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Readers of *The Naturalist* will have noticed that the number of photographic illustrations has increased in recent years. Good clear photographs, suitably captioned, to accompany articles or as independent features are always welcome.

To encourage this development, a long-standing member of the YNU, who wishes to remain anonymous, has most generously offered to make a donation, the income from which would finance the publication of a plate or equivalent illustration in future issues whenever possible. The editor, on behalf of the YNU, wishes to record this deep appreciation of this imaginative gesture.

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THE WASPS AND BEES (HYMENOPTERA: ACULEATA) OF THE UPLAND SITES OF BRIMHAM ROCKS, CAYDALE, GUNDALE AND SECKAR MOOR WITH WOOLLEY EDGE QUARRY IN WATSONIAN YORKSHIRE

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Characteristically, the aculeate wasps and bees are active during warm sunny days and, except for the social species, stop foraging activities if the temperature drops too low. Thus with increasing latitude (Archer, 1996a) and altitude it might be expected that the number of species (or species diversity) would decrease. The effect of altitude on species diversity will be investigated for four upland sites in Watsonian Yorkshire.

Brimham Rocks (SE2064) is situated in the natural area of the Yorkshire Dales at an altitude of about 260 m. It has an underlying geology of Millstone Grit, from which some spectacular rock formations have developed. Brimham Rocks is a National Trust property with an area of 157 ha. The moorland is mainly covered by heather and bilberry with scattered oaks and silver birches, and willows in boggy areas. The surrounding slopes are covered by deciduous woodland including oak, birch and rowan. The flowers of the heather, bilberry and willow provide important food sources for the aculeate species. Importantly nesting areas for the subterranean nesting species occur where the sandy soil is exposed, especially heavily used footpaths and at the bases of the rock formations. During May 1982, for example, 105 freshly dug burrows of the mining bee, *Andrena cineraria*, were counted in the sloping ground just below the wall in the front of the house. Further during June 1983 about 120 burrows of several species were counted in the path behind a house.

Caydale (SE5386) is situated in the natural area of North York Moors and Hills at an altitude of 210-250 m. The valley cuts into the Coralline Oolite plateau with good exposures of the underlying Calcareous Grits in old quarries near the top of the valley sides (Atherden, 1985). The dry friable soils of these old quarries provide nesting sites for the subterranean nesters. The valley sides have some dry and damp limestone grassland which is being invaded by hawthorn and ash. The valley bottom around the stream is largely marsh. Some areas of old woodland and isolated trees are present, some of which are dead and now providing nesting sites for the aerial nesters. The flowers of hawthorn, raspberry, dandelion, white clover, rock rose, figwort and even heather are important food resources. The area for study is 49 ha centred around the public footpath, but similar habitats extend over a larger area of private property.

Gundale (SE8089) is situated in the natural area of North York Moors and Hills at an altitude of 130-150 m. The study area of 59 ha consists of a northern section of long narrow exposures of extremely soft sandstone with surrounding herb-rich acid grassland and a southern section of herb-rich limestone grassland openings in the deciduous woodland. The tops of the sandstone exposures are dominated by heather and the bases of the slopes by flower-rich ruderal communities. Shrub hawthorn has also invaded the open areas. Bare soil areas of the limestone grassland and the sandstone exposures provide nest sites for the subterranean nesters.

Seckar Moor (SE3214) at an altitude of 90 m and Woolley Edge Quarry (SE3013) at an altitude of 160 m are both situated in the natural area of the Coal Measures. The underlying geology is Millstone Grit of the Upper Carboniferous. Seckar Moor consists of heath, bog and birch woodland with occasional oak, alder and sallow. The study area of 20 ha is mainly in the open heath habitat which contains much heather and bilberry with some bramble, but the herb flora is poor. The nests of the subterranean nesters are associated with the well-used footpaths, particularly where a small slope or bank has appeared. Woolley Edge Quarry has been abandoned and consists of gritstone crags with sandy pockets of soil in which subterranean nesters nest. The quarry has some heather and bilberry surrounded by deciduous woodland.

Methods

Between 1974 and 1998, 20 visits were made to Brimham Rocks, distributed throughout the year as follows: April (1 visit), May (3), June (8), July (4), August (3), September (1). Between 1984 and 1998, 13 visits were made to Caydale as follows: May (3), June (4), July (3), August (3). Between 1986 and 1994, 18 visits were made to Gundale as follows: April (1), May (3), June (5), July (4), August (3), September (2). Other people also visited Gundale: W. D. Hincks on 30 June 1956, J. H. Flint on 10 June 1979 and 3 May 1980, R. S. Key on 6 September 1985 and J. D. Coldwell on 19 June 1994. The specimens collected on these visits except *Priocnemis perturbator* (J. D. Coldwell) and *Hylaeus communis* (W. D. Hincks) have been seen. The remaining specimens collected by W. D. Hincks were found at the University Museum, Manchester. Between 1983 and 1999, 17 visits were made to Seckar Moor and Woolley Edge Quarry as follows: April (1), May (4), June (3), July (5), August (3), September (1). In addition W. D. Hincks visited Seckar Moor on 3 July 1943 and his specimens were found at the University Museum, Manchester except for *Symmorphus bifasciatus*. Unless specifically noted in future Seckar Moor will cover both Seckar Moor and Woolley Edge Quarry. During my visits which lasted for approximately two to three hours, all species of aculeate wasps and bees were recorded (Archer sample) and usually collected with a hand net for identification, except possibly the visits to Brimham Rocks during the 1970s.

In the following account, the nomenclature can be related to that of Kloet and Hincks (1978).

Species Present and Seasonal Progression of Species

A full list of recorded species is given in the Appendix. At the family level, Tables 1 and 2 show the taxonomic distribution of species and records. A record represents a specimen differing in one of the following three variables: name, sex and day of visit. The solitary wasp family, Sphecidae, and the solitary bee families, Andrenidae and Halictidae, are the dominant families in terms of both the number of species and records.

Table 3 shows the number of species and when species were first recorded for each month. The most productive month for the species of solitary wasps at the four sites was July except for Caydale when June and July were particularly productive. Most species of solitary wasps were first recorded either during June (Caydale), or July (Brimham Rocks, Seckar Moor) or both June and July (Gundale). Since June and July are summer months, most species of the solitary wasps would seem to have to wait until the warmer summer months before the adults can become active. During the spring months of April and May very few species of solitary wasps were found and at Brimham Rocks and Seckar Moor no species were found. The most numerous species of solitary wasp recorded from Brimham Rocks was *Crossocerus dimidiatus* which was usually found when hunting for its prey of small flies; from Caydale were *Chrysis impressa* and *Trichrysis cyanea* found on fence posts probably on a mating circuit; from Gundale were *Crossocerus tarsatus* and *C. ovalis* usually at their subterranean nesting sites, and from Seckar Moor, where very few solitary wasps were found, *Lindenius albilabris* was the most numerous species, usually found at its subterranean nesting sites in the very small banks at the side of the path.

The most productive months for the species of solitary bees was June except for Caydale when June and July and Gundale when May and June were particularly productive. Most species of solitary bees were first recorded either during June (Brimham Rocks, Caydale), or May and June (Seckar Moor) or April, May and June (Gundale). Unlike the solitary wasps, solitary bees were present in numbers during both the spring and summer months. The most numerous species of solitary bee recorded from Brimham Rocks were *Andrena fucata*, *A. cineraria* and *Lasioglossum calceatum*; from Caydale *Andrena haemorrhoa* and *Halictus tumulorum*; from Gundale *Andrena haemorrhoa*, *Lasioglossum fratellum* and

TABLE 1
The number of species of aculeate wasps and bees recorded from Brimham Rocks, Caydale, Gundale and Seckar Moor with Woolley Edge Quarry.

	Brimham	Caydale	Gundale	Seckar
Solitary wasps				
Chrysididae	0	4	3	0
Mutillidae	0	0	1	0
Sapygidae	0	1	1	0
Pompilidae	5	5	7	1
Eumenidae	0	3	2	3
Sphecidae	9	13	14	6
Total solitary wasps	14	26	28	10
Solitary bees				
Colletidae	1	3	2	2
Andrenidae	10	9	13	13
Halictidae	10	11	13	12
Megachilidae	0	2	1	0
Anthophoridae	5	3	7	9
Total solitary bees	26	28	36	36
Total solitary species	40	54	64	46
Social wasps and bees				
Vespidae	4	5	5	3
Apidae	13	11	11	9
Total social species	17	16	16	12
Total aculeate wasps and bees	57	70	80	58

TABLE 2
The number of records of aculeate wasps and bees in the Archer sample from Brimham Rocks, Caydale, Gundale and Seckar Moor with Woolley Edge Quarry.

	Brimham	Caydale	Gundale	Seckar
Solitary wasps				
Chrysididae	0	13	4	0
Sapygidae	0	1	0	0
Pompilidae	6	8	16	1
Eumenidae	0	3	3	1
Sphecidae	26	20	42	8
Total solitary wasps	32	45	65	10
Solitary bees				
Colletidae	4	7	0	6
Andrenidae	30	23	54	48
Halictidae	32	27	70	39
Megachilidae	0	5	1	0
Anthophoridae	8	6	20	31
Total solitary bees	74	68	145	124
Total solitary species	106	113	210	134

TABLE 3
The number of species and when species were first recorded per month of solitary wasps and bees at Brimham Rocks, Caydale, Gundale and Seckar Moor with Woolley Edge Quarry.

	April	May	June	July	August	September
No. species						
Wasps						
Brimham	0	0	5	10	5	1
Caydale	–	1	15	14	5	–
Gundale	1	4	12	19	8	5
Seckar	0	0	0	8	2	–
Bees						
Brimham	2	5	17	9	8	3
Caydale	–	8	18	17	6	–
Gundale	10	19	26	12	7	9
Seckar	5	16	25	13	6	–
No. species first recorded						
Wasps						
Brimham	0	0	5	8	1	0
Caydale	–	1	15	8	2	–
Gundale	1	4	10	9	3	1
Seckar	0	0	0	8	2	–
Bees						
Brimham	2	4	13	2	5	0
Caydale	–	8	12	5	3	–
Gundale	10	10	11	2	0	3
Seckar	5	12	12	3	4	–

L. rufitarse, and from Seckar Moor *Colletes succinctus*, *Andrena lapponica*, *A. cineraria* and *A. tarsata*. All these species are subterranean nesters and are either found at their nesting sites, e.g. *C. succinctus* and *A. cineraria* in nesting aggregations, or at foraging sites, e.g. *A. haemorrhoa* on hawthorn flowers and *C. succinctus* on heather flowers. Some of the above findings at Caydale, and particularly at Brimham Rocks, must be regarded as provisional – it will be shown later that many further species may be present at these two sites.

Species-area relationship and potential number of solitary species

The species-area relationship can be found by plotting the number of solitary species recorded at a site against the area of the site, with both the number and area expressed as natural logarithms (ln). Archer (1999) plotted a species-area figure for 18 sites from the north and north midlands of England and found that the points fell on a line indicating a highly statistical significant positive linear relationship. The regression equation for this linear relationship is: in number of species = 3.84+0.11 x ln area (ha). From Archer (1998a, 2000) the sample can be increased to 20 sites, with no change to the regression equation.

Of the four sites under investigation only the Caydale species – area dot falls within the range of the 20 sites, with the dots for Brimham Rocks, Caydale and Seckar Moor (excluding Woolley Edge Quarry) being below the range of the 20 sites. If a site falls below the range of sites with which it is being compared, this could indicate either more recording is needed to find additional species, or the site is less favourable for solitary aculeates than the sites with which it is being compared.

To test whether more recording is needed, the potential number of species can be estimated using non-parametric statistical procedures. The presence/absence Chao (in Colwell and Coddington, 1994) and jackknife (Heltshe and Forrester, 1983) estimators have been used, using the software of Pisces Conservation Ltd. The Chao estimate depends on the number of species found and the number of species found only on one (unique species) and two (2-occasion species) visits or samples. The jackknife estimate also depends on the number of species found and the number of unique species. The statistical procedures are run a number of times equal to the number of samples or visits. In practice the software selects 1, 2, etc. samples at random each time calculating a mean estimate of species richness. With a small number of samples the estimates are erratic, but as larger sample sizes are selected the estimates may stabilise giving confidence in the estimates. The estimates with increasing sample size are shown in Figs 1-4 and the estimates from the largest number of samples in Table 4.

TABLE 4
Non-parametric estimates of species richness of solitary wasps and bees at Brimham Rocks, Caydale, Gundale and Seckar Moor based on the Archer samples.

	Chao estimate	Jackknife estimate
Brimham Rocks		
No species – recorded	40	40
– estimated	70	58
95% confidence limits	40-100	48-68
% of estimated species found	57	69
Caydale		
No species – recorded	54	54
– estimated	86	81
95% confidence limits	59-114	65-96
% of estimated species found	63	67
Gundale		
No species – recorded	59	59
– estimated	75	79
95% confidence limits	59-90	68-90
% of estimated species found	79	75
Seckar Moor		
No species – recorded	35	35
– estimated	46	48
95% confidence limits	32-60	41-55
% of estimated species found	76	73

For Brimham Rocks, the Chao estimates do not stabilise (Fig. 1), the two estimates disagree with each other and fewer than 70% of the potential number of species have been found (Table 4). These calculations indicate that more solitary species could be found at Brimham Rocks and further visits should be made. Since it is probably not possible to record all the species from a site, provided the estimates stabilise and the two estimates agree with each other, Archer (in press) arbitrarily decided that sampling could stop when 70% or more of the potential number of species has been found.

For Caydale, the Chao estimates stabilise (Fig. 2), the two estimates are similar to each

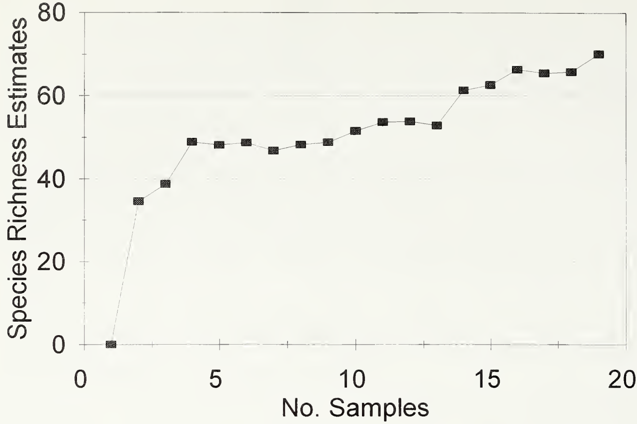

FIGURE 1
The Chao presence/absence estimates of species for Brimham Rocks.

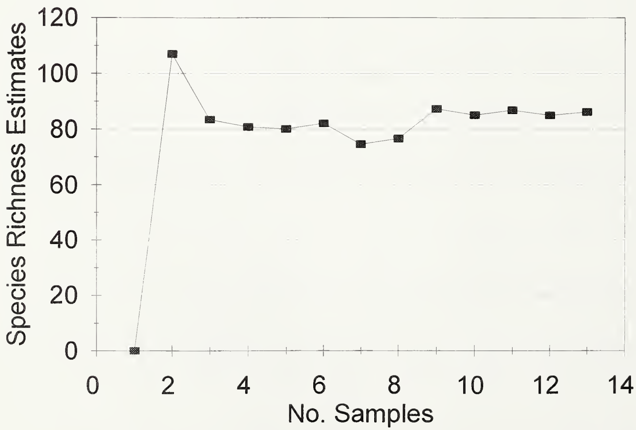

FIGURE 2
The Chao presence/absence estimates of species for Caydale.

other although just less than 70% of the potential number of species have been found (Table 4). Further visits could therefore be made. However the estimates probably refer to a larger area of Caydale than those covered by my visits and, as such, further visits should be made to the private larger area. It is unlikely access will be possible. If the larger area is considered as a truer measure of the area of the site then the dot would fall below the 20 comparison sites on the species-area figure.

For Gundale and Seckar Moor, the Chao estimates stabilise (Figs 3, 4), the two estimates are similar to each other and more than 70% of the potential species have been found at each site.

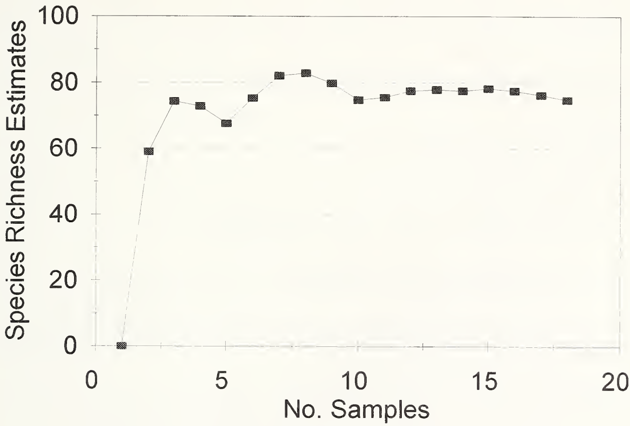

FIGURE 3
The Chao presence/absence estimates of species for Gundale.

In summary more recording needs to be done at Brimham Rocks, but not at Gundale and Seckar Moor, and probably Caydale, which can be considered less favourable sites for solitary aculeates; this is because of the less favourable weather at a higher altitude rather than the lack of nesting sites and foraging resources which are present. The altitude effect becomes even more noticeable at higher altitude: at Malham Tarn at an altitude of 375 m Hincks (1963) found only three solitary species.

Species Quality

Three Yorkshire rarities have been found: *Priocnemis susterai* and *Andrena ocreata* at Gundale and *Sphecodes crassus* at Woolley Edge Quarry. *P. susterai* is currently considered to be a southern English species so that the population at Gundale is an isolated one, although the species has recently been found in Nottinghamshire (Archer, 1996b). *Andrena ocreata* extends its range into Scotland. *Sphecodes crassus* is difficult to identify, but current knowledge suggests that this species is at the northern edge of its range in Yorkshire.

Two national rarities have been found (Shirt, 1987; Falk, 1991): *Nomada lathburiana* (RBD3) at Brimham Rocks, Gundale, Seckar Moor and Woolley Edge Quarry, and *Andrena ruficrus* (RDB3) at Gundale. Recent work by the Bees, Wasps and Ants Recording

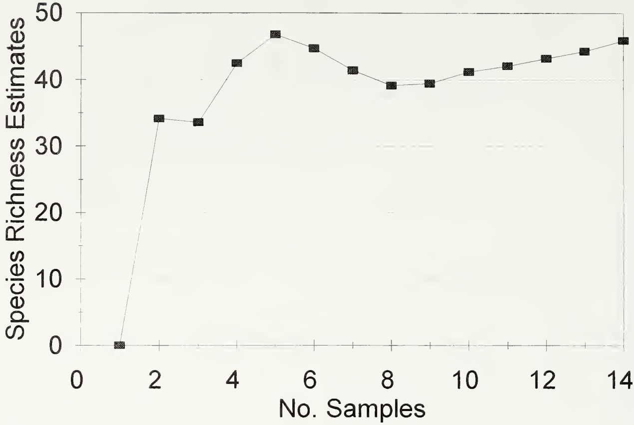

FIGURE 4
The Chao presence/absence estimates of species for Seckar Moor.

Society indicates that the status of *N. lathburiana* should be downgraded. *N. lathburiana* has a "frequent" status in Watsonian Yorkshire and its national distribution is concentrated in northern and western England. In Watsonian Yorkshire *A. ruficrus* is at the southern edge of its range and has an "occasional" status.

According to Falk (1991) three national scarce (or notable, Nb) species have been found: *Sapyga clavicornis* and *Priocnemis schioedtei* at both Caydale and Gundale, and *Sphecodes crassus* at Woolley Edge Quarry. *S. clavicornis* is at the northern edge of its range and has an "occasional" status in Watsonian Yorkshire. The range of *P schioedtei* extends into Scotland and has a "frequent" status in Watsonian Yorkshire.

According to Archer (1998b) the following Yorkshire "rare" bumble bees have been recorded: *Bombus magnus* from Brimham Rocks and Caydale, and *B. jonellus* from Brimham Rocks and Gundale. In addition, the "northern local" bumble bee (Williams, 1985), *B. monticola*, has been recorded from Brimham Rocks and Caydale. Brimham Rocks with twelve species of bumble bees is one of the richest sites for bumble bees in Watsonian Yorkshire.

Giving each solitary species a regional status, a regional quality score and species quality score (RSQS) (Archer, 1993) can be calculated for Gundale and Seckar Moor, (Tables 5 & 6). Similar calculations have not been made for Brimham Rocks and Caydale since less than 70% of the potential number of species have been recorded. The RSQS for Gundale is similar to those calculated for Keswick Fitts (2.7), Duncombe Park (2.9) and Blaxton Common (3.1), and the RSQS for Seckar Moor is similar to those calculated for Skipwith Common (2.2), Burton Leonard Lime Quarries (2.3) and Shipley Glen (2.4). Thus Gundale and Seckar Moor in terms of their SQSs are as important as some lowland sites.

Giving each species a national status, a national quality score and species quality score (NSQS) (Archer, 1999) can be calculated for Gundale and Seckar Moor (Tables 5 & 6). In these calculations *Nomada lathburiana* is given a "scarce" status. The NSQS for Gundale is similar to those calculated for Shipley Glen (2.0), Keswick Fitts (2.1) and Shipley Glen (2.4). The NQSQ for Seckar Moor is similar to those calculated for Holmehouse Wood,

TABLE 5
The regional and Archer national quality scores of the solitary species of wasps and bees recorded at Gundale.

	Status value (A)	No species (B)	Quality Scores (A x B)
Regional Status			
Common	1	32	32
Frequent	2	22	44
Occasional	4	4	16
Rare	8	2	16
Nationally scarce	16	3	48
Nationally rare	32	1	32
Total		64	188
Species quality score 188/64 = 2.9			
National Status			
Universal	1	43	43
Widespread	2	16	32
Restricted	4	1	4
Scarce	8	3	24
Rare	16	0	0
Very rare	32	1	32
Total		64	135
Species quality score 135/64 = 2.1			

TABLE 6
The regional and Archer national quality scores of the species of solitary wasps and bees recorded at Seckar Moor with Woolley Edge Quarry.

	Status value (A)	No species (B)	Quality Scores (A x B)
Regional Status			
Common	1	25	25
Frequent	2	12	24
Occasional	4	7	28
Rare	8	0	0
Nationally scarce	16	2	32
Total		46	109
Species quality score 109/46 = 2.4			
National Status			
Universal	1	30	30
Widespread	2	14	28
Restricted	4	0	0
Scarce	8	2	16
Total		46	74
Species quality score 74/46 = 1.6			

near Keighley (1.5), Burton Leonard Lime Quarries (1.6) and Skipwith Common (1.6).

Cleptoparasitic Load

The cleptoparasitic load (CL) is the percentage of aculeate species that are cleptoparasitic (or parasitoids) on other host aculeates. The CLs for the species of solitary wasps and bees for Gundale and Seckar Moor are given in Table 7. Wcislo (1987) showed that the amount of parasitic behaviour among the aculeate Hymenoptera correlated with geographical latitude, being higher in the temperate, compared with the tropical, regions. As such, CLs for sites in Britain should have similar values.

TABLE 7

The relative frequency of the cleptoparasitic (or parasitoid) species among the solitary species recorded from Gundale (G) and Seckar Moor with Woolley Edge Quarry (SW).

	No hosts (H)		No cleptoparasites (C)		Cleptoparasitic Load CL = 100 x C/(H+C)	
	G	SW	G	SW	G	SW
Solitary wasps	21	10	7	0	25.0	0.0
Solitary bees	25	22	11	14	30.6	38.9

For Watsonian Yorkshire the CLs for species of solitary wasps vary from 10.3%-20.5% (range 10.2%). The CL for Gundale at 25.0% slightly extends the range to 14.7%. At Seckar Moor very few species of solitary wasps, and no cleptoparasitic species were found. The relative lack of species of solitary wasps could be a consequence of unfavourable weather conditions when host populations were too small for cleptoparasitc populations to survive.

For Watsonian Yorkshire the CLs for species of solitary bees vary from 25.5%-36.6% (range 10.8%). The CL for Gundale falls within this range and the CL for Seckar Moor at 38.9% slightly extends this range to 13.8%.

Aerial Nester Frequency

The aerial-nester frequency (AF) is the percentage of host aculeate species that have aerial nest sites. Aerial nesters mainly use old beetle burrows in dead wood and central stem cavities such as dead bramble. Subterranean nesters nest in the soil, usually in burrows dug by themselves, but sometimes holes and crevices are used after being altered. The AFs for Gundale and Seckar Moor are given in Table 8.

TABLE 8

The nesting habits of the host solitary species recorded from Gundale (G) and Seckar Moor with Woolley Edge Quarry (SW).

	No aerial nesters (A)		No subterranean nesters (S)		Aerial nester frequency AF = 100 x A(A+S)	
	G	SW	G	SW	G	SW
Solitary wasps	6	5	15	5	28.6	50.0
Solitary bees	2	2	23	20	8.0	9.1

The AFs for the solitary wasps in Watsonian Yorkshire vary from 0.0%-84.4% and for the British species is 46.2%: the AF for Gundale is below average and for Seckar Moor just above average. The AFs for the solitary bees in Watsonian Yorkshire vary from 6.7%-30.8% and for the British species is 17.9%: the AFs for Gundale and Seckar Moor are below average.

The above-average AF for the solitary wasps from Seckar Moor contrasts with the other lower AFs. Why should this be so? It is known that the summer abundance of solitary wasps is more sensitive to summer weather conditions than the summer abundance of solitary bees, and that for solitary wasps aerial nester frequency increases along a decreasing warmth gradient (Archer, 1999). Thus the relative high AF for the solitary wasps from Seckar Moor could be a consequence of more unfavourable weather conditions – a speculation that matches the CL information.

Conclusions

1. In terms of the number of aculeate species Gundale is a very good site, Caydale a good site and Brimham Rocks and Seckar Moor with Woolley Edge Quarry promising sites.
2. Estimates of the potential number of species present on a site indicate that Brimham Rocks should receive more recording effort and that the recording effort at Caydale could be extended over a greater area.
3. A species-area investigation indicates that Gundale, Seckar Moor (excluding Woolley Edge Quarry) and probably Caydale are less favourable sites for aculeates because of the altitude effect. Seckar Moor with Woolley Edge Quarry seem to be particularly unfavourable for species of solitary wasps.
4. National rare or scarce species and Yorkshire rare species have been recorded from all four sites.

Acknowledgements

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Appendix

The list of species of aculeate wasps and bees recorded from Brimham Rocks (B), Caydale (C), Gundale (G) and Seckar Moor with Woolley Edge Quarry (S)

Chrysididae. *Chrysis angustula* Schenck (C), *C. ignita* (Linn.) (C,G), *C. impressa* Schenck (C,G), *Trichrysis cyanea* (Linn.) (C,G).

Mutillidae. *Myrmosa atra* Panzer (G).

Sapygidae. *Sapyga clavicornis* (Linn.) (C,G).

Pompilidae. *Dipogon variegatus* (Linn.) (B), *Priocnemis parvula* Dahlbom (B), *P. schioedtei* Haupt (C,G), *P. perturbator* (Harris) (C,G), *P. susterai* Haupt (G), *Arachnospila anceps* (Wesmael) (B,C,G,S), *A. spissa* (Schiødte) (B,C,G), *Evagetes crassicornis* (Shuchard) (B,G), *Anoplius nigerrimus* (Scopoli) (C,G).

Eumenidae. *Odynerus spinipes* (Linn.) (G), *Ancistrocerus oviventris* (Wesmael) (C), *A. parietinus* (Linn.) (S), *Symmorphus bifasciatus* (Linn.) (=mutinensis) (C,G,S), *S. gracilis* (Brullé) (C,S).

Vespidae. *Dolichovespula norwegica* (Fab.) (B,C,G), *D. sylvestris* (Scopoli) (B,C,G,S), *Vespula austriaca* Panzer) (C,G) *V. rufa* (Linn.) (B,C,G,S), *V. vulgaris* (Linn.) (B,C,G,S).

Sphecidae. *Tachysphex pompiliformis* (Panzer) (S), *Trypoxylon attenuatum* Smith (C,G), *T. clavicerum* Lepeletier (C), *T. figulus* (Linn.) (C,G), *Crabro cribrarius* (Linn.) (G), *Crossocerus elongatulus* (Vander Linden) (B,C,G), *C. ovalis* Lepeletier & Brullé (G), *C. pusillus* Lepeletier & Brullé (B,G,S), *C. tarsatus* (Shuckard) (B,G,S), *C. annulipes* (Lepeletier & Brullé) (C), *C. capitosus* (Shuckard) (S), *C. megacephalus* (Rossius) (C), *C. nigritus* Lepeletier & Brullé) (G), *C. podagricus* (Vander Linden) (C), *C. quadrimaculatus* (Fab.) (B), *C. dimidiatus*. (Fab.) (B,G), *Ectemnius lapidarius* (Panzer) (B,C), *E. continuus* (Fab.) (C), *Lindenius albilabris* (Fab.) (S), *Rhopalum clavipes* (Linn.) (S), *Psen dahlbomi* (Wesmael) (C), *P. equestris* (Fab.) (B,G), *Pemphredon lugubris* (Fab.) (C), *P. inornata* Say (C), *Passaloecus singularis* Dahlbom (C), *Mellinus arvensis* (Linn.) (B,G), *Nysson spinosus* (Forster) (G), *Gorytes tumidus* (Panzer) (G), *Argogorytes mystaceus* (Linn.) (B,G).

Colletidae. *Colletes succinctus* (Linn.) (B,C,S), *Hylaeus communis* Nylander (G), *H. confusus* Nylander (C,G), *H. brevicornis* Nylander (S), *H. hyalinatus* Smith (C,).

Andrenidae. *Andrena clarkella* (Kirby) (B,G,S), *A. fucata* Smith (B,C,G,S), *A. fulva* (Müller in Allioni) (S), *A. lapponica* Zetterstedt (B,G,S), *A. scotica* Perkins (B,C,G,S), *A. bicolor* Fab. (C), *A. ruficrus* Nylander (G), *A. angustior* (Kirby) (B,S), *A. cineraria* (Linn.) (B,G,S), *A. nigroaenea* (Kirby) (C,S), *A. fuscipes* (Kirby) (B,S), *A. haemorrhoa* (Fab.) (B,C,G,S), *A. tarsata* Nylander (C,G,S), *A. barbilabris* (Kirby) (B,G), *A. chrysosceles* (Kirby) (C,G,S), *A. saundersella* Perkins (C,G), *A. subopaca* Nylander (B,C,G), *A. ocreata* (Christ) (G), *A. wilkella* (Kirby) (S).

Halictidae. *Halictus rubicundus* (Christ) (B,C,G,S), *H. tumulorum* (Linn.) (C,G,S), *Lasioglossum albipes* (Fab.) (C,G,S), *L. calceatum* (Scopoli) (B,C,G,S), *L. fratellum* (Pérez) (B,C,G,S), *L. fulvicorne* (Kirby) (C,G), *L. rufitarse* (Zetterstedt) (B,C,G,S), *L. cupromicans* (Pérez) (B,C,G), *L. leucopum* (Kirby) (B,G), *Sphecodes crassus* Thomson (S), *S. geoffrellus* (Kirby) (=fasciatus) (B,C,G,S), *S. gibbus* (Linn.) (B,C,G,S), *S. hyalinatus* von Hagens (B,C,G,S), *S. monilicornis* (Kirby) (B,S), *S. pellucidus* Smith (G,S).

Megachilidae. *Chelostoma florisomne* (Linn.) (C), *Megachile willughbiella* (Kirby) (C), *M. circumcincta* (Kirby) (G).

Anthophoridae. *Nomada fabriciana* (Linn.) (B,G,S), *N. flavoguttata* (Kirby) (C,G), *N. goodeniana* (Kirby) (S), *N. lathburiana* (Kirby) (B,G,S), *N. leucophthalma* (Kirby) (G,S), *N. marshamella* (Kirby) (B,C,G,S), *N. panzeri* Lepeletier (B,C,G,S), *N. ruficornis* (Linn.) (G), *N. rufipes* Fab. (B,S), *Epeolus cruciger* (Panzer) (S), *Anthophora furcata* (Panzer) (S).

Apidae. *Bombus lucorum* (Linn.) (B,C,G,S), *B. magnus* Vogt (B,C), *B. terrestris* (Linn.) (B,C,G,S), *B. lapidarius* (Linn.) (B,C,G,S), *B. jonellus* (Kirby) (B,G), *B. monticola* Smith (B,C), *B. pratorum* (Linn.) (B,C,G,S), *B. hortorum* (Linn.) (B,C,G,S), *B. pascuorum* (Scopoli) (B,C,G,S), *Psithyrus bohemicus* (Seidl) (B,C,G,S), *P. campestris* (Panzer) (B,S), *P. sylvestris* Lepeletier (B,C,G), *P. vestalis* (Geoffroy in Fourcroy) (G), *Apis mellifera* Linn. (B,C,G,S).

RECORDER'S SEVENTH REPORT OF THE ACULEATE HYMENOPTERA IN WATSONIAN YORKSHIRE

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Since my last report (Archer, 1997) five new species have been found in Watsonian Yorkshire. In the following account, collectors are identified by the initials: M. E. Archer (MEA), L. Auckland (LA), J. D. Coldwell (JDC), R. Crossley (RC), H. Frost (HF), P. Kendall (PK), C. W. Plant (CWP) and S. M. Saxton (SMS). The new species are: *Priocnemis cordivalvata* Haupt, Howell Wood (SE40), JDC, July 1997. *Dolichovespula saxonica* (Fab.), Beningbrough Hall (SE55), MEA, Aug. 1999. *Philanthus triangulum* (Fab.), Pollington Quarry (SE62), PK, July 1997; Lady Spring Wood, Malton (SE77), RC, Aug. 1997. *Sphecodes reticulatus* Thomson, Pollington Quarry (SE62), MEA, June 1999. *Hoplitis spinulosa* (Kirby), Burdale (SE86), MEA, Aug. 1998, Aug. 1999.

Other important records are: *Omalus aeneus* (Fab.), Langsett (SE10), JDC, Aug. 1997. *Mutilla europaea* Linn. Biller Howe, North York Moor (NZ90), LA, Aug. 1997. *Eumenes papillarius* (Christ), York Cemetery (SE65), MEA, July 1999, vagrant, second British record. *Vespa crabro* Linn. Winstead (TA22), HF, Oct. 1997, queen seeking overwintering site; Brodsworth Hall (SE50), May 1999, overwintering queen. *Crossocerus binotatus* Lepeletier & Brullé, Wombwell Ings (SE40), JDC, June 1997; Stutton (SE44), MEA, July 1998. *Ectemnius sexcinctus* (Fab.), Lindrick Common (SK58), MEA, July 1997. *Pemphredon morio* (Vander Linden), Beningbrough (SE55), MEA, Aug. 1997. *Argogorytes fargei* (Shuckard), Reighton cliffs (TA17), MEA, June 1997; Fulford Ings (SE64), MEA, June 1998, July 1999; Helmsley Castle (SE68), MEA, July 1998. *Nysson trimaculatus* (Rossius), Thornton Ellers (SE74), MEA, July 1997; Lindrick Dale Quarry (SK58), MEA, July 1999. *Hylaeus signatus* (Panzer), Thorne Moor (SE71), CWP, Aug. 1995; York Cemetery (SE65), MEA, July 1998; Monk Bretton Priory (SE30), MEA, July 1999. *Colletes halophilus* Verhoeff, Welwick saltmarsh (TA31), MEA, Aug. 1999. *Andrena humilis* Imhoff, Holmehouse Wood (SE04), SMS, July 1995; Pollington Quarry (SE62), MEA, May 1998, June 1999; Sandall Beat Wood (SE60), MEA, June 1998. *A. ovatula* (Kirby), Pollington Quarry (SE62), MEA, April 1998, July 1998, May 1999. *A. tibialis* (Kirby), Pollington Quarry (SE62), MEA, April 1999; Sandall Beat Wood (SE60), MEA, April 1998. *Coelioxys rufescens* Lepeletier & Serville, Wharncliffe Wood (SK39), JDC, June 1997; Laisterdyke, Bradford (SE13), SMS, June 1998. *Melecta albifrons* (Förster), Lodge Site, Malton (SE77), RC, May 1977. *Nomada lathburiana* (Kirby), Harden Moor (SE03), SMS, May 1994, June 1996; East Morton (SE14), SMS, May 1995; Otley Chevin (SE24), SMS, May 1998; Howell Wood (SE40), MEA, May 1998; Brayton Barff (SE53), MEA, June 1998, May 1999. *N. pleurostricta* Herrich-Schaffer, Brayton Barff (SE53), MEA, July 1998; Pollington Quarry (SE62), MEA, July 1999. *Bombus magnus* Vogt, Holmehouse Wood (SE04), SMS, May 1995; Harden Moor (SE03), SMS, May 1997; Deep Dale (SE99), LA, July 1998. *B. jonellus* (Kirby), Harden Moor (SE03), SMS, May 1994; Fen Bog (SE89), MEA, Aug. 1997; Brimham Rocks (SE26), MEA, Sept. 1998. *B. muscorum* (Linn.), Welwick saltmarsh (TA31), MEA, July 1998. *Psithyrus rupestris* (Fab.), Brayton Barff (SE53), MEA, June 1997.

Reference

Archer, M. E. (1997). Recorder's sixth report of the aculeate Hymenoptera in Watsonian Yorkshire. *Naturalist* **122:** 97-99.

BOOK REVIEW

The European Garden Flora. Volume VI. Dicotyledons (Part IV). Loganiaceae to Compositae. Edited by **S. M. Walters** *et al.* Pp. xvi + 739. Sponsored by The Royal Botanic Garden, Edinburgh, The Royal Horticultural Society, London and The Stanley Smith Horticultural Trust, Cambridge. Cambridge University Press. 2000. £110.00.

This volume is the culmination of a remarkable achievement, the ideas for which were proposed by Dr Max Walters and James Cullen nearly a quarter of a century ago, the first meeting to discuss the project being held in 1976, with an editorial committee well established in 1979. The first volume appeared in 1986, the remaining five appearing at reasonably regular intervals over the next 14 years (and reviewed in *The Naturalist*).

One of this work's strongest features is its intelligibility, being not only of great value to professional botanists but also to those seriously interested in horticultural plants. Taxonomic descriptions of families, of genera and of each plant are based on the highest scientific standards, the more difficult groups complemented with line drawings of diagnostic details. Plant entries also include references to more detailed published descriptions and illustrations published elsewehere. Overlying all this technical input is the inclusion of considerable practical advice not only in the identification of plants but also in the provision of information on soil preferences and cultural requirements.

The present volume, the most substantial to date (covering 38 families), has the added usefulness of providing a consolidated index (to genera, families and higher groups) to all six volumes.

This work is without doubt one of the most important botanical works of the 20th century, which will hold its place well into this, and probably the next, century. In view of its price, this set of volumes is unlikely to find its way on to the shelves of many individuals, but libraries, academic institutions and major horticultural societies are strongly urged to purchase this indispensable seminal reference work.

VAH

SEASONAL VARIATIONS IN NUTRIENT LEVELS IN BEMERSYDE MOSS, BORDERS REGION, SCOTLAND

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SUMMARY

Nutrient levels were monitored over a twelve month period in Bemersyde Moss, a shallow wetland in southern Scotland. The Moss is used by a variety of waterfowl, both as a winter roost by approximately 100-250 greylag geese (*Anser anser*) and in summer as a breeding colony for over 14,000 pairs of black-headed gulls (*Laws ridibundus*). It is surrounded by agricultural land, which along with the birds has an effect on nutrient levels. Phosphate phosphorus (PO_4-P) and combined inorganic nitrogen (NH_4-N, NO_3-N and NO_2-N) concentrations were analysed at fortnightly intervals, both in the drains flowing into the wetland and in the wetland itself. Abiotic parameters including pH, conductivity, temperature, depth, dissolved oxygen were also recorded. P and NH_4-N showed high concentration in summer due to the influx of birds and use by livestock. Although some of the NO_3-N could be attributed to the oxidation of NH_4-N, increased levels in the spring and late autumn/early winter were measured in the field drains, suggesting an input from the surrounding arable fields. It was concluded that birds and livestock were making a major contribution to P and N levels within the wetland.

INTRODUCTION

Shallow wetlands face a variety of problems. They frequently suffer from a reduced freshwater input, large water loss from evaporation, low flow (or even static water) and may show wide seasonal variations in depth with summer droughts and winter flooding. Although this may encourage the growth of certain plant species, providing ideal habitats for wetland breeding birds, it may also lead to eutrophication due to nutrient input from waterfowl and agricultural sources (Bailey-Watts, 1994; Balla & Davis, 1995; Eriksson & Weisner, 1997; Manny *et al.,* 1994; Mundie *et al.*, 1991; Rader & Richardson, 1994). This paper describes the nutrient inputs from avian and agricultural sources into Bemersyde Moss, Scotland, an important habitat for blackheaded gulls (*Laws ridibundus*).

Wetlands are an important habitat for wildlife and in Europe are decreasing in numbers. This paper presents preliminary results from an ongoing study which began in January 1997.

The aims of the study were to:
1) identify the sources of nutrients entering the wetland;
2) assess the various factors contributing to this nutrient enrichment.

Background to Site

Bemersyde Moss is located four miles east of Melrose, Borders Region (Figure 1; grid reference NT 612 330). It is owned by Earl Haig, managed by the Scottish Wildlife Trust (SWT) and Scottish Natural Heritage (SNH), and designated as a Site of Special Scientific Interest (SSSI) in 1987. The wetland lies in a shallow depression of Upper Old Red Sandstone (Greig, 1971), and is fed only by rainwater and field drains in the surrounding catchment. Although the water level now varies from 0.4 m to 1.2 m, prior to the 19th century it was known as Mertoun Loch and was used for eel fishing, cutting reeds for matting and to power local water mills (Russell, 1881). It was later drained and used for hay; the 1802 map shows a meadow with a single drain running through the middle. However, the main drain gradually silted up, creating the present wetland which continues to increase in size (Gaskell, 1995).

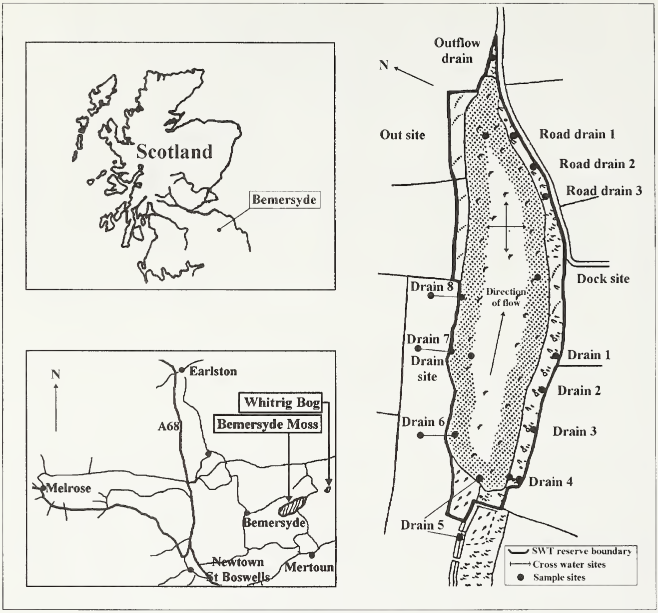

FIGURE 1
Location and site map of Bemersyde Moss, Scotland.

Description of Site

The main drain enters the wetland at the south west and leaves by the north east end, eventually flowing into Maidenhall Burn (Figure 1). No springs are known to be present. The depth and water quality of the wetland is therefore heavily dependent on the amount of precipitation, other local weather conditions (e.g. temperature and wind speed) and agricultural practices.

Bemersyde is a valuable site for plants, invertebrates and birds. It has over 136 species of flowering plants including several species of regional importance and numerous bird species. In the winter it has regionally important populations of wigeon (*Anas penelope*), teal (*Anas crecca*), whooper swans (*Cygnus cygnus*) and greylag geese (*Anser anser*) and smaller numbers of other migratory species. From mid-March to late July, it hosts approximately 14,000 pairs of black-headed gulls, three-quarters of the South Scotland population, along with several other duck species (mallard, *Anas platvrhvnchos;* pochard, *Avthva ferina*; ruddy duck, *Oxvura jamaicensis*), black-necked grebes (*Podiceps nigricollis*), a pair of mute swans (*Cygnus olor*), coots (*Fulica atra)* and moorhens (*Gallinula chloropus*)). The various waterfowl have two obvious effects on the site. The first is nutrient enrichment through defecation which is exacerbated by the large number of black-headed gulls in the summer when the water levels are at their lowest, compounded by additional inputs by winter-roosting birds (mostly geese and ducks). Most of these species feed elsewhere (e.g. on surrounding arable ground and pasture or further afield), hence input into the wetland is additional loading. The second effect is the damage to vegetation by breeding birds trampling the reed beds, thereby inhibiting their growth and increasing the amount of open water (Gaskell, 1995; *pers. comm.*) In addition, the wetland is surrounded by arable fields (winter and spring barley, wheat, oats, oil seed rape, turnips), coniferous forestry (sitka spruce, *Picea sitchensis,* Norway spruce, *Picea abies*) and grazed pasture, all of which have drains feeding into the moss, each with their own input of nutrients from agricultural fertilisers and animal dung.

In this study a neighbouring site, Whitrig Bog, was used to compare water quality. Whitrig lies about 0.5 km to the east of Bemersyde and has similar geology and water conditions. It was drained around 1790 but, unlike Bemersyde, large amounts of clay were extracted between 1801 and 1900. It is also used by winter roosting geese and various duck species in the winter and summer. Livestock graze in the adjoining pastures from spring to autumn but, unlike Bemersyde, it does not have a large colony of nesting black-headed gulls.

Methods

Water samples were taken from the drains flowing into and out of the wetland along with the areas of open water at fortnightly intervals for a 12-month period, although some drains dried up between late July and mid-November, making sampling impossible. A total of 12 drains, five water's edge sites and three open water sites were sampled and are described in detail in Table 1. A cross water transect was carried out by dinghy in mid-March and again in early August to assess uniformity of nutrient levels in the deeper parts of the wetland. The pH and conductivity were measured for all sites; in addition, dissolved oxygen (DO) and water temperature were recorded for the open water sites and Whitrig (Table 1), along with concentrations of phosphate phosphorus (PO_4-P), ammonium nitrogen (NH_4-N), nitrate nitrogen (NO_3-N) and nitrite nitrogen (NO_2-N) (APHA, 1996; Kirika, *pers. comm.*). Water samples were also taken from Whitrig Bog at fortnightly intervals.

Results

Table 1 summarises the site details, including location, classification, pH, conductivity, dissolved oxygen, temperature and a brief description of the site. The abiotic information is consistent with expected seasonal variations and responses to changes in water chemistry.

Nutrient levels

Sampling sites were classified according to their location and were amalgamated into the categories summarised in Table 1. The mean, maximum and minimum concentrations of the various nutrients for both Bemersyde Moss and Whitrig Bog are given in Table 2.

Phosphate-Phosphorus (PO_4-P)

Figure 2.1 shows the changes in phosphorus concentration in the water flowing into the wetland through the drains and out via the outflow. Also indicated is the duration of the presence of the black-headed gull breeding colony. Phosphorus remained at low concentrations throughout the winter and early spring. Peaks occurred in the open water sites (drain, dock and out) in April, early June and again in mid-July where concentrations stayed high until early December. They then decreased to previous winter levels. It should be noted that the drain site has reduced levels compared to the other open water sites, and that all of these have phosphorus-levels above the recommended levels set by environmental standards (Jarvie *et al.,* 1998).

Ammonium Nitrogen (NH_4-N)

It can be seen in Figure 2.2 that ammonium has a single peak in mid-June, then rose again

TABLE 1: Site descriptions.

Drain Sites	Source	pH	Conductivity (µS/cm)	temp (°C)	DO mg/l	Description
Drains 1-3	ploughed field	6.7-8.1	250-770			*Notes:* field planted with winter wheat 1996-7; sampled source only as impossible to find outlet into the wetland
Drain 4	pastures, arable land and forestry	6/6-7.6	300-1200			*Notes:* main inflow into the site from the west, sampled source and outlet into wetland
Drain 5-8	pasture	6.5-7.8	280-1670			*Notes:* sampled source and outlet into wetland
Road drains 1-3	ploughed field, road	6.5-7.8	410-2460			*Notes:* drains running under the road, which may be subject to road run-off in heavy rain
Outflow drain	wetland	6.6-7.9	280-570			*Notes:* outflow from Bemersyde
Open Water Sites						
Drain	pasture	6.7-8.1	300-720	2.6-20.8	1.21-10.67	*location:* at the west end of wetland, an open site with a large field drain (drain 6) running into it *sediment:* densely packed fine mud mixed with sand and grit *notes:* few macrophytes than the other sites, used by cattle and sheep for drinking; particularly heavily used in August/September/October when the cattle forage amongst the vegetation
Dock	no obvious inflow	6.9-7.8	300-610	1.8-21.1	1.68-10.87	*location:* in the middle of the southern edge of the wetland, a wooden jetty extending approximately 4 m into the mire *sediment:* large plant matter, including decaying leaves mixed with fine particulate mud *notes:* neighbouring vegetation includes a band of mixed woodland, bulrush (*Typha latifolia*), canary reed grass (*Phalaris arundiacea*) and sedges (*Carex sp.*); samples taken in the open water; the surrounding area is well vegatated
Out	Bemersyde	6.9-7.9	300-540	3.0-18.1	0.83-11.02	*location:* at east end of the wetland cut off from main body of water by reeds and bogbean (*Menyanthes trifoliata*), adjacent to outflow drain *sediment:* Very fine mud with some larger plant matter *notes:* north side includes corridor of pasture with arable field above it, west side conifer plantation, south side mixed woodland
Whitrig		7.2-8.6	210-480	1.8-16.8	2.82-12.26	*location:* 1 mile east of Bemersyde *sediment:* fine mud and sand *notes:* surrounded by permanent pasture grazed by cattle and sheep

TABLE 2
Mean, maximum and minimum concentrations of nutrients at Bemersyde and Whitrig.

Nutrient	Site	Mean	Minimum	Maximum
PO_4-P	Bemersyde	7.610	1.288	16.909
	Whitrig	0.098	0.000	0.340
NH_4-N	Bemersyde	7.617	0.322	30.483
	Whitrig	0.304	0.000	0.913
NO_3-N	Bemersyde	4.208	0.080	35.398
	Whitrig	0.460	0.004	3.162

in early August in the three open water sites and outflow drain. The levels gradually decreased in all open water sites except the drain site, maintaining low levels from October onwards. In contrast, the drain site showed a gradual decrease until early October, rising until mid-November and dropping in early December.

Nitrate Nitrogen (NO_3-N)
In contrast to the phosphorus and ammonium, nitrate was found mainly in the input drains at source and at the water's edge (Figure 2.3). Increased levels occurred in May-June and again in mid-November through to early January. However, in the second period the drain site also had an extremely high level of nitrate, which was not replicated in any other open water site.

Nitrite Nitrogen (NO_2-N)
Nitrite levels were low at Bemersyde and added little to the nitrogen budget of the site.

Cross water samples
The cross water samples showed the concentrations of the phosphorus, ammonium and nitrate were similar throughout the area surveyed and consistent with the samples taken from the open water sites (Figure 3). All results were significantly different ($p<0.001$): phosphorus and ammonium were higher in August, while nitrate had increased levels in March.

Nutrient levels recorded in 1994-96
The wetland was sampled for free and saline ammonium, nitric nitrogen and PO_4-P soluble phosphate in 1994-96 by SEPA, Melrose, Scotland (Table 3). When the results from this study were compared with similar measurements taken by SEPA for SWT in 1994-96, they showed similar trends, although magnitudes differed. The latter may reflect true values, or be attributable to differences in sampling methods and analytical procedures employed.

Discussion

Bemersyde is a unique habitat that has altered considerably over the last 300 years. Although anthropogenic factors were responsible for the initial changes, the subsequent use by wildlife has had a major effect. The black-headed gulls are of particular interest mainly due to their enormous increase in numbers since 1967: 1500 pairs, (Meikle, 1967) to 9050 in 1984, 14,320 in 1991 and 15,000 pairs in the summer of 1999 (Murray, Recorder, British Trust for Ornithology, Borders Region, *pers. comm.*).

Nutrient Inputs
Examination of the main nutrient inputs shows that phosphorus and ammonium levels are much higher in the open water sites, with very little nitrogen and phosphorus input via the

TABLE 3
Results from water analysis 1994-96 carried out by SEPA, Borders Region*.

Date	pH	PO_4P (mg/I)	NH_4 (mg/I)	NO_3-N (mg/I)
20/3/94	7.4	0.33	0.16	2.00
21/6/94	7.4	4.67	25.70	0.31
19/9/94	7.25	1.02	0.26	0.5
31/1/95	7.3	0.43	0.39	2.45
22/3/95	7.4	0.64	0.30	2.20
19/6/95	7.25	4.15	11.30	0.40
25/9/95	7.5	0.22	0.49	0.35
4/2/96	7.0	1.31	2.90	1.55

* Results courtesy of L. Gaskell, Chairman of Bemersyde Management Committee, SWT.

drains. Since the high phosphorus levels occurred during the prime gull breeding period, it can be inferred that the gulls are the cause. This is in agreement with other studies on bird related phosphorus inputs to lakes and rivers (Downing & McCauley, 1992; Manny *et al.*, 1994; Marion, *et al.*, 1994).

Gould and Fletcher (1978) recorded amounts and main components of black-headed gull faeces under captive conditions and found that gulls on average produced 38 mg total (30 mg of soluble) phosphorus per 24 hour period. Studies comparing free living with captive gulls of other species suggested that captive studies may underestimate the actual amount of faeces produced by a free-living bird by as much as 50% (Portnoy 1990), hence the total amount could be twice that given above. Even though the gulls did not spend all of their time on or above the water, over 14,000 pairs of gulls along with their offspring would have a considerable effect on phosphorus loading of the wetland.

Phosphorus lodged in sediments is another potential source of contamination (Mayer *et al.*, 1999). Although living plant material has a negligible effect on phosphorus levels, fallen dead material can make a major contribution (Granéli & Solander, 1988). Furthermore the amount released may vary with season (Mason & Bryant, 1975; Morris & Lajtha, 1986) and the disturbance to substrate caused by waterfowl and livestock using the wetland. It is notable that the drain site, although an open water site, showed lower concentrations of P than the other two open water sites or the outflow drain. The substrate here had a higher proportion of sand which would remain more oxidised, hence less release of P would occur. Moore *et al.*, (1998) measured phosphorus flux from various sediment types and suggested that the flux was lower from sandy sediments than the other zones tested. Preliminary work is being carried out on the amount of phosphorus in the substrate, and early indications are that the sediment is acting as a net sink for phosphorus.

The peaks in ammonium may be attributed to several factors. Since there is very little ammonium in the drain samples, the main sources must be gull dung (in the form of uric acid broken down by biological processes), urine and faeces from the livestock and/or released from pore water into the sediments (Mayer *et al.*, 1999). An additional factor is that the first major peak in ammonium occurred after a period of unusually heavy rainfall (150.5 mm recorded for month of June 1997 compared to an average of 57.59 mm for the previous 18 years, Scottish Agricultural College Veterinary Station (SAC), St. Boswells, Roxburghshire). This would facilitate the direct run-off of dung and urine from the surrounding pastures. Cooke and Prepas (1998) reported higher amounts of ammonium in run-off from agriculture with cow-calf units. This is particularly evident at the drain site, which shows an extra peak in mid-October to mid-November. It is believed that this peak is entirely due to the activity of cattle at this site in the late autumn. The site showed evidence

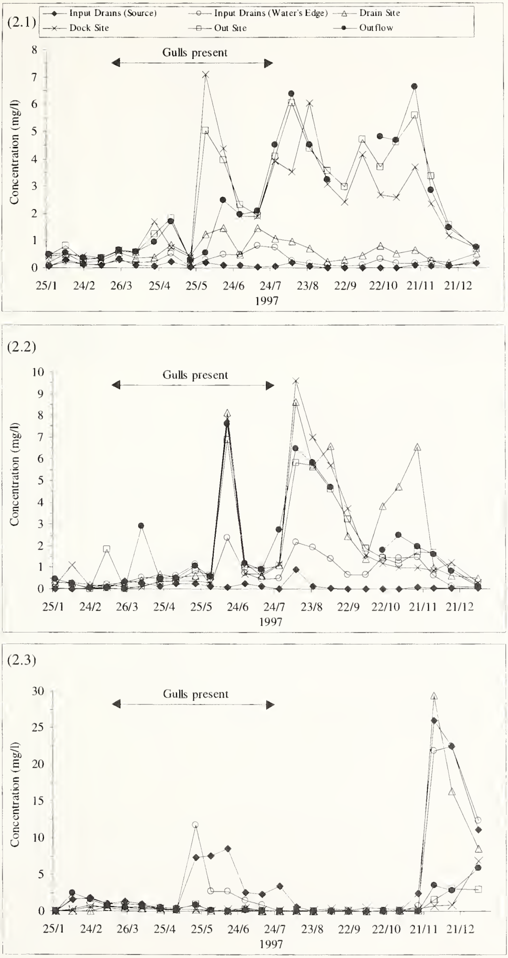

FIGURE 2
Phosphate phosphorus (2.1), ammonium nitrogen (2.2) and nitrate nitrogen (2.3) concentrations January 1997 to January 1998.

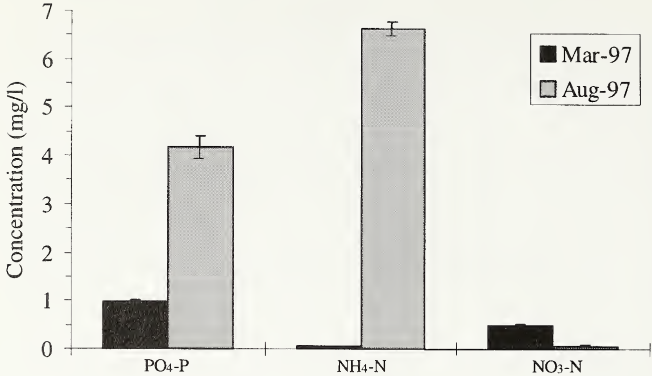

FIGURE 3
Cross water sample concentrations of PO_4-P, NH_4-N, NO_3-N.

of cattle wading into the area, presumably to drink but also to graze on the *Juncus* spp. that surrounds the site. Cattle frequently defecate and urinate while grazing, thereby contributing to the overall concentration of ammonium. A final factor relevant to the high concentrations in the summer and early autumn is the reduced availability of dissolved oxygen which would limit the process of nitrification.

In contrast, both combined oxidised inorganic N levels are higher in the input drains, suggesting that these compounds are entering the wetland via the drains in the adjoining fields and production on site. The peak in nitrate in the field drains in mid-May relate to local seasonal applications of nitrogen (with appropriate time lag) in the form of fertiliser to arable crops and in November from leaching due to ploughing and possible pre-ploughing slurry applications. Nitrate is highly mobile and thus has a tendency to leach from disturbed soil (Marston, 1989; Cooke & Prepas, 1998). The autumn peaks might also reflect the renewed flow of water from the drains bringing with it a flush of nitrate along with the bacterial oxidation of ammonium to nitrate and nitrite.

The ratio of N:P was calculated for all samples. The ratio of N:P was less than 16:1 in all samples taken at the open water sites. Hence nitrogen may be a limiting factor (Vollenweider, 1968).

Conclusions

This preliminary study shows that the birds and agricultural practices are having an effect on Bemersyde Moss. However, the information derived so far leaves many questions unanswered. Further work is being undertaken on the amount of phosphorus in the sediments, potential disturbance to the sediment/water interface, the role of the vegetation in buffering the nutrient input and most importantly the management of the site for the gulls. They are a valuable asset and one that makes this site unique.

Acknowledements

We are indebted to Earl Haig, the SNH and SWT who have granted permission for us to sample the site. We are also grateful to the many students who have assisted with the field work and the analysis, including: Sally Johnson, Natasha Schuttinga, Imka Renner, Nathan Leishman, Morag Wilson and Aileen McManus. Finally, we would like to particularly thank Dr Alex Kirika, Institute of Freshwater Biology, ITE, Prof. Nick Christofi, Dr John Kinross and Mrs Jill Sales, Napier University, Mr Luke Gaskell, Chairman, Bemersyde Management Committee, SWT and Mr Ray Murray, British Trust for Ornithology.

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BOTANICAL REPORT FOR 1999
FLOWERING PLANTS AND FERNS

COMPILED BY
D. R. GRANT
19 The Wheatings, Ossett, West Yorkshire WF5 0QQ

The recorders thank all those who have sent records: Nomenclature is according to Kent, D. H. (1992) *List of Vascular Plants of the British Isles* and Stace, C. A. (1991) *Flora of the British Isles.*

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EAST YORKSHIRE (VC61) (P. J. Cook)

Equisetum x *litorale* Hoddy Cows, Buckton TA17; YNU Excursion.
Polypodium interjectum On mortar, central Withersea TA32; P.J.C. conf. R.H.R.
Chenopodium polyspermum On waste ground, Withernsea TA32; P.J.C.
Malva neglecta On farmyard waste, Easington TA41; P.J.C.
Juncus ambiguns Near Humber at Easington, on sand with *Glaux maritima* TA31, P.J.C.
Elytrigia x *oliveri* West Hull dockland TA02; B.B.G. Excursion 1998, conf. T.A.C., Spurn TA41; B.B.G Excursion 1999 conf. T.A.C.

NORTH-EAST YORKSHIRE (VC62) (T. F. Medd)

Ranunculus arvensis Pickering SE78 A.B. per I.W.
R. auricomus Forge Valley SE98 A.I. per E.C.
R. lingua Old oxbow, Wykeham SE87 M.H.
Thalictrum flavum East Ness SE77 M.H.
Rumex hydrolapathum Doodales fish ponds, Old Malton SE87 M.H.
Malva neglecta Roadside, Rievaulx SE58 N.A.T.
Umbilicus rupestris Scaling Dam NZ71 D.F.
Potentilla palustris Doodales fish ponds, Old Malton SE87 M.H.
Rosa canina x *sherardii* = *R.* x *rothschildii* Ingleby Greenhow NZ50 and Brotton NZ61 V.J. conf. G.G.G.
R. caesia x *sherardii* Ingleby Greenhow NZ50 and Little Moorsholm NZ61 V.J. conf. G.G.G.
R. sherardii x *mollis* = *R. shoolbredii* Ingleby Greenhow NZ50 V.J. conf. G.G.G.
Ornithopus perpusillus Set-aside, Terrington SE67 M.H.
Myriophyllum alternifolium Fish ponds, Gilling SE57 M.H.
Lythrum portula Strensall Common SE66 M.E.; pond, Goathland NZ80 T.F.M.
Menyanthes trifoliata Old oxbow, Wykeham SE87 M.H.
Lithospermum officinale Wath Wood SE67 M.H.
Euphrasia artica x *micrantha* = *E.* x *difformis* Ingleby Greenhow NZ50 V.J. conf. A.J.S.
E. confusa x *nemorosa* Ingleby Greenhow NZ50 V.J. conf. A.J.S.
E. confusa x *micrantha* Ingleby Greenhow NZ50 V.J. conf. A.J.S.
E. scottica Ingleby Moor NZ60 V.J. conf. A.J.S.
Utricularia vulgaris (most probably *E. australis*) Fish ponds, Gilling SE57 and pond, Strensall Common SE66 M.H.
Potamogeton gramineus Fish ponds, Gilling SE57 M.H.
Groenlandia densa Costa Beck, Pickering SE78 M.H.
Eleogiton fluitans Y.W.T. Reserve, Strensall Common SE66 M.H.
Schoenus nigricans Mire, Coulton Mill SE67 M.H.
Carex vesicaria Fish ponds, Gilling SE57 and East Ness SE77 M.H.
Calamogrostis canescens Fen in valley along Coulton Beck SE67 and Doodales fish ponds, Old Malton SE87 M.H.
Polygonatum multiflorum Beadale Wood, Wrelton SE78 M.H.
Orchis moria Kirbymoorside golf course (one spike) SE6 8 M.H.

SOUTH-WEST YORKSHIRE (VC63) (D. R. Grant)

Spergularia marina A1 roadside, Wentbridge SE4916 V.J.
Populus tremula Cockersdale, Tong, Bradford SE2330 T. S.
Rubus scissus Royds Hall Great Wood, Norwood Green SE1327 D.R.G.
R. sciocharis Old Hanna Wood, Norwood Green, SE1427 T.S.
R. armeniacus Dewsbury Moor, Dewsbury SE2220 E.T. and Attercliffe, Sheffield, SK3788 T.S.
R. ulmifolius Dewsbury Moor, Dewsbury SE2220 E.T. and Slade Hills, SK5489 D.R.G.
R. mucronulatus Cromwell Bottom, Elland SE1222 D.R.G.
R. infestus Near Upper Denby SE2107 T.S.
R. rufescens Gregory Spring Wood, Mirfield SE2118 D.R.G
R. echinatoides Woolley, Wakefield SE3212 D.R.G
R. hylocharis Bagger Wood, Hood Green SE3002 T.S. and Bretton Hall Estate, Wakefield SE2712 D.R.G.
R. warrenii Attercliffe, Sheffield SK3788 T. S. and Sykehouse SE6417 T.S.
R. pruinosus Woolley, Wakefield SE3212 D.R.G.
Prunus padus Cowling SD9743 T. S.
Rosa sherardii Near Cowling SD9443 D.R.G.
Berula erecta Durkar,Wakefield SE3216 D.P.

Oenanthe lachenalii Torne Bridge, Hatfield SE6703 T.S.
Dipsacus fullonum Woodhouse Washlands, Y.W.T. Reserve SK4385 T.S.
Hieracium umbellatum Durkar, Wakefield SE3216 D.R.G.
Potamogeton pectinatus Torne Bridge, Hatfield SE6703 T.S.
Zannichellia palustris Upton Country Park SE4813 D.R.G.
Carex otrubae Woodhouse Washlands SK4385 T.S.
C. pseudocyperus Torne Bridge, Hatfield SE6803 T.S.
C. spicata Bretton Hall Estate, Wakefield SE2712 D.R.G.
C. rostrata Pond near Roche Abbey, Maltby SK5489 J.N.
Calamagrostis epigejos Durkar, Wakefield SE3216 D.P.
Puccinellia distans Honley, Huddersfield SE1311 J.L.

MID-WEST YORKSHIRE (VC64) (P. P. Abbott)

Hymenophyllum wilsonii Ingleton SD6974 E.N. Staff
Chenopodium hybridum Bridge Hewick SE3370 M.W.Y.P.R.G.
Rumex x *lingulatus* (*R. hydrolapathum* x *R obusifolius*) Burley-in-Wharfedale SE1546 M.W. det. J.R.A.
Salix myrsinifolia Scar House Reservoir SE0677 P.P.A.
Lepidium heterophyllum Hunsingore SE4155 P.P.A.
Lepidium latifolium Blubberhouses SE1455 J.K.
Vaccinium x intermedium Whit Moor SE1359 Y.N.U. Botanical Section
Hottonia palustris Nova Scotia Wood SE4849 P.P.A.
Rubus chamaemorus Conistone Moor SE0070 B.B.
Rosa canina x *R sherardii* Woodside Quarry SE2538 P.P.A., MW det. A.L.P.
Trifolium micranthum Scar House Reservoir SE0676 P.P.A.
Apium inundatum Clapham Moor SD7-6- B.B.
Mysotis stolonifera Woogill Moor SE0778 P.P.A. and Thruscross SE1359 Y.N.U. Botanical Section.
Dipsacus pilosus Thruscross SE1557 M.J.L.
Viburnum lantana Slaidburn SD7250 M.A.
Juncus compressus Lawsings Brow SD7466 G.T.D.W.
Carex x involuta (*C. rostrata* x *C. vesicaria*) Rathmell SD7759 P.P.A., G.T.D.W.
Carex digitata Studley Royal SE2968 M.F., M.P.
Carex divulsa ssp. *divulsa* East Keswick SE3644 P.P.A., H.E.F. and Studley Royal SE2769 M.F., M.P.
Carex muricata ssp. *muricata* Gordale SD9-6- P.P.A., H.E.F., M.F., M.P.
x Agropogon littoralis Woodside Quarry SE2538 M.W.
Hordelymus europaeus Lees Wood SD6643 P.J.
Narcissus pseudonarcissus Buckden SD9-7- P.P.A., H.E.F.
Epipactis atrorubens Stackhouse SD8165 M.W.N.
x Dactylodenia st-quintinii Hellifield SD8556 P.P.A., G.T.D.W.

NORTH-WEST YORKSHIRE (VC65) (T. F. Medd)

Thelypteris palustris Near Ripon SE37 S.W.
Dryopteris expansa Hurst Moor NZ00 T.W.
Ranunculus sceleratus Leyburn SE19 D.J.M.
Thalictrum flavum Crakehall SE29 Y.N.H.S.
Atriplex littoralis Near Ripon SE37 M.B. and A66 Gretna Bridge NZ01 C.J.L.
Spergula arvensis Barnard Castle NZ01 C.J.L.
Coronopus squamatus Aysgarth SE08 D.J.M.
Pyrola minor Whitcliffe Wood NZ10 T.W.
Trientalis europaea Langthwaite NZ00 T.W.
Saxifraga hirsuta x *spathularis* = *S.* x *polita* Langthwaite NZ00 T.W.
Laburnum anagyroides Swale Bridge SE38 D.J.M.

Epiloblum parviflorum x *montana* = *E. limosum* Whorlton NZ11 T.D.D.
Sium latifolium Crakehall SE29 Y.N.H.S.
Silaum silaus Crakehall SE29 Y.N.H.S.
Gentianella amarella ssp. *septentrionalis* Leyburn SE19 P.P.A.
Solanum nigrum Leyburn SE09 P.P.A.
Senecio aquaticus x *jacobaea* = *S.* x *ostenfeldii* Whorlton NZ11 T.D.D.
Juncus alpinoarticulatus Cronkley Fell NY82 C.M.
Carex divulsa ssp. *divulsa* Richmond SE19 T.W.
Tofieldia pusilla Mickle Fell NY82 J.A.
Neottia nidus-avis Whitcliffe Wood NZ10 T.W.
Anacamptis pyamidalis Bellflask SE27 B.M.

ALIEN PLANTS (G. T. D. Wilmore)

Azolla filiculoides Hull Br., Near Beverley TA04 W.R.D.
Pseudotsuga menziesii Riverside, Bingley SE101308 B.A.T.
Nigella sativa Bolton Lane, Bradford SE 165347 B.A.T.
Berberis gagnepainii Bolton Lane, Bradford SE 167344 B.A.T.
Juglans regia Tip, near Sprotborough SE5525 D.R.G.
Chenopodium capitatum Tip, Esholt, Bradford SE178598 M.W.
Salsola kali ssp. *ruthenica* St Andrews Quay, Hull TA0726 J.M.
Amaranthus hybridus Garden in Driffield TA031577 E.C.
Amaranthus cf. *rudis* Albert Dock, Hull TA02 R.A.E. det. T.B.R.
Lychnis coronaria Verge, Beverley TA03 J.D.
Rumex pseudoalpinus Braithwaite SE1460 S.E.
Hypericum calycinum River bank, Saltaire SE143382 M.W.
Coronopus didymus Gearstones SD7481 M.P.
Cyclamen hederifolium Copt Hewick SE3471 P.P.A.
Sempervivum tectorrum Goit Stock, Harden SE0737 G.T.D.W.
Saxifraga x *arendsii* Wall, Bolton Wood, Bradford SE163357 B.A.
Saxifraga cuneifolia Goit Stock, Harden SE0737 M.W.
Spiraea x *vanhouttei* Buck Wood, Esholt SE174391 B.A.T.
Potentilla recta Woodside Quarry, Horsforth SE2538 M.W.
Geum macrophyllum Goit Stock, Harden SE0737 B.A.T.
Cotoneaster induratus Hey Road, Bradford SE155331 M.W. det. J.F.
Colutea arborescens Railway Station, Bradford SE 166334 M.W.
Vicia villosa William Street, Sheffield SK3486 O.L.G.
Lathyrus annuus Bolton Lane, Bradford SE168350 B.A.T.
Trifolium incarnatum ssp. *incarnatum* Fairburn SE4627 M.J.L.
Epilobium komarovianum Garden weed, Driffield E.C.
Euphorbia amygdaloides ssp. *robbiae* Bolton Hall Road, Bradford SE162363 B.A.T.
Tropaeolum majus Tip, Ainsbury Avenue, Bradford SE178395 M.W.
Solanum chenopodioides Goole Docks G.T.D.W.
Solanum rostratum William Wright Dock, Hull TA02 R.A.E.
Symphytum bulbosum Plantation, near Kirkburn SE9854 E.C.

CORRECTION

During the YNU visit to the Ingleborough Hall Estate, Clapham in July 1995, one of the plants introduced by Reginald Farrer into the woodland upstream from the lake, and reported in *The Naturalist* **125**: 182-183, was misidentified at the time as *Maianthemum bifolium.* It was eventually realised that the plant in question differed from our native species in that it was glabrous and had larger leaves. It was, in fact, *M. kamtschaticum*, an Asian species. I apologise for this error.

Phyl Abbott

YORKSHIRE NATURALISTS' UNION EXCURSIONS IN 1999

COMPILED BY
A. HENDERSON

RAVENSCAR (VC62) 15 May (J. M. Blackburn)

A party of 28 members assembled at Ravenscar on a dry sunny morning. The area to be examined, north of the village, is owned largely by the National Trust with open access. The way in was along the disused railway between Scarborough and Whitby and also by the Cleveland Way which crosses the area. The sandstones and shales present in the area produce an acidic environment. Much of the interest centred around the old marl quarries, the first of these including extensive spoil heaps colonised by broom and gorse. Parts of this quarry were wooded with willow, birch, holly and rowan all present, much of the willow existing as carr. There was much evidence of the latest use of the quarry as a brickworks. Progress through the second quarry, at Stoupe Brow, was much restricted by gorse and heather. Most members reached this point at some part of the day.

The fields between the railway and the coast were in use for grazing, but several gullies, dividing them, were largely impenetrable near the cliffs. The field bottoms, to some extent due to recent heavy rains, were very wet, resulting in some rewarding areas of willow carr. The shore was accessible at Peak Scar and several members took advantage of the state of the tide to spend time there. A roe deer was seen during the day, also rabbits, with one large burrow present. Mole, common lizard, frogs and an adder were also seen.

The tea and meeting was held in Ravenscar village hall, attended by 16 members representing 13 societies. Following the lively reports, the chairman Mr Albert Henderson wound up the meeting after the proposal of thanks to the Divisional Secretary.

ORNITHOLOGY (W. F. Curtis)

[A circular walk of the area was undertaken by the lone ornithologist.]

In the vicinity of the parking area, the only location with any concentration of houses, the expected species were reported. Swallow, House Martin, Chaffinch, House Sparrow, Great Tit, Blue Tit and Robin, whilst in the fields opposite the houses Skylark, Willow Warbler, Magpie, Jackdaw and Wood Pigeon were present. The woodland, open fields and golf course near the Ravenscar Hotel revealed some 20 species, including Song Thrush, Chiffchaff, Greenfinch, Linnet, Yellowhammer and Rook, whilst both Cuckoo and Curlew were heard calling. The golf course itself was rather devoid of birds excepting the numerous Jackdaws, though in the gorse to the south of this area Common Whitethroat, Wren and Willow Warbler were well distributed. Both Common and Herring Gull were seen over-flying this area. Descending the cliffs to the beach a pair of Fulmars were noted prospecting the area, whilst further north near Stoupe Bank at least two pairs were considered breeding.

With the tide well out, though on the flood, numbers of Oystercatcher were feeding on the exposed rocky areas together with a single Whimbrel, Purple Sandpiper and two Turnstones. Only small numbers of gulls were seen, with Black-headed, Herring and Common all being equally represented. A single Great Black-backed Gull was seen flying south as were a party of five Kittiwakes. Rock Pipits were numerous along the shore-line whilst Sand Martins and Pied Wagtails were also noted. A single, male, White Wagtail was seen near the steps at Stoupe Beck.

Lunch was taken on the cliff-top at Stoupe Beck during which time Cormorant, Shag, Gannet, Kittiwake, Sandwich Tern, Guillemot and Fulmar were observed off-shore. A lone Grey Heron was also seen by a rock pool at this point. The road was then followed past Stoupe Brow Quarry to the bridlepath leading towards Church Farm and finally back to the parking area. The quarry itself revealed little though along the road and bridlepath Whitethroats were well distributed as were Linnets, Greenfinches, Goldfinches, Yellowhammers and Meadow Pipits. During this walk the only bird of prey seen all day was a male Kestrel. A Green Woodpecker was heard "yaffling" on several occasions. Tree Pipits were observed displaying at three locations, where also the only Lesser Whitethroat of the day was seen. At a damp/marshy area, visited by other members, Mallard, Moorhen and Spotted Flycatcher were recorded and, near the cricket pitch, a female Wheatear and a Redlegged Partridge were observed whilst a Bullfinch was noted towards the hotel. A total of 60 species was recorded during what was an excellent day.

CONCHOLOGY (A. Norris)

The land and freshwater mollusca proved scarce amongst the acid shales, which make up much of the cliff habitat, with a total of only fourteen species being found. The area surrounding the alum spoil heaps, however, did produce small numbers of *Punctum pygmaeum*, *Columella aspera* and *Nesovitrea hammonis*. The edge of the field bordering the main road, close to the Ravenscar Hotel, contained large numbers of dead shells of the calcicole species *Cemuella virgata*, their empty shells being the results of spraying the area with herbicides.

The marine mollusca proved almost as difficult, due to the tide having turned at almost the same time as we arrived on the shore, which severly restricted the time available for examining the lower shore area. This area of the coast is well known for the speed at which the tide advances. The rocks on the lower shore, below Old Peak, had several areas on which the fry of the common mussel *Mytilus edulis* have become established in very large quantities. In this area small numbers of the small gastropod *Onoba semicostata* occurred. The lower shore also produced numbers of the coat-of-mail-shell *Tonicella rubra*. The mid-shore level was dominated by various species including numbers of the dog whelk *Nucella lapellus*, some of which showed signs of parasitic infection. The large pools in this area contained small numbers of the common coat-of-mail-shell *Lepidochitona cinereus*, the large sea-slug *Archiodoris pseudoargus* and the limpet *Patella aspera*. This area also contained a single dead shell of *Colus gracilis*. The undoubted find of the day, however, was made by Dr Peter Tannett, who found an adult Curled Octopus *Eledone cirrhosa* amongst the seaweeds of the lower shore.

All the published records from the Yorkshire coast are of the Curled Octopus; there are no old records of the Common Octopus. It is interesting to note, however, that neither of these species has ever been accepted officially onto the county list.

OTHER INVERTEBRATES (A. Norris)

The list of isopoda found on the cliffs at Ravenscar was predictable with the five most common species being found under stones and wood. At the base of the cliffs, a small number of the largest British woodlouse, the sea slater, *Ligia oceanica*, also occurred. The rock pools produced a number of species of crab, including the Shore Crab *Carcinus maenas*, the Fiddler Crab *Portunas puber*, the Hermit Crab *Eupagurus bernhardus* and the Porcelain Crab *Porcellana longicornis*, as well as adult and young of the Edible Crab *Cander pagurus*. The Beadlet Anemone *Actinia equina* and numbers of the Common Starfish *Asterias rubens* and the Brittle Star *Ophiothrix fragilis* occurred under rocks and in rock pools.

LEPIDOPTERA (J. A. Newbould)

In spite of the promising habitats and with extensive beating, Dr P. Tannet and I recorded few species, reflecting the cold weather earlier in the week. Larvae of the Northern Oak Eggar *Lasiocampa quercus* ssp. *callunae* were plentiful on the heather and large numbers of Drinker Moth *Philudoria potatoria* larvae were reported. Only four butterflies were seen, six Small White *Pieris rapae*, and Green-veined White *P. napi*, Peacock *Inachis io* and Small Tortoiseshell *Aglais urticae* were seen in small numbers. Common Heath Moth *Ematurga atomaria* and the micro-moths *Anthophila fabriciana*, *Glyphipterix simpliciella* (associated with Cock's-foot) were seen. The leaf mine of *Stigmella aurella* was common on bramble.

DIPTERA (R. Crossley)

Collecting was mainly confined to small wet hollows dominated in parts by willows (*Salix* spp.) scattered along the hillside. A limited range of common species of Tipulidae (crane flies) and *Empidoidea* were found, but there were disappointingly few syrphids (hover flies), of which the most interesting was the wasp mimic *Chrysotoxum arcuatum*.

Only one sciomyzid (snail killer fly) was found, which proved to be the Red Data Book *Ectinocera borealis*. This boreo-montane species was first recorded in Yorkshire at Austwick by Chris Cheetham in 1926 and also by him at Grass Woods. It has since been found at Malham Tarn and I found a specimen at High Spring Wood in Swaledale in 1993. The majority of British records are from Scotland.

FLOWERING PLANTS (J. Lambert)

The main route taken was along the railway path north of Ravenscar towards Robin Hood's Bay. Here a magnificent show of flowering Gorse *Ulex europaeus* and Broom *Cytisus scoparius* was to be seen in the area of the disused quarries. Ling *Calluna vulgaris*, Bell heather *Erica cinerea*, Bracken *Pteridium aquilinum* and Bilberry *Vaccinium myrtillus* were characteristic of this dry, heathy terrain. Cowberry *V. vitis-idaea*, a much less common plant, was also recorded.

Some members found Prickly Heath *Gaultheria (Pernettya) mucronata*. This South American shrub is mentioned in Nan Sykes's book *Wild Plants and their Habitats in the North York Moors* as being established in the area, presumably bird-sown. Another interesting plant was the White Ramping Fumitory *Fumaria capreolata* which appears to have a somewhat coastal distribution on the North Yorkshire Moors.

As the path continued it was noticeable that species preferring acidic types of soil such as Heath Milkwort *Polygala serpyllifolia*, Wavy Hair-grass *Deschampsia flexuosa* and Foxglove *Digitalis purpurea* decreased, and a more calcicolous flora such as Crosswort *Cruciata laevipes*, Glaucous Sedge *Carex flacca* and Hard Rush *Juncus inflexus* began to appear. Some good areas of damp deciduous woodland showed Golden Saxifrage *Chrysosplenium oppositifolium*, Woodruff *Galium odoratum*, Hard Shield-fern *Polystichum aculeatum* and Pendulous Sedge *Carex pendula*, with more common woodland species.

Elsewhere pools and wet ground had such species as Round-leaved Crowfoot *Ranunculus omiophyllus*, Bog Pondweed *Potamogeton polygonifolius* and Blinks *Montia fontana*.

Ladies from the Cleveland Naturalists' Field Club handed in a magnificent list of the plants they had found, making a final total of 150 species recorded on the day.

(John Newbould)

The day was spent examining the woodland associated with the Cleveland Way in GR NZ 9702 and NZ 9701 along with the Low Peak Alum Works.

Much of the woodland recorded was considered to be of the *Ouercus robur-Pteridium aquilinum-Rubus fruticosus*, NVC type W10, but, with an *Acer pseudoplatanus-Oxalis acetosella* sub-community. During the existence of the alum works the woodland was exploited as a fuel source, evidenced by many pollarded trees. Oak was scarce and the Birch was *Betula pendula* in the damp areas. In wet areas the scrub was dominated by *Salix cinerea* s.s. and also *Salix cinerea* ssp. *oleifolia*. There were extensive areas of NVC type W23 *Ulex europaeus-Rubus fruticosus* scrub and areas of W25 *Pteridium aquilinum-Rubus fruticosus* underscrub. The quarries to the south-west of the disused railway, east of Stoupe Brow, had a disused brick-lined kiln and the worked shales were extensively covered with *Calluna vulgaris* and *Erica cinerea* NVC type H10 heathland.

A meadow adjacent to the Low Peak Alum Works was NVC type MG6. *Lolium perenne-Cynosurus cristatus* grassland had yellow rattle *Rhinanthus minor* and Pignut *Conopodium majus* forming an *Anthoxanthum odoratum* sub-community. The area has been scheduled in one of the joint conservation schemes operated by English Nature, the Countryside Agency and English Heritage.

