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# THE NATURALIST

A Quarterly Journal of Natural History for the North of England

*Edited by* M. R. D. SEAWARD, MSc, PhD, DSc, FLS, The University, Bradford

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THE

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**VOLUME**
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# STUDIES ON THE FLORA OF TEESDALE

MARGARET E. BRADSHAW

*Presidential Address to the Yorkshire Naturalists' Union, Ilkley, 3. December 1983*

'A journey of a thousand miles begins with a single step'

In these introductory words of thanks to you, the Yorkshire Naturalists' Union, for the honour you have bestowed upon me by electing me your President, I wish also to remember the Darlington and Teesdale Naturalists' Field Club who provided me with the opportunity to meet Kit Rob soon after I migrated north over the Tees, and Kit herself, for her hospitality and exaggerated expectations of an 'ignorant' graduate and fledgling taxonomist and field-botanist which both flattered and encouraged me. It was Kit who suggested I join the YNU. As you know, my attendance at YNU meetings has been irregular, but I have valued greatly the friendships of several botanical members who happen also to have become Presidents: Eva Crackles, Joan Duncan and Max Walters. I was born near Driffield and went to Leeds University where long plant lists out of Tansley (1939) almost put me off ecology. I regret not taking the opportunity to visit Teesdale when I was a second-year student. Later, I did move to teach at Bishop Auckland because it was near Teesdale, which I had heard had an interesting flora. So began a series of botanical journeys.

The first started from a suggestion by Max Walters that I 'look at *Alchemilla*' in the Durham Pennines. There are advantages in being a novice in a strange land; one learns to use one's eyes, being less blinkered than those who go fully primed with what to look for and where or with knowledgeable friends. My beginner's luck was the discovery of a lady's mantle new to Britain which Max determined as *Alchemilla subcrenata* (Walters, 1952). Obversely, I spent many fruitless days searching for *A. gracilis*, eventually found in Northumberland 25 years later by G. A. Swan. Now, I suggest someone look in moderately base-rich pastures in Teesdale instead of the meadow habitats I searched. By the end of the first summer, and with much help from Max in checking my near-weekly postal packages of leaves and inflorescences, I had learnt the nine critical *Alchemilla* species occurring in Teesdale. Max's suggestion that I plot their distributions onto maps eventually resulted in a published paper (Bradshaw, 1962). So began my fascination with plant distributions — and I had become knowledgeable in a plant group and the Teesdale 'locality'. H. G. Baker, Max Walters and D. H. Valentine initiated the second journey, the pursuit of a Ph.D. at the University of Durham, and more papers in *Watsonia* (Bradshaw, 1963, 1964).

The third journey began in autumn 1964, when the Cow Green Reservoir project threatened to flood parts of the botanically famous Upper Teesdale. Suddenly, it became essential to know where the rare species grew in relation to the top-water-line of the reservoir (488 m; 1603 ft O.D.). However, as with many other 'assemblages' and 'localities', many botanists knew one or more sites for each species but no-one knew the complete distribution of all of them. A detailed search and mapping programme was immediately begun by myself and friends, using improvised maps constructed from black-and-white aerial photographs (Meridian, 1956) as a base. In the light of our later work I am amazed at the completeness of our records of the vital data. The outcome of the reservoir proposal is well known. However, this ill wind stimulated me to expand the mapping into a research project, suitable for the students of the then Extra-Mural Department of the University of Durham, to map the distributions of the Teesdale Assemblage on the upper part of Widdybank Fell. Working two or three weeks each summer, we recorded some 21 members of the Assemblage and six other species in an area totalling 1 × 0.25 miles (1.6 × 0.4 km); the project took ten years. The products of those hours of crawling over the often stony Teesdale fell, and evening paperwork in Langdon Beck Hotel and later, form the core of this address.

For two-and-a-half centuries the Teesdale locality has attracted people interested in plants to see and add to the Teesdale Assemblage — that 'unorganized grouping of plants or animals occurring in a particular locality' (Poore, 1964). By 1950, when I 'discovered' Teesdale, published data were in old Floras and plant lists or thinly scattered elsewhere. In 1954, Pigott and Walters included Teesdale in a paper seeking to explain the phenomena of 'assemblages' and 'localities', and in 1956 Pigott published the first paper on the vegetation of Upper Teesdale. Since 1956 studies have multiplied, and can be traced in the collective works on the natural history of the area edited by Clapham (1976) and Bradshaw (1976). The former is essential background reading to this paper.

Recent work (Johnson, Robinson and Hornung, 1971) on the origin of the metamorphosis of the Melmerby Scar Limestone to crystalline marble in Teesdale indicates some contributory factors: the intrusion of the Whin Sill is at the lowest level in the strata; here it is at its thickest, and the limestone is pure. Darker limestones with free carbon have not metamorphosed. Weathering of the marble is now thought to have mostly taken place below ground at the junction of drift and limestone under the influence of percolating water and roots. When the drift erodes, rotten marble is exposed which rapidly breaks down to the familiar loose calcite sand ('sugar limestone'). The types of soil which have developed on the Fell have been shown (mainly by Hornung) to be related to the depth and nature of the deposits over the bedrock and to their water regime. Over the marble, the following develop according to the depth of the drift: over 60 cm – podzols, peaty gleys and deep peats; 30–60 cm – brown-earths, calcareous brown soils and calcareous gleys; under 30 cm – rendzinas. These last are subdivided: rendzina α is formed *in situ* on the rotten crystalline marble; rendzina β (the most widespread) is a complex of drift and rotten marble, and rendzina γ is formed in areas of aeolian erosion and accretion as on Cronkley Fell. All these rendzinas are characterized by alkaline reaction and excessively free drainage so that a water-deficit develops after even short dry periods (Welch and Rawes, 1969).

Finally, Alison Jones's phytosociological study of the vegetation of Widdybank Fell (Jones, 1973) is a most valuable contribution towards understanding the distribution of the mapped species. I am greatly indebted to her for permission to draw liberally on her thesis and that part of her work published as a booklet and vegetation maps at the scales 1:10 000 and 1:2500 (Bradshaw and Jones, 1976). She analysed complete plant lists from over 550 representative sample plots[1] of the vegetation of the whole Fell, and grouped them into the communities ('mapping units') which form the basis of the maps. Habitat features of aspect, slope and vegetation cover were recorded for each plot, and Hornung provided descriptions and analyses of the soils. Outlines of the phytosociological method, and general descriptions of the vegetation of the Fell appear in Bradshaw (1976) and Clapham (1976). Precise characterizations of the mapping units are available in Bradshaw and Jones (1976).

Correlation of the species-maps with the vegetation-maps and Jones's thesis has provided much ecological information about each species and its affinities within the vegetation classification of the phytosociologists to put beside my own field experience. Jones found that 60 per cent of the Teesdale Assemblage species on Widdybank Fell (Table 1) are diagnostic species or frequently present in either the short, freely-drained limestone grasslands[2] or the calcareous flushes and short-sedge-marshes;[3] several of them belong similarly to two corresponding arctic-alpine vegetation types[4,5] in continental Europe. Most of the remaining 40 per cent are diagnostic of the vegetation types of old lead-mine spoil, springs with calcareous water, and acidic grasslands on damp soils.[6,7,8] Two species, *Plantago maritima* and *Armeria maritima* are usually characteristic of coastal saltmarshes[9], but also occur in inland habitats. In addition, several of the species are frequent in the man-influenced, 'neutral' grassland[10] and in the acid rush- and short-sedge-marshes.[11]

In the following pages the mapping units are referred to by the numbers used in the booklet and the maps (e.g. m.u.5), and the frequency of the species as determined by Jones on the scale I to V.[12]

### Distribution of the Plant Species

The area of Widdybank Fell searched by the study-groups is shown in Fig. 1. It comprised the calcareous grasslands, flushes and short-sedge-marshes and associated communities overlying and influenced by the sugar limestone and base-rich drainage water on the west, south-west and south slopes of the Fell — including part of the reservoir basin, and the unaltered Robinson limestone which forms a small plateau east of the Track, south of Slapestone Sike. Sample areas only were searched: (a) on the Robinson limestone, (b) immediately south of the meteorological station and (c) on the heather-covered upper part of the limestone escarpment to the south. Jones's vegetation map (1:10 000) shows a much larger area of the 'dry' communities (coloured pink, yellow and the adjacent pale green) than of the 'wet' communities (blue) which are especially scarce in the south-east of the surveyed area. The Slapestone Sike area to the north-west is isolated from the remainder by blanket-bog covering the sugar limestone escarpment and the Whin Sill, and by the suitable 'wet' communities being destroyed by the construction of the access road before the mapping commenced.

Examination of the distribution maps of the 25 members of the Teesdale Assemblage of this survey shows they can be divided into three groups: (a) those predominantly of the drier habitats, (b) those of the wetter habitats and (c) those which occur frequently in both drier and wetter habitats.

1. In the dry habitat group the most widespread and frequent are: *Gentiana verna*, *Polygonum viviparum*, *Antennaria dioica* (Fig. 3) and *Galium boreale* (Fig. 4); *Potentilla crantzii* (Fig. 2) is equally widespread but of much lower frequency. Initially the *Gentiana* and *Polygonum* were not recorded because I believed them to be ubiquitous in the study area; consequently we lost some of the finer detail. Conversely, the mapping of *Kobresia simpliciuscula* and *Carex capillaris* was discontinued because they can be mapped more quickly from their autumn leaf colours (though to date the maps are incomplete). *Juncus alpinus* proved too difficult to identify with certainty from the immature fruits in July. *Gentiana verna* and *Polygonum viviparum* are indeed almost ubiquitous in the freely-drained limestone grasslands (m.u.1–7; on rendzinas, calcareous brown soils and brown-earths), and in the related man-influenced, 'neutral' grasslands (m.u.19–21; on slightly more acidic, gleyed brown-earths) which contain many synanthropic species (*Bellis perennis*, *Prunella vulgaris*, *Ranunculus acris*) and lie adjacent to the Track. Nevertheless, there are some differences between the two species.

*Gentiana verna* is absent from the driest communities (m.u.1/2) on or around the eroding sugar-limestone edges where the almost humus-free shallow rendzina soils are subject to extreme xeric conditions (Park, in Welch and Rawes, 1969). Jones gives it a high frequency (IV) (see Table 1) in the dampest grassland (m.u.7), which can occur on all the calcareous soil-types. It is usually absent from the wet communities, though it can be found on the drier parts of hummocks. Apparently the gentian avoids the extremes of soil moisture. It can tolerate the competition and light shade produced by the low shrubs of heather in m.u.4, where it is probably rooted below the somewhat acidic surface litter.

*Polygonum viviparum* has a distribution which is very similar to but wider than that of *Gentiana verna*. Where records were made on the escarpment, which included much of the heather grassland (m.u.4), it rarely failed to appear. Unlike the gentian it occurs

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Footnote

Phytosociological terminology:

[1] Aufnahmen, [2] Seslerio-Mesobromion (m.u.1–7), [3] Caricion davallianae (m.u.8,9,11–14), [4] Kobresio-Dryadion (Elyno-Seslerietea), [5] Caricion bicoloris-atrofuscae (Tofieldietalia), [6] Violetea calaminariae (m.u.V), [7] Cratoneurion (Montio-Cardaminetea) (m.u.▲), [8] Nardo-Callunetea (m.u.25,32,33), [9] Asteretea tripolii, [10] Ranunculo-Anthoxanthion (m.u.19–21), [11] Caricion curto-nigrae (15,16), [12] Constancy value.


Potentilla crantzii
530 km
529 km

Fig. 2

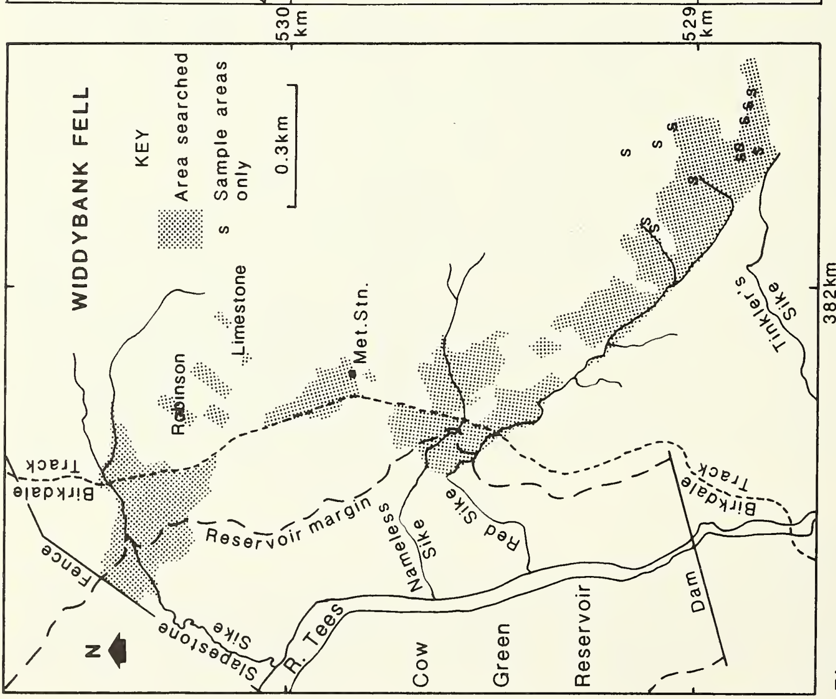
WIDDYBANK FELL
KEY
Area searched
s Sample areas only
0.3km
Robinson
Limestone
Met.Stn.
Birkdale Track
Fence
Slapestone Sike
Reservoir margin
Nameless Sike
Red Sike
R. Tees
Cow Green Reservoir
Dam
Tinkler's Sike
382km
N

