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Recording bias in botanical surveys

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ABSTRACT

Recording bias in botanical surveys arises primarily from the recording behaviour of individual botanists, sometimes coupled with the survey techniques and the types of plants being recorded. Recording bias is probably widespread in botanical surveys; it does not invalidate the records, but requires that care is taken with interpretation. Some generalizations are made to help assess recording bias, and are illustrated using examples found during the B.S.B.I. Monitoring Scheme.

INTRODUCTION

In any botanical survey, there is an inevitable degree of recording bias (Hope-Simpson 1940; Sykes *et al.* 1983; Nilsson & Nilsson 1983; Kirby *et al.* 1986; West & Hatton 1990, etc.). Efforts are therefore usually made to minimise bias by adopting a controlled, systematic, repeatable method (Greig-Smith 1964).

In the recording techniques adopted for most national or county plant atlases (e.g. Perring & Walters 1962; Hall 1980), recorders individually select the areas within squares to visit, and then record the species present to fill the time available, or until the list is felt to be comprehensive. Such an unstructured recording technique might be expected to introduce considerable local bias to the data collected, and especially if the surveys are to be repeated. For instance, only 52% of the records collected by two independent parties of botanists six weeks apart in the same tetrads (2-km squares) were common to both surveys (Rich & Woodruff 1990, 1992). Efforts are often made to achieve even coverage (e.g. Dony 1963), but failure to achieve this is only one of many sources from which bias can arise. Documentation of what was done and where and when and by whom can help with interpretation of the data, but such details are rarely collected.

Bias originates primarily from differences in the recording behaviour and the ability of individual botanists, but may also arise from the survey techniques or the types of plants being recorded. The extent of bias in the data collected is rarely known, and few cases are described in detail. Perring & Walters (1962) presented provisional distribution maps of about 40 taxa and explained why the data were thought to be inadequate. Nilsson & Nilsson (1983) found that sampling error accounted for two-thirds of the apparent species turnover rates on islands in Sweden. Preston & Eversham (1992) describe selected examples of botanical and zoological recording bias.

The purpose of this paper is to draw attention to the problems of recording bias by using some examples encountered during the B.S.B.I. Monitoring Scheme (Rich & Woodruff 1990, 1992). The B.S.B.I. Monitoring Scheme was a 10-km square sample survey of Britain and Ireland during 1987 and 1988 to assess the current status of the flora. Over 1600 botanists collected 985,000 records in 425 out of the 429 sample 10-km squares, representing 2660 taxa. Many of the examples are drawn from a comparison of these data with those collected for the *Atlas of the British flora*† (Perring & Walters 1962).

Nomenclature follows Clapham *et al.* (1987).

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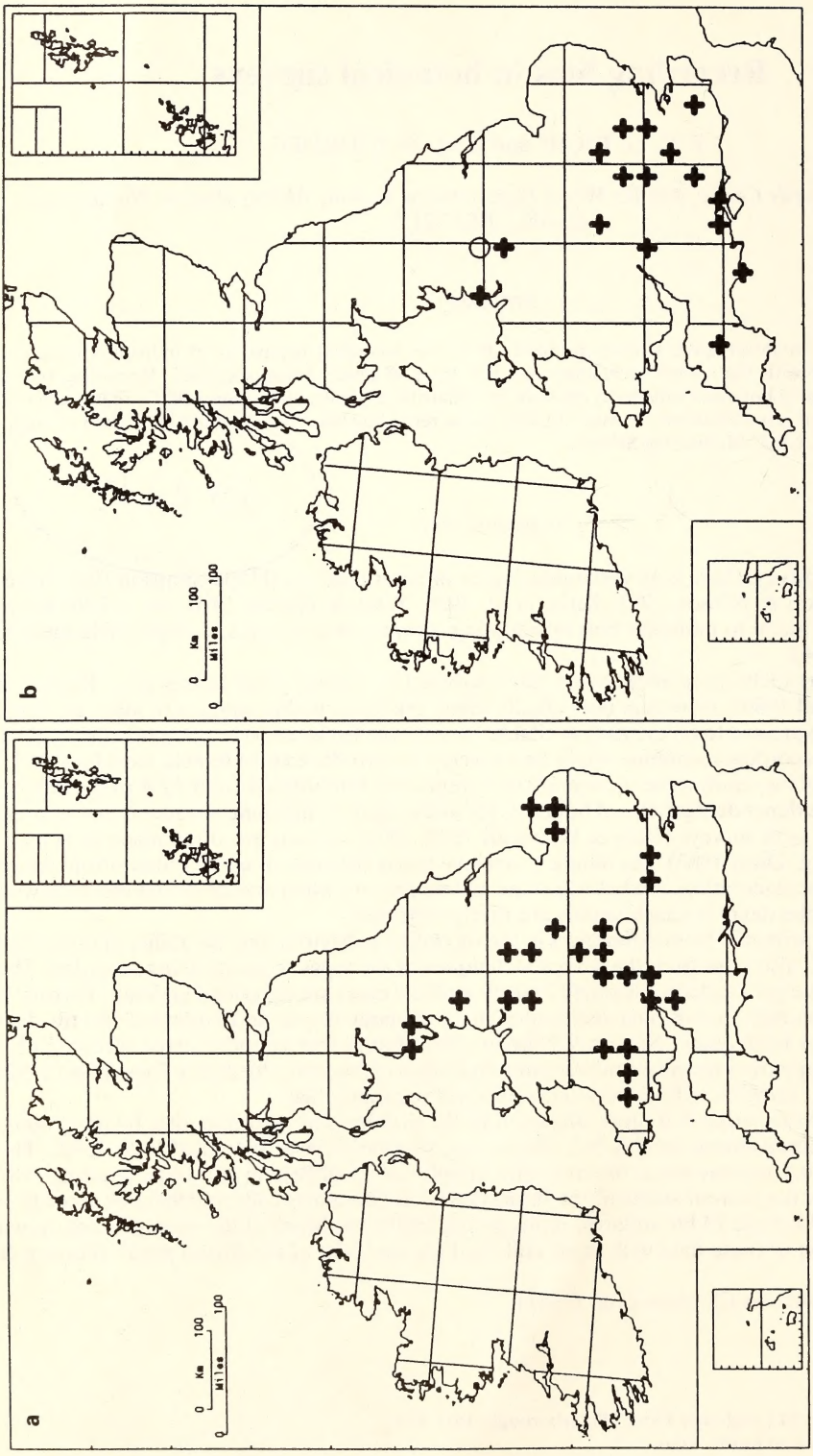
† hereafter referred to as the *Atlas*.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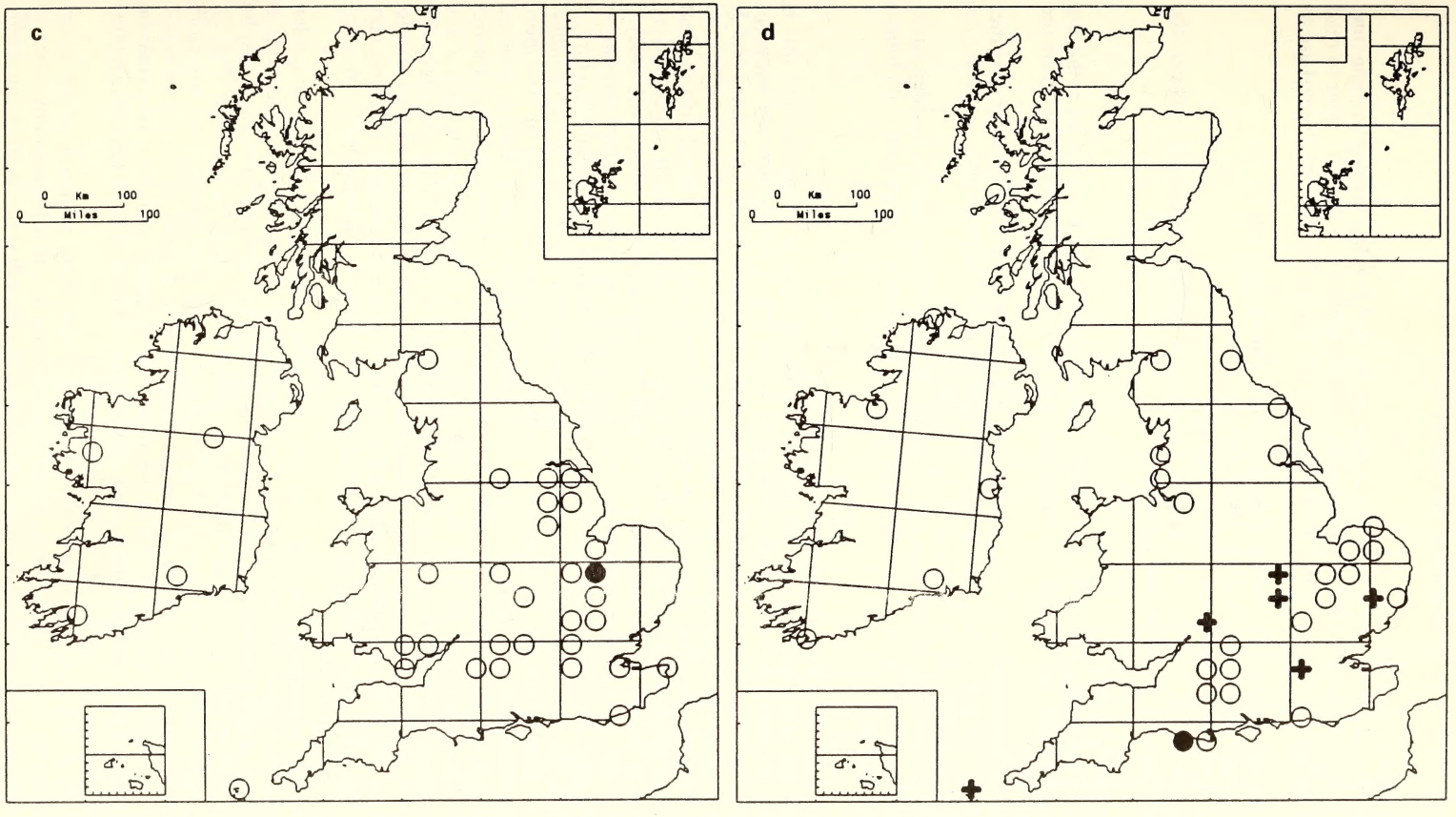


FIGURE 1. Selected pairs of taxa showing apparently similar patterns of change: (a, b) *Rubus vestitus* and *Lagarosiphon major*; (c, d) *Polygonum nodosum* and *Agrostemma githago*.

EXAMPLES OF RECORDING BIAS

NOTE ON PRESENTATION OF THE MAPS

The maps show only data from the 10-km squares sampled for the B.S.B.I. Monitoring Scheme (one in every nine; see Rich & Woodruff 1992). The symbols are enlarged so that they are clear to read when the maps are reduced and do not indicate the actual areas covered. The symbols used are as follows:

○ Recorded only for the *Atlas* (1930–1960 in Britain, before 1960 in Ireland).
✚ Recorded only for the Monitoring Scheme (1987–1988).
● Recorded for both the *Atlas* and the Monitoring Scheme.

Thus, a predominance of open circles may suggest a decline in relative frequency between the surveys, and a predominance of pluses, an increase.

THE IMPORTANCE OF ASSESSING BIAS

The importance of assessing bias can be seen from the apparent similarities between the following selected pairs of maps. Unless the extent of recording bias is known, any conclusions drawn from the data may be misleading.

Rubus vestitus and *Lagarosiphon major* (Figs 1a, b): The increase in records for the former species reflects an increase in recording of critical taxa coupled with incomplete historical data; for the latter it reflects a real increase in the frequency of the plant.

Agrostemma githago and *Polygonum nodosum* (Figs 1c, d): The former species has decreased markedly during the last 30 years; the latter has undergone a taxonomic revision and is no longer recognised by most recorders.

BIASES RELATED TO THE QUALITY AND QUANTITY OF RECORDING

It is often said that the distribution of plants reflects the distribution of botanists, and this is particularly true for the more critical taxa and for small areas. Fig. 2 shows how the apparent distribution of *Carex hostiana* × *viridula* correlates with areas recorded by A. O. Chater and J. Harron who know this obscure hybrid well. It is, however, probably widespread in the north and west where its parents grow together. Another botanist, M. Porter, recorded critical taxa in great detail in Brecon for the Monitoring Scheme, resulting in apparently highly localised concentrations of records of species of *Rubus*, *Hieracium*, *Taraxacum* and *Euphrasia* (Rich & Woodruff 1990).

Taxonomic awareness and recording fashions may bias results on a wider scale and for commoner taxa. Many critical groups have been more widely recorded for the Monitoring Scheme than for the *Atlas* (e.g. *Hieracium*, Fig. 3a), but some were more widely recorded for the *Atlas* (e.g. *Rhinanthus*, Fig. 3b), resulting in artificial changes in frequency. Compared to a general average of 16% more records for the Monitoring Scheme than the *Atlas*, there are 24% more records for five selected genera (*Carex*, *Polygonum*, *Populus*, *Rumex* and *Salix*) covered by the *B.S.B.I. Handbook* series (Jermy *et al.* 1982; Kent & Lousley 1981; Meikle 1984). Trist & Sell (1988) drew attention to the occurrence of two subspp. of *Molinia caerulea* in the British Isles; there were four records of the subspp. in 1987 and 33 in 1988. These increases in records are no doubt due to increased awareness of the taxa concerned. Fig. 4 shows 10-km squares where above average percentages of critical taxa were recorded for the *Atlas* and Monitoring Scheme surveys; the squares correlate well with areas known to have been well-recorded.

There are differences in opinion between recorders over which introduced species or garden escapes to record. In recent years it has also become more acceptable to record all introductions as they have become more widespread in the wild. Consequently, exaggerated rates of increase may be observed for species which were present but often ignored during recording for the *Atlas* (Fig. 5). However, it is also still more acceptable to record some introductions than others – taxa are more likely to be recorded if they are included in national or local Floras or if listed on the record cards. Crops such as Wheat (*Triticum aestivum*) and Barley (*Hordeum vulgare*), which are not listed on cards, are poorly recorded on roadsides compared to others, such as Oil-seed Rape (*Brassica napus*) (Fig. 6), which are listed on the cards and are widely recorded.

Bias also arises from differences in taxonomic opinion and also from common errors; many recorders simply follow the major floras. There is little agreement on the current taxonomic status of the subspp. of *Juncus bulbosus*, resulting in confusion between the records (Fig. 7a, b). *Viola canina*

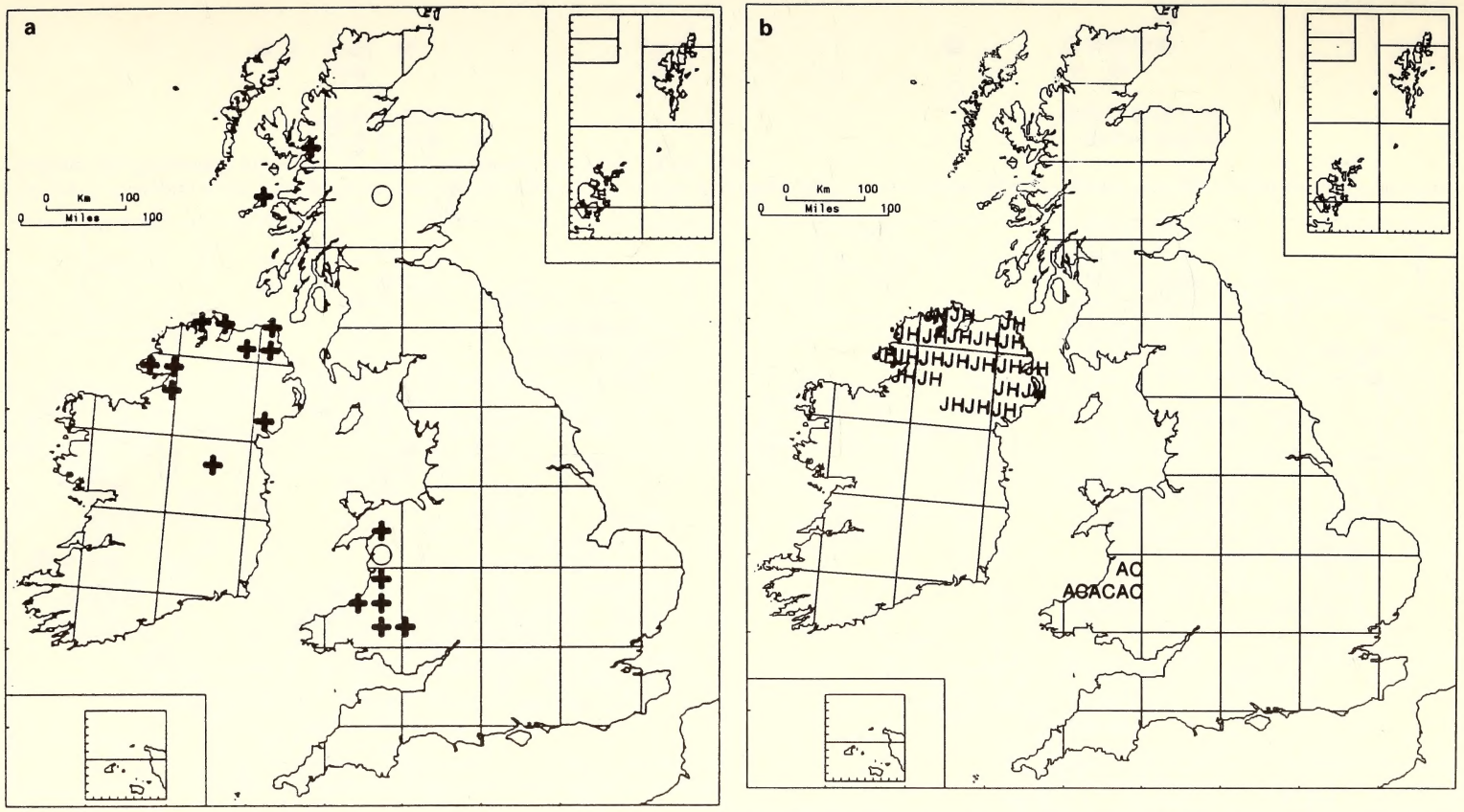


FIGURE 2. Correlation between (a) the distribution of *Carex hostiana* × *viridula* and (b) the areas recorded by two botanists (AC = A. O. Chater, JH = J. Harron).

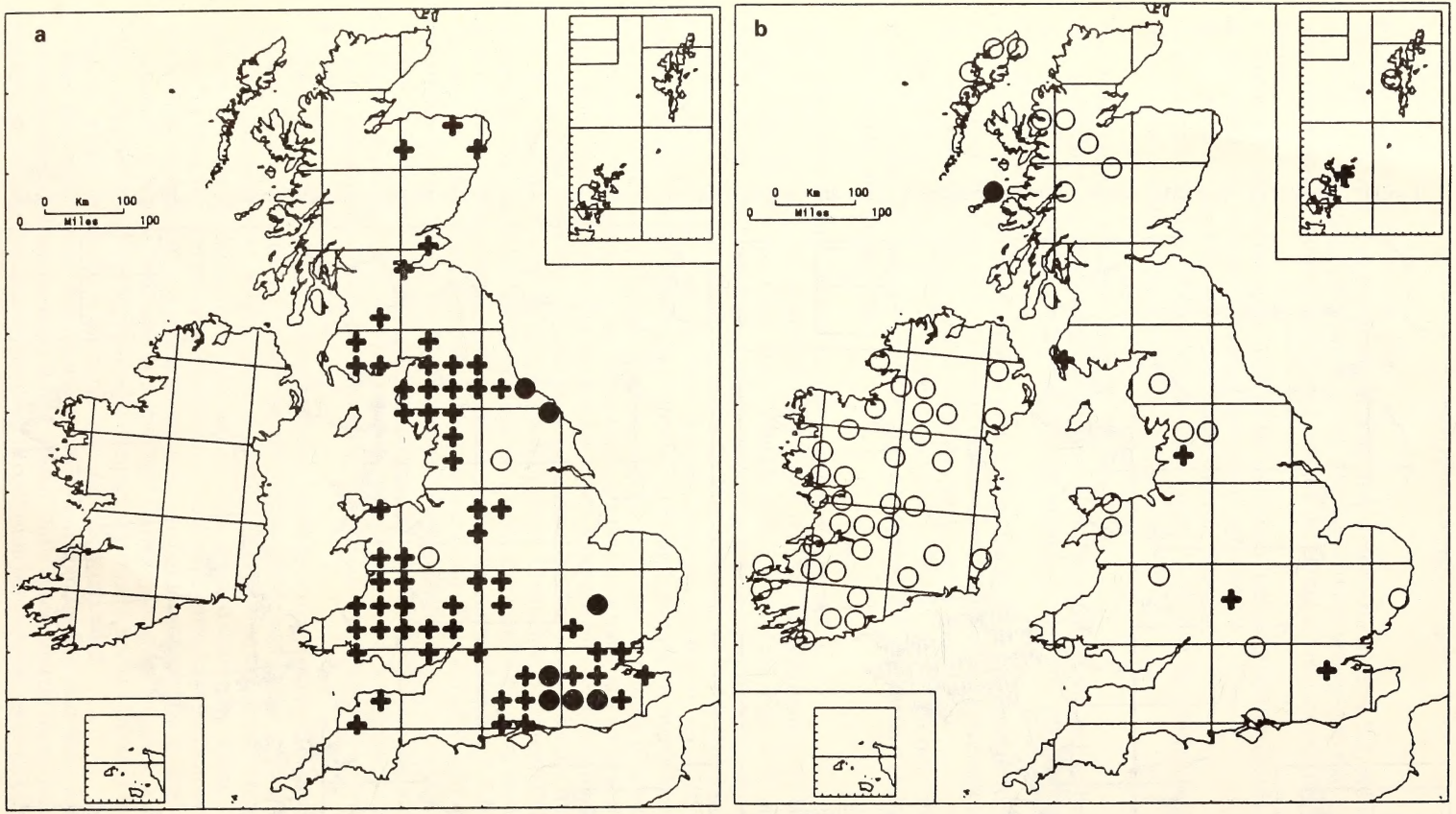


FIGURE 3. Examples of critical taxa better recorded during one survey than the other: (a) *Hieracium perpropinquum*, more widely recorded for the Monitoring Scheme; (b) *Rhinanthus minor* subsp. *minor*, more widely recorded for the *Atlas*.

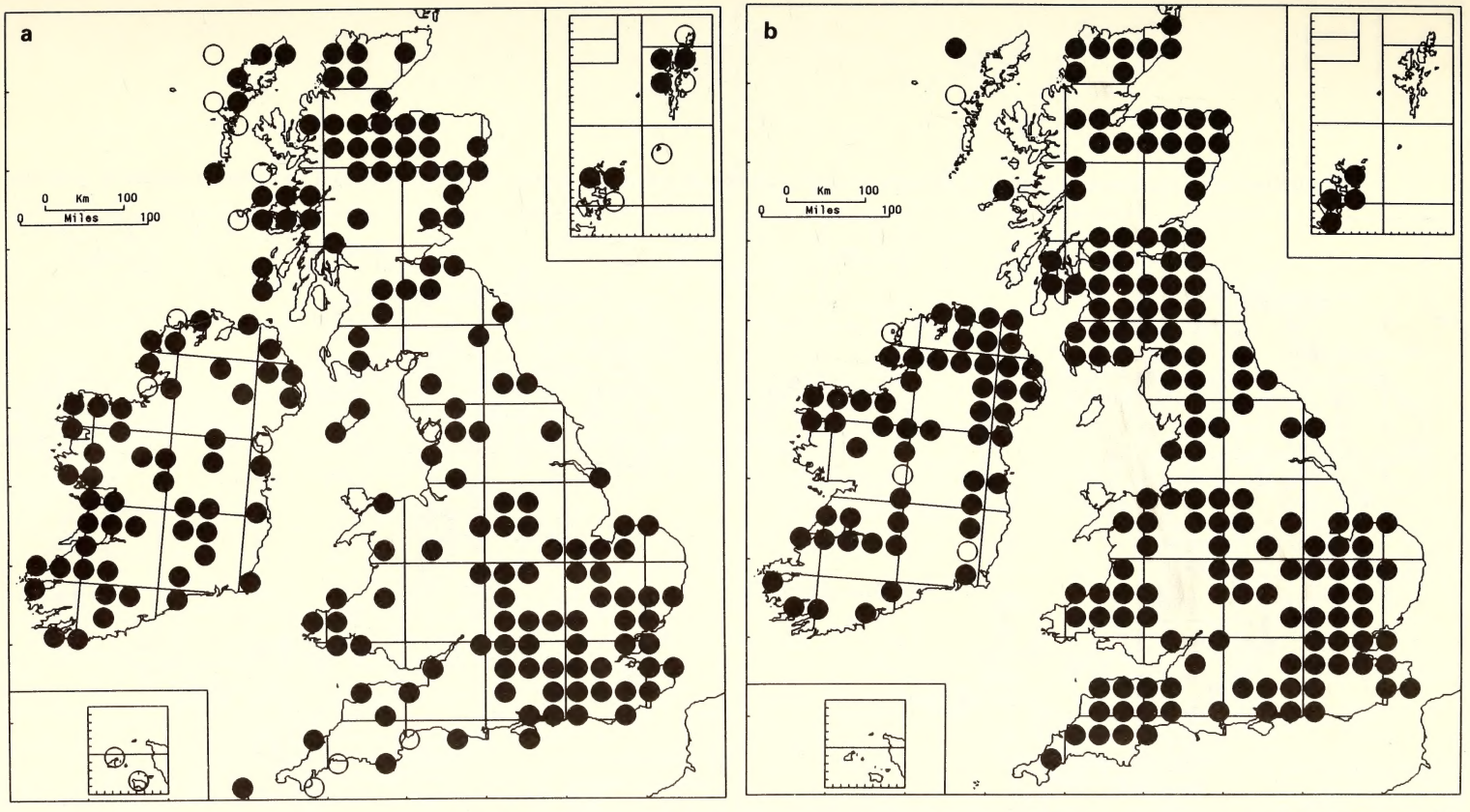


FIGURE 4. 10-km squares with an above average % of critical taxa recorded (number of critical taxa/total number of taxa recorded per square): (a) *Atlas* survey; (b) Monitoring Scheme survey. Britain and Ireland have been assessed separately due to inherent differences in the flora. Open circles show 10-km squares not recorded for both surveys.

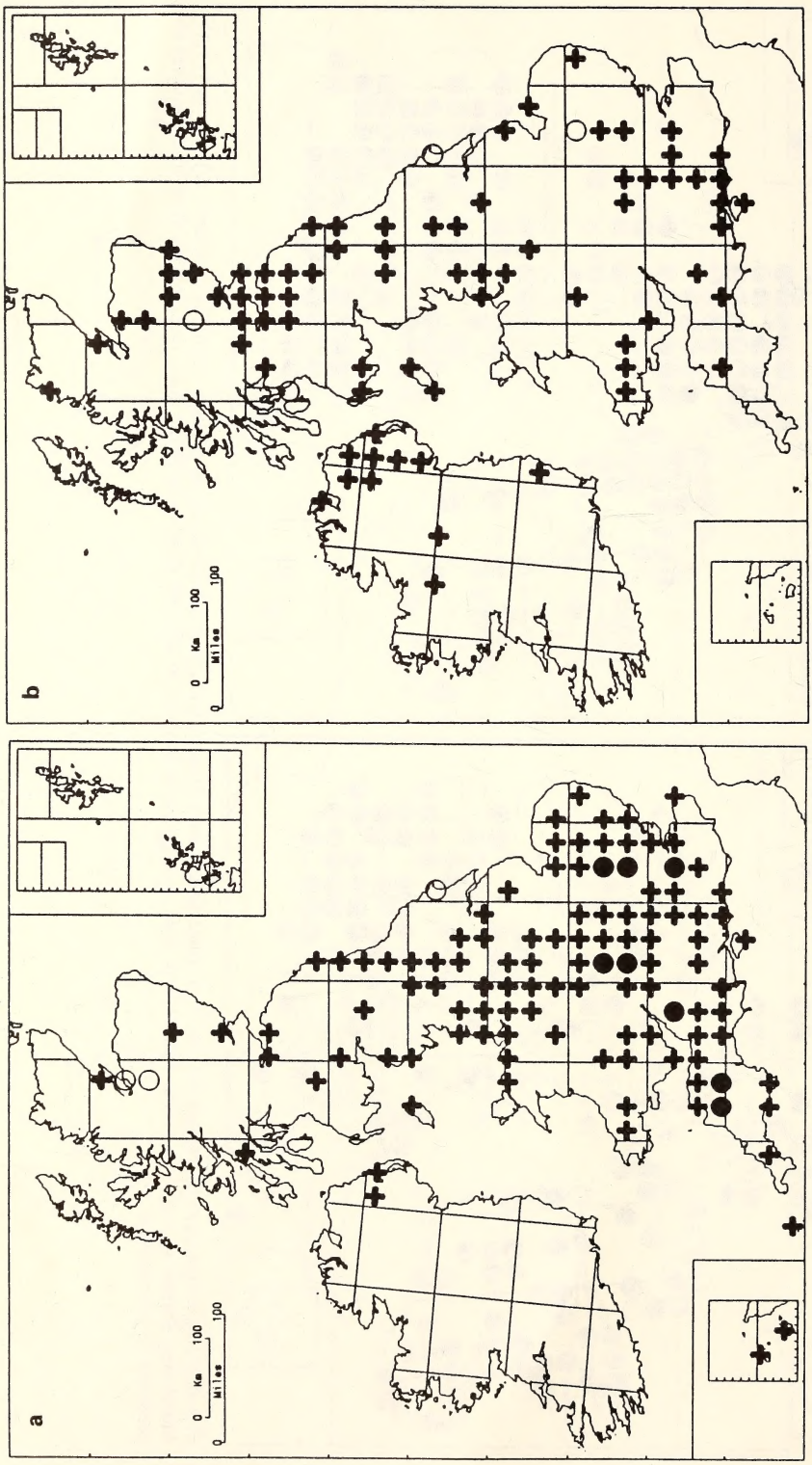


FIGURE 5. Examples of increased recording of garden escapes resulting in exaggerated rates of increase: (a) *Lunaria annua*; (b) *Ribes sanguineum*.

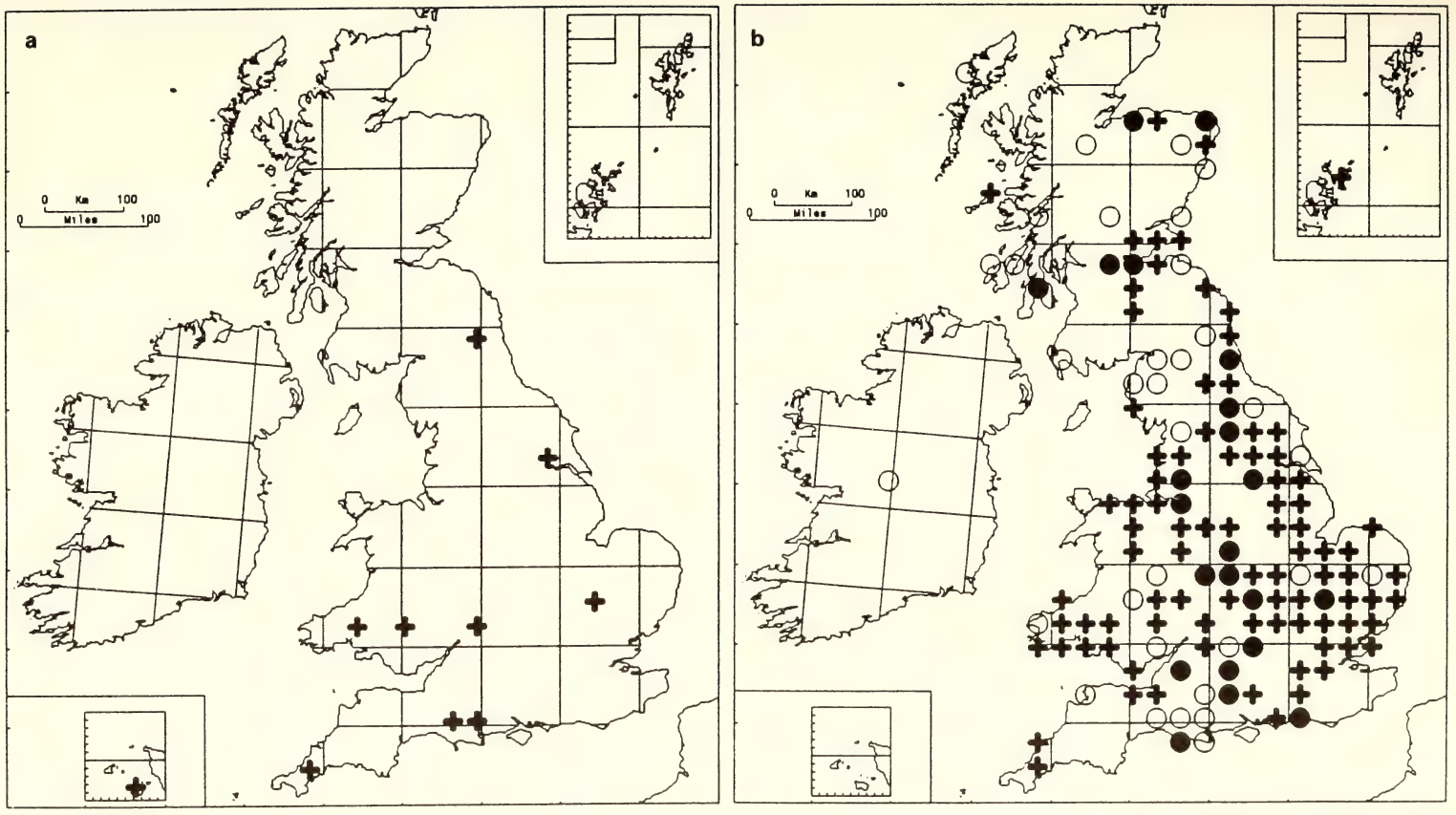
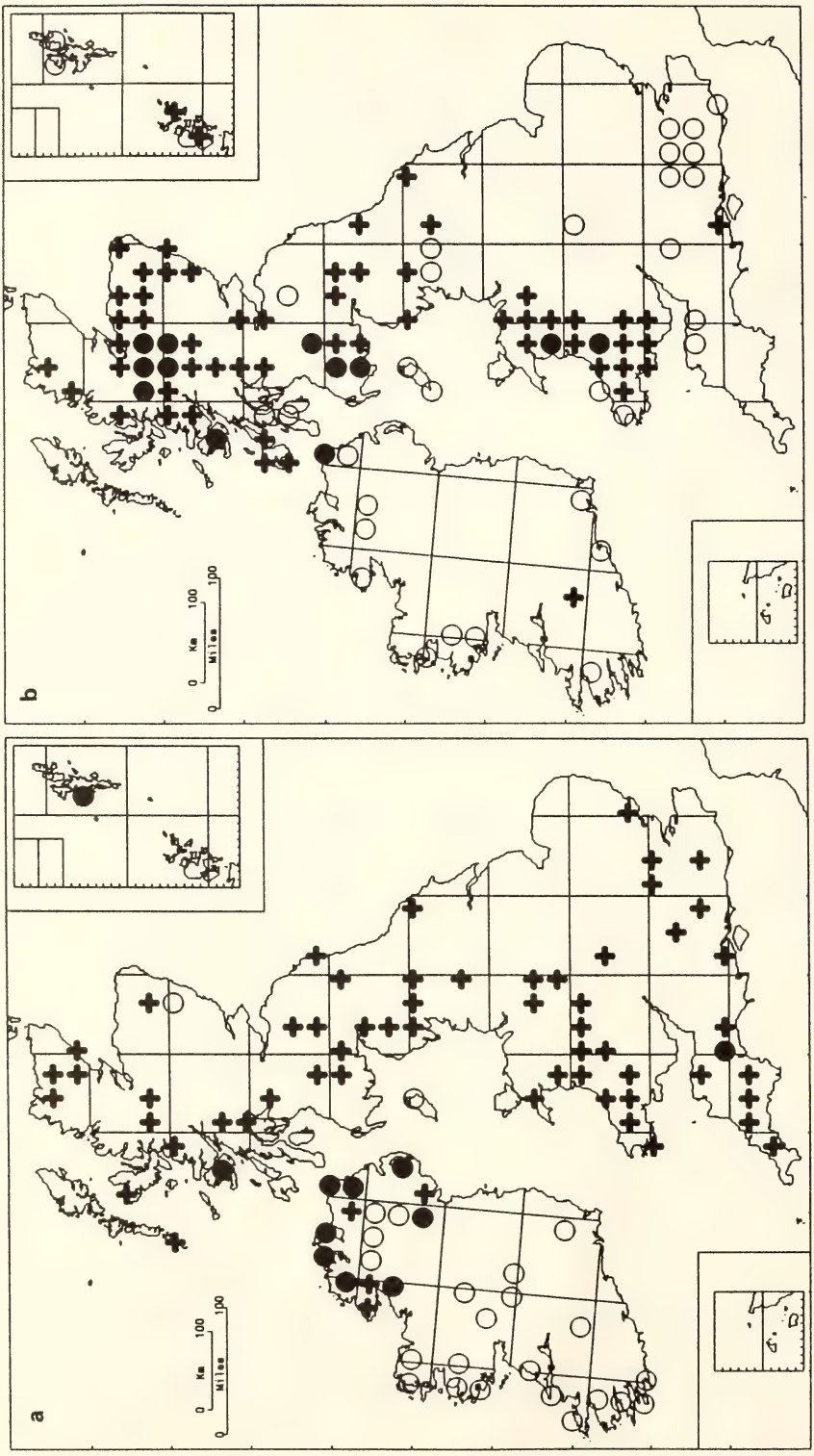


FIGURE 6. Differences in recording of crop plants occurring outside cultivated fields. It is much less acceptable to record (a) Barley (*Hordeum vulgare*) than (b) Oil-seed Rape (*Brassica napus*) despite the widespread occurrence of both on roadsides.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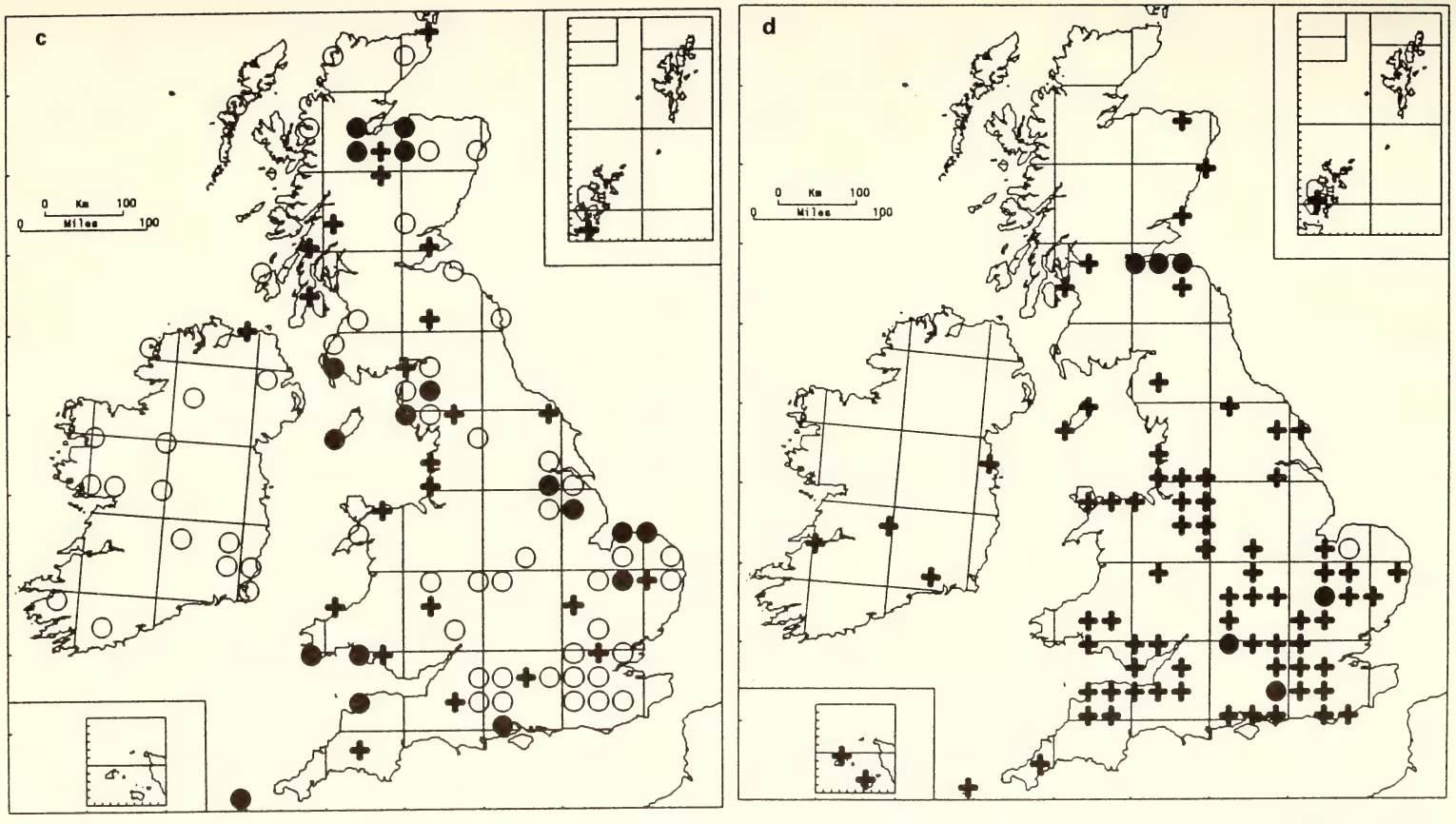


FIGURE 7. Examples of taxa recorded with differences of opinion or recorded erroneously (see text for details): (a) *Juncus bulbosus* subsp. *bulbosus*; (b) *J. bulbosus* subsp. *kochii*; (c) *Viola canina*; (d) *Hyacinthoides hispanica*.

may have been over-recorded inland for the *Atlas* (Fig. 7c), possibly because in *Bentham & Hooker*, the Flora that most British botanists at that time had been raised on, *V. riviniana* was included in *V. canina* (F. H. Perring, pers. comm.). *Hyacinthoides hispanica* has been over-recorded in error for the much more common but less well known *Hyacinthoides hispanica* × *H. non-scripta* (Page 1987; Fig. 7d); the latter is not included in Clapham *et al.* (1987).

