnhold Wood, SU/37.28. D. E. Allen, 1994, **BM**, conf. A. Newton.

75/8.218. Rubus leyanus *26, W. Suffolk: Assington Thicks, TL/92.38. A. L. Bull, 1979, **herb. A.L.B.**, conf. A. Newton.

75/8.222. Rubus adenanthoides *79, Selkirks.: Side of B7039 E. of Bowhill, NT/43.27. A. Newton, 1993, **herb. A.N.** *99, Dunbarton: Trackside by margin of wood, Rosneath, NS/273.819. A. McG. Stirling, 1994, **GLAM.**

75/8.231. Rubus echinatoides *79, Selkirks.: Roadside near Yarrow Kirk, NT/35.27. A. Newton, 1993, **herb. A.N.**

75/8.234. Rubus flexuosus *46, Cards.: Dominant in oak/ash wood W. of Nant Adal, Llanilar, SN/622.743. D. E. Allen & A. O. Chater, 1994, **NMW**, det. D.E.A.

75/8.264. Rubus atrebatum *9, Dorset: Hedges, Pilsdon Pen, ST/413.011. D. E. Allen, 1994, **BM**, conf. A. Newton. Extension of range 130 km westwards.

75/8.305. RUBUS BRITANNICUS *12, N. Hants.: Clay copse, Clanville Lodge near Andover, SU/322.483. D. E. Allen, 1993, **BM**, conf. A. Newton.

75/8.310. RUBUS HEBRIDENSIS *94, Banffs.: Dufftown, NJ/323.392. D. Welch, 1992, **ABD**, det. A. Newton.

75/8.313. RUBUS NEMOROSUS *46, Cards.: Thickets on stream bank, Afon Wyre E. of Llanrhystud church, SN/538.696. D. E. Allen & A. O. Chater, 1993, **BM**, conf. A. Newton.

75/8.314. RUBUS PICTORUM *42, Brecs.: Woodland, Cusop Dingle, SO/2.4. A. Ley, 1896, **BIRM**, det. M. Porter.

75/8.321. RUBUS CAESIUS *67, S. Northumb.: By disused railway track near Wylam, NZ/125.649. Shaded bank of River Tyne near Riding Mill, NZ/017.618. Both G. A. Swan, 1994, **herb. G.A.S.**, det. A. Newton. 1st and 2nd confirmed records. *68, Cheviot: Open wood above Howick Burn, NU/251.172. G. A. Swan, 1994, **herb. G.A.S.**, det. A. Newton. 1st confirmed record.

75/8.ari. RUBUS ARICONIENSIS *44, Carms.: Edge of forestry plantation, Forestry Picnic Site near Cenarth, SN/262.406. B.S.B.I. meeting, 1994, **NMW**, det. A. Newton.

75/8.vag. RUBUS VAGENSIS *42, Brecs.: Woodland, Park Wood, Talgarth, SO/168.338. M. Porter, 1991, **herb. M.P.**

75/13.2. GEUM URBANUM **102**, S. Ebudes: By unmetalled road through Colonsay House Woods, Colonsay, NR/393.966. R. L. & M. C. Gulliver, 1993. 1st post-1930 Colonsay record.

75/15.2. AGRIMONIA PROCERA **50**, Denbs.: Laneside bank, Nantglyn, SJ/009.636. W. McCarthy, 1994. 1st post-1930 record.

†75/17.3b. SANGUISORBA MINOR subsp. MURICATA **26**, W. Suffolk: Bank by A45, Bury St Edmunds, TL/862.644. M. D. Crewe, 1993. 1st post-1930 record. *35, Mons.: Grassy bank of Nant Hafod-Tudur, Wattsyille, ST/203.916. T. G. & U. T. Evans, 1986, **herb. T.G.E.** Bank of River Ebbw, Risca, ST/2.9. J. Harper, 1992. 1st and 2nd records. *77, Lanarks.: Grassy area, New Stevenston, NS/761.598. P. Macpherson, 1993, **herb. P.M.** 1st record of established population.

†75/18.1. ACAENA OVALIFOLIA *77, Lanarks.: Long abandoned railway platform, Hillhead, NS/56.67. P. Macpherson, 1994, **herb. P.M.**, conf. P. F. Yeo.

†75/18.4. ACAENA INERMIS *44, Carms.: Disturbed river shingle, Carreg Sawdde Common, Llangadog, SN/706.277. I. K. Morgan & R. D. Pryce, 1987, **NMW**, det. G. Hutchinson. 1st Welsh record.

†75/19.15. ALCHEMILLA MOLLIS *40, Salop: By path, Marrington Dingle, SO/27.98. F. H. Perring, 1988. *48, Merioneth: Bushy lake shore, Llyn Tegid near Llanycil, SH/9.3. P. M. Benoit & A. O. Chater, 1993, **NMW**.

75/21.5 × 17. ROSA PIMPINELLIFOLIA × R. MOLLIS (R. × SABINII) *98, Main Argyll: Foot of cliff of raised beach S.E. of Castle Coeffin, Lismore, NM/855.436. A. McG. Stirling & B. H. Thompson, 1994, det. G. G. Graham.

†75/21.6. ROSA RUGOSA *80, Roxburghs.: Steep bank above Kale Water near Corbet Tower, NT/778.238. R. W. M. Corner, 1991, **herb. R.W.M.C.** Hedge N. of Lochside, Yetholm, NT/800.283. R. W. M. Corner, 1994, **herb. R.W.M.C.** 1st and 2nd records.

75/21.12. ROSA CANINA **102**, S. Ebudes: Scrubby margin of road, W. side of Kiloran Bay, Colonsay, NR/397.978. C. Wilson, 1993. 1st post-1930 Colonsay record. **108**, W. Sutherland: Rocky trackside, Ardroe, NC/071.246. P. A. Evans, 1994, det. G. G. Graham as Group *Transitoriae*. 1st confirmed record.

75/21.12 × 5. ROSA PIMPINELLIFOLIA × R. CANINA (R. × HIBERNICA) *49, Caerns.: Roadside hedge, Porth Neigwl, SH/262.292. A. Burns & A. P. Conolly, 1994, det. A. L. Primavesi. 2nd Welsh record.

75/21.12 × 13b. ROSA CANINA × R. CAESIA subsp. GLAUCA (R. × DUMALIS) *1, W. Cornwall: Scrub on bank near Rosehill, Penzance, SW/462.306. D. T. Holyoak, 1994, conf. A. L. Primavesi.

75/21.13b. ROSA CAESIA subsp. GLAUCA 3, S. Devon: Top of beach, Strete Gate, SX/835.456. R. E. N. & C. J. Smith, 1994, det. G. G. Graham. 1st confirmed record. **108**, W. Sutherland: Roadside scrub, Achmelvich Road, NC/082.247. P. A. Evans, 1994, det. G. G. Graham. 2nd post-1930 record.

75/21.15. ROSA TOMENTOSA *68, Cheviot: Hedge near Alnmouth, NU/239.107. G. A. Swan, 1994, **herb. G.A.S.**, det. G. G. Graham.

75/21.16 × 5. ROSA SHERARDII × R. PIMPINELLIFOLIA (R. × INVOLUTA) *46, Cards.: Grassy coastal heath, R.A.E. site, Aberporth, SN/245.524. A. O. Chater, 1994, **NMW**, det. G. G. Graham as hybrid with *R. sherardii* as female parent.

75/21.18. ROSA RUBIGINOSA *67, S. Northumb.: Under deciduous trees on E. bank of River South Tyne, NY/683.518. G. A. & M. Swan, 1994, **herb. G.A.S.**, det. G. G. Graham. 1st confirmed record. **73**, Kirkcudbrights.: Bank of river, Holm of Dalry, NX/614.810. O. M. Stewart, 1993, **E**. Only extant locality.

75/21.19. ROSA MICRANTHA *68, Cheviot: Hedge by road near Weldon, NZ/139.993. G. A. Swan, 1994, **herb. G.A.S.**, det. G. G. Graham. 1st confirmed record.

75/21.20. ROSA AGRESTIS **11**, S. Hants.: One shrub in scrub on chalk grassland, Gallows Hill, SU/134.212. P. D. Stanley, 1994, **herb. R. P. Bowman**, conf. R.P.B. 2nd record.

†75/28.7. SORBUS INTERMEDIA *40, Salop: Lynclys, SJ/273.240. J. Pedlow, 1990, det. P. J. M. Nethercott.

†75/30.1. AMELANCHIER L AMARCKII *77, Lanarks.: Old industrial site, Dalmarnock, NS/61.63. P. Macpherson, 1993, **herb. P.M.**, conf. R. D. Meikle.

†75/32.9. COTONEASTER FRIGIDUS **25**, E. Suffolk: Long established in grounds of old isolation hospital, Ufford, TM/288.518. M. D. Crewe, 1993. 2nd record. *44, Carms.: Hedgerow, Kidwelly, SN/399.063. G. Hutchinson, 1990, **NMW**, det. J. Fryer.

†75/32.9 × 10. COTONEASTER FRIGIDUS × C. SALICIFOLIUS (C. × WATERERI) *50, Denbs.: Woods, Colwyn Bay, SH/844.786. G. Battershall, 1993, det. J. Fryer.

†75/32.10. COTONEASTER SALICIFOLIUS *49, Caerns.: Hedgerow, Little Orme, SH/81.81. G. Battershall, 1993, det. J. Fryer.

†75/32.11. COTONEASTER DAMMERI *58, Cheshire: Riverbank, Wilmslow, SJ/838.822. D. Shaw, 1993. *77, Lanarks.: Breast wall of River Clyde near Govan, NS/56.65. P. Macpherson, 1994, **herb. P.M.**, det. J. Fryer. 2nd record.

†75/32.13. COTONEASTER LACTEUS *47, Monts.: Limestone scree, Llanymynech Rocks, SJ/261.218. M. Wainwright & J. Pedlow, 1993, det. J. Fryer.

†75/32.22. COTONEASTER HJELMQVISTII *47, Monts.: Limestone scree, Llanymynech Rocks, SJ/261.218. M. Wainwright & J. Pedlow, 1993, det. J. Fryer. *49, Caerns.: Edge of path, West Shore, Llandudno, SH/769.822. W. McCarthy, 1994, det. G. M. S. Easy.

†75/32.26. COTONEASTER DIVARICATUS *58, Cheshire: Wood on lime waste, Witton, SJ/656.752. G. M. Kay & E. & O. Kearns, 1994, det. G. M. S. Easy.

†75/32.29. COTONEASTER VILLOSULUS *77, Lanarks.: Wood near Busby, NS/58.55. P. Macpherson, 1993, **herb. P.M.**, det. J. Fryer.

†75/32.33. COTONEASTER SIMONSII *108, W. Sutherland: Rocky banks of burn, Tumore, NC/186.269. P. A. Evans, 1994.

†75/32.34. COTONEASTER BULLATUS *50, Denbs.: Limestone rocks, Llandulas, SH/914.777. W. McCarthy, 1994, det. J. Fryer. *69, Westmorland: Coppice behind Arnside railway station, SD/462.788. M. Baecker, 1994, **LANC**, det. J. Fryer.

†75/32.39. COTONEASTER FRANCHETII *26, W. Suffolk: Roadside at junction of A45 and A120 N. of Newmarket, TL/633.660. M. D. Crewe, 1993.

†75/32.40. COTONEASTER STERNIANUS *35, Mons.: Top of railway embankment off Spytty Road, Newport, ST/332.868. G. Hutchinson, 1990, **NMW**. *44, Carms.: Steep hedgebank S. of Llanybyther, SN/52.42. G. Hutchinson, 1991, **NMW**, conf. J. Fryer. 1st Welsh records.

†75/35.5. CRATAEGUS PERSIMILIS *35, Mons.: Hedgerow, Y Sguborwen, ST/411.958. T. G. Evans & P. Macpherson, 1993, **NMW**, conf. C. A. Stace. 1st Welsh record.

†75/35.10. CRATAEGUS LACINIATA *57, Derbys.: Disused railway sidings, Rowsley, SK/26.65. Various recorders from 1970s onwards. Railway bank, Butterley, Ripley, SK/407.519. J. P. Bailey, 1994, **LTR**. 1st and 2nd records.

77/4.2. ASTRAGALUS DANICUS **108**, W. Sutherland: Limestone grassland, Ardvreck Castle, NC/238.237. T. Fowler, 1987; refound by P. A. Evans in 1994. 2nd record.

†77/14.11c. VICIA SATIVA subsp. SATIVA *12, N. Hants.: Roadside below Noar Hill, SU/75.32. Lady A. Brewis, 1982. Field edge, North Warnborough, SU/728.517. C. R. Hall, 1993, **herb. Lady A. Brewis.** 1st and 2nd records. **46**, Cards.: Reconstructed roadside slope by Glanyrafon Industrial Estate, Llanbadarn Fawr, SN/609.805. S. P. Chambers, 1994, conf. A. O. Chater. Only extant locality. *81, Berwicks.: Reseeded verge of A1, English Border, NT/974.570. M. E. Braithwaite, 1994, **herb. M.E.B.** 1st localized record.

†77/15.7. LATHYRUS GRANDIFLORUS *12, N. Hants.: Scrub, Norris Hill, Fleet, SU/832.533. C. R. Hall, 1993, **herb. Lady A. Brewis**.

77/15.12. LATHYRUS NISSOLIA *40, Salop: Rough grassland, Randlay, Telford, SJ/712.072. Roadside, Stirchley Grange, Telford, SJ/702.070. Both J. Box & J. Mincher, 1985. 1st and 2nd records.

77/19.1. TRIFOLIUM ORNITHOPODIOIDES **12**, N. Hants.: Very sparse short vegetation on sandy soil, Kennels Lane near Southwood, SU/840.548. T. Dove, 1992, **herb. Lady A. Brewis**, conf. A. R. G. Mundell. Only extant locality.