BRYOLOGY (J. M. Blackburn)

The old railway track was profitable for many of the commoner species of bryophytes such as *Atrichum undulatum*, *Bryam capillare*, *Dicranella heteromalla*, *Dicranoweisia cirrata*, *Dicranum scoparium*, *Mnium hornum*, *Plagiomnium undulatum*, *Polytrichum formosum*, *Rhytidiadelphus squarrosus* and *Scleropodium purum*. The old marl quarry along here produced some of the more interesting finds of the day. In an area of willow carr the uncommon *Calliergon cordifolium* was seen in a typical habitat for the moss, which is only thinly scattered in the vice county. Also here was *Sphagnum squarrosum* and, on old logs and even bricks, *Aulacomnium androgynum*, with its prominent "drumsticks". The shale had a good cover of acid-loving species, *Barbilophozia floerkei*, the three commoner *Calypogeia* species, *Cephalozia bicuspidata*, *Diplophyllum albicans* and *Gymnocolea inflata*. Further along the railway track an elder tree was found with a large colony of *Ulota phyllantha* with its clusters of brown gemmae on the tips of the upper leaves. This is predominantly a moss of coastal areas and is found in several places along this stretch of coast between Hayburn Wyke and Sandsend, with one inland site near Northallerton.

Stoupe Brow quarry was comparative moorland in character, with much Ling and Gorse. Species found here, not seen in the first quarry, included *Pleurozium schreberi*, *Pogonatum aloides*, *Rhytidiadelphus loreus*, the very uncommon *Barbilophozia atlantica*, *Lophozia ventricosa*, *Marsupella emarginata*, *Ptilidium ciliare* and *Riccardia chamedryfolia*.

The wet field bottoms were examined and the main interest was three *Sphagnum* species, *S. fallax* ssp *fallax*, *S. fimbriatum* and *S. palustre*. The cliffs at Peak Scar had little extra to offer, with *Aneura pinguis* the only notable addition. Despite the wholly acidic nature of the ground covered a gratifying total of 94 bryophytes was recorded.

MYCOLOGY (M. W. Sykes)

Two species, *Bolbitius vitellinus* and *Stropharia semiglobata*, found on acidic grassland were associated with dung. *Kuehneola uredinis*, *Puccinia obscura* and *Uromyces muscari* were found on living plants. Species such as *Stereum hirsutum*, *Hypoxylon fragiforme* and *Lycogala epidendrum* (a Slime Fungus) occurred on wood, and *Marasmius oreades*, the Fairy Ring Champignon, grew in the soil by a path. Altogether 13 species were recorded, a boundary hedge being the most productive habitat.

LICHENOLOGY (A. Henderson)

Ravenscar holds particular interest for the lichenologist with its fine array of spoil heaps from the old alum farm, heather and gorse clumps aplenty on the seaward-exposed mounds and slopes, among them stretches of well developed *Cladonia-Coelocaulon-Stereocaulon* sward and, here and there, patches of *Porpidia* species, *Micarea lignaria*, collemataceous species and, more occasionally, the delightful pink-flushed thalli of *Baeomyces roseus*. A sheltered mine-slope north of the old railway line held the secretive species *Bryophagus gloeocapsa*, immersed in a thick mat of the purplish filamentous alga, *Zygonium ericetorum* (see *Bulletin of the Y.N.U.* **34:** 28-29 [1991]. Since this area and the coastal bay immediately below the hotel, where *Pyrenocollema halodytes* speckles the massed barnacles on intertidal rock and stone with its black pimply fruits, have been well observed lichenologically over the last 25 years, the opportunity was taken to explore the lower slopes of Low Peak and Stoupe Brow, north-east of the disused railtrack to Robin Hood's Bay. Here the flora had few real surprises, although considerable interest derived from the rather 'suburban' flora of old building remains and the dust-enriched lichens of agricultural fencing. The corticolous and saxicolous floras of this area are of limited diversity, no doubt due in part to past pollution from the huge firestacks heaped and burned by the alum industry, the carbonaceous deposit from which is still thick on the local wall copings.

BRETTON PARK (VC63) 5 June (D. G. Hemingway)

Fine weather assisted us in our exploration and investigation of the extensive landscape of

Bretton Hall, with a choice of habitats ranging from parkland to mature beech woodland, marsh, scrub and two stretches of lake alongside the Dearne.

Tea and the concomitant reports meeting were held in the canteen. The President, John Dale, chaired the meeting which produced some detailed accounts of the area, all the more fascinating for the detailed knowledge gained over years by many of the contributors.

Mammals & Lower Vertebrates (J. A. Newbould & C. A. Howes)

Traditionally a very well worked site, Bretton Park can boast a long list of recorded mammals including the now locally extinct Otter, Pine Marten, Dormouse, Red Squirrel and Water Vole. The Y.N.U. visits of 1890 (listing 6 species) and of the Coronation year of 1953 (listing 13 species) contributed records of 16 mammal species for the Park. Recent developments in night-vision optics and ultra-sound detection have added an enviable bat list including the nationally very local Leisler's bats and indicating a rich mosaic of bat-feeding habitats and a good range of arboreal and built roost sites. Bob Croxton and John Newbould visited the park with bat detectors the previous evening and recorded Noctule, Daubenton's and the newly separated species of Pipistrelle Bat which produces ultrasound at 55 Kh (a first for any Y.N.U. gathering).

The site's long history of recording has enabled faunal continuity and changes to be monitored. This latest Y.N.U. visit showed that Hedgehogs, present in 1953, still occurred, probably in abundance, judging from the numerous droppings deposited across the managed park and arboretum lawns. Moles, recorded from 1890, were evidenced by fresh mole-hills in both lawn and woodland habitats. Brown Hare, present in 1953, was seen in adjacent arable fields. Rabbit, recorded from 1890, was abundant according to sightings, droppings and burrows. Red Squirrel, recorded in 1953 (and indeed up to the 1970s), had been replaced by the numerous and tame Grey Squirrel. Fox, present in 1953, was still present in the woodland Nature Reserve area (footprints and fresh scent). Fallow Deer listed in 1890 and 1953 were absent but footprints of the recently spreading Roe were noted in woodland.

Sadly, no small mammal trapping was undertaken or bird pellets examined, so rodent and shrew populations went largely unevaluated, though Woodmouse runs and burrows were evident in woodland and Brown Rat was present in riparian sites where Ms H. Thornton saw one being caught by a Stoat. Roe Deer was also recorded.

Although Water Voles were a part of the riparian fauna of the canal and the lake in 1953 and at least until the 1970s, a wading survey of the feeder streams (by CAH) from the upper dam bridge upstream to the edge of the Y.W.T. Nature Reserve failed to locate any current signs. However, numerous old burrows, now algae- and moss-covered, indicating past occupation, were a feature at and below water level and one wondered if they had also provided refuges for Crayfish. It is likely that the removal of vole grazing influence has led to the current dominance in riparian situations of tall herbage rather than short sward. A possible cause for the Water Vole's demise is colonisation by Mink during the 1980s; indeed a Mink was seen hunting by Tim Kohler at the water's edge near the upper dam.

A Badger sett with at least five entrances, three of which appeared to show signs of occupancy, was located on an escarpment shaded by mature Sycamore and Horse Chestnut canopy, with a characteristic understory of elder and surrounded by brambles and tall herbage. In contrast to the adjacent thickly vegetated woodland, the sett area was largely devoid of a herb layer and had well worn paths leading off into the adjacent undergrowth.

Common Toad tadpoles and Smooth Newts were present in an ornamental pond on the college campus. Three-spined Stickleback was also present here. Les Magee and the freshwater biologists, in discussion with anglers, recorded Common Carp, Bream (which had evidently undergone a recent decline), Gudgeon (in lake and feeder streams), Perch, Pike, Roach and Tench (to 31b).

Ornithology (J. E. Dale)

A relatively calm mild day gave good conditions for locating birds. The total of 44 species recorded was not exceptional for this site, where breeding surveys regularly produce at least 60 species. However, coverage was confined to the lakes and the immediate surrounding woodland; the more distant peripheral areas of hedgerows and grasslands were not visited on the day.

Breeding species included: Grey Heron (20+ young), Mallard, Canada Goose (over 80 young), Moorhen, Coot, Kingfisher (2 pairs), Swallow, House Martin, Grey Wagtail (2 pairs), Pied Wagtail, Wren, Dunnock, Robin, Blackbird, Willow Warbler, Long-tailed Tit, Blue Tit, Tree-creeper, Chaffinch, Greenfinch and Goldfinch. In addition at least 6 Song Thrushes, 3 Garden Warblers, 10 Blackcaps and 8 Chiffchaffs were heard in song. Surprising absentees from the regular breeding list were Little Grebe and Great Crested Grebe (only a single seen).

Other species included Sparrowhawk, Green Woodpecker and Nuthatch, and also Tawny Owl which had been heard by members visiting during the previous evening.

Conchology (A. Norris)

The Y.N.U. reserve at Bretton Park was last surveyed for mollusca on 11 October 1969. On that occasion we recorded 18 species, 9 freshwater and 9 land, including 2 slugs. This visit produced 29 species, 7 freshwater and 22 land, including 7 slugs. 10 species from the original 1969 list were not re-found, making a total of 39 species recorded for the reserve over these two visits, with Dr Lloyd-Evans addition of *Pisidium obtusale* to the fauna of the reserve on January 16 1972. Thus a total of 40 species have been recorded for the Yorkshire Wildlife Trust Reserve.

The molluscan fauna of the reserve is fairly typical of the acid woodlands of South and West Yorkshire, with such species found as *Zonitoides excavatus*, a calcifuge species, restricted to acid woodlands. Slugs, so sparse in 1969, proved to be about in large numbers; in particular almost every large log examined produced several specimens of *Limax maximus*. The lake edge proved much more difficult to access than in 1969 and the few areas of lakeside marsh appeared to have a very different mixture of species. The restricted access resulted in a number of freshwater species not being refound on this occasion. The most remarkable difference in the molluscan fauna of the lakeside marshes was the large number of specimens of such species as *Lymnaea truncatula* and *Oxyloma pfeifferi*, neither of which was noted in 1969.

In general it was felt that the habitat, in several areas, had deteriorated to some extent, particularly the general water quality and lakeside marsh vegetation. The reported drop in the overall water level since 1969 has resulted in the extensive growth of rank herbage and trees. The large numbers of Canada Geese present on the lakes could also have adversely affected the water quality, and the lack of grazing on the grassy slopes and marshy edges has resulted in the growth of rank vegetation.

Lepidoptera (J. A. Newbould)

Mr R. Croxton, Mr R. F. Botterill and myself visited Bretton Lake on the evening before the meeting. We set a mercury vapour light trap, following a heavy shower at 8.30 p.m. on the north side of the eastern lake. With temperatures at 7°C only three moths were observed: Silver Ground Carpet (in good numbers), and singles of Common Wave and Clouded Silver. On the day of the meeting the temperature rose to 16°C and the number of species seen improved. Only two butterflies were observed all day. These were Small White and Gatekeeper. The larvae of Orange-tip were seen. Two macromoths were reported: Angle Shades and Common Carpet. The following micromoths were observed in good numbers, all quite expected at this time of the year: *Micopterix aruncella*, *Glyphipterix simpliciella*, *Olethreutes lacunana*, *Anthophila fabriciana*, *Nemophora degeerella* and *Chrysoteuchia culmella*. The mines of *Eriocrania subpurpurella* were observed on *Quercus* species and the mines of *Phyllonorycter maestingella* were present on beech.

Coleoptera (M. L. Denton)

The coleopterists present spent most of the day searching the area to the south of the lower lake. The use of the sweep net produced very few beetle species and, therefore, a thorough search of the dead wood and associated fungi was undertaken. By the end of the day a good selection of saproxylic species had been encountered. It was pleasing to see *Bitoma crenata* in such profusion, groups of up to 20 being located under the bark of several dead trees. *Sinodendron cylindricum*, the males of which sport a robust horn which projects from the head, was found in a number of the beech stumps. The Notable B species, *Scaphisoma boleti*, was located in decaying fungi. The finding of the woodboring beetle *Hemicoelus fulvicornis* provided Yorkshire with its seventh record. Although said to be common nationally, the species is predominantly southern in distribution. Several dead trees were found to be peppered with the emergence holes of *Ptilinus pectinicornis* and the click beetle *Denticollis linearis* was seen as it flew in the sunshine.

The only longhorn beetles located were *Clytus arietus* and *Grammoptera ruficornis*, both of which are common and widely distributed. The splendid longhorn, *Anaglyptus mysticus*, although not recorded on the day, has been encountered in the past.

The retention of dead wood, both standing and fallen, is paramount to the continued existence of these species which can carry out their life cycle in no other medium. An impressive list of 110 species of coleoptera was recorded on the day.

Trees & Landscape History (C. A. Howes)

(**NB:** These observations are informed by subsequent investigation of the relative frequency and history of the park's trees and its landscape/historical ecology.)

The population of Common Alder, which now obtrusively lines the northern fringes of the two lakes, seems to be a recent phenomenon since none of the specimens predates the 1950s. An interesting cohort of trees with a girth range of 20-24 inches, forming 15% of the current population, is estimated to date from the late 1970s and early 80s and possibly reflects the implementation of the Reservoirs Act of 1975. This Act led to the reduction of water levels in many reservoirs of over 25,000 m^3 in order to reduce pressures on elderly dam and weir structures. 63% of the population however, is within the younger 5 to 9 inch girth range which probably developed in response to the much publicised droughts of the past decade. Lowered water levels revealing an uncolonised shoreline, particularly on the main lake, would have allowed the germination of this new generation of alders. This sudden advance may also have been made possible by the coincidental demise of the water vole population, the grazing pressure of which, in the past, would have controlled the rate of riparian seedling survival.

The Hornbeam, one of the more interesting trees of the Park, joined the tree population at the turn of the 19th century. Small numbers (6% of the population), which from their proximity to the original trees were possibly seedlings, became established up to the 1950s. Recruitment accelerated between the mid-1960s and mid-1980s, accounting for 18% of the population. However, trees which germinated and passed through the sapling stage from the mid-1980s and now have girths between 5 and 14 inches, comprise some 70% of the current population. This noteworthy botanical development will in due course significantly alter the ecological complexion of the nature reserve.

The sample as a whole showed that the visually and ecologically highly significant oaks and beeches, surviving from the original post-1777 landscaping of Richard Woods, now constitute less than 1% of the current tree population. Although grazing pressure from deer, cattle and sheep would have effectively suppressed natural regeneration during the 18th to the early 20th centuries, various lavish phases of development in the estate would have been accompanied by extensive tree planting as noted in Bartle's *Short History of Bretton Hall* (1977). However, a curious absence of trees of the early decades of the 19th century may be due to a sale in 1832. A paucity of mid- to late-19th century trees is probably a consequence of felling during the First World War national timber crisis. Although oak and to a lesser extent sycamore rallied between the wars, relatively little regeneration seems to have taken place during the first half of the 20th century. The purchase of the estate in 1948 by the West Riding County Council, to be developed as a teacher training college, largely signalled the end of the park's browsing and grazing herds. In addition, the myxomatosis epidemic of 1954 brought about the demise of rabbit grazing pressure. In consequence, subsequent decades have witnessed dramatic natural regeneration phases of most woodland tree species, though pioneer species like silver birch, whose cycle of regeneration peaked in the 1980s, are increasingly shaded out.

FLOWERING PLANTS (D. R. Grant)

The Bretton Hall estate is situated on the Coal Measures series of rocks which are represented by sandstones and shales, these rocks giving rise to acid soils. There are several woods which contain both natural species and commercial timber trees. The open parkland has many introduced tree species, there being a very fine example of the Tulip tree. The river Dearne flows through the estate from the west, running to the north of the lake, then taking an almost 90 degree bend on the eastern border. This is due to the harder rocks of Woolley Edge which force the river southwards to flow into the River Don near Mexborough. The reserve, part composed of Bath Wood and Bridge Royd Wood, was thoroughly examined. Over 100 species of native plants were recorded. A new find for the reserve was *Carex spicata* which was growing beside one of the main footpaths. Many of the plants expected to grow in this type of acid woodland were found. There was plenty of *Rubus dasyphyllus* and *R. newbouldii*. By the old boat house there was *Carex remota*, *Sparganium erectum* growing with the introduced *Ranunculus lingua*.

Near the boundary wall in Bath Wood *Rubus rufescens* together with *Melicia uniflora* indicated ancient woodland. There is much *Rhododendron ponticum* here but open spaces have *Milium effusum* and *Luzula pilosa*. *Carpinus betulus* and *Quercus cerris* are becoming naturalised in these woods. The most notable species is the large colony of *Epipactis helleborine*. The upper lake has a very poor marginal flora, but the lower lake sides have *Acorus calamus*, *Lycopus europaeus* and many other common marsh land plants. The lake has *Elodea canadensis*, *Ranunculus trichophyllus* and a grass-leaved *Potamogeton* sp., the last two species being recent arrivals.

Other introduced plants of note in the parkland are *Petasites albus* and *Doronicum pardalianches*.

BRYOLOGY (T. L. Blockeel)

Recording was concentrated in Bridge Royd Wood and about the margins of the two lakes. At first, in Bridge Royd Wood, the flora proved to be poor in species, as often in Coal Measure woodlands. However, the ground at the western end of the upper lake was more productive, with a greater extent of moist and waterlogged habitats. Particularly noteworthy was a fine population of *Calliergon cordifolium* half submerged in a shaded channel. Also of considerable interest was a small amount of *Ulota phyllantha* growing on the bark of an elder bush. This is only the second record for the vice-county. Another *Ulota* species, *U. bruchii*, was found on a tree on the south bank of the upper lake. Other records from this area were *Plagiomnium affine* from damp, shaded ground, *Campylopus pyriformis* on peaty soil and some fine patches of *Lepidozia reptans* under Rhododendron. More open areas by the lower lake produced *Pseudephemerum nitidum* on a moist bank, and *Scapania undulata* on a damp, compacted track. A notable record from the sandstone of an old bridge was *Seligeria recurvata*, a species more usually found on gritstones in the Pennines.

A concrete pyramid near the lower lake had a fine growth of bryophytes, including *Syntrichia intermedia* (*Tortula intermedia*] and *Rhynchostegium murale*. The natural habitat of the *Syntrichia* is on limestone rocks and it is rare in Coal Measure districts. The total number of species recorded was 68.

LICHENOLOGY (A. Henderson)
The lichen flora of trees in general, down from the Hall and around the lakes, was little more than a *Parmelietum-Xanthorion* of limited diversity, although noticeably prolific by the bridge east of the Lower Lake; old ash and willow in sheltered corners here had *Ramalina farinacea* and *Evernia prunastri* and sported up to 16 lichen species per tree. Saxicolous lichens, too, showed their fullest presence around the lakes, especially on the bridge wall copings. Fencing above the Lower Lake and Cut had throughout its entire length an impressive continuum of *Micarea denigrata*, *Lecanora conizaeoides*, *Placynthiella icmalea*, *Trapeliopsis granulosa* and *T. flexuosa*, infrequently and startlingly spotted by isolated, upstanding thalli of *Platismatia glauca*, *Evernia prunastri*, *Ramalina farinacea* and *Usnea subfloridana*, looking strikingly like miniature sculptures in this setting.

The park's sculptures proper are kept free of lichen colonisation, being checked daily by curatorial staff for damage, deposition of dirt, epiphyte intrusion, etc., and the bronzes receive a protective film of microcrystalline wax, giving defence against the weathering process of climate, acidic deposition and biodeterioration. Such protection is essential in the care of valuable *objets d'art* in outdoor situations, particularly in view of their loan status, their welfare being the responsibility of the Sculpture Park.

The pyramidal form by the Lower Lake, which is generously covered in moss and lichen and quite often mistaken for one of the park's sculptures by members of the public, is in fact an old pump-house, the form of its construction possibly due to the fashion for follies in 18th/19th century landscaping.

FRESHWATER BIOLOGY (L. Magee)
Bretton Park lakes are typical of many similar ornamental lakes created during the boom period of country estate landscaping in the 18th century. They are mainly eutrophic but can suffer from pollution due to the presence of large flocks of Canada Geese. There are no reed beds or obvious extensive beds of aquatic plants. The pH value was 7.92 and there were large deposits of silt and sludge from decaying leaves from the mature trees. The left bank of the lower lake was formerly open but there is now a heavy growth of willows and alders. A few hirundines were seen feeding over the lakes.

The most accessible area near to the bridge spanning the lake was thoroughly surveyed using standard nets. The bulk of the invertebrate population consisted of: Toad tadpoles (many thousands); the Molluscs, *Planorbis* species and *Potamopyrgus jenkinsi*; the Water Hog Louse *Asellus aquaticus*; the Freshwater Shrimp *Gammarus pulex*; the Leech *Helobdella stagnalis*; the Corixids, *Sigara dorsalis* and *Notonecta glauca*; the Diptera, *Culex species* (larval skins) and Chironomidae species (adults and larvae). A few adult Caddis flies were seen, captured adults including the Grouse Wing *Mystacoides longicornis*, *Polycentropus flavomaculatus* and the Cinnamon Sedge *Limnephilus lunatus*. The Mayflies, *Baetis rhodani*, *B. vernus*, *Caenis robusta* and *Cloeon dipterum* were all present, *C. dipterum* abundantly so (nymphs, exuviae and adults).

River Dearne. The stream, 4-10 cm deep, with a shale bed and algal flora, was very clear but with a strong smell of ammonia and some sewage pollution. However, there was a large population of the mayfly nymphs, *Ephemerella ignita* and *Baetis vernus*. The Shrimp *Gammarus pulex* was common. A few gudgeon were collected.

Lower Lake. The main area surveyed was close to the boathouse. Minnows and Three-spined Stickleback were plentiful. Other fish caught by anglers were: Common Carp, Mirror Carp (juvenile), Roach, Pike and Tench (a specimen of the latter, in good condition, weighing about three pounds was examined). A large population of Perch and native Crayfish present in 1998 was reported to have disappeared.

The flowering plants, *Potamogeton berchtoldii* and *Ranunculus lingua* (introduced) were seen near the boathouse; *P. perfoliatus* and *P. pectinatus*, formerly plentiful, were not seen.

(D. T. Richardson is thanked for several invertebrate determinations.)

FLAMBOROUGH & BEMPTON (VC61) 19 June (P. J. Cook)

This venue was chosen for the marvellous spectacle of thousands of breeding seabirds clinging to the cliffs at this time. For other disciplines the area promised chalk, land in transition from arable cultivation to naturalisation, ponds, an excellent fen bog/marsh stretch and old chalk woodland. The weather was pleasantly warm with still air, becoming overcast with light cloud in the afternoon.

18 members representing 13 different affiliated societies attended for refreshment and rest at the Royal Dog and Duck, Flamborough. The President Mr John Dale chaired the reporting session.

MAMMALS & AMPHIBIANS

Mammals reported were: Mole and Rabbit; a Hare seen at the edge of a barley field, a Field Vole (male) found dead but with no obvious injuries by a field of flax; and a Stoat was seen near the lighthouse. A Frog was noted near Hoddy Cows.

ORNITHOLOGY (W. F. Curtis & J. E. Dale)

The day began with most members of the party taking the opportunity to enjoy the fantastic spectacle of the Bempton Cliffs seabird colony. The RSPB do not necessarily supply our recorder for VC61 with breeding numbers at the colony each year. The most recent figures, however, indicate: over 2000 pairs of Gannet; Fulmar, about 700 pairs; Puffin and Razorbill, about 3000-4000 pairs each; Guillemot, over 13,000 pairs; and Kittiwake, an estimate of 75,000 pairs. Other birds of interest in this area included a Garden Warbler singing at the Bempton car park, and Corn Buntings by Bempton Lane and in the Hoddy Cows area. Flamborough Head has been well documented for more than 25 years by the Flamborough Ornithological Group who have consistently supplied the Y.N.U. with annual reports of their observations.

A total of 51 species was recorded on the day including: Eider, a party of 8 non-breeders; House Martin, fewer nesting in the cliffs than in recent years; Rock Pipit; Whitethroat; Blackcap; Tree Sparrow (Old Fall hedge); Linnet; Bullfinch and Yellowhammer.

CONCHOLOGY (A. Norris)

The day was divided between two differing sites and habitats. The morning we devoted to the RSPB reserve on Bempton Cliffs and the Hoddy Cows Springs area. In this fine marshy area a number of interesting species occurred, of which the following are perhaps the most significant: *Vertigo antivertigo*, *Punctum pygmaeum* and *Nesovitrea hammonis*; also *Vertigo substriata* and *Trichia plebeia*, fairly recent additions to the fauna of East Yorkshire with only one or two other sites known. In the afternoon we spent some time amongst the rocks, rock pools and cliffs of North Landing. These proved to be rather disappointing, with only 13 species of mollusca encountered. The conditions should have been ideal with low water in mid-afternoon, allowing us access to the lush beds of *Laminaria saccharina* and *L. digitalis*. The most interesting finds were the coat-of-mail shell *Lepidochitona cinereus* found in small numbers and the limpet *Patella aspersa*. The splash zone, which reached high up on the towering cliffs, produced large numbers of the small winkle *Littorina neritoides*. The wild battering this area of the coast receives makes the lower shore poor, but it also provides ideal conditions for those species adapted to life in the splash zone.

LEPIDOPTERA

The only butterflies reported were single sightings of Large White, Green-veined White and Meadow Brown. Moths reported were Cinnabar (as a single imago and as larvae on Ragwort), and a Chimney-sweeper.

ENTOMOLOGY (W. R. Dolling)
On *Veronica beccabunga* beside the spring-fed chain of ponds at Hoddy Cows was the leaf beetle *Prasocuris junci*, both adults and larvae, and on water-cress by the same ponds another leaf beetle, *Phaedon cochleariae* (both adults and larvae). Considering how little waterwide vegetation survives in VC61, these two leaf beetles, once regarded as common, are probably worth this mention. A rather good find was the larvae and adults of the weevil *Poophagus sisymbrii*. It is interesting to note here that these beetles are *not*, respectively, associated with *Juncus*, *Cochlearia* and *Sisymbrium*, nor does *Poophagus* feed on grasses as its generic name implies. The damp meadow with *Pinguicula vulgaris*, etc., yielded two *Cantharidae* of interest: *Cantharis pallida*, supposedly not common in Yorkshire; and *Malthodes pumilus*, allegedly in decline nationally but still frequent in VC61 at least. This area also produced a single specimen of the weevil *Barypeithes sulciprons*, a Notable B species. The fly *Terellia rupicauda* (family Tephritidae), said to breed in the capitula of *Cirsium arvense* and *C. palustre*, was also seen.

There were no Hemiptera of even passing interest.

PLANT GALLS (J. & K. G. Payne)
We followed the custom of the early field naturalists and collected on our journey to the coast. Our first stop was along Woldgate, the old Roman Road near Kilham, where we found mite galls on *Prunus spinosa* and *Galium aparine* and the galling rust *Puccinia galliverni* on *Galium cruciata*. *Lychnis dioica* was flowering well and after a search the rust fungus *Puccinia arenariae* and the anther smut *Ustilago violacea* were found on the same specimen. The rest of the day was spent in the wooded Danes Dykes valley where there is a road running down to the sea. Here galls were collected on beech, elm, ash and hawthorn. Though sycamore was plentiful no galls were found on it.

C. S. V. Yeates recorded several galls at Buckton. These included an *Apion* weevil gall on *Rumex acetosella*, *Jaupiella veronicae* on *Veronica chamaedrys* and *Phytoptus similis*, a mite gall on *Prunus spinosa*.

A detailed list will be sent to the appropriate local and national recorders.

FLOWERING PLANTS (P. J. Cook)
Vegetation along the cliff-top walk westwards from the RSPB Centre was dominated by a mixture of Cock's-foot, Hogweed and Red Campion, presumed sown, rather than an expected calcareous short turf with plants influenced by the maritime location.

However, *Cerastium arvense*, *Veronica officinalis*, *Centaurium erythraea*, *Cochlearia officinalis*, *Festuca rubra* and *F. ovina* showed through here and there. A field recently left to 'go wild' was doing just that, and although still covered predominantly by *Ranunculus repens* and *Cirsium arvense*, areas were clearly settling down. Gorse seedlings, *Helictotrichon pratensis* and some chalk grassland plants mentioned previously were showing. A marshy area yielded three common rushes viz. *Juncus conglomeratus*, *J. effusus* var. *compactus* and *J. inflexus*. Two ponds on the north-west side of this field contained *Potamogeton crispus*, *P. natans* and *Zannichellia palustris*, and the shallower of the two was notable for sweet grasses viz. *Glyceria fluitans*, *G. notata* and their hybrid *G.* x *pedicellata*, *G. declinata* and *G. maxima*. Some of these species were encountered again by the side of ponds and permanently wet areas near Hoddy Cows Springs. At the approach to the Hoddy Cows area, a trickle of water over the track provided an ideal habitat for *Ranunculus hederaceus* together with *Gnaphalium uliginosum*, *Veronica beccabunga* and *Juncus bufonius*, all crammed into a metre square.

The plants of Hoddy Cows are well documented; to name only five there are *Valerian dioica*, *Menyanthes trifoliata*, *Triglochin palustris*, *Eleocharis quinqueflora* and *Carex echinata* in addition to some mentioned in other reports. Added to the list was the hybrid horsetail *Equisetum* x *litorale*.

Some time was spent at North Landing searching, without success, for *Puccinellia rupestris*, first and last seen in 1935.

BRYOLOGY (T. L. Blockeel)
The cliff tops near Bempton are nearly devoid of bryophytes and it was therefore necessary to seek out habitats elsewhere on the Flamborough headland. The marsh at Hoddy Cows proved to be of considerable interest, particularly in the small zone where butterwort and marsh valerian were growing. Here *Drepanocladus cossonii* (formerly *D. revolvens* var. *intermedius*) was plentiful over a limited area, accompanied by *Campylium stellatum* (in small quantity) and *Cratoneuron filicinum.* The steep banks of a pond in the rough grassland nearer the cliff tops had nice material of *Pleuridium subulatum*, and *Dicranella schreberiana* was present on damp soil.

The afternoon was spent in the steep valley at the southern end of Danes Dyke, a locality well recorded for bryophytes. Danes Dyke is one of the northernmost localities for *Seligeria paucifolia*, a tiny moss which forms a thin felt-like growth on chalk pieces. What was presumably this species was found in good quantity on the banks in the bed of the Dyke, but the material was persistently sterile. Among other species noted were *Plagiochila asplenioides*, *Fissidens viridulus* and *Plagiothecium nemorale. Isothecium alopecuroides* (*I. myurum*) was found at the base of an inclined beech tree. Epiphytes were poor in number, but included *Ulota phyllantha* (noted on two ash trees and one sycamore), *Dicranum tauricum* and *Metzgeria furcata.* The *Ulota* has a long history at this locality, being first reported at the end of the nineteenth century.

The total number of species recorded was 43.

LICHENOLOGY (A. Henderson)
The morning route *via* the ornithological riches of Bempton cliffs and tracks inland to Bempton itself unsurprisingly yielded little for the lichenologist other than fragmentary patches of *Cladonia* and *Baeomyces rufus* in a mid-field quarry, and on an old wooden stile at Hoddy Cows *Scoliciosporium umbrinum* and *Lecanora saligna.* Hedges had *Amandinea punctata* and the young axils of trees *Xanthoria polycarpa*, typical in such an agriculturally enriched atmosphere.

During the afternoon in Flamborough the old wall running past the memorial enclosure produced a list of species expected in such an urbanised limestone/brick habitat, with mosaic assemblages consisting of various selections from the 35 or so species present, with golden/orange *Caloplaca flavescens*, *C. saxicola* and *C. decipiens* and the brilliantly white thalli of *Diploicia canescens* speckling the rusty brown bricks and grey stones. Within the nearby churchyard *Lecidea fuscoatra*, *Lecanora soralifera*, *L. intricata* and *Psilolechia lucida*, plentiful in one of their favourite habitats, helped to extend the species list for a lichenologically uneventful but most enjoyable day.

LEYBURN SHAWL WOODS AND QUARRY (VC65) 24 July (Deborah Millward)
At the Union's 72nd main field meeting at Shawl in 1888 *"very scant attention appears to have been paid to the Entomological Fauna"*. Even the concern over the future of the *Orobanche alba* seems unchanged as Mr John Percival, noted: *"it is now fast disappearing altogether"*. Thankfully *Orobanche alba* has not disappeared altogether, in spite of the best efforts of the rabbits, quarrying and landfill, and we were able to see some 20-30 spikes, including a new record beside the Shawl walk.

In 1888 Mr James Carter felt the Avifauna was *"of such a comprehensive character (both numerically and in rarity) that it was somewhat difficult to particularize"*. He went on to describe how specimens of Slavonian Grebe had been taken from the River Yore and sent to Mr Chapman's (a taxidermist and the father of John Percival, see *Bulletin* **33**) at Carperby for preservation. We no longer do that. Neither do we see many of Mr Carter's Blackcock.

Circular 72 gives good details of the conchology of Wensleydale, a discipline well covered in this year's report too, but sadly it has not been possible to provide the detailed geological data that accompanied the excursion notes over a century ago. The Flag quarries mentioned in 1888 have been filled in, but it would have been interesting to have had up-to-date records of the more recent exposures before they too are infilled.

Where we have advanced most significantly in our recording since those early days is in the fields of lichenology and bryology which were not even mentioned in 1888.

MAMMALS & LOWER VERTEBRATES (C. A. Howes)
Mammals have been recorded on Y.N.U. excursions in the Leyburn district on two occasions: in 1931 when Rabbit, Red Squirrel and Badger were encountered, and in 1957 when Brown Hare, Rabbit, Water Vole, Grey Squirrel and Weasel were seen. However, within this 26-year interval faunal changes were already being detected. Rabbit, though present, was substantially reduced by the 1954-55 myxomatosis epidemic and Red Squirrel, no longer recorded, was replaced by Grey Squirrel, spread from nearby Bedale where it was rashly introduced in 1913. Of Badger, an ancient inhabitant of the Dales and listed in 1931, there was no mention in 1957 and, though in 1999 the south facing wooded slope of Leyburn Shawl still showed landforms of long-abandoned and overgrown badger spoil-heaps, there were no signs of current setts, padded tracks or wire-snagged tufts of brindled hair. Although the badger's continued presence is confirmed elsewhere in Wensleydale (Deborah Millward *pers. comm.*), the several setts known within the SE/09 10 km square are all to the north in adjacent Swaledale.

Moles, according to their "tumps", are today abundant in grassland and woodland. A hedgehog dropping on rabbit-grazed turf near the old lime-kiln rabbit warren, contained the remains of the dung beetle *Typhaeus* which specialises in feeding on rabbit droppings. Rabbits are particularly abundant and influential in vegetation management on grassland, woodland ridings, the newly vegetating quarry floor and the landscaped and planted bunds around the land-fill developments. A particularly fine herb-rich sward near the old lime-kiln site next to the quarry, was protected from rank herbage invasion by the close-grazing of rabbits. Roe Deer, colonising the dale since the 1950s were accidently flushed and their footprints found in the Shawl woodland, and evidence of Roe Deer resting places was seen in Gillifield Wood. Numerous chewed cones from the population of old Scots Pine at the summit of Shawl Wood gave abundant evidence of squirrels, though none was seen to confirm the species. Hare was noted in 1957, and two Hares were seen in pasture land to the east of the quarry.

In the absence of small mammal trapping or bird pellet examination, rodent and shrew populations went largely unevaluated, though in local woodland dead specimens of Common Shrew and Bank Vole were encountered and in the nearby village of Wensley a Water Shrew was a road casualty by the church. In the quarry and associated land-fill, numerous foot and tail prints suggested a substantial Brown Rat population. Footprints also showed recent presence of Fox, whose droppings on the lime-kiln mound and in the quarry indicated a dependence on the Rabbit and Brown Rat populations. Opened nut-shells gathered from beneath odd old hazel bushes in the Leyburn Shawl showed identifiable gnaw marks of Wood Mouse, Bank Vole and Squirrels. Since Dormouse once occurred in coppice woodland at nearby Aysgarth, Askrigg, Bainbridge, Howbank Wood, Middleham and Thoresby Wood, the future management of Wensleydale woods as coppice with a significant element of hazel could be vital in encouraging back this endangered native woodland rodent. Although the underground drainage culverts, the masonry of the disused railway bridge and the numerous fissures in the extensive quarry walls suggested ideal bat roosting and hibernation sites, walks around the site after sunset with an ultra-sonic bat detector failed to detect any bat activity. By contrast, at nearby Wensley Bridge, the warm still evening was throng with Pipistrelle, Daubenton's and the occasional Noctule bat, attracted by huge numbers of insects rising from the river.

Common Toad and Palmate Newt were recorded by conchologists in the shallow quarry ponds.

ORNITHOLOGY (J. E. Dale & K. Good)
The quarry area was visited during the morning when a pair of Ringed Plover with three young were located near the main pool. This species bred near Catterick in 1970 since

when colonisation of gravel-pit sites in particular has continued steadily in VC65 where now at least a dozen sites are occupied annually. A similar pattern of events has occurred in the Vale of York in VC64 and around Doncaster in VC63. Nearby a pair of Oystercatchers showed some territorial behaviour, and family parties of Linnets were frequently located. Up to 30 Sand Martins were feeding in the area, particularly along the quarry face, along with smaller numbers of Swallows and House Martins.

Leyburn Shawl Wood was visited during the afternoon, and as expected at this time of the year things were rather quiet, with only 17 species noted. These included Sparrowhawk, Song Thrush, Blackcap, Spotted Flycatcher (2) and Bullfinch.

34 species were recorded during the visit, including up to three Kestrels hunting along the ridge, and Stock Dove in the quarry area during the afternoon.

CONCHOLOGY (A. Norris)

Molluscan recorders, being human, like to find alternative reasons or "excuses" for those occasions when recording is difficult. It is too hot, too dry, too wet, or any other excuse one can get away with. It is important, therefore, to be able to make comparisons. I visited the area of Leyburn Shawl with John Armitage on 3 August 1967, almost 30 years earlier to the day. On that occasion it was wet and humid, with several of the more local species occurring in numbers on the limestone walls. In those conditions we recorded 33 species; in the hot dry conditions of 1999 we recorded 39 species, 5 of these being freshwater species found in the quarry, an area out of bounds in 1969. The number of land snails found differed on the two dates only by 1, and therefore weather conditions do not necessarily affect the number of species found. These figures do not tell the whole story, however, as 7 species found in 1969 were not refound in 1999, and 8 land and 5 freshwater species are additional to the 1969 list. Adding the two lists gives a total of 46 species recorded on these two visits.

One of the main things to strike a recorder is the number of common species one might expect to occur which are still waiting to be found. We estimated that a further 10 land species should occur, on or very close to the Shawl. Frustration at not being able to find specific species, and recollections of the 1969 visit, took us back to a garden wall in Leyburn, on which large numbers of *Helicigona lapicida* and *Clausilia dubia* were found in 1969. *H. lapicida* still occurred on the wall in numbers but no trace of *C. dubia* could be found. Other species, not refound in 1999, include *Azeca goodalli*, *Vertigo pygmaea*, *Ashfordia granulata* and *Cepaea nemoralis*. Two of these, *A. Goodalli* and *A. granulata*, are associated with damp conditions.

Of the additions to the 1969 list *Pupilla muscorum* and *Vallonia excentrica* are considered to be dry grassland species. Whilst *Acanthinula aculeata*, *Arion (Mesarion) subfuscus*, *Arion fulvus* and *Monacha cantiana* are all catholic in the habitat requirements. Three species, *Vallonia costata*, *Ena obscura* and *Balea perversa* occurred in extremely large numbers on both visits. The only species found that is listed in the Yorkshire Red Data book (*Naturalist* **123:** 113-117), was a few dead shells of *Helicella (Helicella) itala*; this increasingly rare snail was found alive in August 1969.

BRYOLOGY (T. L. Blockeel)

The dry and dusty conditions were not ideal for recording bryophytes, but although the total number of species found (54) was not especially high, they did include some significant discoveries. On the quarry floor, the more established areas of open turf and stable stony ground had *Homalothecium lutescens*, *Campyliadelphus chrysophyllus*, *Syntrichia ruralis*, *Encalypta streptocarpa* and *Ditrichum gracile*. The moist hollows near the pool had a very different flora, which included *Aneura pinguis*, *Leiocolea badensis*, and some very fine *Marchantia polymorpha* ssp. *ruderalis*. A little *Bryum pallescens* was also found in this habitat. The most exciting record in the quarry was a good population of *Aloina brevirostris* on a mound of bare dry soil near the pool. This is the rarest of the British species of *Aloina*, with just a single previous record from VC65.

In Leyburn Shawl Plantation, the ground was much overgrown with nettles and difficult to work. Some of the boulders had good qualities of *Eurhynchium crassinervium* and there was a little *Homalia trichomanoides*. The epiphytic flora proved to be very interesting. As often near limestone quarries, there were a number of normally rupestral mosses which had become established on tree boles, including *Orthotrichum cupulatum*, *Tortula subulata* and *Schistidium apocarpum* s.l. Equally interesting in such places is the occurrence of species normally found in the flood zone of rivers. Thus *Syntrichia latifolia* was found on a sycamore bole. Of the more normal epiphytes, there were several tufts of *Orthotrichum stramineum* on a sycamore, and a good quantity of *Syntrichia laevipila*. *Cryphaea heteromalla* was found on a beech tree on the top of the Shawl. This is one of our most distinctive mosses; it is sensitive to SO_2 pollution, and there were no records from the county for a long period during the present century until it was refound in 1984. The new record is the first for VC65.

LICHENOLOGY (M. R. D. Seaward & A. Henderson)
Although the quarry workings and woodlands to the north and south of Leyburn Shawl respectively were disappointing, the ridge walkway was lichenologically engaging: along a 800 m stretch we recorded 75 species from natural limestone outcrops, a single continuous wall and a variety of trees. Of particular interest was *Anaptychia ciliaris*, a rarely encountered species in eastern counties today, forming a large number of conspicuous rosettes on the south-facing side of the limestone wall. Similar habitats supported the usual calcicolous lichen flora of about 37 species in exposed areas; the diversity was much reduced in shaded places although the mossy wall-top contained mats of *Leptogium gelatinosum*, patches of *Cladonia pocillum* and scattered *Bacidia sabuletorum*. The only natural exposures of limestone studied at one site had patches of leafy *Dermatocarpon miniatum* umbilically attached in crevices, as well as many of the species encountered on the wall-sides. A variety of deciduous and coniferous trees either side of the walkway provided habitats for moderately diverse epiphytic floras, the most notable species recorded being *Collema subflaccidum* (only the third record for the county this century), *Lecanora carpinea* and *Ramalina farinacea*. Other species of interest were collected from a range of other substrata, including siliceous gateposts (about 16 species), and stones (e.g. *Polyblastia gelatinosa*) and dust-impregnated short-turf grassland (e.g. *Peltigera didactyla*, *P. rufescens*, *Collema crispum* and *C. tenax* var. *ceranoides*) on the quarry flora. In all, 80 species were recorded of which 13 were new to the 10 km x 10 km grid square.

DARNBROOK FARM, MALHAM TARN ESTATE (VC64) 14 August (Jean Kendrew)

Despite the inclement weather prospects, over 20 people gathered at Darnbrook and were briefed about the management of the farm since it was acquired by the National Trust in 1995. To overcome the problem of overgrazing the sheep flock has been reduced, and the stock is brought off the moorland during the winter. The meadows are not cut until after July 1 each year, and slurry spreading has ceased.

The site provided a variety of habitats for exploration: high moorland, wooded areas, limestone grassland, limestone cliffs, areas of glacial till and drainage water fed Cowside, Thoragill and Darnbrook Becks. During the day members enjoyed pursuing their individual interests in pleasant, sunny conditions between the intermittent squally showers.

John Dale chaired the meeting in Amerdale Hall, Arncliffe, where 17 affiliated societies were represented.

MAMMALS & LOWER VERTEBRATES (C. A. Howes)
Mammals have been recorded on Y.N.U. Excurisons in the Malham district, at the altitude limits of several species in 1890, 1910, and 1925 and at nearby Arncliffe in 1907, but clearly there is still much to discover. Moles, noted in 1907 and 1925, were present, according to evidence of mole hills, throughout the study area though with particular

concentrations in the deposits of morainic-alluvial soils adjacent to the Darnbrook and Cowside Becks. Fresh sections cut through valley alluvium by floodwater surges revealed the labyrinths of mole workings to be concentrated in zones of 15 to 30 cm deep organic soils with an avoidance of pebble beds. Curiously high levels of mole activity on the very steep sided bluffs on the south-facing side of the Darnbrook Beck were probably responsible for the de-stabilisation and collapse of some, giving rise to exposed soil surfaces. Interestingly, the almost perpendicular convex bluffs were being worked in preference to the concave, wetter, recesses or ravines between the bluffs. The incline of the bluffs was in places so steep that the molehills simply collapsed down the slope creating streaks of bare soil Although Pipistrelle and Brown Long-eared Bats are recorded for the area, torrential rain storms on the evening prior to the meeting prevented bat detector surveys. The Darnbrook farm and associated outbuildings are potentially suitable for bats and probably represent the only available roosting and breeding sites for miles around. Surveys for bat signs would be a worthwhile project for the future. Sadly the road bridge over the Darnbrook Beck had been spray-cemented under its single arch, thus neutralising it as a potential bat site which otherwise it certainly would have been. The main revelation of the day was the apparent absence of some ubiquitous mammals. Considering the huge availability of rabbits, there were no signs of foxes. Perhaps a policy of eradication in this sheep-rearing area could be the reason, though it could be argued that rabbits, which would normally be predated by foxes, presented a commercially significant competitive pressure on sheep pasture.

It would be interesting to compare the sheep biomass per unit of land in areas where rabbits are being controlled by foxes with areas where rabbits are left unpredated and compete with sheep for grazing. Perhaps the farm should diversify into rabbit warrening. Rabbits, noted in 1890, 1907 and 1925, were hugely abundant, particularly adjacent to the isolated plantations with warrens present in escarpments, under dry stone walls and under the rooting systems of plantation or solitary trees. Isolated middle-aged hawthorn shrubs on some steep valley sides may be landscape evidence of the myxomatosis epidemic which reached the high dales in 1954-61, the temporary rabbit-grazing respite at the time enabling these bird-sown shrubs to germinate and develop.

Stoat, also noted in 1890, 1907 and 1925, was seen carrying a bird by Tim Flint. Again, considering the abundance of Rabbit, it was curious that this was the only Stoat sighting and that the prey was not Rabbit but a bird. In the absence of small mammal-trapping or fox-dropping examination, rodent and shrew populations went largely unevaluated, though trapping in the 1980s studied Wood Mice and Bank Voles in isolated sycamore-dominated plantations here at their altitude limit in England. Common Shrew, noted in 1907, was located by hand-searching under rotten tree trunks.

Kestrel pellets collected from beneath tree stumps and fence posts high up Darnbrook Dale, contained remains of Field Vole, Bank Vole and a young Rabbit, indeed, a Kestrel was seen struggling to fly off with a small Rabbit at the Y.N.U. rendezvous point. Rabbits represent a very unusual prey for this small falcon: its presence as a prey item may relate to an apparent absence of other avian or significant mammalian predators. The Field Voles, the main prey of the Kestrel and a new record for the 10 km square, evidently thrived in the tussocky rough grassland. Larger pellet samples might be expected to reveal greater range of prey species.

The Grey Squirrel, generally regarded as being ubiquitous, was strangely absent from the plantations examined and it was curious to see generations of pine and larch cones left unexploited. Perhaps the Red Squirrel, recorded here by the Y.N.U. in 1907, could again survive, safe from the competitive Grey. Similarly, the Roe Deer which has spread to most woodland blocks in the Dales and lowland Yorkshire seemed absent from the plantations. Historically, Pine Marten occurred, one being trapped on Outmoor near Litton in April 1910. Badger, while currently present in SD97, is not known to occur in the study area though the nearby sett at Buckden at an altitude of 1750 ft has the celebrity of being the highest in England. The following species have been recorded in the past but were not observed during the wet and inclement 1999 visit: Pipistrelle Bat (1907); Brown Long-eared Bat (1910); Water Shrew (1907; 1910); Brown Hare (1907); Red Squirrel (1907); Water Vole (1890); Wood Mouse (1907); Brown Rat (1907); Weasel (1890; 1907); Otter (1907) and Feral Goat (1907; 1910).

Groups of Feral Goats were present on the crags around Malham and Kilnsey earlier this century, probably peaking during the Second World War but largely vanishing after the long severe winter of 1946-7. Annually rounded up by hill farmers in April prior to lambing time, their milk was fed to weakly lambs. The last of the herd, an old Billy, was, according to Mitchell, captured and taken to a fancy dress dance in Arncliffe, where its penetrating odours soon led to complaints.

ORNITHOLOGY (J. E. Dale)

The coverage of the area by the recorder was limited to the course of Darnbrook Beck from its confluence with Cowside Beck northwards for about three-quarters of a mile, to just below the plantations of young conifers on the south-facing slopes of Darnbrook Fell, from which Goldcrest were reported.

Throughout our visit considerable feeding activity was observed on the ridge north-east of Darnbrook Farm. This included about twelve Carrion Crows; 40 Jackdaws; over 200 Starlings, mainly juveniles, and, hovering over the slopes taking advantage of the south-westerly wind were at least seven Kestrels, including both adults and juveniles, which were seen to take small rodents on a few occasions.

About 90 Common Gulls were feeding and resting on short cropped grassland to the east of the farm. Meadow Pipit was the most common and widespread passerine breeding in the area, but the vicinity of Darnbrook Farm held a further ten species, all apparently local breeders.

Well into double figures of both Swallows and House Martins, including juveniles, were feeding around the farm buildings. Family parties of Wheatear, Mistle Thrush, Chaffinch, Linnet (at least three pairs) and Goldfinch were near or just downstream of the farm.

All three species of wagtail were present, at least 40 Pied (about 30 of which were juveniles), a female Yellow with four juveniles, and a female Grey with two juveniles. Two other records of Grey Wagtail comprised a family party by Cowside Beck, and a disused nest still holding an egg by Thoragill Beck.

A total of twenty-four species was recorded.

CONCHOLOGY (A. Norris)

The Yorkshire Conchological Society visited the area of Darnbrook Farm on 27 July 1996; on that occasion 33 species were recorded. On this occasion fewer species were found, but a number of additions to the faunal list came to light, bringing the total recorded since the National Trust took over the management of the estate to 37. The land surrounding Malham Tarn is perhaps the best, and most often, recorded area of the county. It would be remarkable therefore, if any species new to the area had been found. However, it is always interesting to find locally distributed species such as *Clausilia dubia*, a species mainly confined to the mountain limestone and old favourites such as *Vertigo pygmaea*. The best record of the day, however, was the find of *Trichia plebia* in a small marsh by the side of the road. This is a very local, if under-recorded, species in Yorkshire.

LEPIDOPTERA & PLANT GALLS (J. & K. G. Payne)

Numerous cocoons amongst the leaves of Bird Cherry *Prunus padus* were considered to be those of the Bird-cherry Ermine *Yponomeuta evonymella* although the adults had already emerged. The same tree had leaf galls caused by the Erophyid Gall Mite *Phytoptus padi*.

OTHER ARTHROPODS (D. T. Richardson)

The waterlogged condition of the ground was not ideal for collecting. Four woodlice (*Oniscus asellus*, *Philoscia muscorum*, *Porcellio scaber*, *Trichoniscus pusillus*), four millipedes (*Brachydesmus superus*, *Glomeris marginata*, *Polydesmus angustus*, *Tachypodoiulus niger*), one harvestman (*Mitopus morio*) and three centipedes (*Necrophloeophagus flavus*, *Lithobius varigatus*, *L. calcaratus*) were recorded. *L. calcaratus* has an easterly and northern distribution pattern within the British Isles, the highest proportions occurring in marsh, grassland and acid heath. The sites within the Darnbrook area fall within the wet grassland category rather than acid heath. This centipede is found at altitudes above 240 m (Darnbrook Fell rises from 310 to 640 m OD). The name *calcaratus* derives from the Latin *calcar*, a spur, referring to a projection on the 15th legs of the males; it does not in any way refer to a calcareous habitat.

FLOWERING PLANTS (P. P. Abbott)

The morning was spent searching the terraces on the north side of Cowside Beck in the hope of confirming an old record of *Polygala amarella*, unfortunately without success. *G. vulgaris* was there in small quantity but not its rare congener. Due to the glacial till overlying the limestone there was a most interesting mixture of calcicole and calcifuge plants. The lime-loving grasses *Briza media* and *Helictotrichon pratense* were growing alongside the heathland grasses *Danthonia decumbens* and *Nardus stricta*. Heather was growing with rockrose and thyme. The limey flushes were typical of many in the Dales, dominated by *Carex panicea* and enhanced by *Primula farinosa*, *Pinguicula vulgaris* and *Parnassia palustris*. *Gentianella amarella* ssp. *amarella*, *Carlina vulgaris* and *Pimpinella saxifraga* were found in the drier areas.

The afternoon was spent walking northwards along Darnbrook Beck where a similar combination of plants was found with the addition of *Cochlearia pyrenaica* and the alien New Zealand Willowherb, *Epilobium brunnescens*, well established on the banks of the beck, and with *Draba incana*, *Scabiosa columbaria* and *Centaurea nigra* looking very attractive on the limestone outcrops.

Asplenium adiantum-nigrum, *Oreopteris limbosperma* and *Triglochin palustre* were seen elsewhere in the area.

The number of species for the one kilometre square SD 8870 was 183.

MYCOLOGY (M. W. Sykes)

This meeting took place in a spectacular area with the weather conditions matching the scenery. However, there was a paucity of fungi. In spite of recent rain the only fungi seen were mainly 'little brown jobs' that often feature in these types of surroundings. *Panaeolina foenisecii* was plentiful along with *Panaeolus rickenii* and *P. campanulatus*. *Agrocybe semiorbicularis* was seen by Cowside Beck along with *Entoloma hirtipes*. *Rhytisma acerinum* was infecting the *Acer pseudoplanatus* near the side of Darnbrook House; *Nectria cinnabarina* was found on cut branches nearby.

LICHENOLOGY (M. R. D. Seaward & A. Henderson)

Despite the unseasonable morning weather of driving rain there was much to occupy the lichenologists during a three hour walk: much of the time was devoted to the walls, a mixture of limestone and gritstone, the different substrata supporting characteristically different lichen floras. Natural limestone outcrops were also investigated, but with the exception of a few species, mainly those favouring rudimentary soils accumulated in crevices, such as *Psora lurida*, *Squamaria cartilaginea* and *Toninia sedifolia*, the flora differed little from that on the limestone used in construction of the walls; *Dermatocarpon miniatum* and its variety *complicatum* were found sparingly on the terraced outcrops. These four species appear to be less plentiful than a few decades ago. *Caloplaca ochracea*, frequent around Malham on the Carboniferous Limestone, was a welcome sight. A few trees along the stream valley and (mainly *Acer*) close to an unoccupied farmhouse by the streamside, supported a few epiphytes with low cover values, the most notable being *Evernia prunastri*, *Lecanora chlarotera*, *Ramalina farinacea* and *Usnea subfloridana* which, although plentiful in parts of the county with cleaner air, are rarely encountered in the Malham area due to lack of suitable trees and long distance transport of air pollution.

Examination of roadside walls and trees in Arncliffe during the afternoon mainly echoed the morning's records. A brief visit to the churchyard prior to the afternoon tea meeting added only three species to the morning's list, confirming that the lichen flora of the area, while prolific quantitatively, had been reasonably well sampled for diversity during the morning's peregrination. In all, 131 species were recorded during the day, of which 6 were new to the Malham area, 2 up-dated former records, and 26 were new to grid square 34/87.

FRESHWATER BIOLOGY (D. T. Richardson)

Thoragill, Cowside and Darnbrook becks were investigated along with some calcareous flushes entering Cowside Beck.

The Amphipod *Gammarus pulex* was found in all three becks, occurring in Thoragill Beck in very large numbers. Mayfly nymphs (*Baetis rhodani* and *Ecdyonurus torrentis*) were in Thoragill and Cowside becks in large numbers, the latter species occurring also in Darnbrook Beck. Large numbers of the Stonefly nymph *Dinocras cephalotes* occurred in Thoragill Beck and it was also present in Darnbrook. *Leuctra fusca* occurred in all three becks; *L. geniculata*, in two not being found in Cowside. Large numbers of the Mayfly *Emphemerella ignita* and *Rhithrogena semicolorata* occurred in Cowside Beck but only the latter species in Darnbrook.

The larva of the Caseless Caddis *Rhyacophila dorsalis* and the freshwater algae *Microspora*, *Spirogyra* and *Zygnema* were in Thoragill Beck, and *Microthamnion knetzingianum* and *Mougeotia* in Cowside.

Large numbers of the Bullhead *Cottus gobi*, some of the individuals very large, were seen in Cowside Beck.

BOOK REVIEW

The Story of Vermont: a natural and cultural history by **Christopher McGrory Klyza** and **Stephen C. Trombulak**. Pp. xiv + 240, with b/w illustrations & maps. Middlebury Series, University Press of New England, Hanover. 1999. US$19.95 paperback.

This is a book about Vermont, from early geologic time to the present. The story of Pangaea, four major glacial periods (the last ice "retreating" from Vermont only some 13,000 years ago), the return of plant and animal species and humans earlier pushed south by the ice, constitute the introduction to this *vade mecum* of Vermont.

The native American (Indian) presence and its interaction with European settlers, joining the Union, and the transformation of the landscape are well described. When Vermont became part of the United States of America in 1791, it had a population of approximately 85,000; by 1995 the population had increased to 585,000, providing a density of 63 people per square mile (nearing the population density of the US as a whole).

In earlier times wood was used for fuel, charcoal, steam power (until *c.* 1850 Vermont's trains burned 63,000 cords of wood per year) and the making of potash. Later, in the twentieth century, forests were allowed to return and tourism and recreation became the dominant industry. Agriculture remains, but as in yesteryear, rocky lands and a short growing season make this a region of effort.

A well written section on ecological communities – forest, terrestrial open communities and wetland and aquatic communities – conclude this interesting volume which includes illustrations, bibliography, and index.

GJM

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A Century and a Half of Change in the Butterfly Fauna of the Huddersfield Area of Yorkshire — *Geoffrey Fryer and M. Jill Lucas*

Published by the Yorkshire Naturalists' Union

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Manuscripts (two copies if possible), typed double-spaced on one side of the paper only with margins at top and left-hand at least 2.5cm wide, should be submitted. Latin names of genera and species, but nothing else, should be underlined. S.I. Units should be used wherever possible. Authors must ensure that their references are accurately cited, and that the titles of the journals are correctly abbreviated. Volumes of *The Naturalist* for the years 1886 to 1975 have been retrospectively numbered 11 to 100 to accord with numbering before and after this period (see YNU *Bulletin* no. 3, pp. 21-22 1985); please cite these volume numbers in all references. Table and text-figures should be prepared on separate sheets of paper. Drawings and graphs, drawn about twice the linear size they are to appear, should be in jet-black Indian ink, and legends should not be written on the figures. **Publishable manuscripts not conforming to the above requirements will be returned for alteration.**

Photographic Plates

Readers of *The Naturalist* will have noticed that the number of photographic illustrations has increased in recent years. Good clear photographs, suitably captioned, to accompany articles or as independent features are always welcome.

To encourage this development, a long-standing member of the YNU, who wishes to remain anonymous, has most generously offered to make a donation, the income from which would finance the publication of a plate or equivalent illustration in future issues whenever possible. The editor, on behalf of the YNU, wishes to record this deep appreciation of this imaginative gesture.

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A CENTURY AND A HALF OF CHANGE IN THE BUTTERFLY FAUNA OF THE HUDDERSFIELD AREA OF YORKSHIRE

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> Much has gone unrecorded . . . for the lack of true naturalists, those curious enough to perceive and to record the changes in the plant and animal populations which are always in progress but which are all too seldom documented until it is really too late.
>
> Alfred Hazelwood (1961). Centenary issue of *Naturalist* **86**: 137.

Introduction

Butterflies have long been a focus of attention for naturalists. The conspicuousness of many of them, the small number of British species, and the ease with which most of them can be identified, has led to the accumulation of much information on their geographical distribution and national status. Country-wide changes in the distribution of certain species that have been documented since recording began yield information, and pose problems, of ecological interest. Changes in small areas can also be revealing if adequate facts have been recorded over a substantial period of time. Although there are inevitably tantalizing gaps, this is fortunately the case for the Huddersfield area of Yorkshire though the key sources of information seem already to have been largely forgotten. Here we consider the changes that have taken place in its butterfly fauna during the past century and a half or rather more.

While the Huddersfield area is well served for early historical information, until a recent upsurge of interest there has been less systematic activity there in the recent past than in not too distant areas such as Sheffield (Garland 1981, Whiteley 1993), Doncaster (Rimington 1992) and Harrogate (Barnham & Foggitt 1987, 1991, Barnham *et al.* 1993) for which excellent accounts of former status and recent changes are available that provide valuable comparative information. Happily the lean period is well covered by the excellent reports of Cain and Baggaley for the area studied by the Halifax Scientific Society, a considerable part of which lies within our adopted boundary. Reports of the Bradford Naturalists' Society, with whose area there is some overlap, have also been helpful, as has information collected by Wakefield naturalists in the extreme east.

Key Sources of Information

What may be the earliest published information on the butterflies of the area are paintings of several species by James Bolton that appeared in the second volume of his book on songbirds, *Harmonia Ruralis*, in 1796. While not proven, it seems probable that the illustrations of at least the common species were prepared from locally obtained material. These and even earlier paintings by Bolton of perhaps locally obtained butterflies are enumerated elsewhere (Fryer 2000).

The first published list of the Lepidoptera of the area appeared in Hobkirk's *Huddersfield: its History and Natural History* (1859). Briefly annotated, it included 25 species of butterflies and was based on information received from nine named entomologists, which indicates that local knowledge had been garnered for some time prior to its appearance. Indeed, some records for moths refer to 1846 and 1847. It is now clear that these were provided by J. W. Dunning, some of whose manuscript notes on Yorkshire Lepidoptera were discovered by Rimington & Beaumont (1996). These provide the earliest dated records of butterflies for the Huddersfield area, eleven species being reported from Storthes Hall in 1846 and 1847. A second edition of Hobkirk's book appeared in 1868: it contained the same list of species as the first and only minor changes to the comments. We can be confident that the two editions give a reasonable qualitative idea of the butterfly fauna of the area in the period between about 1840 and 1865. That several lepidopterists were active in this period is indicated not only by the list of contributors, but by reports of an eight-day exhibition held by the Huddersfield Naturalists' Society in 1864 (see *Naturalist* Old Series **1**: 215-219 (1864)). A catalogue of the event shows that ten exhibitors displayed 55 cases of Lepidoptera. Similar exhibitions were held in at least 1866, 1873 and 1880. In 1866, 81 cases of Lepidoptera were displayed. Confirmation of the adequacy of Hobkirk's list is provided by reports of subsequent changes in the fauna.

Another review of the Macrolepidoptera of the area was given by Mosley (1883) in what would now be regarded as an obscure publication. It includes valuable, if brief, notes not only on the then current situation but often on the past status of the 24 species of butterflies included, several of which were at that time deemed to be extinct. It provides crucial, sometimes dated, information on changes in the fortunes of some of these species in the previous 30 years or so. An annotated manuscript list by Ben Morley of the butterflies and moths of the Skelmanthorpe area between 1896 and 1908 provides another landmark. It lists 12 species from what is biologically a relatively rich part of the district. This he amplified in another manuscript list of about 1928. Wattam (1936) gave a further brief review of the butterflies of the area, listing only 14 then extant species, two irregular migrants being omitted. He noted that his interest in the Lepidoptera spanned a period of 42 years and commented on some of the changes that had taken place during the 53 years that had elapsed since the publication of Mosley's summary. The Huddersfield area is singularly fortunate in having these landmarks, spread over a considerable time span, of which the last falls within living memory. Many areas are less well endowed. Thus no complete list of butterflies of the not far distant Doncaster area, of which Rimington (1992) has provided an excellent account, is known for any earlier period.

Supplementary information is provided by Halliday (1896) on the butterflies of Halifax, a considerable part of which area is encompassed here. This lists only nine species. Later notes, which add the Peacock in 1900 (a species known in earlier years), show that this low total is realistic and not simply the result of inadequate investigation. It confirms the paucity of the fauna at the end of the 19th century. Indeed, although Mosley listed 24 species, only 13 of these were regarded as members of the fauna in 1883 even if such an intermittent migrant as the Clouded Yellow and an even rarer migrant, the Camberwell Beauty, are included. If these and the irregular migrant Painted Lady are ignored, but the Common Blue and Orange Tip which, contrary to Mosley's belief, persisted in some places, are included, the total is still only 12. This is not much higher than Halliday's 10 for the Halifax area 17 years later, and the same as Morley recorded around Skelmanthorpe at about the same time. Although Collinson (1969) listed 20 species for the Halifax area from more than a century of recording, these included migrants and two species recorded only in 1863 outside the area covered here. The total was boosted by species that had begun to colonise the area just before the publication appeared.

Butterfield (1911) gave a gossipy account of the butterflies of the Bradford area, some of whose southern parts fall within that covered here. This emphasises the paucity of the fauna at that time – only about 10 species – fewer than in the previous century. Some of them were also then very rare. A note on plants and animals that had declined or become extinct in the Bradford area "within the memory of local naturalists", given by his son (Butterfield, 1906) also refers to certain butterflies and provides confirmatory evidence of their status at that time.

Since Wattam's summary striking changes have taken place. These have never been adequately recorded yet they make an important contribution to the story. We also draw attention to certain records of historic interest that have been forgotten. Once omitted from a summary such records are often virtually lost. Even summaries can suffer this fate. Thus none of the local lists utilized here is cited in the extensive bibliography in Sutton & Beaumont's (1989) excellent overview of the Lepidoptera of Yorkshire.

Information for wider areas is also relevant to the changes recorded here. For Yorkshire this is provided by the well known "List" of Porritt (1883) and its supplement in 1904; by

The Lepidoptera of Yorkshire (1967-1970), here cited as YNU Lepidoptera Committee (1967), this being the year of publication of the butterfly section; and Sutton and Beaumont (1989). However, it was not the aim of these works, nor of the authoritative Emmet and Heath (1989), nor the *Atlas* of Heath *et al.* (1984), that assessed the then current status of the butterflies of the British Isles as a whole, to provide a detailed treatment of temporal changes in distribution. Indeed they often give no indication of the striking changes that have taken place in the status of various species in specific areas. Such changing fortunes, however, have much to tell us about their biology, and illustrate the rapidity with which their populations have in some cases become extinct, or in others have conquered, or reconquered, the area considered.

Some potentially valuable sources of information have been lost. The Annual Report (1917) of the Huddersfield Naturalists' Society records the presentation to the library by G. H. Crowther of a presumed manuscript work listed as "Lepidoptera of Huddersfield". The society is now defunct, its library dispersed, and this item has not been traced. (This society, subsequently the Naturalist and Photographic Society, and Naturalist, Photographic and Antiquarian Society, is cited throughout as Huddersfield NS or HNS.* In his account of the Lepidoptera of the Halifax area, Collinson (1969) refers to a list for Elland dated 1927, produced by Herbert Spencer, which "forms much of our early knowledge of the eastern end of the parish". While some records apparently extracted from it have been preserved, all attempts to locate a copy of this list, produced by an outstanding lepidopterist, native to Elland, have failed. Sadly, Ben Morley's notebooks, in safe keeping no more than a dozen years earlier, could not be found when we tried to consult them. All references to them are based on items copied onto YNU record cards. Such losses are irreparable. The lesson is that if information is not published, copies should be made and stored in recognised repositories.

The Area Covered

No previous account defines the area covered. Any administrative boundary is artificial and even a circle of six miles radius centred on Huddersfield embraces part of the town of Halifax but excludes places like Marsden and Skelmanthorpe that clearly demand inclusion. Likewise Elland, traditionally claimed by Halifax, is less than four miles from Huddersfield and can hardly be omitted. The boundary adopted is a circle of ten miles radius centred on Huddersfield, but sites just outside it are mentioned when they provide significant information. This small area embraces a wide range of habitats, some of those in the east and west especially being strikingly different.

The entire area is made up of Carboniferous rocks, with Millstone Grit (Namurian) to the west, Coal Measures sandstones (Westphalian) to the east. Calcareous rocks are lacking. To the west, and swinging east in the south of the area, there is a good deal of land at altitudes of more than 1000 ft (*c.* 305 m), some of it considerably higher (maximum 1908 ft: *c.* 582 m at Black Hill). To the east much land lies below 500 ft (*c.* 152 m), the Calder descending to about 100 ft in the extreme east. The coolest and wettest conditions prevail in the west where, on the highest land, rainfall (upwards of 55 in: *c.* 140 cm, and over 63 in: 160 cm in one small area) is more than twice that in the east. Here, in non-urbanised areas non-arable farming gives way to rough grazing and, at the highest altitudes, to peaty moorland often dominated by *Eriophorum vaginatum.* The drier Coal Measures support more productive agriculture and more woodland.

Major rivers and streams are shown in Figure 1. In the west some of them cut deeply into the Pennines where the Calder and its tributaries, and the Colne, are steep-sided. The Calder

*Abbreviations for other societies used in the text are

Bradford NS	=	Bradford Naturalists' Society.
Halifax SS	=	Halifax Scientific Society.
SWYES	=	S.W. Yorkshire Entomological Society.
Wakefield NS	=	Wakefield Naturalists' Society.

FIGURE 1.
The area covered – a circle of 10 miles radius centred on Huddersfield. Land over 800 ft (244 m) shaded. Black Hill (1908 ft: 582 m) is the highest point.

Valley extends into the upland area as a narrow tongue of low-lying land: to the east it becomes much wider. In the west the main valleys are separated by tracts, sometimes ridges, of high, often unproductive, Millstone Grit, sometimes intersected by steep-sided cloughs. There is little woodland here outside the valleys and, apart from fragments in certain cloughs, there was virtually none in the Colne Valley until much planting took place towards the end of the 20th century. The Calder is better wooded in the west, as are the Holme and Hall Dike Valleys. Between the Holme Valley and the Fenay Beck the intervening barrier of Coal Measures is somewhat lower-lying than the western ridges, has more productive soil, and supports several tracts of woodland. In the extreme east there are several ancient woodlands of modest size. Information on the flora is given by Lucas & Middleton (1985) and Lavin & Wilmore (1994). The latter work covers a wider area and includes accounts of the soils and vegetation by J. S. Rodwell. The siliceous sandstones and shales, especially in the west, yield acid soils and have an impoverished flora.

Climate, topography and vegetation have a bearing on the distribution and dispersal of the butterflies involved. What has long been recognised as a modest fauna in part reflects the rigorous conditions that prevail, especially in the west where exposed moorland above 1500 feet is generally shunned. Indeed Porritt (1883) recognised that the least productive parts of Yorkshire "are undoubtedly the cold, clayey districts of the South West Riding", of which the Huddersfield area is one, where "the paucity of lepidopterous life" is "very discouraging to an enthusiastic student". Nevertheless the history of this modest fauna reveals much of biological interest.

The last 150 years have seen a great increase in the human population and continued industrialisation and urbanisation of Huddersfield, Halifax and their immediate surroundings, the lower lying parts of the Colne and Holme Valleys, the regions to the north which include Elland and Brighouse, and in the east towards Dewsbury. This has had mostly deleterious effects on the environment.

Dramatic Changes in the Late 19th Century

Mosley's (1883) paper provides vital information about dramatic and rapid changes in the local butterfly fauna and is an outstanding example of the importance of recording local events and of the vital role that can be played by a local journal. Without it the history of change in the area would be far more imperfect than it is. Drawing particularly on the experience of James Varley (1817-1883), but also on that of himself and other entomologists, Mosley documented a rapid decline, and sometimes apparent local extinction, of several species of both butterflies and moths. The period can be dated with considerable precision. He notes that records credited to Varley were made from about 1855 to 1870 and those of Peter Inchbald (1816-1896) in about the same period. There is evidence that Inchbald was active from 1846, in which year he moved into the area. Many species that were common in about 1855 and the next few years declined or disappeared a few years later. References to the status of individual species "about 20 years ago", or said to have been present "up to within the last 10 or 15 years" indicate that the main period of decline and extinction began about 1865 and was essentially complete by 1870 – a remarkably rapid faunistic change. The Comma became extinct a little earlier. Even if the period of extinction was twice as long, which seems certainly not to have been the case, it was extremely short for such a dramatic change. Mosley's general comments on these changes merit quotation in full. "Since that time" (when various species were common) "great changes have taken place, and the young collector must not now expect to go straight to certain localities and take certain species, for many are now no more. It is very strange to reflect upon a great number of species which, during the period referred to, were common, or even abundant in the pastures between Castle Hill and Farnley Tyas, such as several of the Ringlets [i.e. "browns"] Skippers, Blues, and at other places Burnets and Foresters [day-flying moths] absolutely swarmed, all of which are now entirely gone".

Mosley's account shows that there were extinctions or near extinctions of at least ten species and reductions in abundance of several others. The Dingy Skipper, Holly Blue, Speckled Wood, Wall, Meadow Brown, Ringlet, and Small Heath all apparently suffered local extinction, and the Pearl-bordered Fritillary, last seen by Varley before 1870, was never seen again. The Wood White, very rare since at least the late 1850s, also made what proved to be its last appearance some time before Mosley prepared his list. The Comma had not been seen since Hobkirk's time (pre-1859). Mosley thought that the Orange Tip and Common Blue suffered the same fate, but both survived in a few places. He also evidently thought that the already very rare Silver-washed Fritillary had become extinct, though later records were to indicate either its continued survival or intermittent invasion. In addition to the extinctions, the Small Copper, Small Tortoiseshell, Peacock and Red Admiral all suffered reductions, though as the continued survival of the Red Admiral depends almost exclusively on immigration, the significance of its decline is moot. The Small Tortoiseshell and Peacock also possibly arrive as migrants at times. Nevertheless the declines in these four species conceivably indicate the influence of some pervasive adverse factor.

Corroboration of these changes is provided by Porritt's (1883) list of Yorkshire

Lepidoptera but, being painted on a broader canvas, this does not bring the matter to light with the incisiveness of Mosley. Nevertheless his comments on four species are significant. Porritt, who lived near Huddersfield, believed that the Meadow Brown and Dingy Skipper, both formerly common there, were then extinct, and for the Speckled Wood and Wall says simply "Huddersfield, formerly", which has the same implication.

Changes Between 1883 and 1936

Produced by an outstanding lepidopterist, Morley's briefly annotated manuscript list of the species recorded in the Skelmanthorpe area between 1896 and 1908 provides a valuable qualitative summary of the butterfly fauna of that eastern region at that time. Including the migrant Painted Lady, only 12 species were recorded, several of which were then rare, uncommon, or of restricted distribution. Species that feature in earlier reports, such as Dingy Skipper, Holly Blue, Speckled Wood and Wall were never encountered. The Meadow Brown, of which a single individual was seen in 1901 (Morley 1902) received the comment "seems to have disappeared". This list and its later update are complemented by the short, but significant, paper of Wattam (1936) which not only reported the current status of the butterflies of the district – 14 species only being listed – but noted some of the intervening changes. Without this landmark the story of change would be much more fragmentary than it is. Wattam referred to some of the environmental changes that had taken place in the 53 years that had elapsed since Mosley's summary, which should be borne in mind when making comparisons. In particular he mentioned the destruction of very old woods, old hedgerows "with their broad margins of varied vegetation", the wholesale clearance of "roadside waste" (i.e. verges and adjacent unused land), and extensive building developments in the outer parts of the district. In essence he confirmed the disappearance of several species – Dingy Skipper, Holly Blue, Speckled Wood, Wall, and Ringlet – and provided no evidence for the continued existence of species that had always been rare and, like the Comma, had never been seen since before 1859 or, like the Wood White and Pearl-bordered Fritillary, had persisted somewhat longer as great rarities. On the other hand he was able to report a revival in the fortunes of several species, especially the Small Copper, Small Tortoiseshell, and Red Admiral (predominantly a migrant) and, more significantly, re-colonisation of the area by the Meadow Brown and Small Heath which began only a few years before he wrote. He gave no additions to the local list though there had in fact been one such, though of no significance in the history of the fauna. An American Monarch, an infrequent immigrant, was recorded at Kirkheaton in 1917 (Morley 1928). Another infrequent migrant, the Camberwell Beauty, already recorded in the area, was, perhaps deliberately, also omitted though one had been recorded at Longley Hall in 1924, again an event of scant significance in the history of the fauna. One species, the Green Hairstreak, seen only once, prior to 1884, escaped notice. Wattam also gave information on two rarities, the Large Tortoiseshell and the Silver-washed Fritillary, which has been overlooked by compilers of faunistic reports for the whole of Yorkshire.

Changes since 1936

Since the time of Wattam's summary there have been further, sometimes great, changes, often involving recovery or recolonisation. Some species, such as the Orange Tip and Meadow Brown, that were at a low ebb or were recovering in 1936, have become common. Others, such as the Holly Blue, Comma and Wall, lost in the 19th century, have returned and re-established themselves or, like the Speckled Wood and Ringlet, have begun to do so. Yet others, such as the Large and Small Skippers, never previously recorded, have colonised the area and become common or, like the Purple and White-letter Hairstreaks and Hedge Brown, have been recorded for the first time towards the end of the century. These changes are reported in the following section.

The Changing Fortunes of Individual Species

Over a period of rather more than a century and a half the histories of individual species in the Huddersfield area, each of which is recounted here, have often been very different.

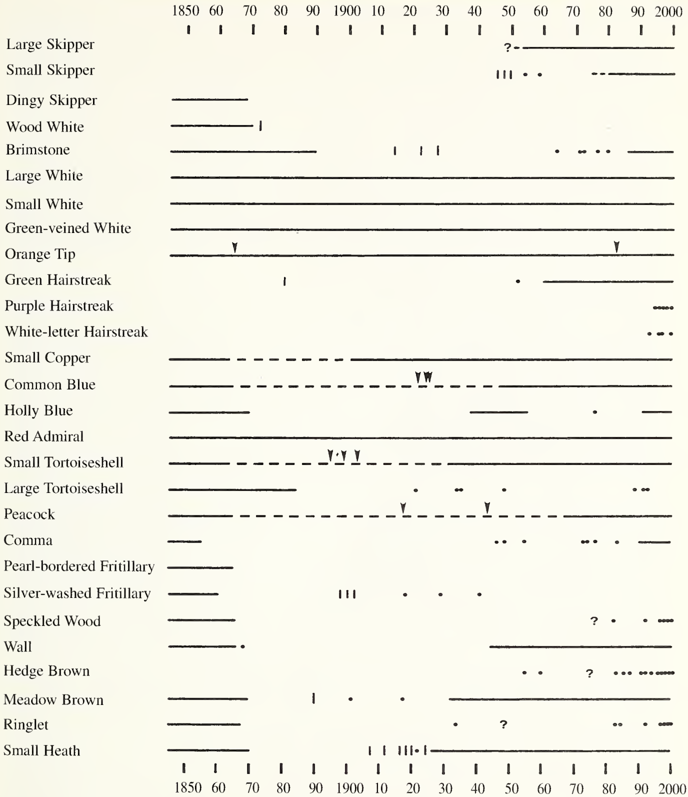

FIGURE 2.

Changes in the butterfly fauna of the Huddersfield area between the mid-19th century and the bi-millennium. The Red Admiral, which depends on migrants but has been a member of the fauna throughout, is included, but irregular migrants – Clouded Yellow, Painted Lady and Camberwell Beauty – are omitted. So too are the Small Pearl- bordered Fritillary and the vagrant Monarch of which there are single records. Records for specific years are indicated by solid circles. Save in two instances, where the accuracy is within a year, they are for the exact year. Records for approximate periods are indicated by vertical bars. Dashed lines indicate periods of scarcity. Arrows in such periods indicate brief local upsurges in numbers. During the long period between the arrows the Orange Tip was generally scarce, but was seen in many years. The late 20th century saw a great increase in its abundance, and expansion of its range to the west.

Chronological changes are summarised in Figure 2, which excludes purely migratory species save the Red Admiral which is a regular component of the fauna. For the benefit of future students, as well as to substantiate the changes involved, we have tried to document the changes, often by citing not easily accessible sources. Biological details are given where they illuminate events. Indeed, an important outcome of the preparation of individual case histories has been that it has sometimes drawn attention to relevant aspects of the biology of the species concerned. Information or suggestions of wider interest that have a bearing on the story are also sometimes included. When relevant, changes that have taken place over wider areas, nationally or nearby, are mentioned to put local changes into context. Many unpublished records have been utilised, especially for recent years. Sources are cited where appropriate. One species, allegedly recorded, is omitted: in a YNU excursion circular, 1961, J. H. Seago noted that the Queen of Spain Fritillary, *Issoria lathonia,* "has been reported" from Gunthwaite, but no such report has been located. Even if valid, this record of a rare migrant would be of scant significance to the story.

LARGE SKIPPER, *Ochlodes faunus* (Turati) (= *O. venata* auct.)
The Large Skipper was unknown in the Huddersfield area by Hobkirk (1859, 1868), Mosley (1883) and Wattam (1936), nor was it seen there by any entomologist during the first half of the 20th century. Particularly noteworthy is that it was never encountered by B. Morley who, in the first three decades of that century, extensively explored what in the context of its history are the particularly relevant eastern parts of the region. He was aware of its occurrence further east, commenting in his manuscript list for Skelmanthorpe (1896 – 1908) "common at Edlington Wood, Thorne Waste etc.".

Widespread in southern Britain, in the west it extends into southern Scotland, and formerly did so in the east where its range contracted somewhat in the 19th century. Its absence from the Huddersfield area was clearly not explicable on geographical grounds. In the 19th and early 20th centuries it was common in parts of Derbyshire and Nottinghamshire (Garland 1981 gives references), perhaps less so in Yorkshire. Here Porritt (1883) simply listed eleven widely scattered localities, mostly in the south, the nearest to Huddersfield being Wakefield, which could imply anywhere in the vicinity of that city. Brady (1884) gave two additional sites, Royston and Hemsworth, in the Barnsley area, both further from Huddersfield than is Wakefield. It evidently persisted in Edlington Wood, south-west of Doncaster, until at least 1917 (Rimington 1992), and was recorded in a few other localities in the Doncaster area in the 1920s, 1930s and 1940s, the nearest to Huddersfield being Wentbridge, some 22 miles east of the town, where it was known in the 1930s and in 1941 (Rimington 1992). It occurred in some places around Barnsley, and at Seckar Wood near Wakefield, just outside the area covered, in 1942 (Proctor 1943). Thus, although unknown in the Huddersfield area, it was present not far to the east and south-east during the last two decades of the 19th century and the first four of the 20th. During this period, however, Rimington (1992) believed that there was some withdrawal to the east.

It began to spread northwards in about 1945 or possibly earlier – it increased considerably around Barnsley in the early 1940s – and eventually became common in much of Yorkshire, but the spread has not been documented in detail. A pioneer may have been a male seen at New Dam, Hawksworth, near Shipley by P. C. Quin in 1949 (Dearing 1950), further north than Huddersfield – the first in the Bradford area. It must have penetrated the Huddersfield area by 1951 or earlier as Hooper & Fletcher (1951) list it for Coxley but give no date. Moreover, Seago (YNU excursion circular, 1953) says "*Ochlodes venata*, formerly rare in the district, is locally common at Bretton and Cawthorne". This means that it must have been present before 1952. For how long it occurred there as a "rare" species, or indeed how Seago defined "the district", is not known. He may have had Seckar Wood – only about three miles from Bretton – in mind, and Coxley is even nearer. It may have arrived as part of the pre-1945 extension of range, but had this been so one would have expected it to have been reported from this entomologically well-known area.