Other plants may simply be overlooked if recorders are unaware of their presence in an area. *Festuca altissima* is an uncommon plant of rocky woods and ravines and was almost certainly under-recorded for the *Atlas* (Fig. 8a). *Chenopodium ficifolium*, a weed similar in appearance to the common *C. album*, may also have been overlooked in some areas (Fig. 8b).

Some habitats may be recorded better or more poorly than others due to differences in accessibility. Arctic-alpines such as *Luzula arcuata* and *Juncus castaneus* in Scotland, and *Polygonum viviparum* in Ireland, were under-recorded for the Monitoring Scheme partly due to the remoteness of the localities and partly due to inclement weather. Conversely, car-parks and churchyards have been well-recorded as they are easily accessible.

Increases in numbers of records may result simply from increased recording effort for the Monitoring Scheme (Rich & Woodruff 1992). Numerous examples could be cited, but a clearer demonstration is probably from outside the Scheme itself where the effects can be seen in a wider context. The spread of *Cardaria draba* has been documented by Scurfield (1962). Fig. 9 shows the cumulative number of 10-km squares from which *C. draba* has been recorded. The enormous increase in the 1950s coincides with the *Atlas* field work and reflects a simple increase in recording effort rather than a dramatic spread of the plant. Similar patterns can also be seen in *Epilobium ciliatum*, *Veronica filiformis* and *Impatiens glandulifera*. The Monitoring Scheme results suggest little increase in *C. draba* since 1960.

BIASES RELATED TO RECORDING METHODS

Constraints imposed by the recording methods may result in some systematic biases in addition to those introduced by the botanists. Bias introduced by changes in the areas recorded, the repeatability of surveys, concentration on the selected A, J and W tetrads, and by the time span of recording have been briefly discussed by Rich & Woodruff (1990, 1992). Examples of how changes in coverage and in the areas recorded may result in apparent increases of plants are shown in Fig. 10. *Plantago maritima* was recorded for the Monitoring Scheme in 22 out of the 26 coastal 10-km squares not recorded for the *Atlas*; if these records are ignored there is no significant change in frequency. Similarly, apparent increases in *Trifolium repens* around the coast are due to the new squares being recorded, and apparent losses in Ireland are squares not re-recorded for the Monitoring Scheme. Examples of species under-recorded in the Dublin square due to concentration on the selected tetrads are *Oenanthe aquatica* and *Myriophyllum spicatum*.

Exaggerated rates of decline of casual species may result from different time spans of surveys. Casuals or fugitives (Preston & Eversham 1992) are usually short-lived, non-persistent species which are unpredictable in occurrence (they are often accidentally introduced by man). As records accumulate with time, a longer survey period is likely to yield more 10-km square records than a shorter period. Table 1 shows the number of sample 10-km squares recorded for three arable weed species; in all cases there are considerably more records for 1930–1960 than 1987–1988 and it might be concluded that the species have declined by 75% or more. If the numbers of records per year are calculated, all taxa appear to have become *more* frequent. Neither conclusion is strictly valid because the numbers of records also need to be corrected to take into account the amount of recording effort which generated them. There is little doubt that these species have declined, but at a lower rate than suggested by a simple comparison of numbers.

The taxa listed on the cards may introduce bias by prompting records for selected taxa. The records for *Malus sylvestris* sensu lato, *M. sylvestris* sensu stricto and *M. domestica* are highly correlated with the taxa listed on the five regional record cards (Fig. 11). Similar effects were found in *Asplenium trichomanes*, *Juniperus communis* and *Veronica serpyllifolia*. The commonest segregate or infraspecific taxon of an aggregate or species may also be under-recorded simply because it is the assumed taxon; there were only two records for *Hedera helix* var. *helix* for the Monitoring Scheme compared to 34 for var. *hibernica* even though the former is the more common taxon (McAllister & Rutherford 1990).

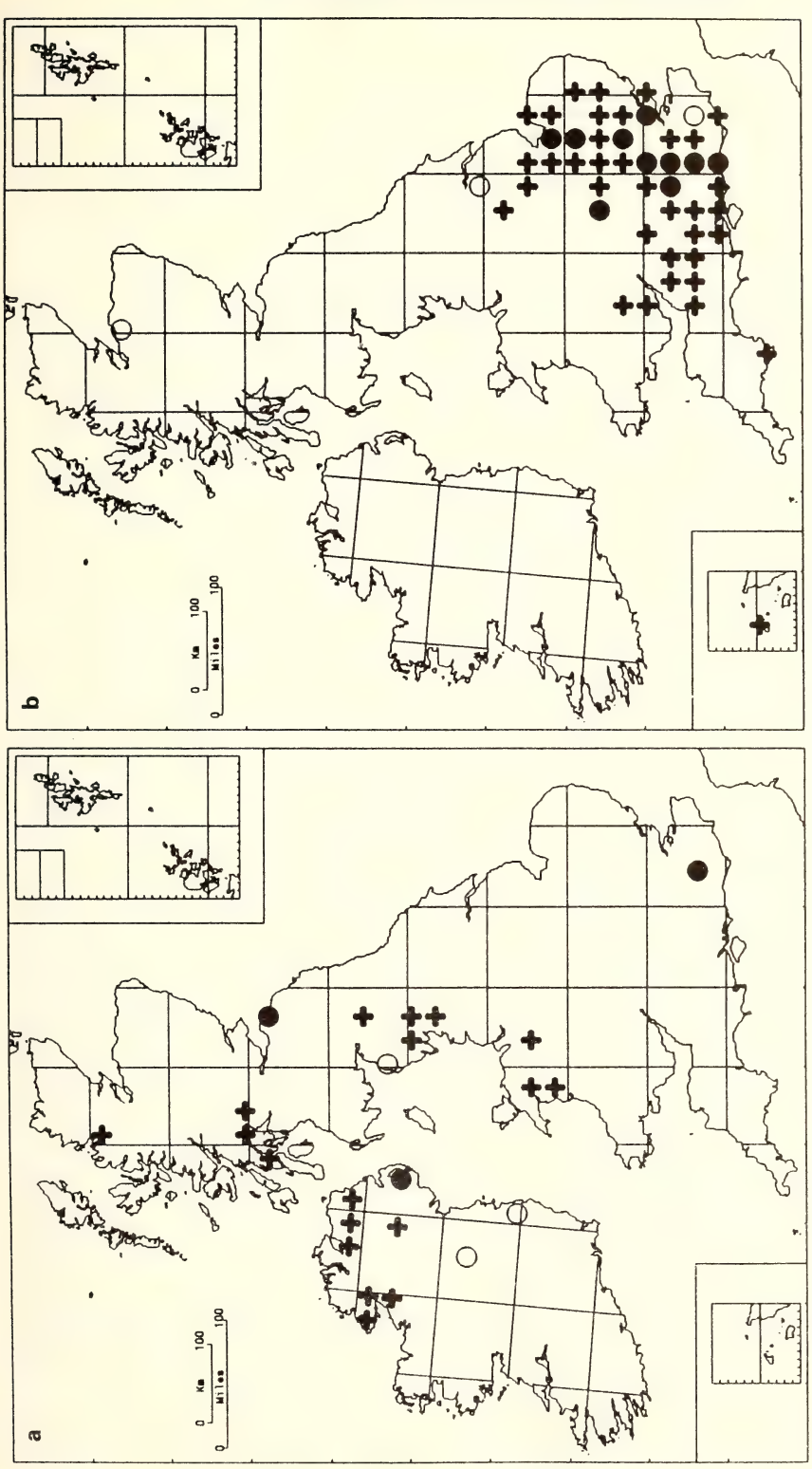


FIGURE 8. Examples of species which may have been overlooked for the *Atlas*: (a) *Festuca altissima*; (b) *Chenopodium ficifolium*.

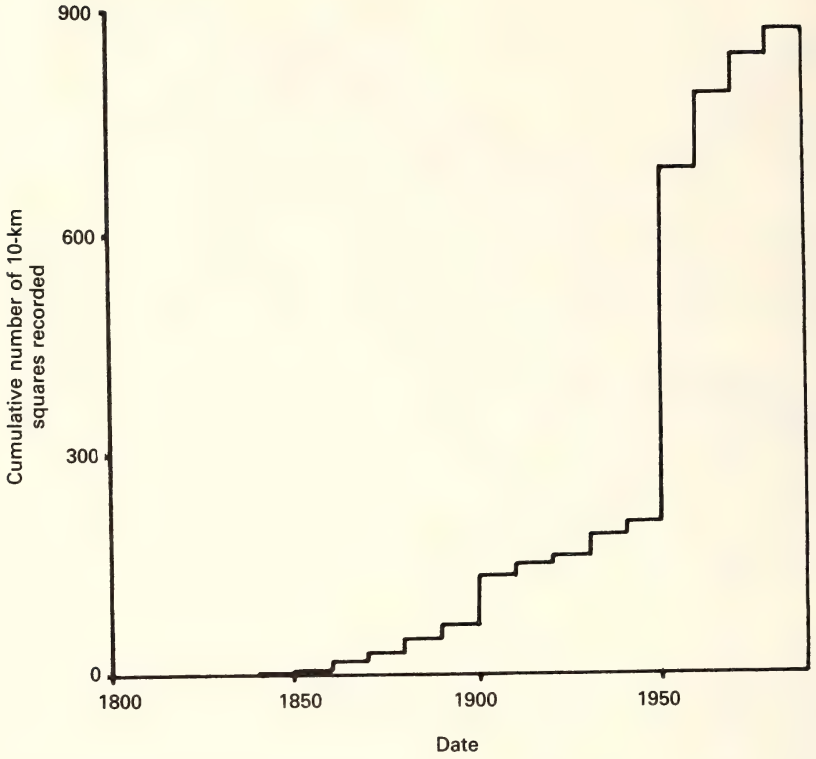


FIGURE 9. Cumulative increase in the number of 10-km squares recorded for *Cardaria draba* with time.

BIASES RELATED TO THE TYPES OF PLANTS BEING RECORDED

Some biases in recording may depend on the type of plants being recorded in addition to the behaviour of the botanists.

The apparency, or ease with which a plant is seen may dictate how consistently it is recorded. *Chamerion angustifolium* has large, purple flowers at eye-level and is unlikely to be missed. *Leersia oryzoides* is a large grass of ditches and watersides which rarely flowers; it is very difficult to see amongst *Phalaris arundinacea* with which it usually grows and closely resembles vegetatively, and is easily overlooked. Small, fine-leaved or widely dispersed taxa are often more poorly recorded than large, broad-leaved or clumped species (Sykes *et al.* 1983; Clymo 1980). Plants abundant in an area are more likely to be found than those less frequent, simply due to the higher probability of a recorder finding them.

The seasonality of appearance of plants is well-known. In the genus *Scilla*, for example, *S. verna* is most conspicuous in spring and early summer, whilst *S. autumnalis* is seen mainly in late summer and autumn. The seasonality of recording by botanists is also well-known, most activity taking place during the summer. Species which are most conspicuous at the beginning or end of a season are likely to be less consistently recorded than those most conspicuous in the middle.

Seasonal bias may arise from variations in the occurrence of the plant (e.g. spring annuals, woodland herbs), variations in the apparency, or from difficulties in identifying particular taxa at certain times of year (e.g. *Nasturtium* spp. are most reliably identified from ripe seeds which are unavailable early in the season (Rich 1987)). Fig. 12 shows examples of seasonal bias based on records collected during 1987 and 1988, and includes records of both flowering and vegetative plants. Fig. 12a shows the relative numbers of records collected in each month; most records are collected between May and September, reflecting seasonality of both plants and recorders.

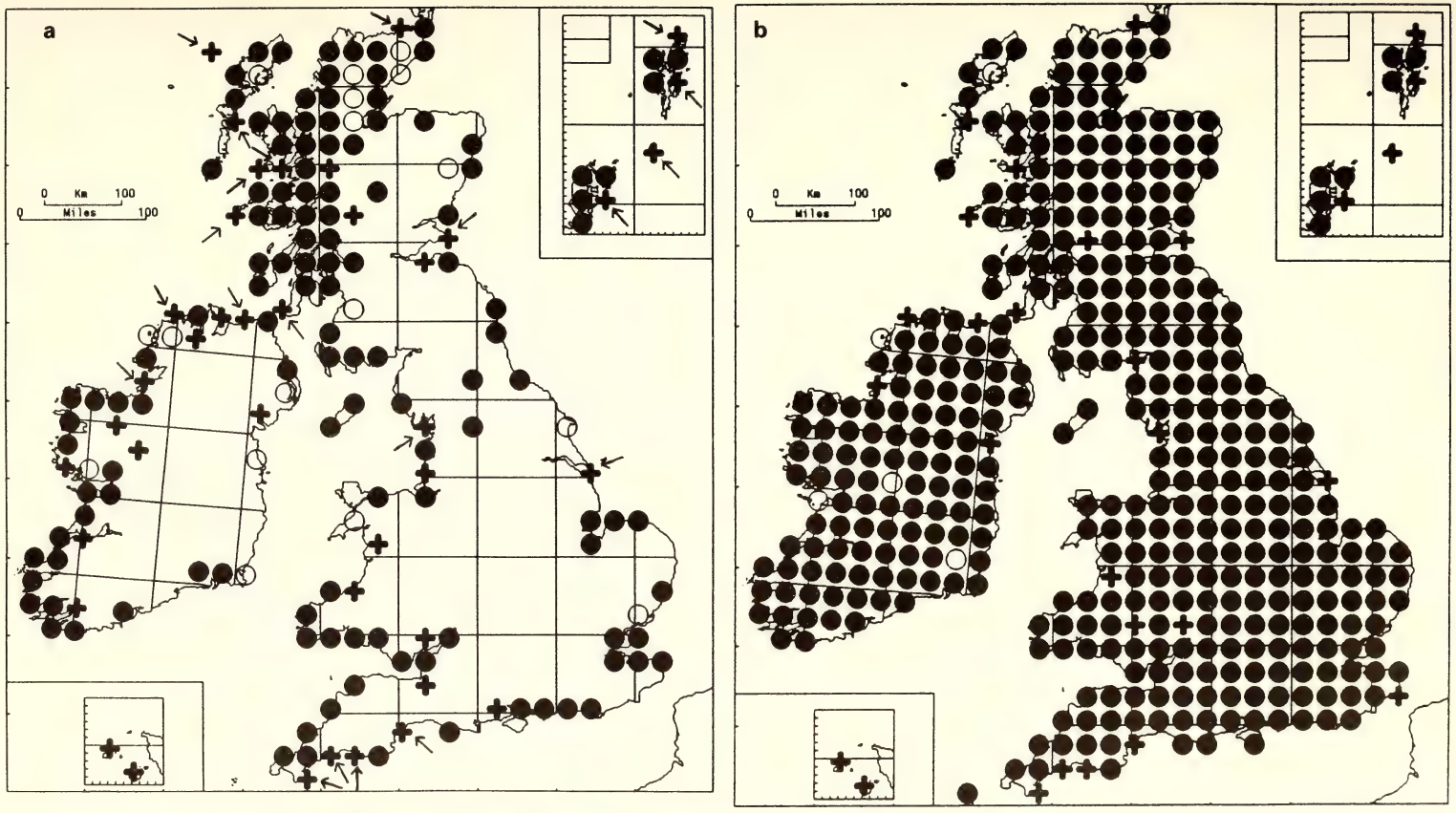
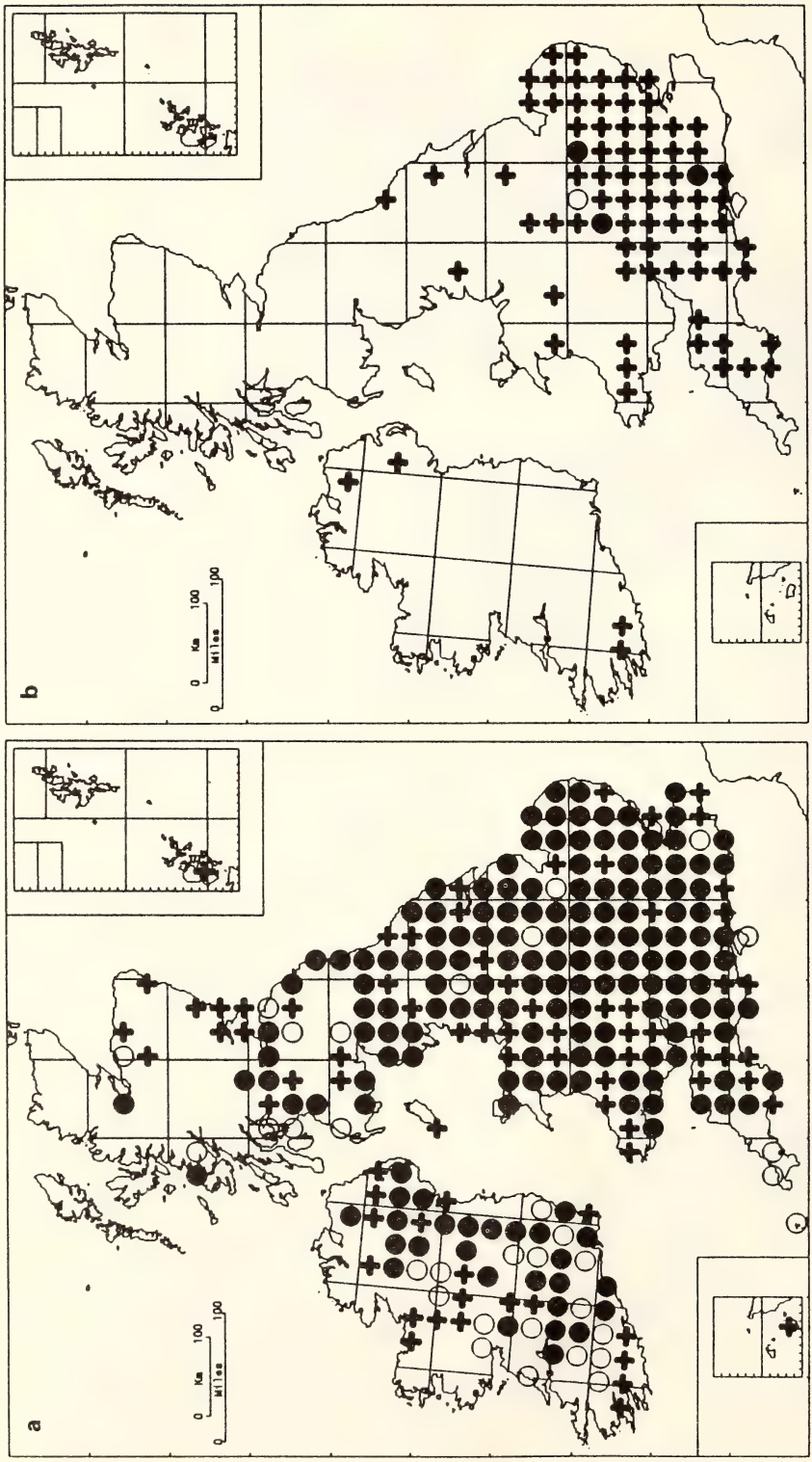


FIGURE 10. Apparent changes due to differences in areas surveyed: (a) Apparent increases in *Plantago maritima* due to increased recording of coastal squares (coastal squares not recorded for the *Atlas* are arrowed); (b) *Trifolium repens*, increases in coastal squares are again visible, and the apparent losses in Ireland are due to squares recorded for the *Atlas* not being re-recorded for the Monitoring Scheme.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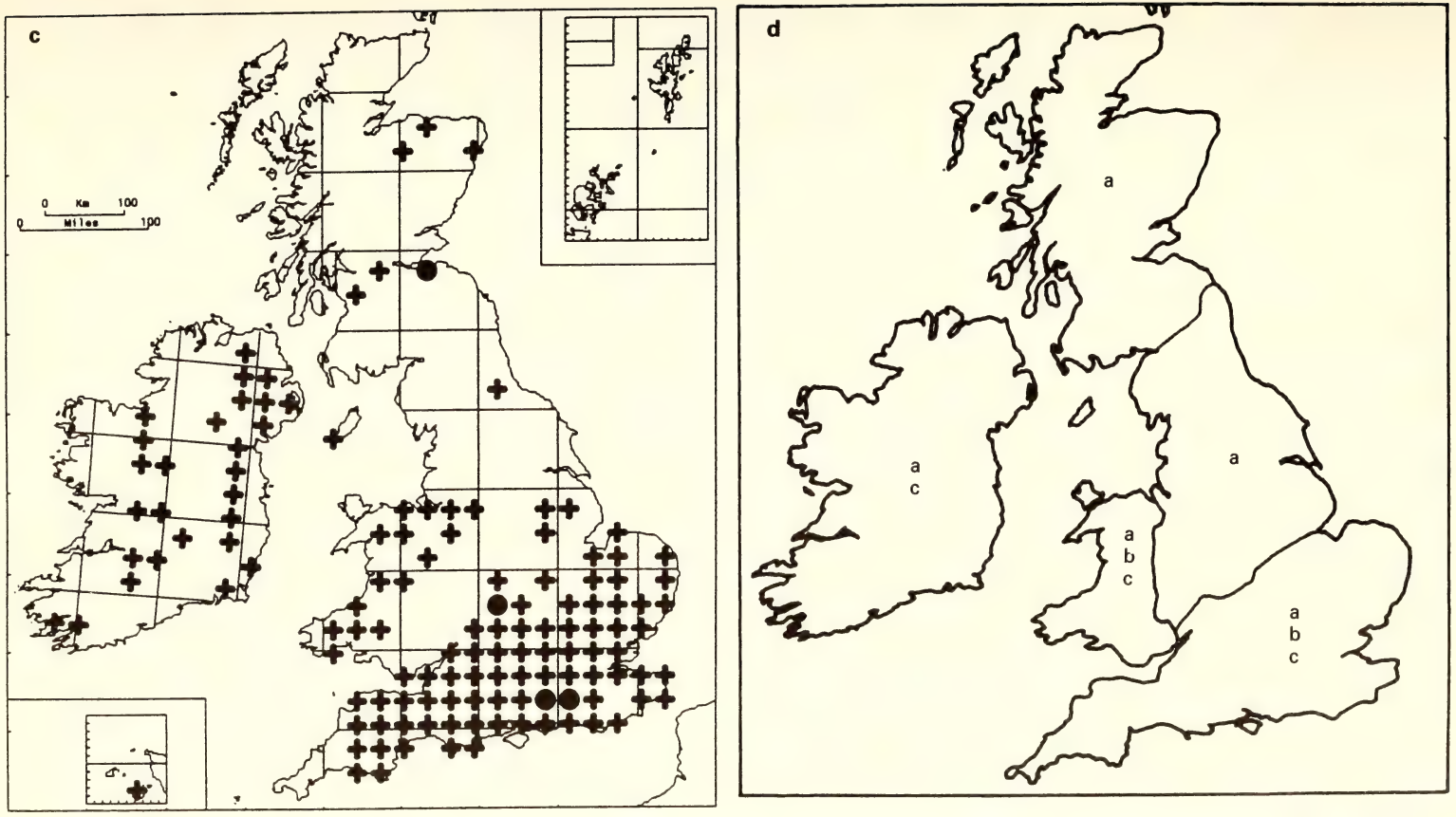

FIGURE 11. Correlations between taxa listed on the record cards and records of the taxa: (a) *Malus sylvestris* sensu lato; (b) *Malus sylvestris* sensu stricto; (c) *Malus domestica*; and (d) taxa listed on the cards (a, b and c as above).

TABLE 1. NUMBER OF 10-KM SQUARES RECORDED AND NUMBER OF RECORDS PER YEAR FOR THREE SPECIES OF ARABLE WEED FOR 1930–1960 AND 1987–1988 BASED ON RECORDS FROM THE B.S.B.I. MONITORING SCHEME SAMPLE SQUARES ONLY

	Number of 10-km squares recorded		Number of records per year	
Species	1930–60	1987–88	1930–60	1987–88
Agrostemma githago	29	7	0·94	3·5
Ranunculus arvensis	55	14	1·77	7
Scandix pecten-veneris	71	6	2·3	3

Trifolium repens is a virtually ubiquitous species present all year, and its seasonal recording pattern would therefore be expected to be similar to that of all records; Fig. 12b shows that it is.

Histograms for species showing seasonal variations in occurrence are shown in Figs 12c–e. *Adoxa moschatellina* is a perennial herb of woodlands and waysides with a very short period of growth from about March to June, after which it withers rapidly and disappears. *Hyacinthoides non-scripta* is also primarily a plant of the spring, but the fruiting stalks persist and it is consequently recorded until late summer. *Spiranthes spiralis* is a perennial herb of calcareous grasslands which flowers in late August and September but whose leaves are usually absent during the summer (Wells 1967). In these cases the seasonality of occurrence of the plants is matched by the records.

Two examples of changes in apparency are shown in Figs 12f & 12g. *Arum maculatum* is a perennial herb of woodlands, hedgerows and waysides, etc. throughout Britain and Ireland. It is conspicuous in spring when the leaves and inflorescences appear, but becomes less obvious in summer when the leaves die back, the fruiting heads are small and green, and other vegetation grows up around them. In August, the fruits begin to ripen and turn red, and the plants once again become conspicuous. These changes in apparency are reflected by the bimodal nature of the records; note that the plant is present in the summer but relatively under-recorded. The seasonality of records of *Viscum album*, an evergreen parasitic herb usually of deciduous trees and shrubs, is not quite as might be predicted. Records increase to May and then decrease, presumably related to the appearance of leaves on the trees. A rise in records might be predicted again in October when leaves are shed, but there is a surprising peak in August instead; the cause of this peak is not known. The small increase at Christmas may not be coincidence.

Fig. 12h shows the seasonality of records of *Salicornia europaea* sensu stricto. *Salicornia* is a critical genus (e.g. Rich & Rich 1988) whose species can only be reliably distinguished in autumn when in fruit, and Fig. 12h reflects this. *Salicornia* records not determined to species show a much broader spread of records as expected. Other similar examples of taxa which can only be identified at certain times of year include *Ruppia*, *Taraxacum* and *Hieracium*.

Such seasonal biases may influence assessments of change with time and might be reflected in the distribution maps. Fig. 13 shows 10-km squares which were not recorded before July or after June for the Monitoring Scheme in 1987 and 1988. Autumn and spring species might be expected to be under-recorded in these squares.

Perring & Walters (1962) noted that some species had died down before observers had arrived to record them for the *Atlas*, and thus appear to be rarer on the maps than they actually are. This effect was particularly marked in S.W. Ireland due to the early flowering season and the remoteness of the south west from the main centres of botanical activity. This is shown by the Monitoring Scheme results for one vernal species, *Anemone nemorosa* (Fig. 14a). The six new records for the Monitoring Scheme in S.W. Ireland are a direct result of more work earlier in the season; five of these new records are for squares visited early in the year (compare Fig. 14a with Fig. 13). No doubt the species also occurs in some of the squares only visited later. Similar results are shown for other vernal taxa such as *Ranunculus ficaria*. An increase in *Chrysosplenium oppositifolium* in Ireland (Fig. 14b), another species most conspicuous early in the year but present all season, may also be explained by this phenomenon.

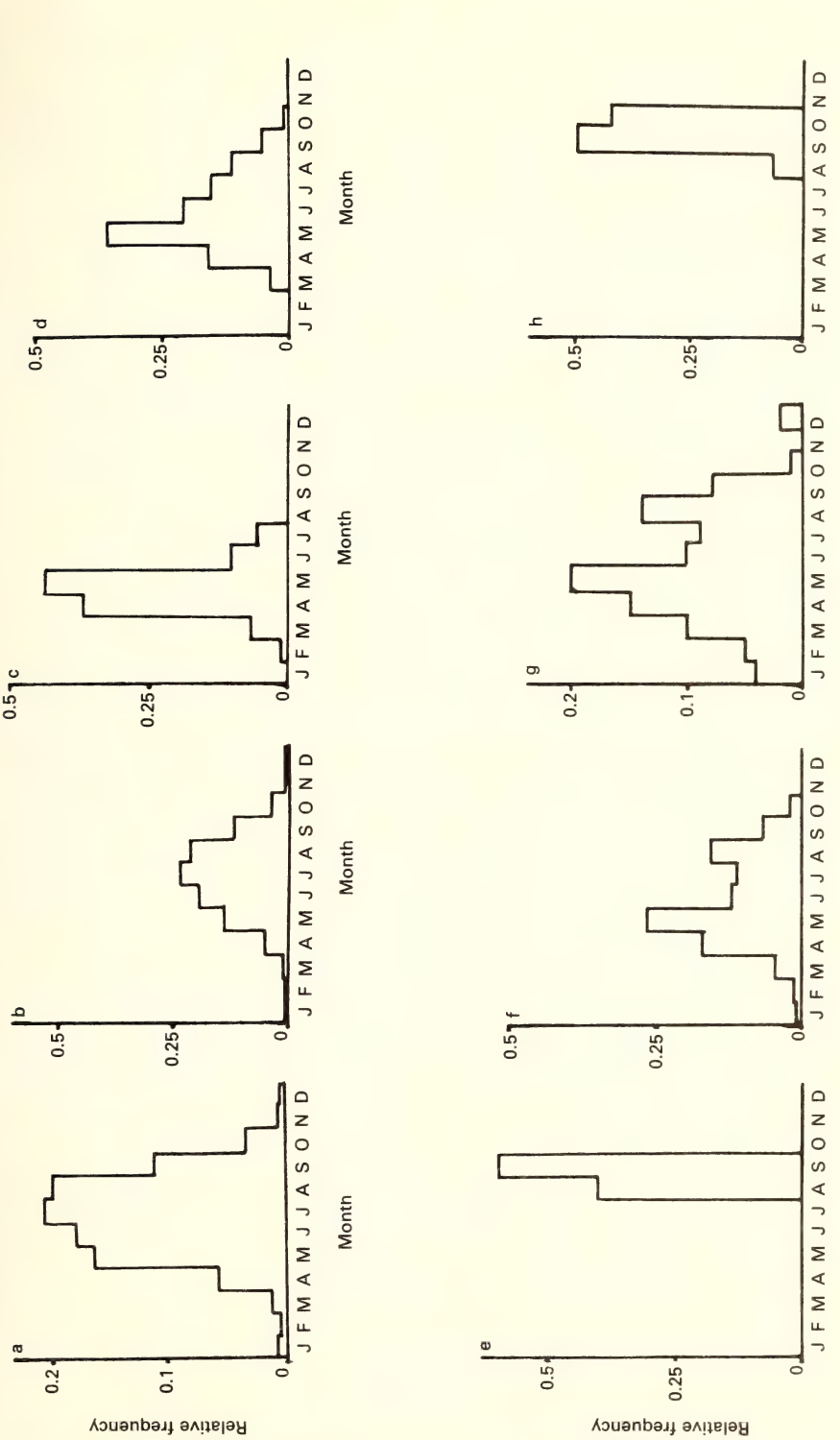

FIGURE 12. Histograms showing relative numbers of records per month for selected species recorded during the Monitoring Scheme in 1987 and 1988: (a) all records; (b) *Trifolium repens*; (c) *Adoxa moschatellina*; (d) *Hyacinthoides non-scripta*; (e) *Spiranthes spiralis*; (f) *Arum maculatum*; (g) *Viscum album*; (h) *Salicornia europaea* sensu stricto.

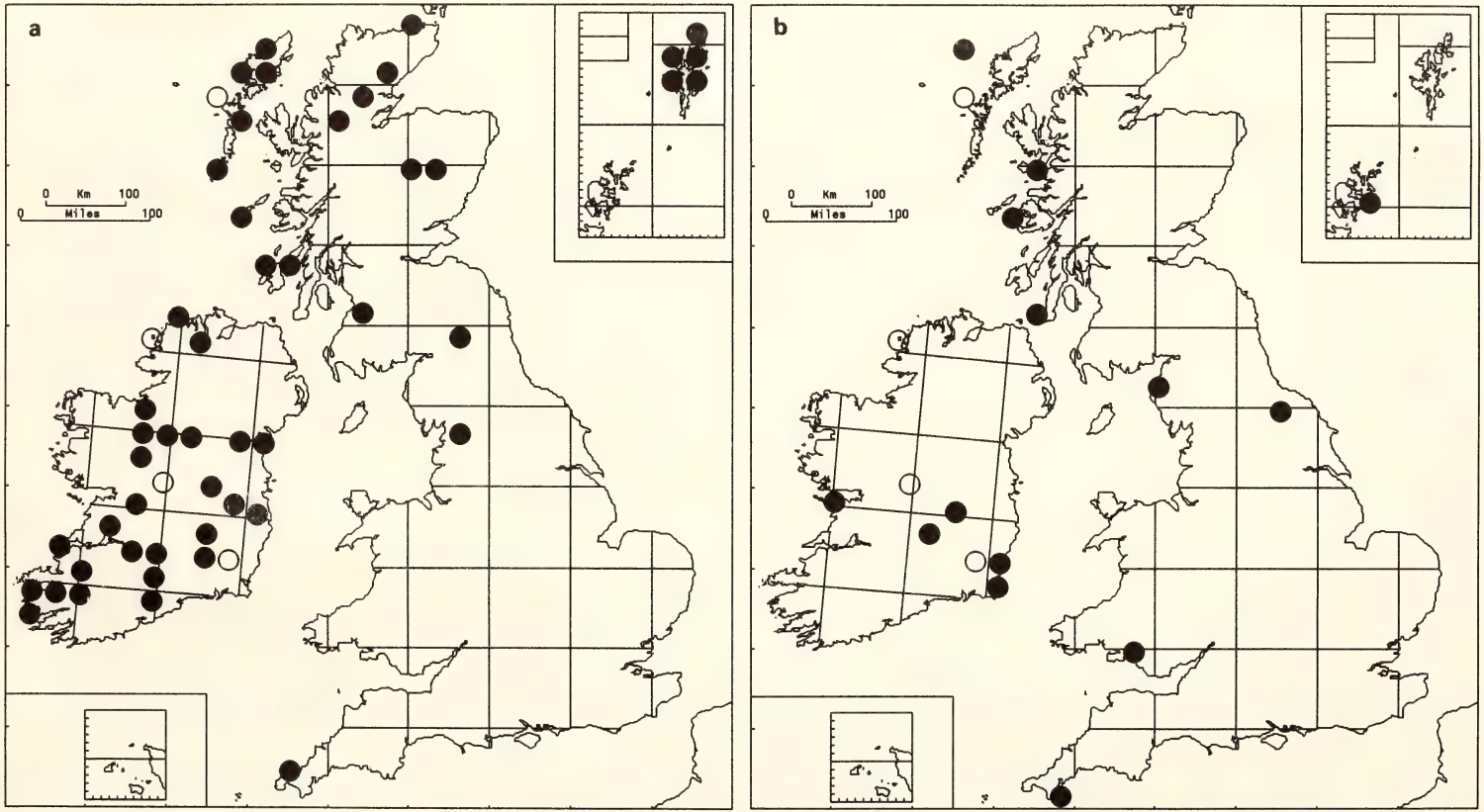

FIGURE 13. 10-km squares with a seasonal bias to the records for the Monitoring Scheme in 1987 and 1988: (a) squares not recorded before July; (b) squares not recorded after June. 10-km squares not recorded for either survey are shown as open circles.

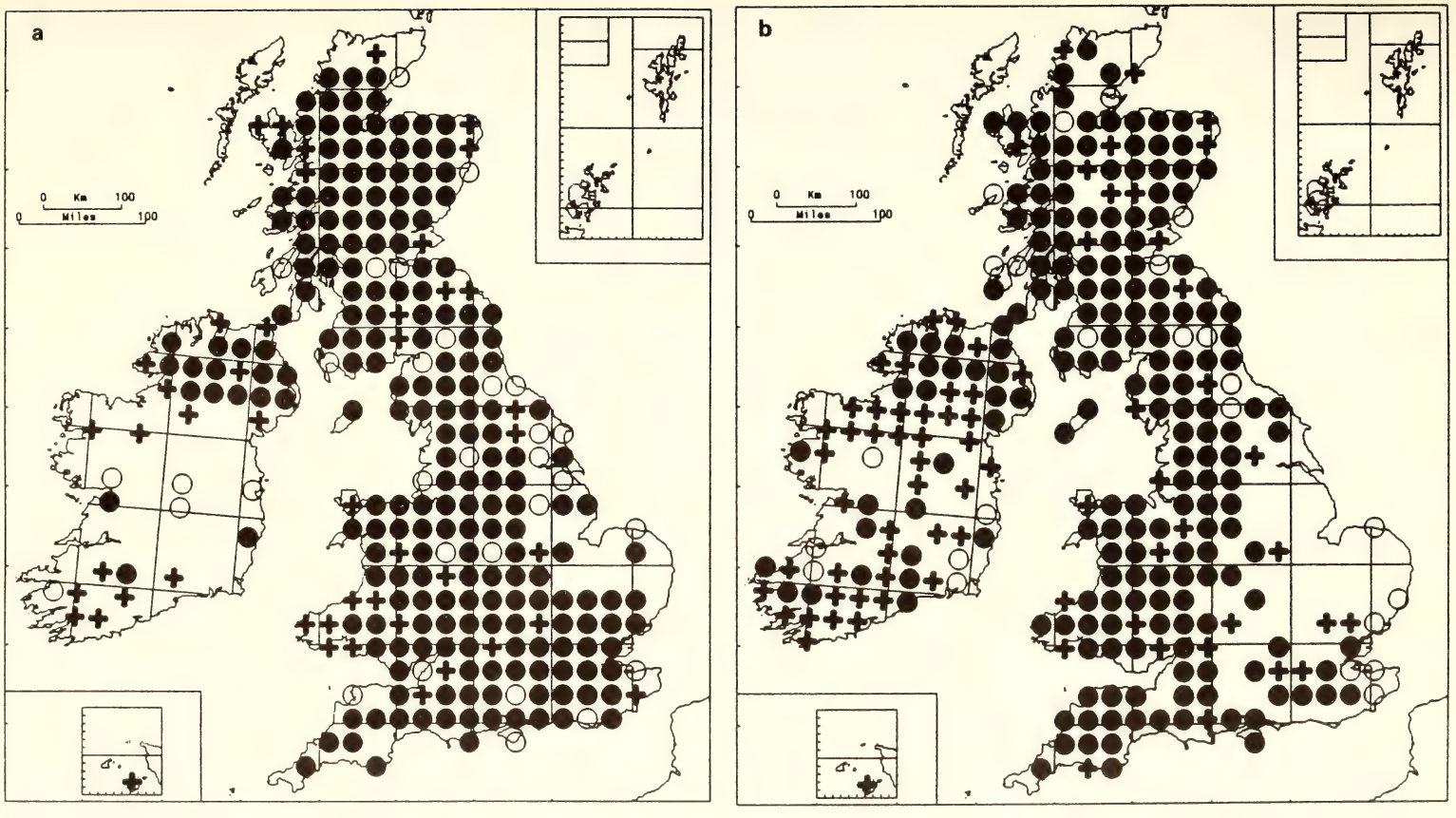

FIGURE 14. Taxa probably under-recorded in S.W. Ireland due to seasonal bias: (a) *Anemone nemorosa*; (b) *Chrysosplenium oppositifolium*.