†77/19.19a TRIFOLIUM INCARNATUM subsp. INCARNATUM *40, Salop: Banks of new A5 bypass, SJ/618.107. J. Martin, 1990.

77/19.25. TRIFOLIUM SUBTERRANEUM *39, Staffs.: Sparse, rabbit-grazed turf, Kinver Edge, SO/837.829. E. Blunt, 1993, det. M. Dowlen.

†77/22.1. LABURNUM ANAGYROIDES *49, Caerns.: Waste ground, Penrhyn Bay, SH/82.81. G. Battershall, 1992.

†77/23.3. CYTISUS STRIATUS *35, Mons.: Side of A4042, Pontypool, SO/299.004 & 300.004. T. G. Evans, 1990. Steep roadside bank N. of Goytre Farm, ST/477.977. T. G. Evans, 1991, **NMW**. Still present at both localities in 1994. 1st and 2nd records.

†77/24.1. SPARTIUM JUNCEUM *50, Denbs.: Railway bank, Llandulas SH/894.784. G. Hutchinson, 1994.

77/26.3. ULEX MINOR **98**, Main Argyll: Stony verge of forest road, A'Bheinn near Tibertich, NM/846.033. B. H. Thompson, 1994, **herb. B.H.T.**, conf. A. McG. Stirling. 1st post-1930 record.

†79/2.2. MYRIOPHYLLUM AQUATICUM *35, Mons.: Pond, Little Campston, SO/37.24. T. G. Evans, 1994. *40, Salop: Ditch near Fenemere, Eyton, SJ/443.232. R. Wells, 1990.

81/1.2. LYTHRUM HYSSOPIFOLIA †*35, Mons.: Weed of potato crop near pond, The Nurtons, Tintern, SO/536.011. A. & E. Wood, 1994, **NMW**, conf. T. G. Evans.

84/1.3 × †8. EPILOBIUM MONTANUM × E. CILIATUM *47, Monts.: Gravel car park, Caersws, SO/031.918. P. M. Benoit, 1993.

†84/1.8. EPILOBIUM CILIATUM **102**, S. Ebudes: Oronsay, NR/3.8. A. Walker, 1992. 1st record from Colonsay or Oronsay.

†84/1.12. EPILOBIUM BRUNNESCENS **12**, N. Hants.: Disturbed ground, recently planted with shrubs, beside Zebon Coppice, Crookham, SU/802.518. C. R. Hall, 1991, **herb. Lady A. Brewis**. 2nd record. **102**, S. Ebudes: Disturbed ground, Ballarulin, Colonsay, NR/384.963. R. L. Gulliver, 1994. 1st Colonsay record.

†84/4.1 × 3. OENOTHERA GLAZIOVIANA × O. BIENNIS *__46__, Cards.: Refuse tip, S.W. side of Pendinas, Aberystwyth, SN/584.799. S. P. Chambers, 1994, det. J. C. Bowra.

84/6.1 × 2. CIRCAEA LUTETIANA × C. ALPINA (C. × INTERMEDIA) **50**, Denbs.: Bank of River Dee, Llangollen, SJ/208.431. J. A. Green, 1994. 2nd record.

†94/1.2. LINUM USITATISSIMUM *__50__, Denbs.: Dawn, Betws-yn-Rhos, SH/874.732. W. McCarthy, 1994, **NMW**.

†103/1.6. GERANIUM PSILOSTEMON *__77__, Lanarks.: Grassy waste ground, site of Garden Festival, Glasgow, NS/56.65. P. Macpherson, 1993. Edge of rough grassland, Burnside, Glasgow, NS/61.59. P. Macpherson, 1994. Both **herb. P.M.**, conf. P. F. Yeo. 1st and 2nd records.

†103/1.8. GERANIUM HIMALAYENSE *__77__, Lanarks.: Rubbly waste ground, site of Garden Festival, Glasgow, NS/56.65. P. Macpherson, 1992, **herb. P.M.**, det. E. J. Clement.

103/2.2. ERODIUM MOSCHATUM **46**, Cards.: Verge of B4321, Llangranog, SN/312.541. A. O. Chater & S. P. Chambers, 1994, **NMW**. 2nd record, 1st since 1941.

†105/1.2. IMPATIENS CAPENSIS *__40__, Salop: N. of Calcott Moss, SJ/448.142. P. Parker & J. Ing, 1984. Bank of River Tern S. of Market Drayton, SJ/671.334. F. H. Perring, 1988. 1st and 2nd records.

†105/1.3. IMPATIENS PARVIFLORA *__91__, Kincardines.: Bank of River North Esk, Kinaber, NO/724.621. D. Welch, 1994, **ABD**.

†106/1.1. HEDERA COLCHICA *__77__, Lanarks.: Wood, Calder, NS/61.72. P. Macpherson & E. L. S. Lindsay, 1991, **herb. P. M.**, det. A. McG. Stirling as var. *dentata*. Grassy bank, Kelvinside, NS/56.67. A. McG. Stirling, K. Watson & P. Macpherson, 1994. 1st and 2nd records. *__98__, Main Argyll: Well established and spreading in disused garden, Ederline, Ford, NM/870.030. B. H. Thompson, 1993, **herb. B.H.T.**, det. A. Rutherford.

†107/5.1. CHAEROPHYLLUM HIRSUTUM *__77__, Lanarks.: River bank, Kelvinside, NS/57.67. A. Walker, 1989, **GL**, conf. E. J. Clement. Still present in 1994.

107/6.2. ANTHRISCUS CAUCALIS **58**, Cheshire: Dunes, Wallasey, SJ/284.931. G. M. Kay, 1994. Only extant locality.

†107/10.1. SMYRNIUM OLUSATRUM *__57__, Derbys.: Roadside verge between Ingleby and Swarkestone, SK/361.274. C. Higginbottom, 1993, **DBY**. 1st localized record.

†107/20.1b. AETHUSA CYNAPIUM subsp. AGRESTIS *__4__, N. Devon: Waste ground, Torrington, SS/492.196. W. H. Tucker, 1994, **herb. W.H.T.**

†107/21.1. FOENICULUM VULGARE *__73__, Kirkcudbrights.: Top of steep embankment by A755 W. of Kirkcudbright, NX/676.518. A. White & O. M. Stewart, 1994.

107/28.4. APIUM INUNDATUM *__78__, Peebless.: Oxbow of River Tweed, Putts' Pool, Innerleithen, NT/34.37. M. E. Braithwaite *et al.*, 1994.

†107/32.1. AMMI MAJUS *__40__, Salop: Garden weed, Chapel Lane, Trefonnen, SJ/259.271. R. Davies, 1988.

†107/33.1. FALCARIA VULGARIS *__14__, E. Sussex: On railway bank and arable margin, Tidemills near Seaford, TQ/463.003. D. J. Manning, 1993, **herb. P. A. Harmes**. 1st record of established population.

†107/41.2. HERACLEUM MANTEGAZZIANUM **50**, Denbs.: Old castle, Holt, SJ/412.537. J. Osley, 1993. 2nd record.

110/8.1. Solanum nigrum **102**, S. Ebudes: Above strand line on shore N.W. of Rubha Dubh, Colonsay, NR/393.916. R. L. & M. C. Gulliver, 1991. 1st Colonsay record.

†111/3.4. Calystegia silvatica ***80**, Roxburghs.: Garden hedge, Dean Road, Denholm, NT/568.182. M. E. Braithwaite, 1988, **herb. R. W. M. Corner**. Roadside bank and hedge above E. end of Linton Loch, Morebattle, NT/788.253. R. W. M. Corner, 1994, **herb. R.W.M.C.** 1st and 2nd records. ***108**, W. Sutherland: Well established garden weed, Lochinver, NC/093.223. P. A. Evans, 1994.

112/1.3. Cuscuta epithymum †**59**, S. Lancs.: On *Cytisus scoparius* in shrub bed planted two years ago, Notre Dame Hospital, Taggart Avenue, Liverpool, SJ/406.875. S. Edmondson, 1994. 1st post-1930 record.

†115/1.1. Phacelia tanacetifolia ***50**, Denbs.: Weedy field, Dawn, Betws-yn-Rhos, SH/874.733. W. McCarthy, 1994, **NMW**.

†116/3.4. Pulmonaria 'Mawson's Blue' ***39**, Staffs.: Damp woodland, Patshall, SJ/800.007. S. O'Donnell, 1994, **herb. B. R. Fowler**.

116/4.3. Symphytum tuberosum †***46**, Cards.: Hedgebank of lane to Y Felin, Ader-Mad, SN/596.763. A. O. Chater, 1994, **NMW**.

†116/4.7. Symphytum caucasicum **26**, W. Suffolk: Roadside verge, Stoke-by-Nayland, TL/998.378. F. W. Simpson, 1993. 2nd record.

†116/12.2. Amsinckia micrantha ***40**, Salop: Beach Bank Dingle, SJ/429.024. K. Thorn, 1991. ***59**, S. Lancs.: Weed in sugar beet field, Ince Blundell, SD/324.036. V. Gordon, 1994.

118/1.1. Stachys officinalis **77**, Lanarks.: Rough grassland near Stevenston, NS/76.59. P. Macpherson, 1994, **herb. P.M.** 1st record this century.

†118/1.2. Stachys byzantina ***35**, Mons.: Waste ground in disused railway station, Golivon, SO/27.13. R. Fraser, 1989. Well naturalized on waste ground, Comin, Coed-y-moeth, SO/158.017. P. A. Smith, 1994. 1st and 2nd records. ***77**, Lanarks.: Grassy bank, Old Dock, Glasgow, NS/57.64. P. Macpherson, 1994, **herb. P.M.**

118/1.5 × 6. Stachys sylvatica × S. palustris (S. × ambigua) **102**, S. Ebudes: Roadside by turning to Balnahard from road to Kiloran, NR/399.974. R. L. Gulliver, 1993. 1st post-1930 Colonsay record.

118/1.8. Stachys arvensis **81**, Berwicks.: Arable edge above Fleurs Dean, NT/924.653. M. E. Braithwaite, 1994, **herb. M.E.B.** 2nd extant locality.

†118/4.1c. Lamiastrum galeobdolon subsp. argentatum ***57**, Derbys.: Wooded trackside by Pitt Wood, Alfreton, SK/412.547. R. Smith, 1993, **DBY.** **80**, Roxburghs.: Woodland, Maxton Woods, NT/609.303. E. G. Cutter, 1994. 2nd record.

118/5.4. Lamium hybridum ***100**, Clyde Is.: Waste ground on roadside, An Garradh, Largybeg, Arran, NS/049.230. A. R. Church, 1988. **108**, W. Sutherland: Recently disturbed ground in car park, Lochinver, NC/094.224. P. A. Evans, 1994. 2nd record.

118/5.6. Lamium amplexicaule **102**, S. Ebudes: Weed in cabbage field S.E. of Balnahard Dunes, Colonsay, NR/401.975. R. L. Gulliver, 1994. 1st post-1930 record.

118/6.2. Galeopsis angustifolia ***40**, Salop: Foot of scree, Jones's Rough, SJ/247.247. C. Johnson, 1987. British Telecom Yard, Llanymynech, SJ/266.210. F. H. Perring & M. Wainwright, 1992. 1st and 2nd records.

118/6.5. Galeopsis bifida **102**, S. Ebudes: Cabbage field, Colonsay, NR/372.954. R. L. Gulliver, 1991. 1st Colonsay record.

118/23.2 × †3. Mentha aquatica × M. spicata (M. × piperita) **102**, S. Ebudes: Sandy banks beside burn through Kiloran Dunes, Colonsay, NR/399.975. C. Wilson, 1993. 1st post-1930 Colonsay record.

†118/23.3. Mentha spicata **102**, S. Ebudes: Marshland, Port Mor, Colonsay, NR/362.947. C. Wilson, 1993. 1st Colonsay record.

118/23.†3 × 4. Mentha spicata × M. suaveolens (M. × villosa) ***47**, Monts.: Car park, Caersws, SO/031.918. P. M. Benoit, 1993.

118/23.†3 × lon. Mentha spicata × M. longifolia (M. × villosonervata) ***3**, S. Devon: Waste marshy ground, Torcross, Slapton Ley, SX/823.420. L. J. Margetts & L. M. Spalton, 1994, **herb. L.J.M.**, det. R. M. Harley. 1st certain record. ***81**, Berwicks.: Damp bank by burn, Milldown Burn, Coldingham, NT/913.661. P. A. Green, 1954, **E**, det. D. R. McKean.

120/1.4. Callitriche platycarpa ***75**, Ayrs.: Wet depressions, Garnock Floods, Irvine New Town, NS/30.41. K. Watson, 1992. Marshy depression, Knadgerhill Pond, Irvine New Town, NS/33.40. K. Watson, 1992. 1st and 2nd records.

121/1.4. Plantago media **77**, Lanarks.: Grassy area, New Stevenston, NS/76.59. P. Macpherson, 1993, **herb. P.M.** 1st post-1930 record.

124/1.7 × 11. Verbascum thapsus × V. pulverulentum (V. × godronii) ***26**, W. Suffolk: In large colony of *V. pulverulentum* by side of A45, Higham junction, TL/748.663. M. D. Crewe, 1993.

124/5.1. Limosella aquatica **73**, Kirkcudbrights.: Damp mud, Southwick Merse, NX/918.564. O. M. Stewart, 1994. 2nd extant locality.

†124/15.1. Erinus alpinus ***77**, Lanarks.: Well naturalized on walls where first planted c. 1967, Coulter, NT/02.33. D. J. McCosh, 1994.

†124/16.9. Veronica scutellata ***102**, S. Ebudes: Margin of shallow pool, Lochan Chille Moire, NR/361.888. A. Walker, 1992. 1st post-1930 record from Colonsay or Oronsay.

124/16.24. Veronica hederifolia ***102**, S. Ebudes: Disturbed ground at base of tree in woodland, Colonsay House Woods, Colonsay, NR/393.966. R. L. Gulliver, 1993.