Fig. 1

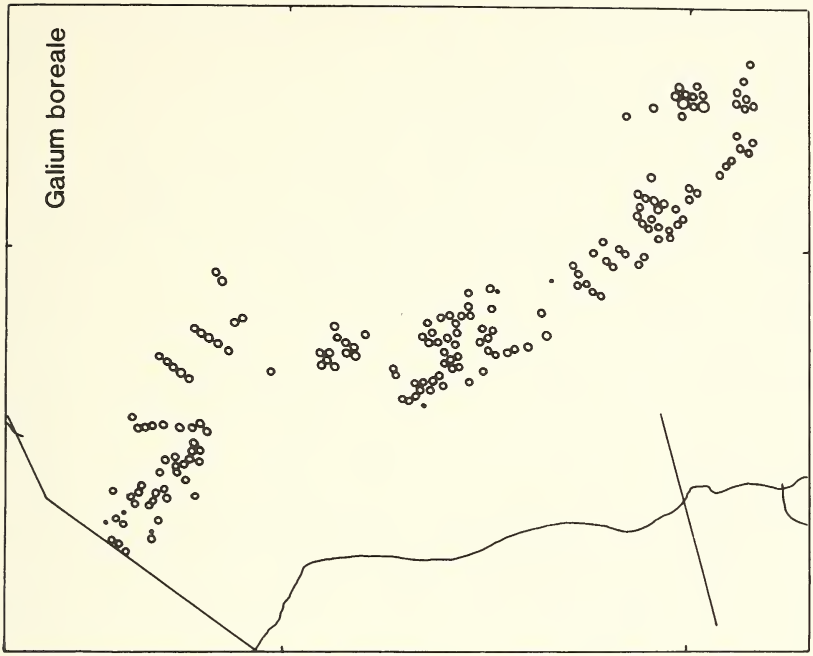


Fig. 4

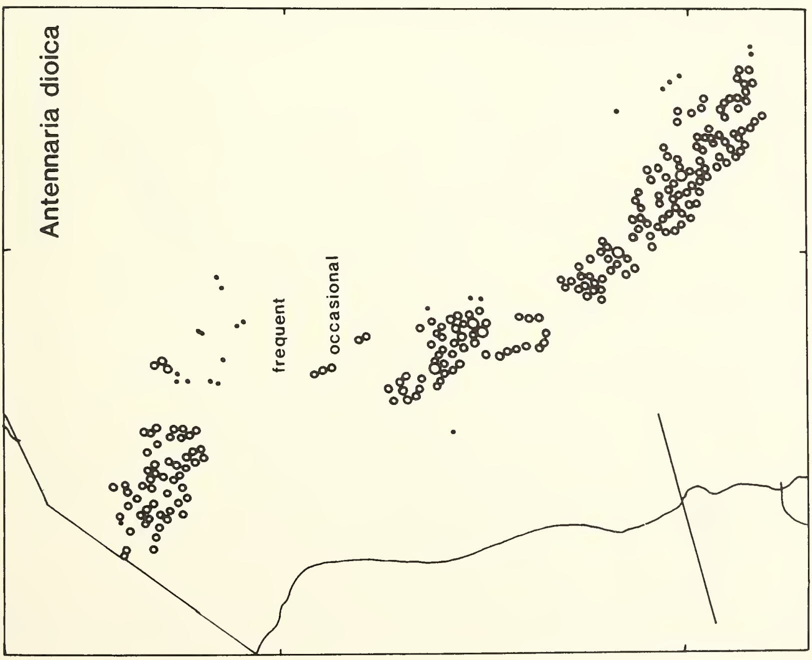


Fig. 3

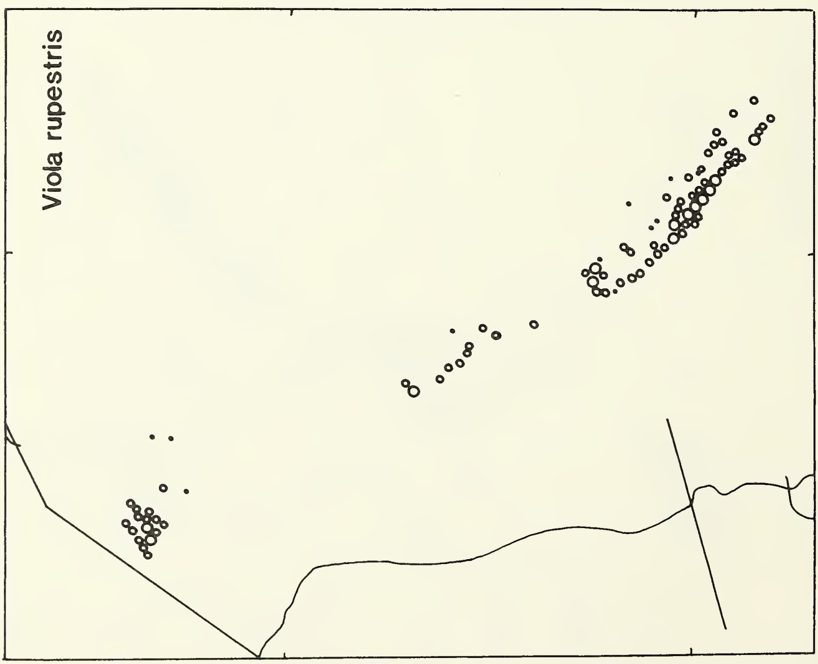


Fig. 5

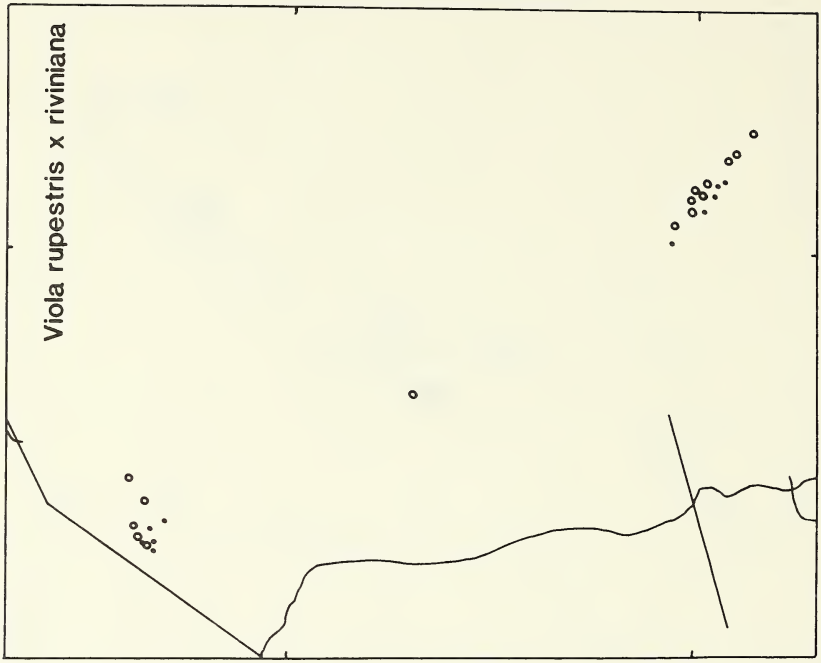


Fig. 6

occasionally on the driest sugar limestone (m.u.1/2) but was unrecorded in the wettest (m.u.7). It has a low frequency in the very similar m.u.8 and the turfy marshes (m.u.11) where the hummocks provide suitable sites; the maps show it to be frequent in a complex of flushes and drier communities at the east end of the area. Its ability to tolerate some trampling almost certainly accounts for its high frequency (III) in communities (mainly m.u.21) adjacent to the Track. Somewhat surprisingly this species is very sparse on the Robinson limestone where the gentian is frequent in all the sampled areas.

*Antennaria dioica* (Fig. 3) and *Galium boreale* (Fig. 4) appear to have broadly similar distributions. Both species are inconspicuous in the sward, the former because of its low, prostrate habit and the latter because of its short brownish-green erect shoots, which are tall only amongst plants such as heather. Sheep quickly remove the sparse inflorescences of *Antennaria dioica* so fruit is rarely found; cultivated plants from the reservoir basin revealed a remarkable range of red, pink and white colour forms in the male inflorescences. I have never seen the bedstraw in flower on the Fell, except on the rocks at Cauldron Snout. Both species spread vegetatively, *A. dioica* forming smallish dense patches and the *Galium* forming more dispersed larger clones. Jones's frequency values appear to be rather low (Table 1). *Antennaria dioica* has the denser distribution, in a slightly wider range of communities, favouring the drier habitats including the open shallow rendzina soils of m.u.1 and 3. It is most frequent in the widespread and species-rich m.u.5 and closely-related m.u.21, and only slightly less frequent in the heather grassland (m.u.4). It is sparse in communities with much *Kobresia* (m.u.6,7), with whose stiff, erect stems it may be unable to compete. In contrast, *Galium boreale* is absent from the driest soils (m.u.1/2) and from m.u.6. Its main distribution is in the widespread communities on the brown-earths and brown calcareous soils (m.u.4,5,21) and in m.u.20 (of the man-influenced, 'neutral' grasslands) which occurs as hummocks in the damp calcareous grassland of m.u.7. It is more frequent than *Antennaria dioica* on the Robinson limestone.

*Potentilla crantzii* (Fig. 2) is another inconspicuous species which is very thinly dispersed throughout much of the grassland on the sugar limestone (m.u.3,4,5,6). None was found on the Robinson limestone, though it is known from unaltered limestone and Whin Sill outcrops in the wider Teesdale area. Only once have I seen it in flower and once in fruit on the Fell.

These first five species are predominantly plants of the more closed communities, including the most widespread of the freely-drained limestone (m.u.5) and the man-influenced, 'neutral' (m.u.21) grasslands. The next group of species have high frequencies in the more open, dry habitats associated with the eroding sugar limestone: *Viola rupestris*, *V. rupestris* × *riviniana*, *Carex ericetorum*, *Plantago maritima* and the more local *Draba incana*. *Minuartia verna* belongs to this group (Table 1), but for some reason now forgotten was not included in the mapped species.

*Viola rupestris* (Fig. 5) is the next most widespread and frequent species; it has been recorded in all the freely-drained limestone grassland communities except that dominated by heather (m.u.4). Though not rhizomatous the plants occur in fairly dense colonies as well as small groups and isolated individuals. Distribution on the Fell is in large and small disjunct patches, which more-or-less coalesce towards the south-eastern end of the limestone. Jones gives it high values (V and III) in m.u.1 and 2, but, in my experience, her value (I) is too low in m.u.5 and 7, and particularly so in some areas of m.u.3 and 6. When looking at the total distribution on the Fell it appears possible that each major disjunct colony had its origin on or around the bare eroding limestone (m.u.1/2). It is known that flower production is inversely correlated with the percentage cover of the plant community (Bradshaw and Doody, in Clapham, 1976) and that plants in the open habitats (m.u.1/2,3) produce the most chasmogamous flowers, whose capsules are borne on longer peduncles than the small self-pollinating cleistogamous flowers. The explosive discharge from the elevated capsules would have facilitated seed dispersal from these centres (m.u.1/2). This view is supported by the observation that areas of closed grassland (m.u.5,6) and isolated or large tracts of disturbed grassland (m.u.3) where *V. rupestris* is

TABLE 1
**Distribution of some Teesdale Assemblage species in the mapping units**

| | Calcareous grasslands | | | | | | | Mine-spoil sites | 'Neutral' grasslands | | | Calcareous flushes and short-sedge-marsh communities | | | | | | | Other communities | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mapping unit no. | 1 | 2 | 3 | 5 | 4 | 6 | 7 | V | 21 | 20 | 19 | 8 | 9 | 14 | 12 | 13 | 15 | 16 | ▲ | 25 | 32 | 33 |
| Number of samples | 7 | 12 | 11 | 33 | 12 | 17 | 13 | 6 | 8 | 12 | 5 | 27 | 8 | 10 | 9 | 9 | 19 | 23 | 9 | 15 | 8 | 7 |
| Species of dry habitats | | | | | | | | | | | | | | | | | | | | | | |
| *Gentiana verna* | — | — | III | III | III | III | IV | — | — | — | — | I | — | — | — | — | — | — | — | — | — | — |
| *Polygonum viviparum* | I | I | III | II | III | III | — | — | III | I | I | I | — | — | — | — | — | — | — | — | I | — |
| *Antennaria dioica* | I | — | I | II | I | I | I | — | II | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Galium boreale* | — | — | — | I | I | — | II | — | I | I | — | I | — | — | — | — | — | — | — | — | — | — |
| *Potentilla crantzii* | — | — | I | I | II | II | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Viola rupestris* | V | III | I | I | — | I | I | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *V. rupestris × riviniana* | I | — | + | I | — | + | — | — | + | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Carex ericetorum* | IV | III | — | I | I | + | + | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Plantago maritima* | III | II | I | II | I | IV | V | II | I | IV | IV | V | III | IV | III | III | II | I | I | I | I | — |
| *Minuartia verna* | III | IV | IV | II | — | I | I | IV | — | — | — | I | I | III | — | — | — | — | — | — | — | — |
| *Draba incana* | + | + | I | I | — | — | I | + | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Polygala amarella* | — | — | I | I | — | II | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Diphasiastrum alpinum* | — | — | — | — | + | — | — | — | — | — | — | + | — | — | + | — | — | — | — | — | — | + |
| Species of both dry and wet habitats | | | | | | | | | | | | | | | | | | | | | | |
| *Plantago maritima* | III | II | I | II | I | IV | V | II | I | IV | IV | V | III | IV | III | III | II | I | I | I | I | — |
| *Thalictrum alpinum* | — | — | + | — | II | + | II | — | — | — | II | II | + | — | — | I | II | II | — | II | — | — |
| *Primula farinosa* | — | I | — | — | — | — | V | — | — | — | — | IV | II | III | IV | II | — | — | — | I | — | — |
| Species of wet habitats | | | | | | | | | | | | | | | | | | | | | | |
| *Tofieldia pusilla* | — | — | — | — | — | — | II | — | — | I | — | III | II | I | III | — | — | — | — | I | — | — |
| *Juncus triglumis* | — | — | — | — | — | — | — | — | — | — | — | + | I | I | — | — | — | — | — | — | — | — |
| *Equisetum variegatum* | — | — | — | I | — | — | — | — | — | I | I | III | V | II | I | II | III | — | II | I | — | — |
| *Saxifraga aizoides* | — | — | — | I | — | — | — | — | — | — | — | I | I | — | II | — | — | I | — | — | — | — |
| *Minuartia stricta* | — | — | — | — | — | — | — | — | — | — | — | + | I | I | — | — | — | — | — | — | — | — |
| *Eriophorum latifolium* | — | — | — | — | — | — | — | — | — | — | — | I | — | — | — | — | — | — | — | I | — | — |
| *Armeria maritima* | — | — | — | — | — | — | — | — | + | + | + | I | + | I | — | I | — | — | — | — | — | — |
| Widespread species: not mapped | | | | | | | | | | | | | | | | | | | | | | |
| *Sesleria albicans* | V | V | V | V | V | V | V | — | IV | IV | — | IV | — | — | I | — | I | — | — | — | I | — |
| *Kobresia simpliciuscula* | V | — | — | I | I | V | V | — | — | — | — | V | V | I | IV | III | I | II | — | I | — | — |
| *Carex capillaris* | — | I | V | IV | I | V | V | III | — | IV | IV | IV | — | III | II | — | I | — | — | — | II | — |

Constancy values I – V from Jones (1973); + = observed in field by M. E. Bradshaw absent are distant from open eroding sites (m.u.1/2). Nevertheless the violet is absent from a few areas of apparently suitable habitats where the slope is gentle and the eroded edges shallow. Could these sites be too recent in origin? Plants are scarce on the sugar limestone furthest away from its contact with the Whin Sill and absent from the Robinson limestone.

*Viola rupestris* × *riviniana* (Fig. 6) is a sterile hybrid which spreads vegetatively by root-shoots and does form very dense colonies. It was recorded in a number of more or less discrete patches, mainly at the north and south ends of the sugar limestone escarpment. Close comparison of the species- and vegetation maps shows the hybrid to be concentrated in m.u.1/2, but I know it avoids the eroding edges and extends into the adjacent more closed communities of m.u.5,6,3,21 and vegetation which contains *Calluna* and *Empetrum*. The major colonies are very dense, between 2 and 5 metres in diameter, and each may be a single clone. The single plants and very small colonies (small dots on the map) may be the beginnings of new clones or plants which have not inherited the capacity of the *V. riviniana* parent to reproduce vegetatively. Established clones frequently occupy a habitat which is intermediate in character and position between the extreme m.u.1/2 of *V. rupestris* and the denser, closed communities in which *V. riviniana* is common. Lack of such habitats near the base of the escarpment may explain the absence of the hybrid between the Track and the southern records. Most of the isolated small colonies are at the lowest edge of the limestone escarpment in the transition zone between the limestone grassland and calcareous sedge-marsh communities — an ecological niche which may favour a hybrid taxon. Hybrids from the reservoir basin grown in Teesdale soil at Durham exhibited much hybrid vigour.

*Carex ericetorum* (Fig. 7) is a rhizomatous sedge which forms locally dense clones of more-or-less evenly distributed shoots. It is always associated with the eroding sugar limestone (m.u.1/2) in the lower part of the strata. Like *Viola rupestris* its distribution is disjunct but more contiguous in the southern part. It is much more restricted, occurring mainly around the bare limestone patches. In one area a large dense colony extends from the edge of an eroded area into the closed and/or taller vegetation with heather or *Kobresia*, possibly indicating tolerance of slight shade. The soils are rendzinas or calcareous brown-earths. In a few places on the exposed edge it is associated with *Rhytidium rugosum*, a Teesdale Assemblage bryophyte. On Cronkley Fell it is widely dispersed through the drier limestone grassland communities of the summit plateaux. Here, but not on Widdybank Fell, on the shallowest soils it forms circular tufts and rings as in the Breckland. Could this habit be induced by soil-moisture stress? Teesdale plants, but not Breckland, are winter green. Winter photosynthesis may be important at this northern edge of the species' range, as flower production can be much reduced by severe winter or early spring conditions when the distal part of the leaves of the monocarpic flowering shoots may be so extensively killed that the starved inflorescences produced only one male spike in contrast to good years when one male and two–three female spikes are produced. In most years fruit is produced, though much seems to be lost before maturity, maybe eaten by sheep or stripped between their divided hooves.