DISCUSSION

It is clear from the examples above that recording bias is widespread in data collected for the *Atlas* and for the Monitoring Scheme. Approximately one third of the taxa analysed for the Monitoring Scheme were found to have unacceptable degrees of recording bias which could not be corrected. More than one form of bias may also be present – all examples presented here include a bias of greater recording effort (Rich & Woodruff 1990, 1992) for the Monitoring Scheme. Presumably biases similar to those presented here occur in most other botanical surveys, though they are rarely pointed out.

The extent of recording bias indicates that care should be taken with interpreting sets of records. Assessing recording bias is difficult and requires intimate knowledge of the taxa concerned, how they are recorded now and how they were recorded in the past, their habitats, general distribution and frequencies, variations in the quality and quantity of recording, etc. Although each case has to be judged on its merits, a few generalizations can be made:

1. Critical, infraspecific, hybrid and the more obscure taxa will generally show larger amounts of recording bias related to individual recorders.
2. Aliens, casuals, garden escapes, forestry trees, crops and deliberately planted taxa may be less consistently recorded than native species.
3. Areas briefly covered by few botanists will be less consistently recorded than areas well-covered by many botanists.
4. Localized areas may show considerable bias related to the activities of individual recorders.
5. Some habitats with difficult or limited access (e.g. mountains, cliffs, water) will be relatively poorly recorded. Others with easy access (e.g. car-parks, churchyards) may be well-recorded.
6. Large, obvious or clumped taxa will be more consistently recorded than small, inconspicuous or widely dispersed ones. Abundant species will be more consistently recorded than rarer species but national rarities tend to be well documented.
7. Species characteristic of the beginning and end of the field season will be less consistently recorded than those in mid season.
8. The number of records will primarily be dictated by recording effort put into collecting them.
9. Methods of survey may introduce systematic bias.

As records accumulate, the influence of recording bias will diminish, provided that adequate quality control is exercised. Experience is required to judge whether the bias is large enough to affect the interpretation of the records. It is easier to spot bias by comparing two similar surveys than to assess it in isolation.

The widespread occurrence of recording bias suggests that information about recorders and their behaviour should be collected and analysed as carefully as information about the organisms themselves. Unrecognised bias in a sample of records will result in an incorrect interpretation of the data. Those who collect, compile and present the data should therefore also provide interpretation to guide those unfamiliar with the problems.

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A method for predicting the probability of species occurrence using data from systematic surveys

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ABSTRACT

Presence data for species in 2-km squares, recorded systematically during the B.S.B.I. Monitoring Scheme, were smoothed to derive probability response surfaces for *Euonymus europaeus* L., *Hyacinthoides non-scripta* (L.) Chouard ex Rothm., *Trientalis europaea* L. and *Veronica montana* L. Logistic regression was used to predict species frequencies from the response surfaces together with information on species occurrence in 10-km squares. Predicted frequencies were compared with those reported in some recent county floras. Agreement was generally good, but county differences in recording intensity were apparent.

INTRODUCTION

Accurate information on the spatial distribution of plants is now needed more than ever as human impacts on the environment intensify. Agricultural expansion and intensification (Green 1989), atmospheric pollutants (e.g. nitrogen compounds – see Tamm 1991) and climate change (Huntley *et al.* 1989) – thought to be a consequence of the increasing release of 'greenhouse' gases – are all seen to result in habitat change and species loss. Some gains are also to be expected as governments try to reduce agricultural surpluses by extensification and habitat creation, for example planting new woods on farms (Insley 1988).

Currently, and perhaps foreseeably, it is not possible to predict the presence or absence of a species from a knowledge of environmental factors and autecological characteristics alone. Prediction is dependent on good floristic survey data. Plant distribution maps with 10-km square resolution (Perring & Walters 1976), and local floras with tetrad (2-km square) resolution, are examples of such data for Britain. Dony (1963) described how floristic surveys can be used to predict the numbers of species occurring in tetrads. Hill (1991) demonstrated a method for using environmental data to estimate the probability of finding bird and plant species in 10-km squares. He concluded that the quality of the estimates varied with habitat preference, and that those species with strong edaphic requirements (e.g. *Helianthemum nummularium* (L.) Miller) were only poorly predicted in a broad-scale analysis.

For many species, the frequency of occurrence in tetrads provides a better indication of local abundance than a map of distribution at the 10-km square scale. However, a complete survey of vascular plants in Britain and Ireland at the tetrad scale would hardly be feasible, even if it were desirable. Fortunately, a systematic survey of a selected subset of tetrads not only is feasible but was accomplished by the B.S.B.I. Monitoring Scheme (Rich & Woodruff 1990). Data from this survey can be used to estimate the probability of finding species in tetrads that were not surveyed, and hence give an indication of local frequency.

The main purpose of this paper is to develop and compare methods for estimating such probabilities, using data from the Monitoring Scheme and other systematic surveys. In addition, we show how probability estimates can be used to generate species frequency maps at the national scale.

MATERIALS AND METHODS

The B.S.B.I. Monitoring Scheme (funded by the Nature Conservancy Council and the Department of the Environment, Northern Ireland) was a survey carried out in 1987 and 1988 and administered

TABLE 1. SAMPLING STATISTICS FOR THE B.S.B.I. MONITORING SCHEME
The British subset used in this work excludes data from Ireland and the Channel Islands.

Sample units	Sample size	Actual number surveyed	Number in British subset
10-km squares	429	425	298
Tetrads (A, J & W only)	1114	1080	796
Mean number of tetrads per 10-km square	2·60	2·54	2·67

through *B.S.B.I. News* (see Ellis 1986; Rich 1986, 1987, 1988, 1989). For the survey, one in nine of the 10-km squares were systematically selected from the British and Irish National Grids. Within selected 10-km squares, presence records for plant species were recorded in each of three systematically positioned tetrads (designated A, J and W). Some tetrads did not contain land, so that, on average, slightly fewer than three tetrads were sampled per 10-km square (Table 1). The Monitoring Scheme data are held by the Biological Records Centre (B.R.C.) at the Institute of Terrestrial Ecology (I.T.E.), Monks Wood. They are in ORACLE database format on a VAX computer cluster running under VMS (Rich & Woodruff 1990).

Records of species presence or absence in tetrads were smoothed to a response surface whose z-axis value is the probability of finding that species in the local tetrad. Each smoothed value is a weighted average of the neighbouring values, with weights specified by the bivariate Gaussian function with a root-mean-square deviation 30 km (Fig. 1). This smoothing radius was chosen because 30 km is the spacing of the Monitoring Scheme 10-km squares. A smaller radius would result in a response surface that showed marked local variation, reflecting frequencies in individual 10-km squares.

The smoothed value is

$$p_i = \frac{\sum_{k=1}^{n} w_k \alpha_{ik}}{\sum_{k=1}^{n} w_k}$$

where $w_k = \exp(-(x_k^2 + y_k^2)/r^2)$, p_i = estimated probability of finding the i^{th} species in the target tetrad, w_k = weight assigned to the k^{th} tetrad in the sample area, α_{ik} = value (1 or 0) specifying presence or absence of the i^{th} species in the k^{th} tetrad, r = smoothing radius (30 km), and x_k and y_k are the easting and northing distances of the k^{th} tetrad from the target tetrad. A smoothing radius of 30 km ensures that 98% of the weight comes from within a 60 km radius. Note that the summation is taken over tetrads surveyed for the Monitoring Scheme. A tetrad near the coast is given a smoothed value by averaging over nearby tetrads inland. This average is taken over a smaller number of points than for a non-coastal position, but is not otherwise affected by proximity to the sea.

Since presence and absence data are not normally distributed, the method of logistic regression analysis (cf. Jongman *et al.* 1987) was used to estimate species frequency in 10-km squares. Each Monitoring Scheme 10-km square was allocated a species frequency value which was calculated as the ratio of the number of occupied tetrads to the number of recorded (maximum three) tetrads. These values were regressed against the mean of the expected probabilities, estimated from the response surface, averaging probabilities over all the tetrads (25 maximum) within that square. Two models were considered: firstly, a model using only the spatially smoothed probability as independent variable (Model 1 below); secondly, a model (Model 2) using the spatially smoothed probability together with 10-km presence and absence data. For this purpose, 10-km data were obtained from the records held by B.R.C. at I.T.E., Monks Wood. These data comprise validated plant records from a variety of sources and were the records used to plot the *Atlas of the British flora* (Perring & Walters 1976).

The regression models, fitted by means of generalized linear modelling using the GENSTAT computer package, were

$$\log_e \left(\frac{q_i}{1-q_i}\right) = a_i + b_i \bar{p}_i \qquad \text{Model 1}$$

$$\log_e \left(\frac{q_i}{1-q_i}\right) = a_i + b_i\bar{p}_i + c_iB_i \qquad \text{Model 2}$$

where q_i = probability of finding the i^{th} species in a given tetrad of a Monitoring Scheme 10-km square, $\bar{p}_i$ = mean estimated probability of occurrence smoothed over the tetrads in the 10-km square, B_i = presence or absence (one or zero) of the i^{th} species in the 10-km square, and a_i, b_i & c_i are constants.

The accuracy of the smoothed probability surface was further investigated using a validation set of data from independent surveys obtained from a selection of those English county Floras meeting three criteria. Firstly, publication had to be relatively recent; secondly, records had to be available in atlas form for ease of data extraction; thirdly, mapping had to be at tetrad or 1-km square resolution. Those selected were for Bedfordshire (Dony 1976), Devon (Ivimey-Cook 1984), Durham (Graham 1988), north-east Essex (Tarpey & Heath 1990), Hertfordshire (Dony 1967), Kent (Philp 1982), Leicestershire (Primavesi & Evans 1988) and Sussex (Hall 1980). None of the available atlases from Wales or Scotland met the criteria (McCosh 1988). Only those 10-km squares falling wholly within the county (or vice-county) boundaries were considered. For each species and each 10-km square a table of presences out of the number of tetrads per 10-km square (25) was produced. For the north-east Essex Flora the published data are for 1-km squares and were summarized for each tetrad prior to processing.

Data from the county atlases were compared with both point estimates from simple Gaussian smoothing and predicted values from each of the logistic regression models. The basis for the comparison was the average number of presences in tetrads per 10-km square, county by county. Analysis of variance was used to test the significance of differences. Accuracy of predictions was measured by the root-mean-square difference between predicted and observed values.

To illustrate the technique we have selected four species, namely *Euonymus europaeus* L., *Hyacinthoides non-scripta* (L.) Chouard ex Rothm., *Trientalis europaea* L. and *Veronica montana* L. *E. europaeus* is a southern species of calcareous soils. *T. europaea* is a boreal species having a requirement for cooler northern winters. The other two species are generally distributed in older woodlands, but *H. non-scripta* is much the commoner of the two. Tetrad presences and absences (obtained from the B.S.B.I. Monitoring Scheme database) for each species have been plotted in Fig. 2. Version 6 of the UNIRAS computer package (I.U.C.C. Information Services Group 1989) was used for this and subsequent distribution maps and figures. Orkney and Shetland have been omitted. For them, as for the Isle of Man (which was included, but which had only three tetrads), a larger smoothing radius than 30 km might be desirable.

RESULTS

The response surfaces obtained by Gaussian smoothing are illustrated in Fig. 3. Regression coefficients and significance levels for Models 1 and 2 are shown in Table 2. Highly significant results can be expected because the independent regression variables were derived from the observed values (dependent variables) by smoothing. Both Models 1 and 2 contain the derived variable $\bar{p}_i$.

The comparisons between county atlas records and the estimated values from Gaussian-smoothed and regression models are shown in Table 3. The Gaussian-smoothed values were obtained by summing p_i for each tetrad in the 10-km square; predicted values from Models 1 and 2 were obtained by inserting appropriate $\bar{p}_i$ values into the regression equations to obtain values of q_i. Although many of the estimated values were close to those expected from the county Floras there were some substantial differences (Table 3).

The mean deviation (bias) was smallest for the prediction method using Model 2, but the bias of all three methods was small and not statistically significant (Table 4). The root-mean-square error for Model 2 was less than for Model 1 and approached that of the Gaussian-smoothed probabilities. The analysis of variance shows no effect due to species but a highly significant county effect. The bulk of the county effect can be attributed to underestimation by the three methods of tetrad frequencies in Kent and possible over-estimation in Bedfordshire.

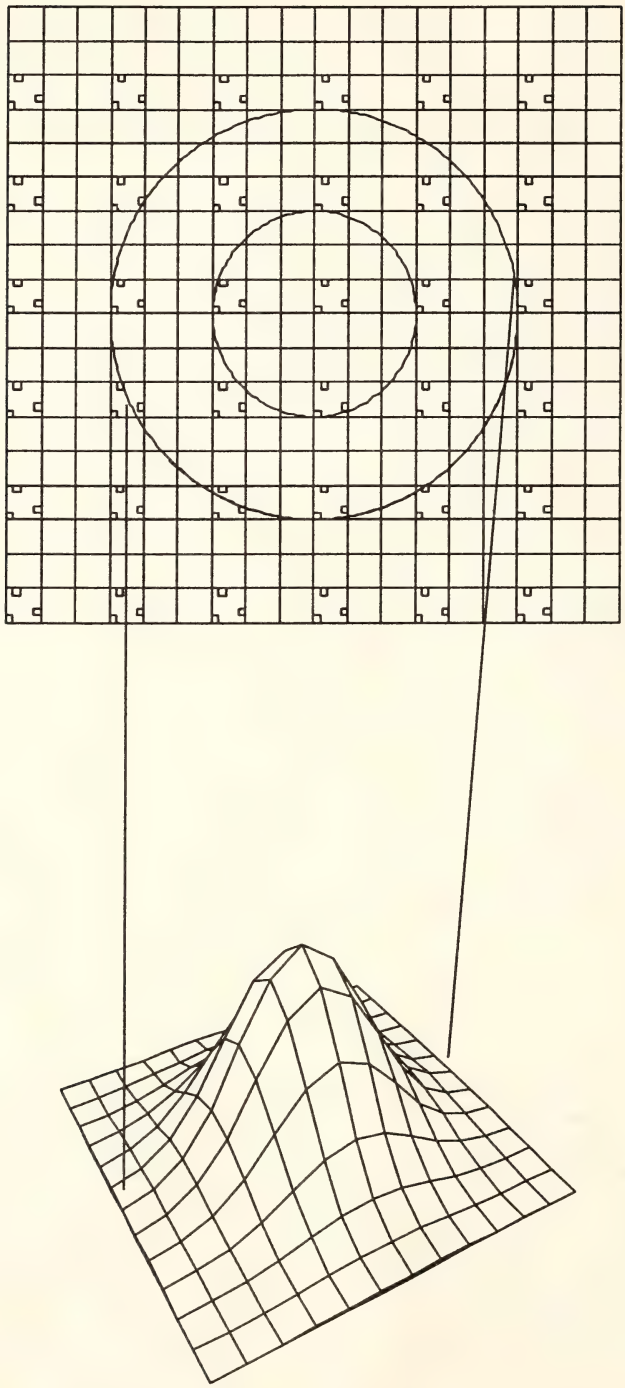


FIGURE 1. Gaussian smoothing of occurrence in tetrads (2-km squares). At any point in Britain the probability of a species being found in that tetrad is estimated as a weighted mean local frequency. Weights are defined by a Gaussian function with root-mean-square deviation 30 km. The diagram shows the weight function projected on to a 10-km square grid with the A, J and W tetrads for the one-in-nine sample indicated.

TABLE 2. LOGISTIC REGRESSION OF OBSERVED AGAINST PREDICTED FREQUENCIES IN 10-KM SQUARES OF THE B.S.B.I. MONITORING SCHEME

Coefficients a_i, b_i and c_i are defined in the text for Models 1 and 2. Degrees of freedom were (1, 296) for Model 1 and (2, 295) for Model 2.

Species	a_i	b_i	c_i	Deviance explained (%)	Significance
		Model 1			
Euonymus europaeus	−4·27	8·50	—	74·3	p<0·001
Hyacinthoides non-scripta	−3·86	7·40	—	69·2	p<0·001
Trientalis europaea	−5·51	11·71	—	83·3	p<0·001
Veronica montana	−3·90	9·29	—	62·7	p<0·001
		Model 2			
Euonymus europaeus	−10·35	6·35	7·34	80·8	p<0·001
Hyacinthoides non-scripta	−10·28	6·86	6·80	71·9	p<0·001
Trientalis europaea	−10·20	7·68	6·73	87·9	p<0·001
Veronica montana	−10·81	7·65	7·67	72·1	p<0·001

TABLE 3. OBSERVED (1) AND PREDICTED (2–4) NUMBERS OF TETRADS OCCUPIED BY SPECIES PER 10-KM SQUARE IN SELECTED COUNTIES

1 – average number of tetrads occupied according to the county atlases; 2 – expected value using the Gaussian-smoothed Monitoring Scheme data; 3 and 4 – expected values using regression models 1 and 2 respectively.

	Beds.	Devon	Durham	Essex	Herts.	Kent	Leics.	Sussex	Total
n	5	49	15	7	5	22	10	24	137
				Euonymus europaeus					
1	11·4	9·8	0·0	13·0	15·2	19·7	0·4	15·4	11·0
2	15·7	14·1	0·0	15·1	19·6	8·0	0·5	11·4	10·4
3	18·4	15·4	0·4	17·5	22·9	4·8	0·4	11·3	10·7
4	18·0	11·4	0·3	13·0	21·9	7·0	0·7	11·3	9·4
				Hyacinthoides non-scripta					
1	14·8	20·1	13·1	15·6	20·2	23·2	14·4	23·8	19·6
2	20·1	18·8	17·0	19·4	22·8	13·2	8·3	18·4	17·1
3	21·8	20·4	18·8	21·6	23·6	12·8	5·8	20·4	18·2
4	21·8	20·4	16·7	21·4	23·4	13·2	5·7	20·4	18·0
				Trientalis europaea					
1	0	0	0	0	0	0	0	0	0
2	0	0	0·2	0	0	0	0	0	0
3	0·2	0·1	0·1	0·1	0·2	0·1	0·1	0·1	0·1
4	0	0	0·1	0	0	0	0	0	0
				Veronica montana					
1	0·8	12·0	6·9	5·0	11·0	14·2	3·6	16·0	11·1
2	4·1	13·2	11·4	7·2	10·0	6·1	3·1	10·5	9·9
3	2·4	17·0	14·5	6·0	11·5	5·9	1·5	12·4	11·7
4	2·7	15·2	11·8	6·7	12·1	6·7	1·4	11·9	10·9

n = number of 10-km squares.

DISCUSSION

Smoothed distribution maps (Fig. 3) demonstrate the potential of the Monitoring Scheme data for depicting probabilities of occurrence in tetrads. Similar smoothed maps could be used in future to compare survey and re-survey results given a common survey protocol.

The ability of all the methods, including simple Gaussian smoothing and regression, to predict the

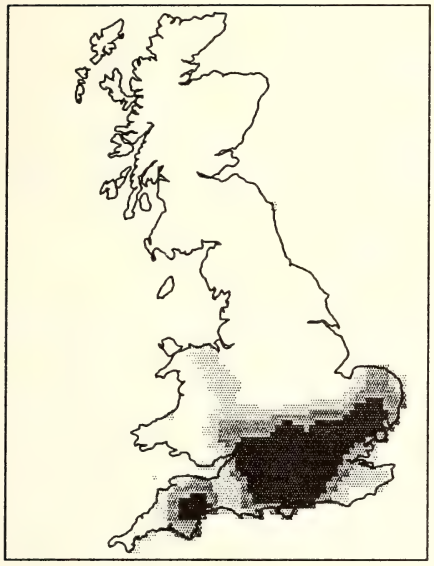
Euonymus europaeus

Hyacinthoides non-scripta

Trientalis europaea

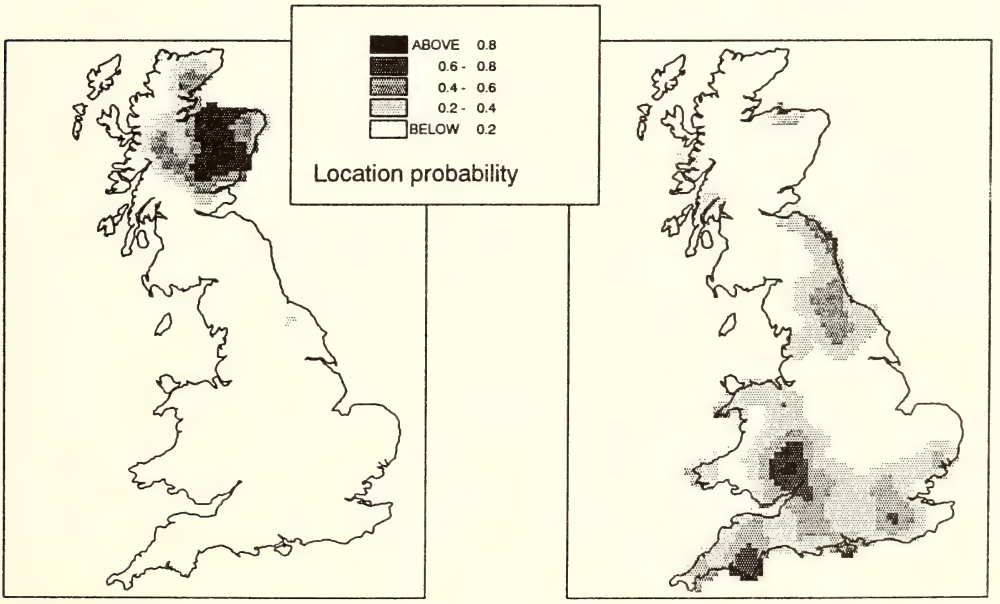
Veronica montana

FIGURE 2. Species occurrence in tetrads (2-km squares) recorded during the B.S.B.I. Monitoring Scheme.



Euonymus europaeus

Hyacinthoides non-scripta



Trientalis europaea

Veronica montana

FIGURE 3. Probabilities of species occurrence in tetrads (2-km squares), estimated by smoothing the data in Fig. 2 with a Gaussian function.

TABLE 4. ANALYSIS OF THE DIFFERENCES BETWEEN TETRAD FREQUENCIES FOR 10-KM SQUARES, COMPARING FREQUENCIES OF *EUONYMUS EUROPAEUS*, *HYACINTHOIDES NON-SCRIPTA* AND *VERONICA MONTANA* PREDICTED FROM THE MONITORING SCHEME WITH THOSE OBSERVED IN COUNTY FLORAS

Models 1 and 2 are defined in the text. Method effect refers to tests of the null hypothesis that the mean deviation is zero.

Observed mean county density	Mean deviation (bias)	RMSE	Method effect t_{14}	Species effect $F_{2,14}$	County effect $F_{7,14}$	Kent vs others $F_{1,14}$
Gaussian smoothed	−0·50	4·91	−1·05 ns	0·25 ns	13·11 ***	56·6 ***
Regression Model 1	0·32	6·10	0·46 ns	0·10 ns	8·88 ***	39·0 ***
Regression Model 2	−0·19	5·34	−0·36 ns	0·00 ns	8·97 ***	37·6 ***

RMSE = root-mean-square error; ns = not significant; *** = $p<0·001$.

B.S.B.I. Monitoring Scheme data was generally quite good. The mean deviation (bias) was smallest for the prediction method using Model 2, the root-mean-square error indicating its advantage over Model 1. However the error was least for simple Gaussian smoothing.

There was a notable and statistically very significant difference between counties (Table 4). In terms of effort per tetrad, Kent was more intensively surveyed for the county Flora than for the Monitoring Scheme, whilst Bedfordshire was less so. In any survey the uniformity of sampling effort is of great importance. The B.S.B.I. Monitoring Scheme was carefully controlled with this objective (Rich & Woodruff 1990), but differences must inevitably have occurred. Variation also exists between the county Floras, some being over-sampled in comparison with the Monitoring Scheme, whilst others were relatively under-sampled.

For validation we have selected county Floras with a high and fairly uniform sampling coverage. Even though the per-tetrad effort may sometimes have been less than that achieved by the Monitoring Scheme, overall they will all have had more intensive sampling. Thus the resolution of the response surfaces produced from the Monitoring Scheme will be poorer than those which could be obtained from the county Floras. In general we would expect those species with a fairly general but patchy distribution, such as those requiring habitats in old woods, to be less easy to predict than those species with distributions depending on some more widespread factor of the physical environment such as climate or soil type. This seems to be the case when comparing the deviances explained for *E. europaeus* and *T. europaea* on the one hand, with *H. non-scripta* and *V. montana* on the other (Table 2). It is also supported by the closer agreement between overall county atlas data and the Gaussian-smoothed response surface (rows 1 and 2 in Table 3) for *E. europaeus* than for *H. non-scripta* and *V. montana*.

The ability to predict species presence or absence using regression methods also seems to be somewhat species-specific (Table 2). Those whose distribution is strongly restricted by specific environmental factors such as climate (*E. europaeus* and *T. europaea*) are seen to be better predicted than the others. Predictions were substantially improved by including information on 10-km square occurrence (Model 2). It is interesting that the coefficients a_i, b_i, c_i in Model 2 were so close in value that a single regression would have sufficed for all four species.

One of the main advantages of the logistic regression approach is that it can readily be extended to include other information (Le Duc *et al.* 1992). Such information might include, for instance, soil type (Avery 1973) and local climate (Bendelow & Hartnup 1980). Perhaps more important for many widespread species would be inclusion of additional habitat information such as the presence of woods, rivers, or a coastline. Such information is now becoming available in, for instance, the I.T.E. land classification database (Bunce *et al.* 1981). The more accurately the present frequency of a species can be estimated the better we shall be able to detect change in the future.

CONCLUSIONS

In Great Britain, sufficiently good survey data are now available to derive reliable national estimates of the probability of species occurrence in tetrads. Such estimates can be validated using

independent data from county Floras. Using Gaussian-smoothed data from the Monitoring Scheme, combined with additional information about each tetrad, regression models can be developed which would improve the accuracy of estimates. These estimates can be used in future to detect the effects of major disturbances such as climate change or large-scale shifts in land use.

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The distinction between the *Festuca ovina* L. and *Festuca rubra* L. aggregates in the British Isles

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ABSTRACT

The *Festuca rubra* L. and *F. ovina* L. aggregates (Poaceae) are defined and reliable means of distinguishing them in the British Isles are given. The best character concerns the young tiller leaf-sheaths, which are tubular in the former and split and overlapping in the latter aggregate. Characters that are often used to separate the two aggregates but are unreliable and therefore frequently cause misidentification are also listed.

INTRODUCTION

Festuca ovina L. and *F. rubra* L. fall into section *Ovinae* Fries (= sect. *Festuca*) according to Hackel's (1882) classification of the genus in Europe. Apart from these two species, which were each subdivided into a complex hierarchy of subspecies, varieties and subvarieties, Hackel included only nine other species, none of them British. He divided the section into two groups: *Intravaginales*, including *F. ovina* and eight other species; and *Extravaginales vel Mixtae*, with *F. rubra* and *F. porcii* Hackel.

Markgraf-Dannenberg (1980) abandoned Hackel's infrageneric classification, placing the 170 European species that she recognised into a number of informal, unnamed groups. However, it is clear that 129 of these species would have been included in section *Ovinae* by Hackel. The increase from eleven to 129 over a period of 100 years is partly due to the description of newly discovered taxa, and partly due to a much narrower species concept that gradually developed.

All the British taxa now recognised were placed by Hackel (1882) into either *F. ovina* or *F. rubra*, which are for convenience here referred to as the *F. ovina* and *F. rubra* aggregates. These taxa are listed under the names used by Hackel, Markgraf-Dannenberg and us (Wilkinson & Stace 1991, Al-Bermani 1991) in Table 1.

Both the aggregates are very variable and also very important from both ecological and economic points of view. It is vital that plants of such importance are identified correctly, so it is particularly unfortunate that not only have the segregates of both aggregates been very widely misunderstood, but the two aggregates have been and are still frequently confused, particularly by British botanists. Virtually all the current British Floras, identification manuals and flower-guides that we have examined contain errors that would prevent accurate determination of at least some plants. Although most taxa of *F. ovina* agg. are easily separated from most taxa of *F. rubra* agg., certain taxa are not so easily placed. For example, within *F. ovina* agg., *F. lemanii* Bast. and *F. brevipila* Tracey are usually much more robust than, for example, *F. ovina* and are often misidentified as *F. rubra*. Conversely, *F. rubra* subsp. *commutata* Gaudin usually lacks rhizomes and is sometimes identified as a robust variant of *F. ovina* agg. In addition, pseudoviviparous variants of *F. rubra* are quite frequent and usually misdetermined as *F. vivipara* (L.) Sm., which belongs to the *F. ovina* agg. Although characters such as spikelet, lemma or awn lengths, leaf thickness and flatness and degree of adaxial ridging, culm height, degree of tuftedness and presence of rhizomes are important diagnostically in the section as a whole, they are of very little value on their own in distinguishing between the two aggregates, being in fact the most usual causes of confusion. Moreover, habitat preferences are of very limited value in separating these aggregates. For accurate determination it is

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TABLE 1. CLASSIFICATION OF *FESTUCA RUBRA* AND *F. OVINA* AGGREGATES IN THE BRITISH ISLES

Hackel (1882)				Markgraf-Dannenberg (1980)	Present paper
F. ovina	subsp. *eu-ovina*	var. *vulgaris*	subvar. *genuina*	*F. ovina*	*F. ovina* subsp. *ovina*
—				—	subsp. *hirtula*
			subvar. *guestphalica*	?*F. guestfalica*	
				F. ophioliticola	subsp. *ophioliticola*
			subvar. *firmula*	*F. lemanii*	*F. lemanii*†
		var. *capillata*		*F. tenuifolia*	*F. filiformis*
—				*F. armoricana*	*F. armoricana*
—				*F. huonii*	*F. huonii*
		var. *supina*	subvar. *vivipara*	*F. vivipara*	*F. vivipara*
		var. *glauca*	subvar. *caesia*	*F. longifolia*	*F. longifolia**
		var. *duriuscula*	subvar. *trachyphylla*	*F. trachyphylla*	
				F. brevipila	*F. brevipila*†
F. rubra	subsp. *heterophylla*			*F. heterophylla*	*F. heterophylla*
	subsp. *dumetorum*			*F. juncifolia*	*F. arenaria*
	subsp. *eu-rubra*	var. *genuina*	subvar. *arenaria*	*F. rubra* subsp. *arenaria*	
			subvar. *vulgaris*	subsp. *rubra*	*F. rubra* subsp. *rubra*
—				subsp. *litoralis*	subsp. *litoralis*
			subvar. *juncea*	subsp. *juncea*	subsp. *juncea*
			subvar. *pruinosa* (1885)	subsp. *pruinosa*	
		var. *planifolia*	subvar. *grandiflora*	*F. diffusa*	subsp. *megastachys*
		var. *fallax*		*F. nigrescens*	subsp. *commutata*
—				*F. richardsonii*	subsp. *arctica*
—				—	subsp. *scotica*

* The name *F. glauca* has often been wrongly applied to this species.
† The name *F. longifolia* has often been wrongly applied to these species.

important that all these misleading characters be abandoned and that attention be focused on the characters described in the next section.

The purpose of this paper is to provide infallible means of distinguishing between the *F. ovina* and *F. rubra* aggregates in the British Isles. Distinctions between the various segregates as listed in Table 1 have been detailed by Wilkinson & Stace (1991) for the *F. ovina* aggregate and will be detailed by Al-Bermani & Stace (in prep.) for the *F. rubra* aggregate. The data presented in the present paper have been gathered from many thousands of specimens, both living and preserved, over the past 20 years. Several hundred clones are grown and frequently studied in the University of Leicester Botanic Garden.

The characters discussed here would require some modification if they were to be used successfully in some other parts of Europe.

DIAGNOSTIC CHARACTERS

The first two characters below provide an infallible distinction between the two aggregates; the others may be useful guides but should not be relied upon.

TILLER LEAF-SHEATHS – FUSED OR OVERLAPPING

In almost all grass leaves there is a clear distinction between the sheath, which encircles the stem and/or developing leaves above, and the blade, which arises from the top of the sheath. In some cases this overlapping structure persists to the base of the sheath, i.e. to the stem-node below, but often it progresses only part of the way down to the node, becoming a fused tube further down. In other cases the sheath has no free overlapping edges, but is a fused tube from the node below right up to the mouth of the sheath. This is particularly characteristic of the genera *Glyceria* and *Melica*.

In the *Festuca rubra* aggregate the leaf-sheaths are tubular right up to or almost to the mouth, whereas in the *Festuca ovina* aggregate they have free overlapping edges for at least the upper 40% (and usually the upper 75%) of their length (Fig. 1). Only in very rare cases in the latter aggregate are the leaf-sheaths as much as 50% tubular.

This difference is very clear-cut, but careful examination (preferably with a lens) must be made in order to avoid mistakes. Fresh material is much more easily observed than dried or pressed material. Moreover the tubular sheaths of *F. rubra* agg. are easily split on handling. It is essential that this observation is made on *sterile innovation shoots (tillers)*, not on flowering shoots (culms), and that only the younger sheaths are examined. Older sheaths, including all those on the culms, become naturally split to the base. The older leaves should be successively stripped back from a tiller, leaving the uppermost sheath that was partly exposed as the one to examine.

This is the single best character to distinguish the two aggregates.

TILLERS – EXTRAVAGINAL OR INTRAVAGINAL

Tillers arise from lower nodes of culms or of other tillers (actually from the axil between the stem and the base of the leaf-sheath) in one of two ways.

In intravaginal branching (Fig. 1) the new shoot grows up more or less parallel with its parent stem and remains enclosed for some distance within the leaf-sheath in whose axil it arose. Higher up, the new shoot diverges from its parent, and later on the parental leaf-sheath often decays away, but the parallel growth of the old and new stems at the very base usually persists as evidence of intravaginal branching. In the *Festuca ovina* aggregate all branching is of this sort.

In extravaginal branching (Fig. 1) the new shoot does not grow up parallel with the parent stem but grows out more or less at right angles, breaking through the base of the parent leaf-sheath (cf. lateral branches of *Equisetum* stems). Members of the *Festuca rubra* aggregate always exhibit extravaginal branching, but this varies in relative frequency from being the only type of branching to being much less common than intravaginal branching (hence Hackel's group *Extravaginales vel Mixtae*). With copious fresh material the presence of extravaginal branches is therefore diagnostic of *F. rubra* agg. (and their absence diagnostic of *F. ovina* agg.), but with herbarium material, which is often very poorly collected, it is not safe to use this character except in a positive way.

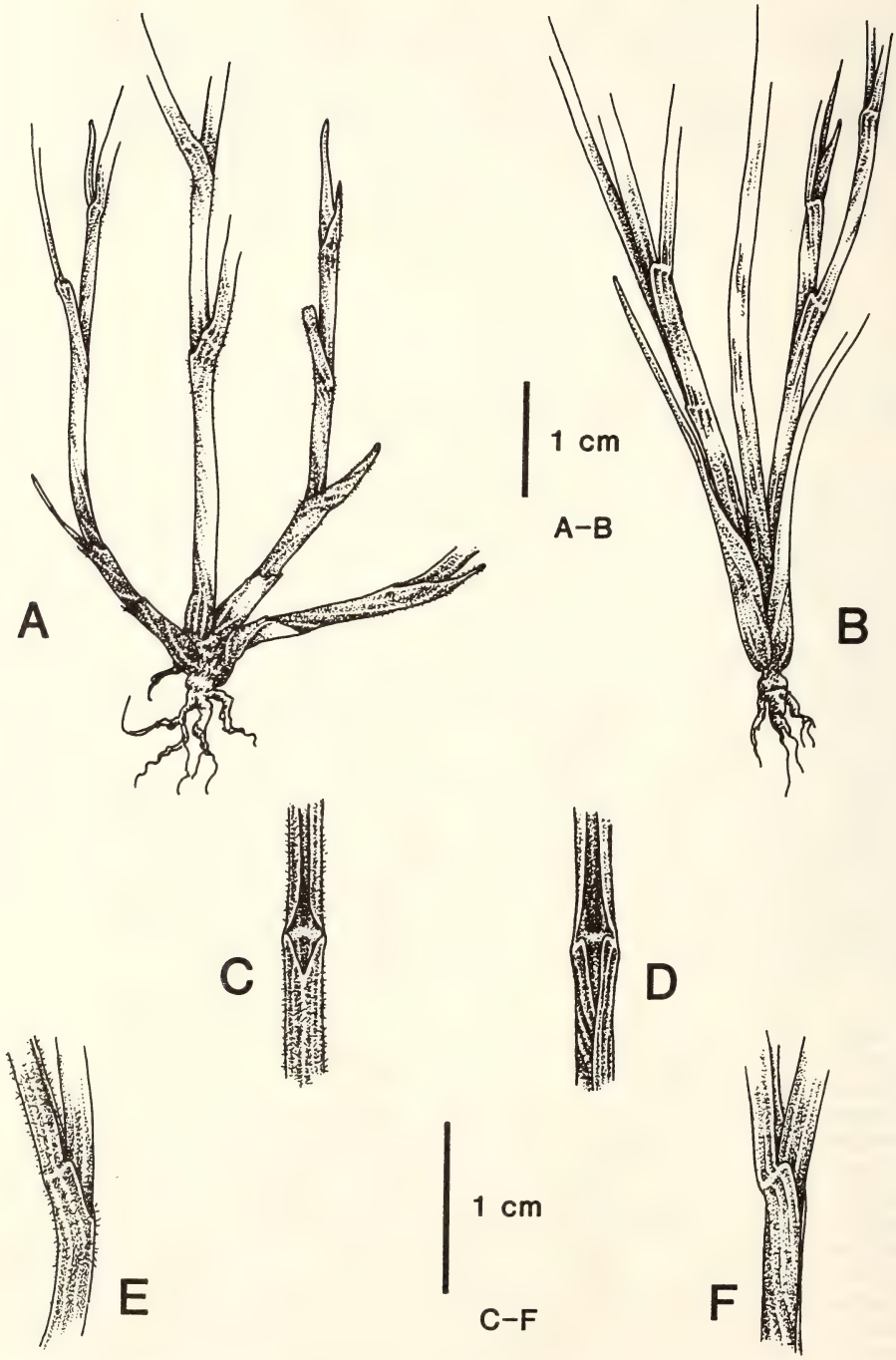

FIGURE 1. Morphological characters of *Festuca rubra* agg. and *F. ovina* agg. A, extravaginal tillers. B, intravaginal tillers. C, fused tiller leaf-sheath as in *F. rubra* agg. D, overlapping tiller leaf-sheath as in *F. ovina* agg. E, vestigial auricles as in *F. rubra* agg. F, distinct auricles as in *F. ovina* agg.