†124/17.1. Hebe salicifolia ***73**, Kirkcudbrights.: Abundant on wall by River Nith, Maxwelltown, NX/967.760. A. White & O. M. Stewart, 1993.

124/20.7 × 9. Euphrasia nemorosa × E. confusa ***25**, E. Suffolk: Chalk pit, Blakenham Chalk Pit Nature Reserve, TM/109.490. P. G. Lawson, 1993, det. A. J. Silverside. ***47**, Monts.: Mortar-rich turf below tumbledown building, Dylife, SN/862.941. S. P. Chambers, 1993.

124/23.1. Parentucellia viscosa †**46**, Cards.: Reconstructed roadside slope by Glanyrafon Industrial Estate, Llanbadarn Fawr, SN/609.805. S. P. Chambers, 1994. 2nd record.

†125/1.2. Lathraea clandestina ***40**, Salop: Hardwick estate, Clive, SJ/510.222. A. Johnson, 1991.

†125/2.7. Orobanche crenata ***18**, S. Essex: One plant at edge of rape field, Cranham Marsh, TQ/574.852. A. Dunton, 1994, conf. in field by K. J. Adams. Re-occurrence at only site in Britain where this species has become established.

†129/1.9. Campanula portenschlagiana ***49**, Caerns.: Wall between road and railway, Cadnant Park, Conway, SH/777.777. R. Lewis, 1994, **NMW**.

130/6.5b. Galium palustre subsp. elongatum ***46**, Cards.: Stream in wooded dingle E.N.E. of Nantyronnen, Aber-ffrwd, SN/667.778. S. P. Chambers, 1993.

130/6.7. Galium mollugo ***78**, Peebless.: Roadside near Broughton, NT/11.38. D. J. McCosh, 1994, **herb. D.J.McC.**

130/7.1. Cruciata laevipes **93**, N. Aberdeen: Abandoned railway, Maud, NJ/930.481. M. Faulkner & D. Potter, 1993, **herb. D. Welch.** 2nd record.

†131/1.3. Sambucus canadensis ***77**, Lanarks.: Old Canting Basin, NS/56.64. P. Macpherson, 1994, **herb. P.M.**, det. R. D. Meikle as var. *acutiloba*.

†131/2.3. VIBURNUM TINUS **12**, N. Hants.: Railway cutting, Overton, SU/51.50. J. & P. Rollinson, 1993. 2nd record. ***50**, Denbs.: Woodland, Bryn Euryn, SH/83.80. Roadside, Tal-y-cafn, SH/79.72. Both R. Lewis, 1993. 1st and 2nd records.

†131/3.orb. × mic. SYMPHORICARPOS ORBICULARIS × S. MICROPHYLLUS (S. × CHENAULTII) ***44**, Carms.: Forge Quarry N. of Cwmdwyfran, SN/408.257. G. Hutchinson, 1992, **NMW**, det. R. M. Burton. 1st Welsh record.

†131/5.1. LEYCESTERIA FORMOSA **50**, Denbs.: Plas Muriau plantation, Capel Garmon, SH/80.56. W. McCarthy, 1994. 2nd record.

†131/6.1. LONICERA PILEATA ***77**, Lanarks.: Waste ground, Hutchestown, Glasgow, NS/59.64. P. Macpherson, 1988, **herb. P.M.**, conf. E. J. Clement. Rubbly waste ground, Dalmarnock, NS/61.63. P. Macpherson, 1993, **herb. P.M.**, conf. D. R. McKean. 1st and 2nd records.

†131/6.3. LONICERA INVOLUCRATA ***77**, Lanarks.: Damp wood near Busby, NS/58.55. P. Macpherson, 1992, **herb. P.M.**, det. E. J. Clement. By River Kelvin, Kelvinside, NS/56.67. K. Watson, 1993. 1st and 2nd records.

†131/6.4. LONICERA XYLOSTEUM **77**, Lanarks.: Rough grassland at edge of wood, Burnside, Glasgow, NS/61.59. P. Macpherson, 1994, **herb. P.M.** 2nd record.

†131/6.6. LONICERA JAPONICA ***12**, N. Hants.: By railway, Alice Holt, SU/8.4. Lady A. Brewis, 1971. Thoroughly established in scrub by road, Pondtail, Fleet, SU/823.535. C. R. Hall, 1993. 1st and 2nd records.

133/1.2. VALERIANELLA CARINATA ***27**, E. Norfolk: Top and base of garden wall, Kenninghall, TM/043.859. J. Hawksford, 1994, **herb. J.H.**

134/1.1. DIPSACUS FULLONUM ***91**, Kincardines.: Waste ground next to gravel pit, Edzell, NO/631.670. D. Welch, 1994.

135/6.6 × 9. CIRSIUM HETEROPHYLLUM × C. PALUSTRE (C. × WANKELII) ***78**, Peebless.: With both parents on bank of River Lyne near West Linton, NT/14.52. D. J. McCosh, 1994.

135/11.7. CENTAUREA NIGRA **75**, Ayrs.: Light soil amongst boulders near the lighthouse, Ailsa Craig, NX/02.99. B. Zonfrillo, 1994, **GL**. 1st Ailsa Craig record.

135/16.3. LEONTODON SAXATILIS †**81**, Berwicks.: Old lawn, Mellerstain House, NT/648.389. R. W. M. Corner, 1994. 2nd record.

†135/19.2. TRAGOPOGON PORRIFOLIUS **35**, Mons.: Rough wet grassland, Alpha Steelworks, Newport, ST/337.844. T. G. Evans & M. Jones, 1994, **herb. T.G.E.** 2nd record.

135/26.1. CREPIS PALUDOSA **102**, S. Ebudes: Oronsay, NR/3.8. A. Walker, 1992. 1st record from Colonsay or Oronsay.

†135/28.137. HIERACIUM SEVERICEPS ***98**, Main Argyll: Near Kentallen, NN/003.578. E. Norman, 1993, **BM**, det. P. D. Sell.

135/28.147. HIERACIUM CALEDONICUM ***94**, Banffs.: Serpentine outcrop, Craigs of Succoth, NJ/435.363. D. Welch, 1992, **ABD**, det. D. J. McCosh.

†135/32.1. ANAPHALIS MARGARITACEA ***12**, N. Hants.: Anton Lakes Local Nature Reserve, SU/357.466. M. F. Wildish, 1992. ***40**, Salop: Corbets Park, Wyre Forest, SO/740.778. J. Bingham, 1990. 1st certain record.

†135/40.4a. SOLIDAGO GIGANTEA subsp. SEROTINA ***50**, Denbs.: Waste ground, Cadole, SJ/205.626. K. Watson, 1993. **81**, Berwicks.: Grass by Milldown Burn, Coldingham, NT/913.661. M. Little, 1994, **herb. M. E. Braithwaite**. 2nd record.

†135/41.3. ASTER LAEVIS ***69**, Westmorland: By reservoir, Barrow-in-Furness, SD/19.70. P. Burton, 1988, **LANC**, det. P. F. Yeo.

†135/41.3 × 4. ASTER LAEVIS × A. NOVI-BELGII (A. × VERSICOLOR) *73, Kirkcudbrights.: By River Nith, Nithside, Dumfries, NX/970.765. O. M. Stewart, 1993.

†135/41.5. ASTER LANCEOLATUS **69**, Westmorland: By River Bela, Milnthorpe, SD/496.813. C. E. Wild, 1989, **LANC**, det. P. F. Yeo. 2nd record.

†135/43.4. ERIGERON KARVINSKIANUS *__42__, Brecs.: Pavement and walls, Crickhowell, SO/216.183. M. Porter, 1993. *__44__, Carms.: Street weed, Queen Street, Carmarthen, SN/414.200. J. Davies, 1994.

†135/43.5. ERIGERON ANNUUS *__77__, Lanarks.: Rough grassland, Cessnock, Glasgow, NS/56.64. P. Macpherson & E. K. Lindsay, 1993, **herb. P.M.**, det. P. F. Yeo.

135/43.6. ERIGERON ACER †*__75__, Ayrs.: Sandy waste ground, site of former Barassie Works, Troon, NS/329.322. E. Nugent, 1994, **GLAM**, conf. A. McG. Stirling.

†135/44.2. CONYZA SUMATRENSIS *__11__, S. Hants.: Bare ground amongst shrubs by A3, Portsmouth, SU/645.017. D. P. J. Smith, 1994. Derelict building site, Keswick Road, Woolston, SU/436.110. P. D. Stanley, 1994. 1st and 2nd records, both conf. E. J. Clement. *__13__, W. Sussex: Garden weed, Pagham, SZ/891.973. A. C. Leslie, 1994. *__14__, E. Sussex: Garden weed, Upper Lewes Road, Brighton, TQ/319.057. Waste ground on quayside, Newhaven, TQ/448.011. Both A. Spiers, 1994, **herb. P. A. Harmes**. 1st and 2nd records.

135/50.3. ARTEMISIA ABSINTHIUM †**81**, Berwicks.: Rocky grassland, Coldingham Law, NT/907.657. M. E. Braithwaite, 1994. Only extant locality.

†135/50.4. ARTEMISIA STELLERIANA *__75__, Ayrs.: Sandy shore between Barassie and Gailes, NS/32.34. A. McG. Stirling, 1994, **E**.

†135/51.1. SANTOLINA CHAMAECYPARISSUS *__77__, Lanarks.: Rough railway bank, Old Dock, Glasgow, NS/57.64. P. Macpherson, 1994, **herb. P.M.**

†135/58.lac. × max. LEUCANTHEMUM LACUSTRE × L. MAXIMUM (L. × SUPERBUM) *__26__, W. Suffolk: Roundabout on A45 at Westley, TL/82.65. M. D. Crewe, 1993.

135/59.1. MATRICARIA RECUTITA *__108__, W. Sutherland: Disturbed ground in new car park, Lochinver, NC/094.224. P. A. Evans, 1994.

135/62.12. SENECIO ERUCIFOLIUS *__48__, Merioneth: Roadside bank, Pont Islyn, Trawsfynydd, SH/7.3. P. M. Benoit, 1994, **NMW**. 1st certain record.

†135/62.13. SENECIO SQUALIDUS *__91__, Kincardines.: Railway yard, Laurencekirk, NO/717.718. D. Welch, 1994, **ABD**. *__98__, Main Argyll: Waste ground, former livestock mart, Oban, NM/859.296. A. McG. Stirling & B. H. Thompson, 1994, **herb. B.H.T.**

135/62.†13 × 18. SENECIO SQUALIDUS × S. VISCOSUS (S. × SUBNEBRODENSIS) *__47__, Monts.: Derelict railway land, Caersws station, SO/029.919. P. M. Benoit, 1993.

†135/67.1. SINACALIA TANGUTICA **40**, Salop: Croesau Bach, SJ/239.272. F. H. Perring, 1988. 2nd record.

†135/69.2. DORONICUM PLANTAGINEUM *__40__, Salop: Near Great Ness Church, SJ/397.190. J. Hooson, 1987.

†135/71.3. PETASITES ALBUS **50**, Denbs.: Hedge, Bontuchel, SJ/094.584. I. Evans, 1994, conf. J. A. Green. Only extant locality.

†135/81.4. BIDENS FRONDOSA *__29__, Cambs.: With *B. tripartita* amongst flood debris in ditch E. of River Great Ouse, Brownshill Staunch, Over, TL/370.729. C. D. Preston, 1994.

†138/4.2. ELODEA NUTTALLII *__40__, Salop: River Severn, Atcham, SJ/540.093. C. D. Preston & T. C. G. Rich, 1987, **CGE**, conf. D. A. Simpson. Pool, Lynclys Common, Pant, SJ/271.236. F. H. Perring, 1993. 1st and 2nd records.

†147/3.1. Calla palustris *59, S. Lancs.: Quarry pool, Hunter's Hill Quarry, Parbold, SD/501.122. P. Jepson, 1994.

148/1.1. Spirodela polyrhiza *46, Cards.: Amongst *Lemna minor* in ox-bow pond in pasture, S. side of Afon Teifi W. of Cenarth, SN/253.413. A. O. Chater, 1994, **NMW**.

148/2.3. Lemna trisulca *78, Peebless.: Ornamental pond, Baddingsgill, West Linton, NT/13.54. D. J. McCosh, 1991. Appeared spontaneously after weed clearance.

†135/2.4. Lemna minuta *40, Salop: Montgomery Canal near Queen's Head, SJ/335.264. N.C.C. Field Course, 1989. Merrington Green, SJ/466.210. J. Martin, 1989. 1st and 2nd records. *42, Brecs.: Edge of lake, Llangasty Tal-y-llyn, SO/133.262. M. Porter, 1993. Garden pond, Cathedine, SO/146.231. M. Porter, 1994. 1st and 2nd records.

151/1.3. Juncus compressus *41, Glam.: Upper limit of saltmarsh, The Groose, Whiteford Point, SS/444.945. R. Murphy, F. H. Perring & T. G. Evans, 1993, det. C. A. Stace.

151/1.8. Juncus ambiguus *81, Berwicks.: Brackish mud, mouth of Eye Water, Eyemouth, NT/945.640. M. E. Braithwaite, 1994, **herb. M.E.B.**, det. T. A. Cope.

151/1.11. Juncus subnodulosus 68, Cheviot: Marshy edge of pool, Newton Pool, NU/241.240. M. Jeffries, 1993, **herb. G. A. Swan**. 2nd record.

151/1.13 × 14. Juncus articulatus × J. acutiflorus (J. × surrejanus) *79, Selkirks: Mire, W. end of Akermoor Loch, NT/404.208. R. W. M. Corner, 1993, **herb. R.W.M.C.**, det. C. A. Stace.

151/1.25 × 26. Juncus effusus × J. inflexus (J. × diffusus) *46, Cards.: Slope between fen and pasture, W. of Maesymeillion, Penparc, SN/196.483. J. P. Woodman & A. O. Chater, 1994, **NMW**.