*Plantago maritima* (Fig. 9) in Teesdale is found in both very dry and wet sites. This pattern of distribution along water courses and eroding limestone in the lower part of the strata is clear. Though most common in the more basic, wet communities (see below), it is frequent in dry communities with open ground and grassland with 10 per cent or more of exposed soil (m.u.1/2,5,6), and the community of the open-cuts and spoil heaps from the lead workings (m.u.V). This latter can be clearly seen along Rods Vein. The highest frequency (IV) is in m.u.6 which can have open pockets and rendzina soils. Jones gives a moderately high frequency (III) in m.u.3 and 4 and 21. Close scrutiny of the distribution suggests that *Plantago maritima* is a primary coloniser of open habitats. It was seen in this role on quarry floors and spoil on the magnesian limestone of east Durham. Like *Viola rupestris* it can colonize the rendzina α soils but it maintains its position less well as the soil develops and the community becomes closed (e.g. m.u.5). The only records of high density in closed turf on a dry rendzina soil are from a small area (10–12 sq m) in a

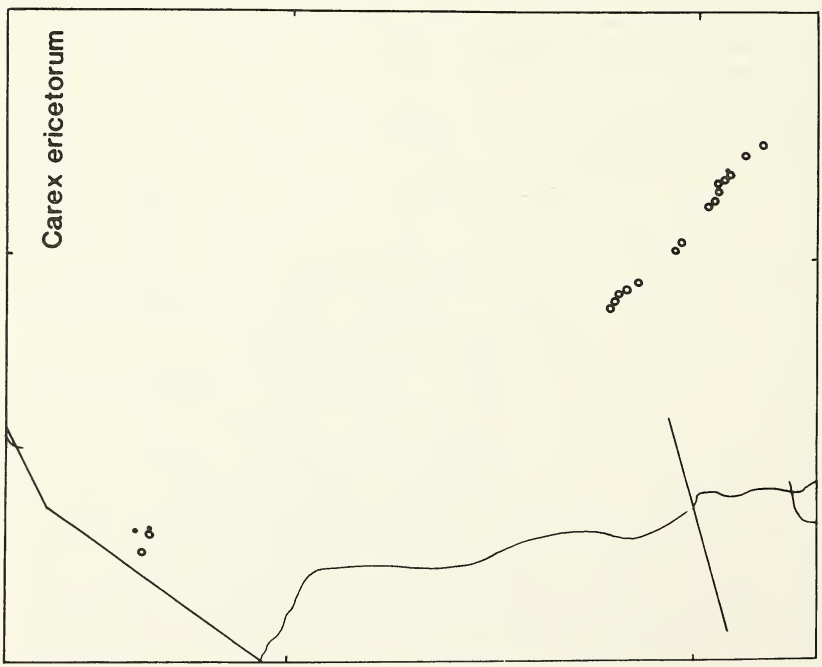


Fig. 7

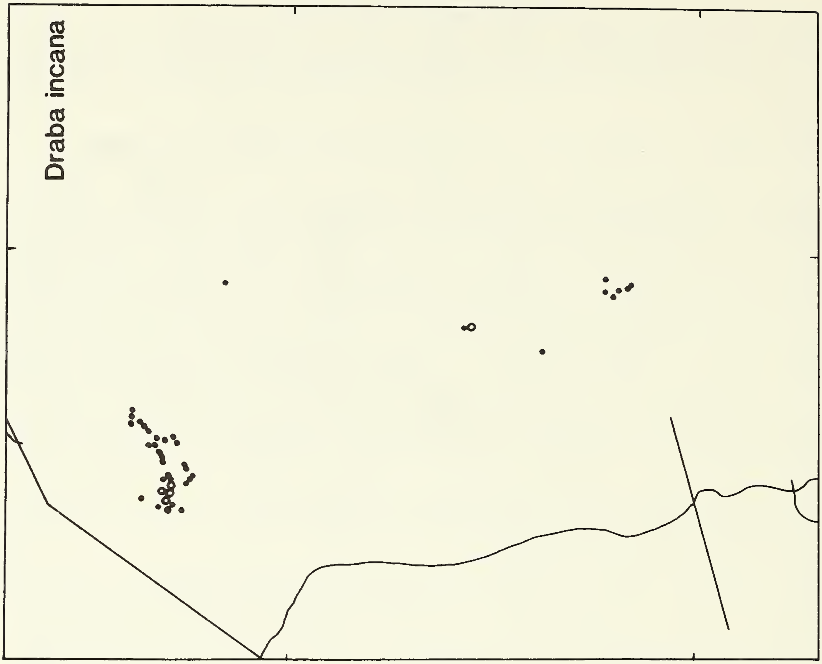


Fig. 8

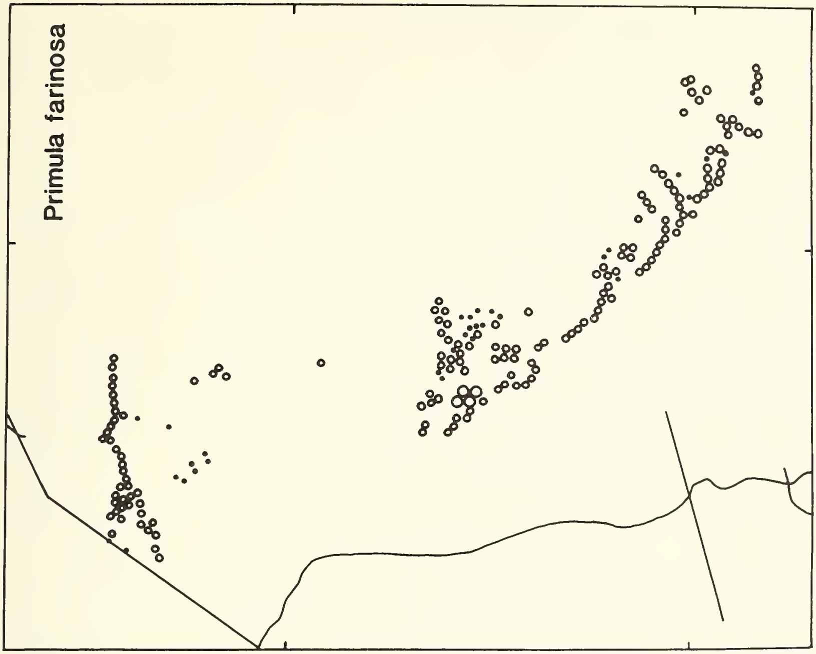


Fig. 10

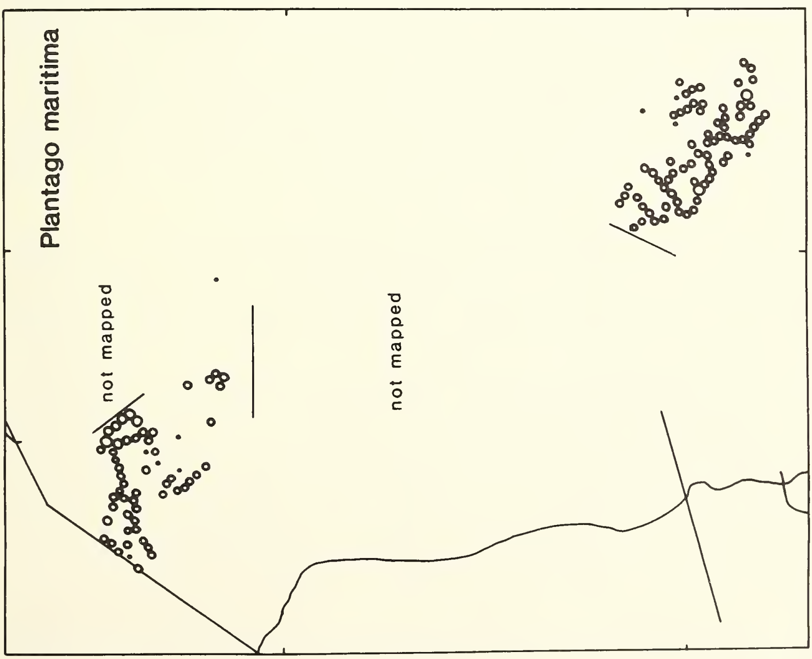


Fig. 9

pre-myxomatosis rabbit warren, suggesting the original colonization was probably about 25–30 years ago. The other locations of high density are in the 'neutral' grassland (m.u.21) adjacent to the Track where trampling has opened up the turf and the plantain, like *Polygonum viviparum*, tolerates the disturbance and dry-flushing from the Track. Predictably, the plantain is absent from large areas on the Robinson limestone where the soils and communities appear too mature and closed; but its absence from all but one of the open-cuts is surprising as the high density of plants in the flushes around the edge of the plateau could have provided seed for colonization of the new bare ground.

*Draba incana* (Fig.8) is much more localized than I expected. It is most frequent on the spoil and open-cuts of the mineral workings (m.u.V) and occasionally on moss, and in m.u.1/2 on soils which include rendzina α and γ on redistributed calcite sand. Jones records it in more closed communities (m.u.3,5,7), where in my experience it always occupies bare soil — eroded mole-hills and very small pockets which may be collapsed sub-surface mole-runs. Its distribution is disjunct, with comparatively isolated populations occupying natural habitats on bare limestone and shallow rendzina soils and ledges on ordinary limestone as in the open-cuts on the Robinson limestone and outside the survey area. In the north, the larger number of records is in part due to the presence of eroding limestone, the only extensive area on this Fell where moles create sub-surface runs, and many worked veins and spoil-heaps, especially Rods Vein, which have provided additional habitats in which large populations of *Draba* have developed. *D. incana* is a short-lived monocarpic perennial, whose population size is known to have fluctuated considerably between 1968 and 1976. It may be more at risk on Widdybank Fell than is generally realized. It is much more common on Cronkley Fell, especially on the redistributed sugar limestone (rendzina γ) where its behaviour can be observed and could be recorded in a habitat-stabilization experiment in the Thistle Green exclosure.

*Polygala amarella* was for some time thought to be confined in Upper Teesdale to Cronkley Fell, but I have known it on Widdybank Fell since 1957. It is present as a small number of more-or-less disjunct colonies along a short stretch of the sugar limestone escarpment. It shows some preference for m.u.6 and is also present in m.u.3, 4 and 5 in semi-open and closed grassland including short plants of heather and crowberry. It is more tolerant of light shade than many of the Teesdale Assemblage rarities. In these relatively small colonies the number of individuals can be several hundreds but the species is a short-lived perennial and the numbers in monitored populations have changed alarmingly from high to very low (though now increasing again) over the last 15 years. During the mapping project an isolated plant was recorded on a sheep track some 200 metres from the nearest population, but several later searches have failed to refind it.

2. The species with wide distributions in both wet and dry habitats are *Plantago maritima*, *Thalictrum alpinum* and *Primula farinosa*. All three are more widespread than the other mapped species of the calcareous flush and short-sedge-marsh communities (m.u.8,9, 11–14) and all occur in the drier communities, especially those of the freely-drained limestone grassland group as well as several other communities and vegetation-types.

*Plantago maritima* (Fig. 9) was recorded by Jones in the highest number of communities (23) of all the Assemblage species (Table 1). Its occurrence in the drier communities has been considered above. It is most frequent in the highly calcareous, flushed communities of m.u.7 and 8 (pH 7.5–8.0) which may be hummocky with some open ground and on a range of soils from rendzina β to calcareous gleys. Almost similar frequencies occur on the more acidic (pH 6.0–7.0) damp, calcareous, peaty gleys of the man-influenced, 'neutral' grassland (m.u.19,20), which often occur in the base of open-cuts, and where the plantain has low frequencies on the sides and edges (m.u.V). It is frequent in all the gravelly flush and short-sedge-marsh communities (m.u.9,14; 11,12,13) but less common in the closely related, slightly taller and more acidic (pH 5.5) but species-rich *Calluna-Erica tetralix* community (m.u.25) and in springheads (m.u.▲). Obviously the plantain favours open habitats, both dry and wet, e.g. m.u.1/2,9 and 14. Maybe the greater soil moisture enables it to survive in the more closed, short-sedge-marsh communities (m.u.7,8,9pp, 12,13); whereas the greater acidity of the peaty gleys and shade from the taller vegetation (m.u.15,16,25) reduce its frequency.

*Thalictrum alpinum* (Fig. 14) is most common in the wet vegetation complexes which overlie the Whin Sill below the Sand Hill on both sides of the Track and in the zone between the lower part of the sugar limestone escarpment and the bogs to the south. Occurrences of *T. alpinum* towards Tinkler's Sike and in the lower Slapestone Sike areas, below the Access Road to the dam, are outside the surveyed area and consequently are missing from the distribution map. Its absence from the rest of the Slapestone Sike area, though slightly surprising, is real. It has slender rhizomes and though the shoots are usually dispersed it can form very dense patches, especially in moss-based communities. Comparison of the species-map and the vegetation-maps and Jones's records show that the species usually have low frequencies in a slightly odd array of 16 mapping units in six separate vegetation-types. It is most frequent in the *Calluna-Erica tetralix* community (m.u.25(II)), and complexes of that, with the sedge-marsh communities (m.u.9, 12 and 8), all of which have wet, gleyed and sometimes peaty soils. It occurs also in communities on progressively drier calcareous and slightly more acidic mineral soils in the freely-drained limestone grasslands (m.u.7, 6 and 4). Many of these communities are marginal in their vegetation-type and close to another, e.g. m.u.7 and 8, 16 and 13, 4 and 32, 5 and 21. Although *Thalictrum alpinum* does grow in quantity in some pure stands of single communities, much of its distribution is in the transitional zones between vegetation-types; this is clearly seen by its frequent occurrence in the zone between the base of the limestone escarpment and bogs over the Whin Sill towards Tinkler's Sike and lower Slapestone Sike. Both zones are enriched by in-washed calcite crystals, especially so from the Rod's Vein adit and adjacent sugar limestone spoil-heap. In both of these areas *Juncus alpinus* — another Assemblage species — has high frequencies. Ecologically, *Thalictrum alpinum* avoids the most open habitats (m.u.1/2,9pp,14) and is exceedingly rare in m.u.3 which has a shallow rendzina soil and the widespread closed limestone grassland (m.u.5). The absence of *Thalictrum* from the entire Slapestone Sike area from immediately above the base of the escarpment (and Access Road) is difficult to understand in view of its occurrence on the escarpment to the south and its high frequency below the Road; perhaps the flushing caused by the outwash from the Rods Vein adit and spoil has enhanced its density there. It can tolerate light shade as it is found in heather and the taller rush- and sedge-marsh (m.u.16). On the Fell it flowers regularly, though I have seen seed only once.

*Primula farinosa* (Fig. 10) is one of the most familiar species of the Assemblage. Primarily it is a species of the wet habitats, as can be seen in the map which identifies the calcareous springheads, flushes and wet communities thoughout the surveyed area, including the flushes on the edge of the Robinson limestone. It is present in all the flush and short-sedge-marsh communities and wettest calcareous grassland; the highest frequencies being m.u.7,11(V), 8,12(IV) and 14(III); *P. farinosa* is also in the related *Calluna-Erica tetralix* hummocks of m.u.25. The field survey revealed isolated single or small groups of plants in the freely-drained limestone grasslands; frequently these are in small patches in the wettest and the *Kobresia*-rich turf (m.u.7,6) but others are in the relatively dry m.u. 5 and 21. In these sites the individuals are long-lived and the population turn-over is low. The *Primula* has not been found amongst heather (m.u.4), nor on the mine-waste (m.u.V). In most years it flowers well but seed production is low; I believe the scent of the open flowers attracts the sheep which remove a high proportion from all but the tussocky communities, where the grazing is incomplete, and swards where the stiff *Kobresia* shoots give some protection (e.g. m.u.6). This was demonstrated in an area with *Kobresia* where fruits ripened regularly before horses grazed off the stiff shoots and enabled sheep to graze easily: now no fruits mature. Overall, sufficient seed ripens to maintain the population.