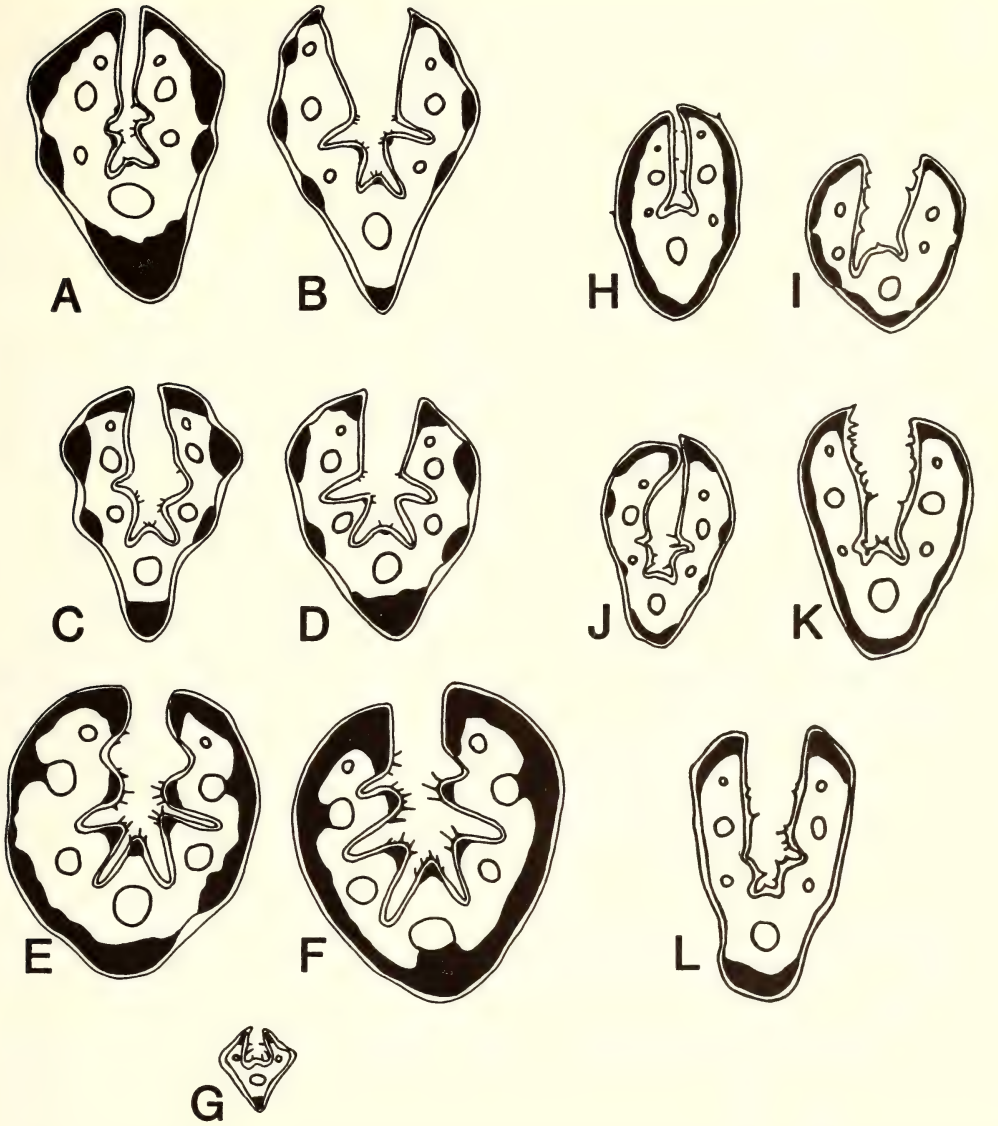

FIGURE 2. Patterns of sclerenchyma distribution (in black) in tiller leaf sections of *Festuca rubra* agg. (A–G) and *F. ovina* agg. (H–L).

GROWTH HABIT – TUFTED OR RHIZOMATOUS

Rhizomes always develop from extravaginal branches, but both intravaginal and extravaginal branches may remain close to the parent stem, resulting in a densely tufted habit. Hence the presence of rhizomes is diagnostic of *F. rubra* agg., but their absence is not diagnostic of *F. ovina* agg. Some rhizomes exist even on plants of *F. rubra* agg. that are very densely tufted, except in *F. heterophylla* Lam. and some specimens of *F. rubra* subsp. *commutata*. Mat-forming plants are almost always rhizomatous to some degree.

AURICLES – CONSPICUOUS OR INCONSPICUOUS

Auricles are developed in many grasses at the top of the leaf-sheath, on either side of its point of junction with the leaf-blade and ligule. In some species, such as *Festuca pratensis* Hudson, these are very conspicuous and developed as pointed projections. In the *F. rubra* aggregate auricles are virtually absent (Fig. 1), but in the *F. ovina* aggregate they are present as distinct rounded extensions (Fig. 1). This difference is clear-cut and unequivocal when the two types are viewed together but it is a comparative rather than absolute character and should be used only after experience with the ranges exhibited by both aggregates.

LEAF ANATOMY – PATTERN OF SCLERENCHYMA

The pattern of sclerenchyma distribution as seen in transverse section of tiller leaves is a very important character in the genus *Festuca*. Knowledge of the range of patterns found in the *F. rubra* and *F. ovina* aggregates (Fig. 2) can be used to distinguish between them.

Sclerenchyma bundles are usually found in the subepidermal position opposite each of the veins (including the midrib) on the abaxial side, and in the subepidermal position at the leaf margins (e.g. Fig. 2B, G, J). Sometimes smaller subepidermal bundles are found opposite the veins on the adaxial side (e.g. Fig. 2A, E, F), and sometimes a girder of sclerenchyma connects the abaxial bundle with its adjacent vein (e.g. Fig. 2E, F). In some cases the abaxial sclerenchyma bundles extend laterally to form a band of sclerenchyma, in extreme cases forming a continuous zone from leaf-margin to leaf-margin (e.g. Fig. 2F, H).

Both the continuous and the discrete patterns of sclerenchyma occur in both the *F. rubra* and *F. ovina* aggregates, but in the case of each pattern the two aggregates can, with practice, be distinguished. The continuous/discontinuous band is almost always accompanied by some girders connecting with the veins and/or by some small adaxial sclerenchyma bundles in the case of *F. rubra* agg., but never in the case of *F. ovina* agg. In addition the sclerenchyma at the leaf-margins and abaxially to the midrib is often much thicker than elsewhere in *F. ovina* agg. (e.g. Fig. 2J, K), but not in *F. rubra* agg. The discrete abaxial sclerenchyma bundles are usually of approximately equal size and are sometimes accompanied by small adaxial bundles in *F. rubra* agg. (e.g. Fig. 2B), whereas in *F. ovina* agg. adaxial bundles are always absent and the marginal and midrib abaxial bundles are usually conspicuously larger (e.g. Fig. 2J) than the others (or there are no others, e.g. Fig. 2L) in *F. ovina* agg. In addition, when the sclerenchyma is in discrete bundles, the leaf outline is much more angular in *F. rubra* agg. (e.g. Fig. 2B, C, G) than in *F. ovina* agg. (e.g. Fig. 2J, L).

SUMMARY

Only two characters can be used with complete success in distinguishing the *Festuca ovina* and *F. rubra* aggregates in the British Isles. Other characters vary in usefulness from being helpful after considerable experience to being highly misleading. The two diagnostic characters are summarized in the following couplet:

Sheaths of young tiller-leaves fused into tube almost up to top; some or all tillers extravaginal ... *F. rubra* agg.

Sheaths of young tiller-leaves with at least the upper 40% with free, overlapping margins; all tillers intravaginal ..... *F. ovina* agg.

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Host range and specificity of *Orobanche minor* Sm. on Crymlyn Burrows

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ABSTRACT

A survey of hosts reported for the broomrape *Orobanche minor* Sm. (Orobanchaceae) in Britain and Ireland, indicates a very wide range for this species with most hosts recorded from the Leguminosae and the Compositae. Results from an investigation of the host range of a large coastal population of *O. minor* Sm. var. *minor* (sensu Rumsey & Jury) on Crymlyn Burrows, West Glamorgan, confirm 15 host species by observation of direct root contact between host and parasite. Some individual broomrapes were noted to parasitise more than one (up to three) host, each a different species. Seeds of *O. minor* var. *minor* taken from plants parasitising *Eryngium maritimum* germinated to produce plants that were able to parasitise *Hypochoeris radicata*, *Trifolium hybridum* and *T. pratense*.

INTRODUCTION

Of the 45 species of *Orobanche* L. recognised in Europe by Webb & Chater (1972), seven were assigned to the *Orobanche minor* group and two of these, *O. minor* Sm. and *O. loricata* Reichenb., are in the British flora (Clapham *et al.* 1987). Both these species have predominantly south-eastern distributions in Britain, with *O. minor* extending discontinuously west and north-west, more or less along the coast. Taxonomically, the *O. minor* group is rather problematic, a situation which is exacerbated by the great intraspecific variation exhibited by *O. minor* itself. In a recent account of *Orobanche* L. in Britain and Ireland, Rumsey & Jury (1991) divide *O. minor* into four varieties, (var. *minor*, *compositarum*, *flava* and *maritima*), and describe a number of features which aid their identification including a guide to their host ranges.

Correct identification of the host can be helpful in the identification of several species of *Orobanche*. Unfortunately, however, although host specificity within the *O. minor* group may be of some significance taxonomically, it is confusing for at least two reasons. Firstly, some taxa appear to have rather wide, overlapping host ranges. Secondly, it is usually difficult to identify the host unequivocally in the field (Chater 1986) and it is likely that several hosts reported in the literature have been recorded in error. Nevertheless, some taxa may parasitise a well defined, narrow spectrum of hosts, e.g. *O. minor* var. *maritima* (Rumsey & Jury 1991), and the concept of physiological races with very specific host requirements (Musselman & Parker 1982) has often been suggested. Comments in county Floras indicate that coastal populations have frequently caused difficulties and this appears to be, in part, a consequence of an incomplete understanding of the host ranges of *O. minor* and *O. maritima* Pugsley (Pugsley 1940) in particular. Recent exchanges in the literature (e.g. Hambler 1991; Rumsey 1991) underline the controversial nature of this problem.

In this account, the host range of a large population of *O. minor* growing in mobile and partially fixed sand dune communities on Crymlyn Burrows in West Glamorgan (v.c. 41) is described. These studies exemplify the problems associated with coastal populations of *O. minor* and confirm a number of hosts, unequivocally.

MATERIALS AND METHODS

A large sand dune population of *Orobanche minor* was studied on Crymlyn Burrows (GR SS/ 710.930). In recent years the size of this broomrape population has usually numbered more than

TABLE 1. HOSTS FOR *OROBANCHE MINOR* RECORDED IN BRITAIN AND IRELAND

Host	Reference
CARYOPHYLLACEAE	
Honkenya peploides	Rumsey & Jury (1991)
GERANIACEAE	
Geranium columbinum	White (1912)
G. rotundifolium	White (1912)
Erodium cicutarium	Petch & Swann (1968)
Pelargonium spp.	Lousley (1976)
	Murphy (1972)
	Jones (1985)
LEGUMINOSAE	
Clianthus puniceus	Margetts & David (1981)
Vicia faba	Jones (1985)
Ononis repens	Savidge *et al.* (1963)
	White (1912)
	Jones (1985)
	Rumsey & Jury (1991)
Medicago arabica	McClintock (1975)
M. lupulina	Bowen (1968)
	Jones (1985)
Trifolium arvense	Trimen & Thiselton-Dyer (1869)
T. campestre	McClintock (1975)
	Jones (1985)
T. hybridum	Grose (1957)
	Jones (1985)
T. medium	Savidge *et al.* (1963)
T. pratense	Ravenshaw (1860)
	Salmon (1863)
	Archer Briggs (1880)
	Grose (1957)
	Savidge *et al.* (1963)
	Bowen (1968)
	Messenger (1971)
	McClintock (1975)
T. repens	Kent (1975)
	White (1912)
	Murray (1896)
Lotus corniculatus	Grose (1957)
Onobrychis viciifolia	Grose (1957)
ARALIACEAE	
Hedera hibernica	Jones (1985)
UMBELLIFERAE	
Eryngium maritimum	Wolley-Dod (1970)#
	White (1912)#
	McClintock (1975)##
	Bevis *et al.* (1978)§§
	Davey (1909)#
	Margetts & David (1981)§§
	Allen (1984)
	Jones (1985)
	Rumsey & Jury (1991)
Anthriscus sylvestris	Grose (1957)
Pastinaca sativa	Grose (1957)
	Holland *et al.* (1986)
	Jones (1985)
Daucus carota (including subsp. *gummifer*)	Ravenshaw (1860)#
	Grose (1957)
	White (1912)#
	McClintock (1975)§
	Davey (1909)#
	Margetts & David (1981)§
	Holland *et al.* (1986)
	Jones (1985)
Garden spp. (e.g. carrot, caraway)	Lousley (1976)
BUDDLEJACEAE	
Buddleja davidii	Jones (1985)
POLEMONIACEAE	
Polemonium caeruleum	Patrick & Hollick (1975)
CONVOLVULACEAE	
Calystegia soldanella	Rumsey & Jury (1991)
SOLANACEAE	
Nicotiana cultivar	Jones (1985)
SCROPHULARIACEAE	
Parahebe catarrhactae	Margetts & David (1981)
LABIATAE	
Salvia verbenaca	White (1912)
Glechoma hederacea	Murray (1896)##
	Grose (1957)
	White (1912)
	Jones (1985)
PLANTAGINACEAE	
Plantago coronopus	Ravenshaw (1860)
	McClintock (1975)
	Davey (1909)#
	Jones (1985)
P. major	Grose (1957)
P. maritima	McClintock (1975)§
CAMPANULACEAE	
Campanula portenschlagiana	Murphy (1972)
C. poscharskyana	Jones (1985)
DIPSACACEAE	
Dipsacus fullonum	Jones (1985)
COMPOSITAE	
Brachyglottis cv. 'Sunshine'	Bowen (1968)
	Swann (1975)*
	Lousley (1976)
	Margetts & David (1981)
	Jones (1985)
	Rumsey & Jury (1991)*
Olearia macrodonta	Jones (1985)
Achillea millefolium	Grose (1957)
Tripleurospermum inodorum	Rumsey & Jury (1991)*
Matricaria spp.	Kent (1975)
Carduus nutans	Rumsey & Jury (1991)*
Cirsium arvense	Grose (1957)
C. vulgare	Jones (1985)

TABLE 1. *cont.*

Host	Reference	Host	Reference
COMPOSITAE *cont'd*			
Hypochoeris radicata	Bowen (1968)*		Petch & Swann (1968)*
	Petch & Swann (1968)*		Jones (1985)
	McClintock (1975)		Holland *et al.* (1986)
	Jones (1985)		Rumsey & Jury (1991)*
	Rumsey & Jury (1991)*	*C. vesicaria*	Dony (1953)
Leontodon autumnalis	McClintock (1975)		
Picris echioides	Dony (1953)	GRAMINEAE	
Crepis capillaris	Linton (1919)	*Elymus farctus*	Rumsey & Jury (1991)
	Grose (1957)	*Ammophila arenaria*	Murray (1896)
	Grose (1957)*		Murphy (1972)

* = recorded as var. *compositarum*; # = recorded as *O. amethystea*; ## = recorded as *O. amethystea* but queried by author(s) as *O. minor*; § = recorded as *O. maritima*; §§ = recorded as *O. maritima* but queried by author(s) as *O. minor*.

5,000 individuals. This presented opportunities to sample a relatively small number of specimens with minimal disturbance to a thriving population. Plants rooted in sand were excavated carefully (usually with ease and minimal disturbance to the rooting systems of host and parasite) and examined for host-parasite root connections. Hosts were traced via their root systems and identified. Often, it was possible to replace plants with little disturbance after substantiating host root contact.

Plants were also cultivated in containers using as hosts *Trifolium hybridum* (cv. 'Alsyke', Elsoms Seeds Ltd, Spalding, England), *T. pratense* and *Hypochoeris radicata* (both grown from local stock). Seeds of *O. minor* were collected from individuals parasitising *Eryngium maritimum* on Crymlyn Burrows. Host plants were established in pots before inoculation with broomrape seeds which were applied in suspension directly on to the host roots.

REPORTED HOST RANGE OF *OROBANCHE MINOR* SM.

A cursory glance at the literature would reveal that *O. minor* has been recorded most frequently as a parasite of *Trifolium* spp., often as a weed in clover fields. It became well known, however, that other (often exotic) species were also parasitised by this broomrape and enthusiastic observations have led to a number of reports of largely unsubstantiated hosts. Table 1 lists a representative selection of hosts that have been reported over the last 130 years, and includes reports referring to all varieties of *O. minor* as well as *O. amethystea* Thuill. which has been recorded in error for *O. minor* in Britain (Clapham *et al.* 1987; Rumsey & Jury 1991). It is not a definitive list and, undoubtedly, many species that have been recorded as hosts for *O. minor* are missing from it.

HISTORY AND IDENTIFICATION OF *OROBANCHE MINOR* SM. ON CRYMLYN BURROWS

The accurate records of Rev. J. Lightfoot describing his visit in 1773 to "Breton Sands", in the vicinity of Crymlyn Burrows (Carter 1954), do not mention any broomrapes. One of the first records of *O. minor* in the region was made by A. M. Barnard at Swansea in 1853 and nearly a hundred years later, in 1943, J. A. Webb, a very active, local botanist, recorded it at nearby Aberavon West Burrows (Hyde & Wade 1957) where it still grows today. During this period, this species would have been regarded as a local rarity and its presence would have attracted the attention of active recorders. It is possible that *O. minor* was present in small numbers on Crymlyn Burrows at that time but, if so, it remained unrecorded until 1970 when a small population of about 100 individuals was noted. By 1979, the population had increased markedly to approximately 6000 plants (author's own records). It appears that *O. minor* is either a relatively recent arrival at Crymlyn Burrows (within the last 50 years) or was present in small numbers until the 1970s but had been overlooked by a number of recorders. Similar, but smaller, populations of *O. minor* now occur elsewhere in West

Glamorgan, e.g. on the sand dune systems of Swansea Bay, South Gower and Margam Burrows and in Mid Glamorgan, on Kenfig Burrows.

Several casual recorders have visited Crymlyn Burrows in the last ten years and named the *Orobanche* population there tentatively as *O. maritima* Pugsley. However, the morphological features of this population conform strongly with *O. minor* var. *minor* as described by Rumsey & Jury (1991).

Thus:

1. Plants varied greatly in size, up to 60 cm in height, with the largest individuals usually found in association with *Eryngium maritimum* and then often in large clumps. Plants associated with other hosts were rarely as vigorous.
2. The bases of stems were not obviously bulbous.
3. The sizes and densities of inflorescences were variable. For example, inflorescence lengths varied from 5 cm to 50 cm with overall flower densities varying between 1·4 and 3·2 flowers/cm. Some individuals had inflorescences which were lax below and dense above and some were relatively lax throughout. Other plants exhibited inflorescences which were relatively dense throughout their length.
4. Bracts were 14–18 mm, similar in length to the flowers but often slightly shorter in upper flowers.
5. Calyces were 11–13 mm and unequally bifid.
6. Corollas were 15–18 mm, suffused purple, glandular pubescent, the lower lip with subequal crisped lobes.
7. Flower diameters were always greater than 5 mm.
8. Filaments were hairy below and inserted 2 mm above the corolla base.
9. Stigma lobes were purple and united at base.

A small number of pigment-less individuals were noted in the Crymlyn Burrows populations during the study; similar albino forms have been noted by Rumsey & Jury (1991).

It should also be noted that *Daucus carota* subsp. *gummifer* is not a host for *O. minor* on Crymlyn Burrows.

HOST RANGE OF *OROBANCHE MINOR* SM. ON CRYMLYN BURROWS

O. minor var. *minor* has been observed to parasitise a number of hosts on Crymlyn Burrows. So far, 15 species of host have been identified and these are indicated in Table 2. Each host was substantiated by direct observation of contact between the host root and the distinct, swollen haustorial region of the parasite. Where indicated, root specimens were taken, sectioned and examined under the light microscope. When this was done, microscopic examination confirmed physical interaction between host and parasite vascular systems.

The most commonly recorded host was *Eryngium maritimum*. On Crymlyn Burrows, this species is very common in open mobile sand communities behind the foredunes, where there are often high densities of broomrape spikes (up to 25 spikes/m^2). Other plants recorded with broomrapes in this type of community are listed in Table 2(a). Many broomrape spikes were noted in the vicinity of Marram Grass (*Ammophila arenaria*) in this community. Indeed, several plants were noted growing in the middle of marram tufts. All such plants were investigated; none made any apparent contact with marram roots, but did make contact with the extensive root systems of *E. maritimum*. Parasitism of hosts other than *E. maritimum* appears to be relatively rare in this community but a single broomrape individual was observed to parasitise *Pastinaca sativa*.

More species were parasitised by broomrapes in partially fixed sand communities where *E. maritimum* is rare but legumes and composites are conspicuous. Typical species in these communities are listed in Table 2(b). The most commonly recorded hosts here were *Ononis repens*, *Lotus corniculatus* and *Hypochoeris radicata*. In addition, the composites *Leontodon taraxacoides*, *Crepis capillaris*, *C. vesicaria*, *Senecio jacobaea*, *Erigeron acer* and *Tragopogon pratensis* were also recorded as hosts. There was only one substantiated record of root contact with the legume *Anthyllis vulneraria*, although this species dominates large areas of partially fixed-dune on Crymlyn Burrows. Other minor hosts recorded were the crucifers *Arabis hirsuta* and *Coincya monensis* subsp. *recurvata*, and the plantain, *Plantago lanceolata*.

TABLE 2. HOSTS FOR *OROBANCHE MINOR* VAR. *MINOR* IN MOBILE AND PARTIALLY FIXED SAND COMMUNITIES ON CRYMLYN BURROWS
+ root contact with *O. minor* observed.

(a) *Mobile sand communities*	
CRUCIFERAE	
Coincya monenis subsp. *recurvata*	−
Matthiola sinuata	−
CRASSULACEAE	
Sedum acre	−
ONAGRACEAE	
Oenothera cambrica	−
UMBELLIFERAE	
*Eryngium maritimum**	+
Pastinaca sativa	+
EUPHORBIACEAE	
Euphorbia paralias	−
CONVOLVULACEAE	
Calystegia soldanella	−
COMPOSITAE	
Senecio jacobaea	−
S. squalidus	−
Hypochoeris radicata	−
Leontodon taraxacoides	−
Crepis capillaris	−
CYPERACEAE	
Carex arenaria	−
GRAMINEAE	
Vulpia fasciculata	−
Ammophila arenaria	−
Phleum arenarium	−

(b) *Partially fixed sand communities*	
CRUCIFERAE	
Arabis hirsuta	+
Coincya monenis subsp. *recurvata*	+
VIOLACEAE	
Viola canina	−
V. tricolor subsp. *curtisii*	−
CARYOPHYLLACEAE	
Cerastium diffusum	−
C. fontanum	−
Arenaria serpyllifolia	−
GERANIACEAE	
Geranium molle	−
LEGUMINOSAE	
*Ononis repens**	+
Trifolium arvense	−
Lotus corniculatus	+
Anthyllis vulneraria	+
UMBELLIFERAE	
Pastinaca sativa	−
GENTIANACEAE	
Centaurium erythraea	−
PLANTAGINACEAE	
Plantago lanceolata	+
COMPOSITAE	
Senecio jacobaea	+
S. squalidus	−
S. vulgaris	−
Erigeron acer	+
Carlina vulgaris	−
Hypochoeris radicata	+
Leontodon taraxacoides	+
Tragopogon pratensis	+
Crepis capillaris	+
C. vesicaria	+
Taraxacum officinale agg.	−
GRAMINEAE	
Festuca rubra	−
Aira praecox	−
Ammophila arenaria	−
Phleum arenarium	−

* Haustoria-root connections of some plants were sectioned and examined under the light microscope.

In transitional areas between mobile and partially fixed sand communities, *Eryngium maritimum* often grows in close proximity to *Ononis repens*, *Lotus corniculatus* and *Hypochoeris radicata*. In those places, broomrapes were observed making root contact with each of these species.

On four separate occasions, single specimens of *O. minor* were observed making root contact with two separate hosts. The following dual-host combinations were noted: (a) *Hypochoeris radicata* and *Ononis repens* (in partially fixed sand); (b) *Eryngium maritimum* and *Lotus corniculatus* (transitional areas); (c) *Crepis capillaris* and *Ononis repens* (in partially fixed sand); (d) *Crepis capillaris* and *Plantago lanceolata* (partially fixed sand).

On one occasion a triple-host combination of *Arabis hirsuta*, *Hypochoeris radicata* and *Lotus corniculatus* was noted in a partially fixed sand community.

Minor hosts such as *Arabis hirsuta* and *Erigeron acer* often appeared greatly weakened by the

parasite and supported smaller broomrape specimens with lax inflorescences. In contrast, common hosts such as *Eryngium maritimum*, *Ononis repens* and *Lotus corniculatus* often showed normal vigour and the roots of leguminous hosts that were investigated always bore abundant nodules. *E. maritimum* often supported large broomrape specimens with dense inflorescences in clusters of 20 or more individual spikes.

Seeds of *O. minor* var. *minor* taken from specimens parasitising *Eryngium maritimum* in mobile sand communities were sown into separate pots containing *Hypochoeris radicata* (grown from seed taken from an individual in a typical partially fixed-dune community), *Trifolium hybridum* (cv. 'Alsyke') or *T. pratense* (transplanted from a local meadow) as potential hosts. All three species were able to act as hosts and supported specimens of *O. minor* that flowered and set seed.

O. minor on Kenfig Burrows (GR SS/796.812) appeared to parasitise *Eryngium maritimum* and *Ononis repens*, mostly, whereas a small and short-lived population which occurred on a roadside verge in Swansea (GR SS/652.912) appeared to be parasitising *Trifolium pratense* and *T. repens*. However, none of these plants was excavated and investigated for root contact.

DISCUSSION

Positive verification of host species for *O. minor* in the field is difficult, particularly when specimens are growing in compacted soil, due to the fragile connections between parasite and host roots. Moreover, in some areas, *O. minor* is a rare or local species and potentially destructive sampling should not be attempted. Under these circumstances the observer has to rely on a judgement based on the presence and proximity of suitable hosts. Most records of host species, such as those in the survey shown in Table 1, are probably based on such observations. However, significant patterns emerge from this survey and a number of relevant points may be deduced from it as follows:

1. Dicotyledonous perennials predominate as hosts for *O. minor*, whereas woody perennials are rarely reported.
2. Certain families such as Leguminosae and Compositae appear to contain several species which are suitable hosts for *O. minor* and there are many reports in the literature of parasitism on members of these families.
3. Other families also appear to be well represented in the survey such as Umbelliferae, Plantaginaceae, Geraniaceae and Labiatae.
4. Reports of the parasite on grasses (Murray 1896; Murphy 1972; Rumsey & Jury 1991) are infrequent and of interest. Parasitism of grasses (or other Monocotyledons) is rare in the genus *Orobanche* although it is a feature of other genera such as *Aeginetia* and *Striga* (Stewart & Press 1990).

The study described here verified a number of the hosts given in Table 1 and underlines the importance of certain families such as Umbelliferae, Leguminosae and Compositae (see Table 2). Nevertheless, although Leguminosae was well represented in the study area, it was notable that certain species such as *Anthyllis vulneraria*, *Lathyrus pratensis*, *L. tuberosus*, *Medicago sativa* subsp. *falcata*, *M. lupulina*, *Melilotus alba*, *M. officinalis*, *Trifolium arvense*, *T. fragiferum*, *Vicia cracca* and *V. sativa* were rarely or never parasitised. In contrast, a much higher proportion of the composites represented were parasitised. Interestingly, two crucifers, *Arabis hirsuta* and *Coincya monensis* subsp. *recurvata*, were recorded as hosts although members of Cruciferae have rarely been reported as hosts before.

One novel feature that emerged from this study was the occasional observation of *O. minor* var. *minor* individuals parasitising more than one host, each one a representative of a separate family. Presumably, this happens during establishment on a primary host when a haustorium also makes contact with the root of another compatible, secondary host in the near vicinity.

Parasitism of more than one host at the same time may occur commonly with other populations of *O. minor* var. *minor*, a consequence of its very wide host spectrum. However, there is evidence that *O. minor* has developed host specific strains (Musselman & Parker 1982) and, clearly, populations of these would be limited in this respect.

From the outset, it seemed possible, but intuitively unlikely, that the Crymlyn Burrows population was composed of more than one physiological strain, each with a limited set of hosts. For example, it could be argued that the mobile dune population which appeared to parasitise *Eryngium*

maritimum almost exclusively, was physiologically distinct from the partially fixed dune population which appeared to parasitise a wider spectrum of hosts. However, *O. minor* var. *minor* also occurs in transitional areas between well-defined mobile and partially fixed sand communities, where *E. maritimum* and other hosts are parasitised. Furthermore, it was shown that seed taken from a specimen parasitising *E. maritimum* in a mobile dune community germinated to produce vigorous specimens in pots containing *Hypochoeris radicata*, *Trifolium pratense* or *T. hybridum*. This evidence, together with observations of individuals parasitising multiple, unrelated hosts (including the combination of *E. maritimum* and *Lotus corniculatus*), does not support the argument that there are a number of host specific strains of *O. minor* var. *minor* on Crymlyn Burrows.

The broomrape population of Crymlyn Burrows has become a striking feature of this actively accreting coastal dune system in recent years. However, although it is likely that a small population of *O. minor* was established there about 50 years ago, it seems probable that only in the last 20 years or so has it spread so conspicuously into mobile and partially fixed dune areas. Indeed, the establishment and spread of this population on Crymlyn Burrows resemble colonisations there by a number of non-native colonists such as *Coincya monensis* subsp. *recurvata*, *Hirschfeldia incana*, *Senecio squalidus* and *Conyza canadensis*. It is notable, therefore, that Rumsey & Jury (1991) suggest that *O. minor* var. *minor* may not be native in the British Isles.

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The current distribution and abundance of *Orchis ustulata* L. (Orchidaceae) in the British Isles – an updated summary

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ABSTRACT

Recent British records of *Orchis ustulata* L. (Orchidaceae) are described and the current range of the species is shown both as a distribution map and in tabular form. This updates information presented by the author in earlier work.

INTRODUCTION

The status and distribution of *Orchis ustulata* L. in the British Isles has been previously described on a regional basis (Foley 1987, 1990). Further exploratory work and additional knowledge gained as a result of publication of this information suggests that an updated summary is now appropriate. The distribution maps which were originally included were to a differing degree of precision, and the opportunity is now taken to combine all the available information on geographical distribution into a single map plotted on a 10-km square basis.

DISCUSSION

The additional records shown below are relatively small in number and do not significantly affect the overall distribution pattern of *O. ustulata* as previously described. They often represent small isolated populations containing just a few plants at, or close to, localities previously thought likely to be extinct. Such examples include Langdon Bay (E. Kent, v.c. 15), Waddingham (N. Lincs., v.c. 54) and Knaresborough (Mid-W. Yorks., v.c. 64), at each of which a welcome reappearance of the plant has occurred. Other new records are for small populations from areas in which there is apparently no previous known occurrence – Scarcliffe (Derbys., v.c. 57), Sandale (N.E. Yorks., v.c. 62), and some in S. Wilts. (v.c. 8). Just occasionally, population strength has been previously underestimated, in some cases significantly so, as at Martin Down (S. Hants., v.c. 11) which in fact is now confirmed to hold two important colonies. One of these is of especial interest in that it is in an area ploughed in 1957, the only instance so far noted where recolonisation has occurred so quickly. During 1987 a significant find was made in N.W. Yorks. (v.c. 65) by the author and a colleague where several hundred flowering plants occur in association with *O. morio* L. on traditionally managed, lightly grazed pasture. This is undoubtedly the best surviving population in northern England. Except by the tenant farmer, by whom its significance and extent were not appreciated, this strong population has apparently been previously overlooked.

Two other unrecorded populations of significance were identified at Great Cheverell Hill (S. Wilts., v.c. 8) by G. Goodfellow, and others have been located, also in v.c. 8, on Ministry of Defence land during lulls in artillery firing. The good flowering season of 1989 illustrated that in Britain, there are still some very significant populations of *O. ustulata* and this was particularly apparent at Parsonage Down (S. Wilts., v.c. 8), where one estimate suggests that the population is in excess of 30,000 flowering plants. This is perhaps the most important surviving single population of *O. ustulata* in north-western Europe.

The late-flowering (July–August) form of *O. ustulata*, often recorded from southern England, has recently been described as var. *aestivalis* by Kümpel (1988) and subsequently raised to subspecific

rank as subsp. *aestivalis* by Kümpel & Mrkvicka (1990). These latter authors record details of its morphometry and deviation from the type, based on observations made on Central European populations where white-flowered plants are also noted for this newly described taxon.

The additional British records described below, together with those previously contained in Foley (1987, 1990) (the latter modified to include new information where appropriate), have been combined and mapped on a 10-km square basis as shown in Fig. 1. The species is considered to be

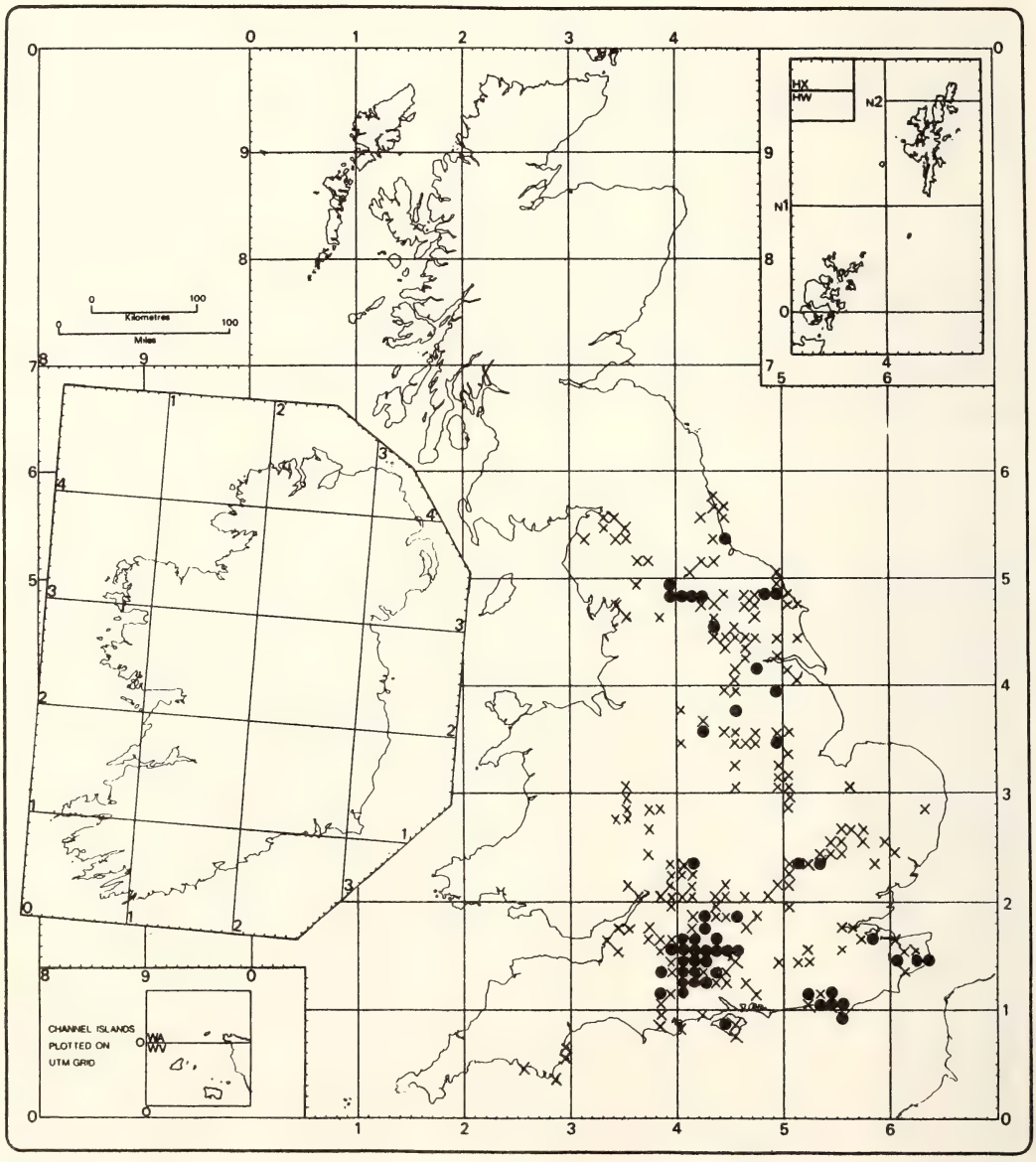

FIGURE 1. The past and present distribution of *Orchis ustulata* in the British Isles. Plotted in 10-km squares: ● still surviving, × considered extinct.

extant if it has been confirmed to be present in or after 1987, or if (and especially in the case of small colonies where an annual reappearance in flower can be unreliable) it has been seen shortly before this date and there has been no known change to the habitat likely to cause its loss. Additionally, all 54 10-km squares of the British Isles in which *O. ustulata* still occurs are listed in Table 1, and this also includes details of the respective population strengths. The 174 10-km squares for which the plant now appears to be extinct are given in Table 2, although it is possible that in some cases the plant may still reappear in small numbers.

Further records for *O. ustulata* from any new or existing localities are still welcomed, and especially so are details of any summer-flowering populations.

RECORDS

The following records should be added to, or where appropriate replace, those given earlier (Foley 1987, 1990). Population strengths (in parentheses) use the code employed in the earlier papers, as follows: A = typically 1–10 flowering plants; B = 11–25; C = 26–50; D = 51–200; E = 201–1000; F = 1000+; PX = possibly extinct; X = extinct; U = unknown status, but likely to be either small colonies or extinct.

N. Wilts., v.c. 7: SU/2.7, three new localities to the north of Aldbourne (A, A, A) (G. Goodfellow pers. comm.).

S. Wilts., v.c. 8: ST/8.3, Whitesheet Hill, a few plants over a large area (A); ST/9.5, Great Cheverell Hill (see Foley 1990), three additional sites (A, B, E); SU/0.2, Hoopside (A); Middleton Down (R. Laurence pers. comm.) (A); Knighton Down, c. 50 plants in 1989 (D); Throope Down, on rank grassland, possibly lost (PX); SU/0.3, Steeple Langford – Cow Down, very good numbers in 1987 when grazing relaxed (R. Laurence pers. comm.) (E) – this should replace "(U)" in Foley (1990); Hadden Hill, about 30 plants in 1989 (C); SU/0.4, Parsonage Down, recent estimates including the very good season of 1989 suggest a population of tens of thousands (one estimate 30,000+ plants), perhaps the best site in north-western Europe – this extends over an area approaching 95 ha and is now considered to be one continuous large colony of plants; SU/0.5, Slay Down, English Nature [formerly N.C.C.] information of a colony in centre of M.O.D. impact area – strong colony, no details, perhaps (D) in 1988; SU/1.2, Homington Down, 40 plants at one site in 1989, status should therefore be (A, C) (see Foley 1990); SU/1.3, Cockey Down, discovered by P. Mobsby in 1988 (A); SU/1.4, Alton Down, two small colonies recorded by English Nature (A, A); SU/1.5, Chisenbury Warren, small colony on M.O.D. land in 1984 (A); Giant's Grave, Pewsey Hill, up to 40 plants in 1985 on an ancient monument (C); Milton Lambourne, 20 plants in 1989 (B); SU/2.2, Witherington Down, 20 plants in 1988 – status now (B); SU/2.5, Haxton Down, reported here in 1986 by D. Soden on M.O.D. land (A). (Except where shown, all details for v.c. 8 are ex G. Goodfellow pers. comm.)

S. Hants., v.c. 11: SU/0.1, Martin Down, two populations, one of which is in old arable, last ploughed in 1957 (E), and on old grassland (E). Also on Bokerley Dyke (P. Toynton pers. comm.) (D). There were substantial populations in 1991 with two plants of the white-flowered form occurring on the Dyke.

E. Sussex, v.c. 14: TQ/4.0, Mount Caburn, Glynde at 44.08 – correct (U) to (F), there were 3000+ plants here in 1991 (F. Rose pers. comm.); TQ/5.0, Charleston Bottom, correct (A) to (D); Lullington Heath, correct (A) to (D), plants of late-flowering variant at both sites (D. C. Lang pers. comm.).

E. Kent, v.c. 15: TR/3.4, Langdon Bay, a single flowering plant was seen in 1981 (F. Horsman pers. comm.) (A).

Surrey, v.c. 17: TQ/2.4, three specimens in **KDL** collected in 1885 (X).

W. Suffolk, v.c. 26: TL/9.5, etc., Shelland, and TM/0.4, near Hadleigh (see Foley 1990) – there is some doubt about these records.

N. Lincs., v.c. 54: SK/9.9, a single plant appeared in 1991 at the Waddingham site (see Foley 1987) after an absence of ten years (I. Weston pers. comm.).