152/3.4. Eleocharis multicaulis *35, Mons.: Stream N. of The British, Abersychan, SO/249.046. T. G. Evans & R. Hewitt, 1987, **herb. T.G.E.** Wet heath S. of Mountain Ash, SO/141.062. T. G. Evans & R. Fraser, 1988, **herb. T.G.E.** 1st and 2nd records.

152/16.9a. Carex divulsa subsp. divulsa 58, Cheshire: Road bank, Shotwick, SJ/339.719. G. M. Kay, 1994. 1st post-1930 record.

152/16.15. Carex remota 102, S. Ebudes: Gully, Choille Mhor Wood, Colonsay, NR/414.965. R. L. Gulliver, 1993. 1st post-1930 Colonsay record.

152/16.29. Carex vesicaria 108, W. Sutherland: *Carex rostrata* mire, Lon na Braclaich, NC/193.147. R. E. C. Ferreira, 1985. 2nd record.

152/16.42. Carex punctata 3, S. Devon: Low cliff slope, Wadham Rocks, SX/578.468. R. E. N. & C. J. Smith, 1994, det. L. J. Margetts. 1st post-1930 record.

152/16.46c. Carex viridula subsp. viridula 40, Salop: Around largest pool, Brown Moss, SJ/563.394. I. C. Trueman, 1985, det. A. O. Chater. 2nd record and only extant locality.

†153/4.1. Sasaella ramosa *46, Cards.: Extensive thickets in woodland, grounds of Glandyfi Castle, SN/692.966. A. O. Chater & W. M. Condry, 1994, **NMW**.

153/11.1. Milium effusum *79, Selkirks.: Edge of woodland E. of Upper Loch, Bowhill, NT/430.277. R. W. M. Corner, 1994, **herb. R.W.M.C.** 1st localized record.

†153/12.5. Festuca heterophylla 78, Peebless.: Light shade in garden, Glen House near Innerleithen, NT/300.329. D. J. McCosh, O. M. Stewart *et al.*, 1994, det. P. J. O. Trist. 1st confirmed post-1930 record.

†153/12.7d. Festuca rubra subsp. commutata *35, Mons.: Waste ground, Alpha Steelworks, Newport, ST/338.846. T. G. Evans & M. Jones, 1994, **herb. T.G.E.**

153/12.8c. Festuca ovina subsp. ophioliticola *77, Lanarks.: Upland heath S. of Daer Reservoir, NS/96.04. P. & A. C. Macpherson, 1994, **herb. P.M.**, det. C. A. Stace.

153/12.14. Festuca longifolia *3, S. Devon: Clefts in rock near coastal footpath, Gara Rock, SX/750.369. L. J. Margetts & R. Takagi-Arigho, 1993, **K**, det. T. A. Cope.

153/12.15. Festuca brevipila *12, N. Hants.: Well-drained acid slope, Farnborough, SU/868.540. C. R. Hall, 1993, **herb. Lady A. Brewis**, det. P. J. O. Trist.

153/12.7 × 14.1. Festuca rubra × Vulpia fasciculata (× Festulpia hubbardii) *69, Westmorland: Sand dunes, Sandscale Haws, Dalton-in-Furness, SD/18.75. P. Burton, 1994, **LANC**, det. C. A. Stace.

153/14.3. Vulpia myuros †*98, Main Argyll: Ballast in siding, Oban Railway Station, NM/857.298. A. McG. Stirling & B. H. Thompson, 1994, **herb. B.H.T.**

153/14.4b. Vulpia ciliata subsp. ambigua *18, S. Essex: Short turf on fixed dunes, Shoebury Old Ranges Nature Reserve, TQ/92.84. K. J. Adams *et al.*, 1994, **herb. K.J.A.**, det. A. Copping.

153/16.2. Puccinellia distans †26, W. Suffolk: Verge of A45 S. of Exning, TL/61.64. M. D. Crewe, 1993. 2nd post-1930 record.

153/18.12. Poa nemoralis **102**, S. Ebudes: Woodland, Colonsay House Woods, NR/372.954. R. L. Gulliver, 1993. 1st post-1930 Colonsay record.

153/20.1. Catabrosa aquatica **78**, Peebless.: Newly cleaned peaty ditch, Kippit Farm, Dolphinton, NT/11.47. D. J. McCosh, 1993, **herb. D.J.McC.** 1st record since 1930.

†153/28.4a. Avena sterilis subsp. ludoviciana *40, Salop: Hodnet area, SJ/60.28. S. Kingsbury, 1991.

153/30.1. Trisetum flavescens **102**, S. Ebudes: Dry turf at foot of ancient cross, Oronsay Priory, NR/349.889. R. L. Gulliver, 1993. 1st record from Oronsay or Colonsay.

153/46.1. Polypogon monspeliensis †*12, N. Hants.: Near dumped soil on sandy heathland, Hawley Hill, SU/845.588. C. R. Hall, 1991. Sandy track near tip, Bramshill Common, SU/752.618. Hampshire Flora Group, 1993. Both **herb. Lady A. Brewis**, det. E. J. Clement. 1st and 2nd records.

153/47.1. Alopecurus pratensis **102**, S. Ebudes: Mown grassland around ruins of Oronsay Priory, NR/3.8. R. L. & M. C. Gulliver, 1991. 1st post-1930 record from Colonsay or Oronsay.

153/47.1 × 2. Alopecurus pratensis × A. geniculatus (A. × brachystylus) *4, N. Devon: Road verge, Mole's Chamber, SS/717.392. I. P. Green, 1994, det. T. A. Cope. *77, Lanarks.: Rough grassland, Mount Vernon, Glasgow, NS/65.62. P. Macpherson, 1993, **herb. P.M.**, conf. H. J. M. Bowen.

153/47.2 × 3. Alopecurus geniculatus × A. bulbosus (A. × plettkei) *44, Carms.: Saltmarsh of Afon Taf near Mwcha Farm W. of Llanstephan, SN/320.112. M. Lloyd, 1994, **NMW**, det. T. A. Cope. 1st Welsh record.

153/50.4. Bromus hordeaceus **102**, S. Ebudes: Dune grassland, Ardskenish Dunes, Colonsay, NR/352.922. R. L. Gulliver, 1991. 1st post-1930 Colonsay record.

153/52.3 Anisantha sterilis **73**, Kirkcudbrights.: Farmyard, Auchinleck, NX/449.709. O. M. Stewart, 1994. 2nd record.

†153/53.3. Ceratochloa cathartica *44, Carms.: Garden weed, Dylan Thomas Boathouse garden, Laugharne, SN/307.111. J. Rees, 1992. **NMW**, det. G. Hutchinson.

153/54.1. Brachypodium pinnatum †*79, Selkirks.: Large colony on side of track, Bowhill estate, NT/427.272. R. W. M. Corner, 1994, **herb. R.W.M.C.**

†153/59.3. Hordeum jubatum *75, Ayrs.: Road verge by A71 near Riccarton interchange, Kilmarnock, NS/44.36. P. J. Cook, 1994.

153/63.1b. Molinia caerulea subsp. arundinacea **44**, Carms.: Flush at edge of willow scrub, Lower Lliedi Reservoir, Llanelli, SN/519.033. I. K. Morgan, 1992, **NMW**, conf. G. Hutchinson. 2nd record.

155/1.1. Typha latifolia **102**, S. Ebudes: Margin of lochan, Colonsay, NR/368.960. P. M. Clarke, 1993, det. D. R. McKean. 1st Colonsay record.

155/1.1 × 2. Typha latifolia × T. angustifolia (T. × glauca) ***35**, Mons.: Edge of sludge pond, Newport, ST/33.84. T. G. Evans & M. Jones, 1993, **NMW**.

†158/6.2. Kniphofia praecox ***49**, Caerns.: Roadside, Bodafon, Llandudno, SH/801.816. W. McCarthy, 1994.

158/7.1. Colchicum autumnale ***49**, Caerns.: Meadowland, Bryn Pydew, Llandudno, SH/81.79. G. Battershall, 1992.

†158/19.3. Scilla siberica ***49**, Caerns.: Woodland, Gloddaeth Woods, SH/80.80. G. Battershall, 1993.

158/20.2 × †3. Hyacinthoides non-scripta × H. hispanica ***49**, Caerns.: Hedgerow, Nant y Gamar, Llandudno, SH/80.81. G. Battershall, 1991.

†158/22.1. Chionodoxa forbesii ***77**, Lanarks.: Rough grass bank, Botanic Gardens, Glasgow, NS/56.67. K. Watson, 1993, **GL**.

†158/23.2. Muscari armeniacum ***49**, Caerns.: Grassy waste ground near Conway, SH/771.764. R. Lewis, 1994, **NMW**.

158/24.1. Allium schoenoprasum †**46**, Cards.: Well established on hedgebank S.W. of Penlan-y-Mor, Gilfachreda, SN/416.594. A. O. Chater, 1994, **NMW**. 2nd record.

158/24.14. Allium scorodoprasum **58**, Cheshire: Side of ditch, Norton Marsh, Runcorn, SJ/569.857. G. M. Kay, 1994. 1st record this century, at a site from which the species was recorded last century.

158/31.1. Leucojum aestivum †**79**, Selkirks.: Margin of pond E. of Lower Loch, Bowhill, NT/431.271. R. W. M. Corner, 1994, 1st post-1930 record, at same site as earlier record.

†158/33.5b. Narcissus pseudonarcissus subsp. obvallaris ***46**, Cards.: Grassy roadside slope, Banc y Warren, Penparc, SN/204.476. A. O. Chater & J. R. Akeroyd, 1994. Well established on hedgebank near The Woodlands, Ciliau Aeron, SN/509.586. A. O. Chater, 1994. 1st and 2nd records.

159/2.1. Sisyrinchium bermudiana †***12**, N. Hants.: Bramshott Common, SU/85.32. C. Darter, 1992, **herb. Lady A. Brewis**, det. A.B. 1st confirmed record.

159/5.8. Iris foetidissima **73**, Kirkcudbrights.: Edge of wood N. of St Mary's Isle, Kirkcudbright, NX/680.502. O. M. Stewart, 1994. 1st post-1930 record.

†159/8.1. Crocus vernus ***46**, Cards.: Extensively naturalized in rough grass, Penparc chapel graveyard, SN/212.478. A. O. Chater, 1994. Abundant in rough grass, Tregroes churchyard, SN/406.447. A. O. Chater, 1994, **NMW**. 2nd record.

159/9.2b. Gladiolus communis subsp. byzantinus ***17**, Surrey: Rough grassland, Woodcote, Epsom, TQ/196.593. J. F. Leslie, K. Page & J. E. Smith, 1994.

†159/13.1. Crocosmia paniculata ***46**, Cards.: Hedgebank E. of Llancynfelyn church, SN/648.922. A. O. Chater, 1994, **NMW**. Grassy bank of Afon Rheidol, Penparcau, SN/592.804. A. O. Chater, 1994. 1st and 2nd records.

†159/13.3 × aur. Crocosmia pottsii × C. aurea (C. × crocosmiiflora) ***81**, Berwicks.: Sea braes below Barefoots, Eyemouth, NT/937.647. M. E. Braithwaite, 1994. Flush on sea braes, Gunsgreen, Eyemouth, NT/950.646. M. E. Braithwaite, 1994, **herb. M.E.B.** 1st and 2nd records.

162/7.3. Spiranthes romanzoffiana **110**, Outer Hebrides: *Molinia caerulea* lawn, Kilpheder, South Uist, NF/737.196. F. Horsman, 1994. 1st South Uist record.

162/10.1. Hammarbya paludosa **2**, E. Cornwall: Wet heath, Rentire Common, SX/004.631. I. Bennallick, 1993, conf. R. J. Murphy, Only extant locality.

162/16.1b. GYMNADENIA CONOPSEA subsp. DENSIFLORA *46, Cards.: Base-rich flush fen S. E. of Afon Mwldan, Penparc, SN/195.483. A. O. Chater, 1986, det. F. Rose.

162/16.1c. GYMNADENIA CONOPSEA subsp. BOREALIS *46, Cards.: Heathy slope, Banc Cwmerfyn, SN/704.824. A. O. Chater, 1988, det. F. Rose.

162/17.1. COELOGLOSSUM VIRIDE 3, S. Devon: Dunnabridge, SX/644.743. R. Keedle, 1994. 1st post-1930 record.

162/18.3c. DACTYLORHIZA INCARNATA subsp. PULCHELLA 2, E. Cornwall: Wet flush in culm grassland, Otterham valley near Otterham Station, SX/144.896. T. J. Dingle, 1994, det. L. J. Margetts. 2nd record.

Book Reviews

Greek wild flowers and plant lore in ancient Greece, H. Baumann, translated and augmented by W. T. Stearn & E. R. Stearn. Pp. 252; with 481 illustrations (mostly colour). Herbert Press, London. 1993. Price £16.95 (ISBN 1–871569–57–5).

This book is translated from the second (1986) edition of Baumann's 1982 work *Die griechische Pflanzenwelt in Mythos, Kunst und Literatur*. It is clearly a labour of love compiled over many years in the field throughout Greece. Its strength is twofold; the profusion of colour photographs, and the references to the literary sources. There are five main sections: the Homeric Landscape, Cults and Myths, Medicinal and Magic Plants, the Gifts of Demeter and the *Lotus* and *Acanthus* in art. These form the core of the book and are the most solid. Less central are sections on lowland and mountain flora, orchids, introduced plants and the ancient awareness of botany.

There are many delights in the illustrations, images of landscape, people or artefacts, scattered amongst the flowers, viz. plate 340 which shows two octopi in a market, to parallel the design on a late Minoan vase. The format of the book is small, less than A5, which makes it a handy travelling companion but robs the photographs of the chance to dazzle the reader which would have happened in a larger format. Some pages have nine small photographs and this leaves one peering at the page to see the detail. That said, the quality and variety of the photographs is outstanding.