It was seen in 1954 "in some numbers" by R. North in Odsal Wood, (near Bradford but less than nine miles from Huddersfield: Bradford Naturalists' Society). Another site, or possibly two, conceivably existed nearby as J. Briggs is mentioned in connection with a site between Odsal and Bierley and was also said to know of a colony "a mile or so towards Bierley". In 1960, however, when it was reported elsewhere in Bradford, outside the area covered here, there was said to be only one other positive record within the city boundary – Odsal Wood 1954 – so Briggs may have been commenting on North's find.

In 1957 it was seen at Elland by W. Ainley, the information being passed on by W. E. Collinson who noted it as new to the records of the Halifax Scientific Society (Hewson 1958). It is therefore curious that Collinson (1969) evidently forgot this when he said that it was first recorded from Elland by R. Crossley in 1965. One was in fact reported to Crossley from near Fenay Bridge in 1958 and he himself saw "at least a dozen" in the nearby Beldon Valley in 1959, in which year Seago again reported it from Cawthorne (Hewson 1960). B. and M.J.L. saw it at Thunderbridge in the late 1950s. By 1960 at the latest it was reported as abundant at Gunthwaite (Seago, YNU excursion circular, 1961), B. D. Cain saw his first Large Skipper in the Halifax area at Park Wood, Elland in the same year, and R. Crossley saw several near Cromwell Bottom. This spate of sightings indicates that colonisation of the area was under way in the second half of the 1950s.

It was seen again at Cromwell Bottom and at Park Wood, Elland in 1961 (R. Crossley), in which year it was also seen at Low Moor (B. Tempest) and North Bierley. In 1963 it was reported from Queensbury and the Bierley area, and again from the latter area in 1965 (Bradford NS). In the early 1960s it was seen near Ogden and in the Shibden Valley (B. D. Cain). By 1969 or earlier there were well-established colonies at Elland and Copley in the Calder Valley (Collinson 1969) and it was seen at various other places. For example B. and M.J.L. saw it at Cowcliffe in 1969, and in 1969 or 1970 during a visit to the Milnsbridge-Cowlersley area of the Colne Valley G.F. saw many Large Skippers – a striking difference from 20 years earlier when it was unknown there.

Colonisation continued, and by the 1980s and 1990s it was well established throughout the area and recorded in many places. These included Bretton, Skelmanthorpe, Scout Dyke, Ingbirchworth, Dunford Bridge, Gawthorpe, Lockwood, Holmfirth, Almondbury, Quarmby, Blackmoorfoot, Norland, sites throughout the Calder Valley and its feeder valleys and many others. (For observers see Acknowledgements.) J. Dale first saw it at Lindley Moor in 1983, where it persisted in small numbers until 1990 before increasing in 1991 and becoming particularly numerous in 1993 and 1995. It continued to be common there until 1997, but was less so in 1998 and 1999, probably for climatic reasons, and maintained this status in 2000 (see also Small Skipper).

West of the Pennine barrier L. N. Kidd first noted it in the Greenfield area in 1983, where it subsequently became common. Colonisation may have been from a source different from that in the east and south-east from which the other Huddersfield populations came, and apparently took place later.

The spread appears to have occurred later than a similar expansion in the Sheffield area, in the extreme east of which it long persisted. There, beginning about 1945, it spread throughout the region where, save on high ground, it was "locally common" by the 1960s (Garland 1981), subsequent to which time it was recorded in many additional localities within the already occupied area (Whiteley 1993).

Unknown around Huddersfield in the 1840s, and remaining so for another century, the Large Skipper evidently penetrated the area by 1951 or a little earlier, gradually spread, and increased in numbers. Within about 20 years it was widely distributed, and already common in some places. Thereafter it continued to increase both in abundance and range and by the late 1980s at the latest had apparently occupied all suitable localities. At the bi-millennium it is widespread in rough and grassy places throughout the region except on the moorlands, but perhaps somewhat less common than a few years earlier.

SMALL SKIPPER, *Thymelicus sylvestris* (Poda)

The Small Skipper for long frequented southern and central Britain and in the second half of the 19th century its range, which extended further north in the east than in the west, reached its limit in Yorkshire. Here Porritt (1883) described it as "fairly common", but listed only nine localities. The nearest to Huddersfield was "Wakefield". It was unknown in the area to early entomologists (Hobkirk 1859, 1868, Mosley 1883) but there is a single record, undated but probably from 1880 or earlier, for Royston in the Barnsley area, only about 14 miles from Huddersfield (Brady 1884). Morley, who lived in Skelmanthorpe and thoroughly explored the eastern parts of the area, never encountered it, and it remained unknown at the time of Wattam's summary in 1936.

Conditions at the edge of an animal's range are often sub-optimal and it may have needed only a slight deterioration in one of its requirements to cause the Small Skipper to yield ground in Yorkshire. A hint of susceptibility to adverse conditions is perhaps given by Newman's (1870-1871) remark that nationally it "has mysteriously disappeared from many places where it was formerly common", but no localities are specified. Sometime before 1900 it retreated from the western parts of its Yorkshire range and in the 1960s (YNU Lepidoptera Committee 1967) it was reported as "occurring commonly though locally" in the eastern half of the county, and additionally only at and near to Strensall, though in fact it occurred nearer to Huddersfield at that time. Shortly thereafter it expanded its range northward and westward and colonised much of Yorkshire. Sutton & Beaumont (1989) say that this happened in the early 1970s, and certainly there was a dramatic spread during this period, but the initial stages began a little earlier. Indeed there was what appears to have been an abortive spread in the late 1940s. It was recorded from three places south and west of Sheffield in about 1948 (Garland 1981) and it appears to have spread into (or persisted in?) sites around Doncaster in the 1950s, including Wentbridge where there was a small colony in 1955 (Rimington 1992). The same author notes that it was present at Barnsley and Bradford in the 1950s. There is confusion about the last record. Although supposed to have been seen at Baildon in 1969 – long after the 1950s – Haxby (1975) stated that it was completely absent from the area. If so the first record would be for Odsal (which falls within the area covered here) in 1985. However, this overlooks a very early record of a single individual seen at Shipley Glen (north of the area covered) by C. Brown in 1949 (Dearing 1950). Lepidoptera were Brown's special interest and the record cannot be doubted.

In the present context the most intriguing report is that of Seago (YNU excursion circular 1953) who said "*Thymelicus sylvestris* occurred near Cawthorne until four years ago but is now apparently extinct". This hints at more than a single sighting, implies its presence there in 1949 and perhaps earlier, and is the first ever report of the species in the Huddersfield area. Credence is given to this record by its coincidence in time with reports from none too distant places. Cawthorne is less than 8 miles from Ewden, one of the Sheffield localities. The Shipley record is also for 1949. Whether its presence represented an incipient colonising event or, less likely in this well explored area, a long established population, is now unlikely to be resolved. Moreover, although Seago suggested that it had become extinct at Cawthorne by 1953, in a bulletin circulated among YNU lepidopterists in 1958 he said "I found a few specimens at Cawthorne and Bierley Common in 1955". The second locality lies outside the area covered. Persistence in, or further colonisation of, the Cawthorne area therefore apparently occurred.

That another incursion into the area took place before the main invasion is indicated by records of single individuals at Wainstalls and in the Shibden Valley within two days of each other in 1959 (Cain 1990). Otherwise, apart from the Cawthorne venture, the Small Skipper seems not to have been seen in the Huddersfield area until the late 1970s when Jackson (1980), who commented on its westerly spread, noted that it had recently been observed near Wakefield and Huddersfield, and who later (Jackson 1983) mentioned an increase in records near Huddersfield. Unfortunately no specific instances are cited nor, more curiously, are such entered on the record cards of which Jackson himself was the meticulous custodian. The first record in the Wakefield area was for Wintersett in 1976 (information from R. M. Sunter) – only about five miles from the boundary adopted here. Apart from Jackson's records, the first traced for the Huddersfield area in this period is for 1983 when it was seen in two places near Bretton by D. S. and V. A. Ives (who also saw it at Pugney's, near Wakefield some four miles distant and just outside the area). Bretton is not more than six miles from Wintersett where it was seen seven years earlier. By 1984 it had already penetrated well into the area. Not only was it seen at Scout Dyke in the extreme southeast by D.S. and V.A.I and at Bretton Park in the east where D. Manchester saw "about 50", but the latter saw it also at Lepton, King's Mill Lane (at the edge of the town), and at Thongsbridge, Holmfirth, and Brockholes in the Holme Valley. This hints at its arrival in these places at least a little earlier, which is in keeping with Jackson's reports indicating its presence in 1979 and the early 1980s but which did not specify particular sites. It was also seen in 1984 at Birds Royd, Brighouse, by B. D. Cain who had searched the area in 1983 without seeing it, and for whom this was his first sighting in the Halifax area, and the first since the two isolated records in 1959. He also saw it at Kirklees Cut, near Bradley, in the same year (Cain 1990). In 1985 it was seen at Royd Moor Reservoir in the extreme south east both by D.S. and V.A.I. and by J. Dale, who also saw it at Lindley Moor. It was also seen at Odsal (see above). Jackson's cards also record it as common at Sinking Wood, New Mill and at Langsett, perhaps his own observations as no authority is cited. It was seen at Mount, Outlane in 1986 by B. and M.J.L. Thus, although there had been earlier incursions, it appears that the Small Skipper began seriously to colonise the area in the late 1970s (an event that is inadequately documented) and had certainly made considerable progress by 1984, following which there was a veritable explosive expansion. It spread rapidly and widely and was reported from many places. Cain & Baggaley (1997) summarised the situation in Calderdale a decade later as "now widespread throughout the district" and noted that "since 1984 [it] has spread throughout the Calder and upland valleys and beyond". In earlier reports Cain (1991, 1992, 1996) and Cain & Baggaley (1994, 1995) list many localities, most of them in the Huddersfield area, and its continued expansion of range is noted. The same can be said of other parts of the area.

Apart from the Cawthorne venture, and the two pioneers seen near Halifax in 1959, invasion of the Huddersfield area seems to have been later than in places to both north and south of it. It was first seen in the Harrogate area in 1966 (Barnham *et al.* 1993) and, apart from the revival in the 1940s, in the Sheffield area in 1967 (Garland 1981). Populations may build up slowly and therefore perhaps undetected. Thus J. Dale witnessed its establishment at Lindley Moor in an area under observation since 1983. It was first seen in 1985, two years after the Large Skipper was first recorded there, but not again until 1991, after which it appeared each year until the bi-millennium. It apparently increased in abundance until 1995, persisted in large numbers until 1997, and declined in 1998 and 1999, probably for climatic reasons, and remained depressed in 2000. Most observers are of the opinion that at the bi-millennium this species is still increasing in the area, and that it is now often more plentiful than the Large Skipper, with which it co-exists in some places.

To summarise, the Small Skipper was unknown in the Huddersfield area in the 19th and early 20th centuries. There seem to have been incursions around the late 1940s, from which there may or may not have been survivors. A few individuals at Cawthorne in 1955 may have been such. Two pioneers (or strays) were also seen in 1959. However, successful invasion did not apparently begin until the late 1970s, whose early stages are ill-documented. The first positive information is a spate of finds in 1984 and 1985, following which an explosive increase in numbers and range took place that led to the colonisation of what appear to be all, or most, suitable habitats within about 10 years. Like the Large Skipper, with which it often co-exists, it frequents rough grassland of various kinds, but is tolerant of more open and exposed sites, which may give it a competitive advantage in some situations. It has been recorded at altitudes of *c.*1025 ft (J. Dale) and 1100 ft (Cain 1992) but is not found on the moorlands. Although it established itself later than the Large Skipper, it outnumbered it in some places towards the end of the century.

DINGY SKIPPER, *Erynnis tages* (L.)

Dunning's record of the Dingy Skipper from "Storthes" in 1847 (Rimington & Beaumont

1996) is probably the same as "Storthes pastures" listed by Hobkirk (1859, 1868), who also reported it from Lepton Great Wood and Castle Hill. Varley also knew it in "Storthes Hall fields" but it had gone from there when Mosley (1883) compiled his inventory. As this was the only Skipper known in the area in the 19th century it may have persisted between Castle Hill and Farnley Tyas until Varley's time, for Mosley (1883) includes "Skippers" among the species that were formerly common there. Porritt (1883) also said that it was "formerly common" at Huddersfield "but now apparently extinct" and cited Varley "and others". It has never since been reported from the Huddersfield area.

Although widespread, but very local, in Yorkshire, which lies well within its northern limits, the Dingy Skipper does not extend into the far western parts of the county (Sutton & Beaumont 1989). R. M. Sunter believes it to be extinct in the Wakefield area.

WOOD WHITE, *Leptidea sinapis* (L.)
Hobkirk (1859) listed this species as "very local" and gave one site, South Crosland. Mosley (1883), added Storthes Hall "many years ago" (P. Inchbald) and Almondbury, without date, by Alan Godward. Inchbald's record must have been post 1846, and as it is not in the first edition of Hobkirk (1859) it could have been after that work was published. That it is not mentioned in the 1868 edition is ambiguous. Hobkirk may have been unaware of any more recent information. Godward's record was probably the most recent. Porrritt (1883), who gave only three Yorkshire sites, listed only one for "Huddersfield", with Inchbald as the authority – presumably the Storthes Hall record. Only Porritt's records were repeated by Sutton & Beaumont (1989). Thus two occurrences in the Huddersfield area eluded the compilers of the standard works on Yorkshire Lepidoptera.

Of only five known localities of the Wood White in Yorkshire, where it has been extinct for well over a century, three were in the Huddersfield area. Of the other two, that for Doncaster was in 1837 (the other was from Sheffield) so the Huddersfield area was one of its last refuges in the county. These were also the most northerly sites from which it was recorded in England east of the Pennines. Furthermore, South Crosland, Almondbury and Storthes Hall are within about four miles of each other, each being less than three miles from its nearest neighbour, and are located in what is still the best wooded area in the immediate vicinity of Huddersfield. This is mixed deciduous woodland, much of it on south- or east-facing slopes, that was slightly more extensive and a little less fragmented at the end of the 19th century. Although it occurs in other habitats in England, the Wood White is generally associated with woodland rides and clearings, which it probably frequented here, but details are not recorded.

CLOUDED YELLOW *Colias croceus* (Geoffroy)
All Clouded Yellows seen in the area are immigrants, or their immediate offspring, whose intermittent occurrence is determined by conditions that prevail beyond our shores. Their occasional presence, while interesting, is of no lasting significance here. Such immigrations, sometimes at long intervals, have taken place throughout the recorded history of the area. The year 1983 saw an exceptional influx. Among those seen near Halifax in September and October were what appeared to be newly emerged adults, ten of them at Copley, which suggests successful breeding.

BRIMSTONE, *Gonepteryx rhamni* (L.)
The near-absence of food plants for its larvae, the Buckthorns, *Rhamnus cathartica* and *Frangula alnus* (see Lavin & Wilmore 1994), precludes the establishment of this species in the Huddersfield area. Both plants, however, have been introduced, and Cain & Baggaley (1995) mention places near Brighouse and Norwood Green where they grow. Wandering individuals of the Brimstone, presumably from the south and east of the area, have been seen intermittently in both the early and more recent periods of recording. Hobkirk (1859) listed it from Lepton, Lockwood and Honley Moor, and added Farnley Woods and Almondbury Bank in 1868. Its occurrence at Mearclough in 1859 was noted in the *Halifax Courier.*

Towards the end of the 19th century it was sufficiently rare, even in the east of the area, for B. Morley to note in the record book of the South-West Yorkshire Entomological Society that one was taken at Skelmanthorpe in *c.*1880 by John Woodhead, this being his only report of this species. Mosley (1883) mentioned its occasional, though rare, occurrence without giving any localities, and noted that the nearest place where it then occurred regularly was Wentbridge. Wattam (1936), however, whose observations extended back to 1894, knew of no record of it during that period. This hints at a period of scarcity. Indeed, in Yorkshire it was for long confined to the extreme south and was scarce around Doncaster in the first 60 years or so of the 20th century (Rimington 1992). Nevertheless, H. Spencer of Elland reported in 1927 that he had seen it in his garden two or three times in the previous 15 years (Halifax SS), after which no records of it in the area have been traced for more than 30 years. Apart from the isolated Elland sightings, it was indeed unknown for more than 80 years. The latter occurrences suggest wanderers following the Calder Valley.

It was seen in Deffer Wood, Skelmanthorpe, in 1964, this being said by Jackson (1965) to be "the first Yorkshire record for several years". It was recorded at Netherton in 1971, 1972 and 1980, and in 1977 was seen at Sowerby, at Halifax, and at Roundhills, Rastrick (YNU Record Cards).

It began to extend its range in Yorkshire in 1982 (Sutton & Beaumont 1989), since when it has been seen in several places in the Huddersfield area. It was seen at Fullshaw, near Langsett, just outside the chosen boundary, in 1985 (J. Dale). Later sites include several near Halifax (Cain & Baggaley 1994), Upper Denby (D. Elliot), Withens Clough, Wheatley, and Halifax (Cain & Baggaley 1998), all in 1996, Cromwell Bottom, in 1997 (J. Dale), and Denby Dale 1998 (T. Melling). Notwithstanding these occurrences, however, whether the Brimstone is to be regarded as a permanent member of the Huddersfield fauna is doubtful.

LARGE WHITE, *Pieris brassicae* (L.)

This species has been continuously present in the area throughout the past 150 years or more, a simple statement that does not however tell the whole story. Although the Large White is a resident, and well able to overwinter in Britain, the native population is regularly supplemented by immigrants from Continental Europe. As these would inevitably mask and replace any local extinctions it is not possible to say whether this species was affected by the events that led to several local extinctions in the late 19th century. Its continuous presence is therefore conceivably deceptive. It appears always to have been widespread, sometimes plentiful, in the area, though apparently less so in recent years, and it shuns the peat-covered uplands though it may migrate across them.

SMALL WHITE, *Pieris rapae* (L.)

Like the Large White this is a well-established resident and a regular immigrant. It has been present in the area since recording began but, as any decline in the resident stock would be made good by immigration, its apparent immunity from whatever caused the local extinction of several species in the late 19th century may be misleading. Like the Large White it has always been widespread.

GREEN-VEINED WHITE *Pieris napi* (L.)

The taxonomic status of the local Green-veined White is problematic. Several races or subspecies have been described of which, according to Emmet & Heath (1989) – whose scheme is said to be provisional – the nominate form is not present in the British Isles, though Porter & Geiger (1995) assign to it individuals from the S and S E of England and the E Midlands. The northern form, to which at least some populations in the Huddersfield area belong, is attributed to *britannica* by Porter and Geiger, to *sabellicae* by Emmet and Heath. Others have treated the situation in yet other ways. Whatever name be adopted it is unclear whether it includes all local populations.

In a study covering much of Europe, Porter & Geiger (1995) sampled five Scottish populations (only four analysed) and one from lowland Yorkshire. The results were confusing and ambiguous, the material being so genetically heterogeneous that "*britannica*" was omitted from further analyses. A possible explanation is that different entities were conflated under the blanket name *britannica*. Fine-grained local studies are needed.

In the Huddersfield area Green-veined Whites have been recorded at altitudes of more than 1200 ft. According to Lees (1970), isolated Pennine colonies that exist above 800 ft, sometimes in exposed situations, are univoltine, producing adults in June and July. They do so irrespective of temperature and apparently do not interbreed with multivoltine populations that occur at lower altitudes, whose peaks of emergence are in May and August, though individuals are to be found throughout the summer. If this is so, the univoltine and multivoltine populations represent two biological species! Porter & Geiger (1995), however, think that there may be a hybrid zone with partial restriction of intragression, but give no evidence of contact between the two forms, though there may be such in some places. More significantly they say nothing about the voltinism of the alleged hybrids! Pupae of the univoltine form normally overwinter but two of those reared by Lees produced adults in the year of their pupation, which perhaps hints at some degree of flexibility in the life cycle. The multivoltine form can be either bi- or tri-voltine. In favourable seasons it produces a third generation; e.g. Cain & Baggaley (1997) reported a partial such in September 1995, as did Morley at Skelmanthorpe in the hot summer of 1911.

It has been suggested that northern, univoltine, forms of *Pieris napi* are descended from populations that survived the Pleistocene glaciations here, and Lees (1970) and Lees & Archer (1974) subscribe to this belief. Such survival is improbable, and Dennis (1977) rejects all ideas that postulate the survival of butterflies in Britain during the glaciations. The last, Devensian, glaciation achieved its maximum between about 25,000 and 15,000 years ago, when ice sheets covered most of Yorkshire and all land to the north of it, extended to S Wales in the west, and covered most of Ireland. Ice-free areas supported a tundra vegetation, there was much bare ground, permafrost prevailed, and exposed rocks were shattered and riven by frost. The edge of the polar waters, currently embracing Greenland, lay about as far south as the latitude of Lisbon. Devensian mammals included Woolly Mammoth, Woolly Rhinoceros, Reindeer, Arctic Fox and Arctic Lemming, and even the first two of these (at least) retreated when this glaciation achieved its maximum. The Woolly Mammoth returned towards the end of it (Yalden 1999). Such cold-adapted mammals are incongruous associates for any of our extant butterflies. Of beetles, which leave resistant remains and are sensitive indicators of temperature, a sparse fauna of Arctic-Alpine species confirms that the climate was of Arctic severity during cold periods in the Devensian. Such conditions would exclude all extant British butterflies. Even in today's mild climate several species are restricted to southern England even when the food plants used by their larvae are more widespread. Some plants used as food were not available during glacial periods. Any butterflies that established themselves in Britain during the previous interglacial were surely eliminated by the Devensian glaciation. Notwithstanding earlier beliefs, such as those of Ford (1945), the first elements of our present butterfly fauna could hardly have arrived until the waning of the Devensian glaciation and the advent of the subsequent Flandrian period.

The univoltine form of the Green-veined White favours cool conditions, could have arrived from refuges in Europe as the ice retreated, or shortly thereafter, and before the multivoltine, more warmth-loving, form did so. The two could have come from entirely different refuges. Several widely separated areas in southern Europe are now known to have served as refuges for a wide range of organisms during the glaciations. If the local populations of the Green-veined White had such a dual origin, genetic distinctions may have arisen before Britain was colonised. Molecular methods are available that can explore such possibilities.

Like the Large and Small Whites, the Green-veined White maintained its presence in the Huddersfield area throughout the past 150 years or more. It is, however, much less given to migration than its congeners. The existence of several local races in different parts of its range is evidence of a low level of such movements. Nevertheless they do sometimes occur. Frohawk (1934) draws attention to considerable migrations observed on the same day in May 1933 in Northumberland and Cumberland by Garrett and Bolam, at an altitude of *c.* 2000 ft in the case of the latter. The univoltine form is less mobile than the multivoltine, which suggests that migrants may be restricted to the latter, individuals of which at such times may venture above their usual altitudinal range. The univoltine form of higher altitudes, which occurs in discrete colonies, almost certainly persisted throughout, and survived the events that led to local extinctions of several species in the late 19th century. Had it been exterminated, recolonisation would have been more difficult than for the multivoltine form, or even impossible. It seems improbable that immigrant univoltine forms cross large tracts of unsuitable terrain to establish, or join, isolated colonies in the Pennines. Persistence of the multivoltine form would be favoured by its tolerance of a wide range of conditions – valleys and cloughs, rushy fields and damp meadows, woodland margins and other habitats – and possibly by occasional immigration. Clearly the biology of this species, or species complex, merits study in the area.

Orange Tip, *Anthocharis cardamines* (L.) (Figure 3, p. 77)
Hobkirk (1859, 1868) regarded the Orange Tip as "not uncommon" but cited only three localities – Crosland, Storthes and Mollicar Wood – while Mosley (1883) noted, on the authority of Varley, that it was common behind Castle Hill some 20 years earlier, then "entirely disappeared". However, he gave a record by Alan Godward for Clayton Roughs, without a date, which perhaps suggests its more recent presence in this eastern area. One was recorded near Elland in 1870 (Halifax SS). Porritt (1883) noted that it was less common in parts of the West Riding than elsewhere in Yorkshire.

Although Mosley (1883) believed that this was one of the species that disappeared by about 1870, it survived in a few places. However, it was certainly rare in, or absent from, most of the Huddersfield area towards the end of the 19th century and continued to be so for some time thereafter. This was so also in the adjoining Barnsley area to the south (Rimington 1992) and in the Halifax and Bradford areas to the north (Halifax SS: Bradford NS). Butterfield (1911) referred to its "almost total disappearance" around Bradford, though the food plant of its larvae remained abundant. There are isolated records from the area (sites not specified) probably outside that covered here in 1881, 1899 and 1901, then no more until 1934 (Bradford NS). On the other hand it persisted around Doncaster (Rimington 1992) and "populations and ranges appear to have been always about the same" around Sheffield (Garland 1981).

It remained rare in the western parts of Yorkshire until the 1940s, but scanty records, sometimes published in obscure places, show that it persisted throughout in the Huddersfield area. Thus, in the Monthly Circular of the Huddersfield NS for June 1891, Mosley himself gave a record for 1886 (Almondbury Bank?), and it was present at Bretton about 1890 (Mosley 1890). B. Morley's manuscript list for Skelmanthorpe (1896-1908) lists it as "Not common. A few seen most years", an entry repeated in the record book of the S.W. Yorkshire Entomological Society. Wattam (1936) knew it at Harden Clough, Meltham from 1896 to 1914, after which it apparently died out. It had been reported from there in 1893 by F. Netherwood in the December circular of the HNS when this was said to be a new locality, though it was actually found by J. Carter who had reported this in the June circular. The same circulars also report its presence at Mollicar Wood, one of the sites mentioned by Hobkirk, and make the comment that it was, "some forty years ago, common in that locality but it has not been seen there for nearly twenty years". In 1900 it was seen at Elland by J. E. Crowther (Halliday 1901) and in that year and in 1901 at Cawthorne, as noted in the Annual Reports of the HNS. Its occurrence at Skelmanthorpe was noted in 1917, "not a common species here" (B. Morley, notebooks), and it was said by G. T. Porritt to be common near Emley in 1922 (Morley 1923). There are undated records, probably for the second and third decades of that century, in the SWYES record book – Coxley, "few" (J. Hooper), Huddersfield (J. Lee), Shelley "once" (H. D. Smart), and a dated record for one individual at Elland in 1934 (H. Spencer). Wattam (1936) commented that "there are always a few at Cawthorne", indicating its persistence there, and that it was known from Skelmanthorpe. From the latter place it was reported as "frequent" in 1941 (Anon. 1942), perhaps part of an increase then beginning in the east of the area. As shown by the SWYES record book the reporter was W. Buckley. This may have been a restricted colony for when several were seen in the nearby Deffer Wood by W. Smith in 1942 he noted that this species had not been seen there for 20 years (Dearing 1943).

In the northern part of the area it was evidently for long very rare, for Collinson (1969) said that at that time there were only four known occurrences in the Halifax district, of which only the two early records for Elland noted above fall within the area covered here. He was not aware of the 1934 record. It was never seen by G.F. in the Colne Valley or adjacent localities between the late 1930s and early 1950s.

It began to extend its range in Yorkshire in the 1940s, and eventually expanded widely in the Huddersfield area. An early indicator came from the adjoining Barnsley district where E. G. Bayford (b. 1865) saw about six individuals in 1944, the first he had ever seen there (Dearing 1945). In 1945 Wattam had three females in his garden at Newsome, again the first to be seen there (Proctor 1946). Records in the Hebden Bridge area in 1947 and 1949, outside the area covered, were doubtless part of the expansion of range.

Notwithstanding these signs of revival, and although it was reported as being more numerous than usual in the Bradford district in 1952 (Dearing 1953), increase and spread in the Huddersfield area were evidently slow. It was present at Lepton in 1958 (A. Steele) and Gunthwaite in 1961 (Flint 1962). By 1970 it was described as appearing to be more widespread than usual in Yorkshire (Jackson 1971). Around Pontefract, to the east of the Huddersfield area, J. D. Pickup had "never known it to be so common". In 1971 it was recorded from Bretton Park (Jackson 1972). Jackson (1983) noted that numbers began to increase markedly in Yorkshire especially in 1974, that it "became particularly common and widespread" in S. Yorkshire in 1976, where it continued to flourish, and was common around Leeds in 1978. In 1977 B. and M.J.L. recorded it at Cowcliffe and there were "occasional sightings" near Halifax in 1981 and 1982 (Cain 1990). In 1983 there were "many sightings" near Halifax, Beacon Hill and Claremount being specifically mentioned (Cain 1990), and in 1984, by which time it was common at Bretton and Gunthwaite (D. S. and V. A. Ives), it was seen at Almondbury by these observers and recorded at Elland (Payne 1985). It was reported from Shelf in five of the years 1983-1990 (Bradford NS) and was evidently established there. First seen at Lindley Moor in 1987 (J. Dale) where it became more frequent in the 1990s, it was present in "good numbers" in 1996. It was seen at Upper and Lower Stones Woods about 1988, at Denby Delf about 1990 (B. & M.J.L.), and at Wyke in 1990 (Bradford NS). By 1989 it had established itself in most of the valleys near Halifax and on damp and boggy upland hillsides (Cain 1990). In 1993 it was recorded from Bradshaw, in 1994 from Cromwell Bottom and Brighouse, and in subsequent years at Greenside, Gawthorpe, Langsett, Emley, Grange Moor, Hade Edge, Holme, Holmfirth, Thongsbridge, Brockholes, Lockwood, Kilner Bank, Quarmby, Cowlersley, Scammonden, Blakestones, Slaithwaite, Marsden and elsewhere. In 1998 it was seen at many widely scattered sites. These included places, such as those around Slaithwaite and Marsden in the upper part of the Colne Valley where, prior to the recent expansion, it had never previously been reported. In 1999 it was seen at Scapegoat Hill, an exposed area in that valley, at an altitude of more than 1000 ft (G. Baldwin). It is deemed by B. and M.J.L. definitely to be increasing at the time of writing. A similar increase took place in the Sheffield area where Whiteley (1993) reported many new sites since Garland's report of 1981. Colonisation was evidently from the east and southeast and it is interesting that the Greenfield area, west of the Pennines, was evidently colonised from a different source. Here L. N. Kidd, who has known the area since 1958, has been familiar with it there since "at least 1981".

Although the Orange Tip has extended its range and greatly increased in abundance in the area, especially in the 1980s and 1990s, and although it clearly declined in the latter part of the 19th century, it seems never to have become extinct there, but persisted, evidently in only a few places, and generally in small numbers. Its history is therefore somewhat different from that of several other species whose increase in the late 20th century it shares, some of which were lost from the locality but later regained the status they enjoyed a century or so earlier. Its history in the Huddersfield area is to a considerable degree paralleled by events in Northumberland and Durham. Here it declined in the 1860s and 1870s, for long persisted in small numbers in a few localities, with occasional short-lived increases, finally to increase markedly in the 1970s (Dunn & Parrack 1986) as it did in much of Yorkshire. Its resurgence around Huddersfield occurred somewhat later.

Green Hairstreak, *Callophrys rubi* (L.)

None of the three historical lists of the Huddersfield area include any Hairstreak and Hobkirk (1859, 1868) specifically alludes to their absence. Porritt (1883) indicates that the Green Hairstreak was at that time known from very few places in Yorkshire, the nearest to Huddersfield being Barden Moors to the north, where it was "rare", Sheffield to the south, and Pontefract to the east. Unknown to Porritt, however, according to Brady (1884), W. White saw or collected a single individual at Cannon Hall Park, in the extreme south-east of the area. The date is not recorded but may have been several years before publication. In his supplement, Porritt (1904) added Skelmanthorpe, "scarce" on the authority of B. Morley. This appears to be an error. In neither Morley's manuscript list of species for the Skelmanthorpe area (1896-1908), nor in his paper on the fauna of that area (Morley 1902), nor in the record book of the S.W. Yorkshire Entomological Society, where there is no entry in the space allocated to this species, is the Green Hairstreak mentioned, nor are any of the specimens in the Morley Collection from Skelmanthorpe. A possible explanation is that he drew Porritt's attention to the Cannon Hall record mentioned by Brady, and Porritt inadvertently attributed it to Morley.

When Collinson (1969) produced his account of the Lepidoptera of the Halifax area, much of which is encompassed here, it was unknown to him there, but apparently occurred in the Widdop Moor area far to the north-west.

The next record for the Huddersfield area was evidently that of G.F. who watched a single individual in Drop Clough, near Marsden, in 1952 (or just possibly 1953), this being the first time he had seen this species anywhere. Apart from informing the late E. W. Aubrook this was not reported. In a "Bulletin" circulated among Yorkshire Lepidopterists, J. H. Seago reported a single individual at Woolley, probably a mile or so outside the area, in 1953, and the discovery in 1954 of a colony near Langsett which may have been just inside or outside it. Seago (1959) mentioned that "recently recorded localities" on the Millstone Grit and Coal Measures in South Yorkshire (south of the area covered here) represented an extension of its range. In 1960, or possibly earlier, B. and M.J.L. recorded it at no fewer than four sites – Hullock Bank, near Jackson Bridge, Holme Styes, near Hade Edge, Underhill (Holmfirth), and Yateholme, all in the upper reaches of the Holme Valley drainage. In 1977 it was found, just outside the 10 mile radius, north of Langsett (Ely 1978), and in 1983 near Royd Moor, about 2 miles from this site and within the area, by D.S. and V.A.Ives. In the early 1980s it was found by J. Dale in Ramsden Clough, again in the Upper Holme Valley drainage, and in 1986 at Crow Edge by D. S. and V. A. Ives. In the 1990s it was found at several places around Langsett, and at Denby Delf, Broadstones, Cheesegate Nab near Hepworth, Crossley's Plantation (near Ramsden Clough), and Holme (B. & M.J.L; D.S. & V.A.I.; J.D.; V.C.63 Butterfly Conservation Group). Three sites in the vicinity of Langsett plotted on Whiteley's (1993) map are at the edge of the area.

In 1998 it was seen by various observers in at least a dozen sites in the upper part of the Holme Valley – Denby Dale area, well over 300 individuals being seen in a group of three closely associated sites, and 88 counted in two other adjacent locations. Four sites near Langsett, some probably just outside the area, were also noted.

Apart from the Drop Clough site in the early 1950s, the Green Hairstreak was not seen in the northern parts of the Huddersfield area until 1997 when B. D. Cain recorded it from three adjacent sites, Scammonden, Hey House Clough, and Red Lane Dyke, in the upper Calder drainage, the nearest less than two miles from Drop Clough but in a different drainage. Since then he has either recorded it or received reliable records from no fewer than 25 sites, mostly west of Halifax and mostly in the area covered, including Norland, Ogden, the Luddenden

Valley and Cragg Vale, and also in the Shibden Valley east of Halifax. In 1998 it was found at Blackmoorfoot (between Meltham and Linthwaite), a site less than three miles from Drop Clough and to the east and somewhat south of it (M. Denton) and in 1999 one was seen not far from this site by J. Keenlyside. In 1999 J. Dale found three individuals at Scammonden in a bilberry area, the first time he had seen this species there during many years of visiting; in 2000 he saw 10 there.

West of the Pennines, L. N. Kidd encountered it for the first time in the Greeenfield area in 1996 when he found a colony at Dick Clough.

Save for Drop Clough and the other northern sites discovered in the late 1990s, all the other, earlier, sites are in the southern part of the area and the indications are of a spread from the south. It was long known as a rarity in north Derbyshire, but Brown (1930) reported it as present in one area "in exceptional numbers" in 1929. Such years of abundance may have been conducive to its northward spread. Garland (1981) mentions "an apparent expansion of range " in the late 1950s, but says that otherwise "it appears to have remained fairly constant throughout its recorded history in the Sheffield area". His map shows no fewer than 44 known sites in 1980. Others, all west of the city like earlier known sites, were added by Whiteley (1993), bringing the total to 104, and indicated a continuing increase. Sites near Langsett were further north than any previously recorded. The increase and spread, which appear to have gathered pace in the last few years of the century, are in keeping with events elsewhere in western Yorkshire, e.g. in the Harrogate area between 1978 and 1992, and particularly between 1983 and 1986 (Barnham *et al.* 1993).

This relative newcomer to the Huddersfield area here favours upland sites (but not the highest ground) and is so far known from an arc of country in the west and south, and also on the western side of the Pennines. Bilberry, *Vaccinium myrtillus*, much favoured as a food plant by its larvae, is often a component of the vegetation in frequented sites. Its preference for such habitats is thrown into strong relief by the complete lack of records from the well studied Wakefield area immediately east of that considered here (R. M. Sunter), and by the considerable number of places in upland regions west of Sheffield from which it is now known (Garland 1981, Whiteley 1993), compared with none in the lowlands east of that city. Its absence from these eastern, lowland areas is noteworthy as in some parts of Britain it occurs on rough land with bushes and rank vegetation, on rough, even calcareous, grassland on chalk downs, and at the margins of woods. Jackson (1980) noted how, until the 1950s, it used to occur on Skipwith Common, near York, and in other low-lying areas, but by 1980 seemed to be confined to hilly regions. He specially mentioned the high moors of N E Yorkshire, and the same holds good for the Huddersfield area and elsewhere in the Pennines. This suggests that a genetic strain with a preference for the uplands has been responsible for the recent expansion of range.

Purple Hairstreak, *Quercusia quercus* (L.)

Although then unknown in the Huddersfield district, the Purple Hairstreak was widespread, but apparently not common, in Yorkshire in the late 19th century (Porritt 1883). It subsequently retreated to a crescentic area east and south east of York. In the 1980s, however, it began to extend its range and was, for example, found for the first time in the Harrogate area in 1983 (Barnham & Foggitt 1987), since when it has become firmly established particularly in the east of that district. Here it has been found over a wide area "in most major blocks of woodland and on roadside and hedgerow stands of oak" (Barnham *et al.* 1993). It was unknown in the Sheffield district when Garland (1981) published his review, but had appeared in the south east, in Nottinghamshire, when Whiteley (1993) updated that survey. Whiteley was also able to add a late record for Rotherham in 1993.

Colonisation of the Wakefield area was recorded from 1992 to 1996 (Barnham 1997), and a westward extension from this region produced the first ever records for the Huddersfield area in 1996 when R. M. Sunter saw 10 individuals at Emroyd Common, Middlestown. An intensive survey in 1997 and 1998 by R.M.S. revealed it to be widespread in the Wakefield area. This, he suggests, indicates that its unobtrusive habits may at first have enabled it to go undetected. Its spread, while real, may have begun earlier than the records suggest. R.M.S. also found it in Strangstry Wood, near Rastrick, in 1998, in Odsal Woods and at Stocksmoor Common in 1999, and at four sites near Bretton in 2000. Meanwhile, in 1997, B. D. Cain found it near Clifton, and subsequently at three adjacent sites, and in 1997, 1998 and 1999 located it in other Oak woodland in the Calder Valley and its tributary Hebble and Luddenden valleys, confirming its continuing expansion of range. It was found at Digley in 1998 by S. Anscombe, in which area it was seen at about 980 ft. by B. and M.J.L. in 1999. Thus, hitherto unknown in the Huddersfield area, it was seen in five consecutive years up to and including the bi-millennium.

WHITE-LETTER HAIRSTREAK, *Satyrium w-album* (Knoch) (Figure 3, p. 77)
Porritt (1883) listed only four Yorkshire localities for this species, but noted it as abundant in Edlington Wood, Doncaster, and in adjoining habitats. Rimington (1992), however, believed that it was not uncommon in some places until about 1910 when it declined but persisted at various sites, with occasional periods of abundance, until the latter part of the century. From the late 1970s, however, in spite of the loss to Dutch Elm disease of Elms that provide food for its larvae, it spread considerably, sometimes possibly stimulated to move from dying Elms; for example, it greatly increased its range in part of the Harrogate district in the 1980s (Barnham & Foggitt 1987). From the mid-1980s however, it declined markedly there following the almost complete loss of mature Wych Elms, *Ulmus glabra* (Barnham *et al.* 1993). Some of the few colonies that established themselves in the Sheffield area also became extinct (Whiteley 1993). It nevertheless continued to survive where regenerating Elms were available and remained widespread in Yorkshire at the bi-millennium. Against this background it is striking that it was first seen in the Huddersfield area in 1993, at Almondbury Bank, by S. Graham. It was recorded in 1996 at Fenay Bridge (D. Knight), in 1997 at Emley (N. Gill), and again at Almondbury (S. Graham), and in 2000 near Ryburn Reservoir (M. Earnshaw) and near Bretton and Cawthorne (*Argus* No. 39).

SMALL COPPER, *Lycaena phlaeas* (L.)
Reported from Storthes in 1846 by Dunning, this species was evidently common in the Huddersfield area in the 1840s and 1850s (Hobkirk 1859, 1868) and has remained a member of the fauna ever since. As elsewhere, however, it has been subject to large fluctuations in abundance, and there was an early period when it was exceptionally rare. By 1883 Mosley reported it as being less common than formerly, and Halliday (1896) said it had "not been seen for years" in the Halifax area. When in 1901 W. Greaves reported its reappearance at Park Nook, Elland, Halliday (1902) added that it was "a great many years" since he had seen or heard of it in the district. Halstead (1902) reported another there in the following year. Butterfield (1911) said that it did not occur in the Bradford area though it had been seen there in the past. The decline probably dates from about 1865 or a little earlier as Porritt (1918), born in 1848, remarked "In my early collecting days *Polyommatus* [now *Lycaena*] *phlaeas* was in my experience quite a rarity in the Huddersfield district", but it had recently become common and "this year was more plentiful than I have ever known it".

Recovery evidently began at different times in different parts of the area and was first noticed at Skelmanthorpe in 1901 – the year it reappeared near Halifax – by Morley (1902) who reported that it had "appeared commonly" there. He confirmed its previous scarcity by adding that it was a species "which had apparently almost disappeared". In 1910 it was present at Coxley and Middlestown (J. Hooper), Emley and Woolley Edge, and was common at Gunthwaite (B. Morley) (YNU record cards). Annual Reports of Huddersfield NS noted it at Honley in 1915 (W. E. L.Wattam), Grimescar in 1916 (C. Mosley), and as abundant at Brockholes and "other places" (C. Mosley) and common at Newsome (Wattam) in 1918, the year in which Porritt reported it as common. It was seen at Cragg Vale, on the fringe of the area, in 1915 and at Mytholmroyd in 1916 (Halifax SS). B. Morley (YNU record cards) recorded that it was common throughout the West Riding in 1917, 1918 and 1919. In the latter year it was common all over the Bradford area where it had been "rare for many years previously", indeed absent according to Butterfield (1911), and continued to "hold its own" in 1920 (Bradford NS). Smart (1918) confirms this pattern at Shelley. He never saw it there before about 1910 when one or two were seen (in the YNU record book it was noted as "increasingly common since 1908"), after which it was always present but uncommon until 1915 when military duties claimed him, but in 1918 he saw it in abundance. It remained common in 1919, being seen at Crosland Moor (C. Mosley), Lindley (A. Kaye), Marsden, where A. Dean saw it for the first time, and was abundant at Farnley and Thurstonland (Wattam). In 1920 it was seen at Skelmanthorpe (Morley) and Mytholmroyd (Halifax SS). Annual Reports of the Huddersfield NS indicate that it was plentiful in 1921, less so in 1922, and only one was reported, from Newsome, in 1923. In 1922, however, it was common at Wyke and Bierley (W. Barraclough, YNU record cards).

While common at Skelmanthorpe in 1924 (Morley 1925), Elland (Halifax SS) and Low Moor (Bradford NS) in 1927, it probably declined elsewhere in the area, later to increase. Wattam (1936), who noted that colonies had always been known from Skelmanthorpe, Netherton and Honley, said it had "increased immensely" since 1928 and was especially abundant in 1934 and 1935, "occurring in great numbers even on the heather moors." On one occasion he counted 22 in his garden at Newsome. It was abundant at Low Moor in 1934 (and apparently also at Wyke) and more abundant than ever seen there in 1935 (W. Barraclough, YNU record cards). By 1936 it was much scarcer (Wattam 1937), as it was in 1939 (Dearing 1940). At Low Moor, however, it remained plentiful in 1936 and was still reported as "common" in 1940 (W. Barraclough, YNU record cards) but there is no information for the intervening years. It was generally abundant from 1940 to 44 inclusive, though possibly less so around Elland in 1943 (Halifax SS) and Low Moor in 1944, but had declined in 1945 and 6. (See Anon., Dearing, Proctor for relevant years). Thereafter, as a familiar species, its status received little attention, the frequent fate of such organisms. In the 1940s and early 1950s it was often seen in the Colne Valley (G.F.), usually in small numbers. It was recorded at Lepton in 1958 (A. Steele). R. Crossley recorded it in the upper Deanhead Valley in 1957, the Longwood Valley 1958, Mollicar Woods 1959, Beldon Valley 1959 and 1960 (commonly in 1960), at Cromwell Bottom 1961 and near Blackmoorfoot in 1965. B. D. Cain has known it in the Halifax area from 1955 to the end of the century, confirming Collinson's (1969) remark that it was then seen every year throughout the district. It was common in the earlier years of his observations, and was described as being so in 1990 (Cain 1991). In 1992, however, numbers were low; in 1993 it was "not as common as formerly" (Cain & Baggaley 1994, 1995); and in 1994, when very few were reported, it was said to be "in severe decline". (Cain 1996). In 1995 it was said to be widespread "but often now on localised sites" (Cain & Baggaley 1997). The few specific records for the 1980s and early 1990s include Honley Wood, 1982, Blackmoorfoot, 1984 (M. Denton), Gawthorpe Green 1984, Shelf 1984, Paddock 1985, Mount (Outlane) 1986 (B.& M.J.L.), Almondbury 1986 (D. & V. Ives), Queensbury 1989, 1990, 1995, Low Moor 1990, 1991, East Bierley 1996 (Bradford NS), Bretton 1994 (L. Lloyd-Evans) and several others. Although the number of observers in the late 1990s was greater then ever before, only 10 records were made in 1998 by observers based around Huddersfield (as opposed to Halifax), mostly in the east of the area. This, however was a poor year in Yorkshire as a whole where, probably in part a result of adverse weather, numbers were far fewer than in 1997, deemed to be an exceptionally good year (Crowther 1998, 1999).

L. N. Kidd noted that it was "by no means as common as formerly" in the Greenfield area in the 1990s.

Common Blue, *Polyommatus icarus* (Rottemburg)

For Huddersfield, Hobkirk (1859, 1868) simply listed this species as "common" without mentioning localities, of which the only one documented for this early period is Storthes where Dunning recorded it in 1846 (Rimington & Beaumont 1996). Whether Hobkirk's remarks applied to the whole of the area or, as is possibly the case, only to the eastern part, is not known. Newman (1870-1871) drew attention to its scarcity in the west of the area.

From reports from many correspondents he judged it to be present everywhere in England "except in a few localities in Yorkshire" and said specifically "I believe that it has escaped the notice of the Halifax entomologists". Of its Yorkshire distribution not long afterwards Porritt (1883) said "Generally distributed but very scarce in some parts of the West Riding". Of its status in the Huddersfield area, Mosley (1883) said only "Mollicar Pastures formerly", implying that it was one of the species to whose earlier disappearance he drew attention. Somewhat to the south-east, Brady (1884) said it was "universally distributed but not plentiful" in the Barnsley area and specifically mentioned it as being common (date not specified) at Darton, just outside the area covered here, and not far from localities mentioned below. It is not included in Halliday's list for Halifax (1896) but there is an isolated record for Wyke in 1898 (Bradford NS).

While there may have been places where it was already rare or absent, an additional late 19th century decline in parts of the W Riding is indicated, not only by Mosley's remark concerning the Huddersfield area, but by comparing Brady's comment on its status around Barnsley, probably prior to 1880, with the experience of E. G. Bayford who, then aged 80, saw this species there for the first time in 1945 (Proctor 1946). Around Bradford, Butterfield (1911) said it was "fast becoming extinct in this locality". It had formerly been "by no means uncommon", but he had not seen it there during the previous ten years. This may suggest persistence in some places, not necessarily in the area considered here, until about the turn of the century, but the dating is not precise. On the other hand, Garland (1981), who showed it to be widespread around Sheffield, noted that its distribution "seems to have remained relatively constant throughout the last one hundred and fifty years", and Rimington (1992) indicates its continued presence around Doncaster since the early 19th century.

It was certainly not common in, or was absent from, most of the Huddersfield area around 1900, but Morley's manuscript list for the area around Skelmanthorpe between 1896 and 1908 gives Skelmanthorpe, Bentley Springs and Gunthwaite. The last locality, in different ink, could, however, have been added later. Wattam's (1936) personal experience of it was from Clayton West only, but he referred to Morley's acquaintance with it at nearby Skelmanthorpe. Indeed it not only persisted but perhaps flourished in a restricted area in the east from at least the end of the 19th century. In his notebooks Morley recorded that it was common near Gunthwaite in 1910 and 1911 and that it occurred sparingly in a few places "about the district", Bentley Springs being mentioned. In 1910 it was reported as rare at Coxley (J. Hooper, YNU record book). It was very common near Skelmanthorpe in 1921, common in 1924 and "not uncommon in a few stations" in 1925 (Morley 1922a, 1925, 1926). At an unknown date, but within this period, H. D. Smart saw one at nearby Shelley (YNU record book). These records, and Wattam's for Clayton West, reveal persistent populations in a restricted area.

Further north L. Stobart recorded it from Wyke in 1933 and 1940 and there is a record for Low Moor in 1936 (Bradford NS). Bearing in mind the Wyke record of 1898 it is tempting to suggest that this species persisted in the Wyke-Low Moor area just as it did around Skelmanthorpe.

It was apparently long unknown to the west of Huddersfield. Wattam worked in Marsden at the head of the Colne Valley, was therefore familiar with the area, and would have been aware of any reports of it in that region. From the late 1930s to the early 1950s G.F. never saw a Common Blue in the Colne Valley or adjacent areas. For the Halifax area, Collinson (1969) says there were only five records up to 1948. Halifax SS records list six, of which, however, four fall outside the area covered here, the only relevant sites being near Elland in 1927 and Halifax 1948. Ironically the others, of which the earliest was for 1863, are for the Hebden Valley or, in one case, Todmorden, perhaps indicating a former extension westward in the Calder Valley.

Polyommatus icarus certainly extended its range in the Huddersfield area from about the mid 20th century but whether the earliest stages of expansion were adequately recorded is uncertain. Perhaps a forerunner of things to come was the recording south east of the area, in Barnsley, in 1945 of the first individual that E. G. Bayford had ever seen there (Proctor

1946). Wattam saw it at Newsome (where he lived) for the first time in 1947 (Dearing 1948). This is highly significant as he had by then been making observations on the butterflies of the area for 53 years. While the exact locations are not known, this site was probably less than two miles from Mollicar Pastures from where Mosley noted its disappearance well over half a century earlier. It was seen at Halifax in 1948 (Halifax SS), and at Bretton in the same year (J. Hooper, A. C. Laughton – SWYES record book). According to J. H. Seago (YNU excursion circular 1953), widely scattered colonies existed in the Bretton – Cawthorne area, presumably in 1952 or earlier. These can reasonably be presumed to be descendants of those known to Morley in the same general area half a century and more earlier (note also previous record), but proof of such continuity is lacking. It was present at Thunderbridge in the late 1950s (B. & M.J.L.), in the Shibden Valley in 1956 (Cain 1990), at Lepton in 1956 and 1958 (A. Steele collection) and in the nearby Beldon Valley in 1959 (R. Crossley), and was reported as abundant at Gunthwaite in 1960 and possibly earlier (J. H. Seago YNU excursion circular 1961). Colonies were found near Cromwell Bottom and at Norwood Green in 1960 (Cain 1990). These observations show that the Common Blue continued to exist to the east of Huddersfield throughout the first half of the 20th century and probably through the latter part of the previous century, and that it spread somewhat westward in the mid-20th century. Newsome was the most westerly recorded site south of Huddersfield but it extended further west up the Calder Valley.

On the authority of W. E. Collinson it was said by Jackson (1963) to be common in a colony near Halifax in 1962, perhaps that at Copley, the only one specifically mentioned by Collinson (1969). A note in the Halifax SS records says "1965-8, well established Copley". This, the colonies mentioned by Cain (1990), another at Brighouse, and other sightings near Halifax, suggest that westward extension here utilised the Calder Valley. With respect to the Huddersfield area, the statement (YNU Lepidoptera Committee 1967) that Porritt's remarks of 1883 "still apply more or less exactly today" was therefore already outdated when it appeared.

There is a dearth of information for the 1970s, but the 1980s and 1990s saw a definite extension of range throughout much of the area. At Queensbury, in the far north, it was reported in 1981 "from an old locality" but no earlier finds were dated. It was evidently established here, being reported again in 1983, 1989, and 1995, as it was at Elland in 1982 (Bradford NS). It was seen at Scout Dike and Royd Moor in the extreme south-east in 1983, 1984, and 1985 and several subsequent years in the latter locality, and its continued presence at sites in the Bretton area was confirmed from 1983 into the 1990s (D. S. & V. A. Ives) and in 1995, 1996 and 1997 (R. M. Sunter). It was known, and was sometimes plentiful, at Cromwell Bottom from 1984 to 2000 (several observers), and seen again at Elland in 1984 (Payne 1985). It was common in the Wyke and Raw Nook – Low Moor area in 1989, and in 1990 was abundant in the latter area, almost 300 individuals being seen on one day in August and about 100 on another (R.M. Sunter, Bradford NS). The indications are that it has persisted in this area for more than a century. Other records include near Clifton, Ainleys, and various sites near Halifax, 1991 onwards (Cain & Baggaley 1992, and subsequent reports), Lindley Moor 1991 (J. Dale), Almondbury 1992 (Ives), Denby Delf 1994 onwards (B. and M.J.L.), Dunford Bridge 1994 (L. Lloyd-Evans), Bank Wood near Emley and near Gawthorpe, Ossett 1995 (Wakefield NS per R.M.S.), Quarmby Clough 1997 (Quarmby Conservation Group), Meltham 1998 (M. Mail), Blakestones, Flush House (near Holmbridge) and near Digley Reservoir 1998 (B. & M.J.L.), Elland (J. Dale) 1999 and Stocksmoor 2000 (B. & M.J.L.). As well as some of those in the Calder Valley, some sites south of Huddersfield lie to the west of the town. Sites in the latter area were unknown until the 20th century expansion, prior to which the Common Blue had an eastern distribution. In the late 1990s it was common and widespread in the adjacent Wakefield area to the east (R. M. Sunter).

Cain (1990) reported it as "locally common on its established sites", but scarcer in 1994. By 1995 it was said by Cain & Baggaley (1997) to be "very local on suitable sites throughout the district", of which, however, there was a considerable number, which confirms the westward spread towards the end of the 20th century. B.and M.J.L. are also of the opinion that it became less common in the late 1990s than some years earlier.

HOLLY BLUE, *Celastrina argiolus* (L.)

Dunning's manuscript notes record the Holly Blue as common at Storthes Hall in 1847 and Hobkirk (1859, 1868) added Honley, Woodsome and Castle Hill, with the comment "rare" appended in 1868, but noted in the text that "it may not infrequently be seen" associated with Holly flowers. In Yorkshire in the latter part of the 19th century Porritt (1883) said it was "usually not uncommon where the holly grows freely". Around Huddersfield, however, Mosley (1883) mentions only its former occurrence at Storthes Hall and Carr Wood, where it "used to be taken freely" among hollies, but where it was by then extinct. Half a century later it was still unknown to Wattam (1936) and had not been seen in the interim.

Its disappearance from the area in the second half of the 19th century may have been for reasons different from those that saw the local extinction of several other species. The Holly Blue is near the northern limit of its range in Yorkshire, and here it retreated at that time, the local situation being part of a wider phenomenon which essentially saw its disappearance from Yorkshire save for persistence near Rotherham and occasional sightings elsewhere in the extreme south. Sharp declines and sudden increases in abundance and the rapid colonisation of considerable areas are indeed a feature of its history in the northern parts of its range. These appear to be related to aspects of its biology that have received little attention but of which evidence has been obtained in Yorkshire. First, however its more recent local history.

After an absence of some 80 years it reappeared in the Huddersfield area in the late 1940s, as it did elsewhere in Yorkshire, persisted into the 1950s, sometimes being common, then again largely disappeared. During its mid-20th century resurgence it was seen in Deffer Wood, Skelmanthorpe, at Brighouse, Elland, Halifax (Dearing 1949, 1950), Horbury (Hooper & Fletcher 1951), in the Deanhead Valley, Scammonden (G.F.) and certainly elsewhere, though the specific sites are not adequately documented. It evidently persisted in the Cawthorne-Gunthwaite area until 1957 or 1958 (J. H. Seago, YNU record cards).

From about 1957 it was virtually unknown in Yorkshire for about 20 years. Among the very few sightings was a female at Huddersfield in 1976 (J. R. Beaumont). In the late 1970s and early 1980s it again showed a modest increase in some places but remained generally rare until the end of the 1980s. The earliest known records for Huddersfield were not until 1991 when it was seen at Lockwood (D. Manchester), Beaumont Park (D. S. & V. A. Ives), Well Head and Slead Syke, Halifax, Triangle, and Luddenden Foot (Cain 1992). In 1992 it was again seen at Beaumont Park and Triangle and, by various observers, at Skelmanthorpe, Almondbury, Fixby, Lindley Moor, Carr Pit, Primrose Hill, Meltham, Blackmoorfoot, Clifton, Southowram, and in more than 20 other sites around Halifax listed by Cain & Baggaley (1994) – a dramatic change in status. In keeping with the situation in Yorkshire as a whole, numbers began to decline in 1993 when only six sightings were reported. These included new sites, such as Waterloo (R. Sykes). Save apparently around Harrogate and for a population between there and York, the Holly Blue had virtually disappeared elsewhere in Yorkshire by 1994 (summary in Parkinson 1999), but it persisted in at least four sites in the Huddersfield area-Sowerby Bridge, Calder and Hebble Canal, Cromwell Bottom (Cain 1996) and Blackmoorfoot (M. Denton) (and was doubtless undetected at others). While there were hardly any records for the rest of Yorkshire in 1995 (Parkinson 1999), there were still at least five sites in the Huddersfield area, two of them, Blackmoorfoot and Cromwell Bottom, evidently populated by descendants of the previous year's population. There was some recovery in Yorkshire in 1996, when again five sites were located in the Huddersfield area. In 1997, for which year, ironically, there were few records for the area, though B. D. Cain regarded it as still established around Halifax, there was a marked recovery in Yorkshire. This was followed by a dramatic increase in 1998, in which year the Holly Blue was again found in many places throughout the Huddersfield area save in unsuitable habitats such as cotton-grass moorland. They included sites near valley heads: as at Marsden (Colne

Valley), Meltham Mills (Hall Dike), Holme, Cheesgate Nab, Washpit and Cartworth Moor (all in tributary valleys of the Holme), which suggests movements up valleys, as did its occurrence in the Deanhead Valley in the late 1940s. It was also in the Luddenden Valley whose head lies outside the area.

It appeared to enjoy mixed fortunes in 1999, being plentiful in some places, as at Denby Dale, but much reduced in others, the general picture being one of reduction compared with 1998 and it was seen at fewer sites, but at some places where it had not been seen before. There were few records in 2000.

Although Williams (1958) does not include the Holly Blue in his account of British butterflies known to migrate, and while neither Emmet & Heath (1989), nor, apparently, earlier authorities, refer to migratory movements, there is good evidence that it makes migratory flights within the country. There are indeed indications that it may sometimes arrive in Britain from elsewhere. In a note whose title gives no indication that it records such a significant observation, Mounsey (1949) reported that in May 1946 a flight of Holly Blues passed through York for two days in a more or less northerly direction, a few being captured for identification. Frost & Frost (1991, 1992) suggest that this species can "explode" northwards in favourable years and deduced a northward movement in August 1990 from a dozen or more sightings in Holderness. Offspring of these gave a good spring generation in 1991 and these in turn a good summer generation. But there was also an enormous influx in July and August when there were almost 200 reports of hundreds of butterflies, 300 being seen at Spurn on one day. Moreover there were several observations of individuals apparently flying in from the sea. Such sightings at least hint at possible invasions from the Continent though Howard Frost (*in lit.*) notes the possibility that these could be individuals that had been blown offshore while migrating northward overland and successfully returned by flying low over the water. Of at least local migrations this is nevertheless good evidence, which confirms the observed fact that, as Heath *et al.* (1984) say, the Holly Blue "seems to colonise new areas frequently," which implies such movements. Migration would also explain the record for Rosshire, just north of Inverness, and well north of its normal range, mentioned by Dennis (1977, p. 232), for which he gives a different explanation.

That this behaviour of the Holly Blue has been generally overlooked is indicated by the fact that, in a detailed survey of the diversity of butterflies on British islands, Dennis & Shreeve (1997) indicate that there are no records of mass movement by this species. The observations of Mounsey and the Frosts, and events in the Huddersfield area, demonstrate otherwise.

It was not until 1991 that it was seen again in the Huddersfield area after an absence of more than 30 years save for the single individual of 1976, itself a putative migrant. Its sudden appearance is understandable if there was an influx of migrants. The dramatic increases of 1992 and 1998 almost certainly reflect immigration as well as local breeding.

There is one potential objection to the idea of immigration from the Continent. The British form of *C. argiolus* is supposedly distinct from the continental form and has been distinguished as *britanna.* The distinction is based on small differences in coloration and on the relative prominence of the underside spots and streaks. These alleged distinctions, which are not emphasised by all taxonomists, are much less than those to be seen for example in the variation of the Common Blue, *Polyommatus icarus*. If immigration does occur, the validity of the distinction will be seriously questioned.

The pattern of change in the Huddersfield area shown by the Holly Blue differs from that of all other species. Recurring large increases and declines are difficult to correlate with climatic events. Indeed weather conditions in 1998, when it became particularly abundant, do not appear to have been especially favourable and several other species fared poorly that year. Parasitism by the ichneumon *Listrodomus nycthemus* has been suggested as being implicated, but efficient host-parasite associations do not usually eliminate the host, as has been the fate of the Holly Blue in the area on more than one occasion. Its sudden upsurge here between 1990, when it was unreported, and 1992 when it was common and widespread, and between 1996 and 1997 when it was rare, and 1998 when it was abundant, certainly indicate a role for immigration. What remains a mystery is what was the prime origin of the immigrants and what caused the sudden expansion and dispersal.

RED ADMIRAL, *Vanessa atalanta* (L.)
Although a few individuals may sometimes overwinter successfully in southern England, the continued representation of this species in Britain depends on migration, whose intensity differs from year to year. Changes in the area concerned are therefore controlled largely by extrinsic factors. It has been recorded throughout the period covered. Dunning recorded it as abundant at Storthes Hall in 1846, and Hobkirk (1859) listed it as common. As it disperses widely in many kinds of terrain and is a conspicuous species, it is noticeable when present. It may be coincidental that it was apparently less common than formerly when Mosley (1883) wrote, or may indicate a period of adverse conditions. It was abundant again in 1899 (Annual Report HNS: Porritt 1900a) in which year it was recorded as "more plentiful than usual" at Halifax (Halifax SS). Wattam (1936) noted that it subsequently increased, an impression doubtless influenced by the fact that 1933 was a year of national abundance.

Around mid-day, Sept. 8, 1960, F. Crawshaw and his brother saw large numbers moving south on Buckstones Moss. This confirms a return migration (Williams 1958) and involved crossing inhospitable terrain at an altitude of >1500 ft.

PAINTED LADY, *Cynthia cardui* (L.)
As such offspring of the Painted Lady as are produced by immigrants in Britain have no overwintering stage its credentials depend entirely on incomers. Like the Red Admiral it has been present, but more intermittently, throughout the period covered and, again like the former, frequents a variety of habitats. Dunning's record from Storthes Hall in 1846 (Rimington & Beaumont 1996) is the earliest traced.

SMALL TORTOISESHELL, *Aglais urticae* (L.)
The Small Tortoiseshell (earliest record 1846: Dunning) was described as very common by Hobkirk (1859, 1868), and according to Mosley (1883) continued to be "abundant throughout the district" until the early 1860s, yet 20 years later "only occasional stragglers" were to be seen. The interest of this decline of a common species is that it coincided with that of other species, and the demise of some, in the area. Porritt (1900a) noted in passing that the Small Tortoiseshell was present in his garden in 1899, "it being . . . now comparatively seldom seen here", though the Annual Report of the Huddersfield NS had recorded that it "swarmed throughout the district" in 1895, which suggests that large, short-term, fluctuations in abundance were involved. A note that it was "more plentiful than usual" at Halifax in 1899 (Halifax SS) confirms Porritt's comment for that year and shows that the decline noted by Mosley was temporary. In 1901 it "simply swarmed" at Skelmanthorpe (Morley 1902), but in manuscript notes, where he specifically records the presence there of single individuals in 1915 and 1917 he says that its appearance is "uncertain", which indicates continuing scarcity. Wattam (1936) reported a definite increase "especially since 1933" – a welcome note of precision – and, with fluctuations in abundance (it was scarce in 2000), it has remained well represented and widely distributed in the area though, by virtue of its regular presence, it tends to go unreported unless included in a survey. In Garland's (1981) survey of Sheffield it was the most frequently recorded species.

Unlike colonial, largely sedentary, species, the Small Tortoiseshell is mobile, often spends much time in direct flights across diverse types of terrain, and frequently traverses several kilometres in a day. In Germany marked individuals have been recovered 150 km. from the point of release. In Britain there is a tendency to move more or less NNW until about mid-August and SSW later in the year (see Emmet & Heath 1989, for summary). Such movements add to the suspicion that occasional individuals arrive in Britain from the Continent. They also demonstrate that it is not only local factors that determine its presence and abundance in a particular area. Its scarcity in the period in the 19th century during which several species suffered extinction in the Huddersfield area may therefore have been coincidental. While it has been a component of the local fauna throughout the period for which information exists, little can be said about what determines its abundance. Much remains to be learned about the biology of this common species.

LARGE TORTOISESHELL, *Nymphalis polychloros* (L.)

Hobkirk (1859) recorded this species from South Crosland and (1868) reported a brood at Birkby in 1859. Mosley (1883) referred to "occasional specimens" from Farnley and Birkby (Porritt) and Penny Spring Wood (Varley). As Porritt was not born until 1848 his Birkby record mentioned by Mosley may be additional to Hobkirk's for the same place. As well as Huddersfield (on his own authority) which would embrace all localities specified by Mosley, Porritt (1883) lists others not far distant, of which Horbury and Halifax, fall within the area considered here. It was also recorded from Clayton West by J. Firth, as reported by Brady (1884), who gives no date. It is significant that most of the Yorkshire records of this species, which Porritt describes as "not uncommon but not often taken in numbers", are from the south-west of the county.

Particularly noteworthy is that Wattam (1936) reported it as "still only seen occasionally" as it was by himself at Newsome in 1934 and 1935, and from where he had earlier reported seeing "a fine specimen of this locally uncommon butterfly" (Wattam 1921). Furthermore, he subsequently reported two from Newsome on August 4, 1949, on which day he saw another at nearby Lower Castle Hill, and saw three more at Newsome on October 15 in the same year – a late sighting (Dearing 1950). (The late 1940s were the last time that this species was comparatively common in Britain.) Unless the indication for V.C.63 in the period 1940-49 shown on the map of Emmet & Heath (1989) refers to Wattam's 1949 sightings, all these records (some of the many treasures buried in the pages of *The Naturalist*) have been overlooked. Indeed, Sutton & Beaumont (1989) say that, apart from three individuals seen at Allerthorpe in 1948, the only other record for Yorkshire this century was from Keighley in 1910. Only the Keighley record is mentioned in YNU Lepidoptera Committee (1967). It seems that the Large Tortoiseshell, one of whose strongholds was in S.W. Yorkshire, and which is now thought by some to be extinct in Britain except as an intermittent immigrant (or even always to have depended on immigrants, see Emmet & Heath 1989) may have persisted in the Huddersfield area longer than suspected by most entomologists.

Unfortunately adults of this species were irresponsibly released at Warley in 1984, and while there were no indications in the following four years that these survived or bred, there is bound to be a faint suspicion that an individual at Norton Tower, near Halifax, in 1989 (Cain 1990) was derived from this introduction. This and another seen at Sowerby Bridge in 1991 were deemed to be migrants by Cain (1992).

Two more were seen in 1992, one at Cromwell Bottom on June 11 and one at Well Head on July 26 (Cain & Baggaley 1994). These were also thought to be migrants, as are most of the rare individuals now seen in Britain. While this may be correct, it may be more than coincidental that four individuals of this now very rare species should be seen in the very area that has yielded a series of records over many years. (Apart from Yorkshire the Large Tortoiseshell was not seen in northern England between 1940 and 1988 – Emmet & Heath 1989.) Is it conceivable that it still survives somewhere in the area?

CAMBERWELL BEAUTY, *Nymphalis antiopa* (L.)

Very intermittent in its occurrence, and a rare migrant, the Camberwell Beauty has a long history of appearing in the area at lengthy intervals. It was recorded in Huddersfield in 1858 and at Newsome in 1859 (Hobkirk 1859, 1868); several were seen in 1872, and others at other times (Mosley 1883). There were subsequent occurrences at Huddersfield in 1899 (Porritt 1900b) and Longley Hall in 1924 (Morley 1926), but Wattam neither encountered nor listed it as he doubtless did not regard it as a true component of the local fauna. More recently it was seen at Southowram in 1983 (per B. D. Cain), and there were several sightings in 1995 – Upper Denby (D.Elliot), Almondbury (B. & M.J.L), Slaithwaite (B.

Brassington), and Lower Shibden (Cain 1997). While of intrinsic interest, such occurrences of this splendid insect are of little significance in the history of the local fauna.

PEACOCK, *Inachis io* (L.)
Listed by Dunning in 1846, the Peacock was described as common by Hobkirk (1859, 1868), but by 1883 Mosley, who confirmed that it was previously common, reported that it had become rare, a state of affairs that, with occasional short-lived local increases, persisted for more than a century. In this instance the decline was not merely local but was related to a general contraction of range in northern Britain that apparently began about 1860. It is interesting that, evidently against the general trend, in the Barnsley area, where it was "universally distributed, but nowhere abundant", "it appeared somewhat plentifully" in 1877 (Brady 1884). It clearly became very scarce, and does not appear at all in Halliday's (1896) list for Halifax, though it had in fact been seen at Ovenden in 1894 (Halifax SS), a record evidently unknown to Halliday and others. This was the first report there since 1876, also from Ovenden. When Robertshaw (1900) caught one in 1900 near Luddenden Foot he noted that it had not been captured "for over a dozen years in the district", and reporting another from Elland in the same year, Halliday (1901) also said that it had not been seen for many years. Fielding (1902) reported one at Wadsworth a year later. Butterfield (1911) said it used to be common in the Bradford area "but is fast dying out". Morley's manuscript list for the Skelmanthorpe area (1896-1908) says "only one or two records of its capture" over the 13-year period. When reporting it at Crosland Hall in 1899, Porritt (1900a) noted that "it is now rarely seen in the Huddersfield district" and the same occurrence elicited the comment "now a great rarity in our district" in the Annual Report of the HNS for 1899. Its long-continued rarity is indicated by the few references to it in Annual Reports of this society – Almondbury 1896, Newsome 1900 (one only) and 1912, and Meltham 1919, a state of affairs that was to prevail for another 50 years or so. It was reported from Mytholmroyd in 1911 (Halifax SS).

Notwithstanding its general scarcity, the Peacock occasionally increased markedly for short periods in restricted areas. This was so near Skelmanthorpe in 1917 where it became common in many places (Morley 1918a, 1918b). Its reappearance here caused him to say that this was noteworthy as it had been very scarce for many years. For the same year Porritt (1917) noted that "a few *V. urticae* and *V. io,* both usually of rare occurrence here, were about". At Elland in 1927 it was said to occur "fairly regularly" but to be variable in numbers (Halifax SS, probably on the authority of H. Spencer).

Wattam (1936) reported it as "still rare", sufficiently so to prompt him to refer specifically to having seen one at Newsome in 1934 and three there in 1935, and to add that he had never found larvae in the area. There was a trickle of records in the later 1930s, 1940s and 1950s. Wattam (1937) saw four at Newsome in 1936. In 1939 several were seen at Elland (Halifax SS) and it was reported from Edgerton, Huddersfield, and again from Newsome (Dearing 1940). Several were seen at Elland in 1941, where it was reported as uncommon in 1943, but in that year many were seen at Ovenden (Halifax SS), a parallel to the local increase at Skelmanthorpe in 1917, and evidently as ephemeral. It was seen at Elland in 1944, Halifax 1957 and Triangle 1959 (Halifax SS). It was absent from, or very rare in, the Colne Valley in the 1940s and early 1950s (G.F.). Collinson (1969) recorded that it was rarely recorded around Halifax and sometimes not seen in the parish for a dozen years.

The area shared in a Yorkshire-wide revival in the late 1960s and early 1970s, that apparently occurred earlier in the Doncaster area in the south east, where the recovery began in the 1930s and 1940s and continued during the 1950s (Rimington 1992). For the years of expansion Jackson's annual reports in *The Naturalist* refer to it as having had an "exceptionally good year", being "very plentiful" and the like, while Sutton & Beaumont (1989) describe it as rare until the last two years of the 1960s, after which it became common. To this generalisation the Doncaster area was an exception. Over this period it became common and widespread in the Huddersfield area and, apart from a possible but ill-documented decline in the late 1980s, remained so to the bi-millennium.

Like the Small Tortoiseshell it is a mobile species that, although with a preference for woodlands, traverses a variety of habitats, and is often seen in gardens. It may move for considerable distances each day – in Germany marked individuals have been found up to 94 km from where they were marked. Like the Small Tortoiseshell it tends to move NNW until about mid August, then, in contrast to that species which moves SSW, it often moves SSE. In the Huddersfield area it has been seen at an altitude of *c.*1050 ft.

The history of the Peacock in the Huddersfield area raises interesting questions. Particularly striking were the localised, short-term increases, as around Skelmanthorpe, and evidently elsewhere, in 1917 and at Ovenden in 1943, in what were otherwise periods of general scarcity. Of such upsurges there may have been another in the Barnsley area in 1877. There were also years when it was not scarce at Elland, and a note by E. Dearing in the YNU Record Book in 1939 says "some years not uncommon". Some (all?) of these upsurges were clearly the result of local breeding – at Skelmanthorpe the period of abundance was in August and September, after the emergence of locally- produced adults. About 450 to 500 eggs make up a typical batch, and as larvae live gregariously, protected by a web, large broods may reach maturity, and certainly do so at times. Having lived at low densities for a long period, populations would be unlikely to suffer greatly from parasitism. A few broods may therefore produce several thousand pupae that are exposed to predation for only about two weeks, so the sudden appearance of large numbers of adults in a restricted area is not difficult to explain. What *is* difficult to explain is why such increases sometimes appear to have been localised within the Peacock's extensive range in the area. Such localisation hints at enormous levels of predation, parasitism, or disease, or adverse environmental conditions, from which these isolated populations were, apparently for a single season, free. Adult mobility would ensure dispersal, either before, or probably more effectively after, hibernation, explaining the ephemeral nature of the events.

Mobility raises another issue. Rimington (1992) shows that the Peacock began to recover in the Doncaster area in the 1930s and maintained its improved status in the following decades, as it did in the adjoining Derbyshire, Nottinghamshire and Lincolnshire. Its mobility is such that individuals must have dispersed north and west from south Yorkshire. That its recovery took place later in the Huddersfield area, and indeed in much of Yorkshire, is therefore difficult to explain. If there are climatic limitations they must be very subtle, and suitable conditions must have prevailed intermittently in the Huddersfield area in the years of localised abundance. Genetically different lineages may have been involved.

Much remains to be learned about the biology of the Peacock. One even wonders whether it was less rare in the Huddersfield area in the lean years than in much of Yorkshire. Although records are few they show persistent occurrence. Comparative quantitative information is, however, lacking.

COMMA, *Polygonia c-album* (L.) (Figure 3, p. 77)

The Comma was recorded at Storthes Hall sometime prior to 1859, this being the only locality mentioned by Hobkirk (1859), who designated it as "rare". Newman (1870-1871) includes "Huddersfield, rarely and singly" as a locality on the authority of Porritt who may have reported the old Storthes Hall record to him. Porritt (1883) does not include any Huddersfield record in his list, which suggests that he deemed the record too ancient to merit citing. Newman also includes Halifax on the authority of Birchall, which Porritt does include but cites the wrong page. This, cited from Newman, is the only 19th century record in the Halifax SS archives (under the erroneous date, 1883, evidently from Porrittt). It was unknown to, and not mentioned by, Mosley (1883) and Wattam (1936) as a component of the Huddersfield fauna. Indeed it had declined throughout Britain by the 1830s, and, following a temporary recovery in the north in the 1850s and 1860s, (to which period the Storthes Hall record may refer) again declined. By the early 20th century it had retreated to the Welsh borderlands and adjacent areas, from which it began to spread in 1914 (summary in Emmet & Heath 1989). It was not, however reported in Yorkshire until 1937 (YNU Lepidoptera Committee 1967) – at Scarborough – but in the 1940s it was seen in several places in the county, especially in the south west, including Elland 1946 (Halifax SS),

FIGURE 3.
Three butterflies with contrasting histories in the Huddersfield area. The Orange Tip (top) persisted, sometimes tenuously, for more, perhaps much more, than 150 years. This historic illustration of a male, drawn and engraved by James Bolton, probably, but not certainly from a locally obtained individual, appeared in his *Harmonia Ruralis* vol. 2, 1796. The orange wing tips were coloured by hand in each copy. The Comma (lower left) has had a complex history in the area where it became extinct three times, once being lost for about 90 years, but is common at the beginning of the present century. The White-letter Hairstreak (lower right) was unknown until, at a seemingly unpropitious time in the 1990s, when its larval food plant – Elms *Ulmus* spp. – had recently suffered considerable losses to Dutch Elm disease, it made its appearance in at least six places. The lower figures, from Sutton & Beaumont (1989), were drawn by David Green, whose artistry it is a pleasure to share.

Cawthorne and Elland 1948 (Dearing 1949), as well as in places just outside the Huddersfield area. Following this invasion it declined and retreated. Perhaps the penultimate sighting was by B. D. Cain at Woodside, near Halifax in 1955, the last record for Yorkshire at that time being in 1957.

Seago (YNU excursion circular 1953) caused some confusion when he said that *Polygonia c-album* was present in Deffer Wood. Although he used the present tense, it is not clear whether he implied that it continued to exist there in 1952 or 1953. However, in a bulletin circulated among YNU lepidopterists, in which he noted that the Comma reappeared in S. Yorkshire "around 1945", he said that he saw one or more every year since that date "chiefly at Deffer Woods, Cawthorne, until 1950" after which he saw no more in Yorkshire. It is not clear that all these were seen in the area covered, or in which years he saw it in Deffer Wood, but he did not see it there in 1951 or 1952 as his note in the excursion circular seemed to suggest. As it was recorded from Cawthorne in 1948 (Dearing 1949), at best Seago added one or more sightings in that area in the 5-year period concerned.

In the 1970s it again recolonised Yorkshire, but was very rare. For this decade there are few published records, all in the south west, the earliest, Potteric Carr, 1973, being outside the Huddersfield area (Sutton & Beaumont 1989). To this can be added an unpublished record for Cowlersley, in the Colne Valley, where it was seen in September of that year by D. Elliot. It was seen in Halifax in 1974, (A. Bannister) and of two records for 1976 (Jackson 1983) one was for Oakenshaw. Jackson also records it from Beauchief, Sheffield, not listed by Sutton and Beaumont. Thus three of the five known occurrences in Yorkshire in that period were in the Huddersfield area.

It was not seen again in Yorkshire until 1980. It then spread quickly throughout the county but was seemingly slow to establish itself in the Huddersfield area, though it was seen at Triangle, near Halifax, as early as 1983 by A. Dale (Sutton & Beaumont 1989). Being very distinctive, and at that time unusual in the area, one assumes it would be recorded if seen, but no further reports have been traced until 1990, at Rastrick and Triangle (Cain 1991), after which it increased, became widely distributed, and was reported in every year until the bi-millennium. Its spread was remarkable – embracing Bretton, Skelmanthorpe and Denby in the east and south-east, Langsett, Ingbirchworth and Hepworth in the south, Slaithwaite, Scammonden, Ryburn Reservoir, Ripponden and Luddenden in the west, and Wyke and Low Moor in the north. It was recorded at many places within these bounds, such as Emley, Almondbury, New Mill, Honley, Holmfirth, Blackmoorfoot, Lindley, Birchencliffe, West Vale, Elland, Cromwell Bottom, Cleckheaton, Brighouse and several others, and the increase continues. An unexpected sighting was near Holme at an altitude of over 1200ft – perhaps a wandering individual.

Small Pearl-bordered Fritillary *Boloria selene* (Denis and Schiffermüller)

In a period of more than 150 years the Small Pearl-bordered Fritillary has been reported only once, at Triangle, near Halifax, in early July 1983, by F. Murgatroyd. This occurrence, almost 40 miles (64 km) from the next nearest known locality at which it existed at that time, remains enigmatic. If it represents a wandering individual it is informative of the way in which colonisation of an area is possible.

Pearl-bordered Fritillary *Boloria euphrosyne* (L.)

Always rare in the area and so designated by Hobkirk (1859, 1868), the Pearl-bordered Fritillary was known in the mid-19th century from Storthes Wood. On the authority of J. Varley, Mosley (1883) added "behind Castle Hill", this presumably being the same as the "Huddersfield, very rare" of Porritt (1883) who cited the same naturalist. There are no further records. It probably became extinct before 1870.

Dark Green Fritillary *Argynnis aglaja* (L.)

Evidence for the occurrence of the Dark Green Fritillary in the Huddersfield area is tantalisingly vague and unsatisfactory. There are no 19th century records and Wattam (1936) makes no mention of it. It was present at Seckar Wood, near Wakefield, about two miles outside the area, in 1942. In comments on the Lepidoptera of the Cawthorne – Bretton area, Seago (YNU excursion circular 1953) stated that there were two colonies in the Cawthorne district. No other reference to such has been found, but Seago was a knowledgeable lepidopterist.

Other reports are also unsatisfactory. Collinson (1969) refers to two large fritillaries watched for half an hour at Copley near Halifax in 1969 by H. Archer and a companion but, while the Dark Green seems the most likely candidate, left their identity unresolved. Sutton and Beaumont (1989), evidently referring to the same incident though quoting a different year, give "Copley, two seen 1967 (per B.D.C.)". The original report made no positive claim to identity. From nearby Beacon Hill there was an unconfirmed sighting of two individuals in 1985, again no more than an unproven possibility.

SILVER-WASHED FRITILLARY *Argynnis paphia* (L.)

This species was recorded at Storthes Hall in 1847 by J. W. Dunning (Rimington & Beaumont 1996) and listed for Honley by Hobkirk (1859, 1868), who added "rare" in the 1868 list. Mosley (1883), on the authority of Inchbald, said only "Formerly at Storthes Hall but very rare". Porritt (1883), on the same authority, simply said "Huddersfield, very rare", obviously no more than a less precise reference to the same locality. It is not clear whether Inchbald saw this species at Storthes Hall subsequent to 1847 but it would be coincidental if Dunning, who arrived there in 1846, should have seen it on its last appearance. It is worth noting that Dunning made the comment on his manuscript, "The most common Argynidd", which, although apparently not referring to Storthes Hall, is relevant to the status of the Silver-washed Fritillary at that time. On the basis of reports from his correspondents, Newman (1870-1871) recorded it as not uncommon in Northumberland, Durham and Cumberland (i.e. in the 1860s and probably earlier) and it was known, but rarely, in Scotland. For the first two of these counties, however, Dunn & Parrack (1986) cite only a few records, either undated or from the 1850s. At the end of the 19th century it was widely distributed, but rare, in Yorkshire which was then near the northern limits of its range in Britain. It may, however, have been more frequent in at least one part of the Huddersfield area than generally assumed. As Collinson (1969) reports, Herbert Spencer (1884-1949) always insisted that in his boyhood the Silver-washed Fritillary "could be *regularly* (our italics) seen flying in the Elland woods near his home". Apparently this was never accepted by the YNU, much to Spencer's indignation. Herbert Spencer was well known to, and was one of the finest lepidopterists ever met by, G.F. Extremely knowledgeable about their habits, the study of these insects was his enduring passion. He had built up a magnificent collection, and also had an encyclopaedic knowledge of Elland Park Wood alongside which he lived. He could hardly have misidentified such a conspicuous and distinctive insect, which is readily recognisable on the wing, and would never confuse it with the Dark Green or High Brown Fritillaries, neither of which has with certainty been seen in the Elland-Halifax area. The High Brown Fritillary is virtually unknown in Yorkshire except for possible strays. Furthermore the Silver-washed Fritillary is much more a woodland insect than the Dark Green Fritillary which favours wild, open areas rather than woodland. There is no valid reason for doubting the report of this excellent entomologist, which is here posthumously rehabilitated.