Derbys., v.c. 57: SK/2.5, eight additional very small populations (see Foley 1990), located as follows: one locality south of White Edge (L. Storer pers. comm.); four additional sites to the

TABLE 1. LOCATION AND RESPECTIVE STRENGTHS OF EXTANT POPULATIONS OF *ORCHIS USTULATA* IN THE BRITISH ISLES BY 10-KM SQUARE

Grid reference of 10-km square	Number of populations	Population strength (for code – see text)
ST/8.1	1	A
ST/8.3	1	A
ST/9.5	4	A,B,E,E
SD/9.8	2	A,B
SD/9.9	1	A
SZ/4.8	1	C
SU/0.1	4	A,D,E,E
SU/0.2	3	A,A,D
SU/0.3	2	C,E
SU/0.4	3	C,E,F
SU/0.5	1	D
SU/0.6	1	A
SU/1.2	4	A,C,F,F
SU/1.3	1	A
SU/1.4	2	A,A
SU/1.5	3	A,B,C
SU/1.6	4	B,D,D,E
SU/2.2	2	A,B
SU/2.4	1	A
SU/2.5	1	A
SU/2.7	5	A,A,A,A,B
SU/2.8	1	A
SU/3.3	1	A
SU/3.5	1	A
SU/3.6	1	A
SU/4.5	4	A,A,C,C
SU/5.5	1	A
SU/5.8	1	B
SP/1.3	1	C
SK/2.5	14	A,A,A,A,A,A,A,A,A,A,A,A,B,D,E
SK/5.7	1	A
SK/9.4	1	A
SK/9.9	1	A
SE/0.8	4	A,A,A,A
SE/1.8	3	A,C,C
SE/2.8	1	A
SE/3.5	1	A
SE/7.1	1	C
SE/8.8	2	A,B
SE/9.8	1	B
NZ/4.3	1	A
TV/5.9	4	B,B,B,D
TQ/2.1	1	C
TQ/3.0	1	D
TQ/4.0	2	F,F
TQ/4.1	1	A
TQ/5.0	7	A,A,B,B,D,D,E
TQ/8.6	1	A
TL/1.3	1	B
TL/3.3	1	A
TR/0.4	1	A
TR/2.4	5	A,A,A,A,B
TR/3.4	1	A
*G.R. withheld	1	E

* details withheld for a sensitive locality in v.c. 65 (N.W. Yorks.).

TABLE 2. 10-KM SQUARES FOR WHICH *ORCHIS USTULATA* IS NOW CONSIDERED TO BE EXTINCT IN THE BRITISH ISLES

SX/5.4	NY/4.5	SK/5.5	TQ/2.0
SX/8.3	NY/5.3	SK/5.9	TQ/2.4
SX/9.5	NY/5.4	SK/6.4	TQ/2.5
SX/9.6	NY/6.1	SK/7.4	TQ/3.1
SY/8.8	NY/7.1	SK/7.5	TQ/5.5
SY/8.9	SZ/0.8	SK/9.0	TQ/5.7
ST/3.6	SZ/2.9	SK/9.1	TQ/6.7
ST/4.5	SZ/5.7	SK/9.2	TQ/7.6
ST/4.7	SZ/5.8	SK/9.5	TL/0.1
ST/5.7	SU/1.7	SE/2.7	TL/0.2
ST/7.6	SU/1.8	SE/3.4	TL/0.3
ST/7.7	SU/2.3	SE/3.6	TL/0.8
ST/8.0	SU/3.2	SE/3.7	TL/0.9
ST/8.5	SU/3.8	SE/4.3	TL/2.3
ST/8.6	SU/3.9	SE/4.4	TL/3.4
ST/9.1	SU/4.2	SE/4.8	TL/4.4
ST/9.3	SU/4.3	SE/5.0	TL/4.5
ST/9.4	SU/4.8	SE/5.1	TL/5.4
ST/9.6	SU/5.4	SE/5.4	TL/5.5
ST/9.9	SU/6.2	SE/5.5	TL/5.6
SO/4.7	SU/6.7	SE/6.2	TL/6.6
SO/5.1	SU/7.1	SE/6.3	TL/7.5
SO/5.7	SU/7.8	SE/6.4	TL/7.6
SO/5.8	SU/9.4	SE/6.7	TL/8.3
SO/5.9	SP/0.0	SE/6.8	TL/9.5
SO/6.0	SP/0.2	SE/7.4	TF/0.0
SO/7.4	SP/0.3	SE/7.6	TF/0.1
SO/7.6	SP/1.0	SE/7.7	TF/0.3
SO/7.8	SP/1.1	SE/7.8	TF/0.5
SO/8.0	SP/1.2	SE/9.2	TF/6.0
SO/8.8	SP/3.0	SE/9.4	TA/0.1
SO/9.0	SP/4.0	SE/9.9	TA/0.7
SO/9.1	SP/4.1	NZ/1.0	TA/0.8
SO/9.2	SP/6.0	NZ/2.1	TA/1.0
SO/9.3	SP/8.0	NZ/2.5	TA/1.4
SJ/5.0	SP/9.1	NZ/3.1	TA/1.7
SD/4.7	SK/0.4	NZ/3.3	TR/0.6
SD/5.6	SK/0.7	NZ/3.6	TR/1.3
SD/6.9	SK/2.6	NZ/3.7	TR/1.5
SD/8.6	SK/4.5	NZ/4.5	TR/2.5
NY/1.3	SK/4.9	NZ/4.6	TM/0.4
NY/3.4	SK/5.0	NZ/9.0	TM/3.8
NY/3.5	SK/5.2	TQ/0.9	
NY/4.3	SK/5.4	TQ/1.4	

north-west of Brassington (L. Storer & B. G. Tattersall pers. comm.); two additional sites to the south-west of Longcliffe (east of Beardsley Plantation) (L. Storer pers. comm.); near Pinder's Rock in 1987, recorded by M. Buckley – all these probably (A); SK/5.7, Scarcliffe, lightly grazed Magnesian limestone meadow, discovered in 1986 by R. A. Frost, three plants (A).

S. E. Yorks., v.c. 61: SE/6.4, Fulford Ings, collected by H. Britten on 13 May 1928, **herb. P. Burnett** (R. Gulliver pers. comm.) (X); SE/9.4, Arras (not TA/0.4, Arram (Foley 1987) – an error) (Robinson 1902) (X).

N. E. Yorks., v.c. 62: SE/5.5, Clifton Ings, still extant in 1926 when collected by H. E. Britten, **herb. P. Burnett** (R. Gulliver pers. comm.) (X); SE/6.7, Hovingham, specimen collected in 1871 by "M.T.", **herb. P. Burnett** (R. Gulliver pers. comm.) (X); Wiganthorpe Park and also Terrington Carr and adjoining area, recorded by Yorkshire Naturalists' Union in 1898 (X); SE/7.6 (or 7.7),

Castle Howard district, old record "in dry stoney meadows" (X); St Ann's meadow, Castle Howard Park (X); SE/7.8, Gundale, possibly Gundale Slack (U); SE/8.8, Sandale, one plant in 1989 (I. Lawrence pers. comm.) (A).

Mid-W. Yorks., v.c. 64: SE/3.5, Knaresborough, east of Birkham Wood, the last sighting was in 1967 after which the site was ploughed, but a single flowering plant was re-found by J. Barker in 1988 nearby. Regrettably this was immediately dug up by an unknown person (A).

N.W. Yorks., v.c. 65: SD/9.8, Seata, Aysgarth, limestone pasture (A); SE/0.8, east of Aysgarth, two new small populations (A, A); SE/1.8, near Middleham, riverside pasture (A). (Note: In 1987 the author and S. Priest discovered a new locality in v.c. 65 on traditionally managed pasture. This is almost certainly the strongest surviving population in northern England (E). No details are given here as this is a very sensitive site, but relevant details are known to English Nature.)

Durham, v.c. 66: NZ/2.5, Urpeth in 1913, J. W. Heslop-Harrison (Graham 1988) (X).

Cumberland, v.c. 70: NY/5.4, Armathwaite, on west bank of the Eden north of the bridge. Last recorded in 1944 by F. Simpson (X).

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Urtica galeopsifolia Wierzb. ex Opiz (Urticaceae) in Wicken Fen (E. England)

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ABSTRACT

A plant resembling the common nettle, *Urtica dioica* L., but almost lacking stinging hairs, occurs in Wicken Fen, Cambridgeshire. It is here considered as a separate species *U. galeopsifolia* Wierzb. ex Opiz, which differs from the former by several morphological characters and also by ploidy level. Some suggestions about the possible hybrid origin of *U. dioica* are put forward.

INTRODUCTION

Many British botanists know the strange almost stingless form of the common nettle (*Urtica dioica* L.), which occurs within the National Trust's Wicken Fen nature reserve in Cambridgeshire, GR TL/55.70. These unusual plants grow in damp mesotrophic fen communities, in particular, at the margins of shrubby areas with other shade-tolerant herbs. Similar plants occur nearby, as at Chippenham Fen (Perring *et al.* 1964).

The variation of morphological characters of *U. dioica*, with special reference to this particular population, was intensively investigated by Pollard & Briggs (1982, 1984a). They explained that the difference of this plant from typical ones arose through a process of gene flow. An exact taxonomic recognition had not been made, but it was mentioned that, probably, the 'Wicken nettle' belongs to var. *angustifolia* Wimm. & Grab. or var. *subinermis* Uechtr. The *Flora of Cambridgeshire* (Perring *et al.* 1964) treats these plants as f. *angustifolia* (Wimm. & Grab.) Moss.

While studying the taxonomy of *Urtica* L. in the former U.S.S.R., I paid attention to the information published by Pollard & Briggs (1982). My assumption was that the "Wicken form of common nettle" seemed to belong to a separate species, *U. galeopsifolia* Wierzb. ex Opiz, which I have recognised for Eastern and Central Europe (Geltman 1986, 1992) or to some intermediate form between this species and *U. dioica*.

URTICA DIOICA AND *U. GALEOPSIFOLIA*

U. galeopsifolia was described from Hungary by F. M. Opiz, *Naturalientausch* **9**: 107 (1825), according to Domin (1943), and it differs from *U. dioica* mainly by characters of the leaf blades: they almost completely lack stinging hairs, but always possess a more or less dense indumentum consisting of simple (non-stinging) hairs. It is also differentiated by the location of its inflorescence; the lowest flowering branches of *U. galeopsifolia* appear on the level of the 13th–22nd node, and in *U. dioica* on the level of the 7th–14th node. Probably, this feature is linked to the period of flowering: *U. galeopsifolia* starts to flower later than *U. dioica*, approximately in mid-July (Geltman 1986).

Not infrequently *U. galeopsifolia* has somewhat longer and comparatively narrow leaves, but this character is unsatisfactory, as typical *U. dioica* with numerous stinging hairs may sometimes have such a leaf shape. It is necessary to stress that neither *U. galeopsifolia* nor *U. dioica* have such narrow leaves as the Asiatic species *U. angustifolia* Fisch. ex Hornem., which does not occur in Europe.

Unlike *U. dioica*, which is mostly tetraploid with 2n = 52 or, probably, 2n = 48 (there are only a

few records of 2n = 26), *U. galeopsifolia* is presumably diploid (2n = 26) and only one specimen was determined as tetraploid (Geltman 1984).

U. galeopsifolia prefers a quite distinct type of habitat: damp woodlands, especially with *Alnus glutinosa* (L.) Gaertner, river banks and valleys, and eutrophic fens. I found a very clear example of the ecological separation of the two species in question in Central Ukraine, Cherkassy region. *U. galeopsifolia* occurred in *Phragmites* fen and *Alnus glutinosa* woodland, situated in deep valleys, bordered with hills, and *U. dioica* is found in more or less dry (at least, not swampy) *Carpinus betulus* L. woodlands on the hills, especially near roads and cattle paths.

In the former U.S.S.R., *U. galeopsifolia* is distributed in the European part to the south of latitude 60°N, and also in the southern regions of Siberia eastwards to the river Angara; some localities are also known from Caucasia. It should be widely distributed in Atlantic, Central and East Europe, but before I had visited some British herbaria, I had seen quite reliable specimens of this species only from Hungary, Czechoslovakia and the Netherlands (Geltman 1986).

In August 1991, I was fortunate to be able to visit Wicken Fen and to observe the local nettle population. In my view, the almost stingless plants which occur in the fen proper do not differ from *U. galeopsifolia*, as it occurs in Russia. So, *U. galeopsifolia* is a new species record for the British flora.

U. galeopsifolia, nevertheless, is not a 'completely good' species, especially in terms of the species concept adopted in *Flora Europaea* (Geltman 1992). Sometimes transitional forms to *U. dioica* may be found, such as forms without stinging hairs but with scattered simple ones (I usually refer such plants to *U. dioica*). So, probably, some botanists may prefer to treat this taxon as a subspecies; the corresponding combination *U. dioica* subsp. *galeopsifolia* (Wierzb. ex Opiz) Chrtek does exist (Chrtek 1981). But I consider that species rank is more appropriate for this taxon for the following reasons. It is correct to apply the rank of subspecies to allopatric taxa of widely distributed species. But in the case of *U. dioica* and related species we have, obviously, quite a different situation: *U. dioica* is, probably, a species of hybrid origin (Geltman 1990). The first of its ancestors might be *U. galeopsifolia* (or a species closely related to it) and the second, *U. sondenii* (Simm.) Avrorin ex Geltman, which occurs mainly in the taiga zone of West and Central Siberia and Northern Europe also. Detailed distribution characteristics with map are given in Geltman (1986). This species has completely glabrous leaf blades with neither stinging nor simple hairs; some scattered stinging and simple hairs are located on the nodes of stems and on the inflorescence axis. It grows in meadows and *Salix*-carrs in river valleys, near streams, in damp forests, etc. Like *U. galeopsifolia*, it is a diploid (2n = 26).

U. galeopsifolia was likely to be formed at least by the Pliocene period and might have penetrated to the British Isles at the time of existence of bridges with the continent. It survived the Pleistocene glaciations not far from the southern limits of the ice front. At the same time *U. sondenii* seems also to exist in the periglacial area, because the first migration of Siberian taiga species to Europe was possible at the end of Miocene, the next ones in the late Pliocene and in the interval between Dnepr and Moscow glaciations (Minyaev 1965)*. So, *U. galeopsifolia* and *U. sondenii* were likely to have opportunities for hybridisation. Probably, there were no ecological barriers, because the ecological niches of both species are similar.

As a result of hybridisation of diploid *U. galeopsifolia* and *U. sondenii*, a tetraploid 'primary' *U. dioica* could have been formed. These plants may have been very polymorphic in leaf shape and indumentum and had no stinging hairs on the leaf blades. Such 'primary' forms spread in Europe after the last glaciation and may also have appeared in Wicken Fen. Then, derived from these plants, the 'secondary', typical *U. dioica* with stinging hairs on leaf blades developed. The main selective factor might be a pressure from animals, including domestic ones. As Pollard & Briggs (1984b, p. 507) have shown, "grazing by large mammals could act as a strong selective force for higher stinging hair densities in nettles". So, the origin of typical *U. dioica* was, apparently, connected with human activity. "Response to the modification of the habitat by human settlement seems to be indicated by the nettle as early as the time of Mesolithic culture" (Godwin 1975, p. 242).

Intermediate forms between typical *U. dioica* with numerous stinging hairs and *U. galeopsifolia* are, in fact, mostly primary hybrid forms of *U. dioica*, which have survived to the present time.

* The interval between the Dnepr and Moscow glaciations seems to correspond with the Hoxnian stage (interval between Anglian and Wolstonian ice periods) in Britain.

Because there are no classical allopatric races in this case, I prefer to treat *U. dioica*, *U. galeopsifolia* and *U. sondenii* as separate species in the framework of an *U. dioica* aggregate or 'complex'.

After the most recent glaciation, *U. galeopsifolia* in Britain survived in damp territories, but in historic times it has become almost extinct due to drainage and now seems to be preserved only in protected wetland areas (like Wicken Fen). Forms intermediate between *U. galeopsifolia* and typical *U. dioica* may be found in various seminatural situations.

It is necessary also to mention *U. pubescens* Ledeb., described from the delta of the river Volga (Ledebour 1833). Sometimes this taxon (more frequently at the rank of the variety *U. dioica* var. *pubescens* (Ledeb.) Trautv.) has been recorded from various regions of Europe. In my opinion, this taxon is a separate species, closely related to *U. galeopsifolia*, but differing from it in some minor characters (Geltman 1986). *U. pubescens* occurs in special wetland territories, mainly in the Volga delta, and recently has been found in lower Dnepr. It may be a relict, which survived in such localities from Tethyan times.

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Short Notes

RUBUS BLOXAMII (BAB.) LEES (ROSACEAE) WITH RED STYLES

Rubus bloxamii, a widespread and locally abundant bramble of central southern England and the central Midlands, normally has styles that are yellowish-green. Towards the south-western limit of its English range, however, at the southern end of the border between N. Somerset, v.c. 6, and S. Wilts., v.c. 8, and abundantly along the Blackdowns astride the border between S. Devon, v.c. 3, and W. Somerset, v.c. 5, A. Newton and L. J. Margetts have respectively come across populations in which the styles are bright red (but which otherwise do not differ from the normal examples of the species in Britain in any significant respect).

On the opposite side of the Channel, in various parts of Normandy and (according to Sudre 1911) just to the south in dép. Sarthe, there is a common bramble which has long been known as *R. multifidus* Boulay & Malbranche. One place it occurs in particular profusion is the Forêt de St-Sauveur, 30 km south of Cherbourg, and specimens I collected there in 1991 have proved to match the red-styled *R. bloxamii* of England. A. Newton and H. Vannerom share my impression that except in this one character *R. multifidus* is not distinguishable from *R. bloxamii* and should accordingly be treated as conspecific, a conclusion reached earlier by Friderichsen (MS note by Rogers 1897 on **BM** sheet), Rogers (1900) and, ultimately, Watson (1958). The name nevertheless seems worth retaining at varietal level in view of the interesting difference in range, and the necessary new combination is accordingly now made:

Rubus bloxamii (Bab.) Lees var. **multifidus** (Boulay & Malbranche ex Corbière) D. E. Allen, **comb. et stat. nov.**
R. multifidus Boulay & Malbranche MS (Assoc. rub. exsicc.); Corbière, *Nouv. Fl. Normandie* 208 (1894); *R. menkei* subsp. *multifidus* (Boulay & Malbranche) Boulay in Rouy & Camus, *Fl. Fr.* **6**: 104 (1900); *R. menkei* microgene *multifidus* (Boulay & Malbranche) Sudre, *Rubi Eur.*, 160 (1911).

Corbière cites no fewer than ten numbers distributed by the Association rubologique as belonging to *R. multifidus*. The lectotype must clearly be chosen from the earliest of these (no. *36*: Forêt de la Londe, dép. Seine-Inférieure, 1873, *A. Malbranche*) and I designate as that the example of that number which I have examined in Paris (**P**).

It is worth adding that *R. bloxamii* var. *bloxamii* also occurs in Normandy, but appears to be much the rarer of the two there. In the North Cotentin (dép. Manche) I have so far seen it in only two places, in both cases just a bush or two. H. Vannerom informs me (in litt. 1992) that two of Letendre's specimens of '*R. multifidus*' from dép. Seine-Inférieure, Association rubologique nos. *656* and *772*, have yellowish styles too. In the Channel Isles, on the other hand, where *R. bloxamii* is locally common in Guernsey though scarce in Jersey, the populations consist of var. *bloxamii* exclusively.

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RUBUS CORBIERI BOULAY (ROSACEAE) IN THE BRITISH ISLES

In 1897 the then leading British authority on *Rubus*, W. Moyle Rogers, paid a first (and only) visit to the Channel Isles and on two of them encountered quantities of an unfamiliar bramble. While he

found it "rather frequent" on Guernsey, on Sark it was "remarkably abundant" (Rogers & Rogers 1898), so much so that, in the words of his companion on that day, it "seemed to monopolise nearly the whole place" (Derrick 1898). And as subsequent batologists have found, these words are indeed no exaggeration: this large, coarse, white-flowered plant is one of the most dominant features of the island's landscape.

Rogers promptly sent a specimen to Focke, who considered it "very near" *R. schlechtendalii* Weihe ex Link (Rogers & Rogers 1898), an opinion Focke was later to refine to "maybe a form of *schlechtendalii*. Not typical", when G. C. Druce sent him a specimen he had brought back from Sark in 1906 (now in **OXF**). Although Rogers initially placed the plant under that name (Derrick 1898, Rogers 1899), within a year he had decided it was best regarded instead as a strong and highly glandular form of *R. macrophylloides* Genev. (Rogers & Rogers 1898). It was not that species, however, as Riddelsdell was eventually to note on one of Rogers' sheets (herb. Barton & Riddelsdell *8743*: **BM**) after study of Genevier's type and description. Nor was it *R. adscitus* Genev., as Watson first supposed on re-examining Druce's specimen in 1931 (a determination he subsequently abandoned for *R. boraeanus* Genev.) – although it is certainly closely related to that species, as A. Newton remarked of a further Sark specimen that was submitted to him by Lady Anne Brewis in 1973 (now in **STP**).

It has always seemed likely that the bramble would prove to be on the neighbouring French mainland; but as the *Rubus* flora of that area has not been much studied, it might well be one of the many species there as yet undescribed. Fortunately, however, the latter has not proved to be the case.

In 1987, on a first reconnaissance of the Cherbourg area, I came across a bramble growing in plenty round the north foot of Le Roule, the high crag which overlooks that city, that proved to match a panicle in **BM** collected by Corbière in 1889 from what are today the outskirts of Cherbourg and later distributed under the name Boulay bestowed on the bramble in his honour, *R. corbieri*. Corbière tended to interpret *Rubus* species over-broadly, and his determinations cannot be accepted uncritically; but the very distinctiveness of this particular plant taken together with his published description of *R. corbieri* (Corbière 1894) leave no room for doubt in this instance. Moreover, there is a further Cherbourg specimen of his so named in **P** (Association rubologique no. *894*) that clearly belongs to the same entity.

Subsequently I discovered that this Cherbourg plant was identical with a specimen in my herbarium that I had collected in Guernsey in 1978, in a deserted garden in the middle of St Peter Port. Because *R. corbieri* is rather variable, however, it was some time before I began to suspect that this might also be the bramble which occurs more widely in the north of that island and in such profusion on Sark. Fuller exploration of the north of the Cotentin Peninsula in 1991, bringing at the same time wider acquaintance with the variation exhibited by the species in the field, showed conclusively that that suspicion was well-founded. *R. corbieri* proved to occur conspicuously all along the coast to the west of Cherbourg (though apparently absent to the east), rising to abundance in the vicinity of Cap de la Hague, the headland facing Alderney, the northernmost of the Channel Isles. The comparable abundance of the species on Sark and its presence in much smaller quantity on Guernsey, which is situated farther out to the west, thus represents a natural prolongation, and gradual tailing-off, of its Cotentin range. I did not have an opportunity of following the coastline south from Cap de la Hague, but the discovery of a patch of *R. corbieri* just outside Carteret, some 40 km in that direction, suggests that the species may similarly prove to extend down to there. Most unusually for a *Rubus* species, it would appear to prefer the proximity of the sea, the coarseness of its foliage presumably rendering it well fitted to the rigours of that environment. Even so it noticeably avoids the most exposed situations, tending to occur on banks offering some shelter from the wind.

Unexpectedly, *R. corbieri* also turns out to occur in England. In the autumn of 1990, while going through **OXF** in search of Channel Isles *Rubus* material, I came across an unmistakable specimen of it collected on Corfe Common in south-east Dorset, v.c. 9, by L. Cumming in 1916 and distributed through both of the exchange clubs that year as a white-flowered form of *R. boraeanus* (as determined by Rogers). The sheet bears a later determination by Watson, confirming that name. In one of the published notes on the gathering (Rogers 1918) the plant was described as locally abundant in the locality in question, which encouraged the belief that it might still be present there; and a visit to the Common the following July quickly revealed that not only was that the case, but

also that the population remains very extensive. Later the same day the species was encountered in a second locality in quite another part of Purbeck, along a lane crossing Studland Heath (GR SZ/01.84 and SZ/02.84). E. F. Linton has also since been found to have collected it in 1892 in a locality nearly midway from Corfe to Swanage, the specimen (**BM**) having been dismissed by Rogers and R. P. Murray as *R. bloxamii* × *vestitus*. In **CGE**, too, there turns out to be a gathering of it (no. *64/368*) by B. A. Miles as recently as 1964 from the south-west part of Rempstone Heath (GR SZ/983.840), in this case with no name hazarded. Possibly, therefore, the species may prove widespread in the south-east corner of v.c. 9. Although that has been relatively well worked by batologists in the past, the superficial resemblance of *R. corbieri* to the common *R. bloxamii* (Bab.) Lees could well have led to its being passed over as the latter.

Work on the *Rubus* flora of Hampshire, v.cc. 11 and 12, and the Isle of Wight, v.c. 10, in recent years has been sufficiently intensive to render it unlikely that so obtrusive a species has escaped notice in those neighbouring counties. Floristically, in any case, the affinity of their *Rubus* floras with that of the French coastal areas directly opposite appears to be but slight. At least the north end of the Cotentin Peninsula has a *Rubus* flora with a markedly more western facies than theirs, which makes the presence of *R. corbieri* in Dorset more congruous and Devon, v.cc. 3 and 4, the likeliest further English county in which the species may occur.

The descriptions of *R. corbieri* by Corbière (1894) and by Boulay (1900) – the latter of whom reduced the species to a 'Forme' of *R. multifidus* Boulay & Malbranche (a common Normandy bramble) and that in turn to a subspecies of *R. menkei* Weihe – are sufficiently detailed and accessible to render providing a further one unnecessary. It is nevertheless worth emphasising that the species, while unambiguously a member of Series *Vestiti* (Focke) Focke, varies considerably in the quantity of stalked glands present as well as in the size of the rachis prickles. In addition, the flowers tend to be pinkish on first opening or on plants growing in shade.

Sudre in his *Batotheca Europaea*, fasc. 10, no. 487, relegated *R. corbieri* to the synonymy listed on the printed label of the bramble he distributed as *R. fuscus* subsp. *retrodentatus* (Mueller & Lef.) Sudre. The latter, however, a specimen of Questier's from dép. Valois, is quite a different plant and it would seem that Sudre had a mistaken idea of the Cherbourg species.

Representative material from Dorset, the Channel Isles and the North Cotentin has been deposited in **BM**.

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A NEW SPIRAL VARIANT OF *JUNCUS EFFUSUS* L. (JUNCACEAE)

The Spiral Rush of gardens, *Juncus effusus* L. cv. 'Spiralis', was discovered as a single plant in Northern Ireland by David Bishop, Curator of the Botanic Garden, Belfast in 1869. It was brought into cultivation and has continued as a curiosity in gardens since then. It differs from the ordinary *J. effusus* in that the stems spiral upwards, often completing six to eight turns. James McNab, Curator at that time of the Royal Botanic Garden, Edinburgh and a most intelligent experimenter, obtained plants of the Irish discovery and sowed seeds from them. He reported that the seedlings all showed the spiral character (McNab 1873). There seems to be no other record of this variety in the wild.

In the autumn of 1988, I noticed on rough croft grazing above Big Sand, Gairloch, W. Ross (v.c. 105), areas of *Juncus* which at first sight had every appearance of having been flattened by animals lying on the plants. Some of the colonies were 1.3–1.9 m across. Closer examination showed that

many of the stems were gently spiral and that all of them were only suberect in contrast to the strictly erect habit of normal *J. effusus* growing nearby. Plants were brought into cultivation. Seed from the 'spiral' plants at Big Sand germinated easily and all the seedlings were spiral and suberect. The Irish 'Spiralis' differs from the Scottish in that the stems in the Irish are quite erect and are much more obviously spiral six to eight turns as against two to three.

There are many other populations in N.W. Scotland between Plockton and Dundonnell: on the village green in Plockton, at Flowerdale, Gairloch, at Red Point, Gairloch, at Cove, Poolewe, on the Inverewe peninsula, Poolewe, along the roadside by Loch Tollie between Gairloch and Poolewe, at Slaggan west of Mellon Udrigle and by the roadside at Dundonnell. It has not been found in the eastern or central Highlands, although once known it can be spotted from a moving car. It usually occurs mixed with normal plants and the contrast between the two is quite striking.

There seem to be no previous records of this spiral rush on mainland Britain but there are specimens in **E** from the Northern Isles: Orkney, 1906, M. Spence; Ramsdale, Orphir, 1927, H. H. Johnston; Flotta, Orkney, 1932, J. Sinclair and all are similar to the West Ross plants rather than the Irish. I have also seen a photograph of an Orkney specimen collected by Linton in **LIV**. However, in 1991, it was evident that the variety had a wide and certainly long established distribution in the Outer Hebrides where I found it on the Island of Killegray (Harris) on the Shiant and Monach Isles just west of Loch Boisdale (Uist) and on Mingulay (Barra).

In view of its considerable occurrence as wild populations over a considerable area of N.W. Scotland it seems appropriate to treat it as a distinct variety of *Juncus effusus*:

Juncus effusus L. var. **suberectus** D. M. Henderson, **var. nov.**
Holotypus: Big Sand, Gairloch, W. Ross, v.c. 105, on rough croft land with var. *effusus*, 6 December 1988, *D. M. Henderson* (**E**).

A varietate typica culmis leniter spiralibus suberectis differt.

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CONTRIBUTIONS TO A CYTOLOGICAL CATALOGUE OF THE BRITISH AND IRISH FLORA, 2

The only recent, published summary of chromosome counts made on native material of British and Irish vascular plants is contained in Clapham *et al.* (1987). The source of many of these counts, however, is unlocalised material or untraceable. The present series of notes is intended to contribute to a properly documented cytological account of our flora (Wentworth *et al.* 1991). We present here chromosome counts of 102 flowering plant species from 122 populations. Only one plant from each population was studied, except where noted. All counts were made from squashes of root-tips, except where noted; supernumerary chromosomes are designated by the suffix 'S'. Voucher specimens have been placed in **LTR**.

Achillea millefolium L., 2n = 54: Caerns., v.c. 49, E. of Sarn, SH/24.32; Westmorland, v.c. 69, near Ulpha, c. 5 km N.E. of Lindale, SD/44.81.
Agrimonia eupatoria L., 2n = 28: W. Lancs., v.c. 60, Silverdale, Gait Barrows N.N.R., SD/48.77; W. Lancs., v.c. 60, Warton Crag, R.S.P.B. nature reserve, SD/49.72.
Agrimonia procera Wallr., 2n = 56: W. Lancs., v.c. 60, Warton Crag, R.S.P.B. nature reserve, SD/49.72.
Ajuga reptans L., 2n = 32: W. Lancs., v.c. 60, near Forton, SD/48.53.
Allium vineale L. var. *vineale*, 2n = 32 + 0–2S: W. Lancs., v.c. 60, near Carnforth, SD/49.71.

Anagallis tenella (L.) L., 2n = 22: Caerns., v.c. 49, Lleyn peninsula, W. end, SH/2.3.
Angelica sylvestris L., 2n = 22: W. Lancs., v.c. 60, near Lancaster, SD/47.59.
Anthriscus sylvestris (L.) Hoffm., 2n = 16: Leics., v.c. 55, Rutland, 4 km S. of Oakham, near Brooke, SK/85.06.
Apium graveolens L., 2n = 22: W. Lancs., v.c. 60, Potts Corner, SD/41.57.
Apium nodiflorum (L.) Lag., 2n = 22: Dorset, v.c. 9, near Sydling St Nicholas, ST/63.00.
Arum maculatum L., 2n = 56: Leics., v.c. 55, Swithland Wood, SK/53.12.
Atriplex portulacoides L., 2n = 36: W. Lancs., v.c. 60, Potts Corner, SD/41.57.
Barbarea vulgaris R.Br., 2n = 16: Caerns., v.c. 49, Tudweiliog, 1 km to W. on Tyd'dyn road, SH/22.36.
Blackstonia perfoliata (L.) Hudson, 2n = 40: Co. Durham, v.c. 66, coastal cliffs between Blackhall and Crimdon, NZ/47.38.
Centaurea scabiosa L., 2n = 20 + 3–8S: Co. Durham, v.c. 66, coastal cliffs between Blackhall and Crimdon, NZ/47.38.
Chelidonium majus L., 2n = 12: Caerns., v.c. 49, Llaniestyn, SH/26.33.
Chrysanthemum segetum L., 2n = 18: Caerns., v.c. 49, N. of Botwnnog, overlooking Cellar Farm, SH/26.32.
Chrysosplenium oppositifolium L., 2n = 42: Derbys., v.c. 57, Dovedale, SK/14.53.
Cichorium intybus L., 2n = 18: Co. Durham, v.c. 66, coastal cliffs between Blackhall and Crimdon, NZ/47.38.
Cirsium vulgare (Savi) Ten., 2n = 68: Caerns., v.c. 49, Botwnnog, above Cellar Farm, SH/26.32.
Clematis vitalba L., 2n = 16: Surrey, v.c. 17, Silent Pool, near Shere, TQ/06.48.
Conyza canadensis (L.) Cronq., 2n = 18: Leics., v.c. 55, Leicester University Botanic Garden glasshouse (spontaneous weed), SK/61.01.
Corylus avellana L., 2n = c. 22: Leics., v.c. 55, Swithland Wood, SK/53.12.
Deschampsia setacea (Hudson) Hackel, 2n = 14: Caerns., v.c. 49, Cilan, near Abersoch, SH/29.24.
Digitalis purpurea L., 2n = 56: W. Lancs., v.c. 60, Lancaster University grounds, SD/48.57.
Euonymus europaeus L., 2n = 32: Westmorland, v.c. 69, Brigsteer Park, 2·5 km S. of Brigsteer, SD/48.87.
Eupatorium cannabinum L., 2n = 20: Dorset, v.c. 9, Hartland Moor N.N.R., c. 4 km S.E. of Wareham, SY/96.85; W. Norfolk, v.c. 28, Foulden Common, TL/76.99; W. Lancs., v.c. 60, near Carnforth, SD/49.71.
Filipendula ulmaria (L.) Maxim., 2n = 14: Leics., v.c. 55, Swithland Woods, SK/53.12; W. Lancs., v.c. 60, Lancaster University grounds, SD/48.57.
Galeopsis bifida Boenn., 2n = 32: Caerns., v.c. 49, E. of Sarn, SH/24.32; Caerns., v.c. 49, N. of Botwnnog, overlooking Cellar Farm, SH/26.32.
Galium cruciata (L.) Scop., 2n = 22: W. Lancs., v.c. 60, Potts Corner, SD/41.57.
Galium mollugo L., 2n = 44: W. Cornwall, v.c. 1, Goonhilly Earth Station, SW/73.21; E. Cornwall, v.c. 2, Rame, near church, SX/42.49.
Galium odoratum (L.) Scop., 2n = 44: Westmorland, v.c. 69, Brigsteer Park, 2·5 km S. of Brigsteer, SD/48.87.
Geranium dissectum L., 2n = 22: W. Lancs., v.c. 60, near Lancaster, SD/46.62.
Geranium lucidum L., 2n = 40: Westmorland, v.c. 69, near Meathop Moss, c. 3 km N.E. of Lindale, SD/44.81.
Geranium pratense L., 2n = 28: Derbys., v.c. 57, Milldale, SK/14.55; Co. Durham, v.c. 66, 2 km N. of Barnard Castle, NY/05.18.
Geranium sanguineum L., 2n = 84: Co. Durham, v.c. 66, coastal cliffs between Blackhall and Crimdon, NZ/47.38.
Geum urbanum L., 2n = 42: Derbys., v.c. 57, Milldale, SK/14.55.
Glaux maritima L., 2n = 30: W. Lancs., v.c. 60, W. of Cockerham, near Bank Houses, SD/42.53; W. Lancs., v.c. 60, Potts Corner, SD/41.57.
Glechoma hederacea L., 2n = 36: Leics., v.c. 55, Rutland, Brooke, by the church, SK/85.06; W. Lancs., v.c. 60, Silverdale, E. of Thrang End Farm, SD/49.77.
Heracleum sphondylium L., 2n = 22: W. Lancs., v.c. 60, Lancaster University grounds, SD/48.57.
Hippuris vulgaris L., 2n = 32: W. Lancs., v.c. 60, near Forton, by canal, SD/48.53.
Hydrocotyle vulgaris L., 2n = 96: Caerns., v.c. 49, Llanbedrog, valley W. of Penarwel, SH/32.32.

Hypericum hirsutum L., 2n = 18: W. Lancs., v.c. 60, near Carnforth, SD/50.70; Westmorland, v.c. 69, Ravens Lodge, S.E. edge of Whitbarrow, base of Whitescar, SD/46.85.
Hypericum perforatum L., 2n = 32: Surrey, v.c. 17, Silent Pool, near Shere, TQ/06.48.
Lathyrus nissolia L., 2n = 14: W. Lancs., v.c. 60, near Lancaster University, SD/48.56.
Limonium britannicum Ingrouille subsp. *celticum* Ingrouille var. *pharense* Ingrouille, 2n = 35: Caerns., v.c. 49, Bardsey Island, E. of Pen Cristin, Ogof y Gaseg, SH/12.21.
Lotus corniculatus L., 2n = 24: W. Lancs., v.c. 60, Gait Barrows N.N.R., near Silverdale, SD/48.77.
Luzula pilosa (L.) Willd., 2n = 62: Co. Waterford, v.c. H6, Nier Valley, S/2.1.
Lycopus europaeus L., 2n = 22: Caerns., v.c. 49, Pwllheli, SH/37.34.
Lysimachia nemorum L., 2n = 16: Leics., v.c. 55, Swithland Wood, SK/53.12; W. Lancs., v.c. 60, near Barkin Bridge, SD/60.63.
Lythrum portula (L.) D. A. Webb, 2n = 10: Caerns., v.c. 49, Rhos Botwnnog, SH/26.32.
Medicago sativa L. subsp. *sativa*, 2n = 32: Co. Durham, v.c. 66, coastal cliffs between Blackhall and Crimdon, NZ/47.38.
Myosotis sylvatica Hoffm., 2n = 18: W. Lancs., v.c. 60, near Yealand Conyers, SD/50.74.
Oenanthe crocata L., 2n = 22: W. Lancs., v.c. 60, Lancaster University grounds, SD/48.57.
Oenanthe lachenalii C. C. Gmelin, 2n = 22: W. Lancs., v.c. 60, Potts Corner, SD/41.57.
Parietaria judaica L., 2n = 26: W. Cornwall, v.c. 1, Newbridge, near St Just, SW/42.31; W. Lancs., v.c. 60, near Silverdale, SD/45.74.
Paris quadrifolia L., 2n = 20: W. Lancs., v.c. 60, Gait Barrows N.N.R., near Silverdale, SD/48.77.
Pedicularis sylvatica L. subsp. *sylvatica*, 2n = 16: W. Cornwall, v.c. 1, between Penzance and St Just, SW/39.31.
Phleum arenarium L., 2n = 14: Caerns., v.c. 49, Abersoch dunes, N. part of Porth Fawr, SH/31.27.
Pinguicula lusitanica L., 2n = 12: Dorset, v.c. 9, Slepe Heath, c. 2·5 km S.E. of Wareham, SY/94.86 (count made on integumentary tissue).
Plantago lanceolata L., 2n = 12: W. Lancs., v.c. 60, Lancaster University grounds, SD/48.57.
Plantago media L., 2n = 24: Dorset, v.c. 9, Fontmell Down, c. 5 km S.S.E. of Shaftesbury, ST/88.18; W. Lancs., v.c. 60, near Lancaster, by dismantled railway, SD/46.62; Westmorland, v.c. 69, Helsington Barrows, c. 3 km S.E. of Kendal, SD/48.89.
Primula elatior (L.) Hill, 2n = 22: Cambs., v.c. 29 (no further details known).
Primula veris L., 2n = 22: Co. Durham, v.c. 66, coastal cliffs between Blackhall and Crimdon, NZ/47.38.
Prunella vulgaris L., 2n = 28: Co. Durham, v.c. 66, coastal cliffs between Blackhall and Crimdon, NZ/48.38; W. Lancs., v.c. 60, Lancaster University grounds, SD/48.57.
Pulicaria dysenterica (L.) Bernh., 2n = 18: Dorset, v.c. 9, Hartland Moor N.N.R., c. 4 km S.E. of Wareham, SY/96.85.
Quercus petraea (Mattuschka) Liebl., 2n = 24: Leics., v.c. 55, Swithland Wood, SK/53.12.
Quercus robur L., 2n = 24: E. Norfolk, v.c. 27, Badley Moor, NT/00.11.
Radiola linoides Roth, 2n = 18: Caerns., v.c. 49, Cwmistir, near Edeyrn, SH/25.38.
Ranunculus auricomus L., 2n = 32: W. Lancs., v.c. 60, near Yealand Conyers, SD/50.74.
Ranunculus bulbosus L., 2n = 16: W. Lancs., v.c. 60, Potts Corner, SD/41.57.
Ranunculus flammula L. subsp. *flammula*, 2n = 32: Westmorland, v.c. 69, Killington, SD/61.88.
Ranunculus omiophyllus Ten., 2n = 32: Caerns., v.c. 49, Garn Fadryn, SH/27.35.
Ranunculus sceleratus L., 2n = 32: W. Lancs., v.c. 60, Potts Corner, SD/41.57.
Rhamnus catharticus L., 2n = 24: W. Norfolk, v.c. 28, Foulden Common, TL/76.99.
Ribes nigrum L., 2n = 16: Leics., v.c. 55, Swithland Wood, SK/53.12.
Ribes uva-crispa L., 2n = 16: W. Lancs., v.c. 60, Silverdale, E. of Thrang End Farm, SD/49.77.
Rubus chamaemorus L., 2n = 56: Derbys., v.c. 57, Snake Pass summit, N. side of car park, SK/08.92.
Salsola kali L., 2n = 36: N. Somerset, v.c. 6, near Berrow, ST/28.53.
Sambucus nigra L., 2n = 36: Leics., v.c. 55, Swithland Wood, SK/53.12.
Sanguisorba minor Scop. subsp. *minor*, 2n = 28: Westmorland, v.c. 69, Brigsteer Park, 2·5 km S. of Brigsteer, SD/48.87.
Sanguisorba officinalis L., 2n = 56: W. Lancs., v.c. 60, near Aldcliffe, SD/46.60.