3. The wetter habitat group contains four species which are widely distributed in these sites across the Fell: *Tofieldia pusilla* (Fig. 11), *Juncus triglumis* (Fig. 12), *Equisetum*

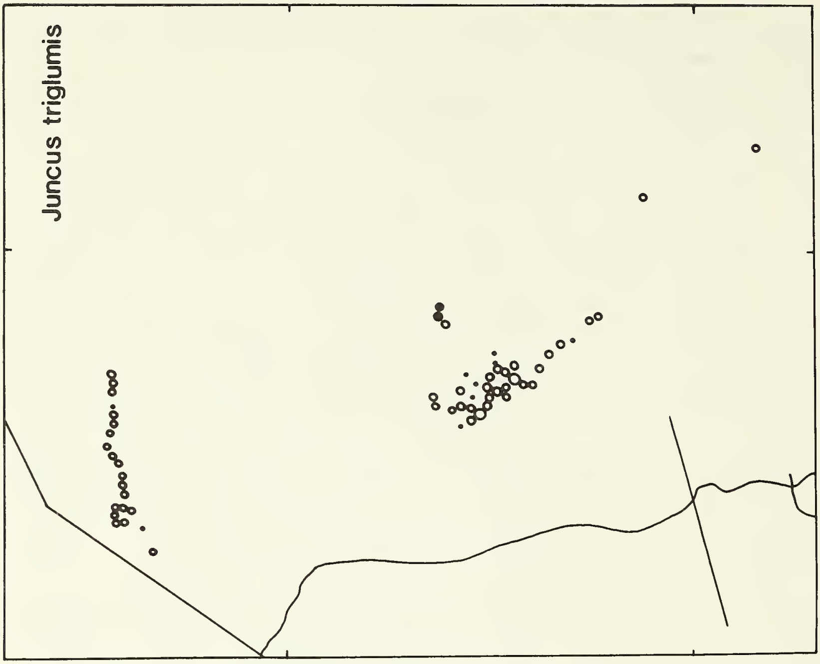


Fig. 12

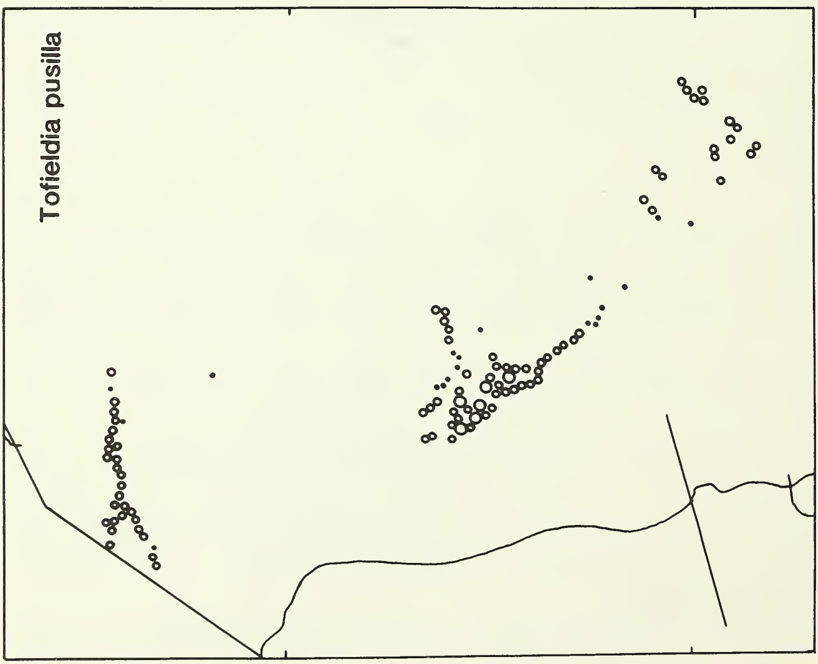


Fig. 11

*variegatum* and *Saxifraga aizoides* (Fig. 13). All are less widespread than the comparable 'dry habitat' group because of the smaller area of wet habitats in the survey area. Though differing in quantity, the distribution patterns of the first three appear to be very similar, but superimposition of the maps does reveal differences. *Juncus triglumis* and *Saxifraga aizoides* are restricted to open communities usually with running water, *Tofieldia pusilla* and *Equisetum variegatum* can occur in closed communities; *Saxifraga aizoides* is the least common on the Fell top. (At some stage data on the distribution of the *Primula*, *Equisetum* and *Saxifraga* in the flushes immediately east of the Track and along Red Sike have been lost. A recent inspection confirmed all three species to be present.)

*Tofieldia pusilla* (Fig. 11), like *Primula farinosa*, hugs the calcareous water courses and flushes and is intermediate between that species and *Juncus triglumis* in the total area, density and range of communities in which it occurs. It is present in all the calcareous flush and short-sedge-marsh communities except one (m.u.13), being most frequent in those which are hummocky (m.u.11(V)) or form hummocks and hollows and complexes with other communities (e.g. m.u.8 and 12 with 9); it is also frequent in the lawn-like forms of m.u.8 and 9 and in m.u.7 of the limestone grassland. It is rarely ever found on bare substrate (as is *Juncus triglumis*) and has low occurrences in the gravelly flushes (m.u.14, 9pp) where it grows on tussocks of other species. Like the *Primula* it is in the closely allied m.u.15 and 25, and in m.u.20. The species is most frequent in the Slapestone and Red Sike areas, becoming even scarcer in apparently suitable communities in the south. Isolated fans of leaves or small clumps have been found on the escarpment and in one spot on the Robinson limestone. Like the *Primula*, it fruits more successfully in the hummocky communities, as its inflorescences are also pulled out by the sheep.

*Juncus triglumis* (Fig. 12), though almost as widespread as the *Tofieldia*, occupies a narrower range of habitats and is even scarcer in the south, though it is known to be present outside the surveyed area in Tinkler's Sike. It is fairly frequent, sometimes very frequent, in the open muddy, silty parts of gravelly flushes and rooted in cracks in rocky stream beds (m.u.9(IV)); it has a low occurrence in the sometimes open hummocky, short-sedge-marsh (m.u.8(I)) but is rarely found in closed communities on the Fell. *Juncus triglumis* appears to have the narrowest ecological range of the Assemblage on the Fell top. It is dependent on a high water table and maybe on moving water; flower production and plant survival are seriously reduced by drought or changes in the course of the water flow. In most years it flowers and fruits freely, though young fruits appear to be eaten by birds.

*Equisetum variegatum* is much less frequent than *Tofieldia pusilla*, being about as common as *Juncus triglumis* with which it shares a high frequency (IV) in the open gravelly flushes (m.u.9), but not always in the same locality, e.g. it is unrecorded at the head of Nameless Sike which may have too little substrate over the bare rock. Like *Tofieldia* it is sparse even in apparently suitable communities in the south of the survey area. It is most frequent in the gravelly-flush and the open *Kobresia*-network form of m.u.9 and in the more closed sward of m.u.8. It is relatively common in the most species-rich, calcareous flushed, peaty community (m.u.15) of the sedge- and rush-marshes (ht. 20–30 cm). Though less widespread than *Tofieldia pusilla* it is in a larger number of communities. As with *Thalictrum alpinum*, this may be due to the outward spread of the extensive rhizomes from communities where it is common (m.u.8,9,15) into ones with which complexes are formed (m.u.11,12,25) or other adjacent communities (m.u.5,20,19). It also occurs with *Primula farinosa*, *Plantago maritima* and *Sagina nodosa* in the moss-dominated springhead and spring side community. It does not fruit freely on the Fell, but transplants in cultivation at Durham grew and fruited vigorously.

*Saxifraga aizoides* (Fig. 13). Nowhere on the Fell top does this saxifrage occur in the high densities found bordering some streams on the east side of Widdybank Fell and elsewhere in its distribution. It is thinly scattered along Slapestone Sike and in the flushes of Red Sike. It is most frequent in the turfy marshes (m.u.11), especially in Widdybank Pasture, and on hummocks of the short-sedge-marsh in m.u.9. A well known patch of plants can still be seen adjacent to the Track near Red Sike, though this appears to have

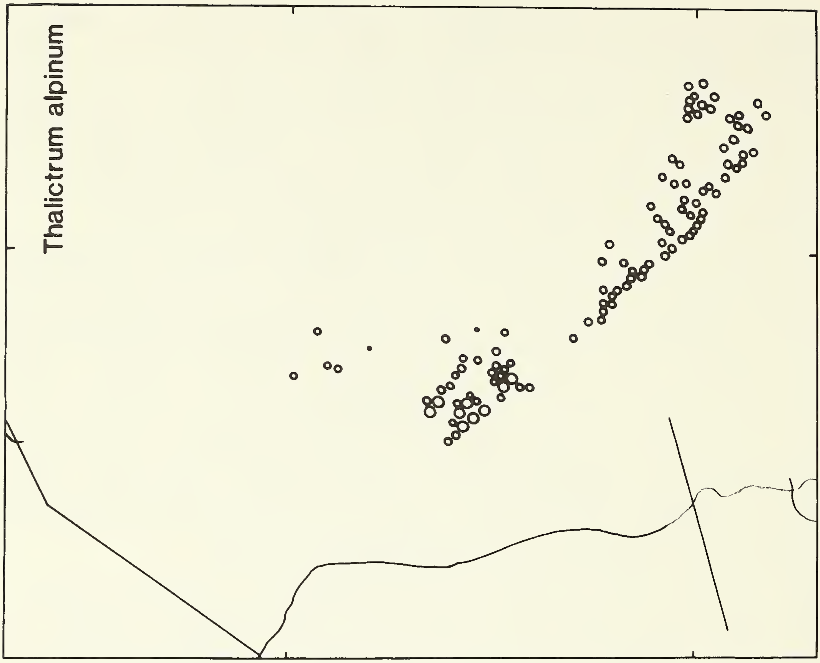


Fig. 14

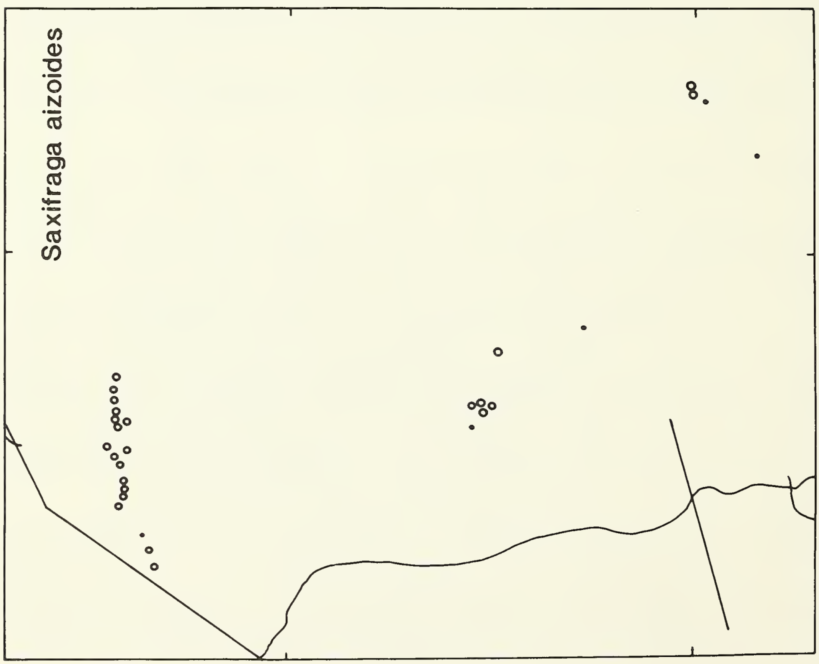


Fig. 13

decreased in recent years — perhaps the result in part of the raising of the surface of the Track and culverting of the stream in 1970, and in part of the low rainfall of the decade 1968–1978.

*Minuartia stricta*, known only in Teesdale in Britain, was found to be very rare in the surveyed area. It was absent from the wet communities associated with Slapestone and Nameless Sike, and from Red Sike within the reservoir area. To the east, it persists in a few small populations but some isolated plants and very small colonies have been short-lived. Mostly it occurs in the gravelly flushes (m.u.9,14) and occasionally in more closed communities (m.u.7,8). Although Jones places both *M. stricta* and *Juncus triglumis* in m.u.8 and 9, in no site were they found together. In thirty years, I have found isolated plants on bare rock and gravel, which suggests that colonization can take place, but none of these plants has persisted long.

*Eriophorum latifolium* was found on the margin of a stretch of Red Sike in the reservoir area. Searches of the banks of Red Sike, lower Nameless Sike and the margins of the hummocks (m.u.25) between the streams failed to find it. It is not now known on the Fell top, but it is not uncommon on the eastern slopes of the Fell in sedge-marshes (m.u.15,16).

*Armeria maritima* occurred in the reservoir basin as a large population in the lower Slapestone Sike area and in the flushes below the sugar limestone near the Sand Hill. Plants of few to many rosettes have been recorded in and adjacent to gravelly flush and short-sedge-marsh communities (m.u.9,14,8). The rosettes are selectively grazed by sheep so the inflorescences rarely survive to flower and never to fruit. Before inundation, a large population of about 60 separate plants grew in the man-influenced, 'neutral' grassland (m.u.20,19 and less frequently in m.u.21) below the entrance to the Rods Vein adit and the associated heap of sugar limestone waste. No doubt the high rainfall and occasional flooding of the Vein (observed in 1967!) would have redistributed the sugar limestone over the former vegetation many times. It is probable that here *Armeria maritima* was a primary colonizer and like *Plantago maritima* on the rabbit warren, survived as the habitat became a closed community. Cuttings from these plants, grown at Durham, showed great variation in vigour, length and width of leaves, scape length, colour of the flowers and both types of pollen and stigma surface. Somewhat surprisingly, no colonies occur on the bare sugar limestone or the mine waste in this part of Teesdale today.

4. Other species. *Diphasiastrum (Lycopodium) alpinum* is not usually included in the Teesdale Assemblage but it is rare in the northern Pennines (Eddy and Welch, 1967; Richards (pers. comm.)). It is very thinly scattered over the survey area, mainly in its northern part. Most records are in species-poor *Agrostis/Festuca* grassland (m.u.33) on acid brown-earths and most colonies are small and rarely extend over more than half a square metre.

*Salix repens*, a low growing shrub present in sedge-marsh communities in Widdybank Pasture, was first found on the Fell top in 1968. By 1975, 16 plants had been found scattered over the sugar limestone escarpment and one plant in a sedge-marsh community of the Red Sike area. On the escarpment most plants were in the heather grassland (m.u.4) and a few in closed turf (m.u.5,6). The small woody plants were usually much branched, about the same height as the surrounding vegetation and showed little lateral spread. *Juniperus communis* was found occasionally as very small plants usually in the open wet habitats; they seem to be short-lived. I know of no bushes on Widdybank Fell despite their abundance on Cronkley Fell and at lower altitudes in the Dale.

A number of additional forbs have been found in the limestone grassland communities. Small quantities of *Solidago virgaurea*, *Serratula tinctoria* and *Thalictrum minus* have been recorded in closed grassland on the sugar limestone, both within (not the meadow-rue) and above the reservoir basin (490–500 m). Golden rod is not uncommon on the Whin Sill rocks in Teesdale, including Cauldron Snout, but the other two are not known nearer to the Fell top than on the banks of the Tees near High Force and Winch Bridge respectively. *Serratula tinctoria* is near the northern limit of its British distribution. *Thalictrum minus* has a disjunct distribution which includes many base-rich upland, East Anglian and coastal localities common to other Teesdale Assemblage species, to which it should be added, falling into place naturally alongside other members of the Assemblage characteristic of the freely-drained limestone grasslands. Three other species with predominantly southern and lowland affinities are *Anthyllis vulneraria*, *Scabiosa columbaria* and *Hippocrepis comosa*. Only *Anthyllis* is on Widdybank Fell, where it is not uncommon on or near eroding sugar limestone (m.u.1/2). *Hippocrepis comosa* and *Scabiosa columbaria* are present in similar communities on Cronkley Fell and the latter is present at lower altitude by the Tees about 1 km below Widdybank Farm.

## Conclusion

The most striking feature revealed by this fine scale survey of the distribution of the rare species is the variety of patterns displayed by the maps: very local and rare or widespread and abundant, disjunct colonies or thinly scattered. All the species differ in their habitat preferences, overtly or subtly, even those which appear to have similar patterns, such as *Antennaria dioica/Galium boreale*, *Juncus triglumis/Tofieldia pusilla*. Our mapping work confirmed the generally held belief that *Gentiana verna*, *Primula farinosa*, *Polygonum viviparum*, *Antennaria dioica* and *Galium boreale* are indeed widespread on the Fell whilst the wide distribution of the inconspicuous *Potentilla crantzii*, thinly scattered over the escarpment, was an unexpected finding. *Viola rupestris* proved to be well represented and to occupy virtually all the apparently suitable habitats on the lower part of the sugar limestone. *Draba incana* and *Polygala amarella* were much more local for no immediately obvious reason, but both are short-lived perennials with no vegetative reproduction and poor seed dispersal, so are likely to be more subject to the vagaries of chance. Most species of the wet communities are comparatively limited because of the absence of suitable habitats, especially open running water in the south-east of the surveyed area. Only such a close search could have revealed the true scarcity of *Minuartia stricta* and discovered *Eriophorum latifolium* — new to the Fell top — and highlighted the puzzling distribution and affinities of *Thalictrum alpinum*. It is gratifying that subsequent comprehensive mapping proved the emergency survey of 1964–1965 to be so accurate, especially in respect of the quantities of the nationally rare plants, *Viola rupestris*, the hybrid violet and *Carex ericetorum*, and the confirmation of the absence of *Minuartia stricta* and *Polygala amarella* in the reservoir basin. The flooding of some 10 per cent of the 90 ha (220 acres) of the dry and wet calcareous communities destroyed 10 per cent, 5 per cent and 40 per cent respectively of the first three plants. Unfortunately, destruction continues in the Slapestone area where the sugar limestone shore receives the force of the prevailing south-westerly winds.