A tantalising rider to this matter is a note in the records of the Halifax SS for 1927 "Fritillary seen in garden at Elland probably this species". If Spencer was the observer, unless he saw this insect only at a distance, he would easily have made a positive identification. Its probable identity may have been based on a description by another observer. While unacceptable one suspects that this record may indeed be valid.

Subsequent events lend credence to the validity of the Elland records. From the turn of the century the Silver-washed Fritillary retreated southwards, but there is more positive information on its persistence in the Huddersfield area than published summaries suggest (and more records for Yorkshire in the 20th century than generally supposed). The earliest documented 20th century record for the Huddersfield area is for Skelmanthorpe in 1918. Although well known in a general sense there has been much confusion over the details, and about the exact site. Indeed published information even suggests that two sites were involved and three woods have been named. The correct facts are as follows. Morley (1919) recorded that in August 1918 "I saw *Argynnis paphia* in a wood near Skelmanthorpe, and Mr J. Hooper confirmed the record by taking one in the same place the following day". This was noted as "new to the local list", that is to the area around Skelmanthorpe. No name was given to the wood, clearly deliberately, but in his notebooks Morley is more explicit, noting that "I saw a fine male in the old garden of the ruined keeper's house in Bank Wood on Aug 10th. 1918. Mr J. Hooper caught a female on the same ground the following day". This is clearly the exact locality. However, in a report of the YNU Entomological section (Corbett 1919) B. Morley is recorded as reporting that J. H. Hooper took a specimen of *A. paphia* in Deffer Wood! To add to the confusion the YNU record book says simply "One, Aug 11 1918 Bankhall Wood, J. Hooper", and the S.W. Yorks. Ent. Soc. record book says likewise! Bank Wood and Deffer Wood are almost 3 miles apart and Bank Wood is nearly 3 miles from Skelmanthorpe. The suspicion is that the finders of this collectable species deliberately gave the wrong locality. Bankhall Wood may also be a deliberately misleading name. No such wood is known by those from whom enquiries have been made, and no wood of this name appears on maps of the area dated 1850 and 1893, nor on recent maps.

The Silver-washed Fritillary was recorded again in the Huddersfield area in 1929. Wattam (1936), who described it as "very rare", saw three at Broken Cross, Almondbury in July 1929. This is more significant than would have been the sighting of a single individual. This important record escaped notice by all subsequent recorders. There was another find, at Emley Park in July 1941, inconspicuously recorded (Anon. 1942) but now well known. Although the finder appears never to have been named it was W. Buckley, who lived at Skelmanthorpe (SWYES record book).

There is also an ambiguous reference to this species by Seago who, in a YNU excursion circular (1953), said that it "occurs very rarely at Bretton". There is nothing to indicate whether this refers to earlier finds – West Bretton is not much more than a mile from Bank Wood and less than three miles from Emley Park – or to a more recent occurrence. As no additional finds have been substantiated in the area, we take this to be a vague reference to earlier finds made there. The last authentic report of this species in that area is therefore for 1941 and this may have been only a vagrant. Nevertheless the Huddersfield area was one of its last outposts in Yorkshire in the 20th century and we believe that there is good evidence that it bred around Elland in the early years of the century, and possibly did so elsewhere.

SPECKLED WOOD *Pararge aegeria* (L.)

Said by Hobkirk (1859, 1868), who gave no date, to have occurred at Honley, the Speckled Wood persisted in the area for some time thereafter and was known at Castle Hill Side, Almondbury, by James Varley, whose main period of activity was between about 1855 and 1870 (Mosley 1883). There is no reference to this site in the second edition of Hobkirk (1868) in which Varley is thanked for additional information on the Lepidoptera, but it is unwise to draw inferences from this. Hobkirk may simply have deemed it unnecessary to update his entry, or Varley could have recorded it after he did so. Before Mosley prepared his catalogue it had "entirely disappeared". The two 19th century localities are in well-wooded parts of the area: many western and south-western parts were probably never suitable for the Speckled Wood during the period of recording.

In spite of its disjunct distribution in the second half of the 20th century – very roughly south Yorkshire southwards, and western and north eastern Scotland – which inspired baseless speculations about its arrival in Britain before the end of the Pleistocene glaciations, the Speckled Wood was more widely distributed in the 19th century. Dennis (1977), like Newman (1870-1871) before him, concluded that before about 1850 it had a continuous distribution throughout much of Britain save for the north of Scotland. High moorland, such as much of the southern Pennines, was of course unsuitable. For Yorkshire, Porritt (1883) simply listed 10 localities without commenting on the pattern. Most are in the south and include Huddersfield, "formerly" on the authority of Varley, this being the most westerly locality. Several others were less than 30 miles to the east and south of Huddersfield the nearest being "Wakefield". Brady (1884) added Hemsworth 1882, and Rimington (1992) gives additional 19th century sites from the Doncaster area.

The range of the Speckled Wood contracted in the late 19th century. Its disappearance from the Huddersfield area may either have been part of this national decline or the result of some local cause. That it evidently became extinct here before it declined, but not always to extinction, elsewhere in Yorkshire, hints at a local cause.

It began to increase again nationally in the 1940s. To the south-east and not far outside the area, one was seen near Barnsley in 1944 by E. G. Bayford, the first he had seen there (Dearing 1945). Expansion continued, particularly in the 1970s. However, in Yorkshire, while it shared in the recovery in the 1940s and early 1950s, it remained essentially confined to the south. It then again decreased, and even disappeared from its long held stronghold at Wentbridge in 1970. (YNU Lepidoptera Committee 1967, Jackson 1980, Sutton & Beaumont 1989, Rimington 1992). By the late 1970s it was reduced to very few known sites. Jackson (1980) commented on the strangeness of this decline at a time when in most parts of England it was holding its own or increasing its range. Shortly thereafter it again increased. It did so around Doncaster in the late 1970s and 1980s, recolonising Wentbridge in 1987, and was described by Rimington (1992) as then being probably as common in that area as at any time since recording began. Indeed more colonies were known in the Magnesian limestone belt of south Yorkshire than in the past. Further north it was known for some years south east of the Harrogate area, then in 1992 it penetrated, suddenly and deeply, in several places (Barnham *et al.* 1993). It continued to spread in the south of Yorkshire throughout the 1990s, showing a small advance westwards (Blakeley 1997-1999). It therefore for long occurred, and increased, just outside the Huddersfield area which, however, it was slow to penetrate.

Its national extension of range in the 1990s is mapped by Hill *et al.* (1999). They suggest that in the past 100 years or so changes in its distribution can be attributed to changes in climate, but this fails to explain the decline in Yorkshire in the 1970s when it was increasing elsewhere. Not surprisingly their model was unable to explain distribution on the basis of climate alone, "whereas a combination of climate suitability and woodland availability was more successful"(!) Equally unsurprising was their conclusion that "distribution of habitat, in addition to climate, may have been important in determining distribution". One does not expect to find the Speckled Wood on moorland or in open fields.

Subsequent to its disappearance in 1870 or earlier the Speckled Wood was not certainly seen again in the Huddersfield area for more than a century. There was an unconfirmed report of its occurrence in the Upper Shibden Valley in the mid-1970s (when it was at a low ebb in Yorkshire) (Cain & Baggaley 1994) and a definite record in the early 1980s when one was photographed at Birds Royd, Brighouse by M. Murgatroyd (Sutton & Beaumont 1989, Cain & Baggaley 1994). It was not recorded again until 1992 when a fresh female was photographed, and another was seen, in North Dean Wood, near Clay House. In May 1996 it was reported in Bank Wood, between Emley and West Bretton, by R. M. Sunter (Blakeley 1998 gives it as 1997), this being the most westerly of several sites in which it has been found since 1995 by Wakefield Naturalists. (At the bi-millennium it is widespread around Wakefield – R. Bedford.) In 1998 it was found at Greenwood, Denby Dale by D. Hemingway, and in 1999 at Almondbury by Stephanie Coughlan. In 2000 it was found at Cromwell Bottom (per B. D. Cain), Langsett (D. Manchester, who also received a report of another at High Hoyland) and, as late as October 23, B. and M.J.L. had one in their garden at Fixby. A significant spread to the west is indicated by finds at Blackmoorfoot, Colne Valley, by M. L. Denton and in the Ryburn Valley by M. Earnshaw. Suitable habitats are fewer than they are for the Large and Small Skippers which colonised the area more rapidly, and until recent tree planting began to rectify this situation, were virtually absent from the Colne Valley. Colonisation, however, is now underway.

In 2000 several were seen for the first time in the Greenfield area, west of the Pennines, by L. N. Kidd, just outside our adopted boundary. North of the area, single individuals were seen in 1996, 1997 and 1998 in the Heaton area of Bradford (Blakeley 1997-1999).

WALL *Lasiommata megera* (L.)
Of the Wall, Hobkirk (1859) was able to say only "has occurred at Honley", while Mosley (1883) noted, on the authority of Inchbald, that it formerly occurred on Castle Hill Side (near Almondbury), but that by then it had "entirely disappeared". One was reported from Hipperholme in 1868 (Halifax SS). It may never have been common in the area in that period but information is inconclusive. Formerly common in north-east England, it suffered a decline in the early 1860s and few were recorded there, sometimes at long intervals, until the early 1970s when it rapidly increased in numbers and spread (Dunn & Parrack 1986). Its disappearance around Huddersfield may have been part of this decline, whose limits are, however, uncertain, or independent of it. It evidently persisted, but became scarce, towards the end of the 19th century, in parts of S. Yorkshire, N. Nottinghamshire and Derbyshire, and apparently never became extinct around Doncaster (Rimington 1992), where it increased in the 1930s 1940s and 1950s. In Huddersfield it became extinct. Wattam (1936) had no knowledge of it there during the previous 42 years, and it remained unknown for some time thereafter.

After an absence of more than 70 years H. Spencer provided "the first local record at Elland" in 1944 (Dearing 1945), and by 1948 it was said to be "now established at Elland" (Dearing 1949). It seems not, however, to have spread widely in the early stages of recolonisation, but may have bred unnoticed for some time a little further down the Calder Valley (up which it clearly advanced from the east) for B. and M. J. L. found it to be very common at Cooper Bridge in the late 1950s, and in 1959 or 60 it was found in the Ryburn Valley, a steep-sided upstream tributary of the Calder (YNU record cards). Further east it had evidently established itself in the Bretton and Cawthorne area by 1952 or earlier as it was noted as occurring there by J. H. Seago (YNU excursion circular 1953). In 1957 one was recorded at Denby Dale by R. Crossley, by which year it was said by J. Hooper to be "now fairly common" at Wakefield, just east of the area covered (Hewson 1958), a picture typical for the lower-lying parts of south Yorkshire in the late 1950s where it was said by Seago (1959) to be widely distributed and "definitely increasing" in many localities. In 1958 R. Crossley saw one near Kirkburton and received a report of another near Fenay Bridge. In 1960 he found it near Thunderbridge and in 1961 at Tag Lock, Elland, and in 1960 C. R. Haxby saw it at an altitude of more than 1000 ft near Queensbury, in the north of the area; "a more barren place for butterflies . . . it would be difficult to imagine" (Bradford NS). In 1961 it was found at Hipperholme, at Birds Royd (Brighouse), and at Elland Wood Bottom (Cain 1990). It was also known in the Gunthwaite area before 1961 (J. H. Seago, YNU excursion circular 1961) and was seen there on the subsequent excursion (Flint 1962). By 1962 it had become more widely distributed in the Halifax area and was found at an altitude of more than 1000ft at Ogden Clough just outside it (Cain 1990). In 1963 Halifax SS records show that it had "moved into the district in numbers", Halifax and Triangle being given as specific localities. By 1968 or earlier it had established a strong colony at Copley (Collinson 1969), and in 1969 it was seen at Cowcliffe (B. & M.J.L.). It was reported from Ovenden in 1976 (I. A. Hogg, Bradford NS). It continued to extend its range and by the 1980s it had not only been found in the south east (whence the colonists probably came) at Scout Dike and Royd Moor Reservoir near Penistone (D. S. & V. A. Ives), but had spread much more widely, being seen at Aspley (Huddersfield), Almondbury, Mount (Outlane), Holmfirth and Cromwell Bottom (D.S. & V.A.I.; B. & M.J.L.), and at Northowram 1984 (Bradford NS). The spread continued in the 1990s when it was widely recorded. It continued to establish itself in the Calder Valley, as at Sowerby Bridge and beyond, being described as "common on suitable grassland sites throughout Calderdale" in 1991 and 1992 (Cain 1992, Cain & Baggaley 1994) and was found in the Luddenden Valley. It may be via the Calder Valley that it arrived at Scammonden where it was seen by J. Dale in 1991. During this decade it was also found at sites as widely separated as Kirkheaton, Grange Moor, Shelley, Upper Denby, Ingbirchworth, Yateholme, Digley, Holme (above 1000 ft), Meltham, Linthwaite, Bradshaw, Clifton, Bailiff Bridge, E. Bierley, Low Moor, Shelf, Queensbury, Lindley Moor, Norland, West Vale, Siddal and elsewhere (various observers). Numbers continue to increase in some places, as in the Denby Dale, Denby Delf, Shelley area where it was abundant in 1999 (T. Melling). On the western side of the Pennines, L. N. Kidd recorded it near Greenfield from 1977 onwards. It probably colonised this area from the west. It was known north of Oldham from at least 1946, and L.N.K. and B. Hodson saw it annually in the Medlock Valley between Oldham and Ashton-under-Lyne from at least as early as 1969.

HEDGE BROWN. *Pyronia tithonus* (L.)
The Hedge Brown, or Gatekeeper, was unknown in the Huddersfield area to 19th century entomologists. After being more widespread in Yorkshire, towards the end of that century it retreated to the south-east of the county and by 1967 was "restricted to very few localities" (YNU Lepidoptera Committee 1967). However, it spread in the 1970s, "displaying a great range extension" since 1973 (Sutton & Beaumont 1989). Limbert (1975) suggested that, habitat destruction and declining temperatures since about 1940 may have contributed to its contraction of range, but added a few localities in 1973 and 1974 – an early sign of revival? Subsequent expansion has coincided, at least in recent years, with a period of warming.

A possible stray, but the first ever reported in the Huddersfield area, was encountered at Lightcliffe in about 1960 by M. D. Bridge (per. B. D. Cain). There was also an unconfirmed report of a colony near Mirfield during the 1970s (per. B. D. Cain), but proven colonisation began in 1983 when two were seen in the Hall Dike Valley (the Hall Dike flows from Meltham to the R. Holme) (YNU record cards but without finder's name). In that year there were two sightings in the Halifax area (B. D. Cain) – where no more were seen until 1996. In 1985 J. Dale saw two at Royd Moor in the extreme south-east, and in 1987 D. S. and V. A. Ives saw it at Almondbury. In 1991 J.D. saw two more at different sites near Ingbirchworth, not far from the 1985 Royd Moor site. Further north it was reported in 1992 from Wyke (Bradford NS), and J.D. saw one at Lindley Moor. It was seen at Bretton Lakes in 1994 (L. Lloyd-Evans), and near Bretton in 1995 and 1996 (R. M. Sunter). In 1996 it was present at Upper Denby (D. Elliot) and J.D. found it again at Lindley Moor and, further west, encountered two at Scammonden. In that year it was seen at three places near the town of Halifax and at Clifton (B. D. Cain). Denby Grange Colliery and two sites near Horbury were added in 1997 (R.M.S.). There were several sightings in 1998 – near Bretton and at Clifton (B. & M.J.L.), at Scout Dike (D. Manchester), Birds Edge, near Ingbirchworth (S. Hey), Shelley (S. Graham) and Denby Delf (T. Melling). In 1999 S. Graham reported it as increasing at Shelley where he saw 10 on July 20, and where it persisted into September; B. Lucas counted 38 at Brickyard Plantation near W. Bretton, B. and M.J.L. saw it near New Mill, M. Dale reported it from Skelmanthorpe, and R.M.S. from two sites at Gawthorpe. It frequented Cromwell Bottom from 1997 to 2000 (B. D. Cain). Persistence at Clifton and several places in the east and south east was confirmed in 2000 (D. Manchester saw up to 50 at Ingbirchworth, and D.S. and V.A.I. saw 30 at Scout Dike) and new sites in that region – Emley, Deffer, Kirkburton, Stocksmoor – were added (B. & M.J.L.; D.M.; D.S. & V.A.I.; D. Knight). Further west, M. Earnshaw saw it in the Ryburn Valley.

Even if the first individual seen, long before the main influx, was a stray, these widely scattered sightings, some at sites occupied for more than one year, reveal that colonisation of the area has been in progress for at least 18 years. This started later than expansion into the Sheffield area, further south and further east. There it began to extend into the vicinity of Rotherham in the 1970s, apparently especially in 1976. Few sites, all to the east, were known near Sheffield by 1980 (Garland 1981), but a great increase, especially in the east, subsequently took place (Whiteley 1993). The main expansion was between 1988 and 1990 with consolidation and further expansion in 1991 and 1992. In the Harrogate area, where it was previously unknown, there was initial colonisation of one small region in 1983, where it persisted until 1987 but was not seen in 1988 and 1989. However, it then rapidly colonised eastern parts of the district, where by 1992 it occupied a large area (Barnham *et al.* 1993) – a pattern that stands in marked contrast to that which prevailed around Huddersfield (see also Ringlet). It will be interesting to see if it is now on the brink of a rapid increase in numbers and range in the latter area.

The spread of the Hedge Brown in the Huddersfield area has been less dramatic than that of the Large and Small Skippers and is still in progress. Its slower advance may reflect its more demanding ecological requirements – hedgerows, the edges of woods, woodland paths and glades, and lanes, especially where brambles (*Rubus* spp.) are abundant. Such habitats are less common in the area than those frequented by the two skippers. It is also rather sedentary and seldom flies across open grassland, which militates against rapid dispersal.

MEADOW BROWN *Maniola jurtina* (L.)
Because it is so common in many places, the loss and long period of absence or great scarcity of the Meadow Brown in the vicinity of Huddersfield are some of the most interesting biological events in the recent history of the area. In the 1850s and 1860s it was "common in meadows", (Hobkirk 1859, 1868) and continued to be so until possibly as late as 1870, prior to which it was reported as very common at Castle Hill and Almondbury, but then disappeared (Mosley 1883). Porritt (1883) said that "at Huddersfield it seems to be extinct" and notes that although he saw it in abundance at Almondbury "many years ago", he had never seen a single individual there since. That it disappeared over an extensive area in the vicinity of Huddersfield is indicated by a comment of Morley (1902) on a single individual taken at Skelmanthorpe in 1901 – "an insect not seen here for twenty years or more". In his manuscript list for Skelmanthorpe (1896–1908), he says "seems to have disappeared", and was clearly struck by the local nature of this event as he added "Swarms at Edlington, Thorne Waste etc.", sites that lie respectively just over 20 and 30 miles east of Skelmanthorpe. It was also long absent from that part of the Halifax area included here. Indeed Collinson (1969) says there were only nine records of single individuals from the entire extensive parish between 1863 and 1955. Of these the earliest and four others were from outside the area covered here. The relevant records (Halifax SS) were near Hipperholme before 1896 (Halliday 1896), Elland 1941, 1944, and Cromwell Bottom 1955 (see below). One of those outside the area was for Crimsworth Dene, near Hebden Bridge where W. Greaves found it in 1921, which elicited the comment that "this species does not seem to have been noticed for some years in the South Western part of the county" (Morley 1922b).

Rimington (1992) gives information on a decline in some northern parts of England that began around 1860 but which seems to have affected neither the Doncaster area, with which he was concerned, nor Lincolnshire nor much of north Nottinghamshire, and Dunn and Parrack (1986) say it has "always been common and evenly distributed" throughout Durham and Northumberland save in the border region of the latter county. However, as around Huddersfield, the decline was well marked in the adjoining Barnsley area. Here Brady (1884) had regarded is as "common and universally distributed" (but until when?) yet the diaries of A. Whittaker (1898), cited by Rimington, record that he had "never seen it in the neighbourhood of Barnsley". Here it then long remained unknown, or so rare as to be unrecorded. It could have disappeared some years before Brady wrote, and probably did so. Whittaker's experience was shared by E. G. Bayford who was 15 years old in 1880 and who never saw the Meadow Brown in Barnsley until 1940 (see below). In the Bradford area, Butterfield (1906) recorded that "it is certainly not a local butterfly at the present time".

In the Huddersfield area it was never seen by Wattam (1936) in the 38 years before 1932 when he then encountered it at Berry Brow. It had, however, been seen in 1917 when C. Mosley (1917), son of S. L. Mosley, cited a mention in the *Huddersfield Examiner* of July 14 1917 by G. K. Crosland of its occurrence at Farnley. That this was deemed worthy of reporting to a newspaper is indicative of the unusual nature of the event. Mosley comments on its disappearance from that locality, as recorded in 1883, and adds "Its recurrence after nearly fifty years is remarkable". Whether a small population then persisted at Farnley and formed the nucleus of that seen there 16 years or more later by Wattam during its recovery cannot be established, but the area was one that he often frequented, which perhaps suggests that, if it persisted, it did so only in small numbers.

Subsequent to 1932, and up to 1936, Wattam witnessed a definite recovery, seeing it again at Berry Brow ("a good many") and at Primrose Hill, Farnley and Gunthwaite, a spate of sightings that heralded recolonisation of the area. Shortly thereafter a similar recovery took place south east of the area. Dearing (1941) reported that "Mr Bayford notes as his most interesting record" of 1940 "a battered specimen" of this species which he had not previously seen within the confines of the old Borough of Barnsley. E. G. Bayford (born in 1865) had long experience of the insects of the Barnsley area and, like Whittaker's comments, his remarks confirm its absence, or great rarity, there for 50 years or more. Here it quickly re-established itself, for two years later it was described as "abundant" in the County Borough of Barnsley "and more especially just outside it" (Dearing 1943). With fluctuations in the interim it was common there in 1946 (Dearing 1947).

In the Huddersfield area two Meadow Browns were seen at Elland by H. Spencer in 1934 (YNU record cards), a record not known to Collinson (1969). Spencer did not see it there again until 1941 (Anon. 1942) which elicited the comment that "this species is not usually seen in the [Elland] district". In the meantime singles were seen at Low Moor by W. Barraclough in 1935 and 1936. These received the comments "a very uncommon butterfly with us" and "very unusual around Bradford" respectively (Bradford NS). Another was seen at Elland in 1944, in which year Wattam saw one at Newsome and several at High Hoyland (Dearing 1945). J. Briggs discovered a small colony between Low Moor and Bierley in 1950. It was common near Newsome in 1951 (Wattam, *in litt.*). GF, who had never previously seen this species in the Colne Valley, clearly recalls seeing a few individuals in a field in the valley bottom between Slaithwaite and Holme Mills, Marsden in 1951 or 1952. In 1955 it was recorded from Cromwell Bottom. It was found at Lepton in 1958 (A. Steele), R. Crossley netted seven at Mollicar Wood, Almondbury in 1959, and singles were seen by B. D. Cain in the Shibden Valley in 1959 and at Scout Hall, Shibden in 1960 (Cain 1990). Colonisation was clearly in progress, but the contrast with the situation to the south-east was still marked. In south Yorkshire and adjacent parts of Nottinghamshire and Lincolnshire, the Meadow Brown was at that time described by Seago (1959) as "common and widely distributed in all areas".

Although initial colonisers of the Huddersfield area were evidently sparse, and observers few, the earliest finds – "several" at Berry Brow (mid-1930s) and High Hoyland (1944) – indicate a spread from the east and south-east. In the second half of the 20th century there was a remarkable increase in range and abundance, slow at first then increasing in tempo. It was apparently common and widely distributed in the Cawthorne-Bretton area by the early 1950s (J.H.Seago, YNU excursion circular 1953), perhaps a northward spread from the Barnsley area. The inhospitable Colne Valley may not have been colonised until the early 1950s, though early prospectors could easily have been missed. Localities in the Calder Valley such as West Vale, Copley, Triangle and others, upstream of the sites at Elland and Cromwell Bottom, where pioneers were seen in 1934, 1941, 1944 and 1955, were evidently not colonised until some time after 1969. In 1976 B. D. Cain found a small colony in the Shibden Valley and saw it near Bailiff Bridge (Cain 1990). It then rapidly extended its range and by the 1980s was widespread in the area, from Bretton and Scout Dike on the eastern and south-eastern fringes, to Almondbury, Honley, Gawthorpe Green, Cowcliffe, Lockwood, Paddock, and the Calder Valley. Further localities were added in the 1990s, from Grange Moor in the east, Hepworth and Yateholme in the south, Queensbury in the north, and from many others between them. It was established throughout Calderdale where by 1991 it was described as "usually our most common 'brown' butterfly" (Cain 1992). Here it was to be found on most natural grassland throughout the valley, as well as on hillsides in upland tributary valleys, a situation remarkably different from that of 50 years earlier when a single individual at Elland was regarded as particularly noteworthy.

West of the Pennines where, if the suggestion made here is correct (see below), it probably suffered extinction for the same reason as it did nearer Huddersfield, it was absent for an unknown period, but appeared in the Medlock Valley, outside the area considered, in 1975. It began to be seen in the Greenfield – Saddleworth area by L. N. Kidd in 1983. Colonisation here was evidently from a source different from that to the east of the Pennine barrier.

Both older and more recent works give the impression that the Meadow Brown, perhaps Britain's commonest butterfly, is virtually ubiquitous. However, large tracts of the uplands to the west and south-west of Huddersfield and Halifax are ill-suited to its needs. Although recorded elsewhere from 'moorland', the acidic, *Eriophorum*–dominated Southern Pennines do not provide suitable habitats. Much land is also too high. According to Emmet & Heath (1989) it occurs at 300 m (*c.* 980 ft) on Dartmoor but its altitudinal limit is a little lower in Scotland, on which basis alone it is hardly to be expected on the local uplands. In the adjacent Sheffield area, where it is now well entrenched in suitable habitats even in the city, and to the north, south and east of it, Whiteley's map (1993) shows that large tracts of land in the west know it not. Occupied sites among the western uplands are essentially in valleys that offer shelter and larval food plants. Although *M. jurtina* probably entered these valleys from the east, exclusion from the inhospitable uplands is clearly shown. Whiteley's maps (1993), incidentally, show how these moorlands exclude several other ecologically tolerant species that frequent their valleys. A map of its national distribution (Emmet & Heath 1989) reveals a large area of the Pennines from which *M. jurtina* is unrecorded. Moreover, as a single record from a valley site on the fringes of this area is given as much weight as a large population on a lowland site, such a map can give a misleading impression of status. During the re-colonisation of the Huddersfield area from the east and south east, the lowlands were inevitably occupied first, since when climate, topography and vegetation have decreed that it spread up valleys, with incursions into adjacent terrain only where this is suitable.

Notwithstanding such facts, near Huddersfield the Meadow Brown sometimes ventures onto high ground. J. Dale has seen it regularly at between 900 and 950 ft at Scammonden and once on the reservoir embankment at 1000 ft, all in the sheltered valley. In 1996 he saw about 20 at *c.* 1025 ft near Broadstone Reservoir (near Ingbirchworth). There is a record from *c.* 1080 ft near Holme, while in 2000 G.F. encountered a colony on a steep, south-facing slope at between 1000 and 1050 ft on the the exposed Scapegoat Hill, and B. and M.J.L saw several just above 1065 ft at Pule Hill, Marsden. Such observations are in keeping with those of Barnham & Foggitt (1987) who reported colonies on sheltered verges at *c.* 1000 ft west of Harrogate, but whose map shows that it shuns the uplands thereabouts and scarcely penetrates into Upper Nidderdale. Climatic warming may currently be permitting colonisation of higher ground, but local moorland remains ecologically unsuitable.

In general, recolonisation of the Huddersfield district at first took place slowly. However, having established itself in a locality it sometimes increased rapidly in numbers, as it did more spectacularly around Barnsley. This pattern is in keeping with the basically sedentary habits of the Meadow Brown which, having located a favourable site seldom emigrates from it (e.g. Brakefield 1982). Most observers agree. Ford (1964) notes that, although powerful on the wing, even 100 yards of unsuitable terrain is an almost complete barrier to it, and that it often turns back within 10 yards after entering an unfavourable habitat. Nevertheless it has colonised offshore islands – 69 of the 73 British islands considered by Dennis & Shreeve (1997) – and, as Ford (1945) himself records, has been caught on a light vessel seven miles offshore! Some individuals of course disperse, but mark and recapture studies suggest that these are few. Of distances moved by many individuals marked by Brakefield, the greatest was 320 m. (cf. the 94 km and 150 km. recorded for the Peacock and Small Tortoiseshell respectively). However, as Dennis & Shreeve (1997) note, such studies are not appropriate for recording between-habitat movements, and low frequency events involving greater distances are not easily detected. Around Huddersfield, early sightings after long absences were, in several cases, of single individuals – Skelmanthorpe, 1901, (seemingly not a forerunner of establishment), Low Moor 1935, 1936, Elland 1942, 1944, Newsome 1944 and, just outside the area, Crimsworth Dene 1921, Todmorden 1923 (?), 1924, 1927, Barnsley 1940. Others were of small numbers, as the two at Elland in 1934.

Extinctions of the Meadow Brown elsewhere do not coincide with those around Huddersfield. Dennis (1977) includes it in a group of species "noted for both local extinctions and numerical depression in the early 20th century", recovery of which seems to have taken place in the early 1930s, reached a peak in the 1940s, and was followed by a decline in the 1950s. No specific example is cited, and such a temporal sequence is completely different from that which took place in the Huddersfield area. Here a rapid decline to virtual or complete extinction took place some 40 years before that indicated by Dennis, and the main recovery occurred later. In a popular account of the butterflies of Bewdley, Worcestershire, Hickin (1987) says of this species "Now everywhere abundant, but was not to be found in Wyre 50 years ago" which is intriguing and does not suggest synchrony with the pattern to which Dennis refers. That the timing of extinction around Huddersfield was different from that indicated by Dennis (1977) points to a local and not an all-pervasive cause.

RINGLET *Aphantopus hyperantus* (L.)

In the 19th century the Ringlet was known from Farnley Mill and Storthes Hall pastures, both in the eastern half of the Huddersfield area, (Hobkirk 1859, 1868), but by 1883 Mosley could only note, on the authority of J. Varley, that it formerly occurred at Farnley. Long known from eastern parts of Yorkshire, its range had contracted by the end of the 19th century. It then long remained unknown in the Huddersfield area, as it was to Wattam (1936) and other entomologists. There was, however, an isolated, apparently unpublished, occurrence at Elland in 1934 where one was seen by H. Spencer, (YNU record book & cards). This was unknown to Collinson (1969) in whose Halifax list the Ringlet has no place. This presumably stray individual had no consequences for the future of this species in the area. The Ringlet was also reported from Great Park, Low Moor, by W. Barraclough in 1949, the single individual being described as "almost v. *obsoleta*" (Dearing 1950). On the relevant YNU record card Hewson noted that this was only seen and not taken, and C. R. Haxby regarded it as highly suspect (Bradford NS). The reason is unclear as Barraclough was an experienced lepidopterist, must even have noted the reduction of the under-surface ocelli, and would hardly confuse even a variant Ringlet with any other species. The unexpected locality (listed as Royds Hall in Bradford NS records) may have engendered doubts. A valid record from this time and place would be interesting, but of scant significance in the history of this species in the area.

In the early 1970s the Ringlet began to increase again in Yorkshire and to spread westwards. The earliest records for the Huddersfield area during this epoch were from near Bretton. In 1983 it was reported from Bretton Park (YNU record cards.) and in 1984 it was seen at two adjacent sites at Bretton (D. S. & V. A. Ives). There were no further reports until 1992 when J. Dale saw one at Lindley Moor, further west than any known 19th century site. In the late 1990s it continued to occur in the Bretton area, and was found in Bank Wood by R. M. Sunter. In 2000 one was seen at Shelley by S. Graham.

Its spread was contemporaneous with penetration of the Harrogate area from the east, which took place very quickly. Between 1982 and 1985 it established itself over a wide area of the lower land there (Barnham *et al.* 1993), since when it appears to be colonising sites at higher altitudes (Blakeley 1999).

While the Huddersfield area now lies within the westward (and northward) extending range of the Ringlet, which includes the Sheffield area (Whiteley 1993), progress has, as yet, been slow with little evidence of firm establishment save in the extreme east. Its pattern of spread resembles that displayed by the Hedge Brown and it is of interest that both species colonised the Harrogate area (to the north and somewhat to the east) at about the same time as they did the Huddersfield area. In both cases, however, colonisation around Harrogate was both more rapid and more extensive than in the Huddersfield area, a possible inference being that habitats in the latter remain sub-optimal.

SMALL HEATH *Coenonympha pamphilus* (L.)
Because it is so common, the history of the Small Heath in the Huddersfield area is particularly significant. It was clearly well known in the mid-19th century when Hobkirk (1859, 1868) simply noted that it was common on dry banks, but in 1883 Mosley was unable to cite a single then frequented locality and only reported it, on the authority of J. Varley, as formerly known at Farnley. Porritt's (1883) comment that it was distributed all over Yorkshire but was rare in some parts of the West Riding is further evidence of its status at that time, and this is borne out by what would otherwise be its surprising absence from the list of Halifax species (Halliday 1896). The situation there was confirmed by Collinson (1969) who says it was recorded in that area only five times up to 1945. Halifax SS records show that one of these was for Luddenden in 1866 and that the three others in the area concerned, were all post-1940 – Elland and Copley in 1942 and Cragg Vale, Mytholmroyd in 1945. This emphasises its absence or great rarity over a long period of time. In the early 20th century it was also absent from, or very rare in, the Bradford area. Butterfield (1906) said it had "almost disappeared from the neighbourhood" and, equally categorically, Butterfield (1911) said "does not occur in this immediate neighbourhood".

Just south of Huddersfield, Brady (1884) noted that "this generally abundant species does not appear to be common around Barnsley", and cited only four known localities but gives no dates. For the more distant, lower-lying Doncaster area, Rimington (1992) noted a lack of records for the 80 years prior to 1923, (an entry for 1919 has since been located in the record book of the S.W. Yorks. Entomological Society). This he found surprising but felt that it tended to confirm the poor 19th century recording there. This can hardly hold good for the Huddersfield area, where it had been regarded as common and where, had it not gone through a period of absence or great rarity, its presence would surely have been detected by entomologists of the calibre of Porritt, Mosley, Varley and others. Moreover Mosley specifically drew attention to species, of which the Small Heath was one, that, formerly abundant, declined dramatically or disappeared. Even in the Sheffield area not far to the south-east, however, Garland (1981) believed that it remained more or less constant in numbers and range in the 19th century, which suggests that the decline – to virtual if not complete extinction – was restricted to a relatively small area.

Indications of what may be the first signs of recovery are records from two localities given in Morley's manuscript list for Skelmanthorpe and vicinity (1896-1908) – Gunthwaite and (in the border area) Langsett. In his notebooks Morley recorded it in 1917 from "Woodhead Moors", an imprecise locality, again in the border region, and, without dates. He also recorded it as common in some years on the railway side at Gunthwaite, and from grassy places on moors near Langsett, all of which are also mentioned in his updated manuscript. Its establishment, at least at Gunthwaite, in the first two decades of the century is implied. These sites are repeated in a YNU record book, that also gives Broadstone (near Ingbirchworth) in 1922 (H. D. Smart) and Coxley (undated). The last is also reported in the record book of the S.W. Yorks. Entomological Society as "rare" (J.H. = J. Hooper) and, although undated, was probably before 1919.

If records from no later than 1908 and onwards mark the early stages of a recovery in the south and east of the area they were apparently paralleled by events further north, though precise dating is not possible. The recorder's report for 1925 (Bradford NS) said "may now be considered to be well established in our area". Whether this refers to the Bradford area as a whole or to the vicinity of Low Moor, where the recorder (W. Barraclough) lived, is not clear. The wording implies recolonisation sometime before 1925, by which time the situation was strikingly different from that which prevailed in the early years of the century. Especially if Low Moor was implied, arrival from the east is indicated.

Information on its recovery was given by Wattam (1936). Comparing its status with that reported by Mosley (1883), he made it clear that "this is another of our local species which is now abundant, especially along the moorland areas at Meltham, Holmfirth, and the Chew Valley". The last locality, on the western slopes of the Pennines, lies just outside the area covered but is continuous with similar terrain that falls within it. It is not known when recovery began hereabouts but Wattam had already mentioned in the appropriate Annual Report of the HNS that the Small Heath was present on Holme Moss in 1926. It was to be seen in parts of the Colne Valley in the 1940s and early 1950s (G.F.), and R. Crossley noted it as abundant near Deanhead Reservoir, Scammonden, in 1957 (Hewson 1958).

It seems to have been slower to recover in the vicinity of Halifax where the records for well scrutinised Elland and for Copley in 1942, and Cragg Vale 1945, were the earliest. It was, however, found in the Hebden Valley, outside the area, in 1946, 1948 and 1949, and was common there in 1955 (and had been seen at Todmorden in 1926), so it is possible that it spread into the western parts of the Halifax area from this region – a route unsuitable for most colonising species. The Cragg Vale population, further west than others, and remote from eastern sites, fits such a scenario. By 1955 it was well established on Norland hillsides (Halifax SS), a region that could have been colonised either from the north-west or from the Colne Valley and Deanhead – Scammonden areas in the south. It was found in the Shibden Valley in 1956 (B. D. Cain).

By 1969 Collinson was able to say that "it is now strongly established through the [Halifax] area especially on hills and moors", a truly momentous change from the situation at the end of the previous century when it had vanished from the area. It continues to be common there (Cain 1991 and subsequent reports), but Cain & Baggaley (1997, 1998) suggest that it may have suffered recent declines in some places near Halifax as a result of habitat loss. It has been common in the southern parts of the Huddersfield area from the 1960s to the time of writing and is known from many sites. Here B. and M.J.L. did not notice any obvious changes in status in 40 years of local acquaintance with this species until a possible decline around the bi-millennium.

The Small Heath favours rough fields with short grass and an admixture of nectar-yielding flowers, grassy moorland, hillside slopes and upland cloughs and, in contrast to most local species, shows a preference for the higher ground in the western part of the area. It has been found at about 1500 ft at Wessenden Head. According to Lees (1962, 1965), some Pennine populations at least are univoltine whereas those from southern England are usually bivoltine. Voltinism in the populations tested was under genetic control but could be modified by temperature. By artificial selection the percentage of individuals of a Pennine population producing two broods per year was increased over two successive years. Nevertheless a long emergence period, even in the upland parts of the area, indicates, as Blakeley (1998) suggests from observations elsewhere, that the pattern of emergence and overwintering may be more complex than generally supposed. Altitude, and therefore climate, doubtless exert an effect and, as the differences between Pennine and S. Devon populations described by Lees confirms, local selection occurs and different areas are populated by genetically different stocks. This may have been involved in some unexplained way in the 19th century decline in the area.

It is impossible to prove that the Small Heath, previously common there, disappeared completely from the Huddersfield area in about the mid-1860s, but its apparent demise was recorded and it was certainly brought at least to the brink of extinction. A few individuals may have persisted but there was no record for the next 30 years or more, and only one positive site, Gunthwaite, is mentioned in the next 20 years. Beginning towards the end of the first decade of that century, and showing a definite increase in the 1920s, it then recolonised suitable habitats, was common in many places by the 1940s and 1950s and seemingly widespread throughout the area in the last four decades of the century.

MONARCH *Danaus plexippus* (L.)

An individual of this rare migrant was found at Kirkheaton in 1917 (Morley 1928), not 1927 as reported by YNU Lepidoptera Committee (1967) and Rutherford (1971). The confusion over the date arose because details were not generally available until the specimen was given to the Tolson Memorial Museum a decade after its capture.

Changing Patterns of Diversity

In little more than 150 years there have been enormous changes in the composition and diversity of the butterfly fauna of the Huddersfield area (Figure 2). The number of species present at different times is indicated in Figure 4. There was a decline in diversity (here defined simply as the number of species: what is now often referred to as species richness), which included a dramatic episode of several more or less contemporaneous extinctions between about 1865 and 1870. The ensuing period of very low diversity then continued into the early decades of the 20th century. Similar faunal impoverishment occurred in nearby Bradford and, as shown by the absence, or extreme rarity, of such generally common species as the Meadow Brown and Common Blue, at least to some extent in the Barnsley region, but was nevertheless confined to a limited area. At the time of minimum diversity at the turn of the century, only 11 species, including the Red Admiral but not intermittent migrants, were present, and of these the Silver-washed Fritillary and Large Tortoiseshell were very rare. The fauna was then probably as impoverished as that of any part of England of similar size that offered a comparable array of habitats, either then or at any time in the previous or subsequent century.

In the 20th century diversity increased slowly until, during about the last two decades, it did so more rapidly. At its point of lowest diversity the fauna consisted of only half as many species as it did in the mid-19th century, but by the bi-millennium it included slightly more species, 23, than ever previously recorded.

Increased diversity was not achieved solely by recovery of species that previously suffered extinction in the area: several disappeared, never to return. The Dingy Skipper,

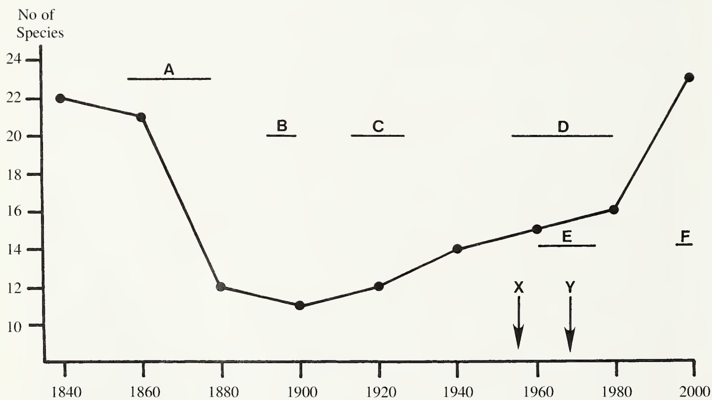

FIGURE 4.
Changes in species diversity of the butterfly fauna of the Huddersfield area. Although a migrant, the Red Admiral, which has been present throughout, is included. Irregular migrants (Clouded Yellow, Painted Lady, and Camberwell Beauty) are omitted, as are the Small Pearl-bordered Fritillary and the vagrant Monarch, each recorded once only. Two of the 11 species present in 1900 were very rare. Some relevant conditions and events are indicated. A: smoke and soot levels high. SO_2 lower than later. B: Small reduction in industrial smoke emission. C: Marked reduction in soot and smoke. D: Reduction in SO_2, especially towards end of period. E: Large reduction in smoke and soot. F: Reduced acidity of rain. X and Y: Clean Air Acts.

Wood White, Pearl-bordered Fritillary, and somewhat later the Silver-washed Fritillary and probably the Large Tortoiseshell, were lost from the fauna. These losses were more than outweighed by the arrival of species never previously recorded, some of which became common and widespread. Species never recorded until the second half of, and often not until the late, 20th century, are Large and Small Skipper, Purple and White-letter Hairstreak and Hedge Brown. The Green Hairstreak, that also became firmly established in this period, had been recorded only once – before 1884.

Excluding migrants and the once-only recorded Small Pearl-bordered Fritillary, of 27 species recorded during the entire period, no fewer than 13 (*c.* 48%) suffered extinction, (the Holly Blue twice and the Comma apparently three times) in less than 150 years. If the Red Admiral, which depends on migration but has been present throughout, be included, then 13 of 28 species (*c.* 46%) suffered extinction during this period. As six species were added to the fauna in the last 50 years or less, this masks the true extinction rate in the 19th century when, of 22 species (residents plus Red Admiral) present in 1850, exactly half were extinct by 1890. Of these, all save perhaps the Comma were still present in 1860, and Mosley's (1883) account suggests that most extinctions happened between about 1865 and 1870 – a biologically cataclysmic event. Only nine species (*c.* 32%) persisted throughout, some tenuously at times. These are the bare facts: possible explanations are considered later.

Faunal differences at the beginning and end of the 20th century are thrown into strong relief by noting that, including the Red Admiral but excluding intermittent migrants, the entire area could muster only 11 species in 1900, whereas in 1998 and 1999 S. Graham recorded 15 such species in, and in the near vicinity of, his garden at Shelley. In 1999 he recorded 13 species, plus the Painted Lady, in his garden alone, as did D. S. and V. A. Ives in their garden at Almondbury on the fringe of Huddersfield. They had previously done so also in 1992. Between 1983 and 1999 they recorded 16 species, plus the Painted Lady, in their Almondbury garden. S. Graham had earlier lived in Almondbury where he recorded 15 species, plus the Painted Lady, in his garden between 1991 and 95. In the last few years of the 20th century 17 species, plus the migrant Painted Lady, were seen in these two gardens. This is more than half as many again as were known in an area of 314 square miles in 1900! This recovery, and the rapid 19th century extinctions, are perhaps the greatest changes ever recorded in any local butterfly fauna in Britain.

Some Aspects of Invasion and Colonisation

Much attention has been directed to island populations of animals, and what is often called the theory of island biogeography has considered rates of extinction and invasion of islands, but similar events take place in localised mainland areas as the rapid changes in the butterfly fauna of the Huddersfield area make plain. These shift the emphasis to local invasions, often by species that are common nearby. There are no such barriers around this area as the sea that confronts potential invaders of islands, though the Pennines are such to some species in the south and west. There is largely unimpeded access from the east. Theoretically, invasions should be easier, and extinction rates lower, than on islands. Contrariwise, emigration should also be easier but, provided conditions remain similar on both sides of the border, should be cancelled out by immigration.

Invasions, whether the result of deliberate or inadvertent human intervention, or of natural extensions of range, have generated much theory. Attempts have been made to ascertain what determines whether a given species will become a successful invader and what properties of the invaded environment facilitate, or resist, invasion. Attention has been concentrated on such matters as the intrinsic rate of population increase as a predictor of the ability to invade. It has been deemed "clearly important" to a colonising species that this should be large (MacArthur & Wilson 1967). High rates of population increase are supposed to reduce the initial risk of random population extinction, and of course to provide recruits for colonisation, but clearly are not always necessary. The Fulmar, *Fulmarus glacialis,* lays a single egg, does not breed until it is between 6 and 12 years old (mean 9.2 years), yet has been a spectacularly successful bird invader.

While it is easy to suggest things that *may* facilitate invasion by butterflies – mobility and good powers of dispersal, the production of several broods per year, long flight periods, wide ecological tolerance, polyphagous larvae and so on – these need not necessarily be effective or, like high fecundity, even necessary, and what is important to one species may be less so to another.

Much nonsense, sometimes couched in "scientific" or mathematical language, has been written about invaders. Examples are cited by Fryer (1987, 1993a). In a consideration of the ecology of invading insects, Lawton & Brown (1986) found it difficult to be sure of hardly anything discussed and concluded that the "*only solution* (our italics) to this empirical uncertainty is more, and better, theory". We strongly disagree. Better understanding of what the animals really do may tell us far more. On the other hand we completely agree with Lawton and Brown when they say that it is not clear what makes an insect species a good invader.

The biology of individual species is highly relevant to changes in status, and colonising abilities presumably differ between species, but details are not easy to elucidate. The Small Tortoiseshell and Peacock, that never became extinct though they passed through periods of great scarcity, are highly mobile – an attribute to which their persistent, if at times tenuous, presence may in part be due. The invasive abilities of the Holly Blue are self-evident. Quite different is the behaviour of the Hedge Brown, adults of which are less mobile, live in colonies, seldom fly over open grassland, and in several respects have more precise ecological requirements than some of the mobile species. It is only slowly establishing itself at the bi-millennium. A correlation of its habits with slow colonisation may seem self-evident – but is certainly suspect as a comparison shows. The Hedge Brown invaded the Huddersfield and Harrogate areas at the same time, but while it made slow progress around Huddersfield it colonised the Harrogate area both quickly and extensively (Barnham *et al.* 1993). Differences in habitat quality in the two areas may be involved, a possibility strengthened by the fact that the Ringlet shows the same difference in the pattern of colonisation of these two regions. Larvae of the Hedge Brown feed on a range of grasses, some of them common, so their food requirements are easily met, though they may have subtle micro-habitat requirements of which we are largely ignorant. Larvae of the Small Tortoiseshell and Peacock are more demanding food-wise and feed exclusively on nettles (*Urtica* spp.) which may impose some restrictions. Thus, at least in theory, adult and larval ecologies may respectively impose restrictions on, and facilitate, dispersal and invasions, or vice versa. It is not easy to assess in which way a particular habit will affect invasive abilities. The Large and Small Skippers are both colony-formers – a habit that might be expected to restrain invasion – yet, as newcomers, they quickly occupied large tracts of the Huddersfield area. On the other hand the colony-forming Hedge Brown and Ringlet made slow progress in the same area – but rapid progress around Harrogate! Generalisation is difficult and dangerous. Only more intensive study of the habits and ecology of individual species (preferably in several localities) will clarify these matters.

Invasion also involves coping with a series of habitat islands. To a woodland species a wood is a habitable island, and open terrain a barrier: for species of open habitats the reverse is the case. The efficacy or otherwise of such barriers differs much in different species according to their mobility, or tolerance, which adds to the complex of interacting factors involved.

Local Extinctions and Recolonisation: Are Explanations Possible?

Preamble

Extinctions of butterfly populations are not rare. Colonies of colony-forming species not infrequently suffer this fate, and persistent contractions of range that extinguished several species over extensive areas are well known in Britain. The striking feature of the 19th century extinctions in the Huddersfield area is that they happened more or less simultaneously in several species, and in several species of moths, and were accompanied by declines in the abundance of others. Such historical events in biology are often not easy to explain. As different species may respond in different ways to a common factor, and each is affected by a medley of influences whose importance differs from species to species, such a near synchronous decline of several species, in some cases to extinction, is particularly intriguing. It points to some potent deleterious factor. Of particular significance is that the events were localised: some affected species continued to flourish in nearby areas.

Like invasions, extinctions have tempted speculation and model making. For butterflies, Thomas (2000) at least attempted to analyse actual situations, but presented the results as generalisations, only three species being mentioned by name, and these only in passing. He sought correlations between adult mortality and the decline and extinction of populations in fragmented habitats. His conclusion was that species of intermediate mobility were most susceptible to decline, and ultimately to extinction – the opposite of what one model had predicted – but that under some circumstances such species may survive best! He also concluded that a population "will not persist if the total mortality due to migration is higher than can be sustained by the reproductive output of individuals within breeding habitats" and even says this twice in rather different words!

Of extinctions around Huddersfield reported by Mosley (1883), all save those of the Comma and Holly Blue were of colonial species – but as most British butterflies are colonial little can be deduced from this. Furthermore, the Comma may have succumbed before the main extinctions, yet, being mobile, belongs to the category supposedly best fitted to survive – if other aspects of its biology are ignored. The most striking feature of these extinctions is the rapidity with which several species with a wide range of habits and ecological requirements disappeared essentially simultaneously. However it may be related to susceptibility to extinction, it is difficult to see how degrees of mobility may have been implicated here.

Animals are continuously adapting to local conditions: natural selection is always operating to this end, and often a measure of phenotypic plasticity is also available. A striking discovery of biology in the 1960s, revealed by electrophoresis, was that a large amount of variation exists in most populations, which enables a species to respond rapidly to changing environmental stresses. Genetic adaptation is often cryptic, but dramatic visible evidence among the Lepidoptera of the Huddersfield area is provided by the development, increase, and spread of industrial melanism in more than 40 species of moths that took place from about 1880 or a little earlier, (perhaps 20 years earlier in the case of the Peppered moth, *Biston betularia* and a few others) and in some cases even later. Porritt (1906) gave a graphic account of these changes, some of which took place "during the collecting experience of many of our present-day lepidopterists", and documented the case of the Mottled Grey, *Colostygia multistrigaria* in which the melanic form largely replaced the normal in ten years.

Aspects of the classical story of selection of melanic and typical forms of *B. betularia* by bird predators on the basis of resemblance to background have been questioned in recent years (Majerus 1998) – which would not have surprised Porritt (1906) – but Cook (2000) regards the essence of the story as valid. Certainly, the spread of melanism in many species in the same area is a dramatic example of evolutionary change. Furthermore it is an example of change that took place convergently and simultaneously many times independently. This implies that it confers a strong selective advantage on several species, even if full understanding of the advantage is illusive. It also provides, many times over, particularly pertinent examples of the rapidity with which genetic changes can spread through a population.

The existence of local races is further evidence of genetic adaptation. Differences in voltinism (the number of generations in a season) may be indicators of racial distinction and, as in the Green-veined White, may perhaps even reveal the presence of altitudinal races (or even more distinct taxa) within a small area. Seasonal forms, as of the three "Whites", *Pieris* spp., provide further evidence, and are even more striking in some exotic species. The latter provide other impressive evidence. In the African *Papilio phorcas* a difference of a single gene gives rise to females that differ in both colour and colour pattern, and the amazingly different mimetic females of *P. dardanus* in different geographical regions are remarkable adaptations to local conditions. Such evidence suggests that the populations of those species that recolonised the Huddersfield area after an absence of several decades or, in the case of the Speckled Wood was recorded again after more than a century's absence, are in subtle ways different from their extinct predecessors, and perhaps better able to cope with prevailing conditions. They may even exploit niches slightly different from those utilised by their predecessors.

What caused the late 19th century declines and extinctions?
Notwithstanding the possibility of different responses by different species to the same influence, the local extinction of several species and the drastic reduction in abundance of others in the same short period of time in the second half of the 19th century suggests that some over-riding common factor was involved. The species concerned belong to different families, frequent a variety of habitats, overwinter in different stages, have larvae that use different food plants, and adults with different flight periods. They have different predators and parasites at all stages of the life cycle, and often differ much in habits. Furthermore various moths disappeared in the same period. Had only a decline, or loss, and no recovery, been recorded, an apparently plausible explanation might have been habitat loss or deterioration. Deterioration indeed occurred yet these habitats were later recolonised by several species.

After considering the national picture since about the 1830s, Heath *et al.* (1984) concluded that "the single main cause of change in the abundance and distribution of butterflies has been change and destruction of their habitats". This is clearly inapplicable to some of the changes in the Huddersfield area. Here, after loss, in several cases recovery took place during periods when, as measured for example by loss of plant species, habitats continued to deteriorate, and also became more fragmented and reduced in availability. Moreover, the extinctions were confined to a restricted area, took place with great rapidity, and included several species that between them frequented a variety of habitats. To be convincing as an explanation, habitat destruction must be shown to have taken place in several habitats in a relatively small area, to have reached a critical stage in all cases essentially simultaneously, and to have led to permanent loss of the species affected. These demands cannot be met. Even on a national scale, 20th century fluctuations in the abundance and range of the Speckled Wood and Comma can hardly be attributed to this cause.

While habitat destruction can be ruled out as an explanation of the extinctions, the deleterious effects of a particular factor or complex of factors that for a time reduced the suitability of the environment without destroying it is a different matter. If one can identify a factor that operated with such severity as to cause declines and extinctions but was later removed, leaving the environment sufficiently similar to its original condition to allow some of the exterminated species to return, it may be possible to suggest a cause for the declines and extinctions. Two candidates suggest themselves, climatic change and the deleterious effects of industrialisation and urbanisation, especially air pollution, and the associated acidic precipitation and deposition of soot. Climatic change is easily ruled out. How this could be responsible for *local* extinctions is difficult to imagine, and such events seem improbable. Some species that became extinct around Huddersfield continued to flourish in adjacent areas. Thus while the Meadow Brown became extinct in the second half of the 19th century it was apparently not affected in nearby Doncaster, from which area Rimington (1992) cites a series of records for the two decades on either side of the change of century, and in whose vicinity Morley noted that it "swarmed" at a time when it was absent even around Skelmanthorpe, in the east of the Huddersfield area. The 19th century declines and extinctions were also out of synchrony with those that sometimes occurred in other areas (see for example under Meadow Brown). This renders all-embracing explanations untenable and emphasises that local factors were operating.

Ironically, at least temperature-wise, the climate seems not to have been adverse during the critical period. Indeed, following a cold period of about 250 years – the so-called "Little Ice Age" – warmer conditions returned around 1830 and continued until the 1950s. This might be expected to have been conducive to the well-being of most British butterflies. On the other hand this general amelioration masks the fact that summer temperatures were generally low in the second half of the 19th century and fell during the period 1870-1895. Heath (1974) thought that this may have tended to cause contractions in range, and Heath *et al.* (1984) argued that the decline of certain species in northern Britain at that time may have been related to this but were nevertheless "certain that climate has not been the main factor in recent declines in abundance and contractions of range of many species". In any case the extinctions in the Huddersfield area had already occurred by about 1870.

That environmental degradation occurred in the area prior to, during, and subsequent to, the late 19th century decline of butterflies is well documented. The loss of many plant species provides concrete evidence of such changes. Important because it is so specific is the list of some 30 species of angiosperms typical of limestone regions of Yorkshire that also grew in the non-calcareous Huddersfield area before 1878 but no longer did so in the 1940s (Grainger 1942). Such a loss hints at a role for acidic precipitation, which long prevailed at high levels as a consequence of the Industrial Revolution. Cohen & Ruston (1925) described how soils in polluted Leeds became depleted of calcium carbonate. Moss (1901) had earlier noted the loss of several angiosperms around Halifax since 1775. The disappearance of lichens is a well known indicator of such adverse conditions, especially of high levels of sulphur dioxide, and the loss of *Sphagnum* and various angiosperms on the southern Pennine moorlands has also been convincingly attributed to atmospheric pollution, especially by oxides of sulphur and nitrogen.

The period of extinctions and declines was one of increasing industrial pollution. The early 19th century saw an increase in the number of textile mills and the replacement of water power by steam engines that became dominant by the 1830s. As early as 1805 the Dartmouth Estate Book (cited by Crump & Ghorbal 1935) referred to the "mills and steam engines" at Farnley that "almost continually contaminate those pleasing features of picturesque beauty, water and air". By 1850 many large textile mills had been constructed in the area (examples are illustrated by Giles & Goodhall (1992) whose fig. 274 shows how a large area south of the town of Huddersfield became dominated by textile mills in the mid-19th century). Similar developments occurred in Halifax and adjacent villages and small towns, and considerable expansion continued in the 1860s. The number of power-looms in Yorkshire woollen mills increased almost eight-fold between 1840 and 1874, which gives some measure of the expansion. The inventory in Giles & Goodhall (1992) lists well over 800 textile mills, mostly built in the 19th century, in the area covered. Some were small: others very large. Increasing engine power meant increased coal consumption and higher levels of smoke pollution, as did an increasing human population, open coal fires being the norm. Contemporary illustrations of the many textile mills and the profusion of their smoking chimneys give a vivid picture of the situation that arose.

In 1830 Read Holliday set up a small chemical works just east of the town and distilled ammonia from ammoniacal liquor wastes from the Huddersfield Gaslight Company. Such was the opposition to the pollution caused that within a few years it moved to Turnbridge where a huge chemical complex eventually developed. Small at first, it produced naphtha, creosote and later benzene, and by 1857 was one of the country's largest coal-tar distillers (Jenkins 1992). Again there was local opposition to the pollution caused, and in the 1860s emphasis changed to the production of analine dyes. (By the end of the 19th century this chemical complex, eventually part of ICI, had a perimeter over two miles in length.) Other chemical enterprises also polluted the area. In 1867 the Rivers Pollution Commission reported that the Colne and Holme were extremely polluted and that four miles of the Ramsden Canal, fed from the Colne, was polluted and a great nuisance to part of the town. No fewer than 22 manufacturing chemists were found to be polluting local rivers. The 1871 report showed the much discoloured Calder at Wakefield to be suffering from pollution originating upstream that consisted of "many kinds of liquid refuse". As evidence it produced a letter written in 1868 with water taken from the river, of which Woodhead (1939) gives a photograph. While water pollution has little direct effect on butterflies it reflects the general and extensive contamination of the environment in the mid-19th century. Some of the offending enterprises doubtless produced volatile wastes and smoke.

Coal mining was also widespread. In 1859 there were 116 coal pits in the immediate vicinity of Huddersfield, Halifax, Dewsbury and Holmfirth – which area then produced about a quarter of the coal mined in Yorkshire (Wray 1929). The number dwindled as shallow seams were worked out and mining moved east. Of at least 20 early 19th century pits in the Holme Valley between Holmfirth and Huddersfield none remained by the early 20th century. Coal mining contributed to environmental degradation by dumping waste, adding to air pollution by burning coal to power steam engines and sometimes firing spoil, and to water pollution by pumping out mineral-rich water. Other contributors to pollution were iron works, foundries, engineering works, dyeworks, and railways.

What they believed to be the deleterious effects of such pollution on living organisms did not go unnoticed by naturalists. Nowell (1866) connected the loss of a considerable number of species of mosses in the vicinity of Todmorden (outside the area but nearby and very relevant) with "the super-abundance of factory smoke". Moss (1901), commenting on conditions that had prevailed around Halifax for more than half a century, attributed the disappearance of various flowering plants to "the dense black smoke" that belched forth from "scores and scores again" of mill chimneys in SE Lancashire, which produced "great smoke drifts" that could be seen crossing the Pennines and mingling with locally produced smoke. 'Black rain' was frequent.

As early as 1842 the situation in Manchester, a prime source of such pollution, of which the Huddersfield area was a recipient (see below), provoked a leader on "The smoke nuisance" in the *Manchester Guardian* (May 28) which not only complained of the density of the smoke that was "palpable to the senses", but alleged that trees were dying as a result of it and that even in open spaces in the city flowering shrubs would "not grow at all". In the 1860s things were even worse in St. Helens where one "might look around for a mile and not see a tree with any foliage whatsoever".

Early observations on the detrimental effects of similar pollution in Leeds, only about 16 miles from Huddersfield, where in 1874 smoke was said to form "a dingy perpetual cloud", are admirably summarised by Seaward (1975) who cites various pioneer studies and observations. Conditions were sufficiently bad as early as 1842 for meetings to be convened in both Leeds and Manchester to discuss smoke abatement and for an Inspector of Smoke to be appointed shortly thereafter.

In the second edition of a book first published in 1912, Cohen & Ruston (1925) vividly described the effects of pollution in Leeds and provided abundant evidence, both observational and experimental, of the effects of air pollutants on plants. They showed how yields of various vegetables, wallflowers and grasses were reduced, most drastically in the most polluted areas where the growing of vegetables was pointless. Modern studies confirm these results and show how pollution reduces photosynthesis, curtails growth, causes crown thinning in certain trees and has other effects, though experimental results have not always been clear cut. For a summary and many references see DoE (1988). Mixtures of pollutants, such as oxides of sulphur and nitrogen, are usually more damaging than are either alone.

Less is known about the effects of pollution on animals. Alstad *et al.* (1982) review information relating to insects. Many studies are inevitably retrospective and describe effects in terms that are correlative rather than causal. Relevant deleterious effects of sulphur compounds, however, include reduced flight and pollination activity in bees. Pertinent to present considerations is that silkworms react by a reduction in feeding rates and in activity in general, and suffer softening of the cuticle and delayed formation of cocoons. Dust particles, as in smoke and soot, disrupt the epicuticle. Delicate insects are more affected than large, heavily sclerotized forms, but highly absorptive dusts, that take up wax lipid secretions, can cause rapid desiccation and death even in large insects. Simultaneous exposure to different kinds of pollution in the past is a complicating factor. Our analysis of the evidence suggests that smoke and soot may have had more adverse effects on butterflies than the more studied sulphur dioxide and oxides of nitrogen, but it must be remembered that the latter were also exerting an influence, perhaps synergistically, at the time of greatest production of smoke and soot.

Surprisingly little attention has been paid to the possible deleterious effects of atmospheric pollution on butterflies in Britain, though concern has been expressed about severe declines of several species in major industrial areas in a number of European countries. Thus, in a discussion on the conservation of British butterflies, J. A. Thomas (1984) devoted less than seven lines to the topic. Although he noted that many Europeans, especially in Germany and Italy, blamed air pollution for the dearth of certain species near some industrial areas, and that a similar situation prevailed in the English Midlands, he concluded that "no more positive evidence links the two phenomena, and research is necessary to elucidate the matter". Contrary to a generally dismissive attitude to the possible effects of pollution in Britain, however, Barbour (1986) considered the regional distribution of extinctions by comparing status in 1984 (Heath *et al.* 1984) with pre-1970 records – many of them much earlier than 1970. Many of the highest extinction rates were in areas close to major centres of industrialisation, the two highest being in south Yorkshire and Nottinghamshire, and north-east of London. In general, areas with most extinctions corresponded to a marked degree with those that comprised the zone in which lichens showed moderate to severe depletion– the zone in which atmospheric SO_2 levels were 60μg m^{-3} or more. (In the classification followed, the zone in which the most serious depletion occurred was characterised by SO_2 levels >170μg m^{-3}). Higher levels in fact long prevailed in some places, including the Huddersfield area. In 1962-1963, by which time local levels of SO_2 had declined, the winter mean at Holmfirth was 263μg m^{-3} and in 1969-1970 was 188μg m^{-3}. Moreover, on a substantial number of days it exceeded 500μg m^{-3} (Ferguson & Lee 1983). Barbour (1986) also considered the effects of "dry deposition" of sulphur, resulting from atmospheric SO_2 (not to be confused with "wet deposition" – "acid rain") and found a strong correlation between extinctions and the amount of sulphur deposited. Indeed the correlation accounted for 79% of variance in number of extinctions. The Huddersfield area lies in the highest of the five zones of annual sulphur deposition, >4g m^{-2}. More recent figures (DoE 1990) show that it lies in the area (E. Lancashire, S. Yorkshire and the N. Midlands) with the then highest sulphur deposition in Britain, – 4.0 – >6g m^{-2} per year – and also in the region receiving among the highest levels of oxidised nitrogen species.

Average figures are not necessarily the most significant. Deposition is episodic and as much as 30% of the acidity deposited in a year may be received on <5% of wet days. Occult deposition (in mist and fog) of sulphur and nitrogen is also important and the amounts deposited in this way were often underestimated in the past.

Notwithstanding the comment of Pollard *et al.* (1995) in one of the few papers to make even passing reference to the topic, that Barbour (1986) suggested that "atmospheric pollution (smoke and sulphur dioxide) may have played a role in the nineteenth-century contractions of range of butterflies", he referred only to SO_2, and made no reference to smoke – an important distinction (see below).

Although he does not refer to the effects of industrialisation, Turner (1986), who considered the influence of climate on butterfly distribution in Britain, noted that in relation to their climates the industrial areas of Yorkshire and Lancashire are exceptionally unfavourable. (He used data on the maxima of species distributions between about 1910 and 1982.) What he did not know, however, was that the pre-industrial butterfly fauna of the Huddersfield area boasted twice as many species as it did after the 19th century extinctions. Both facts are in keeping with the suggestion developed here that pollution was a prime cause of the local extinctions.

The effects on animals of particulate pollutants, especially soot which was formerly deposited in large quantities, is poorly understood. Soot includes toxins such as heavy metals. A pointer towards the possible deleterious effects of such toxins is that several freshwater crustaceans have been found living in more acidic conditions in pollution-free areas, such as the Hebrides, than those in which they have ever been found in Yorkshire. Furthermore, they were doing so even though other conditions – more 'dilute' water and lower calcium levels than generally prevail in Yorkshire – make life physiologically more difficult there. They may owe this ability to the absence of the toxins that accompany pollutants in Yorkshire (Fryer 1993b).

Heavy soot-falls were for long a feature of pollution in the Huddersfield area, falls of hundreds of tons per square mile each year being the norm in some places. However, soot was not uniformly scattered. Just outside the area, Cohen & Ruston (1925) showed that, in the early 20th century, 539 tons per square mile fell on industrial parts of Leeds, but the city centre received only 243 tons, and as little as 29 tons was recorded three miles north of the city. Soot-fall in the four square miles of central Leeds was roughly one ton per square mile per day. Much of the soot produced in industrial and urban areas was dispersed. For example Cohen and Ruston calculated that in 1897 every 12 hours saw the discharge of 80 tons of soot into the air above the 16 square miles covered by the city of Leeds. That is 10 tons per square mile per day. Some of this would fall on the city; most would be blown elsewhere. During the soot-producing era, many industrial sites not only in Huddersfield and Halifax, but in the Colne and Holme valleys and such towns as Elland, Brighouse, Cleckheaton, Batley, Dewsbury, Horbury and Ossett, ensured a generous dispersal of soot, whose fall was affected by the vagaries of wind direction. More was received from the Manchester area (see below). The cleanest region was probably always the Denby Dale, Cawthorne, Skelmanthorpe, Bretton area – which is also biologically richest for other reasons.

Smoke reduces the amount of sunshine and light that reaches ground level, and formerly did so to such an extent as to be detrimental to such sun- and warmth-loving insects as butterflies. Cohen & Ruston (1925) gave examples of the amount of sunlight and light excluded by smoke in Leeds. In 1907 the duration of sunlight in the centre of the city was reduced by 17% compared with that at Adel about 4 miles to the north – and the amount received at Adel must itself have been reduced. That it received its share of smoke is delightfully demonstrated by a still smoke-blackened pair of Raven heads in the corbel table of its Norman church, that thereby achieve a remarkable realism never envisaged by their medieval carver. Light is restricted even more by smoke. Cohen and Ruston found that over a period of 19 days in May and June 1910 an industrial area of Leeds received more than 40% less light than did Garforth 7 miles distant – and Garforth must also have lost light because of smoke.

Unlike insects such as bumble bees that can increase their body temperature by shivering or substrate cycling, butterflies are markedly ectothermic animals. All stages are much affected by summer temperatures and sunshine. As they realise, both Turner (1986) and Dennis & Williams (1986) are only confirming the obvious when they show that multiple regression analysis reveals that, between them, two factors, sunshine and temperature, account for almost 80% of the variance of butterfly diversity. As Dennis and Williams point out, this hides a multiplicity of complications. Nevertheless, biologically (as opposed to statistically) these factors are of prime importance. Many butterflies use their outspread wings as solar panels to absorb the sun's heat, and many fly, and feed, only in sunlight. Larvae of various species also bask in sunshine, which increases their metabolic and growth rates, and warming of the ground by sunshine, when its temperature may greatly exceed that of the air, increases the rate of development of both eggs and pupae. Screening by smoke has the opposite effect, and thus increases exposure time to predators and parasites. Reduction of sunlight by smoke, even by amounts less than those recorded by Cohen & Ruston (1925) must therefore have had deleterious, and perhaps seriously adverse, effects on butterflies in the Huddersfield area during the epoch of heavy smoke pollution.

Statistically every 15 minutes per day of summer sunshine adds one species to the butterfly fauna to be expected in an area of 10 miles radius – the unit used here! – (Turner 1986). The average total of sunshine received in May, June and July in Bradford (the nearest convenient station) in 1951-1980, mostly after marked reductions in smoke levels, was 509.3 hours, or just over 5h. 32 min. per day. Although 15 min. is only about 4.5% of this amount, its loss would be sufficient, statistically, to remove one species from the local fauna. Losses of sunshine of the magnitude measured by Cohen & Ruston (1925) – admittedly in the centre of Leeds – were clearly detrimental. The brief adult life span of non-hibernating British butterflies, often no more than 3 weeks, and sometimes less than generally believed, emphasises the importance of exploiting all available sunshine.

If reduced sunshine did in fact affect the butterflies of the area it might be expected also to have affected day-flying moths. Perusal of Mosley's (1883) catalogue shows that day-flying species were indeed disproportionately represented among those that suffered extinction or became very rare. About half the moths that fall into this category were day-flying – a much larger proportion than of moths as a whole. Although their disappearance, especially in the case of common species, would be more quickly detected than would that of all but the commonest nocturnal species, their preponderance is too great to be attributed solely to this reason. Those lost included the Forester, *Adscita statices,* and the Narrow-bordered Five-spot Burnet, *Zygaena lonicerae,* both of which formerly "simply swarmed" in some places but were reported as "now entirely gone". Also affected were the Wood Tiger, *Parasemia plantaginis,* that perhaps just escaped extinction, and the large and conspicuous Fox Moth, *Macrothylacia rubi*, and Northern Eggar, *Lasiocampa quercus callunae,* of which the last was described as extremely abundant until about 1873. All these have males that fly actively in sunshine. These three are predominantly upland species that live where cloud cover is greater, and the amount of sunshine less, than in the lowlands, and may therefore have been particularly vulnerable to any reduction in sunshine by smoke. Moreover, larvae of the Fox Moth and Northern Eggar bask in sunshine. The effect and significance of warmth is nicely demonstrated by the two-year life cycle of the Northern Eggar as compared with the one-year cycle of its southern sib the Oak Eggar *L. q .quercus.* Other species that fly actively in sunshine and were apparently lost were the Small Yellow Underwing, *Panemeria tenebrata,* Mother Shipton, *Callistege mi,* Burnet Companion, *Euclidia glyphica,* and Small Purple Barred, *Phytometra viridaria.* So was the Cinnabar, *Tyria jacobaeae*, that flies both by day (when its warning coloration is effective) and at night. Its larvae too are often conspicuously exposed to sunshine. That day-flying moths suffered proportionately more extinctions than night-flyers strongly supports the view that reduction of sunshine by smoke was a significant contributor to the extinction of butterflies in the late 19th century.

Thanks to its tar content, soot adheres to vegetation. As a contaminator of the food of butterfly larvae, and as a possible irritant or abrasive of their delicate cuticle, it may have had deleterious effects, but little information on this has been found (see Alstad *et al.* 1982). Smoke and soot, however, may reduce larval growth by impairing the quality of their host plants – as does SO_2. For use in reproduction most female butterflies store in the abdomen, nutrients that have been accumulated by their larvae. If conditions for the larvae are sub-optimal these reserves are liable to be reduced and reproductive capacity impaired. Moreover, in polyandrous species males transfer nutrients, as well as sperms, in the spermatophores at mating. In the Green-veined White the material transferred at a single mating may exceed 20% of body mass. While not all of this provides nutrients to the female, the amount is significant, and, with intervals, the female may be mated several times. If males cannot produce full-sized spermatophores, or if the females receive too few spermatophores, they are unlikely to realise their potential fecundity. Such insidious effects may have contributed to extinctions.

The location of the Huddersfield area is very relevant here, as is made clear by a comparison with the Sheffield and Doncaster areas. It abuts the eastern slopes of the Pennines at their narrowest point. On the western side, and to the south, lies the Manchester conurbation including Stockport, Oldham, Rochdale and other towns, west of which is Merseyside. Manchester was one of the earliest areas of development during the Industrial Revolution and for long continued to contaminate the atmosphere. (Even in 1970 it produced greater amounts of sulphur dioxide than anywhere else in Britain.) Prevailing winds are south-westerly. These carry polluted air from SE Lancashire, and formerly the smoke so graphically described by Nowell (1866) and Moss (1901), across the narrow Pennine ridge into the Huddersfield area where it joins locally produced pollution. Such polluted air passes to the north of Sheffield and Doncaster, whose south-westerly winds come from a much less polluted region. On the fewer occasions on which westerly winds with a northerly component carry Lancashire air towards these towns it has to cross the wider High Peak region of the Pennines, whose altitude is somewhat greater than that of the uplands west of Huddersfield. In the past a greater proportion of the particulate soot, which travels for shorter distances than gases, would be deposited before it reached Sheffield, whose centre lies 32 miles from that of Manchester, than would be the case of that carried to Huddersfield only 21 miles away. Less smoke would also survive the longer journey. Wet deposition of sulphur is also inevitably reduced in the dryer country from Sheffield eastwards. Sheffield and Doncaster produced their own smoke and other pollutants but were regularly refreshed by purer air from the south-west: the same winds added to the pollution load around Huddersfield. Sheffield suffered some losses of butterflies, but the Dingy Skipper and Small Heath, for example, persisted throughout, and species such as the Orange Tip and Common Blue, that declined in the Huddersfield area, appear not to have been affected (Garland 1981). If pollutants, including smoke and heavy loads of soot, had the effects on butterflies suggested here, these facts are consistent with the late 19th century extinction of several species around Huddersfield and their continued presence in the Sheffield, and particularly the Doncaster, areas. As in other cities pollution levels differed in different parts of Sheffield. Industrial Attercliffe received increasing amounts of sulphate sulphur between 1929 and 1954 but Nether Green generally received less of this contaminant between 1934 and 1949 than Marsden in the Huddersfield area (Ferguson & Lee 1983).

It may be more than coincidence that it was in the south-east of the Huddersfield area, least affected by smoke and soot, that the Common Blue and, for the most part, the Orange Tip persisted, albeit in small numbers, during the period of lowest faunal diversity. Both extended westwards when levels of these contaminants declined.

That atmospheric pollution affected the Lepidoptera of the Huddersfield area around the time of the extinctions is shown by the spread of melanic forms among the local moths. The *carbonaria* form of the Peppered moth *Biston betularia* appeared and began to spread at about this time, and the appearance and increased incidence of melanics in many other species subsequently became a feature of the area. Some time lag between cause and effect was inevitable, so the increased incidence of melanism would be after the stimulus of pollution, particularly smoke and soot, began to make itself felt. Of species of which melanic forms later became common, Porritt (1906) noted the breeding in the 1860s of a single black individual of the Mottled Grey, *Colostygia multistrigaria,* and knew of two locally obtained black individuals of the Mottled Beauty, *Alcis repandata* from at least as early as the 1850s, and suggested that the melanic form of this species "may even have been common long before we noticed it". The increased incidence of melanic forms was clearly correlated with the deposition of soot. Melanism favoured survival.

It may be argued that melanisation was not a direct response to pollution but an adaptation driven by predation. Even if this were so the spread of melanic forms would not have happened had the environment not been contaminated by soot. It was therefore a response to environmental change, brought about by pollution, even if the mechanism was indirect. The effects of pollution were deleterious: they rendered the moths conspicuous. Melanism granted protection against predators. In fact larvae of the *carbonaria* form of *Biston betularia* enjoy a 20% selective advantage over those of the pale form and, in contaminated environments, melanic forms of several species are hardier than the normal form which suggests some physiological advantage in these situations.

It is not proven that acid rain or the dry deposition of sulphur have deleterious effects on butterflies, though, acting mostly on their larvae, this would not be surprising. Soot, with its attendant toxins, is a more obvious candidate. Although the amount of smoke had been reduced by the 1930s and 1940s, even in 1947 some 242 tons of soot per square mile were deposited in the Borough of Halifax. In more comprehensible units this was 2.8 oz. per square yard (*c.* 95 g m^{-2}). Vegetation in many parts of the area was still covered by a layer of soot, being particularly in evidence on evergreen leaves, such as those of the Holly, to which its tar content ensured tenacious adhesion. It is worth noting that the extinction of a species such as the Meadow Brown was not confined to the immediate vicinity of the many industrialised and urbanised parts of the area but occurred also in a place like the semi-rural Skelmanthorpe, which received its share of soot, the amount varying according to weather conditions.

A matter we believe to be of great importance is the relative influence of two kinds of pollution. SO_2 levels were lower in the 19th than in the 20th century, during which they continued to rise for many years, power stations being major contributors in some areas. Levels of smoke and soot, however, were very high in the 19th century, and dominated the pollution scene. Although extinctions in industrialised regions can be correlated with high levels of SO_2, as they were by Barbour (1986), those around Huddersfield can just as readily be correlated with high levels of smoke and soot, though these now defy precise quantification. Timewise, the correlation is indeed better than with SO_2 levels. In fact recovery of the butterfly fauna began, and continued, during a long period of *increasing* levels of SO_2 (Figure 4). This suggests that smoke and soot had more deleterious effects than SO_2 and oxides of nitrogen, a matter elaborated below. It was also to soot-blackening of the environment that many moths responded by becoming melanic. Furthermore, and highly significant, is that the *localised nature* of events is much more readily attributable to smoke and soot, than to gases such as SO_2. The former disperse for relatively short distances: the latter more widely, as Scandinavian recipients of SO_2 produced in Britain and elsewhere in Europe are painfully aware. Acid yielding gases may, of course have aggravated the situation.

That pollution may have been a major cause of the extinctions need not deny the vagaries of climate a role in the decline. A period of particularly heavy pollution, with a persistent, dense smoke pall, in a windless but wet period, at a time of year when several species were particularly vulnerable, e.g. when egg-laying, could have had adverse effects. If this happened several times within a few years the effects may have been lethal. Of this however, there is no proof. Further east, warmer and drier summers already provided less stringent conditions, sunshine reduction by smoke, and soot deposition, were less, and somewhat lower doses of acid rain (a reflection of lower rainfall) may have been more easily counteracted by more alkaline soils.

The 20th century recovery and late resurgence

The recovery of several species, if not in such a dramatically synchronous manner as their decline, and the colonisation of the area by others, also suggests the involvement of a common factor or complex of factors. Both climatic amelioration and reduced levels of atmospheric pollution may have been involved. Although the vegetation remained less diverse than a century or more earlier, recolonisation showed that it remained suitable for many of the species that had become extinct. Air quality improved in some respects, but not in others, even before the end of the 19th century. At that time emission of black smoke from mill chimneys was restricted to 5 minutes per hour but, while this had some effect, the regulation was often flouted. Nevertheless, coal-smoke pollution had already passed its peak by about 1927, and Ferguson & Lee (1983) record that in several towns the "total deposited matter" in the gauges installed to measure this had fallen by 50% or more since 1914. Levels of smoke and soot deposition continued to fall following the gradual replacement of steam engines by electric motors, the implementation of the Clean Air Acts of 1956 and 1968, and later by a significant change from coal to other fuels and a decline in the textile industry. To those who remember conditions in the still recent past, today's clean air is little short of a miracle.

Notwithstanding reductions in the levels of smoke and soot, there was not much change in the deposition of sulphur as sulphate in the area between 1929 and 1954, even though by

1954 SO_2 levels had fallen nationally about 10% below the 1939 level (Ferguson & Lee 1983). In the next 25 years, however, SO_2 levels fell rapidly in the area but, as indicated by the figures for Holmfirth in 1962/3 and 1969/70 cited in the previous section, they remained substantial. Levels then fell markedly. For example, in 1952 the mean SO_2 concentration at Slaithwaite was in excess of 250 $\mu g\ m^{-3}$; by 1978 it was about 80 $\mu g\ m^{-3}$ and at Holme Moss in 1979/80 the mean concentration was 46.8 $\mu g\ m^{-3}$.

There was a slow net gain of five species of butterflies between about 1900 and 1980. The comings and goings of the Holly Blue and Comma also showed that environmental conditions were suitable for one or both of them at times in the 1940s, 1950s and 1970s (Figure 2). By the end of the century, by which time pollution by both soot and smoke and acid-producing gasses had been reduced, additional colonisers, would-be colonisers, and re-colonisers brought the total to 23 species (Figure 4).

Various lichens have returned to the West Yorkshire conurbation as a direct result of these improvements in air quality (see Seaward & Henderson 1999 and references therein). The relationship between butterflies and air pollution is likely to be more complex than that involving these sensitive and directly influenced organisms, but improvements could hardly have been other than beneficial. We suggest that early returning species, such as the Meadow Brown and Small Heath, were helped by a reduction in the amount of smoke and lower levels of soot deposition. Conditions in some respects were better when species such as the Large and Small Skippers colonised the area than they were 30 years earlier, which may have facilitated their spread. (Note, however, that these two species were not present even in the 1840s.)