The Ancient Greek doctors, scientists, poets and historians had a tremendous awareness of the botanical diversity of their country. Baumann has trawled the literature for references most assiduously; examples from art and architecture are also included. References to archaeological evidence, however, tend to be general rather than to specific sites or publications and this aspect is less useful to the student. Environmental Archaeology has come late to the Classical world and it would be unfair to dwell on the lack of scientific evidence from recent excavations which one would be expecting in a new work rather than a revised edition.

Whilst the book is a pleasure to dip into, it can feel heavy at times. This is inevitable due to its fundamental nature as a list of plants. The structure also allows for some repetition. The use of the teasel in textiles is referred to on p. 77, plate 128, as a plant of the gods and again in plate 301 in the context of textile preparation. There is no cross-reference in the text but it is picked up in the index. In the same way the olive is discussed in the cults and myths section and again as an economic plant without cross-reference. These are not faults, however, and probably go unnoticed by the student or browser.

This is a very enjoyable survey of the subject and a good blend of economic botany with history. It will be widely read, probably serving to attract visitors to the country and increase their awareness not just of the diversity of the flora but of its long and distinguished heritage.

E. C. SOUTHWORTH

Vascular plant families and genera. A listing of the genera of vascular plants of the world according to their families, as recognised in the Kew Herbarium, with an analysis of relationships of the flowering plant families according to eight systems of classification. R. K. Brummitt. Pp. viii + 804. Royal Botanic Gardens, Kew. 1992. Price £24.00 (ISBN 0 947643 43 5).

The subtitle of this impressive work gives a clear indication of its aims and contents. Even in the three years since it made its appearance, it has become a standard reference work for anyone curating herbarium collections, large or small, or whose work requires up-to-date knowledge of generic and family names. Its predecessors are the various editions of A. J. Willis's *A dictionary of flowering plants and ferns* and D. J. Mabberley's *The plant-book: a portable dictionary of the higher plants* (1987). In contrast to them, the compiler of this lexicon sought advice from a large number (over 160) of specialists throughout the world. The result is a consensus of informed opinion on modern generic and family nomenclature with Kew having acted as arbiter in cases of disagreement or uncertainty. Even with the sophisticated facilities of present-day data bases, the complexities involved in producing such a compendium are obvious and manifold. Over 30,000 generic names have been published over the last two and a half centuries; and where Bentham & Hooker in their classic *Genera plantarum* recognised 200 plant families, current thinking is that more than twice that number should be accepted. It is probably a reasonable generalisation to say that, with exceptions, as one progresses from species to genera to families and higher groupings, their circumscription becomes increasingly beset with problems and subjectivity. Usually botanists agree more about species and generic limits and nomenclature than higher categories; or at least they are more concerned with the former. Decisions about plant families to be recognised resulted from the setting-up of a 'family planning unit' comprising botanists from Kew and the Natural History Museum, London. Their decisions, not surprisingly, are a middle course between the broad concepts of Bentham & Hooker and the apparently narrower views of some present-day authors. Yet in the Kew list there are a surprising number of mono- or oligotypic families recognised, mostly tropical: from the first letter of the alphabet are Aextoxicaceae, Agdestidaceae, Akaniaceae, Alseuosmiaceae, Aizateaceae, Amborellaceae, Aralidiaceae and Asteropeiaceae, strange-sounding names for at least European botanists. Nearer home, Illecebraceae, perhaps surprisingly, are kept separate from Caryophyllaceae. British botanists will be relieved to learn that the status quo of most currently recognised families is maintained, but the Orobanchaceae, surely correctly when the world-wide scenario is taken into account, are subsumed into Scrophulariaceae, Pyrolaceae into Ericaceae, and Ruppiaceae into Potamogetonaceae. They will also be happy that Compositae, Cruciferae, Gramineae and Labiatae are preferred to Asteraceae, Brassicaceae, Poaceae and Lamiaceae, more favoured by continental botanists. The traditional boundaries between such clearly very closely allied families as Araliaceae and Umbelliferae, and Verbenaceae and Labiatae are also maintained.

More than half of the dictionary comprises a straight-forward listing of generic names, their authors, and the families they belong to: generic synonyms are indicated by italics. Again the approach is conservative; not accepted, for example, are the recently published segregate genera of Himalayan Gentianaceae, and the splitting-up of *Thlaspi*. Inevitably, not everybody is going to be happy with all the names given authoritative blessing. For example, in the Chenopodiaceae, the strange-looking Iranian *Esfandiaria* is surely not different from *Anabasis*, *Hammada* is virtually identical with *Haloxylon*, as is *Climacoptera* with *Salsola*. But these are small quibbles.

Part II lists the families in alphabetical sequence with their constituent genera also alphabetically; the numbering of the 454 families recognised are those of the herbarium at Kew. Genera not represented at Kew are indicated by asterisks and it is a clear measure of the enormous wealth of their collections to see how relatively few asterisks there are. And some of the genera asterisked are certainly present at Kew, presumably lurking under another name. For each family is also given an indication of where it fits in within eight other frequently used systems of classification, from Bentham & Hooker about the turn of the last century, through to Cronquist (1981) and Takhtajan (1987). The final Part III gives a synoptic listing of these eight systems which is particularly useful in comparing and contrasting them; for many, the 'Young' system will not strike a chord of recognition.

Throughout the entire 800 pages of this sturdily bound, clearly printed and easy-to-use dictionary, there is little to criticise and much to respect. No doubt there will be botanists and herbarium curators who will find little items to niggle about or dispute, but they will mainly be most happy to possess this invaluable information-source. A small errata slip draws attention to a few omissions and a printing sin. Kew's resources of specimens and expertise are probably unrivalled throughout the world and they have been used in the best possible modern way, giving, with this publication, a lead into the next century. Dr Brummitt and his core of Kew-based colleagues have done a splendid job.

I. C. HEDGE

The West Yorkshire plant atlas. Edited by J. C. Lavin & G. T. D. Wilmore. Pp. 287, six colour plates, 700 maps. City of Bradford Metropolitan Council. 1994. Price £25.00 (ISBN 0–907734–39–1).

Jack Lavin was a pioneer of the local, computerised, biological records centre movement. In the early 1970s his centre was a model used to convince others to go and do likewise – and Jack himself was a splendid advocate, not only outside his county but within where he was able to convince four other local authorities to fund what started as a District centre at Keighley, as a unit to cover the whole of the new county of West Yorkshire when it was created in 1974: it later became their Ecological Advisory Service. His influence with local authorities has continued and this handsome volume carries the imprint of the City of Bradford Metropolitan Council and claims to be the first Flora to be produced by a Department of Local Government.

The primary objective of the Ecological Advisory Service was to organise surveys of all the major semi-natural habitats in the county and the 1-km square was adopted as the recording unit. This has strongly influenced the collection of the data for the Flora and its presentation. The idea of producing a Flora did not come until 1986 when it was realised that the 100,000 plant records collected during surveys in the preceding 12 years could be the basis of a *West Yorkshire plant atlas*. With the help of about 100 individuals and societies an extra 150,000 1-km square records were added in the next 3½ years with over 90% of the squares finally covered. But it is still a by-product of the site surveys and it shows.

First, it is not a Flora of the former West Riding or of v.cc. 63 & 64: the area covered comprises the northern and western half of v.c. 63, v.c. 64 between the Aire and the Wharfe, and some at least of the Pennines in v.c. 59. There may also be overlap with v.c. 58 S.W. of Holmfirth, but no map showing the v.c. boundaries is provided and v.c. distribution is not given in the text. The only map of the area appears in the end-papers and is limited to major rivers and towns, 10-km squares, District boundaries, and a shaded area which may be land over 300 m, though there is no legend to indicate this.

Secondly it is a very large area, with over 2000 1-km squares, and an attempt was made to cover them all. It says a great deal for the enthusiasm of the team that so much was achieved but, with 10% not visited, it suggests that a scheme aimed at covering 500 tetrads would have given a more complete picture without detracting from the interpretation of the results.

However 'interpretation' is not a strong point of this *Atlas*. In a book with that word in the title a range of maps to assist in understanding distribution patterns would surely be expected. Here is an area with stark contrasts between the Magnesian Limestone of the east and the Millstone Grit in the west, between the lowlands of the Vale of York and the Pennines rising to 560 m S.W. of Holmfirth, and with rainfall varying from below 800 mm to over 1250 mm/annum, yet there is no geological map (just an E.-W. section across the county), the one topographical map showing 'Pennine Uplands' in the end papers, and no climatic maps whatsoever though half of the single page given to 'Climate' is a blank.

There *are* maps in the introductory section on 'The vegetation of West Yorkshire' by John Rodwell. This is a valuable and extensive account of the habitats classified in the National Vegetation Classification (N.V.C.) which have been recognised in West Yorkshire. The Ecological Advisory Service provided many original stands for the N.V.C. and this is reflected in the detail in these maps – but even these are difficult to interpret with as many as ten different symbols per map.

This vegetation information is usefully carried into the short accounts of each of the 686 commoner species mapped and other native species: many include lists of 4–6 associated species. Rarer species and aliens are less well served and, though reported as occurring, often neither localities nor grid squares are given.

The book is well produced: the colour plates are ravishing but it would have been so much more useful with those maps. Is it too late to suggest the production of a set of transparent overlays? It has been done before!

F. H. Perring

Catalogue of the Brambles of Britain and Ireland in the herbarium of Liverpool Museum (LIV). Compiled by M. Palmer, edited by J. Edmondson. Pp. viii + 48. National Museums & Galleries on Merseyside, Liverpool. 1994. Price £12.00 (ISBN 0–906367–70–0).
A catalogue of the Herbarium of the British Flora collected by Margaret Stovin (1756–1846). M. Simmons. Pp. 422 text + 102 indexes. Middlesbrough Borough Council Leisure Services Department, Middlesbrough. 1993. Price not stated. (no ISBN).

Cheap printing was one great advantage that the Victorians and Edwardians enjoyed over their successors. Many a local society in those days could rise to a thick, meaty-looking annual report, which was so impressively produced that it was virtually guaranteed eternity by being bound and placed on library shelves. Till only very recently its modern counterpart would have had to make do as often as not with some slight, duplicated effort which almost asked to be discarded once it had been read. Now, at last, presentable alternatives are arriving to rescue us from that era of deprivation and making possible once again such long-despaired-of luxuries as catalogues of museum collections – of which the couple under review are praiseworthy examples of the new genre.

The *Rubus* collection at Liverpool Museum is by no means as rich or extensive as those in some of the other national institutions, but it is large enough and sufficiently fully redetermined in the light of the latest knowledge to justify this very useful compilation for the benefit of vice-county Recorders and fellow-specialists in the group. 225 species from 120 collectors are represented, many of them via the exchange clubs but a particular high proportion W. R. Linton's, whose herbarium was transferred from the University of Liverpool a few years back (and a pleasing vignette of whom features appropriately on the title page). The catalogue excludes a considerable number of further specimens that have been critically (re-)determined since it went to press, also a sizeable residue of material, much of it unmounted, that has so far defeated current specialists.

The Dorman Museum in Middlesbrough acquired the herbarium of Miss Stovin in 1922. The specimens of British vascular plants and charophytes, 1900 in all, fill 20 albums and are mostly localised. The earlier ones were of her own collecting, mainly round Doncaster, but many came later from contemporary botanists all over Britain in the years 1794–1840. The catalogue is essentially a computer print-out of the data taken from the labels, separately indexed by species, (present-day) counties of localities, and collectors. The work was made possible by a grant from the Pilgrim Trust – as other local museums could usefully note.

D. E. ALLEN

Wild plants of the Phoenix Park. P. A. Reilly, with contributions by D. L. Kelly, D. M. Synnott & J. McCullen. National Botanic Gardens, Glasnevin & The Phoenix Park, Office of Public Works, Dublin. 1993. Price IR£7.50 (ISBN 0–7076–0331–5); reprinted from the journal *Glasra.*

When our *Flora of Inner Dublin* was published in 1984, it was said by some that it was a pity we did not include the National Botanic Gardens or indeed the Phoenix Park, which latter adjoins the outer boundary set for the Inner Dublin Flora. However the habitat of this open parkland is very different from the streets and open spaces of the inner city. Now Paddy Reilly has given us the opportunity to discover the Phoenix Park as a site in its own right for botanical exploration.

The Phoenix Park (Páirc Fhionn Uisce – park of the pale water: nothing to do with birds or ashes) is, according to the history given by John McCullen, the "largest enclosed recreational space (707 ha) within any capital city in Europe". He tells us, indeed, that this area is equivalent to the total area of *all* the London parks, including Hyde Park. That alone would make it of botanical interest. It is, in fact, a large deerpark, enclosed since 1667 and managed to a varying degree as such since 1623. To this day, a herd of c. 500 fallow deer remain in the Park, which has been managed since 1860 by the Office of Public Works.

The main part of the book consists of the Flora which is written by Paddy Reilly and prefaced with a brief summary of the history, climate and soils of the Park. The soils are mostly of Limestone drift, but are notable for their lack of permeability. Thus one might anticipate the species there being of neutral or lime-rich soils, some confined, perhaps, to the few gravel pits and esker remnants in the Park. Reilly then follows this with a history of the flora, having meticulously checked printed records and herbarium specimens. The earliest records are from Caleb Threlkeld's *Synopsis Stirpium Hibernicarum*, a Flora/herbal "of native plants such as grow in the vicinity of Dublin", published in 1726. This included the Phoenix Park, known to him then as the King's Deer Park. Already, weeds such as *Cardamine hirsuta* and *Coronopus squamatus* were present. A few woodland/hedge species are also mentioned – *Ajuga reptans*, *Malus sylvestris*, *Ilex aquifolium* and *Arum maculatum*, though only the last two remain today. Possibly there was a greater relict woodland flora in Threlkeld's time than now. The history continues with similar small glimpses of the flora, since, as Reilly states, at no time was the whole flora of the Park ever listed, which would be invaluable now for comparison. It is to be hoped that this present Flora will serve that purpose in years to come. In summary, he states that between 1726 and 1975, 89 species were listed for the Park and of those, only 49 survive today. Most of those that have disappeared are wetland plants, but also species of calcareous habitats (the exhaustion of the gravel pits in the 1880s being cited as relevant) and, of course, of woodlands. Reilly singles out these 'missing' species and lists them, noting their occurrence in the county of Dublin as a whole. Twenty-four species, especially from aquatic and limestone grassland habitats, are now rare in the county, reflecting the decrease in appropriate habitat countywide.