Sanicula europaea L., 2n = 16: Leics., v.c. 55, Swithland Wood, SK/53.12; Westmorland, v.c. 69, Brigsteer Park, 2·5 km S. of Brigsteer, SD/48.87.
Scabiosa columbaria L., 2n = 16: Westmorland, v.c. 69, Helsington Barrows, c. 3 km S.E. of Kendal, SD/48.89.
Scrophularia nodosa L., 2n = 36: W. Lancs., v.c. 60, near Lancaster, SD/47.59.
Sedum telephium L., 2n = 24: W. Lancs., v.c. 60, Gait Barrows N.N.R., near Silverdale, SD/47.77.
Senecio viscosus L., 2n = 40: W. Lancs., v.c. 60, near Carnforth, SD/49.71.
Solanum dulcamara L., 2n = 24: W. Lancs., v.c. 60, near Aldcliffe, close to estuary of River Lune, SD/45.60.
Spiranthes spiralis (L.) Chevall., 2n = 30: Caerns., v.c. 49, Abersoch Bay, below Marchros, on Abersoch golf-links, SH/31.26.
Stachys officinalis (L.) Trev., 2n = 16: W. Cornwall, v.c. 1, Chyenhal, SW/45.27.
Stellaria holostea L., 2n = 26: Leics., v.c. 55, Swithland Wood, SK/53.12.
Tanacetum vulgare L., 2n = 18: W. Lancs., v.c. 60, River Lune estuary, near Lancaster, SD/45.62.
Taxus baccata L., 2n = 24: Leics., v.c. 55, Swithland Wood, SK/53.12.
Teucrium scorodonia L., 2n = 32: Cheviot, v.c. 68, Ingram, River Breamish, NU/01.16.
Triglochin palustris L., 2n = 24: E. Norfolk, v.c. 27, Badley Moor, NT/00.11, (three plants counted).
Tussilago farfara L., 2n = 60: W. Lancs., v.c. 60, Lancaster University grounds, SD/48.57; W. Lancs., v.c. 60, near Carnforth, SD/50.71.
Typha latifolia L., 2n = 30: W. Lancs., v.c. 60, Lancaster University grounds, SD/48.57.
Valeriana dioica L., 2n = 16: Leics., v.c. 55, Swithland Wood, SK/53.12.
Verbascum nigrum L., 2n = c. 30 + 4 (3–7)S: S. Hants., v.c. 11, near Winchester, SU/4.2.
Veronica serpyllifolia L. subsp. *serpyllifolia*, 2n = 14: Caerns., v.c. 49, Bardsey Is., Chapel garden, SH/12.22.
Vicia sepium L., 2n = 14: W. Lancs., v.c. 60, above Saltmire Bridge, SD/51.75; Westmorland, v.c. 69, Whitbarrow (S.E. edge), Raven's Lodge, underneath White Scar, SD/46.85.
Wahlenbergia hederacea (L.) Reichenb., 2n = 36: cultivated plant, originally from S. Devon, v.c. 3, Dartmoor, Newbridge near Hone (W. of Bovey Tracy), SX/71.70.

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THE *ROSA* HERBARIUM OF A. H. WOLLEY-DOD

As far as is known, until last year Wolley-Dod's *Rosa* collection in **BM** had never been examined fully, and certainly had never in its entirety been examined critically, since Wolley-Dod himself. A few of the specimens have been remounted, but most are on Wolley-Dod's original sheets. Large numbers are unmounted, many of them between old and yellow sheets of newspaper dating from the 1920s. The author of this note was asked to go through the collection and label the specimens in the light of modern taxonomic opinion. He received the collection on loan early in 1990, and did

most of the routine work himself, with the assistance of G. G. Graham where consultation or a second opinion seemed desirable.

The collection contains 3091 specimens. Of these, over 100 were indeterminate, in some cases because the specimens had deteriorated, but mainly because they were too immature or too scrappy for determination. A few in the latter category carried a caustic comment from Wolley-Dod, and as he had not attempted identification one wonders why he bothered to keep them. Pasted on to many of the sheets are comments by Sudre, whose reliability Wolley-Dod came to distrust, and more valuable comments by R. Keller, who wrote in a crabbed hand indiscriminately in English, German, French or Latin.

Besides the large numbers of specimens collected by Wolley-Dod himself, he had acquired considerable collections from others, many of them illustrious names in the history of the study of *Rosa*. These, in alphabetical order, are as follows: C. Bailey, J. G. Baker, W. Barclay, E. B. Bishop, C. E. Britton, R. & M. Corstorphine, E. M. Day, G. Claridge Druce, Rev. A. Ley, Rev. E. F. Linton, Rev. W. R. Linton, Rev. E. S. Marshall, Rev. H. J. Riddelsdell, Rev. W. Moyle Rogers, I. M. Roper and W. A. Shoolbred. There are also a few specimens from other well-known botanists such as Rev. A. Bloxam and A. R. Horwood.

Study of the localities from which collections were made would give a fair indication of the distribution of species from north to south. Otherwise, distribution maps compiled from the records would tend rather to show the chosen hunting grounds of the main collectors. Wolley-Dod collected mainly in Devon, Surrey, Derbyshire, Cheshire and the Lake District; Baker from around Thirsk in Yorkshire; Druce from Oxfordshire; Ley from Gloucestershire, Herefordshire and parts of Wales: Moyle Rogers from Devon and Gloucestershire. Other collectors also appear to have concentrated mainly on these same regions, with a plethora of records from Surrey and scattered records from elsewhere in England. Most of the collections in Scotland are from the Perthshire vice-counties, with outlying records by E. S. Marshall from Westerness and Wester Ross, Mrs Corstorphine from Angus and H. Halcro Johnston from Hoy and Mainland, Orkney. There are only about 30 records from Ireland, mostly collected by C. H. Waddell in County Down. The Channel Islands are represented by two specimens from Jersey.

There are a few specimens from Europe. The main interest of these lies in the only two specimens of *Rosa elliptica* Tausch, both from France. These show that Wolley-Dod knew and recognised this species, but presumably had not found it in Britain, which seems to corrobrate the assumption that this is not a native British species (Graham & Primavesi 1990).

Allowing for the somewhat patchy distribution of records described above, there appears in general to have been little change in frequency of *Rosa* species and their hybrids throughout the country between the period during which the collection was made and the present day. Naturally, there are losses in some areas, principally where there has been expansion of the larger towns and cities. There are, for instance, a number of records which at first sight appear astonishing nowadays because the collections were made in what are now solidly built-up areas of Greater London. Only one species shows a marked change in frequency. This is *Rosa agrestis* Savi. There are about 20 specimens of this species in Wolley-Dod's collection, from scattered localities all over the southern part of England. Nowadays this appears to be a very rare species in England, though it is still frequent in parts of Ireland. What has caused this decline in frequency is not known. The other two sweet briar species, *R. rubiginosa* L. and *R. micrantha* Borrer ex Smith, appear to have undergone little or no change in frequency since Wolley-Dod's time.

In his *Revision of the British Roses*, Wolley-Dod (1930–31) repeatedly refers to this herbarium, but he did not re-label the specimens to conform with the nomenclature of that work. The names are those of the multiplicity of species described in his earlier works (Wolley-Dod 1908, 1910). The research which he undertook is reflected in additional comments attached to the sheets. As well as those of Sudre and Keller already mentioned, there are Wolley-Dod's own type-written or hand-written comments, and cuttings from Botanical Exchange Club reports. One cannot help feeling that in the light of modern opinion the work undertaken to elaborate all the Groups, varieties and forms described in *Revision of the British Roses* was an unprofitable expenditure of time that could have been more usefully employed. Indeed, Wolley-Dod himself later expressed doubt and dissatisfaction, stating that rarely in the field did one find specimens which corresponded closely or even remotely with the author's description of a named variety (Wolley-Dod 1936). Keller was more nearly on the right lines, as he frequently suggested the possibility of hybridity. It is a pity that

Wolley-Dod did not pay more attention to Keller's comments, but he would not recognize a *Rosa* hybrid unless the hips showed complete or partial sterility. In the course of the recent examination of this herbarium, we were able to label many specimens as definite hybrids between two species, a large number where there was plainly slight introgression of another named species, some where there was introgression of another indeterminate species, and a few which were such a mixture as to be impossible to determine. As regards the latter category it is not worth spending time on them; there are plenty of roses which can be determined and recorded. Many modern taxonomists allow inclusion of the second and third categories above as permissible variants of a named species (Stace 1975; Webb 1951). There are still unsolved problems in *Rosa* taxonomy and nomenclature, but the appalling difficulties which Wolley-Dod faced, and with his researches laid the foundations for later work, have now largely been overcome.

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ADDITIONAL RECORDS OF *SORBUS LANCASTRIENSIS* E. F. WARBURG (ROSACEAE)

Following documentation of the known sites of *Sorbus lancastriensis* E. F. Warburg (Rich & Baecker 1986), a number of additional populations have come to our attention, including two on Silurian rock, two about Grange-over-Sands, and one west of the Leven Estuary. This note lists the additional sites (we have visited all new localities in June 1991), and updates our previous list. Full details have again been lodged with the vice-county recorders, English Nature, the local Naturalists' Trusts and the Biological Records Centre, Monks Wood.

W. Lancs., v.c. 60:

Gait Barrows N.N.R. (SD/4.7). Three plants have now been found, with *Sorbus aria*, confirming the Ratcliffe (1977) record queried by Rich & Baecker (1986).

Westmorland, v.c. 69:

Farleton Knott, one plant on top of cliff (SD/5.7), and two plants on cliff face, about 300 m north of the above plant (SD/5.8). These confirm the Ratcliffe (1977) record not found in 1982.

Furness, v.c. 69b:

Birkrigg Common (SD/2.7). "One small tree in limestone pavement on summit", F. L. Woodman & K. A. Gunning, 27 May 1982 (**LANC**). This is the first known site west of the Leven Estuary; we have been unable to re-find the plant.

Kirkhead (SD/3.7). About 30–40 plants in scrubby woodland on the west side, with a few *Sorbus rupicola*. This is probably the same locality as found by C. Bailey in 1881 on "exposed limestone ridges near Wray's Holme Tower" (**CGE**, **BM**).

Old Park Wood (SD/3.7). We under-estimated the population size of this site; there are over 100 plants mixed with a smaller number of *S. rupicola* plants.

Grange-over-Sands (SD/4.7). One plant by B5277 at west edge of golf course.

Witherslack and Yewbarrow (SD/4.8). Isolated plants occur on roadsides, in hedges and on limestone rocks in at least six separate localities around the villages. One plant, to the N.E. of Witherslack, is in a shady hedge on Silurian baserock, a very atypical habitat.

Poolbank (SD/4.8). One small tree on woodland edge by roadside, first found by G. Halliday in 1974 (**LANC**). This is a second site on the Silurian slate; the soil pH is about 6–6·5, equivalent to the pH of many of the limestone soils on which it occurs.

Latterbarrow Nature Reserve (SD/4.8). At least four plants on the reserve, and about ten on the S.W. edge in woodland above the old A590. This is almost certainly the same locality as plants collected in 1937 by E. F. Warburg near The Derby Arms (**BM**).

Currently, there are thus approximately 2000 plants known from about 35 sites in eight 10-km squares, with one extinct population.

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We would like to thank the Keepers of **BM**, **K** and **LANC** for access to specimens, and Eimear Nic Lughadha for help in the field.

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Plant Records

Records for publication must be submitted to the appropriate Vice-county Recorder (see *B.S.B.I. Year Book for 1992*), and *not* the Editors. The records must normally be of species, hybrids or subspecies of native or naturalized alien 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 British vascular plants* by J. E. Dandy (1958), from which the species' numbers are taken. Taxonomy and nomenclature follow the *New Flora of the British Isles* by C. A. Stace (1991), except for the genera *Rubus* and *Hieracium*. The Ordnance Survey national grid reference follows the habitat and locality; the 100-km square is given in alphabetical form at the start of the grid reference rather than as numerical co-ordinates. 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, 2, 4, 9, 11–15, 17, 22, 25, 26, 28, 29, 35, 36, 38, 39, 41–50, 52, 58, 59, 61–65, 67–71, 73, 75, 77, 79–81, 88, 93, 98, 99, 102, 111.

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/com. DIPHASIASTRUM COMPLANATUM (L.) Holub *__67__, S. Northumb.: With *D. alpinum* under *Calluna*, William's Cleugh, NY/639.991. G. A. & M. Swan, 1988, **herb. G.A.S.**, det. A. C. Jermy as morphotype *decipiens*.

4/9 × 5. EQUISETUM ARVENSE L. × E. FLUVIATILE L. *__46__, Cards.: Disused railway verge, Pendinas, SN/581.801. A. O. Chater, 1991, **NMW**.

†13/cor. BLECHNUM CORDATUM (Desv.) Hieron. *__98__, Main Argyll: Rock exposures, Craignish Castle, NM/773.015. A. McG. Stirling & B. H. Thompson, 1991, **BM**, det. A. C. Jermy. Present since late 1970s.

15/8. ASPLENIUM SEPTENTRIONALE (L.) Hoffm. *__43__, Rads.: S.-facing rock face, Yatt Wood, Dolyhir, SO/24.58. D. C. Boyce, D. R. Drewett & R. G. Woods, 1991.

21/6 × 7. DRYOPTERIS CARTHUSIANA (Villars) H. P. Fuchs × D. DILATATA (Hoffm.) A. Gray *__80__, Roxburghs.: Birch wood, Din Moss, Hoselaw, NT/805.316. R. W. M. Corner, 1991, **BM**, det. A. C. Jermy.

21/8. DRYOPTERIS AEMULA (Aiton) Kuntze *__93__, N. Aberdeen: Wooded den, Tore of Troup, NJ/832.613. D. Welch, 1991, **ABD**.

25/cam. × int. POLYPODIUM CAMBRICUM L. × P. INTERJECTUM Shivas *__14__, E. Sussex: Old walls of ruined Greyfriars Chapel, Winchelsea, TQ/905.170. L. B. Burt & M. Thomas, 1991, **BM**, det. R. H. Roberts.

†27/1. AZOLLA FILICULOIDES Lam. *__44__, Carms.: Ornamental pond, Gellideg Farm, SN/423.105. T. S. Crosby, 1991. Inlet to lake, Sandy Water Park, Llanelli, SN/493.005. G. Hutchinson, 1991, **NMW**. 1st and 2nd records. __49__, Caerns.: Reservoir near Pistyll Church, SH/328.422. L. J. Larson, 1991, **NMW**. Only extant locality.

28/1. BOTRYCHIUM LUNARIA (L.) Sw. __81__, Berwicks.: Basaltic outcrop, Hareheugh Craigs, NT/687.401. D. G. Long, 1991. 2nd extant locality.

46/7. RANUNCULUS SARDOUS Crantz **46**, Cards.: Sandy field, Gwbert, SN/163.498. A. O. Chater, 1991, **NMW**. 1st localised post-1930 record.

46/9. RANUNCULUS PARVIFLORUS L. **35**, Mons.: Thin grass on bank, R. A. F. Caerwent, ST/467.919. T. G. Evans, 1991. 1st post-1930 record.

46/11. RANUNCULUS LINGUA L. *__98__, Main Argyll: Swamp, Lochan Iliter, NM/749.102. B. H. Thompson, 1991, **herb. B.H.T.**, conf. C. D. Preston.

46/19 × 22b. RANUNCULUS FLUITANS Lam. × R. PELTATUS Schrank *__68__, Cheviot: Whiteadder Water at Whiteadder Bridge, Corporation Arms, NT/959.522. J. M. Croft & C. D. Preston, 1991, **CGE**, conf. S. D. Webster.

46/22a × 21. RANUNCULUS AQUATILIS L. × R. TRICHOPHYLLUS Chaix *__50__, Denbs.: Farm pond, Penley, SJ/408.412. B.S.B.I. meeting, 1991, **CGE**, det. S. D. Webster. 1st Welsh record.

46/22c. RANUNCULUS PENICILLATUS subsp. PSEUDOFLUITANS (Syme) S. Webster var. PSEUDOFLUITANS *__77__, Lanarks.: R. Clyde, Wolfclyde, NT/01.36. R. C. L. Howitt, 1979, **herb. P. Macpherson**, conf. N. T. H. Holmes.

†50/aqu. THALICTRUM AQUILEGIIFOLIUM L. *__79__, Selkirks.: Railway embankment between Bowland and Galashiels, NT/4.3. E. P. Beattie, 1969, **E**. *__80__, Roxburghs.: Riverbank, Ettrick Water below Bridgeheugh, Selkirk, NT/476.307. E. Middleton, 1988, **E**, det. D. R. McKean.

57/1. CERATOPHYLLUM DEMERSUM L. *__44__, Carms.: Lake, Sandy Water Park, Llanelli, SN/493.005. I. K. Morgan, 1991, **NMW**. __70__, Cumberland: Recently dug pond, Bowscar, NY/522.344. K. Raistrick, 1991, **LANC**. 2nd record.

58/3. PAPAVER DUBIUM subsp. LECOQII (Lamotte) Syme *__44__, Carms.: Burnt cliff, Dolwen Point, SN/233.078. I. K. Morgan, 1991.

66/4. FUMARIA BASTARDII Boreau *__67__, S. Northumb.: Waste ground, Mason, NZ/211.735. G. A. Swan, 1990, **herb. G.A.S.**, det. M. G. Daker.

†68/1. ERUCASTRUM GALLICUM (Willd.) O. E. Schulz __70__, Cumberland: Forestry track, Spadeadam, NY/6.7. M. Gregory & J. Parker, 1991, **LANC**, det. T. C. G. Rich. 2nd record.

†71/1. HIRSCHFELDIA INCANA (L.) Lagr.-Fossat *__50__, Denbs.: Kinmel Bay, SH/990.808. G. Battershall, 1991. *__59__, S. Lancs.: Railway siding, Fazakerley, SJ/388.983. V. Gordon, 1991.

79/3. LEPIDIUM HETEROPHYLLUM Benth. __26__, W. Suffolk: Farm track, Eriswell, TL/754.764. D. J. & Y. T. Leonard, 1991, **herb. E. & M. Hyde**, conf. T. C. G. Rich. Only extant locality.

†86/2. CAPSELLA RUBELLA Reuter *__38__, Warks.: Canal towpaths, Rowington, SP/187.699, and Kingswood, SP/187.708. J. C. Bowra, 1991, **WAR**, det. P. J. Copson. 1st and 2nd records.

88/4. COCHLEARIA SCOTICA Druce *__81__, Berwicks.: St Abb's Head, NT/9.6. A. Craig-Christie, 1884, **E**, det. P. S. Wyse Jackson.

†92/1. LOBULARIA MARITIMA (L.) Desv. __50__, Denbs.: Colwyn Bay, SH/846.782. G. Battershall, 1991. 2nd post-1930 record.

†97/rap. CARDAMINE RAPHANIFOLIA Pourret *__49__, Caerns.: Bank of Afon Roe near Pont Gorswen, SH/762.714. R. Lewis, 1990, **NMW**, det. E. J. Clement & T. C. G. Rich.

102/4. RORIPPA ISLANDICA (Oeder ex Murray) Borbás *__46__, Cards.: Flat rock by Afon Teifi below Cenarth bridge, SN/269.416. A. O. Chater, 1991, **NMW**, det. B. Jonsell & T. C. G. Rich. 1st Welsh record, and extension of range 250 km southwards.

102/5. RORIPPA AMPHIBIA (L.) Besser *__44__, Carms.: Banks of Afon Llwchwr, Llanedi, SN/59.06. I. K. Morgan, 1984, **NMW**.

102/6 × 3. RORIPPA AUSTRIACA (Crantz) Besser × R. SYLVESTRIS (L.) Besser *__58__, Cheshire: Edge of lane, Partington, SJ/733.914. A. Franks & P. Newton, 1990, det. T. C. G. Rich.

†108/3. Sisymbrium loeselii L. *25, E. Suffolk: Sandy bank behind Marina, Shotley Point, TM/252.343. E. M. Hyde, 1991, **herb. T. C. G. Rich**, det. T.C.G.R.

111/1. Descurainia sophia (L.) Webb ex Prantl †42, Brecs.: Roadside verge, Llangattock, SO/21.18. A. Newton & M. Porter, 1989. 1st post-1930 record. †48, Merioneth: Disturbed ground by golf links, Morfa Harlech, SH/5.3. P. M. Benoit & D. C. Lang, 1990, **NMW**. 1st record this century.

113/5 × 4. Viola reichenbachiana Jordan ex Boreau × V. riviniana Reichb. *44, Carms.: Roadbank, Garn Fach, SN/571.156. R. D. Pryce, 1985, **NMW**, det. D. M. Moore.

113/6 × 4. Viola canina L. × V. riviniana Reichb. *75, Ayrs.: Dune grassland, Lendalfoot, NX/129.898. A. McG. Stirling, 1991.

113/9b. Viola palustris subsp. juressii P. Fourn. *47, Monts.: Bare peat, Dovey Junction, SN/703.982. P. M. Benoit, 1989.

†113/10. Viola cornuta L. *77, Lanarks.: Woodland, Cleghorn Estate, NS/8.4. W. A. Scott, 1965.

123/1a. Silene vulgaris Garcke 93, N. Aberdeen: Disturbed roadside bank, Auchterless, NJ/706.411. D. Welch, 1991, **ABD**. 1st record since 1930.

123/14 × 13. Silene latifolia Poiret × S. dioica (L.) Clairv. *75, Ayrs.: Shingle shore, Pinbain, NX/136.913. A. McG. Stirling, 1991.

†124/cha. Lychnis chalcedonica L. *35, Mons.: Forestry track, Bishop Barnet's Wood, Godefroy, ST/516.938. T. G. Evans, 1989, **NMW**.

131/10. Cerastium diffusum Pers. †12, N. Hants.: Abundant on roadside verges, Aldershot military town, SU/870.517. C. R. Hall, 1991, **herb. A. Brewis**, det. F. Rose. 2nd record.

133/3. Stellaria pallida (Dumort.) Piré 81, Berwicks.: Basaltic outcrop, Hareheugh Craigs, NT/688.400. R. W. M. Corner, 1991, **herb. M. E. Braithwaite**. 2nd record.

143/2. Spergularia bocconii (Scheele) Graebner †*15, E. Kent: Roadside verge on chalky soil, Lower Bell near Maidstone, TQ/74.60. E. G. Philp, 1991, **MNE**, conf. J. Ratter.

144/1. Polycarpon tetraphyllum (L.) L. 9, Dorset: Sandy shingle, Ferrybridge, SY/667.756. S. M. Eden, 1991. Only extant locality, in area where first recorded in 1774.

146/1. Herniaria glabra L. †*77, Lanarks.: Bare ground, site of 1988 Garden Festival, Glasgow, NS/56.65 and 57.65. P. Macpherson, 1990, **herb. P.M.** Present in increased quantity in 1991.

149/1b. Montia fontana subsp. minor Hayw. 81, Berwicks.: Basaltic outcrop, Hareheugh Craigs, NT/687.399. R. W. M. Corner, 1991, **herb. M. E. Braithwaite**. 2nd record.

†152/1. Carpobrotus edulis (L.) N. E. Br. *25, E. Suffolk: Shingle beach, Landguard Common, TM/28.31. G. E. Steeds, 1990, det. C. D. Preston.

†153/bli. Amaranthus blitoides S. Watson *26, W. Suffolk: Sandy arable field, Icklingham, TL/768.735. E. Milne-Redhead, 1988, det. A. L. Grenfell.

154/14. Chenopodium rubrum L. †*43, Rads.: Dung heap near New Radnor Station, SO/219.605. D. C. Boyce, D. R. Drewett & R. G. Woods, 1991.

156/4 × pra. Atriplex glabriuscula Edmondston × A. praecox Hülph. *68, Cheviot: Saltmarsh, Goswick, NU/054.458. G. A. & M. Swan, 1991, **herb. G.A.S.**, det. J. R. Akeroyd.

160/2. Salicornia dolichostachya Moss 44, Carms.: Channel to dock, Llanelli, SS/499.988. G. Hutchinson, 1987, **NMW**, det. D. H. Dalby. 1st post-1930 record.

163/4. Malva neglecta Wallr. *75, Ayrs.: Car park and shore, Girvan, NX/182.975. A. McG. Stirling & A. Rutherford, 1991, **E**.

164/1. LAVATERA ARBOREA L. **50**, Denbs.: Kinmel Bay, SH/994.807. G. Battershall, 1991. 2nd record, 1st since 1859.

†165/2. ALTHAEA HIRSUTA L. **11**, S. Hants.: Short coastal turf on reclaimed land, North Harbour, Cosham, SU/643.050. R. A. Barrett, 1991. 1st record as established population since 1922.

168/12. GERANIUM ROTUNDIFOLIUM L. †***46**, Cards.: Waste ground and scrub, Llandbadarn Fawr, SN/598.810. S. P. Chambers, 1991, **NMW**.

169/1. ERODIUM MARITIMUM (L.) L'Hér. **14**, E. Sussex: Bare chalk on cliff top, Flagstaff Point, TV/538.967. R. M. Burton, 1991, **herb. P. A. Harmes**. Only extant locality. ***35**, Mons.: Grassy bank near R. Severn, Sudbrook, ST/50.87. T. G. Evans, 1978. Rock garden and drive, La Cuesta, Chepstow, ST/52.93. T. G. Evans, 1981, still present in 1991. Introduced with sand and now well established. 1st and 2nd records.

169/2. ERODIUM MOSCHATUM (L.) L'Hér. †**11**, S. Hants.: Short turf by pavement, Portsdown Hill Road (B2177), Widley, SU/668.064. D. P. J. Smith, 1991, **herb. R. P. Bowman**. 1st record of established population since 1924.

†170/3. OXALIS STRICTA L. ***46**, Cards.: Trackside in pasture, Glanrheidol, SN/663.792. A. O. Chater, 1990, **NMW**.

†170/exi. OXALIS EXILIS Cunn. ***46**, Cards.: Abundant in lawns, Carrog, SN/562.724. A. O. Chater, 1991, **NMW**.

†RHUS HIRTA (L.) Sudw. ***70**, Cumberland: Derelict industrial land, Mealsgate near Fletchertown, NY/201.423. M. Porter, 1991.

†183/2. LUPINUS ARBOREUS Sims ***75**, Ayrs.: Sandy ground near shore, Seafield, NS/328.205. A. McG. Stirling & A. Rutherford, 1991.

†184/alp. LABURNUM ALPINUM (Miller) Bercht. & J. S. Presl **70**, Cumberland: Damp bank E. of Kershopefoot, NY/481.827. R. E. Groom, 1986, **LANC**, conf. A. O. Chater. 2nd record.

187/3. ULEX MINOR Roth †***59**, S. Lancs.: Embankment of disused railway line, Culcheth, SJ/646.950. V. Gordon, 1990.

†191/4. MELILOTUS INDICUS (L.) All. **12**, N. Hants.: Disturbed sandy ground, Aldershot, SU/858.508. T. Dove & A. R. G. Mundell, 1990, **herb. A.R.G.M.** 2nd record.

200/3. ASTRAGALUS GLYCYPHYLLOS L. **35**, Mons.: Rough meadow, R.A.F. Caerwent, ST/483.917. T. G. Evans and C. & G. Titcombe, 1991. 2nd extant locality.

205/1. ONOBRYCHIS VICIIFOLIA Scop. †**70**, Cumberland: Bank near old railway, Maryport, NY/02.36. N. Botham, 1991, **LANC**. 1st record this century.

†206/6. VICIA VILLOSA Roth **12**, N. Hants.: Abundant in disturbed sandy ground, Aldershot, SU/858.508. T. Dove & A. R. G. Mundell, 1990, **herb. A.R.G.M.** 2nd record.

206/10. VICIA SYLVATICA L. **12**, N. Hants.: Wood W. of Appleshaw, SU/296.485. C. Chatters & I. Routh, 1991. 1st record since 1805.

†106/14 seg. VICIA SATIVA subsp. SEGETALIS (Thuill.) Gaudin ***77**, Lanarks.: Grassy verge, Busby near Glasgow, NS/57.56. E. L. S. Lindsay & P. Macpherson, 1984, **herb. P.M.**, conf. A. McG. Stirling.

206/16. VICIA LATHYROIDES L. ***1**, W. Cornwall: Dry, stony soil on bank, Pendennis Castle, SW/824.317. R. J. Murphy & P. E. Tompsett, 1991, conf. R. M. Walls.

207/2. LATHYRUS NISSOLIA L. †**46**, Cards.: Railway embankment, Eglwys-Fach, SN/67.96. W. M. Condry, 1968, 1972. 2nd record. †***59**, S. Lancs.: Weed amongst planted bushes, Risley Moss, SJ/668.928. V. Gordon, 1991.

†Arunᴄus dioicus (Walter) Fern. *70, Cumberland: Lakeshore, Ullswater E. of Lyulph's Tower, NY/410.203. F. J. Roberts, 1991, **LANC**.

211/11/32. Rubus britannicus Rogers *29, Cambs.: Woodland margin, Warren Hill, TL/660.637. A. L. Bull, 1989, **herb. A.L.B.**, conf. A. Newton.

211/11/51. Rubus glanduliger W. C. R. Watson *11, S. Hants.: Edge of clearing, Buckland Wood, Lymington, SZ/31.97. D. E. Allen, 1990, **BM**, conf. A. Newton.

211/11/74. Rubus silvaticus Weihe & Nees *12, N. Hants.: Wood margin, Sydmonton Common, SU/49.62. D. E. Allen & F. H. Brightman, 1986, **herb. D.E.A.**, conf. A. Newton.

211/11/81. Rubus albionis W. C. R. Watson *12, N. Hants.: Birchwood, Mount Pleasant, Tadley Common, SU/60.62. D. E. Allen, 1990.

211/11/83. Rubus crudelis W. C. R. Watson *11, S. Hants.: Wood and heath margin, Chark Common, SU/57.02. D. E. Allen, 1990, **BM**, conf. A. Newton.

211/11/107. Rubus pampinosus Lees *12, N. Hants.: Wood margin, Hawley Common, SU/83.57. D. E. Allen, 1984, **herb. D.E.A.**, conf. A. Newton.

211/11/121. Rubus cissburiensis W. C. Barton & Riddelsd. *4, N. Devon: Plantation verge, Challice's Plantation, Eggesford, SS/68.09. L. J. Margetts & W. H. Tucker, 1991, det, A. Newton.

†211/11/139. Rubus procerus Müller *81, Berwicks.: Rough bank in village, Coldingham, NT/904.662. D. P. Earl, 1991.

211/11/158. Rubus cinerosiformis Rilstone *9, Dorset: Heathy common, Lambert's Castle Hill, SY/363.987. L. J. Margetts, 1991, **RNG**.

211/11/198. Rubus ahenifolius W. C. R. Watson *12, N. Hants.: Roadside verges near Pamber End, SU/60.58. D. E. Allen, 1990, **BM**, conf. A. Newton. *22, Berks.: Roadside, Silchester Common, SU/62.62. D. E. Allen, 1990.

211/11/329. Rubus rilstonei W. C. Barton & Riddelsd. *9, Dorset: Forestry rides, Champernhayes Plantation, Wootton Hill, SY/355.970. L. J. Margetts, 1991, **RNG**.

212/3. Potentilla sterilis (L.) Garcke **93**, N. Aberdeen: Rocky ground by waterfall, Turriff, NJ/712.511. D. Welch, 1991, **ABD**. 1st post-1930 record.

†212/7. Potentilla recta L. *77, Lanarks.: Grassy waste ground, Glasgow, NS/56.64. P. Macpherson, 1991, **herb. P.M.**

†220/3/12. Alchemilla mollis (Buser) Rothm. *50, Denbs.: Waste ground by farm lane, north-east of Llanrwst, SH/837.655. R. Lewis, 1990, **NMW**. This record was erroneously attributed to v.c. 49 in *Watsonia* **18**: 425 (1991).

†223/2. Sanguisorba minor subsp. muricata (Gremli) Briq. *44, Carms.: Llandybie, SN/610.145. R. D. Pryce, 1987. Carway, SN/455.067. F. H. Webb, 1991, det. R. D. Pryce. Both records from hedgebanks on restored opencast sites. 1st and 2nd records. *50, Denbs.: Roadside, Redbrook, SJ/508.412. K. Watson, 1991.

†224/inc. Acaena inermis Hook.f. *77, Lanarks.: Stabilised shingle near Culter Water, Coulter, NT/03.33. D. J. McCosh, 1981, **herb. D.J.McC**. Known here for at least 20 years.

225/8 × 7. Rosa canina L. × R. stylosa Desv. *46, Cards.: Hedge, Mwldan valley, Penparc, SN/197.486. A. O. Chater, 1991, **NMW**, det. G. G. Graham.

225/cae. Rosa caesia subsp. glauca (Nyman) G. G. Graham & Primavesi **50**, Denbs.: Hedge, Plas-yn-rhos, SJ/169.480. K. Watson, 1991. 2nd record.

225/cae. × 8. Rosa caesia subsp. glauca (Nyman) G. G. Graham & Primavesi × R. canina L. *29, Cambs.: Hedge, Fowlmere Watercress Beds R.S.P.B. reserve, TL/405.458. A. Asher, P. H. Oswald & C. D. Preston, 1991, det. A. L. Primavesi. *46, Cards.: Hedge, Gwaryfelin, SN/595.794. A. O. Chater, 1991, **NMW**, det. G. G. Graham.

225/8 × 14. Rosa canina L. × R. rubiginosa L. *64, Mid-W. Yorks.: Hedge, Micklefield, SE/445.336. P. P. Abbott, 1990, det. G. G. Graham.

225/8 × 15. Rosa canina L. × R. micrantha Borrer ex Smith *48, Merioneth: Side of track, Arthog, SH/6.1. P. M. Benoit, 1991, **NMW**, conf. A. L. Primavesi.

225/10. Rosa obtusifolia Desv. *46, Cards.: Roadside verge S. of Glanrheidol, SN/663.789. A. O. Chater, 1991, **NMW**, det. G. G. Graham.

225/13 × 12. Rosa mollis Smith × R. sherardii Davies *46, Cards.: Hedge, Coed Cwmhwylog, Nanteos, SN/622.778. A. O. Chater, 1991, **NMW**, det. G. G. Graham.

225/15. Rosa micrantha Borrer ex Smith *69, Westmorland: Limestone scrub, Heathwaite, SD/451.768. M. Baecker, 1991, **LANC**, det. G. G. Graham.

225/17. Rosa agrestis Savi 11, S. Hants.: Scrub woodland, South Charford Drove, Breamore Down, SU/139.207. R. P. Bowman, 1991, **herb. R.P.B.**, det. A. L. Primavesi. 1st record since 1891 record at this site.

225/17 × 15. Rosa agrestis Savi × R. micrantha Borrer ex Smith *11, S. Hants.: Scrub woodland, South Charford Drove, Breamore Down, SU/139.207. R. P. Bowman, 1991, **herb. R.P.B.**, det. A. L. Primavesi.

†226/7. Prunus laurocerasus L. *12, N. Hants.: By cricket ground, Amport, SU/304.438. M. F. Wildish, 1991.

†227/3. Cotoneaster horizontalis Decne. *12, N. Hants.: Water meadows, Winnall Moors N.R. near Winchester, SU/48.30. M.S.C. team, 1986. Chalk cutting on old road, Weyhill, SU/304.462. M. F. Wildish, 1991. 1st and 2nd records.

†227/atr. Cotoneaster atropurpureus Flinck & Hylmoe *77, Lanarks.: Scrubby waste ground, Cambuslang, NS/649.602. P. Macpherson, 1987. Old industrial site, Cambuslang, NS/646.605. P. Macpherson, 1988. Both **herb. P.M.**, det. J. Fryer & J. R. Palmer. 1st and 2nd records.

†227/hje. Cotoneaster hjelmqvistii Flinck & Hylmoe *77, Lanarks.: Bank of R. Clyde, Glasgow, NS/58.64. P. Macpherson, 1989, **herb. P.M.**, det. J. Fryer.

†227/tra. Cotoneaster transens Klotz *11, S. Hants.: Edge of ride in conifer plantation, Hurn Forest, SU/106.018. R. M. Walls & R. P. Bowman, 1985, **herb. R.P.B.**, det. J. Fryer. Published as *C. affinis* Lindley in *Watsonia* **17**: 471 (1989).

229/1. Crataegus laevigata (Poiret) DC. 50, Denbs.: Edge of lane, Isycoed Farm, SJ/413.519. P. Day, 1990. 2nd record. *63, S.W. Yorks.: Hedge S.W. of Cawthorne, SE/273.062. P. P. Abbott, 1991.

229/1 × 2. Crataegus laevigata (Poiret) DC. × C. monogyna Jacq. *38, Warks.: Hedge, Hampton in Arden, SP/199.829. S. M. Apted, 1991, **WAR**, det. P. J. Copson & J. C. Bowra.

232/5/1 × 1. Sorbus aria (L.) Crantz × S. aucuparia L. †*59, S. Lancs.: Field edge, Rimrose valley, Waterloo, Crosby, SJ/327.985. V. Gordon, 1991.

232/5/7. Sorbus rupicola (Syme) Hedlund *102, S. Ebudes: Bagh Uamh Mhor, Beinn na Capull, Jura, NR/67.99. D. J. McCosh, 1991, **E**, det. A. McG. Stirling.

†232/cro. Sorbus croceocarpa Sell 44, Carms.: Open oakwood, Llety-yr-ychen Fawr, Burry Port, SN/455.015. I. K. Morgan, 1991, **NMW**, det. P. J. M. Nethercott. 2nd record. *77, Lanarks.: Scrubby wood, Shieldhall, Glasgow, NS/53.65. Laneside, Shieldhall, Glasgow, NS/53.66. Both P. Macpherson, 1990, **herb. P.M.**, det. P. J. M. Nethercott. 1st and 2nd records.

235/2a. Sedum telephium L. subsp. telephium †*77, Lanarks.: Roadside west of East Kilbride, NS/59.52. A. C. & P. Macpherson, 1984, **herb. P.M.**, conf. D. R. McKean.

235/10. Sedum forsterianum Smith †*39, Staffs.: With *S. album* on limestone rocks, Milldale, S. of Alstonefield, SK/132.549. B. R. Fowler, 1991, **herb. B.R.F.**

†237/hel. Crassula helmsii (Kirk) Cockayne **2**, E. Cornwall: Shallow pool near Lamledra Farm, SX/011.410. R. E. Lees & R. J. Murphy, 1991. 2nd record. *__64__, Mid-W. Yorks.: Edge of gravel pit, Ben Rhydding, SE/146.476. Yorkshire Naturalists' Union meeting, 1991.

239/6 × 5. Saxifraga hirsuta L. × S. spathularis Brot. †*__77__, Lanarks.: Woodland in old estate, Hartwood, NS/84.59. P. Macpherson, 1975, **herb. P.M.**, det. C. A. Stace.

†240/1. Tellima grandiflora (Pursh) Douglas ex Lindley *__79__, Selkirks.: Riverside, island at confluence of Ettrick and Yarrow Waters, NT/447.273. D. Methven *et al.*, 1988, **herb. R. W. M. Corner**.

†241/1. Tolmiea menziesii (Pursh) Torrey & A. Gray *__47__, Monts.: Edge of R. Vyrnwy, Pont Llogel, SJ/033.154. R. G. Woods, 1991.

†Darmera peltata (Torrey ex Benth.) Voss ex Post & Kuntze *__69__, Westmorland: Laneside N. of Endmoor, SD/537.855. C. E. Wild, 1989, still present in 1991, G. Halliday, **LANC**.

†246/4. Ribes sanguineum Pursh *__49__, Caerns.: Naturalized in woodland near Gwydyr Castle, Llanrwst, SH/792.611. R. Lewis, 1991, **NMW**.