Ferguson & Lee (1983) believed that, notwithstanding the fall in sulphur dioxide levels, the acidity of rainwater in the southern Pennine area was still increasing in the early 1980s, being "substantially more acidic than it was in 1950-1954" and that levels of sulphate in rural rainwater had not declined. This suggests that smoke and soot were more serious hazards to butterflies in the past than was SO_2. More recently there has been a reduction in the acidity of rainwater. A conspicuous sight in the 1940s, now gone, was a brown plume of nitrogen dioxide issuing from a chimney in a chemical works at Deighton just outside Huddersfield – and adjacent to it the vegetation–denuded Kilner Bank. The latter is now wooded. Tree planting took place elsewhere and there was regeneration of Birch and Willows in some places. Whether most butterflies have yet benefited is questionable, though the Speckled Wood in the Colne Valley may be an exception. Such changes are, however, indicators of improved environmental wellbeing. The adverse effects of house building were to some extent offset by an increase in the number of gardens. On the debit side were increased emissions from motor vehicles, now a major source of oxides of nitrogen, which for some years deposited lead, particularly near roads. Indeed there was a sharp increase in the amount of lead in the environment from about 1940 onwards, due mainly to the combustion of Pb alkyls in petrol, but levels have now been much reduced. There was also an increase in organochlorines until their withdrawal, but levels were probably much lower than in predominantly agricultural areas. Even now, however, there is probably a greater use of pesticides in the area than was the case at the time of the 19th century decline.

The climate of Britain showed a slight but steady amelioration between about 1895 and 1950, and Heath (1974) suggested that this may have been conducive to range expansions of butterflies. As Dennis (1977) pointed out, when short periods of national expansion of several species are coincident, as of the Wood White, Comma and White Admiral that culminated in the 1940s, purely local events are unlikely to be the cause, and climate probably played a part. Nationally there were extensions of range and increases in abundance of several species in the 1970s and 1980s. Not all species that extended their range increased generally in abundance, while some that showed no expansion of range did so. Pollard *et al.* (1995) provide details and suggest that changes in weather were involved.

An obvious candidate for association with the late 20th century colonisation and recolonisation of the Huddersfield area is global warming, the reality of which is now widely accepted. A general increase in temperature in the last two decades of the 20th century is now an established fact, and biological consequences in Britain, such as breeding earlier in the year by birds, are already apparent. Particularly pertinent is that, of 35 non-migratory species of European butterflies for which adequate information is available, 63% have ranges that shifted northwards between 35 and 240 km during the 20th century, and only 3% shifted to the south. The southern boundary moved northwards in the previous 30-100 years in 22% of these species, remained stable in 72%, and extended south in 5% (Parmesan *et al.* 1999). It is a reasonable inference that a warming climate assisted recent colonisations of the Huddersfield area, though, save in the case of the Comma, this was not a direct result of a northward spread. While climatic amelioration may have helped such species as the Hedge Brown, Ringlet, and White-letter Hairstreak to extend their range, (even though the last-mentioned species is suffering reduction of its larval food plant – Elms), recolonisation began by some species before global warming gained impetus. The Meadow Brown and Small Heath anticipated this phenomenon by 50 years or more.

A prerequisite for recolonisation is a reservoir of the species concerned in reasonable proximity to the area involved. What constitutes "reasonable proximity" depends on mobility and other biological attributes and differs from species to species. Thomas *et al.* (1992) showed that several uncommon British species, none represented in the Huddersfield area, disperse slowly. The Silver-studded Blue, *Plebejus argus* was found only in habitat patches within 1km of other populated patches, and the Black Hairstreak, *Satyrium (= Strymonidia) pruni*, often takes two to three years to colonise patches within 300 to 700 m of occupied areas, the maximum one-step colonisation recorded being only 1.4 km. Several of the species lost from the Huddersfield area, or that have recently arrived there, were long resident not far to the east. Their failure to colonise until recently seems not to have been because of slow crossing of barriers between habitat pockets as they often spread rapidly when expansion began. This suggests former exclusion by locally prevailing conditions rather than limitations of dispersal ability. Recolonisation by such a species as the Wood White, whose range greatly contracted in the 19th century, then expanded, but of which there is no reservoir within 80 miles (*c.* 130 km), is unlikely at present even if suitable habitats are available. The ability of the Holly Blue to migrate has clearly enabled it to return and to spread rapidly within the area.

Returning species may not only have different, and better adapted, genetic constitutions than their lost predecessors, but may even exploit slightly different niches. Possible examples have been described among the lichens currently recolonising the conurbation of which some of the area is a part. Some species are extensively occupying microhabitats from which they were previously not recorded (Seaward & Henderson 1999). Similar subtle changes may have taken place in the butterflies involved.

Testing the hypothesis

A great problem when seeking explanations of ecological changes is that often no control is available. A control exists in the case of the 19th century extinctions of butterflies in the Huddersfield area. Most of the extinctions were a *local*, not a national, or even a regional phenomenon. Some of the species that were lost over a short period continued to exist in areas less than 30 miles to the east and south-east.

Comparison of events in the Huddersfield area with the recent history of the White Admiral, *Ladoga camilla* (L.), a species never recorded there, throws light on the matter. The range of this species contracted and by 1930 it was largely confined to Hampshire and a few sites in Essex. Between then and 1942 it greatly expanded. An explanation was sought by Pollard (1979). The expansion coincided with the longest run of warm Junes in the century up to that time. These high temperatures led to rapid development of late instar larvae and pupae and reduced the time they were available to predatory birds (the reverse of the effects of smoke). Pollard also believed that the abandonment of coppicing in woodland had increased the area of suitable habitat, which contributed to the spread. June 1972 was as cold as any previous June in the century yet the White Admiral was plentiful in 1973 at

Monks Wood (where its ecology was studied). Pollard suggested that, just as he believed habitat improvement *and* favourable weather were necessary for colonisation, "local extinction is likely only if habitat suitability declines, when the timing of extinction may be determined by a period of unfavourable weather". No controls were available to test these suggestions. In the Huddersfield area extinctions and declines of several species occurred quickly and more or less simultaneously. As shown by subsequent events habitat destruction was not responsible: even though degraded, habitats remained suitable long after the extinctions. However, their quality certainly suffered temporary deterioration as a result of reduced sunlight, the deposition of soot, and perhaps the effects of other pollutants.

A control exists that rules out climatic changes as having had an over-riding influence, and which appears to implicate the deleterious effects of pollutants. In nearby eastern areas subjected to the same climatic regime (though always drier) but where levels of pollution and soot-fall were lower, no such extinctions occurred. Recolonisation took place at a time when, in terms of plant diversity, habitats were less satisfactory than those originally frequented, and availability was less, but pollution had been reduced. In the case of some species this happened before global warming began. It was suggested that range expansion of the White Admiral was facilitated by habitat improvement. The only habitat improvements in the Huddersfield area were reduced levels of pollution, initially of soot-fall, and increased amounts of sunshine as the amount of smoke declined. Such facts strongly suggest that atmospheric pollutants, especially smoke and soot, played a major role in the 19th-century butterfly extinctions around Huddersfield, and that reductions in pollution levels subsequently facilitated recolonisation of what in other respects were somewhat degraded habitats.

In support of this belief are:

(1) The virtually simultaneous extinction of several species of butterflies in a restricted area is an unusual phenomenon, and cannot be related to climatic or natural ecological changes.

(2) Barbour (1986) showed that extinctions of butterflies in Britain can be correlated with atmospheric pollution, and the dearth of certain species in industrial areas in Europe has been attributed to pollution by some continental workers.

(3) 19th-century industrial development in the Huddersfield area was accompanied by atmospheric pollution, including sunshine-reducing smoke, and additional pollution, not least smoke and soot, was received from south-east Lancashire. Contamination from the latter source is generally acknowledged as having exterminated lichens, mosses, liverworts and various angiosperms. Within the space of a few years during this period several species of butterflies became extinct (as did certain moths) and others declined in abundance.

(4) These extinctions were local in nature: the same species persisted in not too distant, less polluted, areas to the east and south-east.

(5) The moths that suffered extinction included a disproportionately large contingent of day-flying species. Like sunshine-dependent butterflies, these may have been affected by reduced sunshine levels caused by a persistent smoke pall.

(6) That industrialisation had marked effects on Lepidoptera is shown by the reaction of more than 40 species of moths in the area that produced melanic forms.

(7) In relation to their climatic merits industrial Yorkshire and Lancashire were deemed "exceptionally unfavourable" to butterflies in the 20th century (Turner 1986). However, before the industrial revolution the Huddersfield area had twice as many species as it did at the beginning of the 20th century.

(8) Timewise there is a better correlation of extinctions with high levels of smoke and soot than with those of SO_2.

(9) Smoke and soot are dispersed for shorter distances than acid-producing gases, and more readily explain the localised nature of the extinctions.

(10) Several species of butterflies recolonised the area as pollution levels, especially of smoke and soot-fall, declined.

(11) Colonisation began when levels of smoke and soot-fall began to decline, but while those of SO_2 were still rising, indicating that smoke and soot had more deleterious effects than SO_2 and oxides of nitrogen.

(12) Reduced smoke levels led to an increase in the amount of sunshine received, and therefore also to higher temperatures at ground level during periods of sunshine.

(13) Colonisation and recolonisation occurred in the face of un-ameliorated environmental deterioration in terms of reduced plant diversity, and even though habitats had been reduced in extent and fragmented.

(14) The recovery parallels a similar recovery of lichens that has been convincingly attributed to reduced pollution.

(15) Towards the end of the 20th century, when atmospheric conditions were much improved, several previously unrecorded species colonised the area, some becoming common. The latter part of this phase may have been facilitated by global warming.

Consistent with this belief is the tolerance by several freshwater crustaceans of high levels of acidity in pollution-free areas (p. 97). While climatic warming may have assisted recovery towards the end of the 20th century, it was clearly not the key factor in this process, and certainly not in its early stages.

This explanation is not proven, but there are better controls than is usually the case when explanations of ecological changes are sought, and it appears to be consistent with the facts. No feasible alternative explanation has suggested itself. If the suggestion is correct, it is possible that similar extinctions took place in other industrial areas at the same time as they did around Huddersfield. Places near Manchester and Oldham suggest themselves. Events around Greenfield-Saddleworth hint at this possibility. Here, isolated from the rest of the Huddersfield area to all save the Small Heath and migrants, some common species were for long lacking. The area was exposed to the smoke, soot, and other pollutants of the adjacent Manchester conurbation rather than to those of the West Riding. Here the Wall appeared in 1977, the Orange Tip about 1981 or a little earlier, the Meadow Brown in 1983, and the Speckled Wood in 2000 (L. N. Kidd). Is it possible that, just as Mosley reported his observations in a local journal, some contemporary naturalist did the same for another area? If such a report can be found, either here or, perhaps a little later, in Germany, Belgium or Poland, where similar events may have taken place, proof would be provided.

Relevant range changes in other insects

Whatever factors have been responsible for the resurgence of butterflies may also have affected other insects. A study of the moths that suffered local extinction would be enlightening. Some have certainly returned. For example the Forester was seen near Flockton in the early 1950s (E. W. Aubrook & G.F.). The Common Field Grasshopper, *Chorthippus brunneus,* invaded the Huddersfield area from the east in the late 1940s (Fryer 1953). Whether it previously occurred in the area and disappeared at the same time as several species of Lepidoptera is unknown. No records appear to exist for this period.

Certain dragonflies have also colonised the area in recent years, or are currently doing so. A survey from 1984 to 1991 showed the Brown Hawker, *Aeshna grandis,* to be established there (Lucas 1992). It was indeed described by Cain (1997) as "the most common large dragonfly" in the Halifax area, yet, as he remarked, in 1901 the occurrence of a single individual merited special mention. The Common Emerald, *Lestes sponsa* was also found in the Huddersfield area for the first time (Lucas 1992), and a breeding colony was located at Cromwell Bottom in 1996 (Cain 1997). The Ruddy Darter, *Sympetrum sanguineum*, a southern species in Britain, (but known north of the area before 1961) was also found for the first time, at two sites, in 1992 (Cain 1997). If an overall controlling factor is involved in recent range extensions, dragonflies, which have aquatic larvae, may be particularly informative. Industrial pollution affected aquatic as well as terrestrial environments in the area. Colonisation of the area by the Emperor, *Anax imperator*, a southern species (Lucas & Lucas 2000) may, however, be related to global warming.

Some Final Observations and Reflections

This history of a localised butterfly fauna dramatically reveals its dynamic nature. Within a century and a half several species declined to extinction and, while some never returned, others recolonised and became common and widespread. Others, previously unknown in the area, colonised it. Yet others have been present throughout its recorded history but have undergone fluctuations in abundance. The enquiry also revealed that some of the changes were confined to a relatively small area. Had a larger unit been the focus of attention, losses, gains, or changes in abundance in adjacent areas may have obscured a more dynamic series of local events.

The exercise would have been impossible had not several generations of naturalists recorded their observations and had these not been preserved for posterity by a variety of organisations. In particular, had it not been for summaries by Hobkirk (1859, 1868), Mosley (1883) and Wattam (1936), and manuscript notes such as those of Morley, it would have been scarcely possible to reconstruct changes in the fortunes of individual species with the degree of precision that has been achieved. In particular, Mosley (1883) recorded what must be among the most remarkable and rapid series of changes in local populations of several species of British butterflies ever to be observed. It is particularly fortunate that, more than half a century later, Wattam (1936), using Mosley's work as a landmark, recorded some of the subsequent changes. If it does nothing else, this overview emphasises the value of accumulating over long periods of time, records of the status of the species that occur in restricted areas. The commonest species are often particularly informative. Continuous monitoring can reveal changes as they take place and enable explanations to be sought as events unfold, perhaps aided by experiments such as habitat manipulation. It is also potentially valuable for conservation, and throws light on the biology and ecological requirements of individual species.

While not unexpected, the changes demonstrate the effectiveness of the Pennines as a barrier to the dispersal of various butterflies. They also indicate that, save for the small area west of this barrier, whenever colonisation or recolonisation, of the Huddersfield area took place it was essentially from the east and south-east. The records also point to the importance of the Calder Valley as a highway for butterflies. From Wakefield westwards it is readily accessible from the south to the point where it receives the Colne, west of which urbanised, industrialised Brighouse is the only substantial barrier, and one that was less so when, for example, the Meadow Brown extended its range. It can still be circumvented to the south. Here, not only are habitats of various kinds provided by terrain adjacent to the river, but the valley hosts a canal and a railway with accompanying tow paths, embankments and open spaces, that to some extent at least form corridors even in built-up areas. West of Brighouse a variety of terrain extends to Sowerby Bridge, approaching which, although the valley becomes narrower and steeper-sided, various low-lying, sheltered habitats are available. Indeed, here it probably acts as a funnel whose steep sides tend to confine certain butterflies to the valley bottom.

The increase in butterfly diversity towards the end of the 20th century, while known elsewhere, runs counter to the trend of impoverishment now often reported for many plant and animal groups. While offering no grounds for complacency, it at least suggests that in areas formerly subjected to environmental degradation and afflicted by heavy pollution, amelioration of these conditions, perhaps aided by climatic warming, provides the opportunity for at least some groups of animals to increase in diversity, and for some species to re-occupy habitats from which they earlier retreated, just as lichens are currently doing. Habitats may be less diverse than originally but can still support many of the butterflies that formerly occurred there. They can also accommodate species hitherto unknown in the area. Both recolonisation and establishment for the first time demand the presence of populations in reasonably close proximity, from which colonists can be drawn, though highly mobile species are to varying degrees free from this constraint.

The situation shows how little we understand the biology of individual species. As recently as 1984 three experts (Heath *et al.*) suggested that without improved knowledge of their ecology and the means to apply it "another twenty years will see a further drastic decline" in our butterflies. The need for knowledge remains but their prediction has proved very wide of the mark.

Many challenges remain. It may be too late to solve conclusively such problems as why the Large and Small Skippers, both of which occurred very near the eastern borders of the area, never colonised it (and were never even recorded as strays) in the 19th century, yet did so more than a century later. Others may be more tractable. For example, it may be possible to ascertain why the Hedge Brown and Ringlet were able quickly to colonise the Harrogate area but made slower progress around Huddersfield. Were the environmental consequences of industrial pollution still exerting deleterious effects around Huddersfield? Or is the somewhat sunnier climate of Harrogate (almost 14 minutes a day more than Bradford in May, June and July) sufficient to explain the difference? Another challenge is to explain why so many species colonised the area towards the end of the 20th century in spite of a continuing loss of habitats as human populations grew. Is it possible to determine the roles of global warming, continued recovery of the environment from contamination, or to pin-point other changes? There is also no species in the area about whose ecology and habits in relation to local conditions more cannot be learned.

The enquiry has exploited a group of insects with a manageable number of species that has attracted continuous interest and the accumulation of information over a period of more than 150 years. This made it possible to consider the entire local fauna. While other groups may provide more difficult material, comparable studies, even of single species, would be valuable. Information on how they reacted at particular times, compared with what has been gleaned for butterflies, may cast light on some of the matters that remain unresolved, or about which we can make only guesses. We hope too that future recording might be encouraged with a view eventually to assessing changes in the butterfly fauna during the next 150 years. Such recording should aim to provide those who might assay this task with more comprehensive data than those with which we have had to work.

Conclusions

The butterfly fauna of the Huddersfield area has undergone many changes since the mid-19th century. Probably always depauperate, it suffered a dramatic series of extinctions between about 1865 and 1870, remained much impoverished for the next half century, then slowly increased in diversity before doing so at an accelerating rate towards the end of the 20th century. Some, but not all, of the species that became extinct in the 19th century returned, and several species not previously recorded colonised the area, and in some cases became abundant.

Many of the extinctions were restricted to a very limited area. Assessment of the evidence suggests that, contrary to what most British lepidopterists have believed, a prime cause of these events was the pollution that accompanied industrial developments in this and adjacent areas. They were not the result of environmental destruction (the most commonly suggested explanation of extinctions of butterflies in Britain) because, even though degraded, fragmented, and reduced in area, the habitats concerned proved suitable for a wide range of species that colonised or recolonised the area as levels of pollution declined. The evidence suggests that smoke and soot were more deleterious than sulphur dioxide and oxides of nitrogen, which may, however, have contributed synergistically. Because of the localised nature of the changes, events in nearby, less polluted areas, serve as controls against which to test this hypothesis. Such controls are seldom available when explanations are sought for historical changes in ecology. Soot and smoke do not disperse as readily as gases and their effects are more localised. Climatic warming may have assisted colonisation towards the end of the 20th century.

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Photographic Plates

Readers of *The Naturalist* will have noticed that the number of photographic illustrations has increased in recent years. Good clear photographs, suitably captioned, to accompany articles or as independent features are always welcome.

To encourage this development, a long-standing member of the YNU, who wishes to remain anonymous, has most generously offered to make a donation, the income from which would finance the publication of a plate or equivalent illustration in future issues whenever possible. The editor, on behalf of the YNU, wishes to record this deep appreciation of this imaginative gesture.

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THE COMPOSITION AND DISTRIBUTION OF MIXED HEDGES IN EAST YORKSHIRE*

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Introduction

The publication of a book on hedges by Pollard *et al.* (1974), stimulated a countrywide interest in the subject amongst both biologists and local historians. Much of the book is devoted to the research done in East Anglia by the authors themselves and they point out that early in their studies they noticed that "hedges tend to be either fairly pure, usually hawthorn or elm, or else rather mixed". After postulating that "the older the hedge the more shrub species it would have" they go on to develop their well-known hypothesis that a hedge can be dated from the average number of species of shrub it contains in a 30-yard section.

Whether or not one accepts this hypothesis, the value of a hedge biologically and from the viewpoint of wildlife conservation increases, other factors being equal, as the number of shrub species increases. In a region of intensive agriculture such as East Yorkshire, hedges are a particularly valuable resource for wildlife conservation but, so far as is known, the only work that has been published on them is that by Boatman (1975, 1980).

The paper published in 1980 is based upon a survey of 117 "mixed" hedges, i.e. those containing 4 or more species of shrub, in East Yorkshire (VC61). In this survey, however, only presence was noted and no restrictions were placed on the length of any hedge. Since, from the viewpoint of wildlife conservation, the value of a mixed hedge is likely to vary with the amounts of the various species it contains, it was decided, in the mid-1990s, to undertake another survey during which the species would be assessed quantitatively.

Of the 117 hedges included in the earlier survey only 75 were incorporated into the current one. Of the rest, 13 had been uprooted, 6 to make way for the bypass on the south side of Beverley, and 11 were considered to be too short. The remainder were discarded because they were composed mostly of a single species or were indistinct from an associated area of scrub.

In order to make the current survey as complete as possible, many routes and tracks which had not previously been visited were explored. This resulted in the discovery of another 95 suitable hedges so the current survey is based on a total of 170 hedges.

Methods

As in the 1980 study, a hedge was defined as one side of a field and only those hedges containing four or more woody species were surveyed. The criterion used for estimating the amounts of woody species in a hedge was frequency. This was determined by recording the species present in each of twelve contiguous lengths of 10 metres (10 paces). This number of lengths was selected so that an average value could be obtained for the number of species present in 30 m lengths, approximately the length recommended by Pollard *et al.* (1974), for estimating the age of a hedge and therefore widely recorded.

Ideally, the survey would have included herbaceous as well as woody species but in practice these would have been very difficult to record. More than one visit to each hedge would have been necessary and anyway many of the hedges were on the far side of a deep ditch. Once grasses, Cleavers (*Galium aparine*) etc. had become well established, it would have been difficult to get close enough to make a sufficiently detailed examination of the hedge bottom.

Individuals of the genera *Rosa*, *Salix* and *Ulmus* are notoriously difficult to identify

* Developed from a poster originally presented at the YNU's Conference on "Recording and Monitoring Yorkshire's Natural Environment", Harrogate, 26 February 2000.

accurately. Either more than one visit is desirable to acquire material in an appropriate condition for identification or material from mature stems (usually not available in hedges) is required. So far as *Salix* is concerned, features characteristic of *Salix cinerea* appeared to be conspicuous in most of the individuals encountered, the roses appeared to belong either to the section Caninae or the species *Rosa arvensis* and the elms appeared to be referable either to *Ulmus procera* or to *U. glabra*. More accurate identification of hybrids or microspecies was not attempted.

The frequency data were analysed using TWINSPAN. Since the programme cannot handle data with quantitative values in excess of 6, the frequency values were grouped in pairs for the analysis.

For wildlife conservation the value of a hedge is influenced by its physical structure and that of various associated features such as ditches and grassy strips as well as its composition. A scheme whereby various features of importance for wildlife conservation can be scored and the scores summed to give an overall figure for the conservation value of the hedge has been devised by Clement and Toft (*pers. comm.*) and this scoring system was applied to the hedges in the current survey. Overall figures are not presented, however, only information on some of the features.

Results

Types of location

There are three main geomorphological areas in East Yorkshire: the postglacial lake bed of the Plain of York, the chalk Wolds and the boulder clay covered Plain of Holderness. Between the west-facing scarp of the Wolds and the Plain of York is a band of Jurassic rocks which, especially in the north, forms low hills. The distribution of the hedges according to these features was as follows:

Plain of York:	58 hedges
Jurassic beds:	15 hedges
Chalk Wolds:	14 hedges
Plain of Holderness:	83 hedges

A map showing the number of hedges found in each 4 x 4 km grid square is presented as Fig. 1.

The great majority of the hedges recorded were alongside unclassified roads (Table 1) but several were found alongside green lanes. After a roadside hedge had been recorded, the other boundaries of the field were often superficially examined from the road, sometimes through binoculars when the field was large, but these boundaries rarely consisted of a species-rich hedge. Of the 13 "field boundary" hedges recorded for Holderness in Table 1, most were alongside public footpaths.

TABLE 1.
Location of the mixed hedges recorded in East Yorkshire.

Location	Plain of York	Wolds + Jurassic	Holderness
"A" class road	0	3	2
"B" class road	5	1	0
Unclassified road	50	19	58
Field boundary (not alongside road)	1	5	13

Species frequency and distribution

In Boatman (1980) a list is given of the species that occurred in more than 2% of the total number of hedges recorded in the first survey. All were present in the hedges included in

FIGURE 1.
Distribution of the mixed hedges recorded in East Yorkshire. Each number represents the number of hedges recorded in a 4x4 km square.

the current survey. Additional species, with the number of hedges in which they were recorded, were *Euonymous europaeus* (4), *Fagus sylvatica* (2), *Populus x canadensis (3), Prunus avium* (3), *Prunus institia* (11), *Prunus padus* (1), *Ribes rubrum* (1), *Ribes uva-crispa* (4) and *Salix viminalis* (1).

Boatman also presents estimates of the percentage of hedges in which each of the species occurred in the Vale of York, on the Wolds and in Holderness. In the second survey the percentages differed to some extent from those obtained in the first so, in Table 2, the results of the two surveys are compared for those species which were represented in 10% or more of the hedges visited in the first survey and which, in the second, differed from the first by ±10% or more for one of the three regions. In Holderness the percentage occurrence for all seven species was within ±10% of that obtained in the first survey but in the Plain of York the percentage occurrence in the second survey differed from the first by more than ±10% for five of the species. For most of these the values obtained in the second survey were more similar to those obtained in Holderness, probably because 47% of the hedges were located on clayey soils compared with 35% for the first.

Although most of the species shown in Table 2 are widely distributed in at least one of the regions, only two, Hawthorn (*Crataegus monogyna*) and Blackthorn (*Prunus spinosa*), commonly occur with a high frequency. In Fig. 2 the frequency ranges of the 10 most common species are shown for Holderness and the Plain of York separately. Here the pairs of blocks above zero represent the proportion of hedges from which the species was absent and it can be seen that, where they are present, most of the species are generally represented by frequencies within the range 1 to 4.

TABLE 2.
Percentage occurrence of selected species (see text) in surveys undertaken in the 1970s (1) and in the 1990s (2), the number of survey 1 hedges used and discarded for Survey 2 and the total number of hedges in each survey.

Species	Plain of York Survey		Wolds and Jurassic Survey		Holderness Survey	
	1	2	1	2	1	2
Acer campestre	17	28	35	52	80	82
Alnus glutinosa	40	28	0	0	0	0
Corylus avellana	40	53	75	55	78	84
Fraxinus excelsior	70	76	50	65	76	69
Malus sp.	47	45	5	17	18	14
Prunus spinosa	50	76	80	86	95	99
Sambucus nigra	23	33	85	90	79	70
Number of hedges						
Survey 1 hedges included		21		17		37
Survey 1 hedges discarded		9		3		30
Total hedges in each survey	30	58	20	29	67	84

As shown in Fig. 3, TWINSPAN separated the 170 hedges into two major groups as follows:

Group I – Field Maple (*Acer campestre*) and/or Elder (*Sambucus nigra*) present (140 hedges)

Group II – Field Maple and Elder absent (30 hedges)

Subsequent divisions of Group I were based principally on the frequencies of one or more indicator species but it so happens that the group of 24 hedges on the right hand side cannot be separated from that of 29 hedges on the left hand side, and from other groups, by the frequencies of less than 3 species.

These two groups have therefore been amalgamated. Thus the groups adopted are as follows:

Group 1A – Elder common – abundant (frequency 3+) – 38 hedges

Group 1B – Hazel (*Corylus avellana*) common – abundant (frequency 5+) – 49 hedges

Group 1C – Frequency of Hazel and Elder low – 53 hedges

Group IIA – Alder (*Alnus glutinosa*) present ± Common Sallow (*Salix cinerea*) 13 hedges

Group IIB – Common Sallow present ± Birch (*Betula pubescens*) – 17 hedges

Within Group 1B is a sub-group (Group IB1) of 12 hedges with a relatively high frequency (3+) of Dogwood (*Cornus sanguinea*).

The distribution of some of these groups is shown in Figs 4 and 5. All of the Group II hedges were in the Plain of York, either just east of the River Derwent which, in East Yorkshire, runs mostly between Eastings 69 and 71, or in the neighbourhood of the Pocklington Canal, which extends east-west between northings 44 and 46 (Fig. 4). Most of the Group 1B hedges were in Holderness between the eastern side of the Wolds and a line extending through Cottingham, Beverley and Leconfield (about 4 km north of Beverley) though there were a few in the Wolds and in the Plain of York amongst the Group II hedges (Fig. 5). The Group IB1 hedges were almost all in Holderness, mostly in the northern part of the range of the Group IB hedges (Fig. 4).

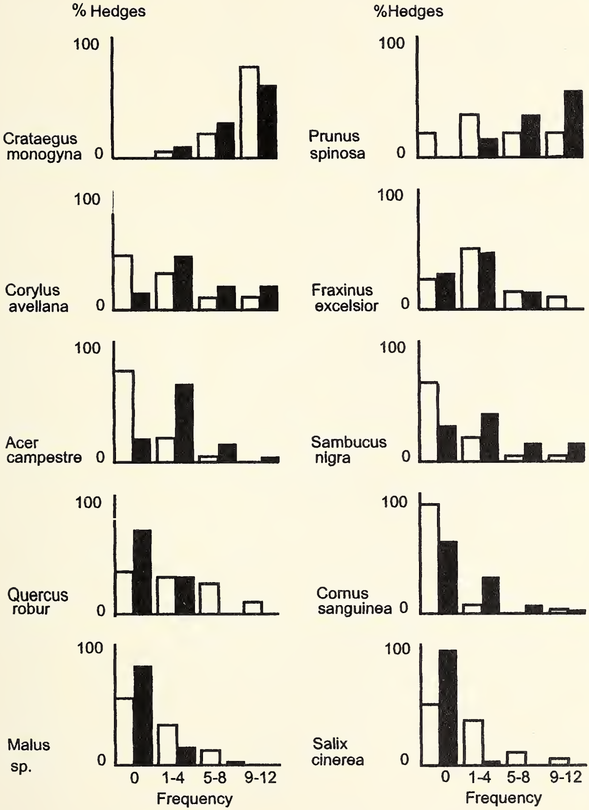

FIGURE 2.
Frequency distribution of each of the ten species most commonly recorded in the mixed hedges of East Yorkshire. Open columns represent the % frequency with which a species occurred in 0, 1-4, 5-8 and 9-12 hedge sections in the Plain of York and filled columns in Holderness.

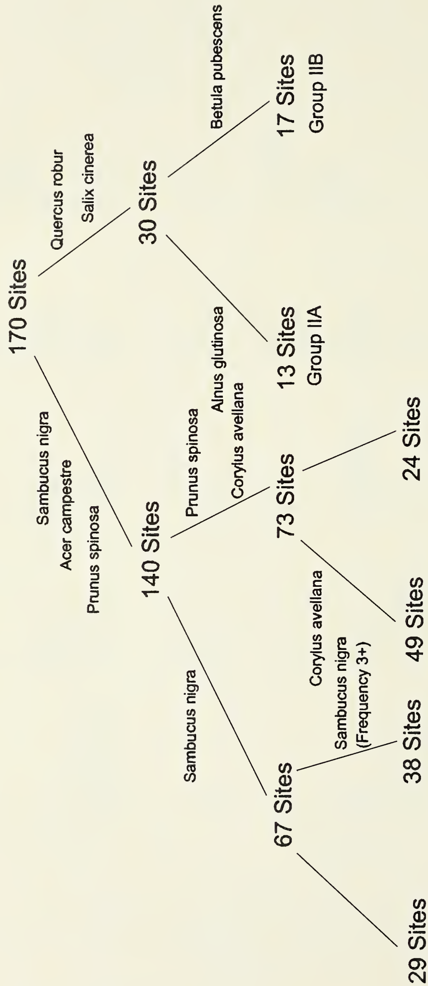

FIGURE 3.
Dendrogram showing the separation of hedges into 5 groups by TWINSPAN (the two unlabelled groups were amalgamated). The indicator species for each dichotomy are shown except for the amalgamated groups.

FIGURE 4.
Distribution of hedges comprising Groups IIA (black numbers), IIB (open numbers) and IA1 (shaded numbers, one in the Wolds the rest in Holderness).

The remaining hedges, i.e. those in Groups IA and IC, were widely scattered in East Yorkshire, some from each group occurring in each of the geomorphological regions.

As can be seen in Fig 2. the distribution of species differed considerably between Holderness and the Plain of York. TWINSPAN also, at the first division, separated species into those that occurred only or with relatively high frequencies in the Plain of York and those that were widespread or were absent from that region. Species which were recorded only in the Plain of York and the number of hedges in which each was found were Alder (13), Alder Buckthorn (*Frangula alnus*) (4), Beech (*Fagus sylvatica*) (2), Birch (11), Broom (*Cytisus scoparius*) (5), Goat Willow (*Salix caprea*) (4) and Mountain Ash (*Sorbus aucuparia*) (6).

Although Field Maple is not represented in Group II hedges, it was recorded in 14 of those that were found in the Plain of York. The soils of this region vary from sands to clays and alluvial soils and Maple was recorded on all types. Nine of them, however, were on clays or alluvium.

In Fig. 6 the distribution of the mean number of species per 30 m of hedge is shown for the Plain of York and Holderness separately. In each region the greatest proportion of hedges contain 5-6 species per 30 m and the percentage occurrence declines progressively above and below this value.

Structural Features

Structural features were recorded for only 123 of the 170 hedges that were surveyed. In Table 3 the features that most clearly represent the structure of a hedge are presented.

FIGURE 5.
The distribution of hedges comprising Group IB (black numbers) and of those containing Holly (open numbers).

"Dendroid" hedges are those without branches on the lower part while "rectangular" hedges have branches almost to ground level. Some of the hedges, generally those with Blackthorn, had spread on to the roadside verge and these are recorded as "with outgrowths". Presumably the value of the hedges for wildlife conservation increases from left to right and top to bottom in the table.

TABLE 3.
Landscape features of 123 hedges in East Yorkshire.

Hedge form	Height (m)			
	<1 m	1-2 m	2-4 m	>4 m
Dendroid in section	6	23	11	4
Rectangular in section	2	31	22	3
With outgrowths	0	3	11	7
Totals	8	57	44	14

Other features which might be particularly important for wildlife are the presence of mature trees and the presence of a ditch. One or more mature trees were present in 36 of the hedges and a ditch was alongside 60 hedges.

Most of the hedges surveyed were complete. Gaps extending for 10% to 30% of the total length of the hedges, i.e. the side of the field, were present at only 6 sites while gaps

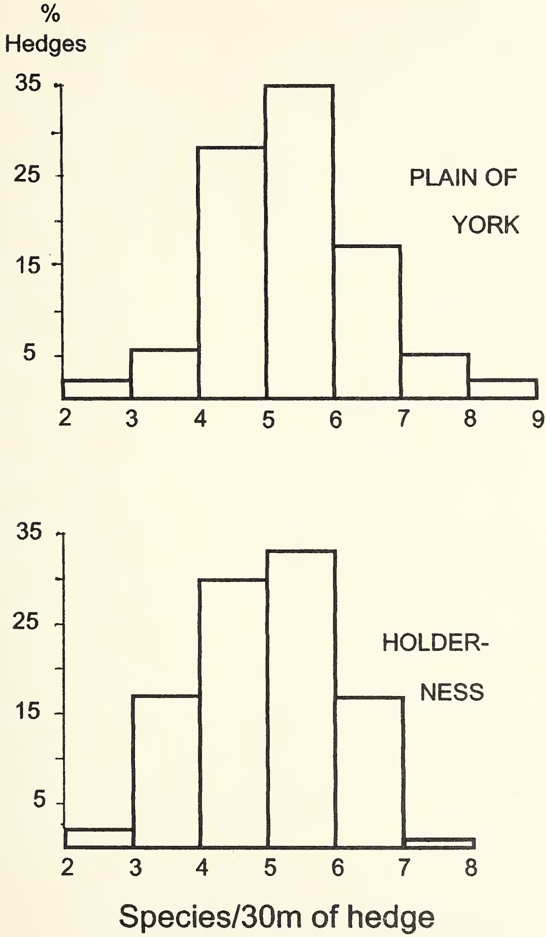

FIGURE 6.
Percent frequency distribution of hedges with means of 2-9 species per 30 m in the Plain of York and in Holderness.

extending for more than 30% occurred at only 4 sites. The gaps were ignored when recording the species present, i.e 120 m of complete hedge were recorded.

Discussion

It is now well established that there is an association between species-rich hedges and ancient countryside features such as old field boundaries, old trackways, former woodlands etc. (Hoskins, 1955; Pollard, *et al.*, 1974; Rackham, 1986; Muir & Muir, 1987) and this lends weight to Pollard, Hooper and Moore's hypothesis that it is possible to estimate the age of a hedge from the number of species it contains in a unit length. The hypothesis is supported by a number of authors, notably Rackham (1976, 1986) but, in their comprehensive review and analysis of the subject, Muir and Muir (1987) point out that "The theory of hedgerow-dating assumes an initial single-species planting" but that "evidence exists in abundance that old hedgerows were commonly planted as mixed hedges of several species". This, they understandably claim, invalidates hedgerow-dating as a practical technique.

No attempt has been made to conduct extensive documentary research into the relationship between the East Yorkshire hedges and ancient countryside features but, from information and maps published in the Victoria County History, Allison (1976) and Neave (1991) and from O.S. maps, it has been possible to relate 93 of the East Yorkshire hedges to ancient features. Sixteen are associated with former or existing woodlands, 8 are along or within the boundaries of mediaeval parks, 14 bound green lanes or old trackways, 15 form the boundaries of ancient enclosures and 32 are parts of parish boundaries. However, 4 are on land which, before 1755, was an open field and 12 are on land which was common pasture until, at the earliest, the beginning of the 17th century and probably until the middle of the 18th century.

If hedges were formerly planted as mixed hedges, it is likely, as suggested by Muir and Muir (1987), that species growing locally were used. Thus the hedges existing today might provide information about the vegetation growing in the locality at the time they were created. The accuracy of such information, however, depends upon the extent to which the current hedges resemble those originally planted. As shown in Figure 2, the only species that are widely distributed within the great majority of the East Yorkshire hedges are Hawthorn and Blackthorn but it seems unlikely that these species would have been used mainly and so consistently in the original plantings with only occasional representatives of other species.

In 1963 a long-term experiment was established at Monks Wood Experimental Station to investigate the extent to which the composition of single species and mixed hedges changed with time. Altogether 44 hedges each about 27 m long were planted and they have recently been re-examined by Downing and Sparks (1999). In many of the hedges Downing and Sparks were able to distinguish the original stems from those that had grown more recently and they claim that the most invasive species have been Hawthorn and Blackthorn. They also claim that "survivorship" of the original stems has been greatest for Hawthorn and Maple though their data show that it has been almost as high for Hazel. Unfortunately, however, these hedges have been severely neglected since they were established and had grown to a height of between 6 and 9 m. It must also be borne in mind that the hedges were growing in close proximity so there was a variety of seed available nearby for cross invasion.

In 1971 Pollard determined the species present in each 5 m section of a 1105 m length of Judith's hedge which is thought to date back to the 11th century. In 1998 the hedge was re-surveyed by Garbutt and Sparks (1999) who claim that there were sufficient permanent markers for them to be able to repeat Pollard's procedure. Garbutt and Sparks report that since Pollard's survey part of the hedge had been neglected and had grown to a height of 4–5 m. Along this part there had been a decline in the mean number of species per section whereas in the remainder, which had been regularly flailed, the number of species had remained more or less constant.

Thus there is evidence that the composition of a hedge can change over a short time-span relative to those hedges discussed here, at least when it is neglected and there are seed sources of various species closeby. There is very little information about the management of hedges in old documents dealing with agricultural practices in East Yorkshire though Latham (1794) mentions that the "vile custom of heading them at the height of three, four or even five feet prevails in many parts". Perhaps the best indication that the composition of the East Yorkshire hedges bears a relationship to that at the time of planting is the very localized distribution of some of the groups extracted by TWINSPAN but it is possible that the frequency of at least some of the species has changed. It can be envisaged, for example, that some individuals died, leaving gaps, and that the gaps were subsequently filled with Hawthorn or Blackthorn.

In this context there is a striking resemblance between the distribution of Groups IB and II hedges and the distribution of woodland at the time of the Domesday Survey as presented by Darby and Maxwell (1962). Here, in a map of East Yorkshire, the majority of the Holderness woodlands, including all of the larger ones, are shown occupying a zone between the Wolds and a line from Cottingham through Beverley to Leconfield while those of the Plain of York, though more widely scattered, occur predominantly in the western half of the region. The Groups IB and II hedges might therefore provide information on the type of woodland that existed at the time of the Domesday Survey. This is particularly important for East Yorkshire because, although much is now known about the distribution of the various types of woodland in Britain as a consequence of the National Vegetation Survey, not a single East Yorkshire woodland was investigated for the survey (Rodwell, 1991).

As can be seen in Fig. 2 very few hedges in Holderness lacked *Acer campestre* and about 75% of them contained *Fraxinus excelsior*. So far as is known to the author, there is only one area of woodland in Holderness which might be old and that is Burton Bushes on the western side of Beverley Westwoods. Harris (1971) was unable to prove from documentary evidence that this 6 ha. of woodland was ancient in the sense that it had been in existence since 1600 A.D. but it does contain several herbaceous species considered by Peterken (1974) to be indicative of ancient woodland, including Dog's Mercury (*Mercurialis perennis*). According to an estimate made by Boatman (1971) 10% of the trees are *F. excelsior* and 8% are *A. campestre*. The most common tree is Pedunculate Oak (*Quercus robur*) with 56% frequency. On the evidence of this woodland fragment and the species-rich hedges, it can be postulated that the ancient woodlands of Holderness consisted of one or more facies of NVC type W8 *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland.

The most common shrub in Burton Bushes is Holly (*Ilex aquifolium*), a species which, according to Rackham (1976), is relatively resistant to grazing. Until recently, Burton Bushes was open to the surrounding pastures and therefore grazed. In Fig. 5 it can be seen that the distribution of hedges containing Holly is similar to that of those with a high frequency of Hazel so this suggests that some of the old woodlands of Holderness were wood pasture.

The hedges in Sub-group IB1 are characterized by a relatively high frequency of Dogwood and are mostly in the neighbourhood of Leconfield (Fig. 4). In the past, two large deer parks existed in this area, one just south of Leconfield, on an estate belonging to the Percys and the other just north of Leconfield owned by the Hotham family. Some of the hedges lie precisely on the boundaries of these parks as shown by Neave (1991) and the presence of Dogwood at relatively high frequency would conform with a landscape which, at the time the hedges were created, was more open than that of the woodlands.

The Group II hedges on the low-lying land near the River Derwent and the Pocklington Canal in the Plain of York are very different from those in Holderness. Field Maple is absent and Alder and Common Sallow commonly occur. Both of these species are common in North Cliffe Wood which, although it is rather remote from the areas mentioned above, is also low-lying. The Alder and Sallow stands of this woodland have not been surveyed using NVC procedures but it is likely that they would conform to one of the two types of

Sallow woodland and one or more of the three types of Alder woodland described in the National Vegetation Classification. On the evidence of the hedges it seems likely that similar woodlands formerly existed in the neighbourhood of the Derwent and the Pocklington Canal.

Unlike the groups considered above, the hedges comprising groups IA and IC were scattered throughout East Yorkshire. Group IA is characterised by a high frequency of Elder, a species which very readily invades existing hedges (Muir & Muir, 1987). It is also a species which cannot be tolerated where a hedge is required to be stock-proof. It is possible, therefore, that the hedges in this group are ones that have suffered long periods of neglect and in this context it is worth noting that, at the time of the survey, 65% were more than 2 m high compared with 48% for the total surveyed for physical features.

Very few mixed hedges could be found on the Wolds. It has been claimed that prehistoric man in East Yorkshire lived mainly on the Wolds and cleared the area for cultivation but, according to Allison (1976), more recent archaeological work has suggested that the situation was less clear-cut. Nevertheless, according to Darby and Maxwell (1962) there is no evidence that any woodland existed on the Wolds at the time of the Domesday Survey and it is known that, from the 15th century on, most of the area was open sheepwalk. It is to be expected, therefore, that the Wolds would have been virtually hedgeless until the period of Parliamentary enclosure when much of the land was enclosed for cultivation. One parish boundary hedge on the Sledmere estate, however, is of particular interest as it consists mostly of Spindle (*Euonymous europaeus*) and Hawthorn with some Field Maple, Purging Buckthorn (*Rhamnus cathartica*) and Barberry (*Berberis vulgaris*). In the earlier survey of East Yorkshire hedges Spindle was found only in two Wolds hedges (Boatman, 1980) but since then it has been found in two Holderness hedges on the boundary of the former medieval park at Scorborough near Leconfield.

Finally, consideration should be given to the long-term future of the hedges surveyed in East Yorkshire. It has been stated that a considerable number have been allowed to grow tall, a practice which, according to Garbutt and Sparks' survey of Judith's hedge, is likely to have led to a loss of species. Furthermore, eight hedges were less than 1 m in height and a further 57 less than 2 m in height (Table 3).

Many of these hedges, especially in the Plain of York, were at least partially smothered by Cleavers, probably a consequence of the spraying of the hedge bottoms, or by tall herbaceous vegetation, especially on the roadside where nowadays only one flail-width of verge nearest the road is regularly cut. Unless action is taken to control the herbs it is likely that the regularly-smothered shrubs will eventually die. Apart from this, coppicing and laying of hedges is almost non-existent in East Yorkshire now and in the absence of these regenerative practices and under the close-cutting management that is so often practiced, there can be no certainty that all of the species that make up a mixed hedge will survive. The implication is, therefore, that a steady decline in the already severely depleted biodiversity of the East Yorkshire countryside can be expected.

ACKNOWLEDGEMENTS

The author wishes to thank Dr Ray Goulder for conducting the TWINSPAN analysis on the hedgerow data and Dr Jan Crowther for help and advice concerning the location of documents dealing with former agricultural practices in East Yorkshire.

NOTE

A copy of the database has been supplied to the local authority and it is intended that another will be lodged at the Beverley Reference Library.

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BOOK REVIEWS

Last-instar Larvae and Pupae of the Simuliidae of Britain and Ireland by **Jon Bass.** 104 pp., 24 figs. Freshwater Biological Association, Ambleside LA22 0LP. 1998. £14.00, incl. postage.

The simuliid flies, otherwise known as blackflies or buffalo-gnats, are very important insects from a medical standpoint in many parts of the world. In Britain the adults sometimes occur in plague proportions, when they can become a major nuisance owing to their persistence and bloodsucking habits. The larvae and pupae are often extremely abundant in less polluted streams and rivers, and will be familiar to all students of freshwater biology. Many treatises exist on all aspects of simuliid morphology, taxonomy and biology and research in these continues to progress rapidly, but for the identification of final-instar larvae and pupae of British species, this will now be regarded as the standard work. The book under review consists mainly of a copiously illustrated key to the final-instar larvae and pupae of the 32 British species, together with brief ecological notes and a synopsis of the known distribution of each. The nomenclature of the species concerned has been updated to accord with current knowledge and usage, enabling today's students of the family to use existing literature on the identification of adults of British species. The book ends with a valuable list of references.

PS

A Key to the Freshwater Triclads of Britain and Ireland with notes on their ecology by **T. B. Reynoldson** and **J. O. Young**. Pp. 72, including numerous line drawings and 1 colour plate. Freshwater Biological Association, Ambleside, LA22 0LP. 2000. £14.00 incl. postage.

This is a welcome addition to the annals of freshwater biology, coming at a time when emphasis is being put on the necessity of monitoring the state of freshwater as a whole. The text is clear and unambiguous and the identification of species made even more useful by the addition of a key to preserved material, something omitted from earlier editions. There is a well designed chapter on the general biology and distribution of the species as well as an extended bibliographical list. Rarely does one get such complete coverage between a single pair of covers. The price may prove a deterrent to students and those with only a superficial interest in triclads, which is unfortunate. For the serious worker it is still a good investment, being more than twice the size of earlier editions and including far more information than is apparent at first glance.

DTR

Caring for Planet Earth: stories and prayers for children by **Ian M. Fraser** and illustrated by **Miles Forde.** Pp. vi + 74. Saint Andrew Press, Edinburgh. 2000. £5.99 paperback.

Intended for use in Sunday schools, assemblies and with youth groups, this is a collection of 25 stories, each with a linked prayer. Every story ends with a question about caring for planet earth, but these links with the environment are often contrived. The stories themselves are quaintly old-fashioned. A tale about an engine called Huffity-puff, which has difficulty climbing a mountain, ends by asking how in caring for the planet we can discover "the steepest hills to climb". A frog arriving late for the toys' party because he got stuck in a snowdrift prompts the author to pose the question "What can we do to care for planet earth and to free people who are in some way trapped?"

Twins called Alice and Andrew have earnest discussions about whether they are making the best use of the small patch of garden given over to them. Out of touch with the reading tastes of today's children, the author writes about humanised vegetables, a wheelie bin called Willie and a bus named Bessie, even a bamboo tree which has thoughts and feelings – all the type of characters that are anathema to modern editors. A few of the stories for older children fare slightly better: an eighteen year old girl who is made aware of the existence of sweat shops in the Far East through her Sri Lankan pen friend vows to buy only clothes produced under proper working conditions and Kofi, a boy blind and deaf from birth, has serious questions to ask about his new life when his sight is restored. There must, though, be less tenuous ways of making young people aware of environmental issues.

PB

Lichens by **William Purvis.** Pp. 112, incl. numerous colour illustrations. Life Series, The Natural History Museum, London. 2000. £9.95 paperback.

This superbly produced work does justice not only to the beauty of these fascinating plants but also to their uniqueness. Stunning photography is supported by an informative text that effectively portrays their biodiversity, ecological role, ability to survive in extreme environments and value as biological monitors; other sections deal with their structure, growth, dispersal, classification and economic uses, and some practical projects are appended. Thoroughly recommended as an introductory text for schools and natural historians in general.

MRDS

RECOVERY BY AQUATIC VEGETATION IN A WOLDS HEADSTREAM SUBSEQUENT TO THE 1988-1992 DROUGHT*

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ABSTRACT

During the 1988-1992 drought the flow of a winterbourne in the Yorkshire Wolds became irregular, culminating in dryness from summer 1991 through summer 1992. Aquatic plants were reduced in species richness and abundance but had partially recovered by summer 1993. Their pre-drought luxuriance was re-established through 1994-1999.

INTRODUCTION

Global warming and potential change in UK weather patterns might lead to greater frequency of hot dry summers (Marsh, 1997; Mayes, 1998) with accompanying drought conditions. The study of vegetation during and following past drought potentially throws light on the response of vegetation to future drought events. The 1988-1992 drought in Southern and Eastern England (Marsh *et al.,* 1994) diminished the recharge of aquifers. This, often coupled with abstraction by pumping from wells, led to low flows and wider occurrence of dry stream beds in chalk river systems. These conditions are associated with loss and impoverishment of aquatic flora (Giles *et al.,* 1991; Hill & Langford, 1992).

In the Yorkshire Wolds the drought was evidenced by rainfall between August 1988-February 1992 of 70-75% of long-term average, by aquifer recharge over the four winters 1988/89-1991/92 of 30-70% of the pre-1988 average, and by river run-off between September 1990-August 1992 of 50-60% of long-term average (Marsh *et al.,* 1994). Mill Beck, a Wolds stream near to Market Weighton, was much influenced by the drought. The spring-fed beck, part of the River Foulness drainage system, rises from beneath the Upper Cretaceous Chalk at National Grid Reference SE 899 426. Through the 1980s Mill Beck was a winterbourne, with maximum discharge during January-March and with flow continuing till about September. During spring and summer unshaded reaches, flowing through damp pasture, supported luxuriant emergent aquatic vegetation, largely dominated by *Apium nodiflorum* (Fool's Water-cress), *Rorippa nasturtium-aquaticum* (Water-cress), *Veronica anagallis-aquatica* (Water-speedwell) and *Glyceria fluitans* (Floating Sweet-grass) (Goulder, 1984; Rimes & Goulder, 1986a, 1986b, 1987). During 1989-1992, however, the flow of Mill Beck became irregular, culminating in a dry stream bed from summer 1991 to beyond August 1992 (Goulder, 1992).

Water levels in the chalk aquifer are exemplified by data from Southwood Farm (SE 922 441), 2.8 km north-east of the Mill Beck source. As was typical for the 1980s, lowest water levels during 1985-1987 were recorded in the final quarter of each year (Fig. 1), a time when Mill Beck was largely dry. Water levels then increased substantially to highest levels in the subsequent first quarter. This coincided with maximum stream flow. During the drought, however, the early-year increase was much less in 1989 and 1990, and failed completely in 1992. Hence the dry stream bed from summer 1991 to the end of 1992, a state which may have been exaggerated by continuous pumping through the drought years from Springwells borehole, about 100 m south of the Mill Beck source. The monthly average abstraction rate from January 1988 to December 1992 was 2.16×10^3 m^3 d^{-1} (range $0.97\text{-}2.87 \times 10^3$ m^3 d^{-1}) compared to the similar 2.26 (0.36-2.82) $\times 10^3$ m^3 d^{-1} between January 1984 and December 1987.

Surviving aquatic vegetation in the dry bed of Mill Beck during summer 1992 was described by Goulder (1992). The bed of the stream from 0-50 m downstream of the source

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* Developed from a poster originally presented at the YNU's Conference on "Recording and Monitoring Yorkshire's Natural Environment", Harrogate, 26 February 2000.

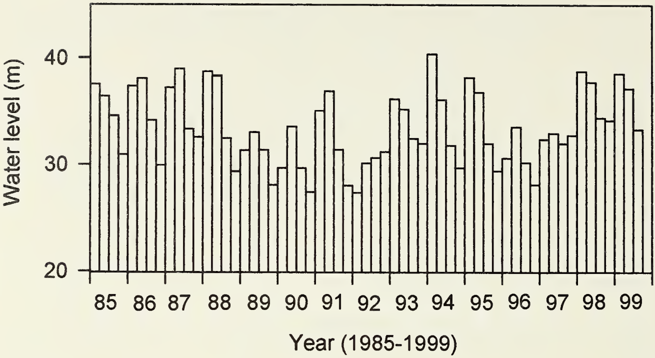

FIGURE 1
Mean quarterly water level in the aquifer at Southwood Farm, 1985-1999 (m above ordnance datum), prepared from records supplied by the Environment Agency.

had become a grassy sward and only six of the 13 species of aquatic macrophyte recorded in 1983 survived (Table 1). Of these, the grass *Agrostis stolonifera* (Creeping Bent) had much increased in abundance, otherwise the survivors were stands of perennial emergent species, together not occupying more than about 15% of the dry stream bed, most notably *Glyceria maxima* (Reed Sweet-grass), *Iris pseudacorus* (Yellow Iris) and *Mentha aquatica* (Water Mint). Seedlings of hawthorn (*Crataegus monogyna*) and dog rose (*Rosa canina*) were establishing themselves while the formerly dominant hydrophytes *A. nodiflorum, R. nasturtium-aquaticum* and *V. anagallis-aquatica* were not recorded.

Similarly, the stream bed from 225-360 m downstream of the source was a grassy sward, with abundant thistles (*Cirsium arvense*) and stinging nettles (*Urtica dioica*). Seven species of aquatic macrophyte were recorded compared to 12 in 1984 (Table 2). The formerly dominant *A. nodiflorum* and *R. nasturtium-aquaticum*, along with *Berula erecta* (Lesser Water-parsnip) and *Veronica beccabunga* (Brooklime), were reduced to a few plants in a damper, more shaded, area towards the upstream end of the reach.

Following the end of drought, Mill Beck flowed again during 1993. In that summer, some of the missing hydrophytes reappeared (Goulder, 1993). Nine species were recorded in the 0-50 m length compared to six in 1992 (Table 1); while 12 species were recorded in the 225-360 m reach compared to seven in 1992 (Table 2). However, the vegetation had not fully recovered. Approximately 80% of the steam bed was occupied by inundated non-flowering grasses, thoroughly entangled by filamentous algae. Many terrestrial plants remained conspicuous, especially thistles and stinging nettles in the 225-360 m reach.

The aim of the present contribution is to describe the summer aquatic vegetation in Mill Beck over the longer-term, post-drought, period up to 1999.

Materials and Methods

A yearly visit was made to Mill Beck, during June-July 1994 to 1999, and aquatic macrophytes were recorded in the lengths of stream 0-50 m and 225-360 m downstream of the source. The checklist used was of aquatic plants in England and Wales (Palmer & Newbold, 1983); nomenclature follows Stace (1997). Presence or absence was recorded

TABLE 1

Aquatic macrophytes recorded 0-50 m downstream of the Mill Beck source.

	1983	1992	1993	1994	1995	1996	1997	1998	1999
Agrostis stolonifera	+	+	+	+	–	2	3	1	1
Apium nodiflorum	+	–	+	+	+	3	3	3	3
Berula erecta	+	–	–	–	–	–	–	–	–
Caltha palustris	+	+	–	+	+	1	1	1	2
Eleocharis palustris	–	–	–	+	–	–	1	–	–
Glyceria fluitans	+	–	–	+	+	–	1	1	1
Glyceria maxima	+	+	+	+	+	3	3	3	3
Iris pseudacorus	+	+	+	+	+	3	3	3	3
Mentha aquatica	+	+	+	+	+	2	3	2	2
Myosotis scorpioides	+	+	+	+	+	2	3	2	2
Ranunculus flammula	+	–	–	–	–	–	–	–	–
Rorippa nasturtium-aquaticum	+	–	+	+	+	3	3	3	3
Veronica anagallis-aquatica	+	–	+	+	+	2	3	1	1
Veronica beccabunga	+	–	+	+	–	2	–	1	–
Number of species	13	6	9	12	9	10	11	11	10

(+) = Present, (-) = not recorded, 1 = <0.1% cover, 2 = 0.1-5% cover, 3 = >5% cover. Pre-1994 data are from Goulder (1993).

TABLE 2

Aquatic macrophytes recorded 225-360 m downstream of the Mill Beck source.

	1984	1992	1993	1994	1995	1996	1997	1998	1999
Agrostis stolonifera	+	+	+	+	+	–	1	–	1
Apium nodiflorum	+	+	+	+	+	3	3	3	3
Berula erecta	+	+	+	+	–	2	2	2	1
Callitriche sp.	–	–	+	+	–	–	–	–	–
Caltha palustris	+	+	+	+	+	1	1	1	1
Eleocharis palustris	–	–	+	+	+	1	3	1	1
Equisetum fluviatile	+	–	–	–	–	–	–	–	–
Glyceria fluitans	+	–	–	+	+	3	3	3	3
Mentha aquatica	–	–	+	+	+	2	–	2	1
Myosotis scorpioides	+	+	+	+	+	3	3	2	2
Ranunculus aquatilis	+	–	+	–	–	–	–	–	–
Ranunculus flammula	+	–	–	–	–	–	–	–	–
Rorippa nasturtium-aquaticum	+	+	+	+	+	3	3	3	3
Veronica anagallis-aquatica	+	–	+	+	–	3	3	1	2
Veronica beccabunga	+	+	+	+	+	2	2	3	3
Number of species	12	7	12	12	9	10	10	10	11

(+) = Present, (–) = not recorded, 1 = <0.1% cover, 2 = 0.1-5% cover, 3 = >5% cover. Pre-1994 data are from Goulder (1993).

during 1994-1995. From 1996-1999 an abundance score was used (Holmes, 1983); i.e. 1 = <0.1% of stream bed covered, 2 = 0.1-5% cover, and 3 = >5% cover.

Results and Discussion

Water flowed from the Mill Beck source during June-July in every year from 1994-1999. Substantial flow was observed in 1994, 1995, 1998 and 1999 whereas the flow was low in 1996 and modest in 1997. These lesser flows followed the 1995 drought and continuing rainfall deficiency in 1996 (Marsh, 1996). During the low flow years, especially 1996, first-quarter water levels were low in the aquifer at Southwood Farm (Fig. 1). That flow continued was perhaps due to cessation of pumping at Springwells borehole from April 1995 onwards.

The stream from 0-50 m downstream of the source was occupied by an 80-100% cover of luxuriant aquatic vegetation in each of the years 1994-1999, with the exception of 1996. The vegetation was dominated by *Apium nodiflorum* and, usually profusely flowering *Rorippa nasturtium-aquaticum*, emergent to 50 cm or more. The adjacent pasture, and the stream vegetation, were not grazed, unlike in the early 1980s when there was grazing by cattle. In the low flow year of 1996, the macrophyte vegetation, largely *R. nasturtium-aquaticum*, was restricted to about 50% cover, while the shallow water of the gaps between, mostly <10 cm deep, was extensively colonized by filamentous algae attached to the stream bed.

The stream from 225-360 m downstream of the source supported a dense, nearly complete, cover of emergent aquatic vegetation in every summer from 1994-1999. Again *A. nodiflorum* and floriferous *R. nasturtium-aquaticum* were most conspicuous, encouraged by absence of grazing from 1996 onwards.

By June 1994, the second summer with post-drought water flow, the number of aquatic plant species, in both reaches of stream, was similar to that in the pre-drought early 1980s. That is, for 0-50 m, 12 species compared to 13 in 1983 (Table 1); and for 225-360 m, 12 species in both 1994 and 1984 (Table 2). In following years the number of species, the species composition, and their relative abundance (from 1996) remained fairly constant (Tables 1, 2). Some of the, minor, variation may reflect plants being overlooked during once-a-year visits. Probably genuine losses, however, are *Ranunculus flammula* (Lesser spearwort), scarce in both lengths in 1983-1984 and not recorded since, and *Ranunculus aquatilis* (Common Water-crowfoot) a few plants of which were found in the 225-360 m reach in 1984 and 1993 but not since.

Goulder (1992) suggested that the Mill Beck vegetation represented an aquatic vegetation type, characteristic of intermittent calcareous streams, not widespread in the Yorkshire Wolds, and potentially threatened by drought and abstraction. It is pleasing that the present study showed rapid recovery after drought.

Recovery of chalk streams from even longer periods of dryness has been reported. In the River Ver, Hertfordshire, *Ranunculus peltatus* (Pond Water-crowfoot) was re-established within three years of cessation of groundwater abstraction and resumption of flow after many years of dryness (Mainstone, 1999). Drought tolerance by headstream plant communities is relevant to the ongoing debate over UK climate change (Marsh, 1997; Mayes, 1998). If droughts are to become more frequent it is good news that these communities are sufficiently robust to survive.

Acknowledgements

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BOOK REVIEW

Provisional Atlas of British Hoverflies (Diptera, Syrphidae) by **Stuart G. Ball** and **Roger K. A. Morris.** 166 pp. with b/w maps and tables. Biological Records Centre, CEH, Monks Wood, Abbots Ripton, Huntingdon. Joint Nature Conservation Committee. 2000. [price not stated on cover].

Britain has long been in the forefront of global dipterological research and this extremely comprehensive book on British hoverflies admirably perpetuates this tradition. This indeed provides a notable landmark, for precisely a century has passed since G. H. Verrall published his *magnum opus* on British Hoverflies (*British Flies*, Vol. VIII, published by Gurney & Jackson, London), when the handful of contemporary British dipterists could have been forgiven for believing that the ultimate treatise on these fascinating insects had been produced. Indeed, it is a testimony to the genius of Verrall that his work remains of value to British students of the family today. However things have moved on apace since Verrall, especially since the publication in 1951 of C. N. Colyer and C. O. Hammond's *Flies of the British Isles* (Wayside & Woodland series, Warne, London), which precipitated an explosion of interest in flies that has continued to mushroom worldwide ever since. Indeed, during the past 50 years dipterology has been one of the major growth areas in entomological research on a global scale. Owing to their intrinsic beauty and obtrusiveness, hoverflies have long been one of the most popular families of flies, so vast strides in our knowledge and understanding of these insects have also been made during this same period. Inevitably, with the vast growth in the number of researchers, many hoverflies have been added to the British list since 1950, so that whilst Verrall knew of 194 British species, the number has now risen to 266. The majority of these additions have resulted from "splitting" as species concepts have changed, based mainly on detailed examination of male genitalic characters and fuelled by the kudos derived from describing new species. The "downside" of this activity of course is that in some of the more critical hoverfly genera, such as *Sphaerophoria*, the females cannot be identified with confidence. Research has progressed on numerous aspects such as ecology, larval and adult morphology and biology, and, thanks to the many recording schemes undertaken through the Biological Records Centre at Monkswood, in phenology and national distribution.

During the past 30 years many distributional atlases have been produced through BRC and, amongst these, Ball and Morris's work on British hoverflies stands as a model for emulation. The coverage is phenomenal, based as it is on an analysis of over 30,000 individual records from all parts of Britain. Although many hoverflies are regarded today as endangered or vulnerable, only one species (*Myolepfa potens*) is highlighted as having become extinct in Britain since Verrall's day, whilst several extremely spectacular ones have evidently colonised Britain during the same period (e.g. *Callicera spinolae, Eriozona syrphoides, Volucella zonaria* etc.). Apart from the distribution maps, graphs showing the flight periods, a brief description of the biology and national status is given for each species. A map is provided to show the 10 kilometre squares from which hoverfly records have been received by BRC, and another indicates the intensity of recording per square. This will direct recorders to the poorly recorded areas of Britain and hopefully lead to more uniform coverage. Expectedly, the best-recorded squares are in and around the major conurbations and traditional collecting areas, with the main under-recorded areas being in various parts of Scotland, although surprising gaps even exist in southern England. Collectors in Lancashire and Yorkshire will perhaps be alerted to the presence of four squares in these counties from which no hoverflies have been recorded and will react accordingly. For those involved in site conservation issues, an important chapter deals with habitat indicator species, whilst the current national status of each species is also provided. The nomenclature follows the most recent *Checklist of British Diptera*, edited by P. J. Chandler and published in 2000 by the Royal Entomological Society of London.

This book represents a major milestone in British hoverfly studies and will occupy a prominent place on the shelves of all those with at least a passing interest in these flies. As stated, the book will also prove invaluable in site conservation programmes. There is a comprehensive list of references to all of the literature of relevance to the British hoverfly fauna. Finally the book provides an invaluable basis for the assessment of any future faunal changes, thus fuelling the hotly contested debate on "global warming".

PS

MAPPING *DRYOPTERIS SUBMONTANA* (RIGID BUCKLER FERN) TO THE METRE: EVIDENCE AND IMPLICATIONS FOR FRACTAL DISTRIBUTIONS*

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Introduction

Distributional dot maps are one of the most ubiquitous and useful outputs to emerge from a wide range of recording schemes. As well as suggesting interesting relationships between a species and its habitat requirements, comparisons between maps have been used to assess the relative rarity or commoness of different species. For example, British plants are considered nationally "rare" if they are recorded from fifteen or less 10 km squares (hectads), and "scarce" if known to occur in sixteen to one-hundred 10 km squares. However, the **number** of occupied squares is not the only property of a distribution map, the **relative positions** of the occupied squares can also be used to make useful inferences regarding the local frequency of a species. For example, experience tells us that a grid square in the centre of a cluster of occupied squares is likely to harbour many more populations or individuals than a relatively isolated occupied square. Similarly, those species with a restricted but relatively compact distribution of occupied squares are likely to be much more abundant "on the ground" than those species with a widespread but scattered distribution (see Figure 1A and 1B). One way of formalising this intuition is through the use of fractal geometry.

Fractal objects are characterised by the property of self-similarity: when a small portion of the whole is magnified, it retains certain features which are similar to the whole. Many examples of approximately fractal objects can be found in the natural world, such as cauliflower florets, the branching patterns of trees and fungal mycelia, mountain peaks or the edges of snowflakes (Mandlebrot, 1982; Donnelly *et al.* 1999). The geographical distribution of a species can also be considered fractal if the density of occurrence at a coarse scale (e.g. a national distribution mapped on a 10 km resolution grid) is similar to the density of occurrence in a small, occupied region viewed at a finer resolution (e.g. a county distribution mapped on a 1 km grid). One mathematical test for a fractal distribution is to plot a graph (on logarithmic axes) of the number of grid-squares occupied against grid resolution: a straight line will result if the distribution is genuinely fractal (Hastings & Sugihara, 1993; Gautestad & Mysterud, 1994).

Kunin (1998) provides evidence for the approximately self-similar nature of plant distributions, when viewed at 50 km, 10 km and 2 km (tetrad) resolutions. However, it is not yet known whether the patterns present at these national and regional scales repeat themselves still further at truly local scales (e.g. hectare resolution and below). To test this idea we collected information on the distribution patterns of *Dryopteris submontana* (the rigid buckler fern) and four other plant species. In this paper the results for *D. submontana* will be presented in detail, whilst the distributional patterns of *Dianthus armeria* (the Deptford pink) are used for comparative purposes.

Methods

National Distributional Patterns

National distribution maps were obtained from the Biological Records Centre (BRC), CEH, Monks Wood, at one kilometre resolution. Using these, the number of occupied 100 km squares, 10 km squares and 1 km squares was calculated for each species (dimensions refer to the length of one side of the square).

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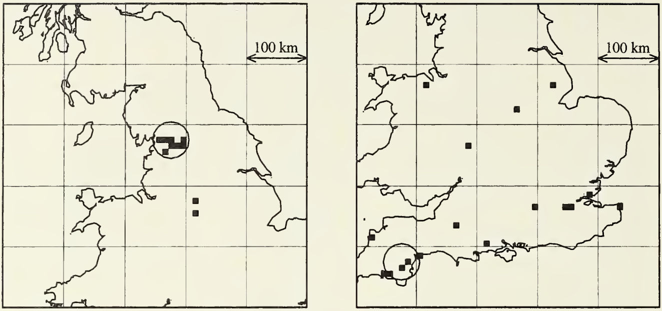
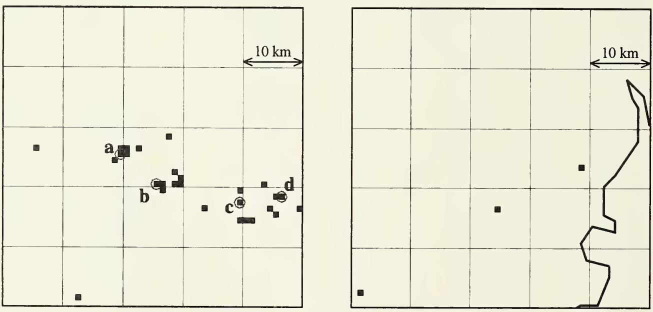
* Developed from a poster originally presented at the YNU's Conference on "Recording and Monitoring Yorkshire's Natural Environment", Harrogate, 26 February 2000.



Dryopteris submontana *Dianthus armeria*

FIGURE 1A.
National distributions of *Dryopteris submontana* (10 hectads occupied) and *Dianthus armeria* (19 hectads occupied), as recorded since 1987 (BRC data, Stewart *et al.,* 1998. and Wigginton, 1999). Circled areas are illustrated at a finer resolution in Figure 1B.



Dryopteris submontana *Dianthus armeria*

FIGURE 1B.
Regional-scale distributions of *Dryopteris submontana* and *Dianthus armeria* mapped at 1 km resolution. With the exception of one additional site for *D. submontana,* all data are courtesy of the BRC. Refer to Figure 1A for further details and location. Circled areas (*D. submontana* only) are illustrated at a finer resolution in Figure 2.

FIELD SURVEY OF LOCAL DISTRIBUTIONAL PATTERNS

To estimate finer-scale occupancy levels, four 1 x 1 kilometre squares were selected at random for detailed field survey during the summer of 1999. At each square kilometre chosen for survey, as far was practically possible, every hectare was searched for an average of twenty person-minutes and the presence or absence of the target species noted, along with a rough estimate of the number of individual plants. This phase of the survey (the coarse-scale field survey) generally took a pair of surveyors two days to complete. The occupied hectares were then ranked according to the estimated abundance of the plant. One hectare from the "high abundance" and one hectare from the "low abundance" half were then selected at random for a "medium-scale" survey at 10 m resolution. To achieve this, a grid of markers was laid out at 10 m intervals within each selected hectare, using Global Positioning Satellite (GPS) equipment that was accurate to ±1 m. Each 10 x 10 m square was then thoroughly searched for three to five minutes (depending upon habitat suitability and complexity) by one person, and once again, population estimates were made for each square. Finally, one "high abundance" and one "low abundance" 10 x 10 m square were selected at random from the medium-scale survey, and the presence or absence of the plant was recorded in a 10 x 10 grid of 1 metre squares. For this, the finest-scale survey, tape-measures and string were used to construct a one-metre resolution grid, and the precise location of each plant within the one metre square was recorded to the nearest centimetre. Obviously, where only one square was found to be occupied at the coarse or medium scale survey, only one square could be surveyed at the respective medium or fine-scale survey.

RESULTS

Table 1 illustrates the national number of grid squares recorded as occupied (since 1987) for the two example species at three relatively coarse-scale resolutions. Table 2 presents the average occupancy at the three finer resolutions, as determined from our field survey of four square kilometres. Specific examples of the distribution of *D. submontana*, at each of the three fine-scales, are given in Figure 2. Note, that there is generally a positive correlation between the number of grid cells occupied at successive scales. This tendency for coarse-scale occupancy to reflect local abundance has been well documented in many

TABLE 1.

Number of grid squares from which a species has been recorded (nationally). Data courtesy of the Biological Records Centre, Centre for Ecology and Hydrology. Available in summary form in Stewart *et al.* (1998) and Wigginton (1999).

	National occupancy since 1987 (BRC data)		
Species	100 km squares	10 km squares	1 km squares
D. submontana	2	10	29
D. armeria	12	19	19

TABLE 2.

Average percentage occupancy of squares at three different resolutions. In each case, the larger square was divided into a 10 x 10 grid of smaller squares. Numbers in brackets refer to the number of square kilometres, hectares and 10 m squares surveyed in the field.

	Average percentage occupancy (from Field Survey)		
Species	Hectares per 1 km square	10 m squares per hectare	1 m squares per 10 m square
D. submontana	3.25 (4)	5.83 (6)	4.80 (10)
D. armeria	1.25 (4)	2.00 (5)	4.00 (7)

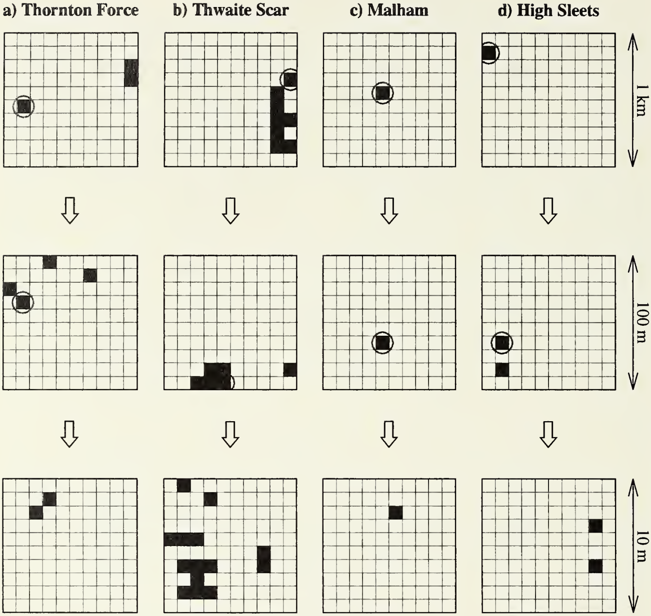


FIGURE 2.
A sample of the field-survey results for the distribution of *D. submontana,* as recorded at three different resolutions. Each 10 x 10 grid is a magnification of the area circled in the map directly above it. The square kilometres in the top row correspond to the four sites circled in Figure 1B, labelled a-d.

species (see Gaston, 1996 for a review), and it is one of the characteristics expected from a fractal-like distribution. Assuming the field survey results from Table 2 are representative for the whole country, we estimate that there are 94 hectares, 549 ten-metre squares or 2363 one-metre squares containing *D. submonata* in Britain. A log-log linear regression of the BRC data (at 100 km, 10 km and 1 km resolution), when extrapolated to finer resolutions, predicts 129 hectares, 516 ten-metre squares and 2066 one-metre squares. This level of agreement between the field survey estimates, and the linear (or fractal) extrapolation from national-scale maps, is illustrated in Figure 3.

The steep slope for *D. submontana* (in Figure 3) reflects the fact that each occupied coarse-scale square contains on average about four occupied medium-scale squares, and each occupied medium-scale square contains on average about four occupied fine-scale squares and so-on up the line for every successive pair of scales. By way of contrast, *Dianthus armeria* is very sparsely distributed at all scales apart from the 1 m resolution grid; each square occupied at one scale contains on average only one or two occupied squares when viewed at ten times finer resolution. The change in slope at fine resolutions is interesting in its own right, but it does signify that the national scale pattern cannot be extrapolated indefinitely.

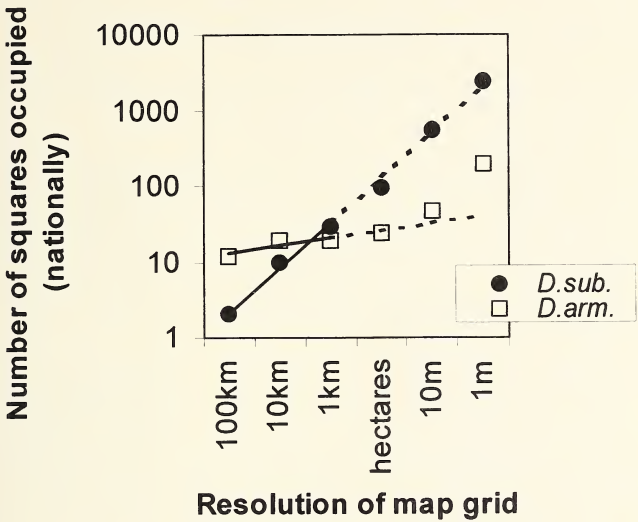


FIGURE 3.
Logarithmic plot of occupancy against resolution for *D. submontana* (filled circles) and *D. armeria* (open squares). Points for 100 km to 1 km occupancy based upon BRC data and points for hectare to 1 m occupancy based upon an extrapolation of field surveys. Solid lines represent a linear regression using the national BRC data, and dashed lines represent the fine-scale predictions made by extrapolating the regression line (i.e. assuming a fractal distribution).

IMPLICATIONS

British definitions of the rarity and scarcity of vascular plants are currently based upon the number of 10 x 10 kilometre National Grid squares that a species occupies (e.g. Stewart *et al.*, 1998; Wigginton, 1999). Figure 3 demonstrates how our perception of a species relative abundance (as measured by the number of grid squares occupied) can be dramatically altered by varying the resolution of the map (see also Pearman, 1997). From a conservation point of view, it may often be desirable to know the national distribution at a much finer resolution. For example, how many hectares or how many square metres are occupied? Such a mapping task would clearly be impractical for more than a handful of species. However, if most species do show fractal tendencies in their distributions, then coarse-scale knowledge can be extrapolated to make reasonable estimates of fine-scale coverage.

We have shown for *Dryopteris submontana* (and to a lesser extent *Dianthus armeria*), that predictions of typical local coverage, made from national distribution maps, broadly agree with our field survey estimates. The key question is, are these species typical or just fortuitous examples? Also, what are the limits of extrapolation? Perhaps the local-scale slope (between 10 m and 1 m in Figure 3) is determined by completely different processes than those that generate national distribution patterns (i.e. the slope between 100 km and 1 km)? This seems to be the case for *D. armeria*. If so, can we relate the slopes of different sections of the graph to the biology of the particular plant species? For example, "Does the plant reproduce vegetatively?", "Does it make a difference whether the seeds are wind-dispersed or animal-dispersed?". By carrying out further work, on more pairs of species, we hope to move closer to answering these and other questions that could make the interpretation of distributional dot maps even more interesting and informative.

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NOTES ON THE DISTRIBUTION OF LARGE-LEAVED LIME (*TILIA PLATYPHYLLOS* SCOP.) ON THE MAGNESIAN LIMESTONE IN SOUTH YORKSHIRE*

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INTRODUCTION

Large-leaved Lime, a nationally scarce tree (Newlands, 1999), is recorded in Perring and Walters (1962) for the 10 km square SK 58 and in Stewart *et al.* (1994) as a pre-1970 record. There are no other records from the Magnesian Limestone in South Yorkshire.

The status of Large-leaved Lime in Britain has been the subject of studies by a small number of authors; for example, Rackham (1980) considered Lime in eastern England and Pigott (1969) reviewed the status of Lime in the Derbyshire Dales and reported in the same paper that Large-leaved Lime was present in Anston Stones Wood in Rotherham and at Pleasley, on the Magnesian Limestone on the Nottinghamshire and Derbyshire border. Peterken (1981) described Maple-Ash-Lime woodland in Lincolnshire, and Oak-Ash-Lime woodland at Edlington Wood, Doncaster (SK59). Peterken (1980) also visited Roche Abbey and produced an internal report for the Nature Conservancy Council. Langridge (Meade & Langridge, 1987) surveyed a number of woodlands in South Yorkshire for the Nature Conservancy Council. This report did not quantify the presence of Large-leaved Lime, although it reported its presence in seven woods in the Rotherham area alone and ten in total. Pigott (1981) reviewed the status of Large-leaved Lime in Britain without mentioning the South Yorkshire populations. Lees (1888) reported that *Tilia grandiflora* (= *T. platyphyllos*) is an alien, always found in parks, stating "the largest I can recollect is in a park near Firbeck".

This study was undertaken in order to estimate the population and map the location of Large-leaved Lime in woods on the Magnesian Limestone in South Yorkshire, and, where possible, in adjacent counties, to ensure that an accurate representation of the species is provided for the BSBI's 'Atlas 2000' project, and to develop a suitable methodology for the regional study of rare and scarce plants proposed by Wilmore (1997). The study also looked for young trees in order to determine whether the population might be on the increase.

METHODS

The present author reviewed the standard floras, e.g. Clapham *et al.* (1987) and Stace (1991), before opting to use the instructions and description of *Tilia* species in Rich and Jermy (1998) to determine the species in the field. Determination in the field was made using only shoots from an exposed portion of the tree's crown, which had flowers or fruits. Shoots from a shaded portion of a tree or the lower shoots growing from the tree's base were rejected on the grounds "that identification is difficult or impossible" (Rich & Jermy, 1998). This policy may have left good [Large-leaved Lime] trees uncounted, as many of the Limes are located on the edge of cliffs or crags and the terrain is dangerous for a lone field worker. Approximately four Limes were not determined in Anston Stones Wood (Compartment 13) due to the terrain. In particular, trees should have cordate leaves with triangular teeth having an acute, well-defined apex. The upper surface should be wrinkled, with sparse simple hairs, especially along the main veins, whilst the lower surface should be pale green, with simple hairs forming a fur, often over the whole surface, but especially on the veins. The inflorescence of Large-leaved Lime has one to five flowers hanging below the leaves whilst Small-leaved Lime (*T. cordata*) is quickly identified by an

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* Developed from a poster originally presented at the YNU's Conference on "Recording and Monitoring Yorkshire's Natural Environment", Harrogate, 26 February 2000.

inflorescence held above the bract. The presence of plant galls on the leaves, such as the red nail gall *Eriophyes tiliae tiliae*, considerably assists a field worker to identify Lime trees in a fully leaved wood.

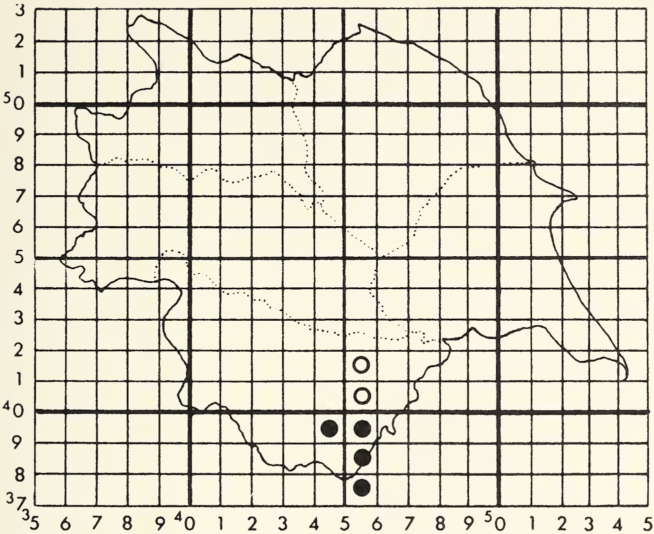
The survey was principally undertaken between the middle of May and the end of July 1999. Ten areas were surveyed during the 1999 season: eight in Rotherham and two in Doncaster. Large-leaved Lime was found in all the Rotherham areas but only confirmed in one Doncaster woodland. The sites were mainly selected on the basis of previous records, but new areas were also inspected. The number of trees and their location are found in Table 1.

TABLE 1.
Woods surveyed for Large-leaved Lime in 1999.