There follows a reference to strictly calcicole and calcifuge species, as these proved to be rarer, especially the latter as acid soils only occur in one artificially created habitat supporting the otherwise rare species *Rumex acetosella*. This intriguing habitat was the site used for fuel storage during the 1939–45 war. The fuel was, of course, turf (or peat), virtually the only source of fuel in Ireland at the time. Great banks of turf lined the roads near the American Ambassador's residence right into the 1950s, as testified by an interesting photograph. Such photographs are interspersed throughout the text and help to illustrate the types of habitat referred to. This includes a very attractive series of 20 colour photographs of landscape, habitat and individual species. This introductory section ends with useful notes on the different habitats in the Park and associated species as well as a summary of the features of each of the five districts delimited for the purpose of the Flora.

The Flora per se lists some 318 species in Latin and English, with their occurrence within each of the five districts as well as annotations on sites where necessary. This, along with the map provided, is accessible to botanists with at least a rudimentary knowledge of field botany and is an invaluable reference for future botanical work in the area. The chapter on bryophytes (so often evaded in Floras) is useful especially as the authors (D. L. Kelly and D. M. Synnott) list nine habitats and the species most commonly associated with each. The small number of hepatics (eleven) found is presumably in part due to the comparatively dry nature of the climate. A total of 87 mosses were found, including one new to Ireland (*Bryum creberrimum*). One confusing aspect of this chapter is that for many species there is only one site listed and there is no direct reference to the botanical districts of the main Flora.

I found it interesting to compare the species found in the Phoenix Park with those listed for Inner Dublin. As predicted, the Park does have a greater pastoral element, with species such as *Primula veris*, *P. vulgaris*, *Veronica chamaedrys* and *Luzula campestris* occurring commonly in the Park but completely absent (at least in 1984) from the inner city. Less surprisingly, woodland species (e.g. *Sanicula europaea*, *Conopodium majus*, *Arum maculatum*, *Allium ursinum*) and some aquatics (*Potamogeton* spp., three *Glyceria* spp., *Eleocharis palustris*) as well as many sedges are present only in the Park. Three species of inner Dublin surprisingly absent from the Park are *Corylus avellana*, *Ulmus glabra* and *U. procera*. There is no mention of the planting of *Corylus* and though many elms were planted, none seem to have seeded themselves.

The book concludes with the history of the Park by J. McCullen, which is interesting in itself, but also gives insight into the origins of the particular flora which exists in the Park today. Particular reference is given to tree planting which only got under way after about 1745 and has continued in several phases of intensive planting ever since. The six appendices are an extension of this chapter, mostly listing the species of tree planted (c. 136, including cultivars), where they occur and, in the case of ceremonial trees by whom and when they were planted. This is of horticultural interest and illustrates the immense diversity of trees, warranting the term 'arboretum' to be applied to the Park.

Thus the book is very attractively presented, remarkably free of spelling and typographical errors – I spotted only two or three, the most misleading being the date of birth of Caleb Threlkeld, which is listed as 1672 and 1676 in the same paragraph! It is interesting reading for any amateur of Floras and their history, but of course should also tempt botanists to visit the Park and discover its richness for themselves.

M. Sheehy Skeffington

An annotated checklist of the flowering plants and ferns of Main Argyll. G. Rothero & B. Thompson. Pp. iv + 132. Published by The Argyll Flora Project. Glenlussa. 1994. Price. £6.00 (ISBN 0–9522852–0–7 paperback).

It is a pleasure to welcome another first-rate local checklist to the growing number for Scotland. Gordon Rothero and Bernard Thompson are to be congratulated on producing a good working checklist for the plants of Main Argyll in a commendably short time – although several botanists had done major groundwork for them. Perhaps we are at last realising that field botanists do not want to wait for ever for the perfect work (which is unattainable anyway) nor a weighty volume which repeats all the taxonomic detail of a national Flora. Much more useful is an easily carried informative booklet cheap enough for revised editions to be economically possible. This latter the authors have given us.

Main Argyll (v.c. 98) is the core of the mainland of Argyllshire less the Kintyre peninsula (v.c. 101). For the *Checklist* this sprawling and diverse area is divided into seven roughly natural areas. The checklist, in family order, is clearly set out; what is known, and more importantly, what requires more investigation, are pointed out. Obviously there is plenty to do both in investigating critical taxa, especially subspecies, and checking up on old and doubtful records. To help with localities there is a most useful gazeteer. The booklet is bound in a soft, damp-resistant cover and slips easily into a large pocket.

All the reader has to do is buy this indispensible manual, go to Argyll – all 3,700 sq. km. of it – and help the authors with data for a second edition!

D. M. Henderson

Scarce plants in Britain. Compiled and edited by A. L. Stewart, D. A. Pearman & C. D. Preston. Pp. 508, 16 tables, 49 figures, numerous maps. Joint Nature Conservation Committee, Peterborough. 1994. Price £34.00 (ISBN 1–873701–66–7).

Scarce plants in Britain is the result of a co-operative project begun in 1990 originally involving the Nature Conservancy Council (N.C.C.), the Institute of Terrestrial Ecology (I.T.E.) and the Botanical Society of the British Isles (B.S.B.I.). The Joint Nature Conservation Committee (J.N.C.C.) took over the N.C.C.'s responsibility following the major reorganisation in 1991.

This is a most welcome and important publication. It at last draws attention to the substantial group of plants which does not meet the fundamental criterion of national rarity (recorded from 15 or fewer 10-km squares), but which form the next tier, by definition, occurring in 16–100 10-km squares. However as rarity is not, of course, synonymous with threat and can in many cases simply reflect natural distribution, some nationally scarce plants are far more immediately threatened with extinction than our classic rarities.

Franklyn Perring points out in his foreword that the nationally scarce plants were a relatively neglected group even in the preparation of the original *Atlas of the British flora* (1962) and many lowland plants, especially arable weeds and wetland species, have undergone significant declines (*Scandix pecten-veneris*, *Centaurea cyanus* and *Sium latifolium* for example) and are more likely to disappear from the British flora than some of our extremely rare denizens of remote mountains whose populations are more stable.

The conservation importance of the nationally scarce plants is well explained in the introduction highlighting their use in habitat evaluation and changes in their status as indicating changes in land use or land management. The aims, methods and data acquisition are all very clearly explained and the importance of voluntary contributions in terms of data supply and species accounts speaks for itself. The maps are well produced but given the constant reference to the *Atlas of the British flora*

(1962) throughout the book it would have been useful to have the maps the same size so that they were compatible with the very useful overlays supplied in that work. The vice-county map (p. 11) is larger still and lacks a superimposed grid thus making the accurate location of records (dots) near vice-county boundaries difficult.

The species accounts are generally of a high standard and as a whole contain a wealth of useful, interesting information. Although the format is consistent, with so many contributors the style and the amount of biological information is a little variable and reference citation is sometimes thin or lacking.

The chapter on habitats of scarce species in Britain is excellent and provides concise accounts of the major habitat types including an historical background and an outline of the most important factors which have led to their decline or modification. In the introduction to the chapter the habitat and species approach to conservation are well explained and to some extent reconciled. However, having pointed out that "both are essential if effective conservation measures are to be developed and applied", it is surprising that nowhere in the chapter is there any mention or reference to the major work *British plant communities* edited by John Rodwell. In such an important contribution to species conservation as *Scarce plants in Britain*, I feel it is a missed opportunity not to make a stronger link or cross-reference to the most important contribution to a general understanding of British vegetation in recent years, although two volumes of the work are cited in the references from individual species accounts.

Finally the chapter assessing the changes in our knowledge of species from 1962–1992 (that is from the date of the original *Atlas* to the present work) makes some important points. For example, some species (tabulated) on the current maps show an increase in records compared with those of the *Atlas*. This is almost entirely due to increased recording and in some cases may mask a decline in number of sites within a 10-km square. Where a decline is shown it is likely to be significant.

Despite these minor reservations *Scarce plants in Britain* is an immensely valuable and well-produced book. It is written with clarity and conciseness and will be constantly referred to by amateur and professional botanists and conservationists. A mark of the success of the project is that the Conservation Agencies have already acted upon the results and several species are currently being studied to obtain further information and also to bring records right up-to-date. The compilers should be congratulated.

P. LUSBY

Flora of Glamorgan. A. E. Wade, Q. O. N. Kay & R. G. Ellis. Pp. viii + 379 with nine colour plates, 14 black and white figures and numerous maps. H.M.S.O., London. 1994. Price £29.95 (ISBN 0-11-3100046-9).

To the uninitiated, South Wales conjures up visions of mining valleys, factories and industrial dereliction. This, however, is something of a calumny. There are extensive areas of industrialisation and urbanisation but much of the botanical vice-county of Glamorgan (v.c. 41), to a greater or lesser extent influenced by Man, supports a rich and varied flora. In habitats ranging from sand-dunes and limestone sea-cliffs in the south to sandstone, shale and limestone Coal-measures ascending to 600 m in the north is a flora containing 80% of Welsh vascular plant species.

The *Flora of Glamorgan*, the first since Professor A. H. Trow's 1906–1911 publication, was almost a quarter of a century in gestation and is a Flora in the traditional style being basically a list of plants together with supporting chapters appertaining to the flora. However, such a summary does a grave injustice to this excellent work.

The introductory chapters are informative and readable and include 'A short history of botany and botanists in Glamorgan' by R. G. Ellis and A. E. Wade, 'Soils of Glamorgan' by P. S. Wright, 'The geological history of Glamorgan' by M. G. Bassett and R. M. Owens and 'Land cover of Glamorgan, a satellite image' by A. J. Morton. This last chapter is a little disappointing, as although it contributes the frontispiece of the book and lists the vegetation and non-vegetation types discerned these are difficult to identify in the colour plate and there are no outlines to assist in this. Surprisingly there is no mention of climate in the book although this is directly relevant to remarks in Chapter 5, 'The history, ecology and distribution of the flora of Glamorgan' by Q. O. N. Kay, and climate is important for anyone interested in plant distribution.

That chapter is a brief account of the ecology and plants of the three main areas of v.c. 41, the Gower Peninsula, the Uplands and Border Ridges, and the Vale of Glamorgan rather than an enumeration and description of vegetation types. As such it makes more interesting reading. Some indication of the extent of these areas, the current (as opposed to past) influences of Man and potential threats would have been useful.

The next three chapters cover vascular plants, bryophytes and lichens, respectively. There are some 1,190 or so native or introduced and 550 casual vascular plant species including about 140 microspecies. Arrangement and nomenclature follows *Flora Europaea* (with more up-to-date names when appropriate) and English and Welsh names are given. For each species there is information on status, frequency, habitat and distribution in Glamorgan. For many species there are data on floral biology often followed by a list of insect pollinators. Recording was based on 5-km squares of the National Grid. When species occur in less than ten such squares, localities are listed. For more frequent species maps are provided (a total of 1,019) with pre-1960 and later records distinguished. Many specimens of critical groups (*Dryopteris*, *Rubus*, *Rosa*, *Euphrasia*, *Taraxacum*, *Hieracium* and *Carex*) were checked by experts.

The chapter on bryophytes by A. R. Perry treats distribution of the 459 recorded species based on a 10-km square survey and in the instance of rarer species, site information is provided. As with vascular plants coverage of the county has been thorough.

The chapter on lichens is by A. Orange. Although there has been no systematic survey of these plants, 518 lichens and 38 non-lichenised fungi are recorded on a 10-km grid square basis. This represents little more than a compilation of available records but with so few competent recorders represents a good start. For all species, pre-1960 and later records are distinguished; there are brief habitat details and, for rare species, localities.

The work ends with lists of collectors and contributors, a four-figure grid reference gazetteer and a map of the botanical vice-county of Glamorgan.

One's first impression on glancing through this softback book is that it is a good Flora and this is confirmed on closer examination. Quality of production is high and the colour photographs of plants and sites are excellent. This is a first-rate addition to the long list of British local Floras.

A. J. E. SMITH

Obituaries

MARJORIE DEVEREAU
(1915—1994)

Majorie Devereau, whose sudden death occurred on 19 December 1994, was one of the two assistant authors of the *Flora of the Isle of Man*, published in 1984 (though bearing a date two years earlier). Together with her friend and principal field companion, Dr Larch Garrad, she was responsible for the culminating impetus that carried the long-deferred work to its conclusion, taking upon herself the onerous task of typing the greater part of the manuscript.

Born on 28 May 1915 and brought up in Douglas, one of four children of a senior official in the Island's Board of Education, Miss Devereau spent her entire career as a primary schoolteacher. Though her first post was 'across' (as the Manx say), in Bootle, and she returned to take up further ones in England during and after the Second World War, her heart always remained in the Isle of Man and it was with relief that she was able to spend her final 23 years of teaching there.

After a chance meeting with Dr Garrad at an evening class in marine biology in 1965, she took up in earnest the interest in botany that she had had from an early age, an interest which nevertheless had to compete with amateur dramatics, gardening, garden history and learning the Manx language. Quickly developing impressive proficiency as a field botanist, she was soon making many notable finds, especially in *Carex*, a genus she was particularly proud of having mastered. *C. dioica* and *C. diandra* were both added to the Manx list through her acumen.