The 'farmer's boot' has a lesson for the botanist; there is no substitute for getting out in the field. The intimate contact with the plants provided by crawling over the communities of the Fell has given all of us a wealth of appreciation and understanding of the plants and their habitats. The data-base yielded by the results has obvious value for conservation management and short- and long-term research. However, do not think that even Widdybank Fell has been 'worked-out' — other areas, particularly the wet habitats, remain and who knows what there is to discover on Cronkley Fell! But the value of work of this kind is not limited to Teesdale or to rare species. There may be few unknown areas on earth left to explore, but there are many near to home which would amply repay close observation — other Assemblages or Reserves, one species or many. Such recording requires little beyond care and persistence, and if well done can be of lasting value.

Finally, if this account of my botanical journeys has any relevance for the Yorkshire Naturalists' Union, Natural History Societies and individual naturalists, it is my modest hope that I may have opened some eyes to some kinds of investigations that can be made by amateurs. I was an amateur naturalist (professional school-teacher) when I started, and the survey of Widdybank Fell was mostly the work of amateurs. The 'President's Message' of that excellent amateur botanist Eva Crackles (1974) is full of sound advice — do re-read it. I urge you to concentrate on a group of organisms or on an area and to make time to become really knowledgeable about it — become a specialist. Such an activity can be very rewarding, not least in personal fulfilment. Please, do not dabble: be serious, it takes little more time, and other experts and professionals will help you. Professionals! You have so much at your finger-tips which would aid and encourage — perhaps you could 'adopt an amateur'. It is my belief that a serious hobby provides those with time on their hands — young or older — with something to live for and maybe a reason for living. Be bold and have the courage to start your journeys. Like Eva, I end with Browning's words: 'Ah, but a man's reach should exceed his grasp or what's a heaven for'.

Acknowledgements

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[Access to the N.N.R. off the rights of way should be obtained from the Reserve Warden via: N.C.C. Regional Office, Archbold House, Newcastle upon Tyne NE2 1EG.]

References

Bradshaw, M. E. (1962) The distribution and status of five species of the *Alchemilla vulgaris* L. aggregate in Upper Teesdale. *J.Ecol.* **50**: 681–706.

Bradshaw, M. E. (1963) Studies on *Alchemilla filicaulis* Bus., *sensu lato*, and *A. minima* Walters. I and II. *Watsonia* **5**: 304–320, 321–326.

Bradshaw, M. E. (1964) Studies on *Alchemilla filicaulis* Bus., *sensu lato*, and *A. minima* Walters. III. *Watsonia* **6**: 76–81.

Bradshaw, M. E., ed. (1976) *Natural History of Upper Teesdale*. 2nd ed. Durham County Conservation Trust.

Bradshaw, M. E. and Jones, A. V. (1976) Phytosociology in Upper Teesdale: Guide to the vegetation maps of Widdybank Fell. With five accompanying maps. The Teesdale Trust. [Obtainable from the The Botany Department, Durham University.]

Clapham, A. R., ed. (1976) *Upper Teesdale*. Collins, London.

Crackles, E. (1974) Seeking to understand the Flora of the East Riding of Yorkshire. *Naturalist* **99**: 1–17.

Eddy, A. and Welch, D. (1967) A species-list of flowering plants and ferns for the Moor House National Nature Reserve in Upper Teesdale. *Proc.Bot.Soc.Brit.Isles* **6**: 325–336.

Johnson, G. A. L., Robinson, D. and Hornung, M. (1971) Unique bedrock and soils associated with the Teesdale flora. *Nature, Lond.* **232**: 453–456.

Jones, A. V. (1973) *A Phytosociological Study of Widdybank Fell in Upper Teesdale*. Ph.D. thesis, University of Durham.

Pigott, C. D. (1956) The vegetation of Upper Teesdale in the northern Pennines. *J.Ecol.* **44**: 545–586.

Pigott, C. D. and Walters, S. M. (1954) On the interpretation of the discontinuous distributions shown by certain British species of open habitats. *J.Ecol.* **42**: 96–116.

Poore, M. E. D. (1964) Integration in the plant community. *J.Ecol.* **52** (suppl.): 213–226.

Tansley, A. G. (1939) *The British Islands and their Vegetation*. Cambridge University Press, Cambridge.

Walters, S. M. (1952) *Alchemilla subcrenata* Buser in Britain. *Watsonia* **2**: 277–278.

Welch, D. and Rawes, M. (1969) Moisture regime of soils on metamorphosed limestone in Upper Teesdale. *Trans.Nat.Hist.Soc.Northumb.*, n.s. **17**: 57–67.

# BOOK REVIEWS

**Quantitative Plant Ecology** by **P. Greig-Smith**. Pp. xiv + 359. Blackwell Scientific Publications. Third edition, 1983.

A long overdue major revision of what has become a standard text on the subject. Since the second edition in 1964, major changes have occurred in the quantitative approach to ecology. This is particularly true in plant ecology, where computing has become an everyday part of a plant ecologist's work and many new techniques to cope with complex multivariate data have been developed. Professor Greig-Smith's third edition has taken full account of these developments and his extensive bibliography contains a great many items published since the second edition. Of the ten chapters covering the various elements of the quantitative approach, four are new to this edition. There are two substantial chapters dealing with classification and ordination, often seen in the past as alternative and conflicting techniques, but adequately shown by Professor Greig-Smith to be complementary. Another new chapter deals with the relationship between vegetation and its environment, but is however suprisingly short and general in nature. The final new chapter, also rather short, and perhaps the focus for any misgivings that I have about this book, is entitled 'Practical Considerations'. Although literally hundreds of mathematical tools are discussed in the preceding nine chapters, the novice is given little advice about choosing techniques appropriate to a particular problem. Admittedly, some general guidelines are given from time to time, but these and the final chapter are insufficient to make this work a comprehensive guide to the quantitative jungle. This edition is a great improvement in this respect but still does not go far enough; although experienced workers will undoubtedly find it, like its predecessors, a valuable reference work. *Quantitative Plant Ecology* is much more than a catalogue of techniques, but there is still a need for a good textbook which adequately discusses this rapidly advancing subject.

JEPC

**Estuarine Biology** by **R. S. K. Barnes**. Pp. 76, with 29 figures and 5 tables. Studies in Biology No. 49, Edward Arnold. 2nd edition. 1984. £3.50.

The second edition of this book follows the same format as the first. Chapter I, an introduction which defines estuaries, and describes their characteristics, is followed by a chapter on the nature of the flora and fauna. Discussion of the latter is much more comprehensive than of the former, as admitted by the author in the Preface, although in this edition the section on micro-organisms has been expanded, and more information about mangroves is given in the section on macroflora.

Chapter III discusses food and food webs, and the sections on detritus and micro-organisms, digestion and assimilation, and density, productivity and biomass have been largely re-written. Chapter IV describes adaptations to the estuarine environment, and anatomical and physiological specializations are discussed; sections on evolutionary aspects and behavioural specializations have been expanded. Chapter V deals with the effects of human populations and industry on estuaries, and describes in some detail different forms of pollution discharging into estuaries. Chapter VI gives a résumé of how estuaries have been studied in the past, and suggests ways in which future studies may be carried out, whilst chapter VII, a short mention of other brackish waters, brings the book to a close.

Some technical terms or phrases are not adequately explained, for example, fetch of the wind, r- and k- selection, and what on earth is the 'brackish water component of Remane'? Nevertheless, this book, like most of the Studies in Biology series, is very readable, and many interesting examples are used to illustrate the points made. As an ecologist concerned with applied aspects, I found the chapter on estuarine biology versus population and industrial pressure was particularly interesting.

JMD

# THE POPULATION AND DISTRIBUTION OF NIGHTJARS *(CAPRIMULGUS EUROPAEUS)* ON THE NORTH YORK MOORS

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## Introduction

The Nightjar (*Caprimulgus europaeus*) population of the North York Moors was surveyed in 1980 and 1981. Information on population, distribution, and past population history, is presented.

## Study Area

The study area was defined as the North York Moors National Park, with the addition of the Givendale section of Dalby Forest. The principal land uses within the study area are shown in Table 1.

The total area of the National Park is 1432 km$^2$. The North York Moors are characterized by a high central plateau, rising to 424 m, dissected by deep valleys. The southern part of the area is a complex of scarp and dip slopes. The dominant soil type is a podzol with a pronounced iron pan, which covers much of the central plateau. Gleys occur on flat ground, and dominate the valleys. Brown earths are found in the valleys, and there are some rendzina areas where the calcareous bedrock outcrops.

A substantial area of open moorland has been afforested since the 1920s, and the area of bracken is expanding. Average rainfall is 762 mm (30″) on low ground, rising to 1015 mm (40″) over higher ground.

TABLE 1

**Area and principal land uses within the North York Moors National Park (North York Moors National Park Committee, 1977)**

| Land use | Area (km$^2$) | % of total |
|---|---|---|
| Open land | 511.0 (1) | 35.6 |
| Disturbed land | 71.6 | 5.0 |
| Forest | 243.4 | 17.0 |
| Agricultural | 606.0 (2) | 42.4 |
| Total Area | 1432.0 | 100.0 |

(1) Bracken Cover: 86 km$^2$

(2) Approximately 50% intensive agriculture

## Historical Status

Available information dating back to the 1920s has been examined, including the Yorkshire Bird Report (Y.B.R.) from 1940 onwards, and unpublished Forestry Commission Records (F.C. Records), compiled largely by G. Simpson. The picture presented is disparate, depending heavily on the activity of a few individuals.

Prior to 1940 the species was apparently sufficiently common not to warrant mention of specific sites. Nightjars are recorded as nesting on 'bare ground in bracken and heather, generally on the fringe of the moors' in Medlicott (1940), and this was still considered to be the normal habitat as late as the 1957 British Trust for Ornithology (B.T.O.) national survey, on the results of which Stafford (1962) states that for Yorkshire 'breeds here in suitable areas in the dales and on the edges of moorland on bracken'.

By the 1940s records of the species' decline appear, for example in the 1941 Y.B.R. 'still decreasing around Whitby' and in the 1944 Y.B.R. 'one pair found where four used to be in Goathland Dale'. Norris (1960) shows the species as present in reasonable numbers in 1952, with at least 10 pairs in the central block of the study area. The 1957 Y.B.R. gives only three localities for V.C. 62. By the 1970s Nightjars were believed to be very uncommon within the study area, with a few localities known in the Scarborough area (particularly Turkey Carpet and Birch Hall) recorded annually, with the highest number being seven localities in the 1978 Y.B.R. One or two localities were reported along the Cleveland escarpment, but there were no records at all in 1979. *The Atlas of Breeding Birds in Britain and Ireland* (1976), covering 1968–1972, reflects this general position.

The only published record referring to use of a true forest site, as opposed to small woodland blocks, prior to the 1970s was in the 1944 Y.B.R. 'increase above Thornton Dale attributable to felling of plantations'. However, there is no doubt that Nightjars have been making use of forest sites since at least 1938, when six individuals and two nests were seen at Skelton Banks in Cropton Forest, followed by at least one nest in 1939 (J. Simpson, in F.C. Records). Nightjars certainly nested in the newly planted Broxa Forest in the 1940s and 1950s (F.C. staff *pers. comm.*) but no written records are known to exist. Between 1965 and 1968 Nightjars, including some nests, were found on forest sites at Harwood Dale, Pexton, Heckdale, Sutherland, Wardle Rigg, Blackpark, Bakers Warren and the Wykeham research plots (all in F.C. Records). Two pairs nested on the Wykeham research plots in 1973 (K. Gabriel *pers. comm.*).

Additional sites located in 1978 and 1979 during pilot work for the 1980 survey included Gale Hill, Cawthorne Moor (a heathland site), Crosscliffe, Middlehead and Sutherland.

There is an interesting footnote to the history of Nightjars in the North York Moors. Skelton Banks, where J. Simpson found nests in the young forest in 1938, were felled in 1982 as the forest had reached maturity. Following ploughing and replanting, Nightjars bred on the site in 1983 (P. and J. Ottaway *pers. comm.*).

### Survey Organization and Coverage

The first year (1980) of the survey was organized locally through personal contact and local natural history societies, whilst the second year (1981) was organized under the auspices of the British Trust for Ornithology. Over 50 volunteer observers participated in the surveys. Records were requested primarily by site and secondarily by 10 kilometre grid square. Extensive planning was undertaken, potentially suitable sites being identified prior to the survey using forest stock maps and air photos.

A locally designed record form was used in 1980, requesting site name, grid reference, area, altitude, soil, habitat, number of visits by month, breeding pairs assessed and other records assessed as not constituting breeding. All areas, altitudes, soil and habitat types were checked and standardized by the organizer. In 1981 the national survey card (Gribble, 1983) was used. Negative records were requested.

A good level of coverage, both geographically and by habitat type, was achieved in both years. Although it is certain that some Nightjars were missed, it is unlikely that a substantial part of the population was not located. Particular emphasis was given to improving coverage of the open ground habitat type in 1981, as it was felt that pockets of the species might have been missed in 1980 on this very extensive habitat. A feature of the survey which greatly enhances the value of the data gathered was the high proportion of negative records received. Out of a total of 113 sites for which cards were submitted, only 40 held Nightjars.

### Interpretation of Data

Interpretation of study data follows Gribble (1983). Gribble based numbers on presence of churring male Nightjars, which differs from the interpretation in Leslie (1981a), which attempted to enumerate pairs by excluding some records where Nightjars were observed only once near the beginning or end of the breeding season, and where no additional evidence of breeding such as the presence of a female was found.

For the purposes of this paper 1980 results have been re-analysed to conform with

Gribble (1983), and reference to Nightjars should be taken as referring to churring males unless otherwise specified. In practice, females were observed at a high proportion of sites, and the difference between numbers of calling males and actual pairs attempting to breed is not likely to be substantial.

Site area presents a problem, as its definition depends on the subjective assessment of how much of an area is suitable habitat for Nightjars. Areas varied from 1 to 200 hectares. Sites classified as 'open ground' tended to have the largest area, often over 100 ha, heathland sites were next largest, and forest sites the smallest, with over half under 20 ha in area.

It was possible to define habitat and environmental factors such as soil type more precisely than was the case in Gribble (1983). Observers' data from forest sites was checked and amplified, using Forestry Commission stock records. Altitude was obtained from Ordnance Survey 1:50,000 series sheets 93, 94, 100, 101 and soil type from the Soil Survey of England and Wales 1:100,000 sheet which covers the study area.

## Population and Distribution

Eighty-six potential Nightjar breeding sites were visited in 1980, and 81 sites in 1981. In 1980, 40 churring male Nightjars were found on 33 sites and in 1981, 46 were found on 25 sites. Only 16 sites held Nightjars in both years of the survey. From the available information it is not possible to establish whether any real change in population level occurred between 1980 and 1981.

Far more sites held several Nightjars in 1981 than in 1980. Out of 33 sites in 1980, 29 held single male Nightjars, two held two birds, and one site each held three and four. In 1981 only 12 sites out of 25 held single Nightjars, eight sites holding two, three holding three and one each holding four and five. Of the sites holding three or more Nightjars, making up 39.1% of the total population, there was only one, Silton Forest, where at least one Nightjar had not been found in 1980. Out of the 29 sites holding single Nightjars in 1980, 10 did not hold Nightjars in 1981, and five were not visited. The remaining 13 sites held one or more Nightjars in 1981. A total of six Nightjars was found in 1981 on sites not visited in 1980.