Wood	Grid Square	No. of trees	Comments
Rotherham:			
Roche Abbey:	Figure 4		
The Nor Woods	SK59	3	
Quarry Hills	SK59	1	
Table Rock	SK58	8	
King's Wood SSSI	SK58	33	1 young tree
King's Wood Lane	SK58	13	In the hedges
Slade Hill Plantation	SK58	2	
Maltby Wood			
Low Castle Lidget Quarter	SK59	1	In cleared area
Low Shoulder of Mutton Quarter, East of station	SK59	5	
Pieces Holt	SK59	1	
Sandbeck Park	SK59	2	In parkland
Firbeck Hall	SK58	1	In plantation
Anston Stones Wood	Figure 5		
Compartment 13	SK58	3	
Compartment 15	SK58	2	
Compartment 18	SK58	1	In cleared area
Compartment 19	SK58	1	By the streamside
Compartment 22	SK58	22	
Compartment 24	SK58	3	
Compartment 26	SK58	1	
Compartment 28	SK58	1	A young tree
Compartment 32	SK58	3	
Compartment 36	SK58	1	
Compartment 39	SK58	1	
Old Spring Wood	SK58	3	
Old Meadow Wood	SK58	3	
Hawk's Wood	SK58	1	
Hooton Cliff Wood	SK49	1	A coppice stool
Doncaster:			
Edlington Wood	SK59	2	At the north end
Sprotborough Gorge	SE50	0	Small-leaved Lime only confirmed

RESULTS

The survey has confirmed the continuing presence of Large-leaved Lime in three 10 km grid squares (Figure 1) and estimated the population on the southern Magnesian Limestone in South Yorkshire. There are, however, only a few young trees, mainly on the edge of



● Species confirmed in the 10 km square during the survey.
○ Report of species not confirmed in the 10 km square.

FIGURE 1.

The distribution of Large-leaved Lime in south Yorkshire, north Nottinghamshire and north-east Derbyshire, within the Magnesian Limestone Natural Area (1999).

paths or woodland rides. One previously unknown site in the Rotherham area has been found and an additional site, unconfirmed by the author or the Record Centre, has been reported to the Doncaster Biological Records Centre. The number of Large-leaved Lime trees present in each of the woodlands has been recorded, and mapped on 1:10,000 ordinance maps. The one km grid map of the Rotherham area (Figure 2) shows the distribution of Large-leaved Lime to the east of Rotherham and the south of Doncaster. A number of old records were clearly errors or could not be found, possibly due to forestry operations, e.g. in Anston Stones Wood Compartment 38.

The Large-leaved Lime at Sandbeck Park is a large standard tree. Within the Roche Abbey group of woods there is a mixture of standard trees and many quite large and very old coppice stools with three to five large trunks sprouting skywards. The situation is similar at Anston Stones Wood and Maltby Wood. The trees in Old Spring Wood, Old Meadow Wood, Pieces Holt and Edlington Wood are all standards of various sizes. The single tree at Hooton Cliff Wood was felled in 1981 during forestry work, but has subsequently produced coppiced shoots.

Additional fieldwork during the summer of 2000 added a new site in Doncaster, *viz.* Wadworth Wood (SK59). C. A. Howes (*pers. comm.*) reported one coppiced tree, but the

● Species confirmed in the 1 km square.
○ Report of species not confirmed in the 1 km square.

FIGURE 2.
The distribution of Large-leaved Lime in Rotherham and south-east Doncaster by 1 km square.

author and Howes failed to re-locate a record of Langridge (Meade & Langridge, 1987) in Engine House Wood, Sprotborough Gorge; the Lime here was all *Tilia* x *europaea.*

Other trees found in these woods during the survey included Yew (*Taxus baccata*), Oak (*Quercus robur*), Wych Elm (*Ulmus glabra*), Ash (*Fraxinus excelsior*), Common Lime (*Tilia* x *vulgaris*), Beech (*Fagus sylvatica*), Guelder Rose (*Viburnum opulus*), Field Maple (*Acer campestre*), Holly (*Ilex aquifolium*), Silver Birch (*Betula pendula*), Spurge Laurel (*Daphne laureola*), Hawthorn (*Crataegus monogyna*), Wild Service Tree (*Sorbus torminalis*) and, additionally, in the Roche Abbey woods, Norwegian Maple (*Acer platanoides*). The survey also revealed that Small-leaved Lime (*Tilia cordata*) is quite scarce in Rotherham, small numbers being recorded in King's Wood, Roche Abbey, Old Meadow Wood and Anston Stones Wood. Small-leaved Lime has been lost to road widening on the A631 through Maltby Wood. In Doncaster, two trees in Levitt Hagg Wood and three trees in Pot Ridings Wood were noted, whilst the species is common in the northern part of Edlington Wood.

Elsewhere on the Magnesian Limestone, Clapham (1969) reported three sites where Large-leaved Lime was found in Derbyshire: Markland Grips, where on 31 May 1999, J. R. Comley and I found a single tree growing out of crags on the south-west side of the wood; Scarcliffe Park Wood, where we found one coppiced tree to the north-east in an area which was mainly plantation, both in SK57; and the Vale of Pleasley, Pigott (1981). There are also a small number of records from Nottinghamshire. We were able to confirm one coppiced tree at Scratta Wood, but were unable to confirm a further record from Cresswell Crags. Two other sites on the Magnesian Limestone in Nottinghamshire may have Large-leaved Lime, but we were unable to visit them to confirm the records. Lavin and Wilmore (1994) do not record the species north of Doncaster, in West Yorkshire. An appeal to the YNU by Newbould (1999) produced no positive sightings, although one member suggested searching woods in the West Tanfield area.

Quadrat data have been collected for a representative selection of the sites (summarised in Table 2). Some of this is of limited value in that, for safety reasons, it was not possible to undertake 50 m^2 quadrats. The quadrat data from Sandbeck reflect a parkland community, rather than woodland.

From the survey, herbs present in the ground flora included Dog's Mercury (*Mercuralis perennis*), Wood Anenome (*Anenome nemorosa*), Ransoms (*Allium ursinum*), Bluebell (*Hyacinthoides non-scripta*), Tufted Hair-grass (*Deschampsia cespitosa*), Bramble (*Rubus fruticosus*), Wild Daffodil (*Narcissus pseudonarcissus*), Ivy (*Hedera helix*), Violets (*Viola* spp.) and Bearded Couch (*Elymus caninum*). Bracken (*Pteridium aquilinum*) is associated with Large-leaved Lime on more acid soils such as in Edlington Wood, the western portion of King's Wood and the eastern side of Maltby Wood.

Additional records were derived from the Recorder database at Rotherham Biological Records Centre; Woolthwaite Bottoms, Loscar Wood, Swinston Hill Plantation and Bondhay Dyke by B. Langridge; Hell Wood by R. J. Hall; Langold Holt by C. P. Harding; Rough Park and Brancliffe Grange area by D. Bailey. C. A. Howes (*pers. comm.*) reported an additional tree, with a 5 m circumference, at Skelbrook Park, Doncaster in SE51. The author was unable to obtain permission to visit these sites.

The results of this baseline survey work have been deposited with the B.S.B.I. 'Atlas 2000' project, Rotherham Biological Records Centre, Doncaster Museum and English Nature, Wakefield.

Discussion

Typically, the Large-leaved Lime was found in national vegetation type W8 woodland (Ash, Field Maple and Dog's Mercury) (Rodwell, 1991). With the exceptions of Edlington Wood, King's Wood, Maltby Wood and Old Spring Wood, the Large-leaved Lime was usually found on steep slopes or crags where magnesian limestone out-cropped. The steep slopes are useless for agriculture, grazing would be hard to manage, and forestry operations often difficult to undertake.

Surprisingly, when analysing the data, Ash was found in only three of the quadrats. In both Anston Stones Wood, where in compartment 41 Ash saplings are extremely common under the Beech plantation, and also from the late 1960s in the Sycamore plantation alongside King's Wood Lane, where Ash is almost a weed. Clearly, in areas where Lime-wood has been cleared, it would be necessary to monitor and probably remove Ash if such areas were to be restored to Lime-wood. The presence of Norwegian Maple in three of the four Roche Abbey quadrats could be of concern when, for example, hundreds of 1999 germinants were noted in King's Wood.

In the ground cover, Dog's Mercury is a constant. The field notes obtained whilst collecting the data show the presence of this species at each site where Lime is recorded. Tufted Hair-grass featured in five of the quadrats; in woodland it occurs in soils of impeded

TABLE 2.
Quadrat data from South Yorkshire Lime-woods.

Plant Each plant is scored using the domin scale see below	Site Norwood 1	Norwood 2	King's Wood 1	King's Wood 2	Anston Stones 22	Anston Stones 28	Edlington Wood	Sandbeck	Frequency
Acer platanoides		3	3	3					II
Acer pseudoplatanus	4	4				5	5		III
Betula pendula						3	4		II
Cornus sanguinea	2								I
Corylus avellana					2	3			II
Crataegus monogyna		1			2	4		1	III
Daphne laureola					3				I
Fagus sylvatica				4L	3		5		II
Fraxinus excelsior		6			3	3			II
Ilex aquifolium	3				1				II
Ligustrum vulgare			1	2	2				II
Quercus petraea	4								I
Quercus robur						4	3		II
Sambucus niger								4	I
Taxus baccata	4		6		4				II
Tilia cordata					4		5		II
Tilia platyphyllos		7	5	7	5	4	5	10	V
Tilia x *vulgaris*	7								I
Ulmus glabra	4	3		2			1		III
Allium ursinum	3	1		4					II
Anenome nemorosa	5	5			1				II
Anthriscus sylvestris						3			I
Arum maculatum		2						3	II
Chamaenerion angustifolium							1		I
Deschampsia cespitosa	3	3		2	1	2			IV
Dryopteris filix-mas					1				I
Filipendula ulmaria		1							I
Hedera helix	4	1		1	6				III
Heracleum sphondylium	1	1							II
Holcus mollis							2		I
Hyacinthoides non-scripta	4	4		2	2		1		IV
Mercurialis perennis	5	5	5	4	4	6	2	4	V
Myosotis arvensis			5					1	II
Narcissus pseudonarcissus				1				8	II
Phyllitis scolopendrium					1				I
Potentilla sterilis								1	I
Pteridium aquilinum							4		I
Ranunculus auricomus								1	I
Ranunculus ficaria s.s.								3	I
Rosa arvensis		3				3			II
Rubus idaeus		2							I
Rubus fruticosus	1	1		1	3	4	7		IV

TABLE 2 continued
Quadrat data from South Yorkshire Lime-woods.

Plant	Site								
Each plant is scored using the domin scale see below	Norwood 1	Norwood 2	King's Wood 1	King's Wood 2	Anston Stones 22	Anston Stones 28	Edlington Wood	Sandbeck	Frequency
Sanicula europaea	1				1				II
Stachys sylvatica	1						1		II
Taraxacum officinale	1							1	II
Urtica dioica	3						1	1	II
Veronica chamaedrys									I
Veronica montana								1	I
Viola reichenbachiana	3			1					II
Viola hirta								1	I
Viola odorata		1							I
Bare ground	5		5	5	5	3		5	IV
Exposed rock					3				I
Viscum album								*	I
Number of species	20	19	6	12	19	12	15	14	
Quadrat size in metres	10x20	20x20	50x50	50x50	20x20	15x30	50x50	20x20	

Note: 4L = leaf litter * epiphyte 3 plants.
COVER of 91-100% is recorded as domin scale 10, 76-90% is 9, 51-75% is 8, 34-50% is 7, 26-33% is 6, 11-25% is 5, 4-10% is 4; <4% 3 is many individuals, 2 is several individuals and 1 is few individuals FREQUENCY: I in 5 sites = 1, 2 in 5 sites = II, 3 in 5 sites = III, 4 in 5 sites = IV five sites V.

drainage, where it is never rank and tall but scattered amongst Dog's Mercury and Ransoms. Bramble caused numerous problems at some sites, restricting access to the very Lime leaves needed for examination. King's Wood 1 is an area where little woodland management has been undertaken since 1820. The present management policy is to let nature take its course. The absence of light has substantially reduced the number of plant species growing in this area.

The four young trees found were all on the edge of woodland rides, or alongside footpaths. Importantly for the future development of Large-leaved Lime in the area, in Maltby Wood, south of the A631, and in Anston Stones Wood (compartment 18), a single Large-leaved Lime has been left in cleared areas of woodland. At both locations, the principal herb on the ground is Dog's Mercury, although at Anston Stones Wood there is also Ransoms. Pigott (1969) reports that seed only sets after a hot summer and that the seeds and indeed the leaves are palatable to small mammals. Rackham (1980) states that he only found seedlings in eastern England after the two hot summers of 1975 and 1976. Peterken (1980) counted 23 1980 germinants in a 30 minute search of King's Wood. It would appear that at these two sites, there is an opportunity for seeds to develop in the future and extend the areas of Lime-wood. The conservation of this species may require more detailed research at such sites.

The question arises as to whether the species is natural in South Yorkshire. There are some large coppice stools at Roche Abbey, Anston Stones Wood and Maltby Wood and many of the existing trees originated in the 19th century, so one is entitled to suspect deliberate planting. However, there are several reasons for thinking it is native:

i Anston Stones Wood is known to have existed prior to 1553, Everson, (1985).

ii) Anston Stones Wood lies to the west of Lindrick Hill, Lindrick Golf Course and Lindrick Dale. Ekwall (1960) states that Lindrick was derived from a 12th century name meaning Lime-tree stream.

iii) Bearstall (1975) states that in 1617, there were about 200 acres of wood at Roche Abbey. Estate records of the management of the woods show timber sales from 1715.

iv) The English Nature site citation for Edlington Wood describes the area as secondary woodland dating from Romano-British times and subject to re-afforestation from about 1700.

v) A review of ancient woodland indicator species at these sites was undertaken by W. A. Ely (*pers. comm.*). The presence of such species as Wood Barley (*Hordelymus europaeus*) in Anston Stones Wood and Table Rock, the presence of the craneflies *Limonia nigropunctuata* and *L. masoni* in Anston Stones Wood, and the hoverfly *Brachyopa scutelloris* at Sandbeck Park are indicative of ancient woodland sites.

The data shows the importance of the Rotherham woods, within the Southern Magnesian Limestone Natural Area, for the 'stock holding' of this species for the area. It highlights the Roche Abbey group of woods as ancient Lime-woods and the importance of the other Maltby area generally for the future of this species.

One failure of the fieldwork, which has become apparent from the generous assistance the author received from Professor M. Seaward and Dr D. Boatman, was the inadequate collection of data on tree sizes to provide an estimation of age across the whole population. In undertaking surveys of this type in the future, a more formal approach adopting a score sheet will be necessary. However, one successful outcome of the work has been a meaningful discussion following proposals by the owner to undertake forestry operations in Edlington Wood (C. A. Howes *pers. comm.*).

In the objectives outlined above, proposals by Wilmore (1997) to produce a regional study of rare and scarce plants were mentioned. This note is offered as a contribution to the inevitable discussion on how monographs for each species could be constructed. Naturally, the author will review the methodology of the fieldwork undertaken following the discussion that will hopefully arise following publication of this note.

ACKNOWLEDGEMENTS

The author is grateful to the Earl of Scarborough who many years ago gave permission to visit his estate; to Dr R. Meade of the Nature Conservancy Council, Wakefield, for making available G. F. Peterken's internal report; to Mr W. A. Ely, Rotherham Biological Records Centre, for making records available; to Mr A. Henderson, for help and encouragement and for obtaining copies of original papers; to Mr D. A. Wood, Nottinghamshire County Council, for assistance with old Nottinghamshire records and the map of Anston Stones Wood; to Dr G. Wyman for assistance with the map of Roche Abbey; to Mr C. A. Howes, Doncaster M.B.C. Biological Records Officer, to Professor M. R. D. Seaward and to Dr D. J. Boatman, for very valuable comments on structuring the paper, and to staff at English Nature, Wakefield for their assistance when records seemed untraceable.

FOOTNOTE

Should the reader wish to study Limes in South Yorkshire, the following note describes suitable sites. Access to King's Wood is generally from the public footpath only. There are important conservation reasons for excluding public access to the centre of the wood (where many of the Limes are located). A representative area of Large-leaved Lime can be viewed safely from King's Wood Lane at SK54658938 (Figure 3). Small-leaved Lime can also be viewed from the southern end of King's Wood Lane. However, the road is narrow and appropriate high visibility clothing should be worn. Alternatively, both species may be

FIGURE 3.
King's Wood, Roche Abbey showing Large-leaved Lime adjacent to King's Wood Lane July 1999. Photograph J. A. Newbould.

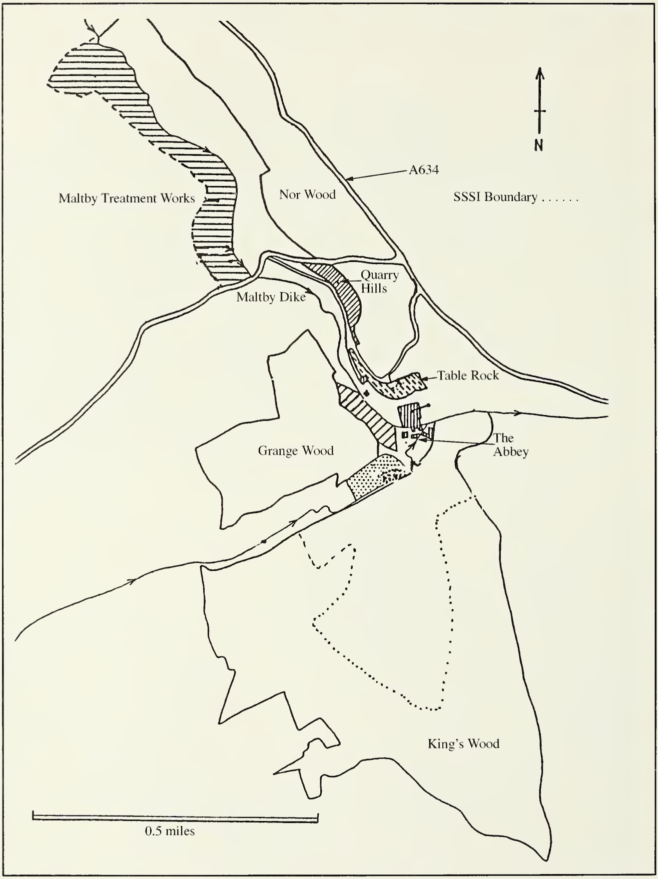


FIGURE 4.
Roche Abbey – location of the woods.

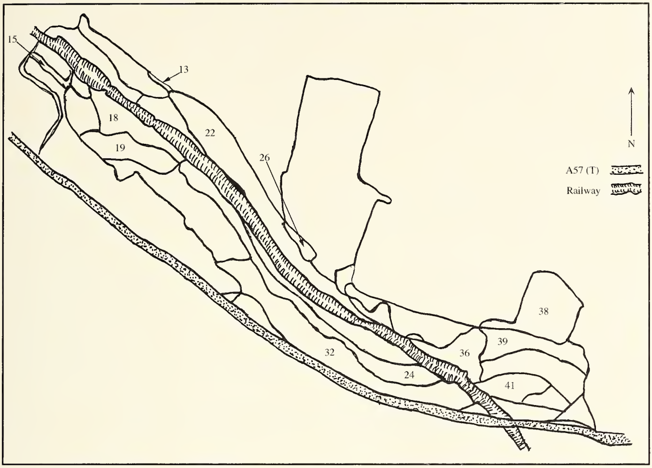


FIGURE 5.
Anston Stones Wood Compartments.

viewed from the public footpath between Thorpe Salvin and Hawks Wood or from the northern public footpath in Anston Stones Wood. At Anston Stones Wood one may have difficulty, due to the terrain, in obtaining suitable material for identification.

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BOOK REVIEW

The Story of Yew by **Guido Mina di Sospiro** Pp. 168, 13 b/w drawings, 1 b/w photograph. Findhorn Press. 2001. £12.95 hardback.

This amazing story is the autobiography of a female yew tree in the Killarney Forest. It spans more than 2000 years and encompasses accurate biological fact, ecology, biodiversity, history, fantasy, legend, but never confusingly. It tells the story of the yew's development from seed, through the fears and uncertainties of youth, of her taking over the mantle of responsibility on becoming Queen of the forest after her mother's death, of being felled by man and of her regeneration through epicormic buds, through maturity to her eventual desire to find eternal peace. All living things in the forest have the ability to communicate but are not over anthropomorphised. We are told of the druids' use of the mother yew as a sacred grove, of the noncolonisation of Ireland by the Romans, of the coming of Christianity (with some cynicism), of the dissolution of the monasteries, of the destruction of forests to make ships for warfare by the English, thus turning Ireland into grassland, and finally of the dawn of conservation bringing the return of hope for the future. This thought provoking story, by a man born in Brazil of Italian parentage and now resident in the United States, is told with a fluency and lyricism which imbues it with an aura of Irish legend but biological accuracy is never lost. There is humour and philosophy. It is brilliant! Buy a copy for each member of your family for Christmas and make sure you read it yourself!

PPA

BRYOPHYTES AND LICHENS OF COLLIERY SPOIL HEAPS IN YORKSHIRE

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Introduction

The vascular plant flora of Yorkshire's naturally colonised colliery spoil heaps is increasingly well accepted by naturalists as being interesting and of significant value both ecologically and scientifically (Lunn & Wild, 1995; Middleton, 2000); however, the bryophytes and lichens that also exist on coal spoil in Britain have received little attention to date. As part of ongoing studies of the wildlife of post-industrial sites in Yorkshire, this paper describes and comments upon the bryophytes and lichens from a number of abandoned colliery spoil heaps.

Incidental records of mosses and lichens were made during survey work 1992-1996 on 40 abandoned collieries and spoil heaps throughout Yorkshire (Lunn, 2000) and gave an indication that further study might prove fruitful. A more detailed examination of naturally regenerated sites at Grimethorpe (SE 415075), Carcroft (SE 552095), Royston Drift Mine (SE 382118), and a restored site at Cudworth Common (SE 402073) was undertaken by Peter Middleton 2000-2001. Lichen records for the Carcroft site were supplied by M. R. D. Seaward.

Coal spoil sites

Spoil heaps are created through the tipping of waste materials (coal spoil) following the extraction of coal from deep-mines. They are frequently extensive, accumulating over many years, and can often be very dramatic in terms of visual impact. Early spoil heaps were not subject to any special treatment, and after abandonment, many have established a full vegetation cover; however, many others, particularly those in active operation over the last 30-40 years, are huge and represent large areas of land with little or no vegetation cover at all. There is thus a range of habitats present on spoil heaps, ranging from completely bare ground through to sparse grassland and even full woodland cover (Lunn, 2000). Establishing the precise vegetation history of spoil heaps is complicated by the treatment of many of them under the Tips Act 1969, after which many sites were regraded due to health and safety considerations following the Aberfan disaster.

Coal spoil is comprised of various sized shales containing small amounts of bituminous and carbonaceous matter, argillaceous sandstone, fireclay, ironstone and limestone. The pH of colliery spoil is usually acid, but not consistent, and tests show that samples can vary considerably, even over very short distances. The lack of neutralising minerals in fresh spoil helps the oxidation of iron pyrites which is a common constituent of material in Yorkshire and results in the acid nature of many spoil heaps. A pH of between 3 and 5 is typical of most coal spoils; however, well-weathered spoil can have a pH of between 5 and 6 and is often found to be only slightly acidic on very well weathered spoil. Nutrients, particularly nitrogen and potassium, are in short supply.

The sites in the more detailed study were fairly uniform and all samples of bryophytes and lichens were taken directly from the coal spoil itself; this does include, however, the humus layer in naturally colonised oak-birch woodland. Records from some other materials available for colonisation such as naturally regenerated trees, stone and rubble are noted as such. A brief description of the four sites subject to more detailed study is given in Table 1. All three of the naturally colonised sites in Table 1 are currently under threat from proposed restoration works or landfill.

TABLE 1.
Description of four Yorkshire colliery sites.

Site	Description
Carcroft	An old abandoned colliery spoil heap, unrestored, but with areas subjected to more recent landform works. Gently rounded but with much micro-scale variation in topography – low plateaux with mounds and hollows. Birch woodland well established as a thick fringe around the edges (*c.* 25%). Bare ground or sparsely vegetated (*c.* 75%).
Cudworth Common	A modern colliery spoil heap tipped between 1970 and 1993, restored as a gently sloped ridge. Largely planted with amenity grasses and trees on lime-treated spoil and top-soil.
Grimethorpe	A large and spectacular old spoil heap with a steep (1 in 2) west face and gullies and plateaux. Naturally regenerated with 80% vegetation cover, much of this pioneer communities and grassland (90%), with the rest (10%) birch-oak woodland. Restoration works imminent.
Royston	A spoil heap tipped upon as recently as 1988 which has been subject to landform works resulting in a rounded mound, and with both planted and naturally regenerated vegetation. Largely pioneer or grassy vegetation, except for some trial areas of heathland planting (<5% of site), and some young amenity plantations.

Results

Bryophytes

Mosses are among the early colonisers of coal spoil. On most sites the contribution to the overall biomass of the vegetation is small, although on others they can be a significant component. The acid nature of colliery spoil, combined with the fact that bare spoil often dries rapidly, results in stressful conditions unsuitable for a range of other plants but on which these early colonisers can flourish.

30 bryophyte species were recorded from samples at 24 sites (Table 2). An average of 16 species per site was recorded in the more detailed studies at Grimethorpe, Royston, Carcroft and Cudworth Common. Of the 30 species, approximately one third are usually found on heather moorland or lowland heath. One third are species of woodland or rotting wood and four are usually found in bog or semi-aquatic conditions. The remainder can be classified as ubiquitous species tolerant of a variety of conditions.

The most frequently encountered species recorded from sites were *Ceratodon purpureus*, *Brachythecium rutabulum*, *Eurynchium praelongum* and the non-native species *Campylopus introflexus*. The most abundant species was *C. introflexus* which in *Agrostis stolonifera-Holcus lanatus* pioneer vegetation was found in up to 20% of samples and up to 50% cover per quadrat (Lunn. 2000). *C. introflexus* can be found virtually anywhere on colliery spoil even in the driest of places and clearly plays an important role in the colonisation by vegetation on colliery spoil. Colonising *Cladonia* lichens were often associated with areas dominated by this species. Both *Ceratodon purpureus* and *Campylopus introflexus* thrive on acid ground and are colonisers of bare peat.

Many of the other mosses found on colliery spoil are characteristic of moorland or lowland heath. *Polytrichum commune*, a scarce species in the lowlands of the region (Blockeel *pers. comm.*) is normally found on wet moorland, but was found on spoil heaps on fairly dry ground. *P. juniperinum* and *P. piliferum*, commonly found on lowland heath were also recorded; indeed, at two sites, all three species were present.

The occurrence of *Barbula unguiculata* is an indication of how much coal spoil can weather, as this species is often at its best in calcareous conditions, and was found growing

TABLE 2.
Bryophytes recorded on Yorkshire colliery spoil heaps.

Species	Incidental records 40 sites (Lunn) % occurrence	Occurrence at 4 sites (Middleton) G	R	C	CC
Ambystegium serpens					+
Aneura pinguis			+		
Aulacomnium androgynum	2.5	+	+		
Barbula convoluta			+		+
Barbula unguiculata	2.5	+		+	+
Brachythecium rutabulum	2.5	+	+	+	+
Bryum argenteum	2.5	+			+
Bryum bicolor		+		+	+
Bryum caespiticium		+	+		+
Bryum capillare			+		
Campylopus introflexus	50	+	+	+	+
Ceratodon purpureus	5	+	+	+	+
Dicranella heteromalla	2.5	+	+	+	
Dicranoweisia cirrata	2.5				
Dicranum scoparium				+	
Didymodon tophaceus	2.5				
Drepanocladus aduncus				+	
Drepanocladus fluitans	2.5				
Eurynchium praelongum	5	+	+	+	+
Funaria hygrometrica	2.5	+		+	+
Hypnum cupressiforme	5	+	+		
Hypnum jutlandicum		+	+	+	
Lophocolea bidentata		+	+	+	+
Lophocolea heterophylla		+		+	
Mnium hornum	5				
Pohlia nutans		+		+	
Polytrichum commune	2.5	+	+	+	
Polytrichum juniperinum	2.5		+	+	
Polytrichum piliferum			+	+	
Sphagnum fimbriatum	2.5				

G = Grimethorpe, R = Royston, C = Carcroft, CC = Cudworth Common (restored).

All species in Table 2 were from the coal spoil itself. In addition, *Tortula muralis* and *Grimmia pulvinata* were recorded from exposed rock protruding from coal spoil, *Hypnum andoi* on trees, and *Atrichum undulatum* and *Tortula truncata* from spoil considered to contain other material.

on a near neutral spoil at a pH of 6.5. Also, the semi-aquatic *Drepanocladus aduncus*, which is almost exclusively found in waters which range from neutral to strongly basic, was found growing in damp naturally regenerated woodland. Other calcicole species recorded from well weathered spoil were *Barbula convoluta* and *Didymodon tophaceus*.

The best microhabitat for bryophytes on coal spoil sites was regenerating oak-birch woodland, where damper and more humid conditions prevail. Here, common species such as *Dicranella heteromalla* and *Brachythecium rutabulum* were recorded in abundance, along with the common liverwort of this habitat, *Lophocolea heterophylla*.

Inspection of a spoil heap at Cudworth Common, restored without the use of top soil but treated with lime, which had an established open sward of Red Fescue (*Festuca rubra*) and White Clover (*Trifolium repens)*, revealed that colonisation of mosses occurred fairly quickly. 13 species had established after five years. However, the moss flora differed from that found on naturally colonised sites. *Barbula unguiculata, B convoluta* and various *Bryum* species were the most abundant colonisers of the lime-treated spoil, unlike naturally colonised spoil heaps where *Campylopus introflexus* and *Ceratodon purpureus* were found to be most abundant. Areas of spoil that had escaped the effects of restoration, such as drainage ditch banks, were also found to be of further interest; here the liverwort *Lophocolea bidentata* was recorded.

Lichens

Given the reduction in diversity and abundance of lichens in the industrialised parts of Yorkshire over many decades, it is perhaps surprising that colliery spoil heaps, often adjacent to centres of atmospheric pollution when collieries were in full production, should be rewarding places for investigation; however, significant areas and communities of terricolous lichens akin to those found on heather moorland were found in the study. It is, however, now recognised that the lichen flora of the Yorkshire conurbation has shown marked improvement in recent years due to improvements in air pollution levels as well as other factors such as nutrient enrichment and the colonisation of a wide range of materials found on industrial wastelands (Seaward 1994).

Many lichens favour semi-open conditions; the sparse vegetation and areas of bare ground, together with the acid conditions of colliery spoil therefore provide ideal conditions for colonisation by some species. Spectacular lichen cover was found on some old weathered spoil heaps.

The most frequent and abundant lichens found on Yorkshire spoil heaps are *Cladonia* species that are commonly found on heaths and moors, but less often encountered in natural habitats in the lowlands (Table 3). The most frequently encountered species on the three naturally colonised sites where detailed records were made were: *C. chlorophaea, C. coniocraea, C. fimbriata, C. floerkeana, C. furcata, C. pyxidata* and *C. subulata*. The most abundant species were *C. chlorophaea* and *C. furcata* whilst the only species that was recorded at all the sites was *C. fimbriata*. 19 species in total were recorded, an average of 13.5 per site.

C. portentosa and *C. floerkeana* are characteristic of the best examples of naturally colonised spoil heaps. They contribute significantly to the wildlife interest of these sites, and an abundance of red fruiting species like *C. floerkeana* and *C. diversa* can look striking in the sparse colonising vegetation on open ground. As many as 17 species of *Cladonia* were present at Carcroft, which is remarkable even for large stretches of local heather moorland with which such species are more normally associated. *C. cyathomorpha*, a very rare lichen usually found on mossy boulders in montane areas, was a remarkable discovery made by M. R. D. Seaward on Carcroft spoil heap.

Reasonably large patches of mixed *Cladonia* species can be found on coal spoil, which, compared with other areas, is often sparsely covered by vascular plants despite the spoil being apparently homogeneous, old and weathered. Laboratory tests and field experiments conducted in Scotland have confirmed that patches of mixed *Cladonia* species can inhibit the germination and establishment of vascular plants (Hobbs, 1985), a phenomenon that appears to be recognisable on some of the colonised parts of spoil heaps in Yorkshire. This contradicts the traditional view that lichens as pioneers pave the way for the colonisation of other species (Gilbert, 2000).

The restored spoil heap at Cudworth Common that had been treated with lime and seeded with a grass mixture directly on to the coal spoil showed evidence of *Cladonia* colonisation after 5 years. *C. humilis* and *C. fimbriata* were found to be the pioneer colonisers here, which is not surprising considering that both these species are known colonisers of disturbed ground. No other species of terricolous lichens were recorded at this

TABLE 3.
Terricolous lichens recorded on Yorkshire colliery spoil heaps.

Species	Incidental records 40 sites (Lunn)	Occurrence at 4 sites (Middleton, Seaward*)			
		G	R	C*	CC
Cladonia bacillaris	1			+	
C. chlorophaea	1	+	+	+	
C. coniocraea	1	+	+	+	
C. cyathomorpha				+	
C. diversa		+	+	+	
C. fimbriata	4	+	+	+	+
C. floerkeana		+	+	+	
C. furcata	1	+	+	+	
C. gracilis				+	
C. humilis		+	+		+
C. macilenta		+	+	+	
C. scabriuscula				+	
C. polydactyla			+		
C. portentosa			+	+	
C. pyxidata		+	+	+	
C. ramulosa		+		+	
C. rangiformis				+	
C. squamosa	1			+	
C. subulata		+	+	+	
Peltigera didactyla	1				

G = Grimethorpe, R = Royston, C = Carcroft, CC = Cudworth common (restored).

site, therefore the colonisation by lichens on coal spoil was somewhat slow compared with that by the pioneer mosses.

Conclusions

The landscape created by the cessation of the mining of coal in Yorkshire has left a legacy of a large number of colliery spoil heaps, some of which have developed, or are developing, through natural regeneration, communities of plants and animals of interest to ecologists and nature conservationists. This paper has described the bryophyte and lichen flora of some of these sites, which indicate that they can be of interest for these groups, in terms of species diversity and abundance, as well as rarity. Furthermore, through being primary colonisers of such land, sometimes in abundance, bryophytes and lichens can make a contribution to its ecological development, and are an integral part of the interest. Indeed, this subject would repay further investigation, and as lichenologists well know, unusual strata can often reveal rare and unusual taxa.

Acknowledgements

We would like to thank Craig Nicholls and Frank Spode of Sheffield Hallan University for doing the pH tests, Tom Blockeel for the identification of bryophytes and for his encouragement and comments, Dr Oliver Gilbert for identification of lichens and comments, and Prof. M. R. D. Seaward for his lichen records from Carcroft and critical comments on earlier drafts of this paper.

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BOOK REVIEW

Island Hopping in Tasmania's Roaring Forties by **Mary E. Gillham.** 500 pp, incl. 191 line drawings & maps. Stockwell, Ilfracombe. 2000. £20.00 hardback.

Everyone who has done research on island ecology has come across the name of Mary Gillham. Her researches on the subtle interrelationships amongst vegetation, seabirds, mammals and other environmental factors on islands in many parts of the world – West Wales, several parts of Australia, New Zealand, the sub-Antarctic – have been part of the literature for half a century. This book allows a glimpse of the personality of one of ecology's pioneer women scientists.

Mary Gillham visited the many islands scattered throughout the Bass Strait between Tasmania and the mainland of Australia numerous times between the 1950s and 1990s to conduct ecological research, partly as part of an intensive study of the sustainability of the muttonbird (shearwater) industry. (Until relatively recently hundreds of thousands of these birds were culled each year for human consumption.) This book is not a scientific regional account of the islands, nor is it solely a tale of travel and adventure, but is a delightful combination of both. It is well written, and packed with incident: sea journeys in small boats alternate with scary flights in light aircraft. Seamen, farmers, muttonbirders and lighthousemen mingle with naturalists and fishermen. The reader is also introduced to seabirds of many species, wallabies, echidnas, reptiles and fur seals. The science is there: in the 1980s between 132,000 and 281,000 muttonbirds were killed as they migrated across the Pacific by Japanese fishermen (although the total has since dropped); all muttonbird eggs, between Ceduna, South Australia and southern Tasmania, are laid within about 10 days of each other in the southern hemisphere spring.

The book is illustrated by many pleasant, slightly folksy, line drawings of animals, plants and occasional views. The sketches of the plants are better than those of animals. There are also a number of excellent colour plates. An appendix lists the vernacular and scientific names of plants mentioned. The volume is quite well produced, and a hardback of this length, with colour, for £20.00 represents good value.

The book is not without its deficiencies: there is the occasional error (ANARE stands for Australian National Antarctic Research Expeditions, not for Australian and New Zealand Antarctic Expeditions), and lapse in style (oldest for eldest); there is no index, nor are sources for the multitude of facts cited; the maps, useful as they are, could be improved; and it IS long – 17 chapters and exactly 500 pages.

PHA

THE LICHEN HERBARIUM AT LIVERPOOL MUSEUM

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Introduction

The Lichen Herbarium at Liverpool Museum has recently been entered onto a computer database [by M.P.], allowing summary information to be readily extracted. Although the collection is of worldwide scope, it is mainly composed of European material, more particularly from Britain and Ireland. The specimens are stored alphabetically under their modern scientific names, in line with the treatment adopted by Purvis *et al.* (1992).

Principal collections

The most significant lichen collection, containing a number of type specimens, is that of William Gladstone Travis (1877-1958), a Liverpool patent agent who for many years was Secretary of the South Lancashire Flora Committee (Allen 1960). His *Flora* of VC59 was published posthumously in 1963 and while it contains a comprehensive treatment of vascular plants and bryophytes, it omits lichens (Savidge *et al.*, 1963).

Numerous fascicles of the lichen exsiccatae of Charles Du Bois Larbalestier (1838-1911) are represented in the collection, including *Lichenes Caesarienses et Sargienses Exsiccati* (lichens of Guernsey and Sark) and his *Lichen Herbarium* (eight fascicles). Another collector, Dr Donald Cameron of Rodney Street, Liverpool supplied a collection of lichens of the Pyrenees and S. France (1835-1855) as well as a bound volume of lichens with the title *Lichenes Britannici*. There is also a mixed volume of lichens and algae from the collections of Walter Boult of Birkenhead dating from the late 1800s (Greenwood 1968).

One of the most comprehensive modern collections is that of Vera Gordon, formerly Secretary of the Liverpool Botanical Society and an indefatigable collector of lichens from throughout Britain and Ireland. The collections mainly date from the 1950s and 1960s, with one earlier specimen from 1934.

A collection of lichens dating from 1955-1959 which came mainly from Devon and North Yorkshire, particularly the area around Malham, was made by David Briggs. Dr Hugh McAllister, Deputy Director of Ness Botanic Gardens, donated this collection along with another sizeable one of his own collected mainly from Scotland and Iceland. The co-collector of the Iceland material in 1971 was J. M. Hardaker.

Another significant post-war collection was made by two of the Museum's botany staff: Barbara Greenwood (*née* Walker) collected in Merseyside, Lancashire and the Isle of Man, some jointly with her husband Eric Greenwood who also supplied material from Lancashire and Cheshire in his own right.

Other historically important collections

One of the oldest collections of lichens was purchased by William Roscoe from the estate of Thomas Velley (1748-1806), who is known primarily as an algologist but whose friendship with Dawson Turner and Sir James Edward Smith had stimulated an interest in lichens. Velley served as a lieutenant-colonel in the Oxfordshire Militia and made collections of marine algae from the south coast of England, where his company was stationed during the Napoleonic Wars to counter a French invasion. His few lichen specimens are sadly unlocalised. Another early collection was made by Henry Shepherd (*c.* 1783-1858) who was the second Curator of Liverpool Botanic Garden. His lichen collections are mainly unlocalised, but one is from Spitzbergen.

Parts of Sir James Edward Smith's herbarium were given to the Liverpool Botanic

Garden in 1806 and 1816. The Botanic Garden's herbarium, which was transferred to the Liverpool Museum in 1909, contains a few lichen specimens collected by him from England, Scotland and Wales and also some specimens from North America and the Pacific islands from Archibald Menzies (1754-1842). Smith's main lichen collections, however, are kept at the Linnean Society of London (Edmondson & Smith, 2000).

Another historically noteworthy collection came from William Gardiner (1808-1852), author of a *Flora* covering a radius of ten miles around Dundee (*c.*1840) whose lichen collections are exclusively Scottish; they come in the main from the Sidlaw Hills and Glen Clova in Forfar.

Material collected in the second half of the 19th century came from a number of sources. The most noteworthy of these was from Rev. Henry Hugh Higgins (1814-1893), Chaplain of Rainhill Asylum and a member of the board of trustees of the Liverpool Museum, who made extensive cryptogamic collections during an expedition to the Caribbean on the M.V. "Argo" in 1876 (Higgins, 1877). The lichens from this voyage came mainly from Madeira, Dominica, Trinidad and Venezuela.

At the start of the 20th century, prior to the work of Travis, only one other collector stands out, namely William West (1848-1914), Lecturer in Botany at the Bradford Technical College, who was a member of the Lichen Exchange Club and provided some Scottish specimens, most of which came from the Isle of Arran in 1910.

Major collectors

The following list contains only the names of those responsible for ten or more specimens, with dates of birth and death in the case of deceased lichenologists. More comprehensive information, such as geographical origin and dates of collection, can be provided from the Liverpool Museum's Lichen Herbarium Database.

Andreev, M. & co-collectors
Borza, A. (1887-x) & co-collectors
Briggs, D.
Cameron, D. (fl. 1830-1850)
Cretzoiu, P. H. (1909-1946) & co-collectors
Edmondson, J. R.
Gardiner, W. (1808-1852)
Glover, J. G. (1844-1925)
Gordon, V.
Greenwood, B. D. & co-collectors
Greenwood, E. F.
Hackney, P.
Hancock, E. G.
Hebden, T. (1849-1931)
Higgins, Rev. H. H. (1814-1893)
Jamieson, D.
Knight, H. H. (1862-1944)
Kurz, W. S. (1834-1878)
Kuták, V. (1876-1956)
Larbalestier, C. D. (1838-1911)
Lee, W. A. (1870-1931) & co-collectors
Livens, Rev. H. M. (1860-*c.*1946)
McAllister, H. & co-collectors
Menzies, A. (1754-1842)
Parsons, H. F. (1846-1913)
Rhodes, Rev. P. G. M. (1885-1934)
Royle, J. F. (1798-1858)
Salisbury, G. (fl. 1950)
Seaward, M. R. D. & co-collectors
Shepherd, H. (*c.*1783-1858)
Smith, D. G.
Smith, Sir J. E. (1759-1828)
Travis, C. B. (1878-1949)
Travis, W. G. (1877-1958) & co-collectors
Velley, T. (1748-1806)
Walker, B. D. (= Greenwood)
Watson, W. (1872-1960)
West, W. (1848-1914)
Wheldon, J.A. (1862-1924) & co-collectors
Wilson, A. (1862-1949) & co-collectors

Geographical coverage

The following list summarises the geographical coverage by country or island territory.

AFRICA
Algeria, Canary Islands, Madagascar, Madeira, Morocco, South Africa, Tunisia.

ASIA
China, India, Turkey.

EUROPE Austria, Croatia, Czech Republic, Finland, France, Germany, Great Britain, Greece, Hungary, Iceland, Ireland, Italy, Moldova, Netherlands, Norway, Poland, Romania, Russia, Spain, Spitzbergen, Sweden, Switzerland, Ukraine.

PACIFIC ISLANDS
New Caledonia, New Zealand.

AMERICAS
Bolivia, Brazil, Dominica, Jamaica, Martinique, Mexico, Venezuela, Trinidad.

ACCESS TO THE COLLECTION

The lichen herbarium is currently (Spring, 2001) stored off-site during work to extend the Liverpool Museum and create new collections stores. From 2002 it will once more be available to researchers in a newly constructed herbarium in the Liverpool Museum's Mountford Building. With the exception of bound exsiccatae, specimens are mainly stored in drawers in individual packets; a few oversized specimens are mounted on sheets kept in conventional herbarium folders. Specimens, including types, are available for loan to recognised botanical institutions.

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BOOK REVIEWS

Sea Beans and Nickar Nuts by **E. Charles Nelson.** Illustrations by **Wendy Walsh** and **Alma Hathway.** Pp. 156, with 54 figures. Botanical Society of the British Isles Handbook 10. BSBI, London 2000. Price £13.50

This handbook of exotic seeds and fruits found stranded on beaches in north-western Europe is the first in the BSBI Handbook series to deal with plants not native to Great Britain and Ireland. It is also the first to depart from the established cover design of that series. With regard to the subject matter, presentation and excellence of treatment of the subject it would have been better to have matched this publication with the BSBI's *Alien Plants* and *Alien Grasses* as a developing series at a time when there is an increasing interest in alien flora.

Starting at the back of the book I soon found that Dr Nelson's interest in the subject is not unique, for he presents a page of addresses of like-minded botanists and of websites. There is a bibliography containing more than 200 references spanning 350 years, demonstrating his depth of historical research. The seeds and fruits of 55 species of plant are described and about 40 are superbly illustrated. Seed viability, cultivation and description of the mature plant is given, although reading the "Frequency and buoyancy" entries for most of the species, the likelihood of ever finding a viable seed appears to be very remote.

Of interest to me personally is the consideration given to the possibility of our native coastal flora being supplemented by viable drift seeds, some examples being sea pea (*Lathyrus japonicus* subsp. *maritimus*), sea bindweed (*Calystegia soldanella*), sea rocket (*Cakile maritima*) and lyme-grass (*Leymus arenarius*).

The first 54 pages of the book examine numerous aspects of the study of drift-seeds, including their buoyancy and flotation times; the work of Charles Darwin and Joseph Hooker on seed viability in salt water in relation to seed dispersal; Praeger's work on seed buoyancy; uses such as in the manufacture of snuff and match boxes, and extensive reference to various driftseeds in northern European folk lore. This part of the book could stand alone as a very interesting publication.

PJC

A Right to Roam by **Marion Shoard**. Pp. ix + 438. Oxford University Press, Oxford. 1999. £8.99.

Published the year before the *Countryside and Rights of Way* (CROW) Act was passed, this book is essential reading for those involved with applying the new Act or affected by its implications, including ramblers and naturalists. In a book brimming over with facts, figures and specific examples, Marion Shoard reviews the history of land ownership and the reasons why the public are kept out of so much of the countryside. She traces this exclusion to the Norman Conquest, when she claims the ancient Saxon notions of shared resources were overturned. She sees modern estate owners as the direct descendants of the Norman barons and believes passionately that they have stolen our birthright.

The author traces in detail the legislation on access and rights of way and considers the various attempts since the 1890s to achieve a general right to roam. Anyone who has read her earlier books (*The Theft of the Countryside* and *This Land is Our Land*) will not be surprised that she pulls no punches in her attack on landowners and their attempts to charge people for enjoying the countryside, limit them to certain areas or bar them altogether. She wants a general right of access to all open countryside, not a partial solution for the uplands only. She compares access in Britain unfavourably with that enjoyed in several other European countries, such as the Netherlands, Sweden, Germany and Switzerland.

Perhaps the most interesting chapter is the last one, in which she considers how such right to roam legislation could be made to work. She investigates questions of restricting access at certain times, safeguarding privacy, security and vandalism. She sets out her ideas on the responsibilities of walkers, as well as the duties of landowners. This book will be a useful reference work for those now charged with the job of defining "mountain, moor, heath, down and common-land" and making the CROW Act work. However, it will be interesting to see if Marion Shoard is right in her prophecy that the partial solution embodied in the Act will turn out to be unsatisfactory and eventually require legislation for a more general right to roam.

MAA

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Readers of *The Naturalist* will have noticed that the number of photographic illustrations has increased in recent years. Good clear photographs, suitably captioned, to accompany articles or as independent features are always welcome.

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A SURVEY OF FERAL GEESE IN THE HARROGATE AREA IN THE YEAR 2000

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Introduction

In 2000, the second complete survey of feral geese in Great Britain was carried out. This was an attempt by the various ornithological conservation bodies (WWT, BTO, JNCC, Dúchas and BirdWatch Ireland) to quantify and update the numbers and distribution of Canada *Branta canadensis*, introduced Greylag *Anser anser* and other naturalised goose species (e.g. Barnacle *Branta leucopsis*, Snow *Anser caerulescens*, Egyptian *Alopochen aegyptiacus*) that occur in Britain. Four previous surveys have been carried out on Canada Geese in 1953, 1967-1969, 1976 and 1991. The aim of this paper is to compare the results obtained in 2000 with previous surveys where possible, and to provide an update on the population sizes and trends of Canada and Greylag Geese in the Harrogate & District Natural History Society's (H&DNHS) area.

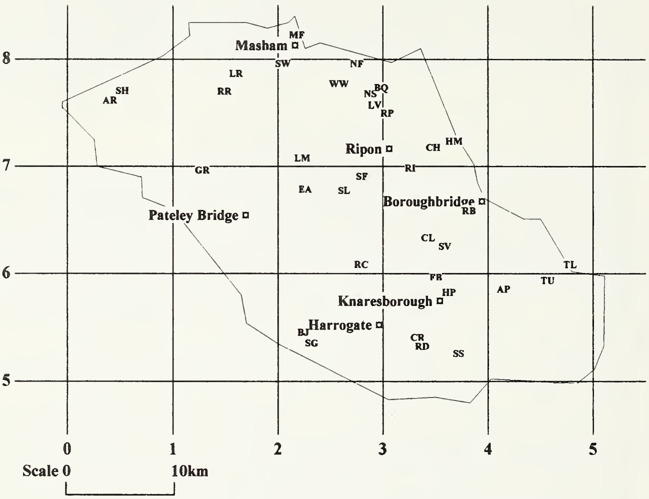
Canada Geese were first introduced into Britain in 1665 (Willoughby, 1676) as an ornamental species and there are documented cases of birds being introduced and subsequently translocated to several parts of the country, including Yorkshire, in the 18th century, and again in 1910. A full study of these translocations can be found in Kirby *et al.* (1999). By the 1950s Canada Geese were occasionally seen in flocks of up to 100 birds, and the growth of man-made ponds and gravel pits aided the population to grow rapidly (Mather, 1986). By 1953 there were an estimated 300-440 birds in Yorkshire (Blurton-Jones, 1956). This rose to 1,310 birds surveyed in 1967-1969 (Ogilvie, 1969), and then further to 1,550 in 1976 (Ogilvie, 1977), in addition to a moult-flock of 920 birds on the Beauly Estuary originating in Yorkshire and the Midlands. The highest figure was put at *c.*2,600 birds in 1979 when the population was still considered to be rising (Walker, 1991). At this time work was being carried out by the Canada Goose Study Group of Yorkshire (CGSGY), which studied the species from 1968 to 1982. The 1991 survey put the North Yorkshire population at 1532, with 958 of these being in the Harrogate area (Owen, 1991). It must be remembered, however, that this last total does not include birds from Harewood House, Eccup, and the Washburn Valley reservoirs, which frequently mix with Canada Geese in the Harrogate area at certain times of year, but which are outside the Society's recording area. Further work on Canada Geese in North and West Yorkshire was carried out by the Central Science Laboratory (CSL) between 1991 and 1996.

Feral Greylag Geese were introduced into south-west Scotland and East Anglia in the 1930s, presumably as hunting quarry. Following the translocations of Canada Geese in the 1950s by the Wildfowlers' Association of Great Britain & Ireland (WAGBI), attention was turned to the Greylag in 1959 by WAGBI 'to try to re-establish the Greylag as a wild nesting bird in England' (Harrison, 1960).

Birds were introduced into the Swale area and Castle Howard in 1970, a total of 190 birds being present by the 1970s. It is the birds from the Swale area and from the Midlands that are thought to have moved into the Harrogate area, whilst the flock at Castle Howard has remained relatively discrete. By the end of the 1970s the Yorkshire population stood at around 40 birds. This increased to an estimated 600 in 1985-1986 (Owen & Salmon, 1988). The 1991 survey produced a total of 172 birds in the Harrogate area (Owen, 1991).

Methods

Birds were counted on an individual site-basis between 21st June and 22nd July 2000, during their annual moult, and aged where possible. In addition, crèche sizes and brood sizes were noted where appropriate. The precise methodology was determined by the Wildfowl & Wetlands Trust; in addition there was also a random tetrad-based survey carried out by the British Trust for Ornithology. Data from that study are not yet available, so only counts from the site-based survey are included in these results. It is thought, however, that most of the geese in the area will have been counted by this method. Moorland-nesting geese (which numbered 25-35 pairs with 100-150 goslings on Dallowgill Moor alone in the mid-1970s (Garnett 1980)) are not included, no known counts being carried out at this site during the 2000 survey. Figure 1 shows the sites covered during the 2000 survey and a list of the sites covered (with their national grid references) is given in Appendix 1.



KEY TO SYMBOLS: **AR** Angram Reservoir, **SH** Scar House Reservoir, **GR** Gouthwaite Reservoir, **RR** Roundhill Reservoir, **LR** Leighton Reservoir, **SW** Swinton Castle Lakes, **MF** Marfield Nature Reserve, **LM** Lumley Moor Reservoir, **BJ** Beaver Dyke and John O'Gaunt's Reservoirs, **EA** Eavestone Lake, **SG** Scargill Reservoir, **SL** Sawley Lake, **WW** Westwood Lake (West Tanfield), **NF** Nosterfield Nature Reserve and Nosterfield Gravel Pit, **RC** Ripley Castle Lakes, **SF** Studley Royal and Fountains Abbey, **NS** North Stainley Pond, **LV** Lightwater Valley, **BW** Bellflask Quarry, **RP** Ripon Parks, **RI** Ripon Racecourse, **CR** Crimple Valley (Travellers Rest), **RD** Rudding Park Lake, **CL** Copgrove Lake, **FB*** Farnham Gravel Pits and Bar Lane Quarry (Knaresborough), **SV*** Staveley Nature Reserve and Fish Ponds, **HP** Hay-a-Park Gravel Pits, **HM** Hutton Moor Closes Pond, **SS** Spofforth Sewage Farm, **RB** Roecliffe Brick Ponds, **AP** Allerton Park, **TU** Thorpe Underwood Fish Ponds, **TL** Thorpe Underwood Lakes.

*Some sites that were counted separately (marked *) have been combined, as they are geographically too close to show separately on a map of this scale.*

FIGURE 1.
Map showing the locations of the count sites of the 2000 survey.

TABLE 1.
Number of feral geese recorded at site during the 2000 survey.

Site	Canadas				Greylags				Other Species
	Adults	Juvs.	Not aged	Total	Adults	Juvs.	Not aged	Total	
Copt. Hewick Hall	0	0	0	0	4	8	0	12	
Swinton Castle Lakes	6	11	0	17	2	8	0	10	
Spofforth Sewage Farm	4	6	0	10	0	0	0	0	
Scargill Reservoir	42	13	0	55	0	0	0	0	
Studley Royal & Fountains Abbey	58	4	0	62	14	4	0	18	Canada x Grelag 2 Greylag x Chinese 6 Chinese 1 Unid 2
Gouthwaite Reservoir	121	12	0	133	131	10	0	141	Barnacle 1 Canada x Greylag 1 Snow x unid 1
Angram Reservoir	2	3	0	5	0	0	0	0	
Scar House Reservoir	9	8	0	17	2	5	0	7	
Marfield NR	6	6	0	12	37	68	29	134	
Leighton Reservoir	0	0	0	0	5	12	10	27	Barnacle 1 + 4 juvs
Roundhill Reservoir	0	0	0	0	24	54	42	120	
Allerton Park	0	0	0	0	12	3	0	15	
Thorpe Underwood Fish Ponds	0	0	4	4	2	4	0	6	
Bellflask Quarry	2	5	0	7	2	4	0	6	
Lightwater Valley	0	0	0	0	6	8	0	14	
Ripon Racecourse	0	0	0	0	46	13	0	59	
Nosterfield North GP	0	0	2	2	0	0	32	32	
Nosterfield NR	0	0	0	0	0	0	407	407	
Farnham GP	71	15	0	86	0	2	6	8	Greylag x Canada 1
Hay-a-Park GP	65	4	0	69	62	0	0	62	Greylag x Domestic 10 Greylag x Canada 5 Canada x Domestic 1 Canada x L. Snow 1
Crimple Valley (Traveller's Rest)	0	0	0	0	0	0	0	0	Domestic 20
Copgrove Lake	2	4	0	6	4	5	0	9	Barnacle 3 Egyptian 1
Lumley Moor Reservoir	0	0	0	0	4	2	0	6	
Sawley Lake	0	0	0	0	2	3	0	5	
Ripley Castle Lake	0	0	0	0	0	0	66	66	Greylag x Domestic 2 Barnacle x Lesser Snow 1
TOTALS	388	91	6	485	359	213	592	1164	

Results of the summer 2000 survey

Counts were undertaken at 37 sites in the Harrogate area, the total numbers of Canada and Greylag Geese being 485 and 1,164 respectively. Canada Geese were recorded on 14 waters (37.84% of sites covered) whilst Greylags were recorded on 21 waters (56.76% of sites covered).

Canada Geese

Of the 485 Canada Geese counted in the Harrogate area, only Gouthwaite Reservoir held more than 100. This site accounted for 27.42% of the Canadas recorded. Four further sites held more than 50 birds; these were Farnham Gravel Pits (17.73%), Hay-a-Park Gravel Pit (14.23%), Studley Royal and Fountains Abbey Lakes (12.78%) and Scargill Reservoir (11.34%). A total of 479 of the geese were aged, 388 being adults and 91 being juvenile, giving a ratio of only 0.23 juveniles per adult. Of the 91 juvenile birds recorded, 64 were assigned to a total of 19 broods. The mean brood size was 3.17 young (median = 3.5 goslings per brood).

Greylag Geese

Four sites held more than 100 Greylags, with Nosterfield Nature Reserve having the highest number with 407 birds, 34.97% of the total recorded. Other sites holding more than 100 birds were Gouthwaite Reservoir (12.11 %), Marfield NR (formerly Masham Gravel Pits) (11.51%) and Roundhill Reservoir (10.31%). In addition, Ripley Castle Lakes, Hay-a-Park Gravel Pits and Ripon Racecourse Gravel Pits held more than 50 birds. 49.14% of the Greylags were aged, with 358 being adults and 214 juveniles. This gives an age ratio of 0.6 juveniles per adult. Only 96 of the 214 juveniles recorded were assigned to broods. A total of 29 broods was noted, with the average brood size being 4.83 birds (median = 4.5 goslings per brood). Table 1 summarises the results.

In addition, a further twelve sites were found to have no geese present during the time of the survey; Roecliffe Brick Ponds, Staveley NR, Staveley Fish Ponds, Eavestone Lake, Rudding Park Lake, Ripon Parks, Bar Lane Quarry (Knaresborough), Thorpe Underwood Lakes, North Stainley Pond, Westwood Lake (West Tanfield), Hutton Moor Closes Pond, John O'Gaunts and Beaver Dyke Reservoirs.

Comparison with the 1991 survey

In 1991, 788 Canadas and 172 Greylags were counted (Owen 1991). A comparison of these figures with the 2000 survey shows that Canada Geese have decreased in the Harrogate area by 42% whilst Greylags have increased by a staggering 677%.

Table 2 gives the total number of each goose species recorded at the various sites during the two surveys. The changes in distribution between the 1999 survey and the 2000 survey of the two species are shown in Figures 2 to 5.

The results show that there has been a significant decrease in the number of Canada Geese at most sites in the region, with the exception of the Knaresborough Gravel Pits complex and Gouthwaite Reservoir. In contrast, Greylags have spread from their stronghold in the north of the region to most of the major waterbodies. At some locations, e.g. Scar House Reservoir, these are new Greylag sites, but at most locations Greylags were present there in 1991 only in much lower numbers. However, there still remains a high concentration of Greylags at Nosterfield. It is likely that the spread has stemmed from this site and numbers there have been kept constant by birds expanding from other sites further north (e.g. the Bolton-on-Swale area).

Information on the brood sizes was not available for the 1991 survey. However, age ratios of 0.25 and 1.83 juveniles per adult were recorded in 1991 for Canadas and Greylags respectively. This compares with figures of 0.23 and 0.6 juveniles per adult in the 2000 survey. Age ratios at selected sites for both surveys are given in Table 3. However, these data are only for sites where age ratios could be compared between the two surveys and

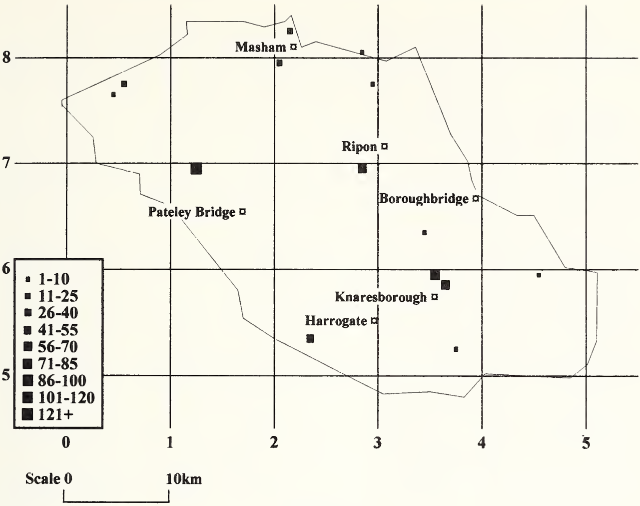


FIGURE 2.
Distribution of Canada Geese in the Harrogate area in 2000.

may not represent the populations as a whole. It is interesting to note that the Canada age ratios have stayed fairly constant at these sites, whilst the Greylag ratios are generally lower.

Other Species and Hybrids

The 1991 survey recorded only four geese that fall into the above category. These were two 'Chinese' Geese at Studley Park, and a single Barnacle Goose and an unidentified hybrid at Scar House Reservoir. In 2000, 64 geese of other species, and hybrids, were recorded from eight sites. These are shown in Table 1. The Domestic geese at Crimple Valley are typical farmyard types and probably flightless and the Egyptian and Barnacle geese at Copgrove Lake were seen to be pinioned. However, the 'Chinese' goose at Studley Park may possibly be the same bird that was recorded there in 1991. Likewise, the Barnacle that was at Scar House Reservoir in 1991 may be the same bird that was recorded at either Gouthwaite Reservoir or Leighton Reservoir in 2000, the median lifespan for wild male Barnacle geese being 10 years (Owen & Black, 1990).

The increase of hybrid geese may be due to there being more Greylags in the area than in 1991, thus more chance of inter-specific pairings. In addition, the Snow geese that were commonly seen in the Harrogate area in the 1990s *(Harrogate & District Natural History Society Reports)* have probably interbred with other species to account for the three Snow hybrids that were seen in 2000.

Discussion

The results shown in Figure 2 clearly show a massive increase in the number of Greylag

TABLE 2.
Number of Canada and Greylag Geese recorded during the 1991 and 2000 surveys.

Site	Canadas			Greylags		
	1991	2000	% Change	1991	2000	% Change
Copt Hewick Hall	not counted	0	–	not counted	12	–
Swinton Castle Lakes	81	17	–79.01	7	10	142.86
Spofforth Sewage Farm	16	10	–37.50	0	0	no change
Scargill Reservoir	21	55	161.90	0	0	no change
Studley Royal & Fountains Abbey Lakes	95	62	–34.74	8	18	225.00
Gouthwaite Reservoir	118	133	12.701	1	141	14100.00
Angram Reservoir	61	5	–91.80	0	0	no change
Scar House Reservoir	135	17	–87.4	0	7	α
Marfield NR	16	12	–25.00	15	134	893.33
Leighton Reservoir	not counted	0	–	not counted	27	–
Roundhill Reservoir	2	0	–100.00	15	120	800.00
Allerton Park Lakes	25	0	–100.00	20	15	–25.00
Thorpe Underwood Fish Ponds	not counted	4	–	not counted	6	–
Bellflask Quarry	0	7	α	4	56	50.00
Lightwater Valley Lakes	not counted	0	–	not counted	14	–
Ripon Racecourse GP	3	0	–100.00	7	59	842.86
Nosterfield GP & NR	0	2	α	59	439	744.07
Farnham GP	66	86	30.30	0	8	α
Hay-a-Park GP	112	69	-38.39	12	62	516.67
Crimple Lake (Travellers Rest)	8	0	–100.00	0	0	no change
Copgrove Lake	not counted	6	–	not counted	9	–
Lumley Moor Reservoir	not counted	0	–	not counted	6	–
Sawley Farm	not counted	0	–	not counted	15	–
Ripley Castle Lake	4	0	–100.00	?	66	–
Staveley NR	0	0	no change	18	0	-100.00
Westwood Lake (West Tanfield)	0	0	no change	2	0	-100.00
Eaveston Lake	19	0	–100	0	0	no change
Aldfield Pond	10	not counted	–	0	not counted	–
Queen Mary's Dubbs	0	0	no change	4	0	–100.00
	788	485		172	1164	

Geese in the area whilst Canada Geese have decreased by approximately 40%. A study by Wright and Giles (1988) suggested that Canada Geese nest earlier, and so are more susceptible to higher mortality rates, due to adverse weather conditions. They also speculated that as the population of Canada Geese was increasing so rapidly, inexperienced parenting could lead to a higher mortality. The latter is unlikely to be the case as, considering the large Greylag population recorded in 2000, one would expect this species to show a similar mortality rate.

Another study (Fabricius *et al.*, 1974) on mixed colonies of Canada and Greylag Geese suggested that Canada Geese have the propensity to prevent breeding by Greylags within a pairs' territory through inter-specific competition; however, they tolerated Greylags nesting

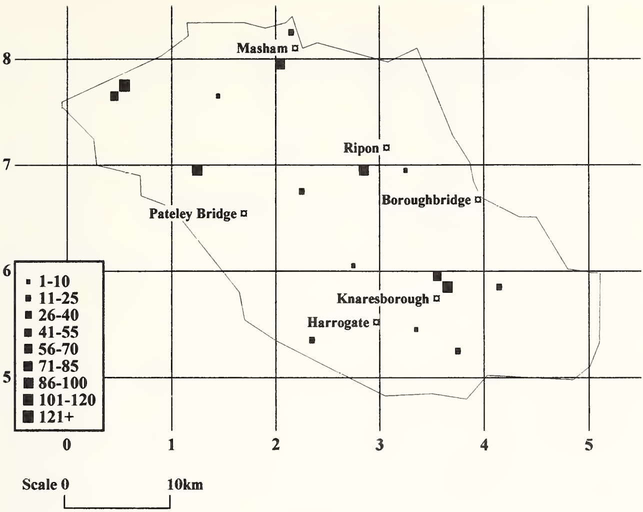


FIGURE 3.
Distribution of Canada Geese in the Harrogate area in 1991.

at closer distances than conspecifics. This could help explain the decrease in Canada numbers and the increase in Greylags. If the population of a site (or area) reached the carrying capacity for Canadas, newcomer Canadas to the territories would be fought off by

TABLE 3.
Age ratios for Canada and Greylag Geese at selected sites.

Site	Canadas		Greylags	
	1991	2000	1991	2000
Swinton Castle Lakes	1.31	1.83	2.50	2.00
Harrogate Sewage Farm south	1.00	1.50		
Studley Royal & Fountains Abbey Lakes	0.07	0.06	0.60	0.29
Gouthwaite Reservoir	0.46	0.10		
Angram Reservoir	0.45	1.50		
Scar House Reservoir	0.17	0.88		
Masham GP	3.00	1.00	3.50	1.84
Allerton Park Lakes			0.66	0.25
Bellflask Quarry			1.00	2.00
Ripon Racecourse GP	0.50		2.50	0.28
Nosterfield GPs (Combined)			3.21	
Farnham GP	0.27	0.21		
Hay-a-Park GP			5.00	0.00

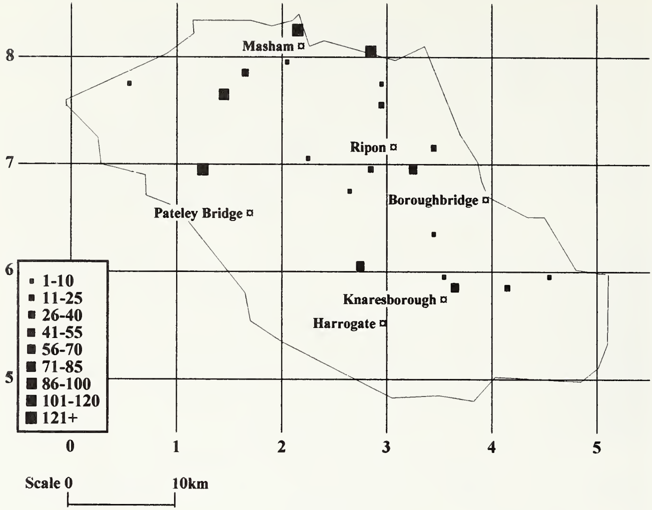


FIGURE 4.
Distribution of Greylag Geese in the Harrogate area in 2000.

Canada Geese already holding territories, whilst nesting Greylags may be tolerated more by nesting Canada Geese sharing adjoining, or overlapping, territorries. In addition, Greylags are much less territorial than Canadas and this may allow a loose colony of Greylags to build up.

Timing of wing moult may also be of importance. It is known that the timing of wing moult in Greylags is related to latitude. The wild population in the Western Isles (latitude 57°) starts around the middle of June, but for non-breeding, migratory Greylags in the Netherlands (latitude 53°) wing moult typically starts as early as 10th June and continues until 10th July; the mean date being 25th June (Loonen *et al.,* 1991). This latitude is nearer that of the birds in the Harrogate area (latitude 54°). For Canada Geese in the Harrogate area wing moult timing is thought to be slightly later with a mean date approximately a week later (*pers. obs.*). Thus, if a site has limited resources, and has been taken over by moulting Greylags, by the time Canada geese arrive to moult, food resources may be at a premium, forcing late-moulting Canadas to find new sites outside the area. This hypothesis cannot be tested here, as data from the rest of the country are not yet available. Thus, only the larger sites (e.g. Gouthwaite Reservoir) have enough resources to support both species in large numbers.

Feeding habits are also slightly different. The changes in recent agricultural practices including the prohibition of burning-off stubble fields has meant a ready source of grazing for geese. Due to morphological differences, Greylags are better equipped to deal with tougher foodstuffs and frequent such fields in greater numbers than the slimmer-billed Canada Goose, which prefers softer foods (e.g. young cereals and grass).

The population of Canada Geese in the Harrogate area (and Yorkshire) is thought to have

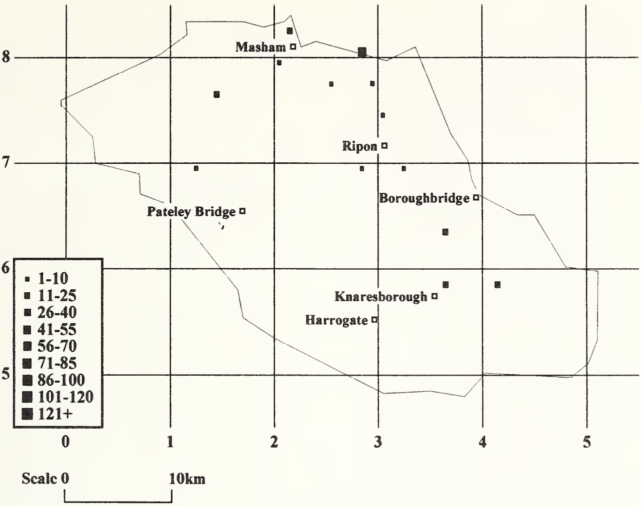


FIGURE 5.
Distribution of Greylag Geese in the Harrogate area in 1991.

peaked in the late 1970s. Whilst some control methods are known to have been carried out (egg-oiling, egg-pricking, shooting and controlled culls), the number of birds has not decreased at a rate that can be explained by these alone. This is shown by the figures in Table 3, where the age ratios of Canadas on estates have remained fairly constant whilst those of Greylags have decreased at these sites.

It is likely, therefore, that the population drop has occurred due to a combination of biotic and abiotic factors. One of these may be the massive national population increase in Greylags in some way affecting the Canada Goose population in the HNDS area. Whether this trend is national or regional is part of the reason for this survey, and at the time of writing the results are not available. It is a matter for debate as to whether the Greylag population will follow the same decrease as that of the Canada Goose, or if they will eventually find a population capacity and level out. This may be at the expense of the Canada Goose in the area, but due to differing habits and breeding habitats, it is likely that the two species will remain common in the Harrogate area for the foreseeable future.

Acknowledgements

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APPENDIX 1

List of all sites surveyed in 2000 (including grid reference)

Site	Grid Ref.
Angram Reservoir	SE040761
Scar House Reservoir	SE052770
Gouthwaite Reservoir	SE128696
Roundhill Reservoir	SE149769
Leighton Reservoir	SE160786
Swinton Castle Lakes	SE205795
Marfield Nature Reserve	SE218822
Lumley Moor Reservoir	SE223707
Beaver Dyke and John O'Gaunts Reservoirs	SE224545
Eavestone Lake	SE226678
Scargill Reservoir	SE232535
Westwood Lake (West Tanfield)	SE258776
Sawley Lake	SE263677
Nosterfield Nature Reserve and Nosterfield North Gravel Pit	SE275795
Ripley Castle Lake	SE279608
Studley Royal & Fountains Abbey	SE280690
North Stainley Pond	SE288767
Lightwater Valley	SE292757
Bellflask Quarry	SE298773
Ripon Parks	SE304749
Ripon Racecourse	SE326698

Site	Grid Ref.
Crimple Valley (Travellers Rest)	SE333540
Rudding Park Lake	SE337532
Copgrove Lake	SE343633
Copt Hewick Hall	SE348717
Farnham Gravel Pits	SE350596
Barr Lane Quarry (Knaresborough)	SE356590
Staveley Fish Ponds	SE359625
Staveley Nature Reserve	SE360630
Hay-a-Park Gravel Pits	SE363582
Hutton Moor Closes Pond	SE368723
Spofforth Sewage Farm	SE373525
Roecliffe Brick Ponds	SE382658
Allerton Park	SE415585
Thorpe Underwood Fish Ponds	SE457593
Thorpe Underwood Lake	SE483608

BOOK REVIEWS

Photographic Guide to the Sea and Shore Life of Britain and North-west Europe by **Ray Gibson, Benedict Hextall** and **Alex Rogers**. Pp. xiv + 436 with numerous coloured photographic plates, line drawings and maps. Oxford University Press. 2001. £35.00 hardback. £15.95 paperback with plastic cover.

This book is a guide to the common animals and plants that can easily be seen with the naked eye without the need of habitat destruction, e.g. digging in sand and mud. A 'conservation of specimens attitude' is encouraged with identification in the field, or where this is not possible a sketch or photograph should be taken. A brief introduction is given to rocky, sand and muddy shores. All the species considered have been recorded in the British Isles. There is a short introduction to each taxonomic group with references for further study. There is a caution not to be surprised if a specimen cannot be identified but there is no indication of the number of species within each taxonomic group. There are no keys. Each species is illustrated in colour in its natural habitat with the following information: its English and biological name with taxonomic position, description supported by line drawings where needed, distinctive features, differences from similar species, geographical distribution with a map and ecological habitat. This book will be useful to the beginner and student.

MEA

Animal Tracks and Signs by **Preben Bang** and **Preben Dahlstrom.** Pp. 264 with some 240 colour photographs and over 300 drawings and diagrams. Oxford University Press. 2001. £12.50 hardback.

This most practical of pocket guides, containing the masterly illustrations and diagrams by Preben Dahlstrom and very clear text re-edited by Martin Walters, makes it possible to identify a wide range of mammals and birds from the traces they leave behind, whether footprints, feeding debris, hiding places and homes, pellets and droppings.

Originally a classic title in the familiar Collins Field Guide series, *Animal Tracks and Signs is* now issued as one of the new Oxford University Press *Pocket Guides.* My 1970s copy, now dilapidated and stained from close contact with countless muddy footprints, piles of excrement and pellets, and bearing the forensic evidence of many an engrossing rural excursion, is in need of replacement. Like the welcome return of an old and trusted friend it is heartening to see this title re-issued and improved for the benefit of a new generation of naturalists.

Though the art-work is virtually identical to earlier editions, improvements in reprographic technology substantially enhance the illustrations in the OUP version and the photographs have been supplemented by some very dramatic additions.

A slight, though intriguing, problem with this guide is its significant reliance on tracks and signs in the snow. Since Bang and Dahlstrom compiled the first edition back in 1974 prolonged snowfall in Britain has become somewhat less frequent – a field sign in its own right, though of a somewhat larger footprint.

Even if readers have the old edition in their rucksacks, I would recommend replacing it with this new improved version – but save the old dust jacket featuring Dahlstrom's fabulous art work, re-using it to mask the drab corporate formality of the OUP covers.

CAH

The New Encyclopaedia of Mammals edited by **David Macdonald.** Pp. 960 with over 960 colour photographs and over 700 drawings and diagrams. Oxford University Press. 2001. £35.00 hardback.

With a team of eight world class mammalogists as advisory editors supported by 240 academic experts (including Prof. M. J. Delany, the editor of *Yorkshire Mammals*) as sectional authors, Professor David Macdonald has compiled a truly encyclopaedic review of the lives, evolution, adaptations, ecology, behaviour and social structures of the 2 sub-classes, 27 orders, 139 families, over 1,100 genera and some 4,600 species of mammals of the world.

Since 1984 when the first edition was assembled, Professor Macdonald's team have collated the veritable deluge of new discoveries resulting from a revolution in new techniques for the study of mammals. This, with the benefit of word processing and access to the internet, not generally available two decades ago, has resulted in the extensive revision and in most cases the entire re-writing of most sections of the encyclopaedia.

The work covers all species from the smallest mammal, Kitty's hog-nosed bat weighing 1.2 g, to the blue whale which weighs 100 million times as much. Interesting changes in the sequence of the mammalian orders have occurred since the earlier edition; for example, the Golden moles and Tenrecs are now placed with the Hyraxes and Elephants in a new super-order, the Afrothernia. Arranged generally according to orders and families, the book introduces at appropriate places a range of case studies and special features which illustrate a wide range of fascinating biological phenomena. These make compelling reading and are given both magazine-style and technical headings such as 'Mammalian central heating – endothermy and its costs'; 'Body size, the cost of living and diet – nutrition and metabolism'; 'Size and the energy crisis – allometry'.

With quick access 'Factfile' panels and with compelling yet authoritative text well punctuated with punchy subject headings, each of the eighteen chapters serve the needs of pressured students with essay deadlines, yet allows the general reader to wallow in this rich, stimulating and fast developing subject.

This truly luxurious volume is remarkable in combining glamorous magazine-style presentation with critical academic rigour. It succeeds in placing the best in reprographic technology, high quality artwork and exciting prose style at the service of a very broad readership.

The New Encyclopaedia of Mammals is a standard work ideally designed for any school, college or public library yet at a price which puts it within reach of many a domestic bookshelf – though weighing 4.5 kg, some DIY shelf reinforcement may be necessary!

CAH

LICHEN FLORA OF COUNTY DURHAM (VC66): SUPPLEMENT 1

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Since the publication of the Lichen Section in the Flora and Vegetation of County Durham (Graham, 1988), a systematic survey of VC66 has taken place and a considerable number of new species have been found. A number of species not seen for over 100 years have now been refound in the county. This is therefore a convenient time to produce an update. Where the distribution of species has changed considerahly since that known in 1988, this has been commented upon. The vast majority of the records are the results of my own investigations and are not credited. Where joint ventures were involved both recorders are credited. Other recorders are duly credited.

G. G. Graham's herbarium has been examined and several changes have been noted under the appropriate species. Unfamiliar material has been either confirmed or determined by colleagues in the Brilish Lichen Society and this is noted.

More recently, leprose crusts have received greater scrutiny from notable taxonomists and the parameters for identification of species have moved considerably. A reasonable attempt has heen made to keep up with the evolving situation and in particular the devolution of *Lepraria incana* which in the past has been a convenient catch-all. Several new species have been segregated from it, but it still remains the commonest member of the group and its widespread distribution remains valid. This area of study remains a major challenge for future lichenologists. The occurrence of lichenicolous fungi or "parasites" has scarcely been noted and the time is ripe for further investigation, especially as recent discoveries in Northumberland are proving to be so exciting.

84 species are reported as being new to VC66. 14 species not seen for many years now have a modern record. The total of reliably recorded species now stands at 604. Two species of *Parmelia* collected by W. Mudd have been commented upon but not added to the county list as they may have been collected from VC65.

Nomenclature follows Purvis *et al.* (1993). E = Herbarium, Royal Botanical Garden, Edinburgh. * = new species, including a few previously rejected because of insufficient supporting data. • = modern records of species not seen for a very long time.

**Acarospora cervina* A. Massal. Ledge on limestone outcrop, Coldberry End, 35/83, 1998, conf. B. J. Coppins.

• *A. Sinopica* (Wahlenb.) Körb. On levelled colliery shale on the backshore, S. of Noses Point, Seaham, 45/44, 1997.

A. smaragdula (Wahlenb.) A. Massal. Now known to be frequent in the W. of the county, especially on metalliferous rocks.

* *Acarospora verruciformis* H. Magn. Rare on metal-rich boulders in the vicinity of old lead mines. First record Killhope Burn, 35/84, 1997; Scaud Hill, 35/83, 1997.

Agonimia tristicula (Nyl.) Zahlbr. Sparse but widespread. Generally associated with decaying mosses on limestone. Recorded from 8 squares.

Amygdalaria pelobotryon (Wahlenb.) Norman. On several acidic stone walls in the Derwent Vallen, 35/94, 1992.

Anisomeridium polypori (Ellis & Everh.) M. E. Barr. Widespread. Generally in woodland and often on mature elders.

* *Arthonia arthonioides* (Ach.) A. L. Sm. At base of vertical acidic cliffs, Gibraltar Point, 35/94, 1990, det. B. J. Coppins.

A. didyma Körb. On smooth bark of old hazel, Lower Hisehope, 45/04, 1990, G. G. Graham; Westernhopeburn Wood, 35/93, 1994; Slit Wood, also 35/93, 1997.

* *A. lapidicola* (Taylor) Branth & Rostr. On iron tube railings next to concrete post in wooded valley, West Butsfield, 45/14, 1997, conf. B. J. Coppins.

Anaptychia ciliaris (L.) Körb. Not seen during the present survey and feared to be extinct in the county.

Arthrorhaphis grisea Th.Fr. On *Baeomyces rufus* in recess on bankside, Lady's Rake Mine area, 35/83, 1997.

Aspicilia caesiocinerea (Nyl. ex Malbr.) Arnold. Now known from 9 squares, mostly in the western uplands of the county.

* *A. grisea* Arnold. On dolerite block in wall, Force Garth, 35/82, 1996, det. B. J. Coppins.

• *A. laevata* (Ach.) Arnold. Now known from 35/93, 35/94 & 45/05 on damp rocks in and near streams in woodland. First modern record Nookton Burn Woods, 35/94, 1990.

Bacidia arceutina (Ach.) Arnold. Base of ash on dry bank of stream, Crimdon, 45/43, 1997; low on boles in shaded woodland, Bishop Middleham Quarry, 45/33, 1998; on bleached sheep bone on open moorland, Muggleswick Common, 45/04, 1992.

B. bagliettoana (A. Massal. & De Not.) Jatta Over mosses in old limestone quarry, Wingate, 45/33, 1997.

B. caligans (Nyl.) A.L.Sm. Decaying bark on larch fence post, Nookton Burn, 35/93, 1991; on moss and soil on basic outcrop, Killhope, 35/84, 1997; similar substratum, Coldberry End, 35/83, 1997.

* *B. chloroticula* (Nyl.) A. L. Sm. An early coloniser of the tops of shaded fence posts, gates, benches, etc. Widespread in the E. of the county and recorded from 9 squares. First record from tops of fence posts near Winlaton, 45/16, 1996.

* *B. naegelii* (Hepp) Zahlbr. First record from shaded old Populus by the R.Tees near Whorlton, 45/01, 1988, det. B. J. Coppins. Now known also a 35/93, 35/94 & 45/11.