Retirement in 1975 brought her more leisure and allowed her at last to attend B.S.B.I. field meetings elsewhere in the British Isles, as well as to visit choice botanical areas on the Continent. She also undertook most of the Isle of Man coverage for the B.S.B.I.'s Monitoring Scheme and was compiling the records for two of its 10-km squares for the new *Atlas* at the time of her death. Retaining a sharp eye to the end, she celebrated her penultimate field season in fitting style by detecting two new county records of *Trifolium* species in a stretch of ground repeatedly worked over by botanists from John Ray onwards.

Though she formed no herbarium (her vouchers were pressed under her living-room carpet) and was too diffident ever to publish on her own account, the size of her contribution to knowledge of the vascular flora of her native island will fortunately be abundantly apparent to posterity through the great number of records that stand to her name in print.

D. E. ALLEN

DOROTHY MARY GREENE
(1928—1994)

Mrs Dorothy Greene died on 31 October 1994. Although few B.S.B.I. members will have known her, she played a crucial rôle behind the scenes as database manager at the Biological Records Centre, Monks Wood, in the 1980s. Those who use the animal and plant distribution maps and atlases produced by B.R.C. owe a great deal to her dedicated work as a pioneer manager of biological databases.

Dorothy Douglas was born in Coleraine, Northern Ireland, on 6 June 1928, the daughter of a schoolteacher. After attending Coleraine High School, she entered Trinity College, Dublin, graduating with a B.Sc. in Natural Science in 1951. At a Trinity College Bible-reading she met Stanley Greene, the son of a Co. Cork landowner, who she married at a teetotal wedding in 1953. (Their presence at a Bible-reading and at any teetotal event will astonish those who knew them only in later life!) After her marriage Dorothy initially worked as a medical technician, but she was employed as a part-time demonstrator in Botany at the University of Birmingham after Stanley obtained a post there in 1955. In 1959 she obtained an M.Sc. for a thesis on British bryophytes, and in 1961 she began to study Antarctic bryophytes, the main research interest of her husband. She was probably the first British woman scientist to 'go south' with the British Antarctic Survey, and her visit to South Georgia in the summer of 1967-68 was one of the highlights of her life. She retained vivid memories of hazardous transfers from ship to ship in rough weather, of the wonderful landscape of South Georgia and of the superb seafood available from the Antarctic waters. She was officially taken on to the staff of B.A.S. in 1969, and transferred to the Institute of Terrestrial Ecology's research station at Penicuik, Midlothian, with the rest of the Birmingham team in 1974. During this period she was the co-author of a number of papers on polar bryophytes, and she began work on *A conspectus of the mosses of Antarctica, South Georgia, the Falkland Islands and Southern South America*. This detailed checklist of 1,959 taxa, with relevant synonyms and a detailed and meticulously compiled bibliography, was eventually published in 1986. She also set up a database of Antarctic botanical records, based on specimens in the B.A.S. herbarium. This database, which was fully operational by 1971, was one of the first of its kind.

In 1978 Dorothy's marriage to Stanley broke up, and she transferred to Monks Wood. In 1979 she became database manager at the Biological Records Centre. The ten years she spent at B.R.C. were marked by major changes in the structure of the database. Dorothy did not write computer programs herself, but her knowledge of the needs of biologists and the strengths and limitations of databases allowed her to develop the B.R.C. system in collaboration with computer specialists. When she arrived at Monks Wood only the minimum details of a record were routinely placed on computer file. In 1981 the database was radically revised so that full details were added for new records. Programs were developed to check the records for geographical inconsistencies, and new software enabled maps to be plotted by computer rather than mechanically or by hand.

The first task Dorothy tackled at B.R.C. was the preparation of maps for the new edition of the B.S.B.I. *Sedges* handbook. This began with a major trauma, when the first set of maps lacked many of the significant records plotted in the *Atlas of the British flora* but which, it turned out, had never been computerized. However, Dick David stepped in to work with Dorothy and revised maps were produced. At the same time she and Jenny Moore set up a database of Charophyte records, from which distribution maps and a catalogue of the Natural History Museum collection were published. The days working with Jenny Moore in London provided a welcome break from the Monks Wood routine, and the resulting publications revived interest in these neglected plants. Experience with these data sets enabled her to tackle some large data sets built up by recording schemes which had been set up after the successful completion of the *Atlas of the British flora*. She was responsible for computerizing the records for the atlases of bryophytes, butterflies, mammals, marine algae, myxomycetes and woodlice, and for other publications currently in press.

Dorothy brought a formidable energy and determination to her work at B.R.C. She would regularly start work at 6.30 or 7 a.m., taking advantage of the more rapid performance of the computer before it was slowed down by other users. Sustained by cigarettes and frequent cups of almost black coffee, she worked from Monday to Friday and sometimes through the weekend as well. She affected a cynical attitude to recorders and recording, and frequently expressed her frustration at the tendency of records to 'multiply in captivity', as she put it, or to emerge 'from under the bed' after she had been told that the database was complete. Much of her work involved labour-intensive manipulation of computer files, using software which was less sophisticated than it is now. She took a pride in the speed with which she could deal with mountainous piles of computer print-out. If she was given a large job she would often put it aside, saying that she could not possibly deal with it now, but by the next morning it would be dumped unceremoniously in the centre of your desk with a curt note 'Please check by lunchtime, D.'. The permanent employees at B.R.C. found that working with her was both enjoyable and rewarding, and she was always at hand to help in a crisis. However, sometimes she could be caustic to those who, in her opinion, were not pulling their weight. Anyone complaining that they could not complete a task in time was likely to be advised to cut down on the excessive number of hours they spent sleeping. Sadly, a few of those she attempted to goad into action failed to see the human being behind the ruthless front she presented to them. She resented anything that interfered with the job in hand, avoiding administrative chores, internal seminars and meetings outside Monks Wood whenever she could. In the evenings she returned home to relax with her long-haired cat, Sheba, and a stiff drink. When not working over the weekend she cajoled Sheba into her travelling basket and drove off on Friday afternoon in her MG Midget to Herefordshire, where she was restoring and modernizing a decrepit old cottage with two friends. After a weekend of strenuous labour on the cottage, she would be back at work at 9 a.m. on Monday, proudly displaying her work-torn hands.

Dorothy's last task at B.R.C. was to manage the migration of the database to ORACLE, a far more efficient database management system than had hitherto been available to B.R.C. During the period between her appointment in 1979 and her retirement in 1989 the database had nearly doubled in size, from 2.5 to 4.5 million records. She retired to her Herefordshire cottage, the modernization of which had been completed with her characteristically good taste and eye for detail. She died of cancer, after a short illness. Her friends will cherish memories of her forthright and vigorous personality.

J. M. Croft & C. D. Preston

LEONARD ALBERT LIVERMORE
(1919—1994)

When Len Livermore died of cancer on 5 August 1994, Lancashire lost one of its best and most independent botanists.

Len was born on 7 January 1919 at Lancaster, the son of Frederick Charles and Rachael Livermore. He was educated at local schools and in 1935 joined Lansil Ltd of Lancaster as a laboratory technician working on textiles. In 1939 he joined the Territorial Army and was called up two days before the Second World War began. After brief training he was sent to France as an artillery signaller, saw action in 1940, and was lucky enough to escape home from Dunkirk. In 1941 he transferred to the Royal Army Ordnance Corps and was sent to North Africa to destroy dangerous captured ammunition as the Allies pushed west. He rose to the rank of Staff Sergeant before being demobilized in 1946. He returned to Lancaster and Lansil, and obtained qualifications as an industrial chemist at night school, ultimately gaining Fellowship of the Royal Institute of Chemistry in 1956. He retired in 1980 as Works Chief Chemist when Courtaulds Ltd closed their Lancaster factory.

In 1947 Len met his future wife, Pat, through a mutual friend. Together they discovered the pleasures of fell-walking and photography in the Lake District. They were married in 1949, thus beginning a happy marriage and a lifelong partnership. Their only child, David, was born in 1958.

Len's interest in botany came via horticulture. He grew orchids and other tropical plants (he was a founder member of the Bromeliad Society) and, later, alpines, with a special fondness for *Primula* and *Cyclamen*. He won many prizes at horticultural shows in the North-West for his displays of greenhouse plants and cut flowers. Gradually, through Pat's interest in photographing wild flowers using a camera Len had bought her after winning an *Amateur Gardening* competition, he became interested in wild plants. They joined the B.S.B.I. in 1974, and in 1980 retirement allowed him to take up botany full-time.

Botany was treated with the same care and dedication as explosives, chemistry and horticulture. Len's most important contribution to botany, *Flowering plants and ferns of North Lancashire*, was jointly written with Pat. This local Flora (using the term in its best sense) was the first for the area since Wheldon & Wilson's *Flora of West Lancashire* (which covered all v.c. 60) in 1907. It was recorded between 1976 and 1986, almost exclusively by Len and Pat. They complemented each other, Len seeking out the more critical groups, ferns and aquatics, leaving Pat to look for the commoner plants and the grasses, rushes and sedges.

Len would always ask permission to record on private land. He would knock on a farm door, and spend ten minutes or more chatting about the farming and explaining what he was doing, whilst establishing his local credentials. This exemplary approach paid off, and Len and Pat were never once met with refusal, allowing them into places never botanized previously. Some sites off the beaten track were absolute gems; I accompanied them on one recording trip in 1982 to the Greta Gorge, where sunlight dappled through the alder woods on to the white sheets of large bittercress (*Cardamine amara*), still the most extensive and beautiful stand I have ever seen.

The Flora was carefully planned, and Len's determination to get proper coverage of all groups and tetrads was influenced by an unfair *Watsonia* review of another local Flora. The Flora was concisely presented with tetrad maps in the current fashion, each dot coloured by hand. He carefully costed it (even down to complimentary copies, but he forgot all his family would want one too!), and kept the price down so that people would buy it. The Flora was very well received.

Len was not daunted by critical species, and he particularly enjoyed pottering in the meadows around Lancaster looking for *Taraxacum*, amassing a very respectable number of species (Livermore & Livermore 1991b). In May, the conservatory had row after row of carefully labelled yoghurt pots with clocking dandelion heads. He retained many critically-determined voucher specimens for reference; the collections have now been deposited at Lancaster University (**LANC**) and Liverpool Museum (**LIV**). Each autumn as the botanical season came to a close, Len and Pat would switch attention to fungi, this time Pat providing the expertise and Len the support.

With the bit between his teeth Len was not one to stop, and detailed accounts of the canals, coast, dismantled railways and the City of Lancaster were produced in rapid succession, again with Pat. These reports were published by persuading companies to type and print them as a public relations exercise. Len would carefully negotiate with the senior executives and then encourage the typists often with garden produce; after many years in management in the private sector, he knew how to get what he wanted. As the reports were not for sale, he deposited copies in libraries, and put notes in *B.S.B.I. News* so that others knew they were available.

Together with Pat and other friends, including Margret Baecker, Ruth Berry, John Leedal and Neil Robinson, he also spent many happy botanical holidays abroad in Canada, Turkey and Europe. On occasions, with the aid of some wild horses, Margret and I even managed to drag him over the Lancashire border into Cumbria to look for *Sorbus lancastriensis*!

Len was committed to conservation. For many years he was on the Northern Regional Committee and the Scientific and Conservation Committee of the Lancashire Naturalists' Trust (now the Lancashire Wildlife Trust). He had strong views on nature conservation, and had little hesitation in letting people know when he thought they were doing nothing or doing the wrong thing. Rightly, he felt that conservation policies should be based on sound information, and the initial objective of the Flora was to gather systematic data to determine priorities for conservation in North Lancashire. He felt too little attention was paid to groups like lower plants, fungi and invertebrates, which were largely ignored by the statutory nature conservation bodies in selecting sites, simply because they rarely collected the information. He and Pat made the point to the Nature Conservancy Council with the outstanding list of fungi from Gait Barrows National Nature Reserve, which is unique for its detail and coverage. Len was of the non-intervention school for site management, and thought that some sites would be better left to look after themselves.

Len was a shrewd, tough, independent northerner who knew his own mind. He preferred action to words, and had little time for committees or people who just talked. He held forthright views on the Civil Service, the state of the manufacturing industry and botanical referees who did not answer letters. He would fervently argue his corner over a cup of tea and a cigarette, and would usually give better than he got. He was always very cagey with his information, and most of us rapidly learnt not to pass on his records to third parties; he was upset if people re-used his records without taking the courtesy to ask him first. He taught me, a mere southerner, a lot both about botany and handling people, and I remember with pleasure botanizing with him in the field.

When he was diagnosed as having cancer in 1992, true to form he would not give in and carried on as normal, researching his family history and caring for his garden. He is survived by Pat and their son David.

PUBLICATIONS OF LEN AND PAT LIVERMORE

Livermore, L. A. & Livermore, P. D. (1987). *Flowering plants and ferns of North Lancashire*. Privately published, Lancaster.

Livermore, P. D. & Livermore, L. A. (1987). *Fungi of Gait Barrows National Nature Reserve*. Nature Conservancy Council, Blackwell.

Livermore, L. A. & Livermore, P. D. (1989). *Flowering plants, ferns and rusts of the Lancaster Canal in the Lancaster District*. Privately published, Lancaster.

Livermore, L. A. & Livermore, P. D. (1990). *Coastal plants and rust fungi of the North Lancashire coast*. Privately published, Lancaster.

Livermore, L. A. & Livermore, P. D. (1990). *Plants and rust fungi of the dismantled railway lines in the Lancaster District*. Privately published, Lancaster.

Livermore, L. A. & Livermore, P. D. (1991a). *Lancaster's plantlife – a botanical survey*. Privately published, Lancaster.
Livermore, L. A. & Livermore, P. D. (1991b). *Taraxacum* flora of north Lancashire. *B.S.B.I. News* **57**: 9–10.

T. C. G. Rich

PETER JAMES WANSTALL
(1924—1993)

Peter Wanstall died suddenly at his home in Thrandeston, Suffolk, on 29 January 1993. He had been a member of the B.S.B.I. since 1949 and had served as a member of the Council for two terms (1955–59, 1965–69), as the Society's representative on the Biological Council and as a member of the Conservation Committee. Perhaps his chief contribution, however, was as Honorary Secretary to the Publications Committee, a post that he held from 1954 to 1968. During this period he edited two of the Society's conference reports, *A Darwin centenary* (1961) and *Local Floras* (1963). He was elected an Honorary Member in 1968.