Table 2 shows the distribution of churring male Nightjars in the study area on a 10 km grid square basis. The population is concentrated in the extensive coniferous forests of the south-east quarter of the study area, in which 72.5 per cent of the population was located in 1980, and 76 per cent in 1981. Cropton and Dalby forests held most Nightjars, with a maximum of 11 in both years in the western 10 km square of Cropton, SE79. SE89, extending from Newtondale to Allerston High Moor and Crosscliffe, held second most in both years, although in 1980 all but one was in Cropton forest, whilst in 1981 four out of eight were in the Crosscliffe/Blakey section of Dalby forest.

Whilst Cropton forest was relatively well populated, the Dalby dales (SE88), in which extensive felling had provided much apparently suitable habitat, proved disappointing, with only one of the many dales holding three Nightjars in both years. Less area has been felled in Wykeham forest (SE98) and both there and in Broxa forest (SE99) young forest research plots held most of the Nightjars, totalling nine in 1981.

Although concentrated in the south-east quarter, only the north-east of the study area held very few Nightjars (one only in NZ80 in 1981). A small concentration was found north of Helmsley (SE58) in both years, whilst numbers down the western escarpment of the National Park (SE48, SE49) were surprisingly good, as there had been virtually no records from this area in recent decades. In 1981 three Nightjars were located in the north-east corner of Silton forest.

A small number of Nightjars was also found in the Cleveland section of the study area (NZ50, NZ60, NZ51), in particular the young Ingleby Forest.

## Habitat

Table 3 shows the habitat types on which Nightjars were recorded. Ninety per cent of all Nightjars were found in young, predominantly coniferous, forest in 1980, and 80.4 per cent in 1981. They were almost equally distributed between newly planted sites, those

TABLE 2

**Male Nightjars located in 1980 and 1981, based on 10 km grid squares.**

| 10 km square | | | No. of male Nightjars | |
|---|---|---|---|---|
| Number | Name | | 1980 | 1981 |
| SE 57 | Newburgh | (1) | 0 | 0 |
| SE 67 | Hovingham | (1) | 0 (2) | 0 (2) |
| SE 48 | Thirsk | (1) | 2 | 1 |
| SE 58 | Rievaulx | | 3 | 4 |
| SE 68 | Helmsley | (1) | 0 (2) | 0 (2) |
| SE 78 | Pickering | (1) | 0 | 0 |
| SE 88 | Dalby Forest | (1) | 4 | 3 |
| SE 98 | Wykeham | (1) | 5 | 6 |
| TA 08 | Scarborough | (1) | 0 (2) | 0 (2) |
| SE 49 | Osmotherley | (1) | 1 | 3 |
| SE 59 | Bilsdale | | 1 | 0 |
| SE 69 | Bransdale | | 0 | 0 |
| SE 79 | Cropton Forest | | 11 | 11 |
| SE 89 | Newtondale | | 6 | 8 |
| SE 99 | Langdale | | 3 | 7 |
| NZ 40 | Crathorne | (1) | 0 (2) | 0 (2) |
| NZ 50 | Broughton | (1) | 1 | 0 |
| NZ 60 | Castleton | | 2 | 2 |
| NZ 70 | Glaisdale | | 0 | 0 |
| NZ 80 | Grosmont | | 0 | 1 |
| NZ 90 | Robin Hood's Bay | | 0 (2) | 0 (2) |
| NZ 51 | Middlesbrough | (1) | 1 | 0 |
| NZ 61 | Guisborough | (1) | 0 | 0 (2) |
| NZ 71 | Loftus | (1) | 0 | 0 |
| NZ 81 | Whitby | (1) | 0 | 0 (2) |
| | Total | | 40 | 46 |

(1) Only part of 10 km square within study area.

(2) No visits made to 10 km square in the year.

where trees had been planted on previously bare land, and restocked sites, those where trees had been planted on clear-felled forest sites.

Tree cover on occupied forest sites ranged from felled forest not yet replanted to the point at which the canopy closes, about three metres top height. Age of trees varied greatly, several Nightjars being found on 'checked' patches of up to 15 years age, where tree growth has been arrested by heather competition. The largest number of Nightjars was found on recently planted sites with trees of between one and two metres in height.

Tree species planted on occupied sites included Sitka Spruce, Lodgepole Pine, Douglas Fir, Japanese Larch and Scots Pine, and the birds showed no obvious preference for a particular species. A majority of sites adjoined mature Scots Pine stands, through this being the most widely planted first rotation species. Ground cover ranged from bare soil or a dense cover of dead branches to bracken, grass, heather or heavy bramble.

Typical heathland, with heather and bracken ground cover and scattered Scots Pine and Birch trees, is relatively scarce in the study area. Both Nightjars in 1980, and four out of five in 1981 were found on sites in Cropton forest adjoining or surrounded by coniferous forest.

Although the majority of open ground sites surveyed were dales such as Bransdale or Rosedale, no Nightjars were found on extensive bracken or along the heather/bracken moorland fringe. One Nightjar was found in both years between Boltby and Thirlby, associated with arable land and small areas of bracken, and the other two, in 1981, were found on heather adjoining forest.

The one Nightjar found in semi-natural woodland was at Turkey Carpet, an area of well developed deciduous scrub with small clearings.

### Altitude

The sites surveyed ranged from 75 to 311 metres above sea level. The study area rises steeply from sea level, with little ground below 75 metres, whilst most land over 300 metres is open heather moorland. Occupied sites were found from 75 to 305 metres, with a mean of 207 metres. The mean of all sites surveyed was 196 metres, and a t test showed that there was not statistically significant difference between the altitude of occupied sites against all sites. The mean altitude of occupied sites in SE79, which held most Nightjars, was 195 metres.

TABLE 3

**Distribution of Nightjar by habitat type**

| | 1980 | | | 1981 | | |
|---|---|---|---|---|---|---|
| Habitat | All sites | Occupied sites | No. of Nightjars | All sites | Occupied sites | No. of Nightjars |
| Open ground | 11 | 1 | 1 | 17 | 3 | 3 |
| Heathland | 8 | 2 | 2 | 5 | 3 | 5 |
| Semi-natural woodland | 3 | 1 | 1 | 3 | 1 | 1 |
| Forest: | | | | | | |
| Conifer, new plantations | 30 | 15 | 16 | 29 | 10 | 18 |
| Conifer, restock | 32 | 13 | 19 | 26 | 8 | 19 |
| Forest: other | 2 | 1 | 1 | 1 | 0 | 0 |
| Forest: total | 64 | 29 | 36 | 56 | 18 | 37 |
| Overall total | 86 | 33 | 40 | 81 | 25 | 46 |

## Discussion

Gribble (1983) identifies the problem of young forest becoming unsuitable for Nightjars as they grow into the thicket stage, and suggests that they may have been numerous in the young plantings of the 1950s. In both the North York Moors (Leslie 1981, 1981a) and Thetford forest the 1970s saw the advent of large-scale felling and replanting of the earliest plantings, and the 1980s will see even larger areas felled and suitable for Nightjars. Staggered scheduling of felling in large forests means that they will not again go through a period when most trees are in the pole stage and thus unsuitable. The 1980/81 surveys provide a baseline against which it will be possible to measure the Nightjar's ability to exploit this newly available habitat; it is possible that the national decline of the species (Stafford 1962, Sharrock 1976, Gribble 1983) may be reversed locally.

The 1981 national figures on the altitudinal distribution of Nightjar sites (Gribble 1983) show that 68.9 per cent of sites were below 122 metres above sea level, suggesting a preference for lower ground. However, this survey indicates that altitude, within the relatively wide limits of the study area, has no identifiable influence on distribution of occupied sites. National figures appear to reflect simply the altitude of suitable habitat, and are particularly biased by numerous sites in Thetford Forest, an area which rarely rises to over 50 m. The lack of altitudinal effect on distribution is of particular interest in a species whose decline is often attributed to a cooling of the British climate, and which in the study area is near the northern limits of its range in Britain.

The Nightjar is generally associated with light, sandy soils (e.g. Sharrock 1976). However, in this study no preference for a particular soil type was established. The greatest number of Nightjars was found on wet, heavy gley soil, despite the availability of light, dryer podzols. It would appear likely that habitat is the main determinant of distribution, and that Nightjars are most often found on sandy soils simply because that is the soil type most likely to support suitable vegetation.

## Summary

This paper reports the results of a detailed survey of the Nightjar population of the North York Moors, carried out in 1980 and 1981. It concentrates on numbers and distribution of the species and discusses the present population, numbering 40 churring males in 1980 and 46 in 1981, in the context of available historical information for the region.

## Acknowledgements

The 1980 and 1981 surveys were very much a team effort, the success of which is attributable to over 50 volunteer observers. The Forestry Commission gave active support to the project, and the author would particularly wish to thank J. A. Spencer, A. M. Calder and Mrs D. A. Smith, and A. J. Wallis who collated the Nightjar records from Y.N.U. Yorkshire Bird Reports.

## References

Gribble, F. C. (1983) Nightjars in Britain and Ireland in 1981. *Bird Study* **30:** 165–176.

Leslie, R. (1981) *The North York Moors Nightjar Survey 1980 Report*. The Forestry Commission, Pickering.

Leslie, R. (1981a) Birds of the north-east England forests. *Qly J. Forestry* **75:** 153–158.

Medlicott, W. S. (1940) *The Natural History of Goathland Dale*. II. The birds: an ecological study 1923–1938. *North Western Nat.* March–June and September 1940.

Norris, C. A. (1960) The breeding distribution of thirty bird species in 1952. *Bird Study* **7:** 129–184.

North York Moors National Park Committee. (1977) *North York Moors National Park Plan*.

Sharrock, J. T. R. (1976) *The Atlas of Breeding Birds in Britain and Ireland*. B.T.O. and I.W.C.

Stafford, J. (1962) Nightjar enquiry 1957–58. *Bird Study* **9:** 104–115.

Yorkshire Naturalists' Union. (1940–1980) *Yorkshire Bird Report*, various editors.

# FRESHWATER MICROTURBELLARIA FROM THE ENGLISH LAKE DISTRICT, INCLUDING THREE SPECIES NEW TO BRITAIN

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Hitherto, the freshwater microturbellarian fauna of the English Lake District has not been investigated. In the present study, carried out in late July and early August 1984, a pond net, comprising a bag-net (23.6 meshes $cm^{-1}$) mounted on a square frame with a 1.5 m pole, was used to sweep through beds of aquatic vegetation in nine lakes and fourteen tarns, all of which are included in the four Outdoor Leisure Maps (1:25 000) of the English Lakes. Vegetation usually supports the greatest abundance and variety of microturbellarian species in lentic situations (Young, 1973). Full details for the collection, extraction and identification of Microturbellaria are given in Young (1970; 1972a, b).

## Results

Microturbellaria were obtained from all the 23 waterbodies sampled, with the exception of Three Dubbs Tarn. A total of 19 species was recorded of which three were new to Britain. These are listed together with the locations from which they were collected. The new British records are asterisked.

**Order Catenulida**

*Stenostomum anatirostrum* Marcus. Derwent Water.
*S. leucops* (Dugès). High Moss Tarn, Knipe Tarn, Stonehills Tarn, Crummock Water and Derwent Water.
*S. unicolor* Schmidt. Mockerkin Tarn.

**Order Macrostomida**

*Microstomum lineare* (Müll.). High Moss Tarn, Watendlath Tarn and Derwent Water.
*Macrostomum distinguendum* (Papi). Rydal Water.

**Order Lecithoepitheliata**

*Geocentrophora sphyrocephala* de Man. Crummock Water.

**Order Neorhabdocoela**

*Castrella truncata* (Abildgaard). High Moss Tarn.
**Gieysztoria expedita* (Hofsten). High Moss Tarn.
*G. infundibuliformis* Fuhrmann. Crummock Water.
*Microdalyellia armigera* (Schmidt). The Tarns (Tarn Hows).
*Castrada armata* (Fuhrmann). High Moss Tarn.
**C. stagnorum* Luther. High Moss Tarn.
*Bothromesostoma personatum* (Schmidt). High Moss Tarn, Kentmere Tarn, Moss Eccles Tarn, The Tarns (Tarn Hows), Wise Een Tarn, Wray Mires Tarn and Esthwaite.
*Mesostoma lingua* (Abildgaard). High Moss Tarn, Knipe Tarn, Moss Eccles Tarn, Stonehills Tarn, The Tarns (Tarn Hows), Watendlath Tarn, Wise Een Tarn, Wray Mires Tarn, Grasmere, Elter Water and Esthwaite.
**Olisthanella truncula* (Schmidt). The Tarn (Tarn Hows).
*Rhynchomesostoma rostratum* (Müll.). High Moss Tarn and The Tarns (Tarn Hows).
*Strongylostoma radiatum* (Müll.). The Tarns (Tarn Hows).
*Gyratrix hermaphroditus* Ehrenberg. Blea Tarn, High Moss Tarn, The Tarns (Tarn Hows), Watendlath Tarn, Bassenthwaite, Buttermere, Crummock Water and Derwent Water.
*Opisthocystis goettei* (Bresslau). High Moss Tarn, Stonehills Tarn and Crummock Water.

The three species which are new to Britain have a wide distribution in Europe. *Gieysztoria expedita* is fully described and illustrated in Luther (1955) and *Castrada stagnorum* and *Olisthanella truncula* in Luther (1963). It should be noted that *Stenostomum anatirostrum* is now regarded as a synonym of *S. bryophilum* (see Kolasa & Young, 1974), which has been recorded earlier in Britain (Young, 1970), and that no attempt was made to split the *S. leucops* recorded in the present study into the several species suggested by Borkott (1970).

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REFERENCES

Borkott, H. (1970) Geschlechtliche Organisation, Fortpflanzungsverhalten und Ursachen der sexuellen Vermehrung von *Stenostomum sthenum* nov. spec. (Turb., Catenulida). Mit Beschreibung von 3 neuen *Stenostomum*-Arten. *Z. Morphol. Tiere* **67**: 183–262.

Kolasa, J. and Young, J. O. (1974) Studies on the genus *Stenostomum* O. Schmidt (Turbellaria; Catenulida). 1. The status of *S. anatirostrum* Marcus 1945 and *S. bryophilum* Luther 1960. *Freshwat. Biol.* **4**: 149–156.

Luther, A. (1955) Die Dalyelliiden (Turbellaria Neorhabdocoela). Eine Monographie. *Acta Zool. Fenn.* **87**: 1–337.

Luther, A. (1963) Die Turbellarian Ostfennoskandiens. IV. Neorhabdocoela. 2. Typhloplanoida: Typhloplanidae, Solenopharyngidae und Carcharodopharyngidae. *Fauna fennica* **16**: 1–163.

Young, J. O. (1970) British and Irish freshwater Microturbellaria: historical records, new records and a key for their identification. *Arch. Hydrobiol.* **67**: 210–241.

Young, J. O. (1972a) Further studies on the occurrence of freshwater Microturbellaria in the British Isles. 1. A description of *Macrostomum johni* sp. nov. *Freshwat. Biol.* **2**: 253–258.

Young, J. O. (1972b) Further studies on the occurrence of freshwater Microturbellaria in the British Isles. II. New records and an emendation to the existing key for the group. *Freshwat. Biol.* **2**: 355–359.

Young, J. O. (1973) The occurrence of Microturbellaria in some British lakes of diverse chemical content. *Arch. Hydrobiol.* **72**: 202–224.

## BOOK REVIEWS

**Britain's Railway Vegetation** by **Caroline Sargent**. Pp. iv + 34, including diagrams, maps and tables, plus 8 pages of colour plates. £3.50; **Moorland Management: A Study of Exmoor** by **G. R. Miller**, **J. Miles** and **O. W. Heal**. Pp. iv + 118, including diagrams and tables, plus 6 pages b/w photographs. £4.50; **Metals in Animals** edited by **D. Osborn**. Pp. 77, including b/w plates, diagrams and tables. ITE Symposium no. 12. £3.50; **Ecology in the 80s** edited by **J. N. R. Jeffers**. Pp. iv + 44. £1.60. All paperback and published by Institute of Terrestrial Ecology, Natural Environment Research Council in 1984.

A selection of the numerous useful titles published each year by one of our major research bodies, some wide ranging and others more selective in their appeal. The Institute's publications include both monographs and collections of papers on a topic, the latter tending to be more variable in quality and style, and often lacking a broadly-based approach to the subject. Naturalists, biologists, etc. would find it well worth their while to acquaint themselves with the full range of titles available and should watch out for ITE's forthcoming publications.