B. rubella (Hoffm.) A. Massal. Very local but not uncommon in the sterile state. Great Wood and Shipley Wood, 45/02, 2000, O. L. Gilbert & D. E. McC.

* *B. saxenii* Erichsen. Cut stump of conifer, Chopwell Wood, 45/15, 1996, det. B. J. Coppins; stone in sheep pasture, Westernhopeburn Farm, 35/93, 1997.

B. subfuscula (Nyl.) Th.Fr. Top of sandstone retaining wall below the Tyne Bridge, Gateshead, 45/26, 1997.

* *B. viridescens* (A. Massal.) Norman. On moss and soil in old mineworks. First record at Bolts Burn, 35/94, 1991; also in other similar sites nearby and at Marl Beck, 35/92, 1997.

* *B. viridifarinosa* Coppins & P. James. Thinly spread throughout the county, although sometimes locally abundant. On shaded boles and rocks, etc. in generally moist situations. First record on shaded bole of birch, Nookton Burn Woods, 35/94, 1991.

* *Bryoria capillaris* (Ach.) Brodo & D. Hawksw. On bole of mature oak near R. Derwent, Gibraltar Point, 35/94, 1992, conf. D. Hawksworth, who commented that the bark was probably acidified.

Caloplaca isidiigera Vezda. Sandstone rock on ground next to gate into pasture, Lamb Shield, 45/04, 1997.

* *C. marina* (Wedd.) Zahlbr. ex Du Rietz. Sparse to frequent on sea defences and piers the whole length of the coast. Very rarely on harder ridges of Magnesian Limestone. Generally in the higher area of the splash zone. First record on concrete sea wall at Seaham, 45/45, 1997. The appearance of this, along with other maritime species, is almost certainly a consequence of the major clean up of the Durham coast during the last decade or so.

* *C. obscurella* (Lahm ex Körb.) Th.Fr. First record from the bole of a huge *Populus* near the R. Tees in woodland, S. of Sledwich Hall, 45/01, 1988, D. E. McC. & G. G. Graham, det. B. J. Coppins 1988; also found in three woods in the Upper Derwent Valley, 45/04 & 45/05, during the 1990s.

* *C. ochracea* (Schaer.) Flagey. Hard part of Magnesian limestone rock at base of cliff, S. of Noses Point, 45/44, 1997.

* *C. teicholyta* (Ach.) J. Steiner. South-facing Magnesian limestone outcrop next to road, Trow Point, 45/36, 1997.

C. variabilis (Pers.) Müll.Arg. On hard limestone blocks in walls and natural outcrops in the hills. Now known from 35/83, 35/92, 35/93 & 35/94.

Candelariella reflexa (Nyl.) Lettau. Generally on nutrient-rich fairly well-lit trees. Now

known from 35/82, 35/93, 45/01, 45/05, 45/13 & 45/16.
* *Carbonea vorticosa* (Flörke) Hertel. Vertical face of siliceous rock in wall, Force Garth, 35/82, 1996.
Catillaria atropurpurea (Schaer.) Th.Fr. At base of old ash in Shipley Wood, 45/02, 2000, D. E. McC. & O. L. Gilbert.
* *C. modesta* (Müll.Arg.) Coppins. Shaded vertical hard limestone outcrop in the hills, Upper Teesdale, 35/83, 1997, conf. B. J. Coppins (E). New to England.
Cetraria pinastri (Scop.) Gray. This species persisted for three or four years, producing soredia which developed into thirteen tiny thalli. After a break of two years, the site was revisited: the boulder that hosted the specimens was now well colonised by *Parmeliopsis ambigua* (Wulfen) Nyl., but with no trace of *Cetraria pinastri* which must now be considered extinct. It was strange that it had been replaced by a species which produces the same coloured soredia. (Could it possibly have been stolen ?)
Chaenotheca chrysocephala (Turner ex Ach.) Th.Fr. Now known from 9 woodlands centred on the Derwent Valley.
C. trichialis (Ach.) Th.Fr. Now known from 12 sites, generally in deeply fissured bark of oak, but also ash. 35/93, 35/94, 45/04, 45/05, 45/15 & 45/16.
* *Chaenothecopsis nigra* Tibell. On shaded rootstock of massive old oak overhanging rock face near R.Tees, Shipley Wood, 45/02, 2()00, D. E. McC. & O. L. Gilbert, det. B. J. Coppins.
* *Chrysothrix flavovirens* Tønsb. Dry bark of mature oak on stream bank, near Tunstall Reservoir, 45/04, 1997.
Cladonia diversa Asperges. All Durham records for *C. coccifera* (L.) Willd. are now considered to belong here.
C. rangiformis Hoffm. Now known to be widespread in the W. of the county in short turf and sparsely vegetated old spoil heaps, etc.
C. scabriuscula (Delise) Nyl. As the previous species, but appears to tolerate rather taller vegetation. Recorded from 13 squares.
* *C. strepsilis* (Ach.) Vain. On wet peat, Bolts Law, 35/94, 1994.
* *C. sulphurina* (Mich.) Fr. On peat in the hills. Castleberry Cleugh, 35/94, 1992; also at Swinhope Head, 35/83, 1997.
• *Cyphelium inquinans* (Sm.) Trevis. On gatepost of cattle grid, near Harwood, 35/83, 1997; on bole of mature ash near stream, Shipley, 45/02, 2000, D. E. McC. & O. L. Gilbert.
Cystocoleus ebeneus (Dillwyn) Thwaites. Now known from 15 sites with a westerly distribution. Always in shaded acidic situations generally near rivers or streams.
* *Dermatocarpon intestiniforme* (Korb.) Hasse In seepage track of basic rocks on steep hillside, Widdybank Fell, 35/82, 1985, conf. O. L. Gilbert.
• *D. luridum* (With.) J. R. Laundon. Submerged on dolerite at the edge of the R.Tees, Upper Teesdale, 35/82, 1993, O. L. Gilbert & V. J. Giavarini.
* *D. meiophyllizum* Vain. On dolerite at the edge of the R.Tees, Upper Teesdale, 35/82, 1993, O. L. Gilbert & V. J. Giavarini.
Diploschistes scruposus (Schreb.) Norman. Now known from numerous walls in the western uplands.
Diplotomma alboatrum (Hoffm.) Flot. On limestone rocks, walls and mortar. Sparsely but widely distributed. Recorded from 10 squares.
Enterographa crassa (DC.) Fée. Saxicolous at Castle Eden Dene, 45/43, 1997.
* *E. hutchinsiae* (Leight.) A. Massal. Deeply shaded underhang at base of crag near waterfall, Allensford, 45/05, 1996, det. B. J. Coppins; on rock underhang at top of gorge, Westernhopeburn, 35/93, 1997.
E. zonata (Körb.) Kallsten. Now known to be widespread on shaded rocks and walls, etc., very rarely on rootstock.
* *Epigloea soleiformis* Döbbeler. On moss over dolerite block in wall, Force Garth, 35/82, 1996, D. E. McC. & C. J. B. Hitch, det. C. J. B. Hitch; near top of shaded rock amongst bank of boulders, Killhope, 35/84, 1997, D. E. McC. & C. J. B. Hitch, 1997, det. C. J. B. Hitch.

Fuscidea lygaea (Ach.) V. Wirth & Vezda. On hard acidic rocks, often in walls, in the uplands. Saltersgate, 45/04, Killhope, 35/84 & Westernhopeburn, 35/93, all 1997.
F. praeruptorum (Du Reitz & H. Magn.) V. Wirth & Vezda. Widespread in the uplands on vertical faces of acid rocks in walls.
* *F. recensa* (Stirt.) Hertel, V. Wirth & Vezda. Sandstone wall in Derwent Gorge, 45/04, 1977, G. G. Graham & B. J. Coppins; acidic boulder in high moorland with *Allantoparmelia alpicola* (Th.Fr.) Essl., Dead Stones, 35/73, 1980, G. G. Graham & R. W. Corner, det. D. E. McC. 1997.
Hymenelia prevostii (Duby) Kremp. Hard part of Magnesian limestone boulder at base of cliffs on the backshore, S. of Noses Point, 45/44, 1997.
* *Hyperphyscia adglutinata* (Flörke) H. Mayrhofer & Poelt. On the bark of dying elm, Stanhope, 35/93, 1989. The elm has now gone, but there are many ash trees present in Weardale and it is possibly still present in that area.
Hypocenomyce caradocensis (Leight. ex Nyl.) P. James & G. Schneider. Now known from several sites in the Upper Derwent Valley woodlands, all on old oaks, 35/94, 45/04 & 45/05, 1990s.
* *Ionaspis heteromorpha* (Kremp.) Arnold. On hard limestone rock at top of gorge, Westernhope, 35/93, 1997; on hard smooth limestone, semi-inundated at edge of Rough Syke, 35/83, 1998.
Lecania cyrtella (Ach.) Th.Fr. Now known to be widespread and recorded from 8 squares, usually on elder.
L. erysibe (Ach.) Mudd. Now known from at least 20 squares, on natural basic substrates and more usually on mortar, gravestones, etc.
* *L. inundata* (Hepp ex Korb.) M. Mayrhofer. On top of carved weakly calcareous sandstone boulder, car park at Winlaton Mill, 45/16, 1996.
* *L. rabenhorstii* (Hepp) Arnold. Around cracks on harder parts of Magnesian limestone cliffs, Souter Point, 45/46, 1997, conf. B. J. Coppins.
Lecanora aitema (Ach.) Hepp. Now known to be widespread in the upland areas of the county, often on lignum, but rarely extremely abundant on exposed conifer twigs and branches, along the edges of fire lanes, etc. Often included in *L. symmicta*, of which most past records almost certainly belong here.
* *L. caesiosora* Poelt. On acidic rocks in walls in the uplands. Recorded from 9 upland squares throughout the 1990s. Most well colonised walls will host this species. Found once in fruit at Hunstanworth churchyard, 35/94. First record on sandstone wall, Westernhope, 35/93, 1988.
L. carpinea (L.) Vain. On older trees and now known from a dozen sites in 6 squares, 35/83, 35/93, 35/94, 45/05, 45/13 & 45/23.
L. epanora (Ach.) Ach. Sandstone wall, W. of Lanchester, 45/14, 1979, G. G. Graham Since found on several walls and rocks, some moderately polluted, 35/94, 45/14, 45/15 & 45/22.
* *L. horiza* (Ach.) Linds. A single thallus on lignum, Westernhope, 35/93, 1997; twig of *Sambucus* at edge of wood, Allensford, 45/05, 1997.
* *L. persimilis* (Th.Fr.) Nyl. On rose on roadside verge, Ireshopeburn, 35/83, 1997; on ash sapling on roadside, Westgate, also 35/83, 1997, det. B. J. Coppins, who comments that it is a common species with a preference for ash. Possibly overlooked as *L. dispersa*.
L. pulicaris (Pers.) Ach. Now known to be frequent in the N/W of the county, rare elsewhere. Generally on smooth bark along the valley woodlands, but also on fence posts, etc. Recorded from 12 squares.
L. saligna (Schrad.) Zahlbr. Horizontal surface of gate, near Esh Winning, 45/14, 1994, P. A. R. J. Stevenson.
L. symmicta (Ach.) Ach. Generally on the nodes of twigs and branches of trees and shrubs. It has been reliably been recorded in the 1990s from 35/84, 35/93, 35/94 & 45/16; see *L. aitema.*
* *Lecidea auriculata* Th.Fr. Very rare. A specimen of *L. confluens* from the collection of

G. G. Graham has been redetermined as this species and is consequently the first county record. Acid rock on high moorland, Lintzgarth, 35/94, 1971, G. G. Graham, det. D. E. McC; sandstone windowsill below iron grill, Hunstanworth church, 35/94, 1991; quartz projection on rock on top of wall, Stanhope Common, also 35/94, 1994, conf. O. L. Gilbert.

L. diducens Nyl. On acid boulders and stone walls in the hills. Recorded from 9 western squares.

* *L. lactea* Flörke ex Schaer. Rare on well-lit acid rocks in the hills especially walls. On rock near top of wall, Westernhopeburn Farm, 35/93, 1988; sandstone rocks in walls, Nookton and Norham Burns, 35/94, 1991, 45/05, 1992 & 35/83, 1998.

L. plana (Lahm) Nyl. Now known to be frequent to abundant on acid rocks and walls in hilly areas. Recorded from 12 generally westerly squares.

L. lapicida (Ach.) Ach. Very rare. The two records in tile Durham *Flora* were both redetermined as *L. plana*, det. D. E. McC. 1997. Only seen on acid rock in wall, Wharnley Burn, 45/04, 1990.

* *L. pycnocarpa* (Körb.) Ohlert. Local in the western hills, on acid rocks usually in walls with a preference for flatter rocks in sheltered, but well-lit moist situations. First record acid stone at top of wall at edge of wood, Thornhope Moor, 45/03, 1987. Forma *sorediata* Coppins & Friday has been found only once on acidic stone in wall near stream, Ladys Rake Mine (disused), 35/83, 1997.

* *Lecidella elaeochroma* f. *soralifera* (Erichsen) D. Hawksw. Very rare on mature old trees. Sycamore beside R.Wear, Stanhope Bridge, 35/93, 1994, G .G. Graham; base of well-lit ash on bankside, Rabbit Bank Wood, near Consett, 45/14, 1997; knurl of pollarded old ash on riverbank, Witton Bridge, 45/13, 1998.

* *Lecidoma demissum* (Rustr.) G. Schneider & Hertel. Soil pocket on shaded ledge in acid wall, Nookton Burn, 35/94, 1991. A specimen collected from Widdybank Pasture in 1973 named as *Schaereria cinereorufa* was redetermined as this species by D. E. McC. 1997.

* *Lepraria cacuminum* (A. Massal) Lohtander. Upper Teasdale, 35/82, 1996, conf. C. J. B. Hitch. On moss on dolerite block in wall, Force Garth, Upper Teasdale, 35/82, 1996, conf. C. J. B. Hitch.

L. caesloalba (de Lesd.) J. R. Laundon. On well-lit acidic outcrops and walls, often on moss, with a stronghold in Upper Teesdale. Seen at 7 sites in 35/82, 35/83, 35/84, 35/92 & 45/04, 1996/7.

* *L. elobata* Tønsb. Near top edge of semi-shaded rock on bankside of boulders, Killhope, 35/84, 1997, det. C. J. B. Hitch & P. M. Earland-Bennett; dangling roots on bankside of old railway line, Saltersgate, 45/04, 1997.

* *L. lobificans* Nyl. Widespread and frequent on mossy rocks and tree bases in medium shade. Generally as fluffy thumbnail-sized light green thalli.

L. nivalis J. R. Laundon. On shaded faces of limestone outcrops in stream valleys. On sheer limestone faces in the gorge of the Stanhope Burn, 35/94, 1994; also in 35/83 & 35/94; 1997.

* *L. rigidula* (Hue) Tønsb. In shaded acidic rocky underhang amongst boulders on bankside, Killhope, 35/84, 1997, D. E. McC. & C. J. B. Hitch, det. C. J. B. Hitch; similar situations at Nookton Burn Woods, 35/94, 1997 & Hamsterly Forest, 45/02, 1998.

* *Leproloma diffusum* var. *chrysodetoides* J. R. Laundon. On bare bank in young plantation on undulating quarry floor, Quarry Wood, 45/04, 1997, conf. A. Orange.

Leproloma membranaceum (Dicks.) Vain. Rare, but true status unclear as past records should be treat with caution; confused in the past with other leprose species.

* *L. vouauxii* (Hue) J. R. Laundon. Widespread on shaded limestone rocks and walls. Recorded from 12 squares from east to west. First noted on shaded vertical rock face (weakly calcareous), Ravens Crag, 45/51, 1996.

Lobaria pulmonaria (L.) Hoffm. Healthy colonies on a few trees in Great and Shipley Woods, 45/02, 2000, O. L. Gilbert & D. E. McC.

L. virens (With.) J. R. Laundon. Almost certainly extinct as the host tree is believed to have fallen into the river.

Micarea bauschiana (Körb.) V. Wirth & Vezda. Now known from 7 modern sites, always in shaded underhangs generally near water, 35/84, 35/94, 45/02 & 45/04.
M. botryoides (Nyl.) Coppins Always in deep shade in acidic conditions. Now known from numerous sites in 7 squares.
M. denigrata (Fr.) Hedl. Now known to be very common on lignum and rarely on stone.
* *M. erratica* (Körb.) Hertel, Rambold & Pietschm. Rare on hard smooth rocks and lignum. Hard stone on open ground near path, Hisehope Burn, 45/04, 1990, D. E. McC. & G. G. Graham; hard pebble on old colliery site, Sacriston, 45/24, 1996; old pallet on waste ground near Newburn Bridge, 45/16, 1996, det. C. J. B. Hitch.
* *M. lithinella* (Nyl.) Hedl. Rare on stones near tracks. On half buried stone at edge of moorland track, 35/94, 1993, conf. B. J. Coppins; sandstone block in corner of field next to farm road, Leadgate, 45/15, 1996; sandstone rock by stream, N. of Tunstall Reservoir, 45/04, 1997.
* *M. myriocarpa* V. Wirth & Vezda ex Coppins. On shaded sandstone rocks, generally in damp valleys. Known from 4 sites in the Upper Derwent Valley and one in Weardale. First record on shaded sides of sandstone boulders by R.Derwent, Allensford, 45/04, 1995, conf. B. J. Coppins.
M. peliocarpa (Anzi) Coppins & R. Sant. Shaded back of acidic rock on hillside, Killhope, 35/84, 1997; stump in woodland, near Winlaton, 45/16, 2000; with *Trapelia coarctata* on siliceous rock on exposed moor, Feldon Carrs, 45/04, 1977, G. G. Graham, det. D. E. McC. 1997.
M. prasina Fr. Now known to be very common in woodland.
M. sylvicola (Flot.) Vezda & V. Wirth. Sandstone boulder on riverbank, near Muggleswick, 45/05, 1989, conf. B. J. Coppins; acidic rocky underhang, N. of Tunstall Reservoir, 45/04, 1997.
* *Moelleropsis nebulosa* (Hoffm.) Gyeln. Very rare, on edge of small bank in old mine area on the bank of stream, Slit, 35/93, 1997, conf. A. Fryday.
• *Mycoblastus sanguinarius* (L.) Norman. Now known from a cluster of 5 sites in the Upper Derwent catchment and one adjacent square in Weardale. On acidic rocks and trees reasonably well-lit but sheltered to some degree. Trunk of oak in valley woodland, Hisehope Burn, 45/04, 1985; locally frequent on acidic capstones of boundary wall of wood, Thornhope Moor, 45/03, 1987; also occurs in 45/05.
* *Omphalina ericetorum* (Fr.) M. Lange ex H. E. Bigelow. Probably frequent to abundant on wet peat and moribund bryophytes on rocks. First fertile record on wet peat, with much sterile material in the vicinity, Swinhopehead, 35/83, 1987.
* *O. pseudoandrosacea* (Bull.) M. M. Moser. On peat on hilltop near heaps of iron-rich rocks, Scaud Hill, 35/83, 1997.
• *Opegrapha mougeotii* A. Massal. Shaded limestone cliffs, Ryehope Dene, 45/45, 1997; a repeat of an 1825 record.
O. ochrocheila Nyi. Shaded base of ash, Westernhopeburn Wood, 35/93, *c.*1992; shaded sandstone underhang near stream, Slit Wood, also in 35/93, 1997.
O. dolomitica (Arnold) Clauzade & Cl. Roux. Limestone rocks near old mine site, Swinhope, 35/83, G. G. Graham, 1981, det. D. E. McC. 1997; shaded limestone cliffs in stream gorge, tributary of Harwood Beck, also in 35/83, 1997.
O. rupestris Pers. Parasitic on *Verrucaria baldensis* on harder part of limestone cliff, Hawthorn Hive, 45/44, 1997.
O. rufescens Pers. At base of elm on riverbank, Great Wood, 45/02, 1997.
O. vulgata (Ach.) Ach. The most frequent member of the genus having been recorded in 10 squares, mostly in the west.
Pachyphiale carneola (Ach.) Arnold. Very local but present in quantity on several old ash and oak in Shipley and Great Woods, 45/02, 2000, O. L. Gilbert & D. E. McC.
Parmelia caperata (L.) Ach. A single small thallus on sycamore, car park, Harperly Hotel, 45/15, 1997.

P. discordans Nyl. Now known to be locally frequent on acid boulders on the high western moorland. Recorded from four upland squares.

P. elegantula (Zahlbr.) Szatala. Alder bole on stream bank, Snowhope Close, 35/93, 1997; bole of mossy sycamore, Hardwick Country Park, Sedgefield, 45/32, 1998.

* *P. exasperata* de Not. Hawthorn twig on woodland margin, Rookhope Burn, 35/94, 1994.

P. incurva (Pers.) Fr. Locally frequent, generally on walls in the hills. At 10 sites in six western squares.

P. laevigata (Sm.) Ach. Without details other than collected in Teesdale by W. Mudd, det. B. J. Coppins, 1991; see *P. sinuosa.*

P. mougeotii Schaer. ex D. Dietr. On siliceous boulder on heather moor, Muggleswick Common, 45/04, 1997; also two sites in 35/94.

P. sinuosa (Sm.) Ach. Two specimens of this species collected in Teesdale by W. Mudd with no details were detetermined by B. J. Coppins in 1991 from a collection ex herb. P. B. Mason lodged at Bolton Museum.

Peltigera canina (L.) Willd. Infrequent, but found in 9 western sites, generally in short turf.

* *P. degenii* Gyeln. Very rare, but locally frequent in one site. On mossy boles of fallen trees and mossy rocks in river gorge woodland, Derwent Gorge, 45/04, 1991, conf. B. J. Coppins. New to England. A specimen of a *Peltigera* sp. collected by G. G. Graham & B. J. Coppins 20 years previously had a scrap of this species attached, det. D. E. McC. 1997; it was collected a few hundred yards downstream, showing evidence of colonisation for some considerable time at this site.

P. didactyla (With) J. R. Laundon. Now recorded from 14 sites in central and western parts of the county.

P. leucophlebia (Nyl.) Gyeln. Limestone outcrop on hilltop, Coldberry End, 35/83, 1997.

* *P. neckeri* Hepp ex Mull.Arg. Locally frequent in short turf on old railway lines and old mine sites in the upland west. First record from short grass at edge of Bolts Burn, Ramshaw, 35/94, 1990; Waskerly Way, 45/04, 1997. Now known from 12 sites in 35/83, 35/84, 35/93, 35/94, 45/03 & 45/04.

* *P. polydactyla* (Necker) Hoffm. Distribution closely follows the previous species. Known from 10 sites in the same areas. First record loose scree and soil on spoil heaps, Jeffries Rake, 35/94, 1 965, G. G. Graham, conf. P. W. James.

Pertusaria coccodes (Ach.) Nyl. Ash bark in gorge woodland, Westernhopeburn Wood, 35/93, 1997.

P. aspergilla (Ach.) J. R. Laundon. Most frequent in the west on acid rocks and especially walls in the hills. Known from 9 sites in 35/82, 35/83, 35/84, 35/92, 45/14 & 45/15.

P. lactea (L.) Arnold. In habitats similar to the preceeding species. Found at 11 sites in 35182, 35/83, 35/92, 35/94 & 45/05.

P. leioplaca DC. Now known to be locally frequent on smooth bark in the moist wooded valleys in the western half of the county.

P. multipuncta (Turner) Nyl. On old rowan in river valley, Beldon Burn, 35/94, 1991.

• *Petractis clausa* (Hoffm.) Kremp. On shaded limestone rock in Castle Eden Dene, 45/43, 1997.

* *Phaeophyscia sciastra* (Ach.) Moberg. On dolerite at the edge of the R.Tees, Upper Teesdale, 35/82, 1993, O. L. Gilbert & V .J. Giavarini.

* *Phaeopyxis varia* Coppins, Rambold & Triebel. Parasitic on *Trapeliopsis gelatinosa,* Force Garth, 35/82, 1996, det. B. J. Coppins.

Physcia aipolia (Ehrh. ex Humb.) Furnr. On dying elm, Crawleyside Bank, Stanhope, 35/93, 1988; nutrient-enriched bark on bank of R.Tees, Neasham, 45/31, 1998; large wayside ash near stream, Shipley, 45/02, 2000, O. L. Gilbert & D. E. McC.

Physconia perisidiosa (Erichsen) Moberg On nutrient-rich bark of large ash in picnic area, Allensford, 45/05, 1992; also in 45/04, 1992.

Placopsis gelida (L.) Linds. Now known from 11 sites in the W. of the county, often on old mine sites. However, all these records probably refer to *P. lambii* Hertel & V. Wirth (B. J. Coppins, *pers. comm.*).

* *P. lambii* Hertel & V. Wirth. Status unclear owing to confusion with previous species. On dolerite boulders amongst juniper scrub, Force Garth, 35/82, 1996.
* *Polyblastia cruenta* (Körb.) P. James & Swinscow. On dolerite at the edge of the R.Tees, Upper Teesdale, 35/82, 1993, O. L. Gilbert & V. J. Giavarini.
Polysporina simplex (Davies) Vezda. Sandstone wall at Baal Hill House, 45/03, 1998, G. G. Graham & D. E. McC.; coarse-grained sandstone rock in wall, Pow Hill, 45/05; 1997; sandstone wall of old workings on hillside, Stanhope Burn, 35/94, 1998.
Porina aenea (Wallr.) Zahlbr. Now known to be widespread on smooth bark in sheltered moist woodland. Concentrated mainly in the major river valleys of the west.
P. chlorotica (Ach.) Müll.Arg. On shaded rocks with a similar distribution to the previous species, but much less frequent.
Porpidia cinereoatra (Ach.) Hertel & Knoph. Most previous records of *Huilia albocaerulescens* will belong here. On rocks and walls in usually moist situations and normally in the hills. At numerous sites in 8 squares in the west, with an outlier in 45/24.
* *P. contraponenda* (Arnold) Knoph & Hertel. Rare on acid rocks on tops of walls in the uplands. Acidic stones in wall top (sheltered by conifers), Stanhope Burn, 35/94, 1994; on dolerite block in wall, Force Garth, 35/82, 1996.
* *P. hydrophila* (Fr.) Hertel & Schwab. Very rare on top of siliceous boulder on bank of R.Tees, partially shaded by trees, Great Wood, 45/02, 1997.
P. platycarpoides (Bagl.) Hertel Emergent acidic rock, Horsleyhope Burn, 45/04, 1992, det. B. J. Coppins. Slightly basic sandstone rocks on riverbank, Great Wood, 45/02, 1997.
P. soredizodes (Lamy ex Nyl.) J. R. Laundon. Now known from numerous widespread sites. Often found on flat stones in old mine sites, and frequently on gravestones by D. H. Smith. Difficult to separate from *P. tuberculosa*, but usually in small neat patches.
Protoblastenia calva (Dicks.) Zahlbr. Rare on pure limestone rocks on hill-top, Coldberry End, 35/83, 1997.
* *P. incrustans* (DC.) J. Steiner. Rare on pure limestone. On limestone rocks, Tarnhole Edge, Teesdale, 35/83, 1993, G. G. Graham & P. S. Graham; on limestone block in wall on road into the hills, Ireshopeburn, also 35/83, 1997.
Pseudevernia furfuracea (L.) Zopf. Both varieties occur in the county, but distribution uncertain as the vast majority of records were assumed in the past to be var. *ceratea*.
* *Psilolechia leprosa* Coppins & Purvis. Widespread in the county under metal run-offs. Found in many churchyards by D. H. Smith; also accompanied by abundant Stereocaulon nanodes on metalliferous clinker on riverbank, Ryton Willows, 45/16, 1997.
• *Psoroma hypnorum* (Vahl) Gray. Very rare in wet underhang on the bank of the Beldon Burn, 35/94, 1988, D. E. McC. & G. G. Graham, det. G. G. Graham.
* *Pterygiopsis lacustris* P. M. Jørg. &. R. Sant. On dolerite at the edge of the R.Tees, Upper Teesdale, 35/82, 1993, O. L. Gilbert & V. J. Giavarini.
* *Pyrenocollema halodytes* (Nyl.) R. C. Harris. Sparse to abundant below H.W.M. on the harder parts of Magnesian limestone rocks, concrete piers and limpet shells, wherever these habitats occur along the Durham coast, except those areas where dense algal growth associated with sewage and coal dust pollution has not been cleared from the rocks. First seen at Trow Point, 45/36 and abundant on S. wall of pier below H.W.M., Roker, 45/45 in coastal survey by D. E. McC. 1997.
* *P. sublitorale* (Leight.) R. C. Harris. Similar habitat to the previous species, but not yet found on shells. On hard ridges of Magnesian limestone boulders below H.W.M., Trow Point, 45/36 1992; also 45/45 & 45/53, 1997.
* *Pyrenula chlorospila* Arnold. On base of old ash in gorge, growing adjacent to Biatorina atropurpurea, Shipley Wood, 45/02, 2000, O. L. Gilbert & D. E. McC.
Racodium rupestre Pers. Shaded damp acidic rocks, generally in gorges, 35/83, 35/93, 35/94, 45/02, 45/04 & 45/05.
Ramalina farinacea (L.) Ach. The distribution of this species has spread more easterly in recent years as efforts to clean up the air have intensified. Now recorded in at least 19 squares.

R. fastigiata (Pers.) Ach. On old ash at edge of pasture, Westernhopeburn Farm, 35/93, 1988; on old sycamore, Horsley House, also in 35/93, 1997.

* *Rhizocarpon amphibium* (Fr.) Th.Fr. On dolerite at the edge of plunge pool below Cauldron Snout, Upper Teesdale, 35/82, 1993, O. L. Gilbert & V. J. Giavarini. Second British record.

* *R. hochstetteri* sensu qtr. Fryday. Very rare on acid rock in pile of stones on hillside of high moorland, Swinhope Head, 35/83, 1997, conf. A. Fryday.

• *R. distinctum* Th.Fr. Very rare on acidic stones in walls in the W. of the county. On acid stone in wall of churchyard, Hunstanworth, 35/94, 1991, conf. O. L. Gilbert; on dolerite block in wall, Force Garth, 35/82, 1996.

R. lavatum (Fr.) Hazsl. Acidic rocks in wall near stream in old mining area, Ladys Rake, 35/83, 1997.

R. polycarpum (Hepp) Th.Fr. Now known to be frequent on acid rocks in walls in the highest parts of the W. of the county.

Rimularia furvella (Nyl. ex Mudd) Hertel & Rambold Now known to be occasional to frequent on well-lit acidic rocks and capstones in walls in the western uplands; very rarely on tops of gates. Recorded from 9 western squares.

• *Rinodina sophodes* (Ach.) A. Massal. Rare, but locally frequent; concentrated in Upper Weardale, but with a far flung outlyer near Sunderland in 45/35. Generally on the nodes of twigs or on smooth bark. First modern record on ash twigs in gorge woodland, Westernhopeburn Wood, 35/93, 1988; also in 35/83 – 6 sites in total.

Sarcosagium campestre (Fr.) Poetsch & Schied. On spoil from old ironworks next to track through woodland, West Wood, Consett, 45/05, 1992, det. O. L. Gilbert; on very short moss on consolidated ground of old colliery site, Hobson Industrial Estate, 45/15, 1996.

* *Schaereria cinereorufa* (Schaer.) Th.Fr. Locally frequent on ledges on walls in the western hill areas. Known from 16 sites in 35/73, 35/83, 35/94 & 45/04. First noted on acidic stones in walls (especially on ledges) in the Upper Derwent Valley, 35/94, late 1980s, conf. O. L. Gilbert. The two entries in the Durham *Flora* listed as this species were erroneous and have been redetermined as *Lecidoma demissum* and *Umbilicaria torrefacta*.

* *S. fuscocinerea* var. *sorediata* (Houmeau & Cl. Roux) Coppins. On acid boulders in boulder field on exposed hillside, N/W of Burnhope Reservoir, 35/83, 1998.

* *Scoliciosporum pruinosum* (P. James) Vezda. Very rare on sycamore in river valleys. On sycamore bole on wooded fringe of R.Derwent, Ravens Crag, 45/04, 1989, det. B. J. Coppins; on sycamore bole on wooded fringe of river Hisehope Burn, also in 45/04 1994.

Sphaerophorus globosus (Huds.) Vain. On top of acid boulders that are big enough to avoid the worst effects of heather burning, 35/93, 35/94 & 45/04.

* *Staurothele fissa* (Taylor) Zwackh. Very rare. On dolerite at the edge of the R.Tees, Upper Teesdale, 35/82, 1993, O. L. Gilbert & V. J. Giavarini; on harder stone in unnamed syke, Ashgill Head, 35/83, 1997.

Steinia geophana (Nyl.) Stein. On spoil from old ironworks at edge of woodland track, West Wood, near Consett, 45/05, 1992, conf. O. L. Gilbert.

Stereocaulon nanodes Tuck. On old mine spoil, Ramshaw, 35/94, 1990, G. G. Graham & D. E. McC.; on small stone in shaded recess of pile of rocks from old mine workings, Scaud Hill, 35/83, 1997; abundant on metal-rich rocks on the riverbank (anti-erosion), Ryton Willows, 45/16, 1997.

* *Strangospora pinicola* (A. Massal.) Körb. Occasional on lignum and rare on bark; mostly on rails in hedges or at the edges of woods. Seems able to cope with moderate pollution. First record on bole of half-grown sycamore, car park, Allensford, 45/05, 1992; also in 45/15, 45/16 & 45/43 – 6 sites in all, with 5 on lignum.

Thelidium minutulum Körb. Now known from 7 sites, usually on shaded rocks or stones, but is probably much overlooked. On shaded limestone rock at side of steps to lower level of cliff, Roker, 45/45, 1997; on emergent hard pebbles/cobbles in R.Wear, Witton Bridge, 45/13, 1998; also in 45/16 & 45/13.

* *T. zwackhii* (Hepp) A. Massal. On limestone in sheltered gorge in the hills, Upper Teesdale, 35/83, 1997, conf. O. L. Gilbert.

* *Tomasellia gelatinosa* (Chevall.) Zahlbr. On hazel twigs near stream, Swinhopeburn Wood, 35/93, 1994, G. G. Graham.

Toninia aromatica (Turner ex Sm.) A. Massal. Now known from 9 sites on limestone, widely separated: three sites in Upper Teesdale, 35/83 and the others on coastal Magnesian limestone, 45/36, 45/43, 45/44 & 45/46.

* *Trapelia corticola* Coppins & P. James. Rare on semi-shaded boles of oak in ancient woodland, Great Wood, 45/02, 2000, O. L. Gilbert & D. E. McC., det. O. L. Gilbert. An inconspicuous species, possibly overlooked elsewhere.

T. obtegens (Th.Fr.) Hertel. On moorland stone on edge of Waskerly Way, 45/04, 1997, D. E. McC. & C. J. B. Hitch, det. C. J. B. Hitch; on block of coarse-grained acid sandstone in wall, Ireshopeburn, 35/83, 1997.

* *Trapeliopsis gelatinosa* (Florke) Coppins & P. James. Rare on decaying roots and bare peat in the uplands. On decaying roots on bankside underhang, Force Garth, 35/82, 1996, conf. B. J. Coppins; on small recess in bankside, Ladys Rake Mine track, 35/83, 1997; on bare peat on heather moor, near quarry at Doctors Gate, 45/03, 1997.

* *T. glaucolepidea* (Nyl.) G. Schneider. Very rare on bare peat at edge of track in mature lichen heath, Waskerley Way, 45/04, 1997.

* *T. pseudogranulosa* Coppins & P. James. Occasional on roots on banks and mossy tree bases in woodland. Scattered in the western half of the county. First record from decaying *Calluna* roots on bankside near Beldon Burn, Castleberry Cleugh, 35/94, 1991.

• *Umbilicaria polyrrhiza* (L.) Fr. Very rare on moorland boulder that has managed to escape the worst effects of heather burning. First seen *c.*1988 on top of large acid boulder on Muggleswick Common, 35/94. Still there in 1997 as three small thalli on top edge of same boulder in a sea of burnt heather and denuded boulders. Refind of a species long thought extinct in the county.

U. torrefacta (Lightf.) Schrader. On large boulder on track to quarry, Harthope Hill, 35/83, 1989, G. G. Graham, D. E. McC., B. Humphreys & S. Wharton; on acidic boulder on exposed grassy hillside, near Mathews Stone, 35/83, 1998.

Usnea filipendula Stirt. Now known from 5 sites in the Upper Derwent Valley woodlands. The first record was in fact from the Burnhope Burn Wood, near Edmundbyers, 45/05, 1985 and not the Bollihope Burn as previously reported; also in 35/94 & 45/04.

* *U. wasmuthii* Räsänen. Very rare on oak in valley woodland, Nookton Burn, 35/94, 1995, conf. B. J. Coppins.

Verrucaria aethiobola Wahlenb. Rare, but status uncertain due to confusion with *V. praetermissa*. On cobbles on the edge of the R.Tees, Great Wood, 45/02, 1989. The Widdybank record should be safe as the species is known to be frequent above Cow Green. Other records are probably *V. praetermissa.*

* *V. amphibia* R. Clemente. Sparse on harder parts of Magnesian limestone and concrete piers at the H.W.M. At base of cliff, Blackhall Rocks, on concrete sea-wall at Seaham Harbour and on concrete and hard boulders at the base of piers at South Shields, 45/36 45/43 & 45/44, 1997.

• *V. caerulea* DC. Rare on shaded limestone cliffs and boulders in gorges at 4 sites near the coast and one in Weardale. First record from shaded harder part of Magnesian limestone cliff, Hawthorn Dene, 45/44, 1997; also Castle Eden Dene, 45/43, Easington Dene, 45/44, Tunstall Hills, 45/35 & Westernhopeburn Wood, 35/93, all 1997.

* *V. funckii* (Spreng.) Zahlbr. Rare on hard pebbles and bedrock in upland streams. On dolerite at the edge of the R.Tees, Upper Teesdale, 35/82, 1993, O. L. Gilbert & V. J. Giavarni; on hard pebbles in upland stream, Swinhope Burn, 35/83, 1997; on hard pebbles at edge of R.Tees, Great Wood, 45/02, 1997; on hard shelves in stream, Slit Wood, 35/93, 1997.

V. margacea (Wahlenb.) Wahlenb. On semi-inundated sandstone pebbles, Swinhope Burn, 35/83, 1997; on emergent acidic boulder in upland stream, S. of Edmundbyers, 45/04,

1997; on semi-submerged acid boulder in upland stream, Wellhope Beck, 35/84, 1997.
V. maura Wahlenb. Sparse but in several sites down the coast where the Magnesian limestone rocks are hard enough and cleared of the debris of pollution. Found in 7 sites in 1997. First seen on harder vertical faces of rough cliffs at Trow Point, 45/36; extending to several metres up cliff face above H.W.M. at Blackhall Rocks, 45/43.
• *V. murina* Leight. Very rare on limestone boulder, adjacent to undescribed Acarospora sp., on shaded stream bank, Westernhopeburn Wood, 35/93, 1995, conf. O. L. Gilbert.
* *V. praetermissa* (Trevis.) Anzi. Widespread and frequent in unpolluted streams. First record uncertain due to confusion with *V. aethiohola.*
V. striatula Wahlenb. Sparsely scattered down the coast and found in 10 sites in similar situations to other maritime *Verrucaria* species, 1997.

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BOOK REVIEWS

Lichens. An Illustrated Guide to the British and Irish Species by **Frank S. Dobson.** Pp. 431, incl. numerous line drawings, maps and colour plates. Richmond Publishing, Slough. 2000. £45.00 hardback, £30.00 paperback.

This fourth edition of Britain's most popular guide to the identification of its lichens is a considerable improvement on its predecessors in terms of its scope and presentation. In all, about 700 species (approx. half the British flora) are treated, the texts to the majority of which are supported by coloured plates and distribution maps. Keys to determine all lichens covered to specific level are provided and where necessary line drawings of diagnostic microscopic features are illustrated. The work is complemented by useful introductory matter, including information on microscopical analyses, chemical tests, photobionts and air pollution zones, and a glossary. There should be no excuse now for the inability of the general natural historian or ecologist to identify such organisms, at least the commoner ones, which form key components of many ecosytems.

MRDS

The Flora of Dorset by **Humphry Bowen.** Pp. viii + 373, incl. numerous line drawing, maps & colour plates. Pisces Publications. 2000. £45.00 hardback + £5.00 postage & packing from Naturebureau, 36 Kingfisher Court, Hambridge Road, Newbury, Berks. RG14 5SJ.

Although the author, a friend and colleague of this reviewer, saw this volume through to print, his recent untimely death precludes his enjoyment of the many complimentary reviews of this splendid work. The scope of the Flora is ambitious in its review of the vascular plants, bryophytes, lichens, fungi and algae, but the author's undoubted knowledge of all these groups provides a balanced coverage, lacking in some Floras where non-vascular plants are often treated as an afterthought. Although the author had been interested in the Dorset flora since 1934, his main work was undertaken after he retired to his holiday home there in 1988; during the last decade, for example, he assembled 220,000 flowering-plant records. However, previous work on the county's flora is not forgotten, and the review (by David Allen) of some earlier workers is first-rate.

In all, over 2000 species of vascular plants (more than 900 of which have distribution maps at the 2 km x 2 km level), 324 mosses, 101 liverworts, 652 lichens, 1496 fungi and *c*.400 algae are treated within the main body of the text. Alien plants are also given full coverage, including details of some ornamental plants in cultivation at selected localities. Introductory chapters by several authors, on physical features, vegetation and effects of man (including archaeobotany by Pat Hinton) are also provided.

This volume is a fitting tribute to a distinguished chemist who through meticulous recording proved himself to be one of Britain's most versatile botanists.

MRDS

The Flora of the Bristol Region by **Ian P. Green, Rupert J. Biggins, Clare Kitchen** and **Mark A. R. Kitchen,** and edited by **Sarah L. Myles.** Pp. vi + 276, incl. numerous line drawings, maps and colour plates. Pisces Publications. 2000. £27.50 hardback + £4.00 postage & packing from Naturebureau, 36 Kingfisher Court, Hambridge Road, Newbury, Berks. RG14 5SJ.

This Flora, the culmination of a 15-year project, details the occurrence of more than 1600 vascular plants, 1008 of them on a 1 km x 1 km basis, within the area formerly known as the County of Avon. Due to the detailed nature of the maps it is possible to gauge the pattern, ecology and status of the species, but template maps of a range of topographical features, etc. would have been useful for comparative purposes; however, useful introductory chapters on the Physical Character and the Habitats of the Region are provided. Of particular interest is the chapter on 20 Sites of Botanical Interest, including the famous Avon Gorge, which are analysed in detail. Other chapters are devoted to the History of the Avon Flora Project and Botanists in the Bristol Region, as well as Lists of Native and Non-native Species not recorded in the area investigated in recent years, and a Gazetteer. This work is a model of its kind in that the comprehensiveness of the botanical survey will provide an invaluable benchmark against which to monitor any future changes.

MRDS

The Aurelian Legacy. British Butterflies and their Collectors by **Michael A. Salmon,** with additional material by **Peter Marren** and **Basil Harley.** Pp. 432, incl. 162 b/w and 42 colour plates. Harley Books, Great Horkesley, Colchester. 2000. £30.00 hardback.

This magnificently produced book is a fitting tribute to dedicated lepidopterists past and present. The author is clearly one of a very long line of enthusiasts, some more appropriately labelled as eccentrics, stretching back over 300 years. By the early 18th century entomology had becomes a social, even fashionable, pursuit. One such group, meeting at the Swan Tavern in London at that time, was dubbed "The Aurelians" (aurelius referring to the gilt-decorated chrysalids of certain nymphalid moths) – hence the title of this book. Collecting reached its zenith in the 19th century, when the esoteric activities of Victorian entomologists were often little more than trophy hunting. Although environmental changes also impacted dramatically on our butterfly fauna, such over-zealous collecting undoubtedly led to the decline, indeed disappearance, of many species.

The main part of this work is devoted to succinct but fascinating biographies of 101 notable lepidopterists. Other sections deal with the history of butterfly collecting in Britain, the techniques and equipment used in their collection, and the development of knowledge of 35 butterfly species recorded at some time in Britain, such as the Large Blue, the Arran Brown and the Scarce Copper. Overall, the volume is a visual delight while the text is both informative and a joy to read. Thoroughly recommended, not only to entomologists but also to those with wider natural history interests.

MRDS

THE COLLYRINAE (*HYMENOPTERA, ICHNEUMONIDAE*) OF YORKSHIRE.

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This small subfamily has two British species whose adults are quite distinctive in appearance (Fig. 1) and which can be identified by reference to Fitton (1984). Kerrich (1936) was the first to recognise that two species of *Collyria* occurred in Britain and Fitton's key introduces a new character for separating them. The "commoner" one is parasitic on the larvae of stem-mining sawflies (Hymenoptera: Cephidae), especially the Wheat-stem Sawfly *(Cephus pygmaeus),* and the other is likely to have a similar host spectrum, though that has not yet been proven. Not surprisingly, the adult ichneumon has a similar slender shape to that of its host.

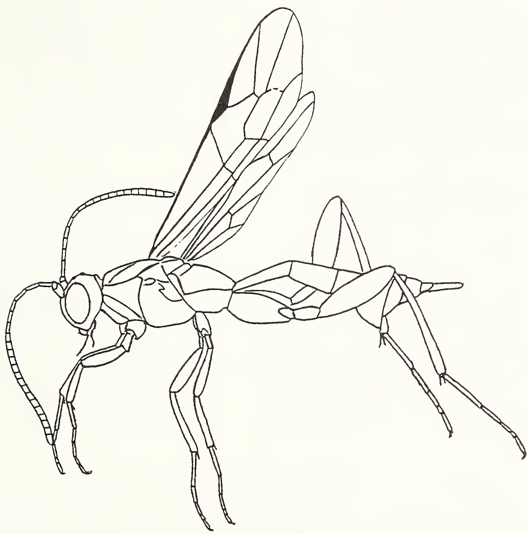

FIGURE 1.
Collyria trichophthalma (Thomson, 1877) left wings omitted.

All the Yorkshire records of *Collyria* have previously been reported as *C. coxata* (Villers) (Hincks, 1946; Hincks, 1951 and Hincks, 1953) and were collected between 1936 and 1947 (Figs. 2 and 3). Most of the insects on which these records are based have been seen by G. J. Kerrich, J. F. Perkins or myself in the Manchester Museum, Leeds Museum or Don Smith collections and all are correctly identified; there remain a couple of records for which I have not been able to trace any specimens. Fitton states that this insect is

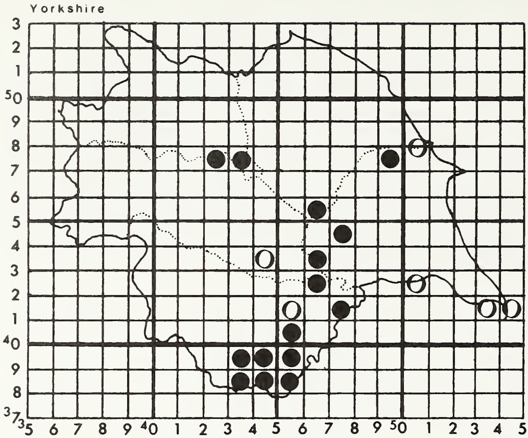

FIGURE 2.
Recorded distribution of *Collyria coxata* (Villers, 1789) (○) and *Collyria trichophthalma* (Thomson, 1877) (●) in Yorkshire.

"common and has been collected as far north as North Yorkshire". However, no specimens of *Collyria coxata* have been seen from Yorkshire since 1947. Fitton records the flight period as June and July, which is true for the Yorkshire records.

The second species is *Collyria trichophthalma* (Thomson), which Fitton states "is rare . . . in southern England . . . as far north as Cambridgeshire". However, I have seen Yorkshire specimens collected from fifteen 10 km squares in 4 vice counties between 1944 and 1991 in the collections of the Yorkshire Museum and Doncaster Museum and Art Gallery as well as freshly-collected material (e.g. Ely, 1986) (Figs. 2 and 3). Fitton records the flight period as May and June but there are Yorkshire records from July and the very first are from August 1944 and April 1945! Both were collected from Malton Road, York, by J. H. Elliott.

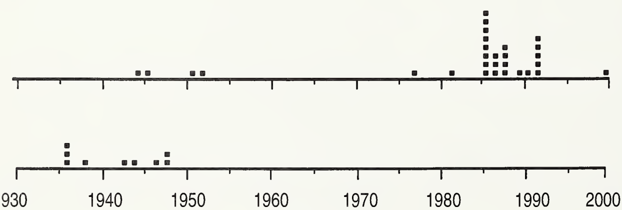

FIGURE 3.
Recorded occurrence of *Collyria coxata* (Villers, 1789) (bottom line) and *Collyria trichophthalma* (Thomson, 1877) (upper line) in Yorkshire.

The Yorkshire records of these two insects fall into two patterns, a temporal one and a spatial one. Although there is an overlap, the records of *C. coxata* generally predate those of C. *trichophthalma* and the latter has been the only *Collyria* recorded in Yorkshire for half a century. This implies that a change in status has occurred and we may have observed the final stages of the replacement of *C. coxata* by *C. trichophthalma.* This change may not have occurred in the south of England, though it would be interesting to know if Fitton's review, which is based on museum specimens and is necessarily historical, reflects the current position there. (I have collected *C. trichophthalma* in the south of England but have never taken *C. coxata.)* The cause of this change in status is unclear and the picture is made more complex than normal because these are parasitic insects. The change may be the result of an effect on its host or on itself or on both together.

The second pattern is again not absolutely clear-cut but most records of *C. coxata* are coastal or estuarine while none of the *C. trichophthalma* records can be so described. The YNU has been as active in the coastal fringe of Yorkshire since 1950 as it was before and the flight periods of both species coincide with the months of the Union's Vice County field meetings, so collector bias seems to be an unlikely explanation for this difference. It may reflect a differential host ditribution, with the effects of the coast exerting an influence on the host instead of, or as well as, on the ichneumon. There are no records for either species from the uplands, which is what would be expected of insects which are at or close to the northern limits of their British ranges.

There are other anomalies in the distribution of the two *Collyria* species and I would like to draw attention to two inexplicable gaps. Two of the most diligent collectors of insects in Yorkshire were William Fordham, operating in the Allerthorpe area from 1920 to 1935, and John Wood, who added so much to our knowledge of the entomofauna of Keighley between 1928 and 1950. Neither naturalist studied the Parasitica but both collected them extensively and passed specimens on to others, yet there are no records of *Collyria* from either of their principal collecting grounds. It is possible that Keighley is too far into the uplands (and Wood did collect *C. coxata* on one visit further east) but Fordham lived in the area which has provided many examples of *C. trichophthalma* recently. His failure to find *Collyria is* particularly interesting.

Acknowledgements

I am grateful to all those collectors who have passed specimens to me or deposited them in a museum collection: Austen Brackenbury, Harry Britten jnr, J. H. Elliott, Simon Hayhow, Douglas Hincks, Alan Lazenby, Joyce Payne, Peter Skidmore, Don Smith, Derek Whiteley and John Wood. I also wish to express my gratitude to Colin Johnson, Peter Skidmore, Martin Limbert, Paul Howard, Stuart Ogilvie, Adrian Norris and Mike Fitton for providing access to the entomology collections at Manchester Museum, Doncaster Museum and Art Gallery, Yorkshire Museum, Leeds Museum and the Natural History Museum.

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BOOK REVIEWS

The Changing Wildlife of Great Britain and Ireland edited by **David L. Hawksworth.** Pp. xvi + 454, incl. numerous tables, graphs & maps. Taylor & Francis, London. 2001. £150.00 hardback.

This volume is a milestone in our understanding of the changes to and current status of our country's fauna and flora. Like its predecessor, *The Changing Flora and Fauna of Britain* published in 1974, it provides a reliable baseline for conservationists since it documents losses and declines, and additions and increases, to a wide range of organisms over the past 25 years. Each of the following groups has received specialist treatment: Flowering plants, Ferns and allied plants, Mosses, liverworts and hornworts, Larger fungi, Microscopic fungi, Lichens, Terrestrial and freshwater eukaryotic algae, Cyanobacteria, Diatoms, Viruses, Protozoa, Freshwater invertebrates, Nematodes, Mites and ticks, Flies, True bugs, leaf- and plant-hoppers, and their allies, Butterflies and moths, Grasshoppers, crickets and allied insects, Dragonflies and damselflies, Land slugs and snails, Birds, Mammals, and Fishes – in all, a remarkable survey that provides a fairly comprehensive database. These 23 chapters are supported by three valuable contributions on 'Fifty years of statutory nature conservaion in Great Britain', 'Tracking future trends: the Biodiversity Information Network' and 'Prospects for the next 25 years', the latter making the point that "monitoring the status of the perhaps 100,000 species in great Britain is unlikely to become realistic in the foreseeable future" and that "overall, the future looks bleaker than the past" – clearly the prognosis is one of on-going concern. This book is an absolute must for the serious naturalist, but at this exorbitant price such readers will only be able to consult library copies.

MRDS

The Correspondence of Charles Darwin: Volume 12, 1864 edited by **Frederick Burkhardt** and others. Pp. xl + 694, incl. several line drawings, plus 13 pp. of b/w plates. Cambridge University Press. 2001. £55.00 hardback.

The latest volume in this monumental series, reviewed extensively in *The Naturalist* over the past 16 years, charts a single but highly productive year: despite his continued ill-health, Darwin reveals through his correspondence the impact of his theory of evolution on the scientific world and the public in general. His researches in support of his theory and in other biological fields are also evidenced from his letters; of particular interest are those relating to his work on cross-pollination and climbing plants, the latter resulting in the publication of his treatise *On the movement and habits of climbing plants* the following year. In 1864 he had also commenced work on what was to be one of his most influential publications in support of his theories, namely *The variation of animals and plants under domestication* (published in 1868).

This volume contains important correspondence with Jean Louis Agassiz, George Bentham, Hermann Crüger, Hugh Falconer, Asa Gray, Joseph Hooker, Thomas Huxley, William Jenner, John Lubbock, Daniel Oliver, John Scott, Richard Spruce and Alfred Russel Wallace and many other notables, as well as considerable information relating to Kew, the Linnean Society and The Royal Society (including the award of its highest honour, the Copley Medal, to Darwin in 1864, detailed in Appendix IV). As would be expected now of this definitive work, the letters are supported by a very considerable textual apparatus, as well as bibliographic and biographic material, and a comprehensive index.

MRDS

FUNGUS-GNATS FOUND NEW TO YORKSHIRE IN 2000

JOHN COLDWELL
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The five families of Nematocerous Diptera popularly referred to as fungus-gnats are essentially woodland insects, which, as the name implies, develop in various types of fungi. Some, like *Keroplatus testaccus*, are characteristic of old forest or parkland around rotting logs whilst a few may be more readily found by sweeping tree foliage. The majority, however, are denizens of damp, shady woodland floors and streamsides with peaks of abundance in early summer and especially autumn.

A number of fungus-gnats are reported for the county for the first time as a result of recording carried out by the author in the Barnsley area and of specimens collected by Roy Crossley in various parts of Yorkshire during the year 2000. The following list consists of species 'reported' for the first time, although it is probable that some will already have been found in the county by visiting dipterists in the past and the author would be keen to hear of any such additions.

Keroplatus testaceus Dalman
Worsbrough Country Park 1♀ swept from a rotting log in willow carr, 3.9.2000. A large yellowish gnat found in southern England with odd records from Cumbria and Scotland.

Neoplatyura modesta Winnertz
Skipwith Common. 1♀ swept by R. Crossley, 22.8.2000. A predominantly southern species although known from Cheshire and Lancashire.

Macrocera fastuosa Loew
Chafer Wood, 7.8.2000. A Red Data Book 1 species, this ♂, found by R. Crossley, constitutes only the third British record.

Boletina dispecta Dziedzicki
Houghton Common, South, Yorkshire. 1♂ swept from bracken in shade under *Quercus*, 8.9.2000. A scarce though widespread fly nationally.

Boletina edwardsi Chandler
Sieve Dale Fen. 1♂ 11.9.2000 by R. Crossley. Very local in the north though proving to be generally widespread.

Boletina rejecta Edwards
Clough Wood, Gunthwaite. 1♂, 9.9.2000. Both this species and the very similar *B. dispecta* are proving to be more frequent than once thought (Chandler, *pers. comm.*).

Boletina trispinosa Edwards
Found at Nabs Wood, Silkstone and by the wooded edge of Ingbirchworth Reservoir. This species will probably prove to be fairly common.

Cordyla fasciata Meigen
A local gnat, found at Houghton Common and Nabs Wood. Presumably overlooked by previous recorders in Yorkshire.

Synplasta ingeniosa (Kidd)
Clough Wood, Gunthwaite. 2♂♂, 29.8.2000. Found in broad-leaved woodland in southern England, the larvae probably developing in soft fungi. Scarce, but beginning to be found more widely.

Anaclileia dispar (Winnertz)
Fox Clough, Langsett. 1♂, 30.5.2000. A small, dark sciarid-like gnat which could overlooked. Scarce nationally.

Neuratelia nigricornis Edwards
Uncommon, with scattered records throughout Great Britain, this species was found near the Little Don Valley in mid-July amd also in a similarly shady streamside moorland valley habitat at Broadhead Clough a few days later by R. Crossley.

Phthinia mira (Ostroverkhova)
Clough Wood. 1♂, 20.8.2000. The one record of *P. humeralis* in Yorkshire (excluding one from Malham Tarn based on an unreliable find in 1980) may well have been this species as the *humeralis* group was not clarified until Chandler (1987).

Sciophila fenestella Curtis
Single ♂♂ found in willow carr by Elsecar Reservoir in July and by streamside vegetation near Wortley, South Yorkshire in September. Mainly southern but present in north-west England and may well have a wider distribution than currently believed.

Two further species have been recorded during 2000, which, although stated as having occurred in 'Yorks' in Hutson *et al.* (1980), only appear in the YNU index on that account and without locality details in the first case and only otherwise on the aforementioned Malham list in the second.

Bolitophila glabrata Loew
1♂, Dearne Valley Park 18.10.2000. Rather uncommon in Great Britain.

Mycomya fimbriata (Meigen)
1♂, Gypsy Marsh, near Wombwell, 16.8.2000. Widespread nationally.

ACKNOWLEDGEMENT
I would like to thank Peter Chandler for checking a number of specimens and also Roy Crossley for collecting and making available material for study, knowing that I had become interested in this group of flies.

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BOOK REVIEW

Riverside Journey: A Portrait of the Derwent by **Ashley Bryant.** Pp. 90, half paintings, half text. The Lutterworth Press, Cambridge, 2001. £30.00 hardback.

Riverside Journey is a portrait of the author/artist's three year journey down the Derbyshire Derwent from its source to where it joins the Trent. The volume contains over 80 paintings and sketches in a variety of media which chart the river in all its moods over these three years. The accompanying text details the author's memories, for example of walks in his home county as a child, and information about the activities of naturalists, historians and others in this beautiful county. Bryant captures the mood of the river in his paintings, which vary from evocations of woodland and moor to the fun of raft races, riverside gardens and walks. The majesty of mills and stately homes contrasts with more tranquil scenes in winter or at night. The book is a pleasure to the eye, of interest to the natural historian and of especial pleasure to those who have lived in or visited the areas of Derbyshire which are covered.

JLA

A TAWNY OWL SEEN TAKING A FYLING BAT IN BRADFORD

DIANE GREGORY
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The role of owls as the major natural predator of bats has been discussed for many years. The literature was reviewed by Speakman (1991). Evidence from owl pellets has left no doubt that owls eat bats. Speakman (1991) concluded that bats account for less than 1% of the prey items taken by owls in the British Isles, but even so, this may be as much as 10% of annual bat mortality. Julian and Altringham (1994) analysed a total of 741 owl pellets, collected on a monthly basis, from a tawny owl's territory in a small wood adjacent to a sewage works on the outskirts of Leeds. They found that bats were regularly consumed, probably by a single owl, and reported that they had encountered no other case where a British owl had predated upon bats to so marked an extent.

On the evening of Monday, 23 July 2001, in the garden of a house north-west of Four Lane Ends, Bradford, a tawny owl was observed using a tree as an observation post and intently watching *Pipistrellus pipistrellus* bats emerging from their roost. The house owners commented that the owl and its mate were regular visitors to the garden at dusk. Bats were both emerging from the roost and feeding in the surrounding garden. The owl launched itself, manoeuvred above a flying bat and in a movement that involved a turn through 180°, took the bat and flew off. The sequence of events was too fast to enable accurate observations of how the bat was taken. Within a relatively short time the owl was back, and again watched the bats as they continued to emerge.

John Altringham *(pers. comm.)* has seen a similar occurrence at Malham. On this occasion the bat was taken during the dawn swarm, before re-entering the roost. Despite the fact that only a single observation was made, it is probable that this particular owl takes regular meals of pipistrelle bats from this Bradford roost. There is little doubt that the numbers of bats from the roost will be severely depleted. It seems that where owls encounter bat roosts within their territories, they learn to exploit bats as a food source, both at dusk and dawn, the periods of maximum bat density. It is likely that such encounters are purely adventitious, and that having recognised the availability of an unusual food supply, owls adopt strategies that enable them to utilise it.

ACKNOWLEDGEMENTS
Thanks are due to the Soni family who allowed me to make this observation, to John Drewett who commented upon the unusual nature of this event, and to Gordon Richardson who encouraged me to describe it.

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BOOK REVIEWS

Snakes by **Peter Stafford** Pp. 112 with 114 colour photographs and 12 drawings and diagrams. The Natural History Museum (Life Series), London. 2000. £9.95 softback.

This book by the editor of the *Bulletin of the British Herpetological Society* highlights the variety and complexity of an often misunderstood group of vertebrates which worldwide includes almost 3,000 living species. The evolution, biology and natural history of snakes is fascinatingly and comprehensively dealt with and the quality of the numerous colour photographs is justification enough to acquire this book.

The Natural History Museum's Life Series form an authoritative, attractive and highly accessible introduction to a range of natural history subjects written by some of the world's leading specialists. A standard and particularly useful feature is a good glossary, up to date bibliography, contact with relevant specialist societies and of great value is the range of addresses for internet resources.

CAH

Deep Ocean by **Tony Rice.** Pp. 96 with over 80 colour photographs and 14 drawings and diagrams. The Natural History Museum (Life Series), London. 2000. £9.95 softback.

A mere 150 years ago the geography of deep ocean areas was a total mystery, biologists judging it inconceivable that they could support life. From 1872 to 1876 tantalising glimpses into the ocean deeps were revealed by the celebrated oceanographic expeditions of HMS *Challenger*. However, in the past couple of decades a range of new technologies have shone an enquiring light into the abyss of 'inner space' producing a veritable deluge of new discoveries. As with the opening up of the world's continents to botanists and zoologists during the 18th century, it is our privilege to live at a time when technological developments, in this case deep sea submersibles, cameras, videos, satellite imaging and computers, are not only revealing a 21st century 'cabinet of curiosities' but pointing to new pathways of evolution and revealing totally new ecosystems fuelled by geological sulphides and chemosynthetic bacteria rather than sunlight and photosynthetic plants.

We are shown the ability of countless vertebrate and invertebrate organisms to signal, deter, attract and lure by a dazzling array of bio-luminescent techniques. We see scavengers at work seven miles down on the abyssal plain. There are giant worms, monster clams, heat seeking shrimps and creatures surviving temperature gradients ranging from freezing point to that of molten lead.

Whether by coincidence or good planning, the issuing of *Deep Ocean* in the Natural History Museum's 'Life' series coincides with the screening of the BBC TVs highly successful marine wildlife spectacular *The Blue Planet*. In covering the same subject areas as the film, even illustrating the same points with the same examples and images, one could be excused for believing this book provided the blueprint for the film's fabulous and revealing deep sea episode.

The author, Dr Tony Rice is a respected authority in the world of oceanography, having worked as a marine biologist at the Natural History Museum and at the NERC Institute of Oceanographic Sciences where for 26 years he led the deep-sea benthic team. Certainly Dr Rice's fascinating and beautifully illustrated book forms an excellent companion volume to the BBC's film and would form an ideal gift for any aspiring oceanographer or marine biologist.

CAH

Earth and You. Tales of the Environment by **Charles Officer** and **Jake Page.** Pp. viii + 254, incl. line drawings & b/w plates. University Press of New England, Hanover. 2000. $25.00 hardback.

A thoughtful appraisal of our planet's environmental health which, while it addresses such major problems as global warming, population growth, resource depletion, species decimation and chemical pollution, is nevertheless optimistic in its approach. The authors show how more imaginative approaches to solving these problems could be pursued through national and international initiatives, moral and religious leadership, and research and development. A refreshingly positive treatment of some very important and sensitive issues, rather than the pessimistic or indeed apocalyptic overview of all too many environmentalists and conservationists.

MRDS

ENTOMOLOGICAL REPORT: DIPTERA (TIPULOIDEA AND EMPIDOIDEA)

ROY CROSSLEY

Introduction

An outstanding feature of this Report are the additions to the County's diptera list made by Andrew Godfrey as a result of his splendid work in rearing specimens from exudations and the debris of rot-holes sampled from Horse-Chestnut (*Aesculus hippocastanum*) and Sycamore (*Acer pseudoplatanus*). Of particular note are the *Systenus* species which are rarely encountered except by rearing them; in twenty years of collecting I have taken only one specimen with the sweep-net. Mr Godfrey's work suggests that these enigmatic flies are probably more widespread and numerous in Yorkshire than had hitherto been thought.

In addition to Mr Godfrey the following dipterists have submitted records, the more significant of which are included in this Report: J. D. Coldwell, W. A. Ely, and A. E. Stubbs, to all of whom I express my thanks; unattributed recent records are those of the writer. New County records are indicated by †, and Vice-County records by *.

National rarity classifications which follow, where appropriate, immediately after the species names, are those provisionally recommended by Falk (1991) for Tipuloidea, and by Falk and Crossley (*in prep.*) for Empidoidea. The systematic order of the list, and nomenclature, follow Chandler (1998).

I am grateful, as ever, to Mr J. H. Cole and Mr A. E. Stubbs for much help and advice.

Tipulidae

Tipula (s.g. *Pterelachisus*) *pseudovariipennis* Czizek Nb. (61) Barmby Moor, 1♀ 29/5/99 (*leg.* & *det.* R. C., *teste* J. H. Cole). The only previously reported occurrence of this species in Yorkshire is from High Batts, Ripon (64), April 1999 (*Nat.* **125** p. 137).

Pediciidae

Dicranota (s.g. *Rhaphidolabis*) *exclusa* (Walker) (63) Broadhead Clough, 15/5/00. The first Yorkshire record was from Malham Tarn (64), 1956, and then Midhope Reservoir (63), 1999 (*Nat.* **125** p. 137).

Limoniidae

**Gonomyia* (s.g. *Prolipophleps*) *abbreviata* Lw. RDB3 (62) Forge Valley Woods NNR, 1♂ 26/7/99. Apart from a 1927 report from Austwick (64), the only previous Yorkshire records are from the Doncaster area (63) in the mid-1980s (Conisborough, Sandall Beat and Pot Ridings Wood).

Hoplolabis (s.g. *Parilisia*) *vicina* (Tonnoir) (62) Seivedale Fen, 11/9/00. There is a record from Mulgrave Woods (62), in 1937 by the late F. W. Edwards of the British Museum (Nat. Hist.) (now the Natural History Museum), where the specimen(s) was deposited. The only other Yorkshire record is from Birk Crag Wood, Harrogate (64), in 1996 (*Nat.* **123** p. 121).

Ormosia (s.g. *Ormosia s.s.*) *pseudosimilis* (Lundström) (*62) Coulton Mill Fen, 5/7/00; (63) Broadhead Clough, 24/8/00. There are a further ten widely scattered records from the west and south of Yorkshire, half of which are fifty or more years old.

Scleroprocta sororcula (Zett.) Nb. (62) Chafer Wood, 22/5/00. (63) Broadhead Clough, 12/6/98 (*leg.* & *det.* R. C., *teste* J. H. Cole). The only previous Yorkshire records are Bilsdale (62), 1921; Colsterdale (65), 1981; Little Don Valley (63), 1997.

Eloeophila trimaculata (Zett.) Nb. (63) Broadhead Clough, 15/5/00. Apparently scarce in Yorkshire, with only four previous widely scattered records, all post-1976 (*Nat.* **124** p. 84).

Hexatoma (s.g. *Hexatoma s.s.*) *fuscipennis* (Curt.) (65) Great Langton, 17/7/97 A.G., swept ex river shingle. This appears to be a very localised species in Yorkshire with only one post-1953 record (Nosterfield gravel pit [65], 1998) (*Nat.* **124** p. 84).

**Limnophila* (s.g. *Limnophila s.s.*) *pictipennis* Mg. RBD2 (65) Pond near Wath (Ripon), -/9/00, A.E.S. The only previous Yorkshire record is from Levisham (62) in 1895.

†*Pilaria decolor* (Zett.) (62) Chafer Wood, 11/7/00. Treated as a variety of *P. discicollis* (Mg.) by Edwards (1938), *P. decolor* has only recently been added to the British List (Stubbs, 1997). *P. discicollis* is common and widespread, and it is probable that examples of *P. decolor* have been incorrectly named as *discicollis* in the past.

Atypophthalmus inustus (Mg.) Nb. (*62) Chafer Wood, 11/7/00. (63) Worsborough Country Park, 23/7/00 J.D.C. There are only two previous Yorkshire records for this species: Rushy Moor Wood (63) 1982, and Acklam (61) 1999. It occurs in damp woodland, where the larvae breed in fungi (Falk, 1991).

**Dicranomyia* (s.g. *Dicranomyia s.s.*) *sera* (Walker) (61) Welwick, 15/8/00. A coastal marsh species; the only other Yorkshire record is from Blacktoft Sands (63), 1976.

D.* (s.g. *Idiopyga*) *nigristigma* Nielsen (62) Ashberry, 1♂ & 1♀, 25/8/89 A.E.S. This species was reported in 2000 as new to Yorkshire, from specimens collected by John Coldwell in 1999 in shady valley-side flushes in the Little Don Valley (63), (*Nat.* **125 p. 138). Further specimens were found in the same locality during 2000. The current record pre-dates the south Yorkshire ones by ten years. The species has only recently been added to the British List (Stubbs, 1998).

D. (s.g. *Sivalimnobia*) *aquosa* Verr. Nb. (63) Broadhead Clough, 19/7/00. This species appears to be scarce in Yorkshire, records since 1954 being: Hayburn Wyke (62), 18/7/96 L. W. Hardwick; Langsett (63), -7/97 *et.seq.* J. D. C.; Cotterdale (65), 24/7/74 J. H. Cole. The Langsett and Broadhead Clough specimens were found in the vicinity of small waterfalls and projecting boulders in woodland streams.

**Helius* (s.g. *Helius s.s.*) *pallirostris* Edw. Nb. (64) High Batts Nature Reserve, 24/6/00. All previous Yorkshire records are from the Doncaster/Barnsley area.

†*Rhipidia* (s.g. *Rhipidia s.s.*) *ctenophora* Lw. RDB2 The following records have been submitted by Andrew Godfrey; all of them are the result of breeding work. (*61) Western Cemetery, Hull: 1♀ emerged 17/6/96 ex sappy Sycamore wood; (*62) Duncombe Park: 8 em. 17/6/96 ex sappy *Aesculus* wood, 2♀♀ em. 16/5/97 ex sappy *Aesculus* wood; (*63) Nostell Priory: 1♂ em. 23/5/96 ex *Aesculus* sap.

HYBOTIDAE

Oropezella sphenoptera (Lw.) (62) Chafer Wood, 19/6-7/8/00. This is the third VC62 locality to be reported in recent years, the others being Duncombe Park and Forge Valley Woods NNR. This is an uncommon species of southern Britain, which is known elsewhere in Yorkshire from sites on magnesian limestone in the Doncaster/Rotherham area (*Nat.* **125** p. 138)

†*Anthalia beatricella* Chandler RDBK (62) Castle Hill Wood, Helmsley, 20/5/00 & 27/5/00. This minute hybotid is the only representative of the genus known to occur in Britain. The first British specimen, a single ♀, was collected at Castle Hill Wood, 21/6/83 by Dr I. F. G. McLean, and it remained un-named until 1992 when the species was described on the basis of specimens collected by Mr Peter Chandler in Windsor Forest at

Crataegus flowers in 1987, and at Old Buckenham Fen, Norfolk in 1990, as well as several submitted from Czechoslovak localities (Chandler, P. J., 1992. *Dipterists Digest*, **No. 12** pp. 16-18). It was gratifying to re-discover the species in quantity ex *Crateagus* flowers at several locations in the general area of the original capture, where it is clearly well established.

**Oedalea tibialis* Macq. (62) Hollin Hill Bog, 16/6/00 (in carr woodland). First reported in Yorkshire from Denaby Ings (63) in 1987, this apparently scarce species has since been found at Thorne Moors (63), and at Burton Constable and Thornton Ellers (both 61).

†*Platypalpus melancholichus* (Coll.) RDB3 Great Langton (65), 17/7/97 A.G.; swept ex, river shingle. Recent records nationally are from river systems in Herefordshire and northern Scotland (Falk & Crossley, in prep.).

**P. stabilis* (Coll.) (61) Hornsea Mere, 9/8/96. The only other Yorkshire record for this species is East Keswick Fitts (64), 18/8/85 R.C.

**P. subtilis* (Coll.) Nb. (65) Great Langton, 17/7/97 A.G.; Gunnerside, 4/8/97 A.G. Both sites are river banks/shingle.

Tachydromia halidayi (Coll.) Nb. (65) Gunnerside, 4/8/97 A.G. 1♀ swept ex river bank. The only other Yorkshire record for this species is from a shingle bank, also on the River Swale, near Hudswell Wood upstream from Richmond (65), 2/7/92 R.C.

EMPIDIDAE

**Hilara clypeata* Mg. (65) Great Langton, 17/7/97 A.G., swept ex river shingle; Nosterfield (gravel pit) (65), 15/5/98 R.C. Apparently a localised species, but widely distributed, with about ten recorded sites scattered across Yorkshire, from Patrington in the east to Malham in the west.

**Hemerodromia unilineata* Zett. (63) Cawthorne, 28/6/00 J.D.C. (reported as being common amongst nettles by stream). This is a widespread predatory species, although somewhat localised, and often associated with water courses.

DOLICHOPODIDAE

**Dolichopus* (s.g. *Macrodolichopus*) *diadema* Haliday (65) Maunby, 16/7/97 A.G. 2♂♂ swept ex sandy river bank. This is a typical salt-marsh species, and all previous Yorkshire records are from such habitats at the coast or on the Humber banks, except for a pond and a saline drain at Thorne Moors.

**Hercostomus* (s.g. *Gymnopternus*) *chalybeus* (Wied.) (62) Hollin Hill Bog, 6/7/00. Known from only two sites in VC61: Hornsea Mere, 26/7/96 and Thornton, 7/7/96; and two in VC63: Doncaster canal, 11/7/87 W.A.E. and Gypsy Marsh, Barnsley, 18/7/92 & 4/8/97 J.D.C.

**H* (s.g. *Hercostomus s.s.*) *chetifer* (Walker) (65) Gunnerside, 4/8/97 A.G. 1♂ swept ex river bank. A widespread though localised species in Yorkshire with six previous records, all since 1986 and in the northern parts of the County; usually associated with heavily shaded watercourses.

†*Medetera dendrobaena* Kowarz (61) Skipwith Common, 1♂ 22/8/00. This is a genus of predatory flies which are found on vertical surfaces such as tree trunks, where they chase their prey. They are rarely captured by standard sweep-netting techniques, and usually they have to be sucked up with an aspirator. This requires a certain degree of dexterity, and

much patience, which may account to some extent for the apparent scarcity of some species!

†*Systenus bipartitus* (Lw.) Nb. (62) Duncombe Park, a series of ♀♀ emerged 17/6-2/7/96 ex *Aesculus* (sappy wood), A.G. (*63) Hugsett Wood, 1♂ bred ex Sycamore rot-hole material, em. 29/5/96 A.G.

S. leucurus Lw. Nb. (*61) Escrick Park, 1♂ em. 20/7/96 ex wood mould from *Aesculus,* A.G. (*62) Duncombe Park, numerous specimens bred ex sappy wood taken from *Aesculus* in 1996/7 emerged on dates ranging from 15/4-24/6, A.G. The only previous Yorkshire record for this species is from Cantley Park (63) when a single ♂ emerged from debris in *Aesculus octandra* rot hole, 8/6/75 P. Skidmore (*Nat.* **102** p. 78).

†*S. mallochi* MacGowan (63) Pot Ridings Wood, 2♂♂ em. 15/6/94 A.G.

S. pallipes* (v. Roser) (62) Duncombe Park, ♂ & ♀ specimens bred ex *Aesculus* sappy wood em. 4/6-2/7/96 and 16/5/97 A.G. The other Yorkshire records for this species are from Cantley Park, 1975 (*Nat.* **102 p. 78) and Pot Ridings Wood, 1992 (*Nat.* **118** p. 15), (both 63). A recent revision of *Systenus* (Kassenbeer, 1998) has resulted in *Systenus pallidus* Vaillant being synonymised with *S. pallipes*. The Field Note by Mr. Godfrey (*Nat.* **118** p. 15) announcing the discovery of *S. pallidus* at Pot Ridings Wood in 1992 must now be disregarded, and the record is corrected above.

†*S. scholtzii* (Lw.) Nb. (*61) Western Cemetery, Hull, em. ex Sycamore (sappy wood) 17/6/96; (*62) Duncombe Park em. ex *Aesculus* (sappy wood) 17/6-1/7/96; (*63) Pot Ridings Wood, em. 16/5-9/6/94; Hugsett Wood, em. ex Sycamore (rot hole) 21/5-23/5/96; Cusworth Park, em. 18/6/96; Nostell Priory, em. ex *Aesculus* (sap) 4/6/96. All A.G.

†*Chrysotimus flaviventris* (v. Roser) (62) Castle Hill Wood, 13/7/00; several examples of both sexes.

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BOOK REVIEWS

The Millennium Atlas of Butterflies in Britain and Ireland by **Jim Asher, Martin Warren, Richard Fox, Paul Harding, Gail Jeffcoate** and **Stephen Jeffcoate.** Pp xx + 433 with full colour maps, diagrams and photographs throughout. Oxford University Press. 2001. £30.00 hardback.

A landmark publication featuring the results of a five-year distribution survey (1995/99) organised by Butterfly Conservation, the Biological Records Centre and the Dublin Naturalists' Field Club, and involving around 10,000 recorders (including many from the YNU and its Affiliated Societies). In all, 1.6 million butterfly sightings were logged and map-referenced, covering 98% of all the 10 km squares in Britain and Ireland.

The end product is a large-size, beautifully illustrated book, written in non-technical language, with four pages devoted to each of our main species and two pages to each of our rarer and extinct species. Full details of foodplants, habitats, past and present status, and conservation requirements are included in the text. Full-page distribution maps use colour to indicate the number of records from each 10 km square whilst phenograms provide a remarkable way of clarifying flight periods and generations by relating the date and latitude of all the records and presenting them in a coloured diagram. These reveal the details of some intriguing north/south clines in the number and timing of the generations of each species.

Long-term trends are examined using data from the recent survey and from 200 years of recording. Over that time 5 species have become extinct, 15 have reduced their range by over 50% and 15 have expanded their range by over 50%. The reasons for these changes are examined in detail and indicate that the future of many of our butterfly species is in the balance. There are huge challenges ahead if we are to prevent more extinctions.

This is an essential reference book for anyone interested in the natural world and particularly for anyone involved in the practical conservation issues concerning butterflies, whether at an amateur or professional level. The book is also quite a bargain, bearing in mind it is profusely illustrated in full colour throughout its 400 plus pages!

HMF

Awesome Insects by **Andrew Whittington**. Pp. 28, with numerous illustrations by **Helen McMullan.** National Museums of Scotland Publishing Ltd. 2001. £4.99, ring-bound card with laminated card covers.

This book introduces the insects to children, perhaps from the age of nine or ten. The text and illustrations show many imaginative features. The text is personalised by the use of Malcolm the mantid who is introduced on page one and whose head appears on each page with a comment. The index is laid out in the form of a quiz. Seventeen topics are considered, including the different kinds of insects, their use as pollinators, beneficial and problem species, mimicry and conservation. This is an excellent book which I have no difficulty in recommending.

MEA

Biologists and the Promise of American Life by **Philip J. Pauly.** Pp. xvi + 313, with b/w illustrations. Princeton University Press, Princeton, New Jersey. 2001 £18.65 hardback.

This excellent book illustrates how the role of biology and natural history in American life has developed over the last two centuries. As such, it makes a fascinating contrast to the UK, especially when it is remembered that the fauna and flora of vast tracts of the USA did not begin to be systematically explored until the Merriweather & Lewis expedition at the beginning of the 19th century. Again, up until the Civil War, it was Harvard University, with the Olympian figures of Asa Gray and Louis Agassiz, which was the dominant centre of activity in biology (over the same period in Britain, Oxbridge played a negligible role).

While in Europe it was the wealthy who guided natural history, the democratisation of American society resulted in a much more heterogeneous mix of individuals being involved. Audubon (of *Birds of America* fame) apparently began life as an "illegitimate ne'er do well". Amos Eaton, a real estate speculator jailed for forgery, returned to prosperity and developed a reputation as an outstanding botanist. Nuttall, who published and probably printed *Genera of North American Plants* with his own hands, crossed America on foot. When wealthy American businessmen did become involved, they were generally more generous, altruistic and public spirited than their British counterparts. For example, their activities were crucial in the founding of such highly regarded institutions as the Arnold Arboretum, Scripps Oceanographic Institute, Johns Hopkins University and the Missouri Botanic Garden.

After the Civil War, when America finally developed its sense of national identity, the major centres of influence shifted to institutions such as the Smithsonian and also to the federal government (which was especially interested in exploiting both marine and terrestrial biological resources). At the same time, a new academic culture began to develop. The oppressive city climates in July and August led to Woods Hole (originally a Fish Commission laboratory) becoming a summer camp for scientists where the relaxed atmosphere encouraged the fertile development of new ideas. Universities, led by Johns Hopkins, began to be active in research several decades before those in England.

At the start of the 20th century, the academic elite ensured that biology was widely taught in High Schools. As the century progressed, biology achieved a high profile through events such as the Scopes trial concerning the teaching of evolution, debates about eugenics, and the work of Alfred Kinsey (of the eponymous report) whose early career was as an entomologist and interpreter of nature. Only with the recent debates on BSE, GM crops and patenting parts of the human genome has biology achieved a similar prominence in Britain.

The author, Philip Pauly, is an academic historian and biographer by profession. This is not the only reason why, by his own admission, the book devotes little attention to the details and discoveries in biology. Rather, it is to be seen as an engrossing natural history of natural historians in America, and their influence on that country.

DCS

Small Woodland Creatures by **Lars-Henrik Olsen, Jakob Sunesen** and **Bente Vita Pedersen.** Pp. 208, with numerous coloured drawings. Oxford University Press. 2001. £12.50 hardback.

This book, a translation of the Danish edition first published in 1997, covers arthropods (insects, spiders, harvestmen, mites, millipedes, centipedes, woodlice), earthworms, snails and slugs. The woodlands refer to those of northern Europe and presumably include the British Isles. The coloured drawing of *Bombus terrestris* is the mainland European form and not the British form so caution is needed when identification is made from the coloured drawings. The woodland creatures are divided into taxonomic groups, each represented by a line drawing at the front of the book. Description and life-history information is given for each taxonomic group. No indication is given of the number of species in each such group and there are no references for further reading. For each species entry the following information is given: biological name, English name if available, coloured drawing with magnification, description, size, habitat where found, adult seasonal activity and characters by which to separate from similar species. No distribution maps or keys are given, and some of the coloured drawings are too small to be of much use. Later in the book some of the small creatures are considered in non-taxonomic groups such as enemies of aphids, invertebrates of carrion and invertebrates that attack people. There is also an extended section on the galls of ferns, trees, shrubs and herbs. The introduction consists of only one page containing some advice on how to search for the small creatures and nomenclature. At the end of the book there are two pages dealing with seven topics, including as warning colouration and pollination. It is difficult to recommend this book although it should be of some use to the beginner.