†246/odo. Ribes odoratum Wendl.f. *__77__, Lanarks.: Bank of R. Clyde, Hutchesontown, NS/59.63. P. Macpherson, 1988, **E**, det. D. R. McKean.

253/1. Ludwigia palustris (L.) Elliott †__14__, E. Sussex: Dew pond, South Hill Barn, Seaford Head, TV/505.980. P. D. L. Maurice, 1991, det. J. Wheatley. 1st record since c.1876.

254/†6 × 3. Epilobium ciliatum Raf. × E. montanum L. *__42__, Brecs.: Disused railway, Llanhamlach, SO/08.27. M. Porter, 1987, det. T. D. Pennington. *__46__, Cards.: Waste ground, Tal-y-bont village, SN/654.893. A. O. Chater, 1990.

254/†6 × 7. Epilobium ciliatum Raf. × E. tetragonum L. *__44__, Carms.: Rank vegetation in flood zone of stream, Pentre-cwrt, SN/390.386. G. Hutchinson, 1991, **NMW**, det. G. D. Kitchener & B. Wurzell. 1st Welsh record.

256/†2 × †1. Oenothera glazioviana Micheli ex C. Martius × O. biennis L. *__38__, Warks.: Waste ground, Emscote, SP/298.654. J. C. Bowra, 1988, **WAR**.

259/4. Myriophyllum alterniflorum DC. __61__, S.E. Yorks.: Pond, Thornton Elers, Thornton, SE/73.45. D. R. Grant, 1990. Only extant locality.

†259/aqu. Myriophyllum aquaticum (Vell. Conc.) Verdc. *__28__, W. Norfolk: Pond, Burnham Market, TF/826.418. G. Beckett, 1989, still present in 1991. *__44__, Carms.: Dafen Pond, Llanelli, SN/531.015. I. K. Morgan, 1991, **NMW**, conf. G. Hutchinson.

262/3. Callitriche obtusangula Le Gall *__67__, S. Northumb.: Ditch near Healeywood, NZ/232.849. G. A. Swan, 1991, **herb. G.A.S.**, det. Q. O. N. Kay.

†Aucuba japonica Thunb. *__99__, Dunbarton: Wooded streamside, Millig Burn, Helensburgh, NS/29.82. A. Rutherford, 1985.

268/1 hib. Hedera helix subsp. hibernica (Kirchner) D. McClint. †*__77__, Lanarks.: Bank of North Calder, Maryville, NS/68.62. A. McG. Stirling, 1986. 1st record of naturalized population.

285/4. Apium inundatum (L.) H. G. Reichb. __80__, Roxburghs.: Side of Woo Burn, Ashkirk, NT/461.178. R. W. M. Corner, 1991, **herb. R.W.M.C.** 2nd extant locality.

287/1. Sison amomum L. __44__, Carms.: Edge of path, Penclacwydd Wildfowl Centre, SS/530.986. B. Stewart, 1991, det. I. K. Morgan. 1st record since 1840s.

319/5. Euphorbia hyberna L. †*__46__, Cards.: Well established in scrub on slope, Llanbadarn Fawr, SN/598.810. S. P. Chambers, 1991, det. A. O. Chater.

320/1/3. Polygonum rurivagum Jordan ex Boreau *__25__, E. Suffolk: Roadside verge, Tunstall, TM/35.54. A. L. Bull, 1991, **herb. E. & M. Hyde**, conf. B. T. Styles.

320/1/are. POLYGONUM ARENASTRUM Boreau *75, Ayrs.: Turf paths, Ardneil Bay, NS/18.48. A. Somerville, 1903, **CGE**, det. B. T. Styles.

320/2. POLYGONUM OXYSPERMUM subsp. RAII (Bab.) D. Webb & Chater **28**, W. Norfolk: Shingle beach, Snettisham, TF/646.329. M. Keene, 1991, conf. K. A. & G. Beckett. 2nd record.

†320/7. PERSICARIA AMPLEXICAULIS (D. Don) Ronse Decraene **64**, Mid-W. Yorks.: Road verge, Wetherby, SE/406.475. P. P. Abbott, 1991. 2nd record.

320/14. PERSICARIA MINOR (Hudson) Opiz **44**, Carms.: Mud in old oxbow of R. Tywi, Bishop's Pond, Abergwili, SN/443.209. I. K. Morgan, 1991, **NMW**, det. G. Hutchinson. 1st record this century. **58**, Cheshire: Edge of Oakmere, SJ/575.678. A. Franks, 1991, **herb. G. M. Kay**, det. J. R. Akeroyd. 2nd extant locality. *75, Ayrs.: Stoney margin of Loch Maberry, NX/286.759. A. McG. Stirling & A. Rutherford, 1991, **E**.

320/†19 × †20. FALLOPIA JAPONICA (Houtt.) Ronse Decraene × F. SACHALINENSIS (F. Schmidt ex Maxim.) Ronse Decraene *4, N. Devon: Hedge, Philham, SS/259.234. W. H. Tucker, 1991, **herb. W.H.T.**, conf. L. J. Margetts. *77, Lanarks.: Trackside in wood, Bothwell, NS/69.59. P. Macpherson & E. L. S. Lindsay, 1991, **herb. P.M.**, conf. D. H. Kent.

†320/22. PERSICARIA CAMPANULATA (Hook. f.) Ronse Decraene *48, Merioneth: Edge of stream near Egryn Abbey, SH/5.1. P. M. Benoit, 1991.

325/2 bif. RUMEX ACETOSA subsp. BIFORMIS (Lange) Valdes-Berm. & Castroviejo. *46, Cards.: With *Crithmum* on sea cliffs W. of New Quay, SN/373.595. A. O. Chater, 1988. Coastal grassland S.W. of Aberaeron, SN/426.607. A. O. Chater, 1991, det. P. D. Sell. 1st and 2nd records.

325/11 × 12. RUMEX CRISPUS L. × R. OBTUSIFOLIUS L. *50, Denbs.: Arable field, Penley, SJ/408.407. D. Tinston, 1991, **NMW**.

325/15 × 13. RUMEX CONGLOMERATUS Murray × R. PULCHER L. *2, E. Cornwall: Footpath S.W. of Pentire Farm, SW/934.800. G. D. Kitchener, 1989, det. J. R. Akeroyd.

343/2 × 1. SALIX ALBA L. × S. PENTANDRA L. *59, S. Lancs.: Disused railway line, Culcheth, SJ/640.956. V. Gordon, 1991, **herb. V.G.**, conf. R. D. Meikle.

343/2 × 4. SALIX ALBA L. × S. FRAGILIS L. *77, Lanarks.: Waste ground, Braehead, Glasgow, NS/52.67. P. Macpherson, 1987, **herb. P.M.**, det. R. D. Meikle.

343/6. SALIX PURPUREA L. **35**, Mons.: Sandy bank of R. Usk, Llanllowell, ST/387.983. T. G. Evans & D. Lewis, 1991, **herb. T.G.E.** Only extant locality.

†351/1. GAULTHERIA SHALLON Pursh *44, Carms.: Edge of conifer plantation, Gelli Aur, SN/597.197. I. K. Morgan, 1991, **NMW**.

†352/1. GAULTHERIA MUCRONATA (L.f.) Hook. & Arn. *46, Cards.: Dry roadside bank, Eglwys Fach, SN/685.952. A. O. Chater & C. D. Preston, 1991, **NMW**.

†370/5. LYSIMACHIA PUNCTATA L. *79, Selkirks.: Steep bank, Clovenfords, NT/452.367. R. W. M. Corner, 1991, **herb. R.W.M.C.**

372/1. ANAGALLIS TENELLA (L.) L. **81**, Berwicks.: Flush in heather moor, Wheel Burn, NT/565.515. M. E. Braithwaite, 1991, **herb. M.E.B.** 2nd record, 1st since 1853.

382/1. CENTAURIUM PULCHELLUM (Sw.) Druce *67, S. Northumb.: Dune slack, Hadston Links, NZ/273.990. G. A. Swan, 1991, **herb. G.A.S.**, det. F. Ubsdell.

387/1. NYMPHOIDES PELTATA Kuntze †*69, Westmorland: Old clay pit, Barrow-in-Furness, SD/194.703. P. Burton, 1991, **LANC**. †*98, Main Argyll: Backwater of R. Awe at Fanans, NN/033.293. D. Dugan, 1985, still present in 1991, B. H. Thompson, **herb. B.H.T.**, conf. C. D. Preston.

†PHACELIA TANACETIFOLIA Benth. *41, Glam.: Railway cutting, Wingfield Road, Whitchurch, ST/152.795. G. Hutchinson, 1991, **NMW**, det. R. G. Ellis. 2nd Welsh record.

392/6. SYMPHYTUM TUBEROSUM L. †**11**, S. Hants.: Edge of wood, Hedgemoor Copse, West Tytherley, SU/265.313. R. P. Bowman, 1966, **herb. R.P.B.**, still present in 1988. 1st record since 1929. †**59**, S. Lancs.: Hedge bank, Formby, SD/308.086. V. Gordon, 1990. 2nd record.

†392/7. SYMPHYTUM GRANDIFLORUM DC. *__77__, Lanarks.: Edge of wood, Carmunnock, NS/60.57. P. Macpherson, 1991, **herb. P.M.**

400/3. MYOSOTIS STOLONIFERA (DC.) Gay ex Leresche & Levier *__63__, S.W. Yorks.: Acidic flush, Hordron Clough, Langsett, SK/175.994. P. P. Abbott, 1991. Southerly extension of range. **80**, Roxburghs.: Wet flush, The Schil, NT/866.215. R. W. M. Corner & B. H. Thompson, 1991, **herb. R.W.M.C.** 2nd record.

406/1 ros. CALYSTEGIA SEPIUM subsp. ROSEATA Brummitt †*__46__, Cards.: Railway embankment, Eglwys Fach, SN/673.962. A. O. Chater & W. M. Condry, 1991, **NMW**. Hedgebank, Tresaith, SN/279.514. A. O. Chater, 1991, **NMW**. 1st and 2nd records.

†416/3. VERBASCUM PHLOMOIDES L. **46**, Cards.: Disused railway, Felin-y-mor, Aberystwyth, SN/581.804. A. O. Chater, 1977, **NMW**, det. I. K. Ferguson. Still present in 1990.

[416/4 × 1. VERBASCUM LYCHNITIS L. × V. THAPSUS L. **46**, Cards.: Delete record published in *Watsonia* **12**: 173 (1978), specimen in **NMW** is *V. phlomoides* L., det. I. K. Ferguson, 1990].

416/7. VERBASCUM NIGRUM L. †*__42__, Brecs.: Garden weed, Gilwern, SO/24.14. S. G. & A. Marshall, 1989, det. M. Porter. 1st localised record.

†420/5. LINARIA DALMATICA (L.) Miller *__64__, Mid-W. Yorks.: Verge of old A65 road south of Settle, SD/813.620. E. Shorrock, 1991, det. N. Frankland.

424/2. SCROPHULARIA AURICULATA L. **71**, Man: Pasture by R. Dhoo, Glenlough, SC/343.779. J. Lamb & P. A. Sayle, 1991, conf. D. E. Allen. 2nd record, 1st as an undoubted native.

†425/cup. × 1 × 2. MIMULUS CUPREUS Dombrain × M. LUTEUS L. × M. GUTTATUS DC. *__41__, Glam.: R. Rhymney between Llechryd and Rhymney, SO/1.0. T. G. Evans, 1989, **NMW**, det. A. J. Silverside.

426/1. LIMOSELLA AQUATICA L. **75**, Ayrs.: Edge of North Craig Reservoir, NS/437.414. R. L. Griffith, 1991, **herb. R.L.G.** 2nd record. *__93__, N. Aberdeen: Mud by dune slack, Sands of Forvie, NK/01.26. J. J. Barkman & C. H. Gimingham, 1990, **ABD**. Northerly extension of range.

430/2 × 3. VERONICA ANAGALLIS-AQUATICA L. × V. CATENATA Pennell *__36__, Herefs.: Disused gravel pit, Bodenham, SO/52.51. J. M. Croft & C. D. Preston, 1991, **CGE**.

†430/25. VERONICA CRISTA-GALLI Steven **46**, Cards.: Waste ground by Church Hall, Llanbadarn Fawr, SN/598.810. A. O. Chater, 1991, **NMW**. 2nd record.

†430/aus. VERONICA AUSTRIACA subsp. TEUCRIUM (L.) D. Webb *__39__, Staffs.: Limestone spoil on railway sidings, Waterhouses, SK/072.492. B. R. Fowler, 1991.

[434/3. MELAMPYRUM PRATENSE L. **29**, Cambs.: Delete record published in *Watsonia* **18**: 429 (1991); specimen in **CGE** is *Stellaria holostea* L.]

435/1/19 × 13. EUPHRASIA ROSTKOVIANA Hayne × E. NEMOROSA (Pers.) Wallr. *__35__, Mons.: Floor of disused limestone quarry, Blackcliff, ST/533.984. T. G. Evans, 1988, **herb. T.G.E.**, det. A. J. Silverside. 1st Welsh record.

440/2. OROBANCHE PURPUREA Jacq. **26**, W. Suffolk: Lakenheath, TL/72.82. M. G. Rutterford, 1990, conf. F. W. Simpson. 1st post-1930 record. **45**, Pembs.: Dunes over limestone west of Manorbier Church, SS/06.97. M. Higgins, 1991. Only extant locality.

440/4. OROBANCHE ALBA Stephan ex Willd. †*__17__, Surrey: On *Thymus* in garden, host planted 20 years ago and not disturbed for at least 10 years, Abinger Hammer, TQ/098.460. P. Verrall, 1991, conf. F. J. Rumsey.

442/2. UTRICULARIA AUSTRALIS R. Br. *__80__, Roxburghs.: Branxholme Wester Loch, NT/422.110. M. E. Braithwaite, 1991, **herb. R. W. M. Corner**.

†464/rus. PHLOMIS RUSSELIANA (Sims) Benth. *70, Cumberland: Railway embankment, Langwathby, NY/575.324. F. Lawson, 1957, **CLE**, and R. W. M. Corner, 1990, **LANC**, both specimens det. G. Halliday.

472/1 int. PLANTAGO MAJOR subsp. INTERMEDIA (Gilib.) Lange *35, Mons.: Black Rock Point, ST/51.88. A. O. Chater, 1987, **NMW**.

472/5. PLANTAGO CORONOPUS L. †*43, Rads.: Close-grazed turf on roadside bank, Llannerch Cawr, SN/900.616. M. Porter, 1991, **NMW**.

†475/5. CAMPANULA PERSICIFOLIA L. **80**, Roxburghs.: Railway cutting, Long Newton, NT/587.277. R. W. M. Corner, 1991, **herb. R.W.M.C.** 2nd record.

485/3 × 4. GALIUM MOLLUGO L. × G. VERUM L. *93, N. Aberdeen: Roadside bank, Auchterless, NJ/706.411. D. Welch, 1991, **ABD**.

485/6. GALIUM PUMILUM Murray **12**, N. Hants.: Isle of Wight Hill, SU/245.373. P. Wilson, 1991. 2nd record.

485/10. GALIUM ULIGINOSUM L. **46**, Cards.: Fen, Banc-y-mwldan S.S.S.I., Penparc, SN/197.483. W. Fojt, 1987, conf. A. O. Chater.

494/2. VALERIANELLA CARINATA Lois. **50**, Denbs.: Colwyn Bay, SH/845.782. G. Battershall, 1991. 2nd record. *81, Berwicks.: Rock outcrop, Muckle Thairn, Girrick, NT/665.374. M. E. Braithwaite, 1991, **E**, det. D. R. McKean. Northerly extension of range.

†502/3. BIDENS FRONDOSA L. **44**, Carms.: Witchett Pool, Laugharne, SN/28.07. V. Gordon, 1956, **NMW**, det. G. Hutchinson. 2nd record.

506/†4 × 7. SENECIO SQUALIDUS L. × S. VISCOSUS L. *58, Cheshire: By gravel track, Alsager, SJ/796.548. G. M. Kay, 1990, **herb. G.M.K.**

506/†4 × 8. SENECIO SQUALIDUS L. × S. VULGARIS L. *45, Pembs.: Waste ground, Goodwick Harbour, SM/95.38. J. W. Partridge, 1988, **NMW**, det. C. Jeffrey.

506/6. SENECIO SYLVATICUS L. **111**, Orkney: Eroded bank at top of beach, Rackwick Bay, ND/197.990. B. H. Thompson, 1991. Only extant locality.

†509/3. PETASITES JAPONICUS (Siebold & Zucc.) Maxim. **2**, E. Cornwall: Roadside bank, Lower Woon, SX/035.623. B. Molland, 1991, det. R. J. Murphy. 2nd record. **49**, Caerns.: Tidal mudbank, Afon Ro near confluence with Afon Conwy, SH/77.69. R. Lewis, 1991. 2nd record. *79, Selkirks.: Side of R. Tweed below Yair Bridge, NT/462.325. D. Methven, 1991.

513/1. PULICARIA DYSENTERICA (L.) Bernh. *99, Dunbarton: Ditch bank, Bannachra Muir, Helensburgh, NS/33.83. K. Futter, 1991, **E**, conf. A. McG. Stirling.

†518/2. SOLIDAGO CANADENSIS L. **50**, Denbs.: Kinmel Bay, SH/990.808. G. Battershall, 1991. 2nd record.

†518/3. SOLIDAGO GIGANTEA subsp. SEROTINA (O. Kuntze) McNeill *38, Warks.: Disused quarry, Little Compton, SP/270.291. J. C. Bowra, 1980, **WAR**, det. C. Jeffrey & D. H. Kent.

†519/8. ASTER LANCEOLATUS Willd. *46, Cards.: Tidal river bank, Afon Rheidol, Glanyrafon, SH/612.804. Waste ground near railway, Aberystwyth, SN/589.811. Both A. O. Chater, 1990, **NMW**, det. P. F. Yeo. 1st and 2nd records.

†519/9. ASTER × SALIGNUS Willd. *46, Cards.: Tidal river bank, Afon Leri, Borth, SN/616.898. Railway embankment, Glandyfi, SN/696.976. Both A. O. Chater, 1990, **NMW**, det. P. F. Yeo. 1st and 2nd records.

†522/1. CONYZA CANADENSIS (L.) Cronq. *77, Lanarks.: Waste ground near R. Clyde, Glasgow, NS/56.65. P. Macpherson, 1991, **herb. P.M.**

538/3. Arctium minus subsp. pubens (Bab.) Arenes *46, Cards.: Disturbed ground by caravan site, Ystrad Teilo, Llanrhystud, SN/546.695. A. O. Chater, 1991, **NMW**, conf. F. H. Perring.

544/3. Centaurea cyanus L. **61**, S.E. Yorks.: Roadside verge, Bursea Lane, SE/803.342. F. E. Crackles, 1991. Only extant locality. **70**, Cumberland: Grass verge, lane off Linefoot-Broughton Moor Road, NY/075.341. N. Botham, 1972. Only extant locality.

552/2 × 1b. Tragopogon porrifolius L. × T. pratensis subsp. minor (Miller) Wahlenb. *25, E. Suffolk: Roadside verge, Tunstall, TM/35.54. P. G. Lawson, 1991.

554/1. Lactuca serriola L. *58, Cheshire: Embankment and ditchside, Helsby, SJ/489.774. G. M. Kay & T. C. G. Rich, 1991.

558/1/3. Hieracium speluncarum Arv.-Touv. *77, Lanarks.: Spoil heaps amongst scrub near Bishopbriggs Golf Course, NS/59.71. D. J. McCosh & K. J. Watson, 1991, **GLAM**.

558/1/45. Hieracium lasiophyllum Koch *44, Carms.: Dry rocks above Troed-rhiw-ruddwen, Rhandirmwyn, SN/7.4. I. M. Vaughan, 1972, **NMW**, det. J. Bevan.

558/1/99. Hieracium grandidens Dahlst. *93, N. Aberdeen: Dyke along shelter belt, Oyne, NJ/671.262. D. Welch, 1989, **ABD**, det. D. J. McCosh & P. D. Sell.

558/1/136. Hieracium caesiomurorum Lindeb. *93, N. Aberdeen: Rock ledge by waterfall, Craig, NJ/472.247. D. Welch, 1990, **herb. D.W.**, det. D. J. McCosh.

558/1/222. Hieracium salticola (Sudre) Sell & C. West *41, Glam.: Grassy waste ground, Cardiff Docks, ST/205.743. G. Hutchinson, 1986, **NMW**, det. J. Bevan.

558/1/223. Hieracium vagum Jordan *41, Glam.: Disused railway line, St Fagans, ST/117.768. G. Hutchinson, 1990, **NMW**, det. J. Bevan.

558/1/mem. Hieracium memorabile Sell & C. West **88**, Mid Perth: Rocky ledges, N. Coire, Beinn Heasgarnich, NN/41.38. D. J. Tennant, 1991, **herb. D.J.T.** 1st record since 1891 specimen from this site.

†571/1. Lagarosiphon major (Ridley) Moss *39, Staffs.: Canal N. of Brownhills, SK/046.071. J. P. Martin, 1990, **K**, det. D. A. Simpson.

577/11. Potamogeton friesii Rupr. *80, Roxburghs.: Branxholme Easter Loch, NT/43.11. P. Macpherson, 1991, **herb. P.M.**, det. C. D. Preston.

577/16. Potamogeton trichoides Cham. & Schldl. *12, N. Hants.: Pond by R. Blackwater, Hawley, SU/855.595. C. R. Hall, 1991, **herb. A. Brewis**, det. N. T. H. Holmes & C. D. Preston. *36, Herefs.: Recently cleared section of Hereford & Gloucester Canal E. of Skew Bridge, Monkhide, SO/61.43. J. M. Croft & C. D. Preston, 1991, **CGE**.

579/1. Ruppia cirrhosa (Petagna) Grande *69, Westmorland: Old mine shaft frequently inundated by sea, Blacks Pond, Askam in Furness, SD/207.763. P. Burton, 1991, **LANC**, conf. C. D. Preston.

601/1. Muscari neglectum Guss. ex Ten. †*70, Cumberland: Quarry, Catlands, NY/2.4. M. Porter, 1991.

602/1. Colchicum autumnale L. †*73, Kirkcudbrights.: Mill Island, R. Cree, NX/409.662. J. McCleary, 1989.

†605/2. Juncus tenuis Willd. *67, S. Northumb.: Grassy track, W. bank of R. Allen opposite Plankey Mill, NY/795.622. G. A. Swan, 1972, **herb. G.A.S.** First recorded in NY/7.6 in 1955; still present in 1991. Waste ground near Albert Edward Dock, NZ/348.671. D. N. Mitchell, 1988, **herb. G.A.S.** 1st and 2nd records.

605/4. Juncus compressus Jacq. **35**, Mons.: Wet hollow, White House Farm, SO/42.14. P. C. & J. Hall, 1991, **NMW**, det. P. C. H. & T. G. Evans. Only extant locality. *58, Cheshire: Boggy area by pool, Middlewich, SJ/699.669. J. H. Clarke, 1991, **herb. G. M. Kay**, det. C. A. Stace.

605/12. Juncus filiformis L. *59, S. Lancs.: Exposed shore of Earnsdale Reservoir, TM/669.221. P. Jepson, 1991.

607/6. Allium oleraceum L. 26, W. Suffolk: Roadside verge, Shaker's Lane, Bury St Edmunds, TL/86.64. P. G. Lawson & E. Milne-Redhead, 1991. 2nd extant locality.

†616/2. Iris versicolor L. 70, Cumberland: Amongst *Juncus* by lakeside between Fawe Park and Lingholm, Derwentwater, NY/254.224. E. Sterne, 1985, **LANC**, det. B. Mathew. 2nd record.

628/2. Listera cordata (L.) R. Br. 46, Cards.: Moorland N. of Cwm Ystwyth, SN/812.778. A. Jones, 1991. 2nd record.

640/3. Ophrys sphegodes Miller 26, W. Suffolk: Open grassland, Lakenheath, TL/7.8. L. Farrell, 1991, conf. J. J. Wood. 1st record since 1793.

643/1 × 3b. Dactylorhiza fuchsii (Druce) Soó × D. incarnata subsp. pulchella (Druce) Soó *62, N. E. Yorks.: Calcareous flush, Dalby Forest near Thornton Dale, SE/8.8. F. Horsman, 1991.

643/1 × 5. Dactylorhiza fuchsii (Druce) Soó × D. purpurella (Stephenson & T. A. Stephenson) Soó *46, Cards.: Dune slack, Ynys-las Dunes N.N.R., SN/611.938. F. Horsman, 1991.

643/3b. Dactylorhiza incarnata subsp. pulchella (Druce) Soó 65, N.W. Yorks.: Marsh, Combe Scar, SD/679.875. F. Horsman, 1991. 2nd record.

643/3a × 2b. Dactylorhiza incarnata (L.) Soó subsp. incarnata × D. maculata subsp. ericetorum (Linton) P. Hunt & Summerh. *46, Cards.: Fen, Mwldan valley N.N.E. of Penparc, SN/201.489. F. Horsman, 1991.

643/4. Dactylorhiza praetermissa (Druce) Soó 62, N.E. Yorks.: Streamside, Keysbeck, Stape, SE/798.953. P. Sykes, 1991, det. F. Horsman. Only extant locality.

643/6 cam. Dactylorhiza majalis subsp. cambrensis (Roberts) Roberts 46, Cards.: Fen near Cardigan, SN/1.4. F. Horsman, 1991. 2nd record.

643/6 cam. × 5. Dactylorhiza majalis subsp. cambrensis (Roberts) Roberts × D. purpurella (Stephenson & T. A. Stephenson) Soó *46, Cards.: Dune slack, Ynys-las Dunes N.N.R., SN/609.939. D. C. Lang & A. P. Fowles, 1990.

643/7. Dactylorhiza traunsteineri (Sauter ex Reichb.) Soó *11, S. Hants.: Flushed marshy clearing, Exbury, SU/4.0. R.P. Bowman, 1984, det. F. Rose.

†646/1. Acorus calamus L. 50, Denbs.: Marchwiel, SJ/355.468. P. Goodhind, 1991. 2nd record. 80, Roxburghs.: Side of R. Teviot below Roxburgh Castle, NT/713.337. J. M. Croft, C. D. Preston & O. M. Stewart, 1991, **herb. R. W. M. Corner**. Only extant locality.

†647/1. Calla palustris L. *47, Monts.: Roadside marsh, Meifod, SJ/160.126. H. Webster, 1989. Known for over 20 years but now almost overwhelmed by *Petasites japonicus*. 1st Welsh record.

†648/1. Lysichiton americanus Hultén & H. St John 46, Cards.: Stream bank, Tyglyn, SN/498.598. R. N. Stringer, 1991. 2nd record.

650/4. Lemna gibba L. 44, Carms.: Ditch north of Glanrhyd Farm, Pembrey, SN/406.043. I. K. Morgan, 1991, **NMW**, conf. G. Hutchinson. 1st record since 1840s. Garden pond, Towy View near Ffairfach, SN/640.225. I. K. Morgan, 1991. 2nd extant locality.

650/min. Lemna minuta Kunth *44, Carms.: Ditch between Bury Port and Pwll, SN/462.012. Reed swamp E. of Bury Port, SN/458.010. Both I. K. Morgan, 1991, **NMW**, det. G. Hutchinson & A. Orange. 1st and 2nd records. 3rd and 4th Welsh records.

653/2 × 1. Typha angustifolia L. × T. latifolia L. *13, W. Sussex: Ponds, Chichester Gravel Pits, SU/872.032. G. H. Forster, 1991. *14, E. Sussex: Ditch in pasture near R. Ouse, Lewes, TQ/428.055. T. C. G. Rich, 1991, **LANC**.

654/3. Eriophorum latifolium Hoppe **81**, Berwicks.: Calcareous flush, Lamberton Moor, NT/955.582. M. E. & P. F. Braithwaite, 1991, **herb. M.E.B.** 2nd extant locality.

655/11. Isolepis cernua (Vahl) Roemer & Schultes **47**, Monts.: Saltmarsh, Dovey Junction Station, SN/695.984. P. M. Benoit, 1989. Only extant locality; last seen here in 1939.

656/6. Eleocharis uniglumis (Link) Schultes *__17__, Surrey: Old sand filter bed, Barn Elms waterworks, TQ/228.774. M. Mullin, 1991.

658/1. Cyperus longus L. †**59**, S. Lancs.: By dried-up reservoir, Pilsworth, SD/755.086. A. Franks. 1991. 2nd record.

659/1. Schoenus nigricans L. **81**, Berwicks.: Calcareous flush, Lamberton Moor, NT/955.582. M. E. & P. F. Braithwaite, 1991, **herb. M.E.B.** 2nd extant locality.

663/23. Carex strigosa Hudson *__63__, S. W. Yorks.: Damp ditch in wood, Margery Wood, Cawthorne, SE/278.095. P. P. Abbott, 1991, det. W. A. Sledge.

663/28. Carex limosa L. **50**, Denbs.: Soligenous flush, Pentrevoelas, SH/890.545. J. A. Green, 1991. 2nd record.

663/60. Carex disticha Hudson *__48__, Merioneth: *Phragmites* swamp near Llanaber, SH/5.1. P. M. Benoit, 1991, **NMW**.

663/61. Carex arenaria L. †**77**, Lanarks.: Waste ground behind High Street Railway Station, Glasgow, NS/59.65. J. H. Dickson, 1989, **GL**. 2nd record.

663/81. Carex dioica L. *__43__, Rads.: *Molinia* flush below Craig y Bwlch, SN/900.619. D. Reed, 1991, **NMW**, conf. R. G. Woods.

667/1 aru. Molinia caerulea subsp. arundinacea (Schrank) K. Richter *__58__, Cheshire: Roadside ditch, Goostrey, SJ/797.729. G. M. Kay, 1991, **herb. G.M.K.**

†Eragrostis curvula (Schrader) Nees *__11__, S. Hants.: Side of disused railway near Mayflower Park, Southampton, SU/416.111. E. J. Clement & A. L. Grenfell, 1989, **herb. R. P. Bowman**, det. T. A. Cope.

†670/6 meg. Festuca rubra subsp. megastachys Gaudin *__25__, E. Suffolk: Earth bank, Landguard Common, TM/28.31. A. Copping, 1987, det. C. A. Stace. *__29__, Cambs.: Roadside verge, Little Shelford, TL/446.513. P. J. O. Trist, 1991, **herb. P.J.O.T.**

670/7. Festuca arenaria Osbeck *__44__, Carms.: Shingle at foot of calcareous cliff, Llansteffan, SN/3.0. I. M. Vaughan, 1967, **NMW**, det. A. K. Al-Bermani.

670/9. Festuca filiformis Pourret *__47__, Monts.: On hummocks in boggy field near Llanfihangel-yng-Ngwynfa, SJ/09.15. P. M. Benoit, 1989.

670/10. Festuca vivipara (L.) Smith **50**, Denbs.: Rocky outcrop at 450 m, Migneunt, SH/778.425. G. Battershall, 1991. 2nd record.

671/†2 × 1. Lolium multiflorum Lam. × L. perenne L. *__38__, Warks.: Farm track, Upper Shuckburgh, SP/486.603. J. C. Bowra, 1991, **WAR**, det. P. J. Copson.

672/5. Vulpia ciliata subsp. ambigua (Le Gall) Stace & Auq. *__48__, Merioneth: Low hummocks in dune grassland, Aberdyfi golf links, SN/5.9 and 6.9. P. M. Benoit, 1991, **NMW**. 1st Welsh record.

673/2. Puccinellia distans (Jacq.) Parl. *__48__, Merioneth: Embankment, Mawddach estuary at Garth Isaf, SH/6.1. P. M. Benoit, 1991, **NMW**.

673/5. Puccinellia rupestris (With.) Fern. & Weath. **2**, E. Cornwall: Abundant on mud on sides of Millbrook Pond, SX/425.523. R. W. Gould, 1991, conf. L. J. Margetts. 1st record since 1917.

676/11. Poa angustifolia L. **2**, E. Cornwall: Penlee Battery, Rame peninsula, SX/440.493. R. W. Gould, 1991, **herb. R. J. Murphy**, conf. L. J. Margetts & R. J. M. 2nd record.

†680/2. Briza minor L. *13, W. Sussex: Halsey's Farm, Chichester Harbour, SZ/871.975. G. H. Forster, 1991.

683/1. Bromopsis erecta (Hudson) Fourr. *43, Rads.: Grassland in base of old quarry, Stanner Rocks, SO/26.58. R. G. Woods, 1988, **NMW**, det. T. G. Evans. One plant.

†683/4. Bromopsis inermis (Leysser) Holub *14, E. Sussex: Edge of Sports Field, Bevingdean Hospital, TQ/331.061. A. Spiers, 1990, **herb. P. A. Harmes**. Chalk downs, Castle Hill, Brighton, TQ/367.070. G. Steven, 1991, det. P. J. O. Trist. 1st and 2nd records.

†683/13. Bromus lepidus O. Holmb. *44, Carms.: Forestry rides, Pembrey Forest, SN/3.0. I. M. Vaughan, 1965, **NMW**.

†683/19. Ceratochloa carinata (Hook & Arn.) Tutin *2, E. Cornwall: Roadside verge, Saltermill, SX/430.637. T. Atkinson, 1991. *11, S. Hants.: Sandy roadside verge, Belvidere, Northam, SU/430.129. P. D. Stanley, 1991, **herb. R.P. Bowman**, det. R. P. B. & P. J. O. Trist.

684/2. Brachypodium pinnatum (L.) P. Beauv. *52, Anglesey: Pine plantation on sand dune, Newborough Forest, SH/398.637. N. H. Brown & R. H. Roberts, 1990, **NMW**.

687/1. Hordeum secalinum Schreber †73, Kirkcudbrights.: Field track E. of Castlecreavie, NX/726.488. O. M. Stewart, 1991, **E**, det. P. J. O. Trist. 1st record since 1910.

687/jub. Hordeum jubatum L. **49**, Caerns.: Sandy beach, Pontlyfni, SH/433.532. L. J. Larsen, 1989, **NMW**, det. R. G. Ellis.

689/1. Koeleria macrantha (Ledeb.) Schultes **44**, Carms.: Limestone grassland near Llandyfan, SN/647.176. D. Grey & S. Gouch, 1989. 2nd extant locality. *48, Merioneth: Calcareous dune grassland, Aberdyfi golf links, SN/6.9. P. M. Benoit, 1991, **NMW**.

700/1. Calamagrostis epigejos (L.) Roth **111**, Orkney: Tall herb community on cliff top, Hoxa, S. Ronaldsay, ND/40.93. E. R. Bullard, 1989, det. P. J. O. Trist.

700/3. Calamagrostis stricta (Timm) Koeler *59, S. Lancs.: Old pool, Charles St, Darwen, SD/690.227. P. Jepson & N. P. Symonds, 1991, det. H. J. M. Bowen.

701/2b. Agrostis vinealis Schreber *44, Carms.: Cerrig Cyffion, SN/68.46. R. Walls, 1988, **NMW**.

†701/8. Polypogon viridis (Gouan) Breistr. *52, Anglesey: Disused limestone quarry, Benllech, SH/51.81. J. E. Hawksford, 1991, det. R. H. Roberts.

†702/1. Apera interrupta (L.) P. Beauv. *77, Lanarks.: Canal towpath, Maryhill, NS/57.68. K. Watson, 1988, **GL**. Princes Dock, Glasgow, NS/56.64. A. McG. Stirling, 1988, **GL**. 1st and 2nd records.

707/4. Phleum phleoides (L.) Karsten *25, E. Suffolk: Chalky hollow on golf course, Stuston Common, TM/136.786. S. Hooton, 1991, conf. A. Copping.

719/2. Digitaria sanguinalis (L.) Scop. *2, E. Cornwall: Pavement weed, Saltash, SN/432.587. S. C. & P. S. Madge, 1990.

Book Reviews

Wild plants of Glasgow. Conservation in the city and countryside. J. H. Dickson, with paintings by Elspeth Harrigan and photographs by T. N. Tait. Pp. 208, including black and white illustrations, maps and tables, and 30 pp. in colour. Aberdeen University Press, Aberdeen. 1991. Price £14.95 (ISBN 0–08–041200–9).

This book is the first fruits of the Flora of Glasgow survey which has been taking place over the last decade. It is aimed at the general reader, and will be followed later by a more detailed and technical publication. It is an extremely attractive book, which describes some of the extraordinary range of plants, native and introduced, growing in the Glasgow area, including something of their history and ecology, and the problems of conservation.

The book is divided into three sections. The first deals with the background and objectives of the survey, and gives an insight into how the data are analysed. Dot maps are used to illustrate some of the different distribution patterns which have been identified, and annotated site lists to indicate the characteristics of different plants.

The second and largest section of the book takes a more detailed look at nine contrasting habitats, and at some of the plants typical of each. These include some amazing finds, such as the wild Fig on the Clyde, and the 'extinct' Mudwort in a dried-up reservoir, as well as more common plants and some interesting hybrids. The final section consists of a chapter on conservation, and is followed by an extensive bibliography, and notes on Field Guides and Societies to join. In short it is a popular book which also succeeds in being scholarly.

Since it is intended for a general audience, popular English plant names are used throughout. Latin names are included for all the plants which receive detailed attention, but not in the captions to the illustrations, which I think is a pity. Personally I like to see both Latin and English used at first appearance even in more technical literature, but this would have made the text too unwieldy in places. Latin plant names are included in the Index (though one or two plants on the site lists have been missed).

But these are quibbles. The whole volume is a work of art and beautifully produced on expensive paper; the colour photographs are excellent, and some of the individual flower paintings are quite stunning. In his Introduction Dr Dickson bemoans the unattractiveness of the books available to him as a youngster, when he first took an interest in botany: he has made sure that no future generation of Glaswegians will be able to make a similar complaint. Let us hope he can pull off a double with the more technical publication still to come.

J. Muscott

The wild flowers of Luton. J. G. & C. M. Dony. Edited by C. Boon. Pp. 64, with maps. Privately published, Luton. 1991. Price £3.50 (inc. postage), available from P. Ellison, 90 Beverley Road, Ruislip, Middx., HA4 9AS.

This, the last work by Dr J. Dony in a line of distinguished books on his local flora, is announced as "an account of the wild flowers known to grow in the immediate past in Luton". Having already accounted in detail for the flora of Bedfordshire in general in two books, we might be excused for thinking that this could not be anything new. We would be wrong. In fact, it is two accounts in one, and breaks new ground in several ways. About a third of the book consists of an annotated check-list of the flora of Luton Borough and its immediate environs, covering some 4,803 ha, an area with a remarkable range of habitat types considering its size. The main body of the book, however, consists of a series of concise 'site reports' of places which "had a vegetation worthy of record". Some 23 sites are dealt with in detail, each having a description, historical notes, grid reference, and a list of

specially selected species recorded between 1987 and 1990. These selected species are those found in 128 or fewer tetrads in Bedfordshire as a whole (i.e. less than 33%). A special innovation is the use of these species lists to construct a 'plant rarity factor' for each site, the higher the resulting score, the greater overall botanical rarity represented by the site. These accounts are rounded off neatly with a clear site map for each site, and there is a coloured general map of the area in the centre spread which can be used both to identify specific sites and to see the extent and location of surviving semi-natural vegetation.

Just as Dr Dony's earlier Floras had pioneered the use of discrete 'habitat studies' as a way of providing a factual base-line for describing the typical vegetation of specific habitats, so this takes the process one step further, to provide an outline assessment, in botanical terms, of the conservation value of sites. The result is a mini conservation review of Luton Borough, based on sound facts. Many a consultancy would be incapable of producing such a document for a local authority's 'green audit', so much the current fashion. Luton has one virtually for nothing.

T. J. James

Fern names and their meanings. A glossary for the fern grower and collector. J. W. Dyce. Pp. iv + 31. British Pteridological Society, London. 1988. Price £3 (ISBN 0–9509806–1–7).

'What do they mean'? 'Why do botanists keep changing them?' This small booklet is an attempt to answer, at least for "the amateur grower of British ferns and their varieties and cultivars", the first of those questions so frequently asked about Latin plant names. The second problem is also addressed briefly but passionately in the introduction.

The booklet has four main parts: an introduction, sections on the etymology of the names of British fern genera, and on the meaning of Greek and Latin word elements commonly found in fern varietal names, and the heart of the book, the main glossary of varietal names. The latter runs to 18 sides and includes over 700 entries, all listed in the neuter form.