# THE HELMINTH PARASITES OF THE EUROPEAN EEL, *ANGUILLA ANGUILLA* (L.) FROM THE DRIFFIELD CANAL, NORTH HUMBERSIDE

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## Introduction

Despite its widespread and common occurrence, and its commercial value as a food fish, there have been few helminthological studies of European eels, *Anguilla anguilla* (L.), from freshwater habitats in the British Isles. The main published studies on the helminth parasites of freshwater eels have been made in the western parts of England and Wales (Chubb 1963, 1964, Kennedy & Lord 1982, Rawson 1952), and a number of other studies made in Mid- and North Wales remain largely unpublished (Jeacock 1969, Powell 1966, Thomas 1954). As far as we are aware there are no published studies on the helminth parasites of eels in eastern England north of the River Humber.

## Materials and Methods

A sample of yellow eels was obtained for us by Mr C. Firth, Yorkshire Water Authority, by electrofishing the Driffield Canal at Wansford, North Humberside, on 1 July 1980. The eels were taken to the laboratory, killed with benzocaine and rapidly frozen to −20°C. They were kept in individual containers at this temperature until required.

After thawing, the body mucus was removed by washing and records made of the body length and weight, and the girth just behind the vent. The external surfaces of the body, the eyes, nostrils, gill chambers and gills, mouth, buccal cavity, and vent were examined for helminth parasites and signs of disease. The body was cut open ventrally from mouth to vent to allow removal of the entire alimentary tract, and this was then separated into oesophagus, stomach and intestine. To facilitate examination the intestine was cut into four pieces of equal length. Each piece of the gut was opened longitudinally and the mucosal surface and contents examined using a stereo-binocular microscope. The number of helminth parasites and the sites they occupied were recorded before the parasites were removed for storage and subsequent preparation. Eels were considered to be female if they possessed a ribbon-like organ and male if they had a lobulate organ.

## Results

Twenty-six yellow eels were available for examination and comprised four males, fourteen females and eight of indeterminate sex. Males measured 0.25–0.37 m (mean ± S.E. 0.31 ± 0.033 m) in length and weighed 25.4–97.5 g (mean 60.3 ± 19.3 g). Comparable figures for female eels were 0.31–0.41 m (mean 0.36 ± 0.008 m) in length and 52.5–131.6 g (mean 83.5 ± 6.11 g) in weight, while eels of indeterminate sex were 0.27–0.36 m (mean 0.32 ± 0.013 m) long and weighed 29.4–98.7 g (mean 60.3 ± 9.46 g). All the eels were in good condition and no external signs of disease were seen.

No helminth parasites were found on the skin, or in the eyes, orbits, nostrils, gill chambers, or on the gills. No helminth parasites were found in the oesophagus or stomach but four species were found in the intestine, namely:

Phylum Platyhelminthes
  Class Cestoda
    Order Pseudophyllidea
      Family Bothriocephalidae
          *Bothriocephalus claviceps* (Goeze, 1782)

Phylum Aschelminthes
  Class Nematoda
    Order Ascaridida
      Superfamily Ascaridoidea
        Family Heterocheilidae
          *Raphidascaris acus* (Bloch, 1779)
      Superfamily Seuratoidea
        Family Quimperidae
          *Paraquimperia tenerrima* (von Linstow, 1878)
Phylum Acanthocephala
  Class and Order Palaeacanthocephala
    Family Echinorhynchidae
          *Acanthocephalus clavula* (Dujardin, 1845)

The prevalence and intensity of infection with these four species are given in Table 1. All 26 eels were infected with *A. clavula*; indeed, this was the only helminth species found in nine eels. Fifteen eels had concurrent infections with two species of helminth parasite; of these eels eight harboured *A. clavula* and *R. acus*, four carried *A. clavula* and *B. claviceps*, and three carried *A. clavula* and *P. tenerrima*. Two eels were infected concurrently with three species of helminth parasite. They comprised a male eel which was infected with 23 *A. clavula*, three *R. acus* and two *B. claviceps*, and a female which carried 13 *A. clavula*, two *R. acus* and one *P. tenerrima*.

No statistically significant patterns of infection distinguished male from female eels nor were any associated with the body size or weight of the host. However, the eight eels of indeterminate sex carried a lighter worm burden than either male or female eels, and five of them were infected with *A. clavula* only.

A total of 491 specimens of *A. clavula* was found in the sample of 26 eels, of which 324 were females and 167 males thus giving a sex ratio of 1.9:1. The frequency distribution of numbers of *A. clavula* in individual eels was characterized by a number of eels harbouring large numbers of *A. clavula*. For instance, the largest number found in a single eel was 145 while three eels harboured between 30 and 40 *A. clavula*, and four harboured between 20 and 29. On the other hand, 12 eels harboured less than 10 *A. clavula* each. The ratio of the variance to the arithmetic mean of the counts was very highly significantly ($P < 0.001$) greater than that expected for a random frequency distribution, thus suggesting a contagious distribution. A number of mathematical models have been used to describe contagious frequency distributions, perhaps the most often employed being the negative binomial and the logarithmic. In the present case, however, the small size of the sample and the very large outlying value mentioned above do not allow a reliable prediction to be made against which to test the observed distribution.

In the present sample of eels the arithmetic mean number of *A. clavula* for all eels was $18.9 \pm 5.52$, while for male eels it was $18.0 \pm 4.98$, for females $24.1 \pm 9.85$ and for eels of indeterminate sex it was $10.3 \pm 3.99$. However, the arithmetic mean is sensitive to large outlying values such as occur in the present sample. Under such circumstances the geometric mean may be a more meaningful statistic for purposes of comparison. Thus the corresponding values of the geometric means were: 9.4 for the entire sample; 15.1 for *A. clavula* in male eels, 11.3 for females and 5.4 for *A. clavula* in eels of indeterminate sex. Though the observed differences in intensity of infection among these three groups, i.e. males, females and eels of indeterminate sex, may have an underlying biological cause, a Kruskal-Wallis analysis of variance of ranks showed that the differences among intensities were not significant at the 0.05 level of probability.

The distribution of specimens of *A. clavula* in the intestine of *A. anguilla* is summarized in Table 2. It was noticeable that both gravid and non-gravid female *A. clavula* were concentrated in the third quarter of the intestine while male worms were most numerous in the second quarter. A comparison of the numbers of male and female worms in the second and third quarters of the intestine showed that the difference between the sexes in this respect was very highly significant ($P < 0.001$).

TABLE 1

**The prevalence and intensity of infection of helminth parasites in 26 freshwater eels, *Anguilla anguilla* (L.), from the Driffield Canal, North Humberside, in July 1980**

| species of parasite | prevalence of infection: no. inf. | prevalence of infection: % inf. | intensity of infection: range | intensity of infection: arithmetic mean ± S.E. |
|---|---|---|---|---|
| *Bothriocephalus claviceps* | 5 | 19 | 1–3 | 2.0 ± 0.32 |
| *Raphidascaris acus* | 10 | 38 | 1–8 | 2.8 ± 0.69 |
| *Paraquimperia tenerrima* | 4 | 15 | 1–2 | 1.8 ± 0.25 |
| *Acanthocephalus clavula* | 26 | 100 | 1–145 | 18.9 ± 5.52* |

* the frequency distribution of *A. clavula* in the sample of eels was contagious and the geometric mean number of *A. clavula* per eel was 9.4

TABLE 2

**The distribution of *Acanthocephalus clavula* in the intestine of *Anguilla anguilla* from the Driffield Canal**

| reproductive condition of *A. clavula* | number of *A. clavula* in intestine (% distance along intestine) 0–25 | 26–50 | 51–75 | 76–100 | total | mean % position in intestine* |
|---|---|---|---|---|---|---|
| male, mature | 31 | 71 | 40 | 25 | 167 | 47.3 |
| female, lacking shelled acanthors | 3 | 46 | 92 | 16 | 157 | 57.8 |
| female with shelled acanthors | 3 | 36 | 102 | 26 | 167 | 61.1 |
| all females | 6 | 82 | 194 | 42 | 324 | 59.5 |

* derived from the grouped data in this table

The tapeworm *B. claviceps* occurred throughout the intestine but was concentrated in the third quarter where five of the 10 worms were found. The preferred site of occupation of the nematode *R. acus* was the first quarter of the intestine where 13 of the 27 specimens were located, whereas only one specimen was found in the last quarter. Two specimens of *P. tenerrima* were found in the second quarter of the intestine, four in the third, and one specimen in the fourth quarter of the intestine.

No gross pathological changes in the intestinal mucosa were associated with the presence of *R. acus*, *P. tenerrima* or *B. claviceps*, but the site of attachment of specimens of *A. clavula* was marked by a small inflammatory nodule.

## Discussion

Driffield Canal is a slow-flowing body of fresh water supporting a rich and varied flora and fauna in which eels are common (Pearson 1974). In such a well-established eutrophic habitat at the height of summer one might expect the parasite fauna of eels to be at its most varied and abundant. Yet only four species of helminth parasites were found in the 26 eels examined, and of these only one species, namely *Acanthocephalus clavula*, had a high prevalence and moderately high intensity and was regarded as abundant (Table 1). The other three species found had moderate levels of prevalence and low intensities, and though common were not considered to be abundant in Driffield Canal eels.

Many of the records of parasites from freshwater eels in Britain and Ireland have been listed by Kennedy (1974). Study of the original accounts of these records together with other literature showed that the adults of about 18 species of helminth parasites have been found in the European eel in freshwater habitats in the British Isles. The most detailed studies are those of Chubb (1961, 1963, 1964) and Powell (1966) on lake eels, and by Chubb (1961), Kennedy and Lord (1982) and Thomas (1954) on river eels. From an examination of the literature and the present study it seems likely that *B. claviceps*, *R. acus*, *P. tenerrima* and *A. clavula* are characteristic and widespread parasites of the freshwater eel throughout England, Wales and Ireland, while information on their occurrence in eels in Scotland is lacking. The prevalence and intensity of these species in freshwater eels varies from place to place, but in comparison with the results of the above-mentioned studies the levels of infection with helminth parasites are relatively high in Driffield Canal eels.

The intensity of infection of eels with the tapeworm *B. claviceps* was found to be low in the present study, thus agreeing with the observations of Chubb (1961, 1963), Powell (1966) and Thomas (1954); usually only two or three worms being present though the prevalence was generally about 19 per cent. *Bothriocephalus claviceps* has been reported from several other species of freshwater fish (Kennedy 1974) but the eel seems to be the most usual host in British fresh waters.

The nematode *R. acus* has been recorded from a wide range of species of predatory fish (Kennedy 1974), and infections are acquired by the eel eating cyprinid and other fish, or species of oligochaetes or aquatic insect larvae, that harbour the infective larva of *R. acus* (Chubb 1982). The intensity of infection with *R. acus* was usually less than 10. *Paraquimperia tenerrima* is usually restricted to the eel, though Thomas (1954) recorded an infection by this species in brown trout, *Salmo trutta*, from the Afon Teifi. As with *R. acus*, the intensity of infection of Driffield Canal eels with *P. tenerrima* was low.

*Acanthocephalus clavula* has been reported from a number of species of British freshwater fish (Kennedy 1974), but, as with *B. claviceps*, was most frequent in eels. The prevalence of *A. clavula* in eels varies widely geographically but apparently not seasonally under British conditions. The overall ratio of female to male *A. clavula* in the sample of 491 worms examined in the present study was 1.9:1, which is close to the ratio of 1.6:1 found among 488 *A. clavula* by Kennedy and Lord (1982). The frequency distribution of *A. clavula* in the present sample of eels was contagious, but because of the relatively small size of the sample of eels it was not feasible to fit the observed distribution to a given theoretical model. Contagious frequency distributions of animal parasites on, or in, their hosts appear to be the rule rather than the exception, and it seems unlikely, therefore, that any single factor is responsible for this type of distribution.

The significantly more anterior position in the intestine of male compared to female *A. clavula* that was found in the present study (Table 2) agreed well with the distribution of this species described by Kennedy and Lord (1982). These authors gave the mean position of *A. clavula* as a percentage of the distance from the beginning of the oesophagus (0 per cent) to the anus (100 per cent), and regarded the intestine as starting at the 11 per cent point. On the other hand, we considered the start of the intestine as 0 per cent and the anus as 100 per cent, and thus the mean positions given by Kennedy and Lord (1982) and ourselves are not directly comparable without adjustment. In passing, it is worth noting that our measurements showed that the oesophagus and stomach together amounted to about 30 per cent of the length of the entire alimentary tract, not 10 per cent as reported by Kennedy and Lord (1982). However, we have converted their data to the same scale we have used, i.e. 0 per cent at the start of the intestine and 100 per cent at the anus. Their mean percentage position for 188 male *A. clavula* is then 52.5 compared to our value of 47.3 for 167 males, while for 300 female worms Kennedy and Lord (1982) gave the mean percentage position as 58.1 compared with 59.5 for 324 females in the present study. It is not known why, in general, male *A. clavula* occupied sites in the intestine anterior to female worms, nor why non-gravid females tended to be found anterior to gravid females.

The life cycles of *B. claviceps*, *R. acus* and *A. clavula* involve the development of an infective larva in a specific intermediate host, while the life cycle of *P. tenerrima* may be direct (Chubb 1982). In any case, ingestion by the eel of an infective stage is necessary before development of the parasite can continue. Thus, any factor that affects the predatory feeding habits of the eel, for instance the cessation of feeding in low water-temperatures during winter or the idiosyncratic dietary preferences of individual eels, or that bears upon the availability of intermediate hosts and infective stages will ultimately influence the likelihood of the eel acquiring an infection. It is known that the specific intermediate hosts of *B. claviceps* (copepods), *R. acus* (aquatic insect larvae, oligochaetes, cyprinid and other fish), and *A. clavula* (the amphipod *Asellus meridianus*) are abundant in the Driffield Canal (Pearson 1974), but as yet no observations have been made on the occurrence of the infective larval stages in the Driffield Canal.

The absence of infection of eels in the Driffield Canal with species of Monogenea and Digenea is worthy of comment. As far as we are aware, there are no published records of Monogenea on European eels in British and Irish waters. Indeed, only one species of monogenean, namely *Gyrodactylus anguillae* Ergens, 1960, is known to occur on this species of fish and the records of its presence on freshwater eels are infrequent, but extend across Europe from Sweden to Albania, and also to Israel.

In view of the variety of freshwater habitats in the British Isles in which eels are found and considering also the wide range of food items taken by eels, it is surprising that infections of these fish with adult Digenea are rare. We are aware of only four published records in the British Isles, namely of *Sphaerostoma bramae* (Müller), which is usually a parasite of cyprinid fish, by Pike (1967), Lacey *et al.* (1982) and Conneely and McCarthy (1984), and of *Crepidostomum farionis* (Müller) and *C. metoecus* (Braun) in the intestine of one of 243 eels from the Afon Teifi by Thomas (1958). However, this author suggested that the presence of *C. farionis* and *C. metoecus* in this host was 'accidental' and had been acquired by the eel eating a salmonid fish itself naturally infected with these digeneans.

## Summary

Four species of helminth parasites were found in the intestine of 26 freshwater European eels, *Anguilla anguilla*, from the Driffield Canal, North Humberside in July 1980. The acanthocephalan *Acanthocephalus clavula* was found in all the eels, the intensity of infection ranged from 1–145 with an arithmetic mean of 18.9± 5.52. The frequency distribution of numbers of *A. clavula* in eels was contagious. The mean percentage position along the intestine of male *A. clavula* was 47.3, and was 59.5 for females. Ten eels were infected with the nematode *Raphidascaris acus*, five with the cestode *Bothrio-*

*cephalus claviceps* and four with the nematode *Paraquimperia tenerrima*. The mean intensity of infection with these three species was 2.8, 2.0 and 1.8 respectively. All the eels were in good condition and the only pathological lesions seen were mild inflammatory reactions at the site of attachment of *A. clavula*.

ACKNOWLEDGEMENT

We wish to thank Mr C. Firth, Yorkshire Water Authority, for invaluable help in obtaining the sample of eels used in the present study.

REFERENCES

Chubb, J. C. (1961) A preliminary investigation of the parasite fauna of the fish of Llyn Tegid (Bala Lake), Merionethshire. Ph.D. thesis, University of Liverpool.

Chubb, J. C. (1963) On the characterization of the parasite fauna of the fish of Llyn Tegid. *Proc. zool. Soc. Lond.* **141**: 609–621.