Peter was born on 21 March 1924 in Guildford, a town for which he retained a lasting attachment. However, the family moved to Brighton when he was 12, and it was in the Sussex downland that his love of nature was nurtured and grew. He attended Varndean School, Brighton, where he ran the Field Club, and Queen Mary College, University of London. The College had been evacuated to King's College, Cambridge at the outbreak of war and this was to have a profound influence on Peter's educational development, for, as he once told me, the 'Cambridge years' were among the most stimulating and formative of his life.

In 1946 he joined the staff of the Botany Department of Queen Mary College, where he remained for his entire professional career, retiring in 1984. He taught courses on bryophytes, pteridophytes and gymnosperms, plant ecology and, latterly, plant geography. In the 1960s he also conducted the University extramural course for the Certificate in Field Biology. As a teacher, Peter came into his own in practical classes and tutorials, where he was much more at ease than in the lecture room. His research interests lay in the field of bryophyte ecology and, for some time, he worked on the structure and growth of populations of two mosses, *Polytrichum formosum* and *P. juniperinum*. Sadly, he published little, not through the lack of ability, for he possessed a good critical mind and wrote well, but mainly, I think, through lack of self-confidence.

For more than 40 years, Peter worked to further the cause of British natural history, giving generously of his time and expertise to the many organizations of which he was a member. With his background and interests, it is not surprising that he became involved in the conservation movement as it developed in the late 1950s and early 1960s. From its earliest days he played a prominent part in the affairs of the Essex Wildlife Trust and, on moving to Thrandeston, became active in the work of the Suffolk Wildlife Trust as Chairman of the Conservation Management Committee. Peter had an especially close relationship with the Field Studies Council, extending over most of the first 50 years of its existence. Apart from running courses at several of the Council's centres, he served in a variety of capacities but notably as a member of the Executive Committee from 1960. At the time of his death he was also Chairman of the Publications Committee, having held the office since 1987.

The British Bryological Society, the Linnean Society of London and the Suffolk Naturalists' Society were other organizations to benefit from Peter's membership. Joining the British Bryological Society in 1946, he served, inter alia, as referee for the moss families Andreaeaceae, Polytrichaceae and Buxbaumiaceae, as a member of the Council for four terms between 1952 and 1984, as Vice-President (1986–87) and as President (1988–89). In 1983 he performed an outstanding service for the Society as principal organizer of the Diamond Jubilee Meeting held at Bedford College, London and Box Hill. He was a staunch supporter of the Linnean Society, having been elected a Fellow in 1953. Serving as a member of Council (1975–80) and as a Vice-President (1976–77), he also played a large part in the organization of the Society's joint meeting with the British Bryological Society in 1987. On a social level he was Honorary Secretary-Treasurer of the Linnean Dining Club for eleven years, standing down in 1989. After retiring, he quickly became involved in the activities of the Suffolk Naturalists' Society, as a Council member (1984–89) and as Botany Section Editor of *Suffolk natural history*, the Society's Transactions.

Peter greatly enjoyed foreign travel, having a keen interest in other cultures, both modern and ancient. Two countries in particular held a special place in his affection – France and Nigeria. France he came to love through his many visits to Provence and the eastern Pyrenees with student groups and, more recently, as leader of courses for the Field Studies Council. His first experience of Nigeria was in 1966 when he spent three months teaching at the University of Ife (Ibadan Campus) under the auspices of the 'VISTA' scheme. He made two shorter visits in 1971 and 1976–77 as an external examiner at the University of Ibadan. It was during the first of these that he and I travelled widely together, collecting and sightseeing in the north-east of the country. Our journey, of almost 5000 km, was not without its share of difficult and trying situations, but Peter's good humour and calm, positive approach to problems invariably helped us through. His bryophyte collections from 1966 and 1971 are now housed in the Cryptogamic Herbarium of the Natural History Museum, London (**BM**).

Lepidoptera were another passion dating back to his school-days. He had a considerable knowledge of the group and always included a moth trap with the equipment taken on field courses to France. I can see him now, deftly wielding his butterfly net wherever we stopped to collect on our travels through Nigeria.

Peter Wanstall's enthusiasm, sociability and courtesy never failed him. He was a wonderful companion in the field, a wise counsellor and a generous and loyal friend. At his funeral, the church was filled to capacity, a striking testimony to the affection and esteem in which he was held.

To his wife, Jane, and children, Sally, Ian and Giles, we extend our sincere condolences in their great loss.

A. J. Harrington

B.S.B.I. PUBLICATIONS

HANDBOOKS

Each handbook deals in depth with one or more difficult groups of British and Irish plants.

No. 1 SEDGES OF THE BRITISH ISLES
A. C. Jermy, A. O. Chater and R. W. David. 1982. 268 pages, with a line drawing and distribution map for every species. Paperback. ISBN 0 901158 05 4.

No. 2 UMBELLIFERS OF THE BRITISH ISLES
T. G. Tutin. 1980. 197 pages, with a line drawing for each species. Paperback. ISBN 0 901158 02 X. Out of print: new edition in preparation.

No. 3 DOCKS AND KNOTWEEDS OF THE BRITISH ISLES
J. E. Lousley and D. H. Kent. 1981. 205 pages, with many line drawings of British native and alien taxa. Paperback. ISBN 0 901158 04 6. Out of print: new edition in preparation.

No. 4 WILLOWS AND POPLARS OF GREAT BRITAIN AND IRELAND
R. D. Meikle. 1984. 198 pages, with 63 line drawings of all species, subspecies, varieties and hybrids. Paperback. ISBN 0 901158 07 0.

No. 5 CHAROPHYTES OF GREAT BRITAIN AND IRELAND
J. A. Moore. 1986. 144 pages, with line drawings of 39 species and 17 distribution maps. Paperback. ISBN 0 901158 16 X.

No. 6 CRUCIFERS OF GREAT BRITAIN AND IRELAND
T. C. G. Rich. 1991. 336 pages, with descriptions of 140 taxa, most illustrated with line drawings and 60 with distribution maps. Paperback. ISBN 0 901158 20 8.

No. 7 ROSES OF GREAT BRITAIN AND IRELAND
G. G. Graham and A. L. Primavesi. 1993. 208 pages, with descriptions and illustrations of twelve native and eight introduced species, and descriptions of 83 hybrids. Distribution maps are included of 31 native species and hybrids. Paperback. ISBN 0 901158 22 4.

No. 8 PONDWEEDS OF GREAT BRITAIN AND IRELAND
C. D. Preston. Due 1995. c.350 pages. 50 full page illustrations and distribution maps. Paperback. ISBN 0 901158 24 0.

OTHER PUBLICATIONS

LIST OF VASCULAR PLANTS OF THE BRITISH ISLES
D. H. Kent, 1992. 400 pages. Nomenclature and sequence followed by Stace in *New Flora of the British Isles*. Paperback. ISBN 0 901158 21 6.

ATLAS OF THE BRITISH FLORA
F. H. Perring and S. M. Walters, 1990. Reprint of 3rd ed, 1982. 468 pages. Distribution maps of over 1700 species including updated maps for 321 *Red Data Book* species. New bibliography of updated distribution maps published elsewhere since 1st ed, 1962. Paperback. ISBN 0 901158 19 4.

ALIEN PLANTS OF THE BRITISH ISLES
E. J. Clement and M. C. Foster, 1994. 590 pages. Lists 3586 species found growing wild and includes frequency of occurrence, areas of origin, means of introduction, references to descriptions and illustrations and location of herbarium material. Excludes grasses, to come in Vol. 2. Paperback. ISBN 0 901158 23 2.

SCARCE PLANTS IN BRITAIN
D. A. Pearman, C. D. Preston and A. Stewart, 1994. 516 pages. Covers distribution of 325 species which occur in 16-100 10-km squares with maps showing records before and after 1970 and text giving details of habitat and associated species. Of vital importance to all conservationists. ISBN 1 873701 66 7.

BSBI

BOTANICAL SOCIETY OF THE BRITISH ISLES (B.S.B.I.)

The B.S.B.I. was founded in 1836 and has a membership of 2,700. It is the major source of information on the status and distribution of British and Irish flowering plants and ferns. This information, which is gathered through a network of county recorders, is vital to their conservation and is the basis of the *Red Data Books* for vascular plants in Great Britain and Ireland. The Society arranges conferences and field meetings throughout the British Isles and, occasionally, abroad. It organises plant distribution surveys and publishes plant atlases and handbooks on difficult groups such as sedges and willows. It has a panel of referees available to members to name problem plants. Through its Conservation Committee it plays an active part in the protection of our threatened plants. It welcomes all botanists, professional and amateur alike, as members.

Details of membership and any other information about the Society may be obtained from:

The Hon. General Secretary,
Botanical Society of the British Isles,
c/o Department of Botany,
The Natural History Museum,
Cromwell Road,
London, SW7 5BD.

INSTRUCTIONS TO CONTRIBUTORS

Scope. Authors are invited to submit Papers and Notes concerning British and Irish vascular plants, their taxonomy, biosystematics, ecology, distribution and conservation, as well as topics of a more general or historical nature. Authors should consult the Hon. Receiving Editor for advice on suitability or any other matter relating to submission of manuscripts.

Papers and Notes must be submitted *in duplicate*, typewritten on one side of the paper, with wide margins and double-spaced throughout. Submission of copy on computer discs is acceptable but must also be accompanied by two hard copies of the text, double spaced throughout.

Format should follow that used in recent issues of *Watsonia*. Underline where italics are required. Names of periodicals should be given in full, and herbaria abbreviated as in *British and Irish herbaria* (Kent & Allen 1984). The Latin names and English names of plants should follow the *New Flora of the British Isles* (Stace 1991). Further details on format can be obtained from the Hon. Receiving Editor.

Tables, figure legends & appendices should be typed on separate sheets and attached at the end of the typescript.

Figures should be drawn in black ink or be laser-printed and identified in pencil on the back with their number and the author's name. They should be no more than three times final size, bearing in mind they will normally be reduced to occupy the full width of a page. Scale-bars are essential on plant illustrations and maps. Lettering should be of high-quality and may be done in pencil and left to the printer. Black and white photographs can be accepted if they assist in the understanding of the article.

Contributors must sign a copyright declaration prior to publication which assigns the copyright of their material to the Botanical Society of the British Isles. Twenty-five offprints are given free to authors of Papers, Notes and Obituaries; further copies may be purchased in multiples of 25 at the current price. The Society takes no responsibility for the views expressed by authors of Papers, Notes, Book Reviews or Obituaries.

Submission of manuscripts

Papers and Notes: Dr B. S. Rushton, School of Applied Biological and Chemical Sciences, University of Ulster, Coleraine, Co. Londonderry, N. Ireland, BT52 1SA.

Books for Review: C. D. Preston, Biological Records Centre, Monks Wood Experimental Station, Abbots Ripton, Huntingdon, PE17 2LS.

Plant Records: the appropriate vice-county recorder, who should then send them to C. D. Preston, Biological Records Centre, Monks Wood Experimental Station, Abbots Ripton, Huntingdon, PE17 2LS.

Obituaries: Dr J. R. Akeroyd, Lawn Cottage, Fonthill Gifford, Tisbury, Wiltshire, SP3 6SG.

Back issues of Watsonia are handled by Dawson UK Limited, Cannon House, Folkestone, Kent, CT19 5EE to whom orders for all issues prior to Volume 20 part 1 should be sent.

Recent issues (Vol. 20 part 1 onwards) are available from the Hon. Treasurer of the B.S.B.I., 68 Outwoods Road, Loughborough, Leicestershire, LE11 3LY.

Watsonia

August 1995 Volume twenty Part four

Contents

Published by the Botanical Society of the British Isles

ISSN 0043-1532

Filmset by
WILMASET LTD, BIRKENHEAD, MERSEYSIDE
Printed in Great Britain by
EATON PRESS LIMITED, WESTFIELD ROAD, WALLASEY, MERSEYSIDE

WATSONIA

THE JOURNAL OF
THE BOTANICAL SOCIETY
OF THE BRITISH ISLES

VOLUME 20

EDITED BY

J. R. AKEROYD, J. R. EDMONDSON, R. R. MILL,

E. C. NELSON, C. D. PRESTON AND B. S. RUSHTON

1994–95

PRINTED FOR THE SOCIETY BY
Eaton Press Limited, Wallasey, Merseyside

PUBLISHED AND SOLD BY THE BOTANICAL SOCIETY OF THE BRITISH ISLES,
C/O DEPARTMENT OF BOTANY, THE NATURAL HISTORY MUSEUM, LONDON SW7 5BD

DATES OF PUBLICATION

Part 1, pp. 1–88, 31st March 1994
Part 2, pp. 89–184, 6th September 1994
Part 3, pp. 185–328, 17th February 1995
Part 4, pp. 329–452, 30th August 1995

Errata

p. 11, line ll up.	For: gerardi read: geradii
p. 78, line 17 up.	For: littorale read: litorale
p. 85, line 2.	For: 16 May read: 15 May
p. 131, caption.	For: sahlinanum read: sahlinianum
p. 136, line 11 up.	For: marshalli read: marshallii
p. 182, line 20.	For: platyphyllus read: platyphyllos
p.205, header.	For: 185–194 read: 205–227
p. 295, line 8.	For: sylvatica read: silvatica
p. 300, line 20 up.	For: Anisandra read: Anisantha
p. 377, line 2 up.	For: alpinim read: alpinum
p. 388, line 18 up.	For: Hippophaë read: Hippophae
p. 427, line 21.	For: 1 amarckii read: lamarckii

INDEX
WATSONIA VOLUME 20 (1994–95)

Prepared by C. R. Boon

CONTENTS