The author indicates in his introduction that his basic source of information is the glossary of fern names prepared by Dr F. W. Stansfield and Rev. Canon Kingsmill Moore and published in the *British Fern Gazette* between 1919 and 1921. What he does *not* say is that his glossary is almost entirely a simple re-ordering of Stansfield & Moore's work (where the varietal names were arranged under each species) into a single alphabetical sequence, but in nearly all cases keeping their original definitions verbatim. One or two of Stansfield & Moore's own, rare, errors have however been corrected: their picturesque definition of *gemmatum* ('decked with gems') has been changed to the prosaic but more accurate 'provided with buds'. Some epithets are misspelt or malformed; in some instances this is obviously due to error on the part of the original fern grower or author (*gracilissimum* should be *gracillimum*, as indicated by Stansfield & Moore) but others (e.g. *minum* and *majum* which should be *minus* and *majus*) show faulty understanding of Latin.

In spite of its deficiencies, this is an admirably useful little book. It makes Stansfield & Moore's work available once again in a handy, accessible and inexpensive form to a new generation of fern growers and collectors who may not have the early volumes of *British Fern Gazette* at their disposal.

R. R. Mill

Atlas Florae Europaeae: Distribution of vascular plants in Europe. Vol. 9, Paeoniaceae to Capparaceae. Edited by J. Jalas & J. Suominen. Pp. 110, 155 maps. Committee for Mapping the Flora of Europe and Societas Biologica Fennica Vanamo, Helsinki. 1991. Price FIM 350 (ISBN 951–9108–08–4).

Volume 9 of *Atlas Florae Europaeae* is of particular interest to British botanists because, in covering mainly the Papaveraceae, it deals with genera such as *Papaver*, *Fumaria* and *Corydalis* (sensu lato) which have species with rapidly changing distributions in this country. *Fumaria parviflora*, for

example, is in decline throughout Central Europe and is hardly known north of 50°N except in Britain where it reaches 57°N, and the same seems to be true of *Papaver hybridum*, now apparently extinct in Belgium and Holland.

Many of the 24 British species mapped in this part are introductions but their treatment is somewhat arbitrary. *Chelidonium majus* is accorded native status throughout its range here whilst all records of *Berberis vulgaris* are regarded as introductions, whereas both are probably best regarded as 'doubtfully native'. Although a map of *Eschscholzia californica* is included, no British localities are shown, though it is said by Stace in his *New Flora of the British Isles* (1991) to be naturalised and perennating on dunes, walls and cliff tops in Guernsey and in quarries and by railways in Kent. There is no map of the ever-spreading Oregon-grape, *Mahonia aquifolium*. This variable treatment is doubtless a reflection of our own uncertainty and it is an area to which the B.S.B.I., with its wide network of recorders, could surely contribute in advance of future parts.

Members may also be able to contribute useful information from visits abroad. I was surprised to find the native status of *Laurus nobilis* in Majorca questioned: I saw it in February 1991 on a cliff at the mouth of the Torrent de Pareis where it was recorded in my 1880 Flora.

The maps in this *Atlas* will be even more fascinating when put alongside the results of the Monitoring Scheme when they are published. Comparison with that scheme will not be as easy as could be wished because some of the recent name changes are long and unattractive. *Corydalis* has been split into *Pseudofumaria* and *Ceratocapnos*, whilst with *Fumaria*, *F. martinii* has been lumped with the more widespread *F. reuteri*, and orthographic research has decided that *F. muralis* now has a subsp. *boroei* rather than subsp. *boraei*. There are times when one would like to recommend that taxonomists be paid a negative productivity bonus.

With this volume the number of maps published since the project began in 1966 has reached 2109 and perhaps 15% of the task is completed. Now is surely a time to salute the efforts of those two botanists from Helsinki, Jaakko Jalas and Juha Suominen, who have masterminded the project as organisers and editors over the 25 years since it began.

F. H. Perring

Wild orchids of Dorset. M. N. Jenkinson. Pp. 120, with drawings, maps and 63 colour plates. Orchid Sundries, Gillingham, Dorset. 1991. Price £17.95 hardback (ISBN 1–873035–01–2); £13.95 paperback (ISBN 1–873035–02–0).

This book, by a police officer, is said to be "directed not so much at the committed orchid enthusiast, but seeking to find new converts to the faith". Indeed much enthusiasm for the field study of orchids is engendered here, even though the perils of looking for *Hammarbya paludosa* are made abundantly clear.

Short introductory sections refer to the objectives of the book, the structure of the orchid flower, the geology of Dorset, the main habitats of orchids in the county (listed under five categories), and the nature reserves. Much of the book is devoted to accounts of some 28 species of orchids which occur regularly. For each species information is given on status, habitat, flowering period, distribution and distinctive features, but there is no overall key. The distribution maps, based mostly on records made during the last ten years, provide more information than previously available, presence being shown within 1-km squares. Although readers are repeatedly reminded not to pick flowers, the wisdom of the publication of such detailed distributions of uncommon species is questionable.

Notable features are the full treatment of the helleborines (including the recent discoveries of *Epipactis purpurata*) and of the dactylorchids, both subjects of special study by the author. In the dactylorchids, nomenclature departs from *Flora Europaea*, and "a newly identified form, var. *bowmanii* Jenkinson" (not validly published) is included under *Dactylorhiza majalis* subsp. *traunsteinerioides*. This form, found also in Hampshire, is robust, has a rather dark flower colour and a fairly narrow, very deeply three-lobed labellum. Hybrids are not prominently treated, but the features of the labellum of many forms of the marsh orchids are illustrated.

There are a few unfortunate statements, e.g. "physiological" features of the landscape, *Epipactis*

palustris spreading by underground "runners, or elongated roots", and one may doubt whether there would ever be "climax pine forest" in the New Forest. However, the valuable points for field identification, and details of the phenology and occurrence, together with the original colour photographs (for each species a general view and a close-up of flowers, mostly of good quality), make this a useful and attractive book, particularly for those exploring the unspoilt countryside of Dorset.

A. J. Willis

The Chelsea gardener: Philip Miller 1691–1771. H. Le Rougetel. Pp. 212, illustrated in black and white and colour. Natural History Museum Publications, London. 1990. Price £14.95 (ISBN 0–565–01101–4).

Philip Miller is, without doubt, the most celebrated English gardener of the eighteenth century. He was a self-educated man, and what he could not learn from his father or other gardeners he learnt from books. Having set up his own nursery in Southwark, he was already established in the small circle of elite gardeners, when, in 1722, he was appointed Gardener (in today's terminology, Curator) of the Society of Apothecaries' Physic Garden at Chelsea. He was soon to put the garden on to a sound footing and to establish over the next 48 years an institution of international repute.

This is a book not just about Philip Miller and his achievements at Chelsea; it is a masterly analysis of Miller's influence on gardening and horticulture – and they were by no means synonymous in those days. The author has arranged her account in 20 interlocking chapters, the first three giving background, others discussing Miller's links with botanists abroad, in Europe and North America, with eminent gardens and gardeners, plant illustrators and the like. His links with Cambridge and the effects his views were having on forestry and agricultural policy are reviewed; and the importance of Philip Miller's published works to botany at large is discussed in Chapter 20 by William Stearn. His most important work, the *Gardeners' Dictionary*, which went through eight editions between 1731 and 1768, contained cultural information for the kitchen, flower and fruit garden, and much descriptive botanical material beside. The last edition appeared after the publication of Linnaeus' *Species Plantarum* in which binomial nomenclature was introduced, and Miller followed the convention and thereby validated many pre-Linnaean genera he had used in earlier editions.

Miller was also a field botanist and a teacher, collecting in many parts of England from the Cheviots to his home county of Kent. He was able to find the Deptford Pink (*Dianthus armeria*) in Deptford, *Aquilegia vulgaris* in Bexley and *Narthecium ossifragum* on Putney Heath.

This book is a 'must' for anyone interested in the history of botany or gardening and the kind of book that will be referred to time and time again. Hazel Le Rougetel is to be congratulated in giving us such a delightful, concise account of what must have been many years of fascinating research.

A. C. Jermy

Shamrock, botany and history of an Irish myth. E. C. Nelson. Pp. xiv + 200 with 5 colour plates and numerous black and white photographs and illustrations. Boethius Press, Aberystwyth & Kilkenny. 1991. Price IR£28 (ISBN 0–86314–200–1 hardback); IR£14 (ISBN 0–86314–199–4 paperback without bibliography, pp. xiv + 158); now only available from the author, 14 Connaught Parade, Dublin 7; p&p extra.

The curtain rises on a sentimental discourse of the importance of shamrock to the Irish, resolving to strip away the facts from the fiction.

Act I opens on an Ancient Briton, St Patrick, himself of whom little is known, and who certainly has nothing to do with shamrock! Indeed as we pass through the centuries nothing is heard of this blessed plant in Latin, Irish or English, until we realise that shamrock is the anglicised version of *seamróg* meaning a young clover. Variations on *scothsheamrachor* or clover-flowered thus abound

in mediaeval manuscripts. The first time the word shamrock made its appearance was in Edward Campion's *The first boke of the histories of Irelande* (1577) where he stated that shamrocks were eaten by the Irish!

By Act V we have caught up with the Herbalists where in 1571 Matthias de l'Obel wrote a strange passage about the Irish passion for a meal of clover or meadow trefoil. This was followed by John Gerard in 1597 who understood that Shamrock was clover and that *seamróg* covered both the red and white clovers. By the early 1600s, it was the accepted view in England that shamrock was eaten daily by the Irish or only in times of dire necessity (depending on the authors' own prejudices).

Some decades later, *seamróg* was being defined as wood sorrel in an Irish dictionary. It was not until 1726 that an Englishman, the Rev. Dr Caleb Threlkeld, set the record straight, recognising the tradition around St Patrick and the shamrock as an explanation of the Holy Trinity, and also that *seamróg* were clovers. He was also the first to record the now renowned ritual of drowning the shamrock with alcohol and food.

By Act XI, the shamrock was beginning to be worn not just on 17 March but as a sacred political badge throughout the year. The Volunteers were the first to use it in 1779, followed by the United Irishmen in 1791. The shamrock motif was seen on flags, belts, cockades, glassware and seals, even in a weekly journal *The Shamroc* and in verse 'The Wearing of the Green'.

With the dawning of a new century, the romantic, mawkish image of the shamrock blossomed forth. At the same time the 'Age of Reason' brought the actual botanical identity of the shamrock into question. The first scientific survey of what plant was worn in Irish buttonholes was undertaken by James Britten in the 1870s. He discovered that the plant mostly in use as the true shamrock was *Trifolium minus* (now called *T. dubium*). Unfortunately, not many people took note of his systematic findings. Indeed, ten years later, one Nathaniel Colgan added to the confusion by establishing all the above plants as rivals, plus the red clover (*T. pratense*).

When the Currency Commission of 1926 decided to ban the shamrock motif from the new coinage there was a mass uproar and by the time the Irish Post Office issued the first definitive stamps and one commemorative one in 1933–4, each one had shamrocks in the design.

And so we finally come to the late 1980s, when Charles Nelson attempted to assess the present day status of the shamrock in Ireland by means of modern communications. In fact *Trifolium dubium* was revealed as the most commonly regarded true shamrock, while black medick (*Medicago lupulina*), red clover, and wood sorrel (*Oxalis acetosella*) accounted for only a few gatherings. The curtain closes on the fact that "shamrock is a young clover, nothing more, nothing less". That is what it always meant "and what it will mean until the end of time."

Had this book been written by anyone else, it might have been both boring and pedantic, but Dr Nelson's sparkling dry wit and wicked sense of humour comes through again and again. Accompanied by some delightful colour plates by Bridget Flinn and a hilarious and irreverent forward by Bernard Loughlin, this book deserves to be read by a wide audience. *Vivat trefolium*!

S. Andrews

The Burren. A companion to the wildflowers of an Irish limestone wilderness. E. C. Nelson & W. Walsh. Pp. 343, with 100 colour and several black and white illustrations. Boethius Press, Aberystwyth, and The Conservancy of The Burren. 1991. Price IR£32 (ISBN–86314–213–3 hardback); IR£19 (0–86314–214–1 paperback); available from 14 Connaught Parade, Dublin 7; p&p extra.

The Burren of north-western Co. Clare is Ireland's premier botanical attraction. Remarkably, it was first explored in detail only in 1851, the year that T. H. H. von Heldreich revealed Greece's Mt Olympus in remotest Thessaly to the botanical world. The two areas are actually very comparable, for they are both karstic landscapes of bare limestone, subterranean water and few human inhabitants, making travel difficult in the days before motorised transport. Each has a rich and diverse flora and is amongst the most precious gems of Europe's natural heritage. My own view (coloured by my affection for Connemara) had long been that the Burren received too much attention from botanists, especially those visiting from Britain, to the detriment of the study of other

regions of Ireland. However, reading *The Burren* has successfully prodded me to take a positive view of the region, the book stirring up as it does images of low, mysterious, grey hills, pastures bright with Spring Gentians in May, and the massed flowering of Mountain Avens, Bloody Cranesbill, Hoary Rockrose and other species in the native rock garden that the Burren presents to the visitor in summer.

Charles Nelson sets out an eloquent, enthusiastic and erudite portrait of a landscape and its plants. He provides background information to the flowers that make the Burren so special, gleaned from a wide variety of sources, whilst maintaining an unobtrusive personal touch by allusions to his childhood in Co. Fermanagh, his interest in tropical drift-seeds and the genus *Fuchsia*, and his knowledge of Irish garden history. The style is discursive, the text packed with observational sketches, anecdotes and quotations from the literature of botany, folklore and Irish history. This is not a new Flora of the Burren: there are many references to David Webb and Maura Scannell's *Flora of Connemara and the Burren* (1983) – reviewed in *Watsonia* **15**: 148–9 (1984). Nor is it a guidebook; for topographical information the reader is encouraged to refer to Tim Robinson's excellent annotated map, *The Burren, a map of the uplands of North-West Clare, Éire* (1977). It is indeed a companion, a book, in the author's words, to be read by the fireside when "a westerly gale hurls stair-rods of rain horizontally across Cappanawalla". It will certainly be a useful item in one's hotel or 'bed-and-breakfast' during a visit. I readily forgive the author for ignoring the mundane plants that excite feeble minds like my own – there is, for example, no mention of any docks or knotgrasses!

The author defines the region more or less on the basis of the (limestone) geology, although he is sensibly a bit vague about the eastern limits around Kinvarra and Gort, where one can still see a 'good' Burren flora. The text is beautifully set out, the words interspersed with water-colour illustrations by Wendy Walsh, deliberately conceived in a sketch format to give a sense of immediacy. There are also black and white topographical scenes and some portraits. I should have been happier with numbers as well as titles at the head of each chapter. Nor am I am at home with the Irish word *scailp* to describe the deep crevices in the limestone; in Yorkshire, where my family came from, they are *grykes* (as they are in Scandinavia).

Charles Nelson has done us all a considerable favour by his distillation of fact and experience, and I urge the many lovers of the Burren to buy this fairly priced book, not least because all proceeds will go to support the work of The Conservancy of The Burren. The future of this special place is uncertain, the worst threat being increased pressure from tourism, notably the proposal to erect a superfluous and environmentally insensitive 'visitor centre', and it is up to botanists above all to promote its conservation. This book is a beginning.

J. R. Akeroyd

The northwest European pollen flora, Volume 6. Edited by W. Punt & S. Blackmore. Pp. v + 275, with 103 black and white plates. Elsevier, Amsterdam. 1991. Price D.Fl. 240 (ISBN 0–444–891641–1).

This latest volume in the northwest European pollen flora project continues to document systematically the pollen morphology of all families of vascular plants indigenous to, or regularly naturalized in, northwest Europe. In this volume the families covered are Selaginellaceae, Oleaceae, Geraniaceae, Juglandaceae, Cornaceae, Globulariaceae, Buxaceae and Ranunculaceae, with the last family occupying more than half of the book. Each family account contains detailed descriptions of pollen types (i.e. the morphologically discernible groups of pollen species) together with keys to their identification, and is accompanied by excellent scanning electron and light micrographs.

The arrangement of the survey is taxonomic and its clearest aim is to provide taxonomic information on the range of form of pollen within families. But pollen identification has become an important aspect of the work of many other plant scientists in disciplines as varied as allergy studies, forensic science and the reconstruction of past vegetation and hence past environments. Palynologists with these interests will look to the *Pollen Flora* as a valuable source of data on pollen

morphology, but the material contained in these volumes has to be used with caution in these areas. The palaeopalynologist, for example, when faced with an unknown pollen grain, does not normally have the assurance that it belongs to a particular family. A spiny trilete spore, such as that of *Selaginella kraussiana* (G. Kunze) A. Braun as described in this volume, could also belong to a bryophyte, such as *Anthoceros* or *Riccia*. Some pollen grains belonging to members of the Oleaceae are very similar to those of certain Cruciferae; but such similarities cannot, of course, be dealt with in a systematically arranged account.

The book will be of greatest value to those concerned with pollen identification when detailed information and illustrations are needed to confirm identity or to provide greater taxonomic resolution in important groups. The Ranunculaceae is of particular note here because most general pollen keys provide limited taxonomic detail, yet distinction between ranunculaceous groups can be of profound ecological value for the palaeoecologist. The '*Ranunculus acris* type' pollen recognized by most palynologists, for example, covers a multitude of ecologically varied species, and the information provided here for more precise identification will be very welcome.

The keys are generally robust, though some expressions are loose and ambiguous, such as the distinction between "reticulum relatively coarse" and "reticulum fine" in the distinction between *Olea* and *Phillyrea*. This could have been improved by providing a count of lumina density across the mesocolpium, which permits very adequate separation. I remain unconvinced whether some of the fine distinctions, such as that between *Erodium moschatum* and other members of the genus, can be effected by light microscopy alone. In the identification of fossil pollen using conventional phase contrast microscopy, the work described in this valuable collection of papers will prove useful, but must clearly be applied with great caution and always with the assistance of reference material.

P. D. Moore

New Flora of the British Isles. C. A. Stace. Pp. xxx + 1226, illustrated. Cambridge University Press, Cambridge. 1991. Price £24.95 (ISBN 0–521–42793–2).

This eagerly awaited and reasonably priced book fulfils almost all expectations and is essential for anyone with a serious interest in the British and Irish floras. It is a manual for identification rather than a descriptive Flora, and so needs to be judged for its usefulness rather than just the information it contains. I make no apology for repeating the words 'helpful' and 'useful' rather often in this review.

Everything in the Flora, from the taxa included (especially non-native taxa) to the nomenclature and the construction of the keys has clearly been worked out afresh. Taking on trust its claim to contain 2990 keyed and numbered species, it thus contains nearly half as many again as the 2030 that are in the 3rd edition of the *Flora of the British Isles* by Clapham, Tutin & Moore (CTM). This gives some idea of the amount of unfamiliar materials made available by Stace. Most of the extra species are aliens, and in some genera the result is quite startling, *Cotoneaster* containing 45 keyed and numbered taxa (five in CTM), *Crocus* containing nine (two in CTM) and even *Trifolium* 32 (22 in CTM). There are 90 more grasses in Stace. His criteria for inclusion of non-native taxa are eminently helpful, the aim being "to include all taxa that the plant-hunter might reasonably be able to find 'in the wild' in any one year. Any such plant, whether native, accidentally introduced or planted, affects wild habitats and is part of the ecosystem, and botanists and others might be expected to need or want to identify it". He thus includes a number of plants that persist rather than regularly naturalise, as well as a wide range of non-persistent but recurrent casuals.

The dichotomous keys seem to work well, and many are quite original. The *Carex* key, for example, broken up into sections like all long keys, differs in many ways from previously available ones, often uses quite different characters, and works at least as well. I personally dislike the layout of the keys, with alternately indented couplets, but one soon gets used to it. Multi-access keys are often provided, but in only a few cases (notably *Epilobium*) are they the only sort available. The ones in *Sorbus*, and in the novel account of the cultivars of *Populus* × *canadensis*, are especially useful. The species descriptions are mostly less than 30 words, and have a limited value for confirming identifications. As so many unfamiliar species are included for which fuller descriptions

will be unavailable to most readers, this does create problems. The drawings, mentioned later, do however somewhat compensate for this. With more familiar species, too, the brevity of the descriptions can be worrying. Is there, for example, no mention of the hairs at the junction of leaf-blade and sheath in *Poa humilis (P. subcaerulea)* because the author considers them not to be diagnostic, or because there is just not the room to include this character?

Abbreviations are few and easily understood. The text in general contains an immense amount of useful comment. Unnumbered and unkeyed "other genera" and "other species" are frequently included, but I cannot help feeling that, as in most other Floras, they do more to salve the author's conscience than to help the reader. They stand out here because the rest of the *Flora* is so helpful. Crop species are especially well treated and up-to-date. *Red Data Book*, scheduled, and Rare species (in fewer than 100 10-km squares) are indicated. English names, many of them new, are provided for all the numbered species. The bibliography is very brief, and it is perhaps a pity that no direct references to more detailed accounts are given anywhere in the text.

The taxonomic stance of the book is a good balance between expert and consensus opinion. It is comforting to find one's doubts about identifying segregates of such species as *Galium mollugo, Rhinanthus minor* and *Sedum telephium* confirmed, but I am sorry to see the subspecies of *Pilosella officinarum* so briskly dismissed (many of us record them, even though we may doubt whether they are worth subspecific status). For once in a British Flora though, subspecies are generally very fully treated. Varieties are rarely and rather unpredictably included. In the case of *Fumaria* the key would probably have worked better if varieties *had* been included (as P. D. Sell, *BSBI News* **41**: 16 (1985) recommends), and this is one of a number of cases where recourse to the *Plant Crib* is still essential. All hybrids known to occur in Britain and Ireland are included. More are keyed and described than in our other Floras, but inevitably, alas, the great majority are not. Here, as elsewhere, the continuing need for a comprehensive critical and descriptive Flora of Britain and Ireland is highlighted. Of the apomictic groups, *Rubus, Hieracium* and *Taraxacum* are treated only in outline, but *Sorbus* and *Euphrasia* are treated in full.

Physically the book is about the same size as the 2nd edition of Clapham, Tutin & Warburg's *Flora*. The binding is sewn, and the cover is pliable plastic. My copy is still in perfect shape after two months' daily use. It is printed from camera-ready copy produced by a word-processor, and the type is large and easy to read (though lacking such refinements as accents and italics). Traditional typesetting would probably have reduced the number of pages by about a third and made the book more suitable for the rucksack, but, as the author remarks, would even so have increased the price. Errors of any sort are minimal. Main Argyll is given for *Rorippa* × *hungarica* instead of *R.* × *armoracioides*. *Veronica hederifolia* should be cross-referenced to the illustrations instead of *V. serpyllifolia*. The drawings of *Ledum* and *Vaccinium uliginosum* are labelled the wrong way round. *Salsola* is missing from the index. The second half of dichotomy 8 on p. 564 should lead to 17 not 16. Otherwise there seem few errors likely seriously to mislead the reader. Even the cm scale inside the front cover is only 1% out. The brevity of the distributional information occasionally leads to slight inaccuracy, but this is almost inevitable and detail of this sort is not what one will chiefly come to this *Flora* for.

There are some 150 pages of illustrations, and it is here that my only serious criticisms of the book lie. The line drawings are mostly by Hilli Thompson and include excellent series of crucifer, umbellifer and *Rumex* fruits. Her habit drawings of unfamiliar aliens are especially helpful and compensate a good deal for the brevity of the description. Most give a good impression of the jizz of the plants but some, for example those of *Cotoneaster*, are curiously diagrammatic, and several of the series of drawings of leaves are unsatisfactory. In a few cases poor choice of specimens rather than quality of drawing means that they fail to show, or even contradict, the diagnostic characters, for example the number of intercalary leaves and angle of branching of *Odontites vernus* subsp. *serotinus*, the leaf-lobes of *Ranunculus omiophyllus*, or the apical leaf-lobes of the *Veronica hederifolia* subspecies. Other artists have also contributed valuable drawings, such as those of *Dactylorhiza* labella by R. H. Roberts and *Oenothera* flowers by J. Zygmunt. The many light photographs often seem to suffer from very poor reproduction, and it is difficult to see why the blurred *Potamogeton* leaf-apices were not drawn instead. The *Euphrasia* silhouettes are too small and murky to be of much use, but those of *Sorbus* are excellent. There are also many scanning electron micrographs (S.E.M.). Those of *Epilobium* seeds and *Isoetes* megaspores are good, and the latter for once show that the sculpturing is not as easily diagnostic as most descriptions imply, but

most of the rest are unsatisfactory. Even the very clear ones of *Montia* seeds, by the very nature of the process, omit the diagnostic shininess or otherwise of the coats. Those of *Tripleurospermum* achenes fail to show even the oil-glands, let alone their diagnostic shapes, and the complete series of *Carex* utricles includes many unrecognisable and often shrivelled examples. S.E.M. pictures are generally unhelpful as identification aids for botanists with a lens or light microscope, and with an artist of Thompson's ability and versatility to hand it is a mystery why they were used.

The *New Flora* was prepared in close consultation with D. H. Kent who was simultaneously compiling a new nomenclatural check-list of British and Irish plants. Thus the nomenclature, like every other aspect of the *Flora*, is uncompromisingly up-to-date according to current knowledge, resulting in a large number of changes to familiar names. These will best be reviewed when the check-list itself is published. Meanwhile the reader's dismay at them should be largely offset by the fact that they are an integral part of an authoritative and user-friendly Flora that will be our standard for taxonomy, nomenclature and identification for some time to come.

A. O. Chater

Pleistocene palaeoecology of central Norfolk – a study of environments through time. R. G. West. Pp. ix + 110, with 44 figures. Cambridge University Press, Cambridge. 1991. Price £40 (ISBN 0–521–40368–5).

This book continues the Pleistocene history of East Anglia from the author's earlier book *The pre-glacial Pleistocene of the Norfolk and Suffolk coasts*, concentrating on a part of the catchment of the River Wensum near East Dereham. Within this area, sections exposed by commercial sand and gravel workings over a period of c. 20 years have provided "an extraordinary wealth of evidence" on environmental changes from the time of the first major glaciation of East Anglia. The presentation of this evidence is organised chronologically. Five chapters deal with the local succession of deposits identified as belonging to the Anglian, Wolstonian and Devensian cold stages and the Hoxnian, Ipswichian and Flandrian temperate stages. The geological evidence and palaeobotanical analyses produced by Professor West's intensive studies are presented in meticulous detail in the form of many clear sections (related to aerial photographs as well as maps), pollen diagrams, and tables of fossil identifications. These numerous sections include glacial tills and gravels and overlying fluviatile deposits with limnic sediments formed in depressions. His synthesis of this evidence supports – through the relative positions of deposits identified by their palaeobotany – the succession of Middle and Upper Pleistocene stages originally proposed for East Anglia by Professor West and co-workers. At the same time he reiterates his caution that it remains possible that additional stages may yet be identified in the terrestrial record.

The form of the book is that of an extended scientific paper. It furnishes an excellent example of how primary data of the highest scientific value have been gathered, processed and synthesized to provide the basis for reconstruction of past environmental – including climatic – changes. Not only does this treatment fulfil the author's claim that "the observations have led to a much better understanding of the Pleistocene in Norfolk and are indeed relevant to the wider understanding of the British Pleistocene" but it provides for the more general reader an insight into the methods by which primary data are obtained and used to reconstruct climatic changes in the past. These reconstructions can then be of use in comparison with models of possible climatic change in the future. This book is indeed, as claimed on the fly-leaf, "a unique 'case study' of an investigation of past climatic change".

Throughout the work there is a new emphasis on the importance to the palaeobotanist of thorough acquaintance with the processes involved in accumulation of each sediment type, in order to reach sound conclusions as to the *taphonomy* of fossil plant assemblages, whether pollen, spores or larger fossils. The influence of this on the relationship between the fossil assemblage and the vegetation from which it was derived is considered throughout. The presentation of the chronologically arranged botanical evidence is followed by two chapters on stratigraphic questions, related especially to periglacial conditions during the cold stages and to inferred changes in water levels. A further chapter discusses, in a review of the history of the Whitewater, Blackwater and Wensum

valleys, the aggradation of the Beetley Terrace during a non-glacial post-Hoxnian cold stage. This preceded the Ipswichian and therefore seems to coincide in time with the Wolstonian. The final very concise chapter placing the work at Beetley "in the context of the East Anglian Pleistocene" should be required reading for all students of the British Quaternary.

The reference list is of a realistic length to encourage further study. Hopefully the work as a whole will stimulate others to undertake this kind of devoted fieldwork and patient study-in-depth in promising areas.

W. Tutin

Obituaries

ADRIAN LEONARD GRENFELL
(1939—1991)

Adrian Grenfell was born on 6 April 1939 and died, aged only 52, on 17 November 1991. It was a great shock to hear from Adrian's wife, Diana, that my good friend had died of a heart attack whilst jogging. We had all known that he was not in the best of health, but none of us realised just how ill he must have been.

He and I have known each other for many years. We both attended the same Grammar School together, although at that time Adrian was not interested in botany. He left school to start a career with the Gas Board, later on changing to become an industrial chemist with a major Bristol company. Redundancy in the early 1980s allowed him to become a self-employed printer and later he moved into publishing. During the last seven years his expertise in printing and publishing was put to good use on behalf of the Bristol Naturalists' Society, the Wild Flower Society and the Botanical Society of the British Isles.

He became interested in plants in about 1972 (reference to the B.S.B.I. list of members shows he joined in 1976). At the same time he joined the Wild Flower Society and the local Bristol Naturalists' Society. He was keenly interested in mammals as well as plants and would often attend meetings of the Mammal Section of the Bristol society. In the early days alien plants became his main interest, brought on possibly by his friendship with Eric Clement, and Adrian became what is known as a 'Tip Man'. He and I, often in the company of other botanists including Clive Lovatt and Trevor Evans, would frequently visit such sites as Brislington Tip, Bedminster Tip, Avonmouth, Newport and Sharpness Docks, and other localities where aliens were to be found. Reference to the 'Bristol Botany' section in *Proceedings of the Bristol Naturalists' Society* and *B.S.B.I. News* shows the many interesting finds made during that period. He had to wait a long time to get into the now Portbury Docks – so jealously was it watched. We were making comparisons all the time with N.Y. Sandwith's 1933 adventive plant list from the Port of Bristol – at one time Adrian intended to publish an updated check-list.

On the local scene botanists eagerly looked forward to Adrian's walks in the Bristol area. He would lead us round such famous localities as the Avon Gorge, Leigh Woods, Brean Down and the Mendip Hills. He was always pleased to help both the 'starters' and the more experienced botanists with determinations. Adrian's hybrids caused some amusement: so often, however, they were confirmed by the correct authority. He truly had a remarkable eye for the unusual.

In the early 1980s Adrian and I were to enjoy several trips abroad to look at plants, sample local wine, etc. I can always remember Adrian one evening dropping off to sleep in a chair after a hard day's collecting and then determining in Portugal, with a volume of *Flora Europaea* in his lap and a glass of wine in his hand. After that we decided that after one bottle in the evening all determinations were suspect! We enjoyed trips to Crete, the Algarve, Mallorca and Scotland; later on Adrian went to Zakinthos and Mt Olympus in Greece, the Alps (where he led B.S.B.I. excursions), the Seychelles and Australia. All the time he was looking for interesting plants and would always bring back something, usually grasses for his friends Ron Payne and Eric Clement.

From April 1983 Adrian took over the Alien News section in *B.S.B.I. News* from Eric Clement, editing it for eight years (see *B.S.B.I. News* **32–57**). Adrian would look forward to his mail and would eagerly open packages of carefully pressed specimens and examine the soggy contents of polythene bags to see what was new. Many of these specimens have been kept and are preserved in his herbarium. Adrian was at the same time helping the Society in other ways. In 1983 he was on the Meetings Committee and helped to organize the A.G.M. in Bristol, arranging accommodation and the field excursions to the Mendips and Sand Point in Somerset, a very memorable day. In April 1991, his successor as editor of Aliens and Adventives, Brian Wurzell, thanked Adrian for his valuable contribution and wished him a speedy recovery from the illness which caused him to resign from the work. Sadly, Adrian only lived a further six months.

In 1979, one year after Early Star-of-Bethlehem (*Gagea bohemica*) was confirmed as occurring at

Stanner Rocks in Radnorshire, Adrian, Trevor Evans and myself went to the site, on a wintry February day with snow in the air, and were rewarded by the sight of two flowers of this plant new to the British flora. We knew that the next weekend Mary Briggs and a party of eminent botanists were to visit the site – so new was it to the British flora. Adrian decided to leave a note addressed to Mary under a stone to record that we had been there and to advise where the flowering plants were to be seen. Mary found the note. Adrian later remembered this occasion when he found the same plant high up above the Samaria Gorge in Crete.

In 1987, Adrian wrote a paper on the notable alien flora of the Avon Gorge, which was included in *The Avon Gorge*, Special Issue No. 1 of *Proceedings of the Bristol Naturalists' Society*. This was elegantly produced by Grenfell Publications and offered for sale to B.S.B.I. members. Other publishing ventures included several editions of the *Proceedings*, the *Supplement of the Flora of Gloucestershire* by S. C. Holland, H. M. Caddick and D. S. Dudley-Smith (1986) and *The difficult and critical plants of the Lizard District of Cornwall* by L. J. Margetts (1988). Every year Adrian would send Professor A. J. Willis, the Bristol Botany recorder, many interesting records – all these can be found in the *Proceedings* or in *B.S.B.I. News*. In the autumn of 1991, Adrian and I had just finished an article on Bristol street trees, which will be published in the *Proceedings* in due course. We had great fun driving up and down the streets of Bristol, identifying, collecting and determining material of a vast range of trees.

There is one plant that will always remind me of Adrian. It is not an alien but the British native, Autumn Lady's-tresses (*Spiranthes spiralis*). It was found by him growing on Eric Clement's Gosport lawn – and Eric had never seen it. Adrian always said with a grin that it would have to be flat or mounted on a sheet for Eric to notice it!

On the basis of his work on alien plants, Adrian was elected a Fellow of the Linnean Society of London in 1982. His private herbarium will be transferred to Bristol City Museum (**BRISTM**) and kept there alongside those of other distinguished Bristol botanists such as I. W. Evans and J. W. White.

Over the years Adrian built up a tremendous number of friends, many of whom stayed with him when they visited the Bristol area. He was always willing to help in any way that he could. Adrian's warm friendship and dry humour will be missed by us all, particularly when we revisit a site where he had shown us a speciality. We extend our sympathies to Diana and his son James.

T. Titchen

WILLIAM ARTHUR SLEDGE
(1904—1991)

Arthur Sledge was a Leodiensian. He was born in Leeds on 14 February 1904 and died there on 15 December 1991, having lived there all his life. He was educated at Leeds Grammar School and graduated from the Botany Department of Leeds University in 1926. He gained his Ph.D. in 1928, the year he joined the staff of the department as a Demonstrator. He was appointed as a Lecturer a year later and eventually became a Senior Lecturer. After his official retirement in 1969 he retained a room in the department and continued his work there as Honorary Research Fellow, usually walking the 3 km from his home in Headingley. A severe heart attack two years ago restricted his physical activities but he bore the resulting debilities uncomplainingly and with fortitude.

His interest in botany was triggered at his junior school by a pressed flower competition, which, of course, he won. While he was out collecting specimens, his vasculum was spotted by Frank Palmer who was taking part in a similar senior school competition. Frank and his father subsequently introduced the young Sledge to the joys of botanising on the Permian Magnesian Limestones a few kms east of Leeds. From this was born an awareness of habitat and an interest in ecology and he was later to become a founder member and council member of the Yorkshire Naturalists' Trust (now the Yorkshire Wildlife Trust).

Whilst still in his early teens, Dr Sledge had found F. A. Lees' *Flora of West Yorkshire* (1888) in

the library and, learning that Dr Lees lived quite nearby, he became a frequent visitor to his home, armed with eggs from his mother's hens and a vasculum of plants for identification. In 1941, *A Supplement to the Yorkshire Floras by the Late F. Arnold Lees*, edited by C. A. Cheetham and W. A. Sledge, was published.

In 1920 Dr Sledge was introduced to Leeds Naturalists' Club by the blind botanist, John Wilkinson. Active members of the club at that time, who all helped to further Dr Sledge's interest, included such famous names as J. H. Priestley, Professor of Botany at Leeds, W. H. Pearsall, Edward Percival, R. W. Butcher, and the bryologist, W. H. Burrell.

It was standard practice at Leeds Naturalists' Club to report on Yorkshire Naturalists' Union meetings and Dr Sledge was inspired to join the Union. All the most knowledgeable naturalists in the county belonged to the Union and from them much was gleaned. Later he more than repaid what he had gained. In the field he was the ultimate authority who could be relied upon to give a correct identification to all but the most esoteric of critical plants, along with interesting comments on habitat and plant associations. His memory for sites of interest was unfailing, even those he had not visited for 40 years and, when he felt there was good reason to give directions to them, these directions were precise and accurate. All of us were in awe of him, but those who showed an intelligent interest and desire for knowledge were subsequently greeted with a warm smile and questions were answered fully, with quiet enthusiasm. In addition to sharing his experience in the field, Dr Sledge edited the Union's scientific publication, *The Naturalist*, from 1943 to 1975. His dedication and skill resulted in *The Naturalist* being read and respected nationally and internationally and, in spite of his modest, unassuming manner, his pride in it and his paternalism towards it were evident.

He joined the B.S.B.I. in 1924 and was appointed Recorder for South-east, South-west and Mid-west Yorkshire in 1949. He relinquished South-east Yorkshire to Eva Crackles in 1969 and continued with South-west and Mid-west until 1987, when failing eyesight made him realise he would not be able to cope with the Monitoring Scheme. In 1987 he was made an Honorary Member of the Society for his "long and valuable service to Yorkshire botany and to the Society as Recorder and Editor". He had edited the Distributor's Report (Exchange Section), which was a supplement to the Society's *Year Book*, in the late 1940s. With our present emphasis on conservation this aspect of the Society's activities has developed into Plant Records.

Dr Sledge was very much a Yorkshireman but he was by no means parochial. During his undergraduate days, much of his travel outside the 'Broad Acres' was by bicycle, accompanied by R. W. Butcher. This included visits to East Anglia, the Gower, the Avon Gorge and Dorset in search of their special plants. In those days specimens were picked and contributed to Dr Sledge's enormous and excellent herbarium. The British sheets were donated several years ago to Bradford Museums Service and they now reside in Cartwright Hall Museum (**CMM**) along with those of Lees. The foreign material is widely distributed internationally.

Dr Sledge was one of those lucky individuals able to combine his interest with his career. His first publication was a contribution to the report of the British Association meeting which was held in Leeds in 1927, for which he wrote sections on the flora of Fountains Abbey, Wharfedale, Nidderdale and Malham. This was followed a year later by his Ph.D. thesis on the rooting of woody cuttings. He travelled widely in Europe and, for research purposes, visited New Zealand, Madeira, Sri Lanka and Samoa. His work was concerned mainly with systematics and, following his first visit to Sri Lanka, he untangled the difficult taxonomy of the native ferns. His paper, written in association with the late Professor Irene Manton, entitled *Observations on the cytology and taxonomy of the Pteridophyte Flora of Ceylon*, published in 1954, remains a classic. Other papers on the taxonomy of tropical ferns followed, as well as numerous articles on aspects of the Yorkshire flora. All his work was carried out with meticulous care and his clear systematic presentation made him a first-class teacher. Even during his period of ill-health, Dr Sledge continued to work. He recently completed an excellent historical review for the forthcoming *West Yorkshire Plant Atlas* to be published by the West Yorkshire Ecological Advisory Service, and he was still collaborating with Professor R. E. Schultes, formerly of Harvard University, on a Symposium to commemorate the centenary of the death of Richard Spruce (1817–1893) pioneer botanist in the Amazon and Andean regions. Professor Schultes and Dr Sledge shared a deep respect for this little-known Yorkshire botanical explorer and they were instrumental in having a commemorative plaque put on the cottage in the Castle Howard estate where Spruce had lived.

We in Yorkshire have lost our most outstanding contemporary botanist, and one of the best in Britain, and we mourn him along with Marjorie, his wife, who has supported him wonderfully since their marriage in 1939. We offer sincere sympathy to her and to their son, Christopher, and his family.

P. P. Abbott

INSTRUCTIONS TO CONTRIBUTORS

Scope. Authors are invited to submit 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.

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 in the References should be abbreviated as in the *World list of scientific periodicals*, and herbaria as in *British and Irish herbaria* (Kent & Allen 1984). 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 Short 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, Short Notes, Book Reviews or Obituaries.

Submission of manuscripts

Papers and Short 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.

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