Chubb, J. C. (1964) Occurrence of *Echinorhynchus clavula* (Dujardin, 1845) nec Hamann, 1892 (Acanthocephala) in the Fish of Llyn Tegid (Bala Lake), Merionethshire, *J. Parasit.* **50**: 52–59.

Chubb, J. C. (1982) Seasonal Occurrence of Helminths in Freshwater Fishes. Part IV. Adult Cestoda, Nematoda and Acanthocephala. In: *Advances in Parasitology* (W. H. R. Lumsden, R. Muller and J. R. Baker, eds.) **20**: 1–292. Academic Press, London.

Conneely, J. J. and McCarthy, T. K. (1984) The metazoan parasites of freshwater fishes in the Corrib catchment area, Ireland. *J. Fish Biol.* **24**: 363–375.

Jeacock, A. (1969) The parasites of the eel, *Anguilla anguilla* (L.). *Parasitology* **59**: 16P (Abstract).

Kennedy, C. R. (1974) A checklist of British and Irish freshwater fish parasites with notes on their distribution. *J. Fish Biol.* **6**: 613–644.

Kennedy, C. R. and Lord, D. (1982) Habitat specificity of the acanthocephalan *Acanthocephalus clavula* (Dujardin, 1845) in eels *Anguilla anguilla* (L.). *J. Helminth.* **56**: 121–129.

Lacey, S. M., Williams, I. C. and Carpenter, A. C. (1982) A note on the occurrence of the digenetic trematode *Sphaerostoma bramae* (Müller) in the intestine of the European eel, *Anguilla anguilla* (L.). *J. Fish Biol.* **20**: 593–596.

Pearson, R. G. (1974) A study of the macro-invertebrate fauna of the River Hull. Ph.D. thesis, University of Hull.

Pike, A. W. (1967) Some stylet cercariae and a microphallid type in British freshwater molluscs. *Parasitology* **57**: 729–754.

Powell, A. M. (1966) A preliminary investigation of the biology and parasite fauna of the charr (*Salvelinus alpinus perisii*). Ph.D. thesis, University of Liverpool.

Rawson, D. (1952) The occurrence of parasitic worms in British freshwater fishes. *Ann. Mag. nat. Hist.*, ser. 12, **5**: 877–887.

Thomas, J. D. (1954) The food, growth and helminth parasites of trout (*Salmo trutta* L.) from four contrasted habitats with similar observations on the salmon parr (*Salmo salar* L.) and eels (*Anguilla anguilla* (L.)). Ph.D. thesis, University of Wales.

Thomas, J. D. (1958) Studies on *Crepidostomum metoecus* (Braun) and *C. farionis* (Müller), parasitic in *Salmo trutta* L. and *S. salar* L. in Britain. *Parasitology* **48**: 336–352.

## CORRECTION

Rappé, G. (1984) An unrecorded 19th-century capture of *Echinorhinus brucus* (*Naturalist* **109**); please note that the date printed as '29 January 1983' on page 113, line 19 should read '29 January 1893'.

## AUTUMN FUNGUS FORAY
## Leeds, 16–18 September, 1982

T F. HERING

This Foray departed from our usual pattern, and comprised a weekend course, run by Dr R. Watling, and aimed particularly at members of local societies. More than 40 people attended, and found good collecting conditions. As well as many commoner fungi, a number of species new to Yorkshire were found. At Otley Chevin, the sawdust heap produced a great wealth of fruit-bodies, especially *Mutinus caninus* and an unfamiliar pleurotoid fungus that turned out to be *Hohenbuehlia geogenia*.

O = Otley Chevin, SE/388389; S = Saw Wood, SE/221447; * = new record for Yorkshire.

I am indebted to Dr R. Watling and Mr B. Ing for most of the list below.

MYXOMYCETES

*Amaurochaete atra* O
*Arcyria pomiformis* S
*Cribraria cancellata* O
*C. piriformis* O
*Didymium nigripes* O
*Mucilago crustacea* O

BASIDIOMYCETES

Heterobasidiomycetes

*Calocera pallidospathulata* O S
*Sebacina incrustans* S

Aphyllophorales

*Clavulina cinerea* O S
*Clavulinopsis fusiformis* O S
*Fistulina hepatica* S
*Hydnum repandum* S

Agaricales

*Amanita inaurata* O S
*Armillaria bulbosa** S
*A. ostoyae* O
*Bolbitius reticulatus* O
*Boletus lanatus* O
*Clitocybe odora* S
*Collybia cirrhata* S
*Cortinarius lepidopus* O
*C. tabularis* O
*Hebeloma sacchariolens* S
*Hohenbuehlia geogenia* O
*Hygrocybe marchii* O
*Lactarius piperatus* O
*L. pubescens* O
*Leccinum variicolor* S
*Lyophyllum leucophaeatum* O
*Macrocystidia cucumis* S
*Naucoria bohemica* O
*Oudemansiella radicata* S
(Albino form; also a form with brown-edged gills)
*Pluteus olivaceus** O
*P. pellitus* S
*P. petasatus* O
*P. umbrosus* S
*P. xanthophaeus** O
*Psilocybe cyanescens** S
*Russula ionochlora** S
*R. nitida* O
*R. sororia* S
*R. subfoetens* S

## SPRING FUNGUS FORAY
## Low Row, Swaledale, 5–9 May 1983

T. F. HERING

This was apparently the first fungus foray ever held by the YNU in Upper Swaledale. Twelve people attended, and the makeshift workroom at our headquarters at Peat Head Gate was crowded, but not uncomfortably so. The local woodlands were all small, and although they did not yield long lists of finds, the proportion of unfamiliar fungi was high. There were a number of new records for Yorkshire, a totally new species of *Omphalina*, and also a second find of *Unguicularia winteriana*, previously collected in the county in 1893.

For most of the lists below I am indebted to Dr R. Watling and to Mr M. C. Clark, who contributed a very valuable list of Discomycetes.

List of sites: B = Barney Beck, SE/008993; K = Kidston Force, NY/900010; L = vicinity of Low Row, SD/990987; S = Stainton Woods, SE/095976; SS = Scar Spring Wood, SE/092974; U = Upper Swaledale, NY/877016; * = new to Yorkshire.

Myxomycetes
- *Enerthenema papillatum* B
- *Perichaena vermicularis* S
- *Trichia scabra* S

Ascomycetes
- *Acrospermum compressum* K
- *Anthracobia maurilabra* S
- *Cheilymenia fimicola** B
- *C. raripila* SS
- *Cordyceps sphaerocephala** B
- *Cyathicula striata** U
- *C. turbinata* S, K
- *Dasyscyphus bicolor* var. *rubi* K
- *D. clandestinus* S, K
- *D. clavigerus** S
- *D. dumorum* L
- *Godronia uberiformis* K
- *Heterosphaeria patella* S
- *Hyaloscypha velenovskyi* B
- *Hymenoscyphus rhodoleucus* K
- *H. vernus** B, K
- *Inermisia fusispora** B
- *Leptosphaeria canescens** B
- *Mitrophora hybrida* L
- *Mollisia millegrana* S
- *M. mutabilis** SS
- *M. urticicola** B, K, S
- *Naevia minutissima* B, S
- *Orbilia comma* K
- *O. leucostigma* K
- *Peziza ampliata* B
- *P. repanda* L
- *Pezizella amenti* SS
- *Pirottaea veneta* S
- *Psilachnum inquilinum* K
- *Pyrenopeziza digitalina* U
- *P. escharodes* L
- *P. lychnidis* B
- *P. petiolaris* B
- *P. plantaginis* S
- *P. rubi* SS
- *Tapesia lividofusca* S
- *Trochila craterium* B
- *Unguicularia winteriana* K

Basidiomycetes
- *Coprinus tuberosus** SS
- *Coriolus hirsutus* K
- *Entoloma sericea* var. *nolaniiformis* B
- *Mycena rubromarginata* B
- *Omphalina fuscopallens* Orton (new species) K
- *Peniophora lycii* S
- *Radulomyces confluens* S
- *Sebacina effusa* S

## HYBRID WILLOWS

EILEEN BRAY

In recent years (1979–1984) I have paid particular attention to willows and willow hybrids and those hybrids noted during botanical outings in Yorkshire are listed below. All identifications have been checked by either the late Brenda Howitt or R. C. Leaver Howitt or by R. Desmond Meikle, author of the B.S.B.I. Handbook *Willows and Poplars of Great Britain and Ireland* (1984). I have included their comments on some of the gatherings, together with any observations of my own which I consider relevant and also some extracts from the *Supplement to the Yorkshire Floras* (1941) which refer to the same hybrids. Entries marked with an asterisk are all hybrids additional to those listed in the *Supplement.*

**S. alba × pentandra = S. × ehrhartiana* Sm. ♂ (61) 44/7467 By the R. Dee about a mile above Kirkham. 'A rare hybrid' R.C.H.

*S. alba × fragilis = S. × rubens* Schrank ♂ (61) 44/6049 Fulford Ings, York. 'An interesting tree as it is nearer *S. fragilis*, usually this hybrid is nearer *S. alba*' B.H. Such a tree exists at the Naburn sewerage works. Lees states that this hybrid 'is not uncommon', but he gives no localities.

**S. babylonica × fragilis = S. × pendulina* Wenderoth ♀ (61) 44/6638 Skipwith Common. 'A very variable hybrid coming from many different clones' R.C.H. Has long pendulous branches.

*S. triandia* × *viminalis* = *S. mollissima* Hoffm. ex Elwert ♀ (61) 44/6049 Fulford Ings, York. 'Fairly frequent about London and Home Counties; not often seen in Northern England' R.D.M. Included by Lees in the *Supplement*, but without localities.

*S. purpurea* × *viminalis* = *S. rubra* Huds.♀ (61) 44/6049 Fulford Ings, York. Resembles *S. viminalis* but leaves greenish on underside; a frequent hybrid.

*S. caprea* × *viminalis* = *S.* × *sericans* Tausch ex A. Kerner ♂ (61) 44/6148 Gemeny Beck, Fulford. 'Used for coarse basket work in former times' R.D.M.

**S. caprea* × *cinerea* = *S.* × *reichardtii* A. Kerner ♂ (61) 44/8340 Disused railway line, Harswell. Have seen this willow in four different stations and each one differs considerably from the others.

**S. cinerea* × *purpurea* = *S. sordida* A. Kerner ♀ (64) 44/5138 Ulleskelf Mires. 'It is either a rare hybrid or more probably overlooked' R.C.H. A very old and broken down tree.

*S. cinerea* × *purpurea* × *viminalis* = *S.* × *forbyana* Sm. ♀ (64) 44/4841 Seavy Carr Wood, Stutton near Tadcaster. 'It is generally an introduction having in the past been used for basket making; almost always female' R.D.M.

*S. cinerea* × *viminalis* = *S.* × *smithiana* Willd. ♀ (61) 44/5947 Naburn Ings. 'An uncommon hybrid in my experience or probably overlooked' R.D.M. The Naburn plant has large conspicuous female catkins. Lees says 'frequent in coppices, hedges and willow garths'.

*S. cinerea* × *myrsinifolia* = *S.* × *strepida* Forbes (62) 44/5784 Ashberry Pastures, Rievaulx. The leaves blacken on drying. Cited for North Yorkshire in Linton's *British Willows* (1913).

**S. aurita* × *viminalis* = *S.* × *fruticosa* Doell (64) 44/3560 Scriven Gravel Pits, near Knaresborough. 'An unusual hybrid or overlooked' R.C.H.

*S. aurita* × *cinerea* = *S.* × *multinervis* Doell ♂ (61) 44/6537 Skipwith Common. A very common and widespread hybrid.

*S. aurita* × *repens* = *S.* × *ambigua* Ehrh. ♀ (61) 44/6537 Skipwith Common. 'Not a very common hybrid as *S. repens* flowers rather later than *S. aurita*' B.H. Recorded from here in Lees' *Flora of West Yorkshire* (1888).

## BOOK REVIEWS

**Systems Ecology: An Introduction to Ecological Modelling** by **R. L. Kitching**. Pp. xx + 275, including numerous figures. University of Queensland Press. 1983.

Thoroughly recommended for anyone who thinks that they should know something about ecological modelling but doesn't know where to start. Dr Kitching starts at the beginning and gradually educates his reader in the systems approach. Computing and mathematics are introduced as the indispensable tools of the systems ecologist and not as ends in themselves. The application of the systems approach to populations, ecological processes and communities is carefully considered and clearly illustrated by well chosen examples from the relevant literature. Finally, in a chapter entitled 'Prospects and Pitfalls', attention is drawn to the strengths and weaknesses of the systems approach and sound advice is given to those who feel that the book has given them the confidence to try their hand at modelling. Dr Kitching does not make heavy demands on the reader's mathematical ability, which will undoubtedly be a great relief to many potential readers. I have just one criticism of an otherwise splendid book: there are a great many typographical errors in it, which in many cases are merely mildly irritating and easily identifiable for what they are. In a number of cases however they alter the sense of the text. Inadequate proof reading at some stage is obviously responsible, but problems of this type can undermine the reader's confidence in the author, which in this case would be totally unjustified. Undergraduate and postgraduate courses in ecology should all include the material contained in this book and they could do far worse than give it required reading status.

JEPC

**Guide to Standard Floras of the World** by **D. G. Frodin**. Pp. xx + 619. Cambridge University Press. 1984. £95.00.

An important analytical bibliography of the vascular plant floras, which evaluates the major published sources, arranged on a geographical basis, superregion, region and country level. As will be appreciated, the scope is so wide that only a selected handful of titles can be given for each area covered, but the strengths and weaknesses of those works included are critically considered in terms of their taxonomic and geographical coverage. Furthermore, detailed references to other bibliographies are provided in many instances, thus extending the scope of this work. Information is also given in the main body of the text on the history, development and current state of knowledge for the areas under study.

Introductory chapters provide valuable information on such topics as definitions, styles, rationale, progress and prospects of floras in general; appendices list major general bibliographies, etc. and abbreviations of titles cited. The whole is complemented by detailed and comprehensive geographical and author indexes.

As this is a very expensive book and therefore unlikely to be bought by many individuals, botanists should, in their own interests, recommend this work most strongly for purchase by their local reference libraries as an essential and invaluable resource.

MRDS

**Flowering Plants of Wales** by **R. G. Ellis**. Pp. x + 338, including b/w plates and numerous maps, plus frontispiece coloured map. National Museum of Wales, Cardiff. 1983. £12.00 (£13.80 with postage).

The large number of taxa (2784) covered in this book include not only native and naturalized species, but also casuals and introductions, together with subspecies, hybrids, and even many micro-species of *Rubus*, *Taraxacum* and *Hieracium*, recorded from a relatively large area. This necessarily resulted in concise treatment: nevertheless, this book packs an amazing amount of information between its covers; each entry in the catalogue gives Latin (including synonyms), Welsh and English names, followed by details of status, habitats, flowering period and vice-county distribution.

In a separate section, distribution maps are provided for 1028 taxa. These afford a good opportunity to update information in the *Atlas of the British Flora*, but of course one must bear in mind that the recorded distribution is not dictated by an administrative boundary and the broader phytogeographical patterns (especially of those species which are westerly, or indeed restricted to Wales) may not be fully appreciated; these maps will therefore need studying in conjunction with the *Atlas*. Further information is provided in the form of a transparent overlay; those outlines relating to vice-county and grid square distribution are relatively successful, but others (e.g. for altitude and rainfall) tend to obscure detail.

Introductory matter covers, albeit briefly, a variety of topics, one of the most interesting being the history of botanical recording in Wales with portraits of 26 notable botanists. A well-produced and reasonably priced reference work for those studying the Welsh flora.

MRDS

**Carrion and Dung: The Decomposition of Animal Wastes** by **Roderick J. Putman**. Pp. 59, including numerous line drawings, diagrams and plates. Studies in Biology No. 156, Edward Arnold. 1983. £2.50.

This book deals with an often neglected part of the biogeochemical cycles, where complex animal tissues and wastes are converted into simpler units suitable for use by primary producers. It examines the organisms responsible and the communities to which they belong and how these communities are replaced by succession. The diagrams and tables are clear and well chosen and the text is written in an easy to follow style. This volume should be of particular value to 'O' and 'A' level students as it covers an area not usually particularly well presented in standard textbooks.

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