MEA

CONTRIBUTORS

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The Naturalist

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Published by the Yorkshire Naturalists' Union

Editor **M. R. D. Seaward** MSc, PhD, DSc, FLS, The University, Bradford BD7 1DP

Notice to Contributors to 'The Naturalist'

Manuscripts (two copies if possible), typed double-spaced on one side of the paper only with margins at top and left-hand at least 2.5cm wide, should be submitted. Latin names of genera and species, but nothing else, should be underlined. S.I. Units should be used wherever possible. Authors must ensure that their references are accurately cited, and that the titles of the journals are correctly abbreviated. Volumes of *The Naturalist* for the years 1886 to 1975 have been retrospectively numbered 11 to 100 to accord with numbering before and after this period (see YNU *Bulletin* no. 3, pp. 21-22 1985); please cite these volume numbers in all references. Table and text-figures should be prepared on separate sheets of paper. Drawings and graphs, drawn about twice the linear size they are to appear, should be in jet-black Indian ink, and legends should not be written on the figures. **Publishable manuscripts not conforming to the above requirements will be returned for alteration.**

Photographic Plates

Readers of *The Naturalist* will have noticed that the number of photographic illustrations has increased in recent years. Good clear photographs, suitably captioned, to accompany articles or as independent features are always welcome.

To encourage this development, a long-standing member of the YNU, who wishes to remain anonymous, has most generously offered to make a donation, the income from which would finance the publication of a plate or equivalent illustration in future issues whenever possible. The editor, on behalf of the YNU, wishes to record this deep appreciation of this imaginative gesture.

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THE STATUS OF THE SMALL PEARL-BORDERED FRITILLARY, *BOLORIA SELENE,* IN WESTERN YORKSHIRE

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Introduction

In the British Isles the Small Pearl-bordered Fritillary, *Boloria selene* (Denis & Schiffermüller) (Lepidoptera, Nymphalidae) and the Pearl-bordered Fritillary, *B. euphrosyne* (L.) are found in the early seral stages of woodland, but the Small Pearl-bordered Fritillary, tolerating damper conditions, can survive on mires of open moors and marshy meadows which are not inhabited by *B. euphrosyne*. This is now the most common location for *B. selene,* reflecting the disappearance of suitable lowland habitat in the south and east of England over the last hundred years. Most of the British *B. selene* sites are now to be found in the west of mainland Britain especially in Scotland, Wales and the West Country, and in northern England the species is locally common in some valleys in the English Lake District. In Ireland, *B. selene* is unrecorded, and the only sites for *B. euphrosyne* are in County Clare (Emmett & Heath 1989, Asher *et al.* 2001).

B. selene is on the wing from mid-May in southern counties but over a month later in the north of England. It is univoltine in northern areas, but partly double brooded in the south. (Emmett & Heath 1989); this has also been reported as far north as Lincolnshire (Duddington & Johnson 1983).

Historical occurrences of *B. Selene* in Yorkshire

Historically, the species occurred widely in the eastern and central lowlands of Yorkshire. Porritt's county list and its supplement (Porritt 1883, 1904), show it present at Askham Bog, Bawtry, Bishop's Wood, Bramham Park, Castle Howard, Edlington Wood, Ingleby Greenhow, Sandbeck Park, Scarborough, Sheffield, Strensall (York), Pontefract, and Tadcaster, often the same locations that are given for the Pearl-bordered Fritillary. It is likely that the marked county-wide decline in the first half of the 20th century of both species of Pearl-bordered Fritillary can be attributed to the end of coppicing and the subsequent decline of their woodland food plant, the Common Violet (*Viola riviniana*) (Warren & Key 1991). Currently the Pearl-bordered Fritillary is restricted to three sites in VC62 near Kirbymoorside (Clough 1998; 1999b; 2000b; Parkinson 1997) and the Small Pearl-bordered Fritillary has disappeared from south, south-east and central Yorkshire. The YNU Lepidoptera Committee (1967), in the first summary of Yorkshire Lepidoptera distribution since the supplement to Porritt's list in 1904, noted *B. selene* as being locally common on sites in VC61 and VC62 but the only 'authentic' VC64 locality was Austwick Moss. This lack of up-to-date information was reflected by the provisional distribution maps of British Butterflies (Skelton & Heath 1975) which show it as present in only three 10km squares in Yorkshire. Additional information was collated during the period 1972-1980 and Emmett and Heath (1989) give a map showing it to be present, in 15 10 km squares of Yorkshire (SE03, SE43, SE54, SE55 , SE56, SE57, SE64, SE77, SE79, SE88, SE89, SE99, SD76, NY70, NZ50). Between 1970 and 1980 individuals were also seen in SD96 and NY82 (Peter Summers *pers. comm.*). However Sutton and Beaumont (1989) were only able to confirm its presence in nine 10 km squares. There was only a single record from the whole of south and central Yorkshire, from Triangle near Halifax SE02 (VC63) in 1983. In 1981 the species was reintroduced to Skipwith Common near Selby (VC61) and was reported as present there until 1988 (Sutton & Beaumont 1989) but it is now extinct again (Butterfly Conservation 1999). In West Yorkshire Sutton and Beaumont listed four sites in VC64 (Austwick Moss, near Clapham, Cocket Moss & Lawkland Moss) and one in VC65 (near Aysgarth) but it is likely that the species was under-recorded.

The current stronghold for the Small Pearl-bordered Fritillary in East Yorkshire is seven 10 km squares (30 tetrads) on the North York Moors (VC62) where it occurs on about 15 sites including Cropton Forest, Dalby Forest, Deepdale, Fen Bog, Jugger Howe, Keldy Castle, Levisham, Newtondale, and Raygates Slack (Figure 1) (Asher *et al.* 2001; Clough & Robinson 1998; Clough 1999a 2000a; Frost & Robinson 1997; Sutton & Beaumont 1989).

The present work set out to relocate and investigate the species on the five west Yorkshire sites given by Sutton and Beaumont (1989) and to look for it elsewhere in VC64, mid-west Yorkshire. Appendix 1 lists the most recent records in VC64. Tables 1 and 2 list the characteristics of the sites and of locations where it may be present but has not yet been confirmed. It has now been confirmed as breeding in five 10 km squares SD85, SD86, SD75, SD76 and SD77 (13 tetrads) (Figure 1). The author was surprised to discover that some of the sites indicated by Sutton and Beaumont, actually comprised several breeding locations. The 'near Clapham' site, originally reported to the Biological Records Centre (ITE, Monkswood) by the late Peter Kelly, is composed of at least 14 local populations spread over 2.5 km^2 on the Newby Moor SSSI (SD7169) (Table 1).

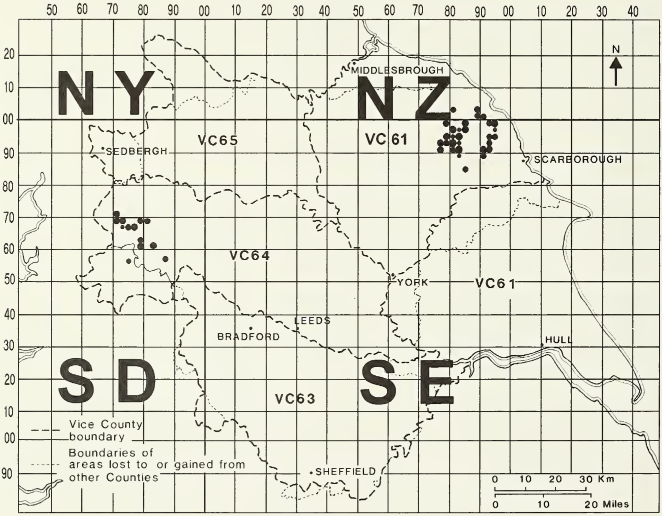

FIGURE 1
Tetrad records of *B. selene* Watsonian Yorkshire.
Small dots represent 1 record, larger dots represent 2-9 records, the largest dots represent 10+ records.

In this study, a site refers to where the imago was recorded close to its food plants. In an exceptional case, the Gisburn Forest site, this designation was based on the sighting of a single adult (Appendix 1). It is very easy to overlook the species at any one site as it may exist in very small numbers, which are on the wing for a short period and only flies in sunshine; a scarce commodity in West Yorkshire. Under-recording in areas remote from population centres is also a common bias of recording, a problem discussed in detail by Dennis *et al.* (1999).

The Life Cycle

A description of the species and its life cycle can be found in Emmett and Heath (1989), South (1962) and Thomas and Lewington (1991) but the following summarises the situation.

Eggs

Eggs are of a rounded conical shape, with 18-20 ribs. Once thought to be discharged in flight in the vicinity of its foodplant, *Viola* spp. (Emmett & Heath 1989), it is, however, more likely that they are deposited directly on to the violets or vegetation near them (Asher *et al.* 2001). They are sticky and adhere to any material they encounter. Their colour initially is greenish, then yellowish and shortly before hatching, greyish, the blackish head capsule of the larvae being visible near the concave tip. Hatching takes place within a fortnight.

Larva

On emerging, the caterpillar eats most of its eggshell. Initially it is of a pale olive colour with brownish warts from each of which a long and jointed bristle emerges. Its head is shining black with a notch on the crown. Small larvae feed until they have moulted to the fourth instar when they enter diapause around the end of September. By this time many of the violet leaves are yellowing and senescent. According to Emmett and Heath (1989), caterpillars overwinter beneath leaves or in ground detritus, but this probably only applies to woodland sites. Sites for diapause of moorland mire populations are not known but are probably within *Juncus* or grass tussocks. Diapause lasts from October to March. With rising temperatures the larvae commence feeding in April. The velvety full-grown fifth instar larva is about 2 cm long, blackish with a brownish line along the middle of the back and a pinkish stripe which runs along the lower sides of the body just above the legs. Its spines are ochreous, tinged with pink and bear pointed black bristles. The upper spines are stouter than the rest and the single pair on the first segment is more than twice the length of the others and passes forward over the caterpillar's head, giving the appearance of a pair of horns. The second and third segments each have four spines which are rather finer than those on the rest of its body where they are arranged in six rows. Larvae appear to be less reliant on solar heat for their well-being than *B. euphrosyne* and do not bask in the sun as do many fritillary larvae. Indeed they are secretive, hiding in the shadier parts of the vegetation and only emerging for feeding forays. Pupation takes place around the end of May in Yorkshire, but is much earlier in milder parts of England and Wales.

Pupa

The chrysalis is suspended from a silk pad by its cremaster, low down on a plant stem or in the detritus. It is brown, with the wing cases being more ochreous and marked with black near the edges. On the thorax there is a black V-mark and metallic silver spots on each side, one silvery spot on the head and other metallic spots near the thorax. It remains at this stage for about three weeks.

Imago

In the west of Yorkshire emergence usually starts around the second week of June but can be up to two weeks later in some years. Adults are seen on the wing for about a month and have been sighted between the second week in June and the last week of July (47 days), a very similar period to the 41 days on the North York Moor sites (Clough 1998, 1999b, 2000b; Parkinson 1997; Sutton & Beaumont 1989). The maximum adult life span is unknown but is unlikely to be more than about two weeks. In VC64 the times when peak numbers of adults have been observed vary from year to year between mid-June and mid-July. Behaviour of the sexes is markedly different. Males actively patrol the breeding sites whereas females usually make short flights or remain at rest low down in the herbage.

When approached, they often initially reject the attentions of the male by moving deeper into the vegetation. These rejection rituals are described more fully by Emmett and Heath (1989). Butterflies are torpid on cool days but when temperatures are low and there is strong sun they may spend considerable periods dorsally basking. If the air temperature is lower than *c.*17°C they remain at rest in the herbage for long periods and are difficult to locate. Their habit of roosting with closed wings on the flowers of *Juncus* spp. has often been noted (Walsh 1956; Emmett & Heath 1989). It is probable that this energy-conserving strategy is fundamental to their survival during inclement weather. Walsh (1956) considered their underside pattern to be cryptic, closely resembling the *Juncus* flower-heads. However, Skinner (1984) mentions another member of the *Juncaceae,* Wood-rush, (*Luzula* sp.), as a nectar source for the moorland moth, Haworth's Minor (*Celaena haworthii*) and Mounsey (2001) records seeing moths collecting in numbers on *Juncus effusus*, finding the flower-heads had 'quite a sweet taste'. Is it possible that *Juncus* itself could be a nectar source? In this study adults were rarely seen on known nectar flowers. Although *Cirsium palustre* was observed as the preferred nectar plant, a single individual was seen on *Erica cinerea*, while all Brian Shorrock's (*pers. comm.*) sightings of the butterfly at nectar were on Marsh Thistle. It is also reported that *Cardamine pratensis*, *Lychnis flos-cuculi* and, on sites with improved pasture adjacent, *Ranunculus* spp., are also nectar sources (Emmett & Heath 1989), but this has not been observed in West Yorkshire.

Foodplants

In the south of England the larval foodplant is usually the Common Violet (*Viola riviniana*), but in northern counties it is now usually the Marsh Violet (*V. palustris*). On the West Yorkshire sites it is almost entirely *V. palustris,* which is readily distinguished from *V. riviniana* by its kidney-shaped (less heart-shaped) leaves. The habit of *V. palustris* plants can be very variable. The leaves grow throughout the season, their widths varying from 1.5 mm to over 6 cm. On some sites they may be heavily overgrown by sedges and grasses by late summer but appear to be able to cope with this and grow through the upright vegetation, their habit becoming very extended. *V. riviniana* is present in small numbers on the drier areas of several sites (Tables 1 & 2).

On the West Yorkshire sites, violet plants occupy discrete areas on the margins of the wettest mire habitat, usually within rush pasture. Most of these areas are of very limited extent (mean site size 167 m^2) ranging up to a maximum of 400 m^2. On Newby Moor the foodplant sites occupy less than 0.15% of the total area of the SSSI (Tables 1 & 2). Whilst mainly occurring towards the wetter parts of the habitat, they occur in the zones shared with sedges and *Juncus*. The violets often grow on the sides of tussocks in areas dominated by *Sphagnum* or *Juncus*. Cotton grasses (*Eriophorum* spp.), are present on the wettest (more waterlogged) parts of most of the sites but not in conjunction with the Marsh Violets. The presence of Marsh Thistle often indicates suitable locations for the less obvious violets, which usually form only a small percentage; less than 5%, of the local vegetation cover. The marginal positions of the foodplant can render it vulnerable to grazing, especially in drier years. On many sites the violets are often flooded in late winter but may be quite dry by midsummer. On some of the driest locations such as Austwick Moss (Sub-site C), the plants are very small and the leaves yellow later in the season; only in marginal areas shaded by birches and sallows do they appear healthy and this may be where oviposition is occurring.

Botanical aspects of the sites

Sites for the butterfly are typically on mires, rush pasture or marshy grassland on shallow clay soils with a wet peaty surface and impeded drainage. These stagno-humic gley soils are mainly derived from glacial drift, chiefly boulder clay. Sites can be divided into two main types by their vegetation characteristics:

1) Moorland mire sites: Most of these vegetation communities are some variant of *Molinia caerulea – Potentilla erecta* Mire (NVC type M25 mire; Rodwell 1991). *Molinia*

may be dominant around the edges but the violets are found in conjunction with *Juncus acutiflorus* and *J. effusus*. Sub-shrubs such as *Calluna vulgaris,* or on wetter ground *Erica tetralix*, are also present away from the wettest areas where *Eriophorum* spp. may dominate. These types of site lack any major trees but small sallows and stunted birches may provide shelter for adult butterflies as on Cocket Moss and Swarth Moor. No trees are present on Long Preston Moor or on any of the Newby Moor sites although hedge-line willows and sallows are present on the southern margin of Hardacre Moss.

2) Rush pasture sites: Mainly NVC M23 *Juncus effusus/acutiflorus – Galium palustre* rush pasture, these are meadows and pastures of moist mineral and peaty soils with flushing or impeded drainage. This community can be indicative of base enrichment These sites have more trees in their vicinity and have Marsh Violet patches amidst boggy rushy meadows dominated by *Juncus effusus* and *J. acutiflorus,* typically with *Galium palustre* and *Potentilla erecta* which is strongly preferential for the M23a *J. acutiflorus* Sub-community. Rushes are characteristically dominant with abundant *Molinia. J. effusus* also tends to be tussocky and these structures enable other species such as *V. palustris* to survive. The *J. acutiflorus* Sub-community is virtually continuous with *Molinia – Potentilla* grassland which is found around the margins of some of the the mires. The central site at Lawkland Moss and the Wharfe Wood sites typify this type. The latter sites are surrounded by copses and small stands of birch and hazel, with some hedgerow sallow and hawthorn. As Rodwell (1991) states 'fen meadows and rush pasture are difficult to define but are generally the product of some sort of agricultural treatment'.

The vegetation on the Newby Moor sites is typical of many moorland mire sites on acidic rocks or impervious substrates. Many sites represent the latest seral stages of late glacial lakes. Sniddle Moss (Newby Moor SSSI) is documented from cores to have passed from a lake with a wide variety of aquatics including stoneworts, through several terestrialization stages of fen and fen carr. This included the establishment of dense *Alnus glutinosa* and *Betula pendula* and *B. pubescens* woodland, from *c.*7,300 BP (Oybak 1993; Oybak & Bartley 1994, 1997). Austwick Moss, Cocket Moss, Locker Tarn and Swarth Moor also represent the wetter residual parts of much more extensive areas of M25 mire vegetation whose extent has been greatly reduced by combinations of seral progression, drainage, grazing and agricultural 'improvement'. The dryer parts of these sites are dominated by *Molinia caerulea*, with *Deschampsia flexuosa*, *D. cespitosa*, *Anthoxanthum odoratum Holcus lanatus*, *Festuca ovina*, *Nardus stricta*, and herbs such as the *P. erecta* and *Galium saxatile*. These areas may merge into wet heath vegetation dominated by heathers (*Calluna. vulgaris* and *Erica* spp.), and *Vaccinium myrtillus*. The Marsh Violet food plant is found in the damper areas typically between tussocks of *Juncus effusus* and *J. acutiflorus along* with small amounts of *J. inflexus, J. articulatus* and *J. conglomeratus*. Various sedges (e.g. *Carex spicata*, *C. flacca*, *C. panicea* and *Luzula multiflora*) are also typically present as are various species of *Sphagnum* moss (especially *S. recurvum*). Forbes such as *Cirsium palustre*, *Lychnis flos-cuculi*, *Cardamine pratensis*, *Galium palustris* and *Ranunculus* spp. are usually present near to the violets. *Erica cinerea* is found on wetter heath often with hummocks of the mosses *Polytrichum commune* and *Calliergon cuspidatum*. In the very wettest parts of many sites is an anoxic mire vegetation dominated by *Eriophorum vaginatum and E. angustifolium* and mosses such as *Sphagnum recurvum, S. magellanicum* and *S. papillosum,* which merges into 'blanket bog' vegetation. Wetland plants such as *Menyanthes trifoliata*, *Geum rivale* and *Narthecium ossifragum* occupy nutrient-rich and less acidic mire locations. Alongside the sluggish drains or minor streams which meander through several of the sites (e.g. Swarth Moor, Cocket Moss and most of the Newby Moor sites) is a well defined strip (2-3 m wide) of M27 mire (*Filipendula ulmaria – Angelica sylvestris* tall herb fen) where *F. ulmaria* is found in profusion as are clumps of *Mentha aquatica*.

The classical site of Austwick Moss is characterised by a mosaic of lowland wet heath and residual raised mire bordered by dense wet birch scrub/woodland. The violets extend into the denser shade of the trees in several places. The main site at Sub-site A is on the

TABLE 1.
Characteristics of *B. selene* sites on the Newby Moor SSSI.

Location						Site Characteristics						
Ref No.	Site Name	Sub-site No.	Grid Ref	VC	County	Height (metres)	Max. Nos seen 95-99	Trees	Adjacent Trees	Wet	Area of violets (ha)	Nearest Improved Land (m)
1	Newby Moor, Un-named mire		SD712701	64	Yorks	165m	?		0	2	0.003	250
2	Newby Moor, North of Railway line	C	SD711702	64	Yorks	163m	50+	0	0	1	0.05*	100
	Newby Moor, North of Railway line	A	SD709701	64	Yorks	160m	1	0	0	1	Incl. above	100
	Newby Moor, North of Railway line	B	SD710703	64	Yorks	162m	3	0-1	0	1	Incl. above	200
3	Newby Moor, Crook Beck nr. A65		SD715702	64	Yorks	162m	2	0	0	1	0.001	100
4	Newby Moor, South of Railway line		SD710698	64	Yorks	160m	1	0	0-1	1	0.001	200
5	Sniddle Moss (West)	A	SD707696	64	Yorks	163m	2	0	0	2	0.015	200
	Sniddle Moss (East)	B	SD709696	64	Yorks	162m	30+	0-1	0	2	0.005	350
	Sniddle Moss (Valley)	C	SD711696	64	Yorks	161m	6	0	0	1-2	0.004	250
6	Mire Near Butt Hill (West)	A	SD706689	64	Yorks	159m	3	0	0	3	0.025	50
	Mire Near Butt Hill (East)	B	SD708689	64	Yorks	161m	4	0	0	2	0.02	200
7	Hardacre Moss, West	A	SD712688	64	Yorks	160m	6	0	1	1-2	0.03	20
	Hardacre Moss, East	B	SD717688	64	Yorks	160m	?	0	1	2	0.04	200
	Hardacre Moss, Far South-east	C	SD722685	64	Yorks	161m	?	0	1	2	0.015	500
	Hardacre Moss, Gill Sike	D	SD718688	64	Yorks	160m	?	0	0	1-2	0.01	250
8	Upper Gill Syke		SD719688	64	Yorks	156m	?	0	0	1-2	0.004	300
9	Mire Near Banks Head		SD717692	64	Yorks	165m	7+	0	0	2	0.025*	150
10	Gill Sike, Near Green Close (N)	A	SD719692	64	Yorks	155m	6+	0	0	1	0.02*	50
	Gill Sike, Near Green Close (S)	B	SD720691	64	Yorks	150m	4	0	0	2	0.01	60
	Gill Sike, Near Green Close	C	SD722690	64	Yorks	146m	6+	0	0	2	0.025	100
11	Newby Mire		SD721693	64	Yorks	145m	1	0	0	1	0.001	20
12	Gregory Hole		SD724688	64	Yorks	150m	12+	0	0	2	0.015	25
13	Near Nutta Farm		SD729681	64	Yorks	140m	?	0	0-1	1-2	<0.005	150

Key Trees on breeding site 0 = No trees, 1 = few isolated trees or bushes, 2 = Significant trees
Trees adjacent site 0 = No trees, 1 = few isolated trees or bushes, 2 = Significant trees
Site Wetness 0 = dry, 1 = damp, 2 = wet, 3 = very wet
? = suitable site species not confirmed present * = *Viola palustris* + *V. riviniana* ** = *Viola riviniana*

TABLE 2.
Characteristics of other *B. selene* sites.

Location						Site Characteristics						
Ref No.	**Site Name**	**Sub-site No.**	**Grid Ref**	**VC**	**County**	**Height (metres)**	**Max. Nos seen 95-99**	**Trees**	**Adjacent Trees**	**Wetness**	**Area of violets (ha)**	**Nearest Improved Land (m)**
14	Railway cutting near Otterburn		SD878571	64	Yorks	159m	3+	1	0	2	>0.001**	<10
	Pitts Hill marsh		SD875565	64	Yorks	162m	?	1	2	0	<0.001	<10
15	Swarth Moor, East	A	SD806693	64	Yorks	220m	20+	2	0	2	0.005	300
	Swarth Moor, West	B	SD805692	64	Yorks	221m	1	0	0	2	0.02	400
16	Studfold Moss		SD808699	64	Yorks	221m	10+	2	1	2	<0.02	<300
17	Wharfe Wood	A	SD781688	64	Yorks	220m	4	1	2	1	0.02?**	<50
	Wharfe Wood	B	SD786688	64	Yorks	226m	4+	0	2	1	0.04	50
	Wharfe Wood	C	SD787688	64	Yorks	225m	4+	0	2	1	0.007	<250
18	Austwick Moss, South	A	SD760664	64	Yorks	130m	50+	1	2	2	0.015	20
	Austwick Moss, West	B	SD759667	64	Yorks	131m	5+	1	2	1	0.005*	30
	Austwick Moss, East	C	SD764669	64	Yorks	130m	+	1	2	1	0.01**	<10
19	Lawkland Moss	A	SD768664	64	Yorks	134m	8+	1	2	2	0.04	10
	Lawkland Moss	B	SD769664	64	Yorks	134m	1	0	2	1	0.001	20
	Lawkland Moss	C	SD769666	64	Yorks	134m	+	0	2	2	0.003	20
	Lawkland Moss	D	SD769667	64	Yorks	134m	+	2	2	2	0.002	20
20	Cocket Moss (Southeast Side)	A	SD787617	64	Yorks	205m	30+	0	2	2	<0.03	100
	Cocket Moss (North End)	B	SD786620	64	Yorks	205m	3+	2	1	3	0.002	<10
21	Long Preston Moor		SD825625	64	Yorks	257m	10+	0	0	2	<0.02	<30
22	Gisburn Forest (Stephen Park)		SD740557	64	Lancs	203m	1	2	2	2	0.03	0.9
	Champion Moss		SD752534	64	Lancs	265m	?	1	0	3	0.04	0.3

Key Trees on site 0 = No trees, 1 = few isolated trees or bushes, 2 = Significant trees
Trees adjacent to site 0 = No trees, 1 = few isolated trees or bushes, 2 = Significant trees
Site Wetness 0 = dry, 1 = damp, 2 = wet, 3 = Very wet
? = suitable site species not confirmed present * = *Viola palustris* + *V. riviniana* ** = *Viola rivineana*

wettest area with abundant *V. palustris*. Austwick Moss is unusual in being the only site with large numbers of *V. riviniana* especially at the eastern end (Sub-site B) where there is virtually no *V. palustris*. This may reflect the drier nature of these locations. There are some indications that Sub-site C is drying out and is evolving into herb rich grassland; certainly the small sub-colony has appeared less abundant in recent years (Stuart Ralph & Brian Shorrock, *pers. comm.*). The whole of Austwick Moss is fenced off and managed for game, and is gradually being overwhelmed by the spread of birch scrub.

Boloria selene is present in a railway cutting near Otterburn (SD878571) on scattered *V. riviniana* in neutral herb-rich grassland. These banks host a relict population derived from that which was probably present on nearby rush pastures adjacent to the small beck flowing north from a larger wet area bordering Pitts Hill. These areas of rush pasture are now useless as a fritillary habitat. North of the railway line almost all the rush pasture is drained and converted to improved pasture. The extensive (3-4 ha) marshy area to the south (SD875566), is now almost devoid of marsh violet and most other forbes and has been converted by eutrophication and heavy grazing to species-poor wet rush pasture dominated by rank *Deschampsia cespitosa* and *Juncus* spp. The residual butterfly population is now restricted to the railway embankments. Unless seral progression is halted by scrub cutting, it is doomed to extinction on this site.

The site in Gisburn Forest (VC64, now in Lancashire) is a NVC type M23 *Juncus effusus/acutiflorus – Galium palustre* rush-pasture. It was planted with conifers in the early 1950s by the Forestry Commission, harvested in 1983, and replanted in 1987. Many conifers planted in the wetter parts now occupied by the Marsh Violets did not prosper and the tallest were only 2 m in height. However, the lack of grazing allowed scrub birch and some sallow to invade the area and the *Juncus* is very rank. In the south of England 35% of *B. selene* colonies were found in young conifer plantations but the future for butterflies in such locations is limited, unless active management is undertaken to conserve the ground flora (Warren & Key 1991).

The altitude of the sites where the species has been confirmed ranges from 130 m to 257 m (mean 171 m). The height range of the sites on Newby Moor is 145 m to 165 m (mean 158 m).

Local Agriculture, Conservation and Management

Grazing Regimes

Grazing on all of the butterfly's breeding sites is light in comparison to the enclosed improved pastures of the region. Sites can be divided according to intensity of grazing regimes into three main groups:

1) Sites grazed by farm stock, mainly sheep but with a few cattle (Long Preston Moor, Newby Moor, Swarth Moor, Lawkland Moss Sub-site A, Wharfe Wood). Farmers do not now allow cattle to range freely and sheep are loath to penetrate onto the wetter parts of mire sites; consequently grazing pressure is often very small in the wetter areas. The Newby Moss SSSI is subject to common grazing rights that extend beyond the boundaries of the SSSI. These rights appear to be more traditional than formally enshrined and the commoners have habitually temporarily enclosed certain areas, now usually with electric fences, which allows intensive grazing. This often follows the flail mowing of rush pastures.

2) Fenced-off sites maintained for forestry or game cover. These are subject to very low levels of grazing mainly by the Brown Hare, Roe and Muntjac Deer (Austwick Moss, Lawkland Moss Sub-sites B, C, and D, Gisburn Forest).

3) Fenced-off sites with virtually no grazing (Cocket Moss, Otterburn Railway Embankment).

Other Agricultural Operations

Rush cutting is allowed on parts of the Newby Moor SSSI, with mown areas on the west side of Crook Beck, the south-west of Tewitt Hall Farm and at Newby Mire. Cutting, originally by hand, was intended to reduce the vigour of *Juncus* and encourage a more open vegetation but is now undertaken annually by close flail mowing to produce big bale silage. The effects of this change needs a more complete assessment of its impact on the flora. Fortunately it can only be done in late summer when the land is at its driest. It usually takes place in mid to late August and generally presents little further danger to the butterfly populations, as there are now few violets in those areas. The single exception could be Newby Mire (Site 11), which is fairly dry but breeding success utilising the sparse violets of that location is questionable. The presence of *Boloria selene* here probably depends on colonists from the adjacent Gill Sike sites. The tendency of the mowing to encroach onto the adjacent *Molinia* grassland has been noted by English Nature and will be discouraged, as will any encroachments on to other known breeding sites.

Streams have been deepened on many of these sites, e.g. the outflow streams of both Sniddle Moss and Hardacre Moss (Gill Sike). This has increased the drainage and probably reduced the extent of the central mires. Close to Austwick and Lawkland Mosses, Fen Beck, the main area drain on the southern boundary, was subject to extensive deepening by the drainage authority in 1984, as was its tributary, the stream near the western boundary of Austwick Moss. This has definitely damaged the SSSI. On the western side of Austwick Moss three parallel drainage ditches were cut across the SSSI to these streams; this was not a permitted operation and was never rectified, despite protests by local conservationists. Damming of the ditches to reduce the drainage of the Moss could help conserve this area of rare lowland mire, which is currently in a major phase of decline. Drainage ditches have also been cut on the Long Preston Moor and Gisburn Forest sites.

Management

No sites have been specifically managed to conserve or encourage *Boloria selene* but certain incidental aspects of management probably benefit the species. A tussocky vegetation structure appears important but light grazing is essential to prevent *Juncus* and grasses from becoming tall and rank and to produce a more open structure suitable for the violets. Not all species of *Juncus* are equally suitable for the violets. In several mires *J. articulatus,* which does not form tussocks, occurs in dense patches which are attractive to sheep but become wind blown later in the season and rot away during winter. This is detrimental to the violets though they are able to grow up through dense standing vegetation of grass or *Juncus* tussocks. Tall rank *Juncus* growth promoted by eutrophication shades out other plants and may be flattened by wind when it forms a dense wet mat. Floral changes observed at Austwick Moss (Sub-site C) may be symptomatic of insufficient grazing. The Moss was regularly grazed by cattle within living memory and the extensive birch cover has only developed in the last four decades, overwhelming over half of the area of original designated SSSI. The fencing off of Cockett Moss took place about seven years ago and this may be similarly detrimental in the long term unless controlled grazing is introduced in future years. Similarly Sub-sites C and D on Lawkland Moss had not been grazed for some years and this was starting to affect the quality of the vegetation but some scrub cutting has recently been undertaken.

Excess grazing can also destroy sites and it is unfortunate that the disused railway line bisecting the north part of Newby Moor was omitted from the SSSI designation. Its previously rich flora with abundant common butterflies has now been totally destroyed by intensive grazing over the last twenty years. (B. & E. Shorrock *pers. comm.*). This was probably an important nectar site for the adjacent Small Pearl-bordered Fritillary populations.

The ban on fertiliser applications on all the SSSIs has maintained floral diversity overall, but illegal applications in the past have seriously reduced floral diversity on parts of Newby Moor especially the mowed areas west of Tewit Hall Farm (SD711700) and near the roadside east of Sniddle Moss. Elsewhere on the moor, fertiliser applications have totally destroyed the floral value of about 2 ha west of Hardacre Farm (SD709689), northeast of Newby Mire at SD724692 and adjacent to Crook Beck (SD723697 & SD723693). The western margin of Sub-site A at Lawkland Moss also appears to have received fertiliser input, probably in drainage from adjacent pasture, as *Juncus* here is unusually dense and rank and infested with nettles. This has exterminated the violets on at least 20% of the Sub-site. The illegal application of slurry adjacent to roadways in the Tewit Hall Farm area of Newby Moor still continues periodically and is difficult to stop unless the perpetrators are caught in the act. The area of Crook Beck received a heavy application of farm slurry as recently as November 2000.

Periodic rush cutting can have beneficial effects. If used as reclamation management it can progressively reduce the fertility of eutrophic areas by removing nutrients with the biomass and could eventually allow the fertiliser damaged areas to recover some of their original floral diversity. It promotes a more open vegetation where smaller plants prosper and more nectar plants are available. Occasional cutting may have enhanced the floral diversity of parts of Newby Moor adjacent to Site 2 (north of the disused railway line). However, annual cutting will eventually destroy the rush pasture habitat.

The survival of *B. selene* at the Gisburn Forest site for over twenty years, despite over-planting of the mire by conifers, is probably the fortuitous result of the site being adjacent to the original compartment boundary and access roadway. The butterfly probably survived on *V. riviniana* which is still sparsely present in that adjacent area. After timber harvesting the re-vegetation of the mire with the re-establishment of *V. palustris* allowed it to spread back onto the mire. When it became aware of the species, Forest Enterprise took a robust management attitude and all the conifers and scrub birch and sallow were removed from the site in Autumn 1999 and the possibility of selective *Juncus* cutting on parts of the site, aimed at reducing the ranker vegetation, is being considered for future years.

THE BUTTERFLY POPULATIONS:

Most animals and plants are distributed across the landscape in a non-random manner, the sub-populations being linked by dispersing propagules (seeds or spores in plants or individual animals). Sets of spatially dispersed populations (metapopulations) interact within a dynamic environment where habitats and sub-populations are gained or lost at variable rates. The result of alternate extinctions and recolonisations in habitat patches is a shifting distribution pattern over the years (Hanski & Gilpin 1991, 1997). Fragmentation describes the process whereby a species' habitat is dissected into smaller units separated by strips of unsuitable land. How this affects survival depends on the extinction rates of sub-populations and the colonising ability of the species from adjacent sub-populations (Opdam 1990; Hanski 1991).

B. selene may have a long history on some of the West Yorkshire sites. It almost certainly became restricted to mire habitats following the general and massive deforestation of 2000 BP (Oyback & Bartley 1997; Warren & Key 1991) and the consequent loss of *V. riviniana* sites. Many of these mire sites were associated with the lowland flood plain of the River Ribble, but most of those have now been lost due to agricultural improvement and drainage and are now confined to a very few slightly higher, more remote sites.

The Newby Moor populations make up a metapopulation which is possibly linked by occasional migration with the seven populations on Austwick and Lawkland Mosses and also perhaps those of Wharfe Wood. It is suggested that this type of breeding population may be typical of *B. selene* populations in northern Britain (Barnett & Warren 1995). On some sites it is probable that the population is totally isolated (Cocket Moss, Gisburn Forest, Long Preston Moor, Otterburn), while others may fall into a spectrum between the extremes (Swarth Moor & Studfold Moss) where occasional vagrants from Wharfe Wood may influence the gene pool. How much migration occurs between the main breeding locations of the Newby Moor/Austwick area and other sites is unknown and would need a detailed mark release and recapture study to elucidate it. Evidence concerning mobility is contradictory. Thomas and Snazell (1989) showed that woodland populations of *B. selene* in Dorset were extremely sedentary. Movement of marked individuals to suitable, newly coppiced areas was very small and vacant sites were not colonised except when the area was immediately adjacent to the original population. Barnett and Warren (1995) suggested that the northern populations may be more mobile but no supporting data have been produced. In West Yorkshire very few butterflies have been seen more than 100 m from suitable habitat patches. This, however, might be related to the priority given by observers to visiting the breeding sites. On emergence, females are very sedentary but this may alter later after mating. Females of all animal species are the colonisers and their dispersive ability determines survival in a changing fragmented habitat. Genetic isolation will occur if the dispersal is poor and the resultant loss of genetic variability may lower the fitness of the individuals in a sub-population (Opdam 1990). Dempster (1991) demonstrated morphological changes (ratio of thoracic width to length) in isolated populations of endangered butterfly species. He considered that the changes could be a measure of a reduction in mobility and that isolation may select for less mobile forms. How observed differences of behaviour between the sexes relate to colonisation ability and genetic isolation of the northern *B. selene* populations is unknown. Hanski (1985) warns that human activities and other factors often decrease the density of habitat patches and such changes may cause the regional extinction of specialist species before the last habitat patches have been destroyed. It could be that we are seeing this sort of erosion of the habitats of the Small Pearl-bordered Fritillary in West Yorkshire.

Summary

The Small Pearl-bordered Fritillary, *Boloria selene,* has become rare in south, central and eastern England. In Yorkshire it has been confined to wet grassland and marshy upland areas in Watsonian vice counties 62 and 64. Its status in West Yorkshire has been unverified since the mid-1980s records published in Sutton and Beaumont (1989). In the present study at least 18 breeding locations for *B. selene* have been identified in rush pasture and mire habitats in VC64. Other sites where the species may be present have been identified. This probably represents an improved identification of the habitat locations rather than any range expansion. The vegetation, management and other characteristics of the sites are discussed and the life-cycle of the insect is summarised. Local populations are primarily using Marsh Violet (*Viola palustris*) as the larval food plant on at least 32 smaller sub-sites within the main locations. The populations on Newby Moor SSSI represent the greatest concentration of locations within the vice county and the species can be locally common. Although many sites in VC64 are SSSIs, erosion of the habitats by agricultural operations continues. However, few local populations in VC64 are considered to be at immediate risk. Habitat management of most sites is sub-optimal or non-existent and this is affecting the long-term persistence of the species; we may be observing its final decline in West Yorkshire. It would be fairly simple and not overly expensive to instal management which would improve the survival prospects of this species in VC64. The remote locations of some of the sites suggest that parts of the population could be genetically isolated. Some basic aspects of the life-cycle and population dynamics such as population densities, the location of larval over-wintering sites and the degree of mobility of the imago, are inadequately known and need further study.

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APPENDIX 1
Recent Records of *B. selene* in VC64 Yorkshire
(Site and Sub-site Records arranged by 10 km grid squares)

SD 96 Local Population not confirmed					
Chapel House Wood, Wharfedale		SD978654	30.6.78	1 female	wanderer? (PS)
SD 86 3 Local Populations					
Studfold Moss		SD808699	27.6.00	10+	
Swarth Moor		SD806693	25.6.98	20+	(BS)
			24.6.99	2	mating (PS)
			25.6.99	4+	(BS)
			27.6.00	10+	(BS)
		SD805692	6.7.99	1	patrolling
Long Preston Moor		SD825605	27.6.00	10+	(ES/BS)
SD 85 1 Local Population					
Railway cutting near Otterburn		SD878571	8.7.95	3+	(BS)
SD 77 2+ Local Populations all on parts of Newby Moor SSSI					
Un-named Mire		SD712701	18.6.78	+	(ES)
Un-named stream valley	A	SD709701	5.7.99	1	patrolling
(North of Railway line)	B	SD710703	5.7.99	3	patrolling

APPENDIX 1 (Continued)

Un-named stream valley	C	SD711702	5.7.99	1	patrolling
			17.6.96	10	(BS)
		SD711703	15.7.96	50+	(PS)
Crook Beck nr A65		SD715701	1997	1	(BS)
Crook Beck nr A65		SD715702	7.7.99	1	N. on marsh thistle
SD 76	**14+ Local Populations? all but three on Newby Moor SSSI**				
Cocket Moss (SE Side)	A	SD787619	26.6.95	30+	(PS)
		SD787617	1995?	Several	(BS)
Cocket Moss (N End)	B	SD786620	26.6.99	3	patrolling
Austwick Moss	A	SD760664	21.6.94	18+	(BS)
			7.6.97	30	(BS)
			16.6.97	50+	(BS)
			6.7.97	8	(BS)
			3.7.98	10	(BS)
	B	SD759667	1999	+	(SR)
	C	SD764669	25.6.98	5+	
Lawkland Moss	A	SD768664	7.6.97	8+	(BS)
	B	SD769664		+	(SR)
	C	SD769666	25.6.98	1	very small colony
	D	SD769667		+	(SR)
Un-named Mires Newby Moor		SD708699	5.7.99	1	patrolling
(South of Railway line)		SD710698	5.7.99	1	patrolling
Sniddle Moss (East)	A	SD707696	5.7.99	2	patrolling
			27.6.00	4+	patrolling
		SD708696	5.7.99	1	patrolling
Sniddle Moss (West)	B	SD709696	24.6.99	1	patrolling
		SD708697	27.6.00	1	patrolling
Sniddle Moss Valley	C	SD710696	5.7.99	1	patrolling
			13.7.99	1 female	disturbed from veg.
		SD711696	24.6.99	2	patrolling
			27.6.00	4+	3 patrolling, 1 Female
		SD712696	15.7.96	30+	(PS)
			24.6.99	1	patrolling
			5.7.99	1	roosting on *Juncus*
New Butt		SD705693	5.7.99	1	wanderer?
Hardacre Moss	A	SD712688	25.6.99	3	2 patrolling 1 Female
		SD712688	5.7.99	3	patrolling
Mire nr Butt Hill	A	SD706689	24.6.99	1	patrolling
		SD706690	24.6.99	1	patrolling
	B	SD708689	17.7.96	4	(BS)
Mire E of Banks Head		SD717692	6.7.99	3+	patrolling
			7.7.99	2	patrolling
		SD717692	13.7.99	1	male patrolling
				1	female disturbed from veg.
			26.6.00	4	patrolling
Gill Syke, Green Close	A	SD719692	6.7.99	3+	patrolling
			26.6.00	5+	patrolling/ basking

APPENDIX 1 (Continued)

Gill Syke, Green Close	B	SD720690	6.7.99	1	patrolling
	C	SD720691	7.7.99	6+	patrolling
			13.7.99	4+	3 patrolling
				1	N. on bell heather
			24.7.99	3+	patrolling (1 very worn)
		SD722690	7.7.99	2	patrolling
			19.7.99	4+	patrolling
			26.6.00	3+	patrolling
Gregory Hole		SD724688	7.7.99	6+	5 patrolling
				1	N. on marsh thistle
			26.6.00	5+	5 patrolling
		SD725688	15.7.96	12+	(PS)
			26.6.00	2	patrolling
Newby Mire		SD721693	7.7.99	1	patrolling
Nr Conisber		SD743671	16.7.99		1 female wanderer (PS)
Wharfe Wood	A	SD781688	27.6.95	4	(BS)
	B	SD786688	26.6.00	5+	patrolling
	C	SD789688	26.6.00	5+	N. on marsh thistle
SD 75	**1 Local Population**				
Gisburn Forest		SD742556	19.7.96	1	(BS)

Key to Record Sources & abreviations:
PE = Paul Evans, SR = Stuart Ralph, BS = Brian Shorrock, ES = Elizabeth Shorrock, PS = Peter Summers. N = at nectar.

NOTES ON SOME YORKSHIRE DIPTERA, 2001

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STRATIOMYIDAE

Odontomyia hydroleon (L.), a striking green and black medium-sized species, is one of Britain's rarest flies (RDB1), thought to be extinct in these islands until a specimen was taken in south-west Wales in 1986; subsequently it was found at a site with calcareous seepages in the North York Moors National Park (Stubbs & Drake, 2001). This is the only known English locality, where it has been monitored for a number of recent years. On the hot sunny morning of 16 July, for a period of an hour before mid-day, I observed a number of males hovering at varying heights up to about 18 inches above the ground. There were possibly six specimens involved, and the resemblance to hoverfly behaviour was remarkable, the flies being capable of moving rapidly sideways as well as remaining in a stationary position. The abdomen of the males is predominantly black and this, coupled with pale yellowish pubescence on the thoracic margins, gave the impression of a large *Cheilosia* species. Occasionally individuals would settle for a while on the leaves of sedges or other low-growing vegetation. No chasing was observed, but the behaviour seemed to be territorial, and this does not appear to have been reported before. Two females were found by sweeping low vegetation, which is the usual way of locating specimens.

SYRPHIDAE

Cheilosia albitarsis Mg. is a widespread spring species, usually found in association with buttercups. It is distinguished by having, on the front legs, yellowish mid-tarsal segments which contrast with the otherwise all-black legs. For some time it has been known that a closely similar species is present in Britain, and this has now been determined as *Cheilosia ranunculi* Doczkal (Doczkal 2000). On 11 May numbers of what I took to be *C. albitarsis* were present at an extensive colony of Lesser Celandine (*Ranunculus ficaria* L.) in Park Wood, Elland, and I collected half a dozen for subsequent examination. All proved to be *C. ranunculi*; subsequently I sought the species in a number of widely scattered Yorkshire localities, but found only one further example. This was at Askham Bog on 26 May when one was present in company with numbers of *C. albitarsis* at Creeping Buttercups (*Ranunculus repens* L.). The two species are only separable in the males, and an examination of collections will probably reveal *C. ranunculi* mixed in with *C. albitarsis*, although this has proved not to be the case with my own collection.

Xanthandrus comtus (Harris) appears to be predominantly a southern species (Falk 1991), for which there are few Yorkshire records. It was gratifying to find a single male example flying sluggishly amongst fringing vegetation at a pond in the Arboretum at Castle Howard on 17 August. Because of the highly episodic and random occurrences it is possible that this is a migrant species.

SCIOMYZIDAE

In my paper 'Notes on the marsh flies (Diptera: Sciomyzidae) of Yorkshire' (*Naturalist* **122** [1997] pp. 93-97), I noted that the only record for *Salticella fasciata* (Mg.) was 'Spurn 1928', by C. A. Cheetham, the precise location not being given. I had overlooked subsequent records from the Warren area in 1950, several specimens having been found there during the Spurn survey undertaken by members of the Y.N.U. Entomological Section (Hincks 1953). It is gratifying to report that I swept a single female from roadside vegetation near 'Chalk Bank' on 4 June, thus confirming the continued presence of this nationally rare species at Spurn. *S. fasciata* was the subject of biosystematic studies during the 1960s based on a coastal population at Tenby, South Wales (Knutson, Stephenson & Berg 1970).

A single female *Ditaeniella* (= *Pherbellia*) *grisescens* (Mg.) was swept on 9 August by the side of a shallow pool in a field north of Spurn Warren. This constitutes the first documented record for this Nationally Notable species in Yorkshire. The majority of British records are from coastal situations (Falk 1991).

Tetanura pallidiventris Fall. is a distinctive species, the female ovipositor being flattened like a shoe-horn. It is reported here for the first time in vice-county 63 on the basis of specimens found in Park Wood, Elland. Although most of the Yorkshire sites are calcareous woodland, and in my experience the fly is often associated with extensive stands of *Mercurialis perennis* L. (Dog's Mercury), this is clearly not always the case, for the Elland site is on the heavy clays of the Lower Coal Measures. In the larval stages the fly is a parasitoid of a number of terrestrial molluscs, so habitat is probably not a limiting factor of distribution.

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EFFECTS OF THE REINSTATEMENT OF COPPICE MANAGEMENT ON THE VASCULAR GROUND FLORA AT EAVES WOOD SSSI, SILVERDALE, LANCASHIRE

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ABSTRACT

This paper assesses the effects of the reinstatement of coppice management on the vascular ground flora at Eaves Wood SSSI, Silverdale, Lancashire. The study was carried out during May 2000 on a selection of neglected and actively coppiced areas within Eaves Wood. The vegetation of the various areas was compared and likely causes of differences were examined. The results showed that the greater ground flora cover, species richness and number of species per quadrat in certain areas appeared to coincide with the reinstatement of coppice management. Although numerous possible influences on the vegetation were recognised, it was concluded that the growth of coppice stems and the amount of leaf litter were likely to have been important influences. It was also found that the ground flora species composition has most probably been influenced by coppice reinstatement, many species having a tendency to occur in coppiced areas. Furthermore, the flowering vigour of certain species was found to be increased in recently coppiced areas. The results did, however, suggest that a small number of shade tolerant species might have benefited from non-intervention.

INTRODUCTION

Despite the fact that coppicing was originally employed as a timber production technique, it is now widely regarded as being an important form of management for the conservation of flora and associated fauna in certain woodlands (Kirby, 1993). However, any form of habitat management is likely to favour some species and harm others (Goldsmith, 1992).

The widespread reinstatement of coppice management is largely the result of concern among conservation managers that ground flora, particularly that of open woodland areas, would be diminished without canopy management (Barkham, 1992a), especially in isolated woodlands (Peterken, 1992). By increasing the rate of gap formation, coppicing can aid the conservation of woodland glade species in small woodland fragments, where the minimum dynamic areas necessary for the survival of some species may be greater than would be provided if the woodland remained unmanaged (Kirby, 1996).

However, many woodland species, especially those which thrive on shade and moisture, may be harmed by coppice reinstatement (Hambler & Speight, 1995). Because of poor dispersal powers and short lived seed banks, such species are particularly vulnerable to management methods that reduce their dominance in the vegetation (Brown & Oosterhuis, 1981). Certain species may also be smothered by tall vegetation resulting from increased light levels and the exclusion of grazers during the early stages of a coppice rotation (Barkham, 1992b). Others may be unable to tolerate the exaggerated microclimate fluctuations associated with coppicing (Hambler & Speight, 1995).

Because of a poor understanding of the requirements of many species and of some of the influences of coppicing, there is widespread reliance on the premise that the species of a site with a history of coppicing are best conserved by coppice reinstatement. Validation of this assumption, through vegetation surveys following coppicing, is desirable in order to ensure the conservation of diversity and of important species on individual sites.

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This paper assesses the effects of reinstated coppice management on the vascular ground flora at Eaves Wood SSSI. A selection of coppice coupes, i.e. areas of woodland cut in a particular year of a coppice rotation, including neglected and restored coupes with varying ages of regrowth, are compared in terms of ground flora cover, species richness, number of species per quadrat, diversity and evenness of species distribution, species composition and flowering vigour. Possible reasons for differences in their vegetation are then examined.

Eaves Wood SSSI is owned by the National Trust and is situated 1 kilometre northeast of Silverdale in Lancashire (grid ref. SD466763). The site lies within the Arnside and Silverdale Area of Outstanding Natural Beauty, which encompasses numerous other woodlands and areas of ecological importance. Eaves Wood is a 50 ha. woodland site, which mainly occupies the southern aspect of a low carboniferous limestone hill and is a designated SSSI on account of its limestone woodland and grassland flora. The site contains a mosaic of habitats, including broad-leaved, mixed and coniferous woodland, scrub, limestone pavement, calcareous grassland and heath. The dominant habitat is broad-leaved semi-natural woodland, including areas of coppice with standards. The coppice stools are dominated by *Corylus avellana*, but with abundant *Fraxinus excelsior*, and the standard trees largely consist of *Quercus* spp. and *Fraxinus excelsior*. Much of Eaves Wood was coppiced until the early 20th century, but was neglected from the mid-1900s until coppice management was reinstated in the winter of 1991/92 (National Trust *c.*1993; Alexander *et al.,* 1984).

Methods

Selection of study areas

Two neglected coppice coupes were selected, which, according to ring counts, appeared not to have been coppiced since around 1950 and 1960 respectively. Five restored coppice coupes were also selected, which were coppiced in the winters of 1993/94, 1995/96, 1996/97, 1997/98 and 1998/99. Study areas were selected on the grounds of similarity of site conditions (Table 1) and proximity to one another, in order to minimise differing influences on the vegetation.

TABLE 1.
Coppice coupe descriptions.

	1998/99	1997/98	1996/97	1995/96	1993/94	*c.*1960	*c.*1950
Restoration	Restored	Restored	Restored	Restored	Restored	Neglected	Neglected
Area (M^2)	375	810	1,160	810	2,250	960	2,300
Geology	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone
Aspect (approx.)	Southwest	South	South	South	South	Southwest	South
Altitude (approx.)	60 m	65-70 m	65 m	65-70 m	65-70 m	60-65 m	55-65 m
Deer fencing	Fenced	Fenced	Unfenced	Unfenced	Unfenced	Unfenced	Unfenced
Dominant species	*Corylus avellana*	*Corylus avellana*	*Corylus avellana*	*Corylus avellana*	*Corylus avellana*	*Corylus avellana*	*Corylus avellana*

Sampling

Sampling was carried out during May 2000, when a relatively complete range of vascular ground flora species would have been visible (Kirby, 1988). Data were collected on vascular ground flora and other ground cover features (Table 2), from 30 quadrats of 1 m^2 within each coupe. The outer 3 metres of the coupes were not surveyed, in order to reduce the likelihood of complications resulting from edge effects. Data were collected on coppice stools and standard trees (Table 2), from up to five quadrats of 10 x 10 metres within each coupe. All quadrats were distributed on a stratified random basis (Kirby, 1988).

TABLE 2.
Data collected from each coupe.

Coupe Feature	Data Collected
Coppice stools	No. of individuals of each species within each quadrat. Maximum height of regrowth for each species. Maximum number of stems for each species. Girth range of stems for each species.
Standard trees	No. of individuals of each species within each quadrat. The range of diameters at breast height (DBH) for each species, measured at 1.3 m above ground level (Kirby, 1988).
Vascular ground flora	The percentage cover of each species (visually estimated to the nearest 5%). Presence/absence of flowers and fruit within the quadrat for each species.
Other ground cover features e.g. leaf litter	Percentage cover (visually estimated to the nearest 5%).

Data analysis
The vascular ground flora of the various coupes was compared in terms of overall mean percentage cover, the mean number of ground flora species per quadrat and the mean percentage cover of individual species (Table 3). The significance of differences was assessed using analysis of variance (ANOVA). The coupes were also compared in terms of species richness and the frequency of occurrence of individual species, as well as the frequency of occurrence of flowers and fruit on individual species (Table 3), and the significance of differences was tested using Chi-Squared tests (Powell, 1996). The diversity and evenness of species distribution within each coupe were then calculated, using the Shannon-Weiner Diversity Index (Kent & Coker, 1992). The similarity of species composition between coupes was also tested using the Czekanowski Coeffcient (Kent & Coker, 1992). The Spearman Rank Correlation Coefficient (Powell, 1996) was used to establish whether the growth or density of stools and standards, time since coppicing or leaf litter cover were related to the ground flora cover, number of species per quadrat, species richness, diversity or evenness of species distribution.

Results

Vascular ground flora cover
Significantly less ground flora cover was recorded in neglected coupes compared to restored coupes (Table 4), the 1998/99 coupe having the greatest cover and the 1960 coupe having the least. No statistically significant correlation between ground flora cover and growth or density of stools and standards, litter cover or time since coppicing was found. However, there was some evidence of negative correlation between ground flora cover and the height of coppice regrowth ($r_s = -0.759$, $p<0.1$, $n = 7$).

TABLE 3.
Definitions and application of vascular ground flora measurement criteria. (Adapted from Kent & Coker, 1992; Powell, 1996).

Measurement	Definition	Application
Mean percentage cover	Mean area covered by overall ground flora or individual species in the survey quadrats of a coupe.	Comparison of overall field layer productivity or growth vigour of individual species between coupes.
Species richness	The total number of ground flora species recorded within the survey quadrats of a coupe.	Comparison of the number of species able to tolerate the conditions throughout the various coupes.
Mean number of species per quadrat	The sum of species scores for the quadrats of a coupe, divided by the number of quadras.	Comparison of the number of species able to tolerate the prevailing conditions in the various coupes giving less weight to species inhabiting only part of a coupe.
Diversity (Shannon -Weiner index)	Diversity $H' = \sum_{i=1}^{s} pi \ln pi$ s = Number of species pi = Abundance of the ith species. ln = log base $_n$	Quantitative comparison of the diversity of coupes, combining species richness with relative abundance of species.
Evenness of species distribution (Shannon -Weiner index)	Equitability $J = \frac{H'}{H'_{max}}$ H' = Diversity $H'_{max} = \ln s$ s = Number of species	Quantitative comparison of coupes in terms of relative abundance of individual species, which may be indicative of factors such as habitat suitability or inter-specific competition.
Frequency of occurrence of species	The number of quadrats within a coupe in which an individual species was recorded.	Assessment of habitat preferences of species, allowing for those which tend not to have extensive ground cover.
Similarity of species composition (Czekanowski coefficient)	$Sc = \frac{2\sum_{i=1}^{m} \min(X_i, Y_i)}{\sum_{i=1}^{m} X_i + \sum_{i=1}^{m} Y_i}$ X_i, Y_i = abundances of species i $\sum_{i=1}^{m} \min(X_i, Y_i)$ = sum of lesser scores of species i m = number of Species	Quantification of similarities in species composition to give an indication of influences on vegetation.
Frequency of occurrence of flowers and fruit	The number of quadrats in which flowers or fruit were present on an individual species as a proportion of the number of quadrats where that species was present.	Comparison of the flowering vigour of a particular species in different coupes.

Vascular ground flora species richness

Significantly fewer vascular ground flora species were recorded in the neglected coupes compared to the restored coupes (Table 4). The greatest number of species was recorded in the 1996/97 coupe, and the fewest in the 1960 coupe. No statistically significant correlation was found between species richness and features relating to stools, standards, leaf litter or time since coppicing, although there was some evidence of negative correlation between species richness and leaf litter cover ($r_S = -0.714$, $p<0.1$, $n = 7$).

TABLE 4.
Vascular ground flora characteristics of coupes, including statistical test results.

Vegetation feature	98/99	97/98	96/97	95/96	93/94	*c.*1960	*c.*1950	Significance
Mean percentage cover	133.83	40.67	63.33	72.00	68.33	19.83	25.50	ANOVA $p = 0.0001$
Species richness	24	18	26	19	21	7	8	$\chi^2 = 18.76$ df = 6 $p<0.01$
Mean number of species per quadrat	6.73	2.97	4.77	4.83	4.46	0.77	2.10	ANOVA $p = 0.0001$
Diversity (Shannon-Weiner index)	2.12	1.52	2.08	1.91	2.32	0.74	1.53	
Equitability of species distribution (Shannon-Weiner index)	0.67	0.53	0.64	0.65	0.76	0.38	0.74	

Number of vascular ground flora species per quadrat

A significantly lower mean number of ground flora species per quadrat was found in neglected coupes (Table 4). The highest number of species per quadrat was recorded in the 1998/99 coupe and the lowest in the 1960 coupe. Although not statistically significant, there was some evidence of negative correlation between the number of species per quadrat and time since coppicing ($r_S = -0.723$, $p<0.1$, $n = 7$), the height of coppice regrowth ($r_S = -0.723$, $p<0.1$, $n = 7$) and the girth of coppice regrowth ($r_S = -0.723$, $p<0.1$, $n = 7$).

Diversity and evenness of species distribution

The neglected coupes and the 1997/98 coupe were found to have relatively low ground flora diversity (Table 4). The coupe with the greatest diversity was the 1993/94 coupe. No correlation was found between diversity and other coupe features. The 1993/94 coupe and the 1950 coupe had the most even species distribution (Table 4), and the 1960 coupe had the most uneven species distribution. No correlation was found between evenness of species distribution and other coupe features.

Vascular ground flora species composition

Significant differences between the coupes were found in the percentage cover of eight species (Table 5). These were *Epilobium montanum, Fragaria vesca Hedera helix* and *Mercurialis perennis*, which had greatest cover in the 1998/99 coupe; *Rubus fruticosus* and *Viola riviana*, which had greatest cover in the 1995/96 coupe; and *Helianthemum chamaecistus* and *Pteridium aquilinum.* which had greatest cover in the 1993/94 coupe. In terms of percentage cover, *Rubus fruticosus* was dominant in all restored coppice coupes, although *Fragaria vesca* and *Hedera helix* were also abundant in the 1998/99 coupe. *Hedera helix* was dominant in the 1960 coupe and *Mercurialis perennis* and *Hyacinthoides non-scriptus* were co-dominant in the 1950 coupe.

TABLE 5.
Mean percentage cover of vascular ground flora species, including results of ANOVA statistical test (NS = Not significant).

Species	Mean Percentage Cover per Coupe							ANOVA
	98/99	97/98	96/97	95/96	93/94	1960	1950	
Arum maculatum	0.8	1.2	0.0	0.0	0.5	1.5	1.3	NS
Brachypodium sylvaticum	1.5	0.5	2.3	0.0	3.2	0.0	0.2	NS
Carex flacca	0.0	0.0	0.0	0.7	1.3	0.0	0.0	NS
C. sylvatica	0.0	0.0	0.2	0.0	0.3	0.0	0.0	NS
Chamaenerion angustifolium	0.3	0.0	1.5	1.5	1.5	0.0	0.0	NS
Cirsium arvense	0.2	0.2	1.2	0.7	0.0	0.0	0.0	NS
C. vulgare	0.5	0.0	0.0	0.0	0.0	0.0	0.0	NS
Cotoneaster sp.	0.0	0.0	0.7	0.2	0.0	0.0	0.0	NS
Daphne laureola	0.0	0.0	0.7	0.3	0.0	0.0	0.0	NS
Epilobium hirsutum	1.8	1.0	1.3	1.8	1.7	0.0	0.0	NS
E. montanum	5.3	2.2	2.5	0.8	0.8	0.0	0.0	p=0.0001
Fragaria vesca	29.5	3.5	5.5	6.2	10.5	0.0	0.3	p=0.0001
Geranium robertianum	1.2	0.2	0.0	0.0	0.5	0.0	0.0	NS
Geum urbanum	4.3	0.0	0.3	0.5	0.3	0.3	0.2	NS
Hedera helix	26.8	0.2	0.2	0.0	0.0	16.2	0.0	p=0.0001
Helianthemum chamaecistus	0.0	0.2	4.2	3.3	5.3	0.0	0.0	p=0.0001
Hyacinthoides non-scriptus	0.0	0.0	0.0	0.0	0.0	0.0	8.2	NS
Lonicera pericylmenum	0.0	2.7	0.2	0.0	0.0	0.0	0.0	NS
Lotus corniculatus	0.2	0.0	0.5	0.3	0.0	0.0	0.0	NS
Medicago lupulina	0.0	0.2	0.0	0.0	0.0	0.0	0.0	NS
Mercurialis perennis	19.3	0.0	1.8	0.0	3.5	0.2	8.8	p=0.0001
Mycelis muralis	0.3	0.0	0.0	0.0	0.0	0.0	0.0	NS
Potentilla erecta	0.0	0.0	0.2	0.0	0.0	0.0	0.0	NS
P. sterilis	0.7	0.0	0.0	0.0	0.0	0.0	0.0	NS
Primula veris	0.2	0.0	0.7	0.0	1.2	0.0	0.0	NS
Pteridium aquilinum	0.0	1.3	0.2	2.8	4.2	0.2	0.0	p=0.007
Ranunculus repens	0.2	0.2	1.2	0.2	0.2	0.0	0.0	NS
Rosa agg.	0.8	0.3	0.2	0.3	0.0	0.0	0.0	NS
Rubus fruticosus	29.7	25.8	31.8	36.3	23.2	1.3	3.8	p=0.0001
Senecio jacobaea	4.3	0.0	0.0	0.0	0.0	0.2	0.0	NS
Taraxacum officinale agg.	3.2	0.7	3.0	4.3	3.7	0.0	0.0	NS
Teucrium scorodonia	0.0	0.0	1.0	4.8	2.0	0.0	0.0	NS
Veronica chamaedrys	0.3	0.0	0.0	0.0	0.0	0.0	0.0	NS
V. hederifolia	0.3	0.0	0.0	0.0	0.0	0.0	0.0	NS
V. officinalis	0.0	0.2	0.3	0.0	0.3	0.0	0.0	NS
Viola hirta	0.0	0.0	0.3	2.7	1.2	0.0	0.0	NS
V. riviana	2.0	0.3	1.5	4.2	3.0	0.0	2.7	p=0.005

In terms of frequency of occurrence, *Rubus fruticosus* was again dominant in most restored coppice coupes, apart from the 1998/99 coupe, where *Hedera helix* had a slightly higher frequency (Table 6). *H. helix* was also dominant in the 1960 coupe, but *Rubus fruticosus* and *Hyacinthoides non-scriptus* were co-dominant in the 1950 coupe. Five species were found to have a significant tendency to occur only in areas coppiced between 1997 and 1999, where deer fencing was still in place. These were *Epilobium montanum, Geum urbanum, Hedera helix. Lonicera periclymenum* and *Senecio jacobaea* (Table 7).

TABLE 6
Frequency of occurrence of vascular ground flora species
(out of 30 quadrats surveyed per coupe).

Species	Coupe/Frequency of Occurence						
	1998/99	1997/98	1996/97	1995/96	1993/94	*c.*1960	*c.*1950
Arum maculatum	4	5	0	0	1	2	5
Brachypodium sylvaticum	4	2	8	0	4	0	1
Carex flacca	0	0	0	3	1	0	0
C. sylvatica	0	0	1	0	1	0	0
Chamaenerion angustifolium	1	0	8	4	6	0	0
Cirsium arvense	1	1	5	4	0	0	0
C. vulgare	2	0	0	0	0	0	0
Cotoneaster sp.	0	0	4	1	0	0	0
Daphne laureola	0	0	2	1	0	0	0
Epilobium hirsutum	8	5	8	9	8	0	0
E. montanum	21	11	13	5	5	0	0
Fragaria vesca	20	9	15	12	19	0	2
Geranium robertianum	2	1	0	0	2	0	0
Geum urbanum	10	0	1	2	2	2	1
Hedera helix	29	1	1	0	0	9	0
Helianthemum chamaecistus	0	1	8	9	9	0	0
Hyacinthoides non-scriptus	0	0	0	0	0	0	18
Lonicera pericylmenum	0	8	1	0	0	0	0
Lotus corniculatus	1	0	2	1	0	0	0
Medicago lupulina	0	1	0	0	0	0	0
Mercurialis perennis	17	0	1	0	2	1	7
Mycelis muralis	2	0	0	0	0	0	0
Potentilla erecta	0	0	1	0	0	0	0
P. sterilis	2	0	0	0	0	0	0
Primula veris	1	0	2	0	6	0	0
Pteridium aquilinum	0	7	1	6	4	1	0
Ranunculus repens	1	1	2	1	1	0	0
Rosa agg.	3	1	1	2	0	0	0
Rubus fruticosus	27	28	30	30	27	7	18
Senecio jacobaea	16	0	0	0	0	1	0
Taraxacum officinale agg.	17	4	16	20	20	0	0
Teucrium scorodonia	0	0	3	7	3	0	0
Veronica chamaedrys	2	0	0	0	0	0	0
V. hederifolia	2	0	0	0	0	0	0
V. officinalis	0	1	1	0	1	0	0
Viola hirta	0	0	1	14	4	0	0
V. riviana	9	2	7	14	8	0	11

TABLE 7
Significance of association between frequency of occurrence of individual species and the stage in the coppice rotation (Chi-squared tests – 2 degrees of freedom).

Species	χ^2	Significance Level (NS = Not Significant)	Apparent Habitat Preferences		
			Recent Coppice (1997-99) Fenced	Older Restored Coppice (1993-97) Unfenced	Neglected Area (Coppiced 1950-60)
Arum maculatum	10.774	p<0.01	✔		✔
Brachypodium sylvaticum	6.047	p<0.05	✔	✔	
Carex flacca	5.437	NS			
C. sylvatica	2.692	NS			
Chamaenerion angustifolium	23.060	p<0.001		✔	
Cirsium arvense	7.867	p<0.02		✔	
C. vulgare	5.048	NS			
Cotoneaster sp.	6.829	p<0.05		✔	
Daphne laureola	4.058	NS			
Epilobium hirsutum	19.465	p<0.001	✔	✔	
E. montanum	44.176	p<0.001	✔		
Fragaria vesca	40.311	p<0.001	✔	✔	
Geranium robertianum	3.244	NS			
Geum urbanum	7.038	p<0.05	✔		
Hedera helix	56.695	p<0.001	✔		
Helianthemum chamaecistus	36.204	p<0.001		✔	
Hyacinthoides non-scriptus	49.219	p<0.001			✔
Lonicera pericylmenum	16.871	p<0.001	✔		
Lotus corniculatus	2.166	NS			
Medicago lupulina	2.512	NS			
Mercurialis perennis	19.471	p<0.001	✔		✔
Mycelis muralis	5.048	NS			
Potentilla erecta	1.340	NS			
P. sterilis	5.048	NS			
Primula veris	8.339	p<0.02		✔	
Pteridium aquilinum	5.575	NS			
Ranunculus repens	2.631	NS			
Rosa agg.	4.138	NS			
Rubus fruticosus	74.484	p<0.001	✔	✔	
Senecio jacobaea	39.075	p<0.001	✔		
Taraxacum officinale agg.	60.120	p<0.001		✔	
Teucrium scorodonia	18.477	p<0.001		✔	
Veronica chamaedrys	5.048	NS			
V. hederifolia	5.048	NS			
V. officinalis	1.296	NS			
Viola hirta	27.853	p<0.001		✔	
V. riviana	5.395	NS			

Chamaenerion angustifolium, Cirsium arvense, Cotoneaster sp. Helianthemum chamaecistus, Primula veris, Taraxacum officinale, Teucrium scorodonia and *Viola hirta* were found to have a significant tendency to occur only in coupes coppiced between 1993 and 1997, where deer fencing had been removed. *Brachypodium sylvaticum, Epilobium hirsutum, Fragaria vesca* and *Rubus fruticosus,* were found to have a significant tendency to occur in a range of restored coppice coupes regardless of the year of coppicing or the presence of deer fencing. *Arum maculatum* and *Mercurialis perennis* were found to have a significant tendency to occur both in neglected coupes and recently restored coupes where deer fencing was present. *Hyacinthoides non-scriptus* had a statistically significant tendency to occur in neglected coupes, although it was present in only one of the neglected coupes.

Similarity of vascular ground flora between coupes

The similarity found between the vascular ground flora species composition of each pair of coupes ranged from 3.9% to 77.4% (Table 8). Between 3.9% and 24.7% similarity was found when comparing neglected coupes to restored coupes. Restored coupes were between 41.1% and 77.4% similar to one another.

TABLE 8

Percentage similarity of ground flora species composition (Czekanowski coefficient).

	1998/99	1997/98	1996/97	1995/96	1993/94	*c.*1960
*c.*1950	20.2	17.5	17.5	14.4	23.9	13.2
*c.*1960	24.7	9.5	5.3	3.9	5.7	
1993/94	47.9	59.7	73.2	72.1		
1995/96	44.2	60.8	77.4			
1996/97	49.3	68.2				
1997/98	41.1					

Frequency of occurrence of flowers and fruit

The frequency of occurrence of flowers on *Geum urbanum* was significantly higher in restored compared to neglected coupes ($x^2 = 7.2$, $p<0.01$). A significantly higher occurrence of flowers in recently restored coupes, where deer fencing was still present, compared to older restored coupes, was found on *Fragaria vesca* ($x^2 = 5.598$, $p<0.02$), *Taraxacum officinale* ($x^2 = 15.721$, $p<0.001$) and *Viola riviana* ($x^2 = 6.144$, $p<0.02$). No significant differences were found for other ground flora species.

Discussion

Low ground flora cover in neglected coupes, and possible negative correlation between coppice regrowth height and vegetation cover, appears to concur with the findings of Grime (1979), who suggests that field layer production tends to decrease as the size of coppice regrowth increases. This may be due to increased shading and associated microclimate changes.

The lower number of species in neglected coupes, compared to restored coupes, reflects the findings of various earlier studies (Mitchell & Kirby, 1989). The possible negative correlation between litter cover and species richness may suggest that a number of species cannot tolerate being smothered by leaf litter.

Compared to the overall species richness of a coupe, the mean number of species per quadrat gives less weight to small atypical areas that may be inhabited by species not present throughout the majority of a coupe. The possible negative correlation between the number of species per quadrat and the height and girth of coppice regrowth, as well as time since coppicing, may suggest that increasing shade and associated microclimate factors results in fewer species being able to tolerate the conditions in the majority of the coupe.

It is difficult to draw conclusions regarding differences between coupes in the diversity and evenness of species distribution, owing to the lack of correlation with other coupe features. This may be due to combined or conflicting influences on the vegetation, perhaps including factors that were not examined in depth during this study, such as variability of conditions within coupes.

The ability of *Mercurialis perennis* and *Hedera helix* to take advantage of undisturbed habitats through lateral vegetative spread and shade tolerance (Grime *et al.,* 1990), may explain their dominance in terms of percentage cover in neglected coupes. The greater cover of these species in recently coppiced coupes, but low cover in restored coupes coppiced prior to 1998/99, may be explained by an initial increase in growth following coppicing, followed by a slow decline in response to disturbance (Barkham, 1992b), or competition from species of open habitats.

The significantly higher cover of many species in actively coppiced areas may be due to factors such as increased light levels and associated microclimate changes or reduced litter cover. Ability to tolerate microclimate stresses or disturbance during coppicing may also be important. The dominance of *Rubus fruticosus*, in terms of percentage cover, in every restored coupe is likely to be a response to increased light levels (Barkham, 1992b) and reflects the findings of Fuller and Warren (1993), who suggest that *R. fruticosus* is likely to develop between coppice stools within three years of coppicing and is likely to persist for up to eight years. This, and its dominance in terms of frequency of occurrence in most restored coupes, also reflects the findings of Van der Werf (1991), who states that it is a species which prefers coppicing to high forest management. The significant tendency of *Rubus fruticosus* as well as species such as *Epilobium hirsutum* and *Fragaria vesca* to occur in restored coupes of all ages may be an indication of their competitive natures and ability to tolerate open habitats as well as some shade (Grime *et al.*, 1990).

Responsiveness to increased light, or a tendency to colonise disturbed ground, are likely explanations for the tendency of a number of species to occupy only recently coppiced coupes. This may include species that have survived as buried seed in neglected coppice areas (Fuller & Warren, 1993). Subsequent reduction in frequency of occurrence may be due to a variety of factors. Some may be reduced by grazing following the removal of deer fencing, for example, *Geum urbanum.* which is rare in grazed habitats (Taylor, 1997). Van der Werf (1991) suggests that the species of recently coppiced areas are likely to include those that may not generally belong in forest ecosystems. This may describe *Senecio jacobaea*, which was found to occur almost exclusively in the most recently coppiced coupe and *Epilobium montanum* which does not have a long term ability to survive under woodland canopies (Fuller & Warren, 1993). Such species are often excluded in the later stages of the coppice rotation (Ash & Barkham, 1976), perhaps as a result of shade or increasing volumes of leaf litter.

Evans and Barkham (1992) suggest that the response time of some perennial species to canopy gaps may be relatively long. Those species that tend to occur mostly in the older restored coupes, coppiced between 1993 and 1997, where the deer fencing has been removed, may therefore be more likely to consist of species of open habitats that are not rapid colonisers. The competitive abilities of certain species may also have been important in allowing them to persist among other light responsive species. Also, the early flowering of some species such as *Primula veris, Taraxacum officinale* and *Viola hirta* (Grime *et al.,* 1990) may have enabled them to survive under a developing canopy and compete with species that flower later in the year. Some species may additionally have been favoured by grazing, following the removal of deer fencing, which may have eliminated some competitors.

The tendency of *Arum maculatum* and *Mercurialis perennis* to occur in both neglected areas and recently coppiced coupes reflects the ability of these species to survive in shaded habitats (Grime *et al.,* 1990), but may also suggest a tolerance of open habitats. However, it may be that they slowly decline in response to disturbance, following an initial reaction to increased light levels (Barkham, 1992b). Alternatively, their shade tolerance may enable them to survive in the shade of light responsive species for a time (Ash & Barkham, 1976), perhaps until they are eliminated through competitive exclusion. Because of the ability of these species to achieve wide ground cover in shaded areas (Barkham, 1992b), when other light responsive species have diminished, and the possibility that they cannot tolerate conditions throughout the coppice rotation, it may be argued that these species would benefit from non-intervention.

For some species, such as *Taraxacum officinale,* the apparent increase in flowering vigour in areas of less shade may be explained by adaptation to open habitats. For species which flower in midsummer, such as *Geum urbanum,* flowering vigour may be increased by the removal of the woodland canopy. This concurs with the findings of Taylor (1997) that the seed production of *G. urbanum* was enhanced in the first two to three years following coppicing at Buff Wood in Cambridgeshire.

It is recognised that there are various possible influences, which have not been discussed, that may have resulted in vegetation differences between coupes, even prior to coppice reinstatement, such as different soil conditions, propagule availability and influences from adjacent land. Nevertheless, the size of coppice regrowth and leaf litter cover appear to be important influences on the vegetation. Furthermore, the relatively low similarity of ground flora composition found when comparing neglected coupes to restored coupes may suggest that coppicing has had a considerable influence on flora composition. The greater ground flora cover, species richness and number of species per quadrat in certain coupes also appears to coincide with reinstated coppice management, as does the increased cover, frequency of occurrence and flowering vigour of various individual species.

The fact that *Arum maculatum* and *Mercurialis perennis* were shown to be potentially disadvantaged by coppicing highlights the importance of retaining areas of non-intervention or high forest management in order to protect those species that depend on shaded, moist or undisturbed areas, especially as they are unlikely to re-colonise an area once they are lost from the vegetation (Brown & Oosterhuis, 1981).

A number of species, however, have been shown to benefit from the conditions provided during discrete stages of a coppice rotation. This includes adaptable open ground species with good dispersal powers, which are not restricted to woodland habitats, such as *Taraxacum officinale* (Grime *et al.,* 1990). However, it also includes a number of open woodland species, such as *Geum urbanum* (Taylor, 1997, Grime *et al.,* 1990) and *Teucrium scorodonia* (Hutchinson, 1968), some of which were absent in the neglected coppice areas.

Because many open woodland species have declined as a result of canopy closure (Van der Werf, 1991), the provision of suitable habitats for such species may justify the reinstatement of coppice management at Eaves Wood, as long as species of woodland shade continue to be protected through the maintenance of areas of non-intervention or high forest management. Vegetation survey prior to coppice reinstatement is, however, very important in order to ensure that the chosen management regime for any site is appropriate for the species present. This can also provide baseline information for monitoring the effects of coppicing.

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THE WASPS AND BEES (*HYMENOPTERA: ACULEATA*) OF CORNELIAN AND CAYTON BAYS AND OSGODBY POINT IN WATSONIAN YORKSHIRE

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Aculeate wasps and bees require open terrestrial habitats. The open landscape that we now know is largely a result of human activity. The habitats originally used by the aculeate wasps and bees would mainly be disturbed areas at the coast (e.g. sand dunes, erosion of hard rock cliffs and soft rock cliffs and slips) or inland (e.g. river banks and inland sand dunes). Cornelian and Cayton Bays are areas subject to frequent landslips and Osgodby Point hard rock cliffs are being eroded by the sea. Thus these three sites could be modern-day representatives of the original disturbed habitats.

The three sites are situated on the coast just to the south of Scarborough (TA0685) and are made up of boulder clay cliffs and a sandstone headland. The sites are in the ownership of the National Trust and the local authority. They are situated in the North York Moors and Hills Natural Area. The study area was about 23 hectares, but probably covered about 39 hectares when others' records are considered. The main habitats within these sites are woodland, dense shrub, flowery basic enriched grassland and marsh. There is abundant dead wood, which in sunny situations is used by aerial nesters. The dry friable bare banks, particularly where the soft sandstone comes to the surface in sunny situations, are used by subterranean nesters. Pollen and nectar sources are readily available from the flowers of trees (sycamore), shrubs (sallow, blackthorn, hawthorn) and herbs (dandelion, kidney vetch). The wide variety of habitats provide the prey, needed by wasps.

The aims of this paper are to describe the aculeate wasp and bee fauna of the three sites, to estimate the potential number of species that could be present, carry out comparisons with other Yorkshire sites and evaluate the conservation value of the sites. The three sites, for the purposes of analysis, will be treated as one site.

Methods

Between 1984 and 2000, 16 visits were made to the three sites, distributed throughout the year as follows: April (2 visits), May (3), June (3), July (3), August (4) and September (1). During these visits, which usually lasted about three hours, all species of aculeate wasps and bees were recorded and usually collected with a hand net for identification.

Some records have been made available by the following: J. D. Coldwell (Cayton Bay, July 1995), W. A. Ely (Cornelian Bay, May 1976), J. H. Flint (Cayton Bay, June 1986, five visits August 1965-1971), A. Grayson (Cornelian Bay, June 1995), P. Kendall (Cayton Bay, July 1983), T. H. Riley (Cornelian Bay, June 1973) and D. H. Smith (Cornelian Bay, July 1987). The additional records added two species not found by the author.

In the following account, the nomenclature can be related to that of Fitton *et al.* (1978).

Species present and seasonal progression of species

A full list of recorded species is given in the Appendix. At the family level, Table 1 shows the taxonomic distribution of species and records. The Archer sample consists of 13 social wasp and bee species and 195 records of 57 solitary species. A record, in the Archer sample, represents a specimen differing in one of the following three variables: name, sex and day of visit. The solitary wasp family, Sphecidae, and the solitary bee families, Andrenidae and Halictidae, are the dominant families in terms of both the number of species and records.

Table 2 shows the number of solitary species and when species were first recorded for each month of the Archer sample. The most productive months for the species of solitary wasps were June and July with most species being first recorded during June. No solitary wasps were found during the spring months (April to May). The species most evident are the aerial nesters (*Trypoxylon figulus, T. clavicerum, Ectemnius cavifrons*) usually flying around and landing on upright dead wood in sunny situations, and the subterranean nesters (*Priocnemis schioedtei, Odynerus spinipes, Diodontus tristis, Mellinus arvensis*). A *O. spinipes* nesting aggregation was found on a boulder clay bare bank facing south, usually with its parasite, *Chrysis viridula*, in attendance. Males and females of *P. schioedtei* were found flying and running over bare exposed boulder clay while males and females *M. arvensis* were associated with sandy outcrops.

TABLE 1

The number of records and species of the Archer sample and total number of aculeate wasps and bees recorded from Cornelian and Cayton Bays with Osgodby Point.

	Archer Records	Archer Species	Total Species
Solitary Wasps			
Chrysididae	13	5	5
Pompilidae	17	7	8
Eumenidae	8	3	3
Sphecidae	89	19	20
Total Solitary Wasps	127	34	36
Solitary Bees			
Andrenidae	23	7	7
Halictidae	37	11	11
Megachilidae	3	3	3
Anthophoridae	5	2	2
Total Solitary Bees	68	23	23
Total Solitary Species	195	57	59
Social Wasps & Bees			
Vespidae		4	4
Apidae		9	9
Total Social Species		13	13
Total Wasps and Bees		70	72

TABLE 2

The number of species and when species were first recorded per month of solitary wasps and bees from the Archer sample for Cornelian and Cayton Bays with Osgodby Point.

	April	May	June	July	August	September
No. species						
Wasps	0	0	23	22	16	5
Bees	6	9	9	9	9	5
No. species first recorded						
Wasps	0	0	23	7	4	0
Bees	6	4	6	3	3	1

The most productive months for the solitary bees were May, June, July and August with most species being first recorded during April and June. The species most evident were the spring species (*Andrena scotica* with its cleptoparasite *Nomada marshamella, A. haemorrhoa*) and the species that appear throughout the spring and summer (*Halictus* *rubicundus, Lasioglossum fratellum, L. rufitarse, L. villosulum*). All these bees are subterranean nesters.

ESTIMATING THE POTENTIAL NUMBER OF SOLITARY AND BEE SPECIES

Twenty-one of the Archer sample of 57 solitary species were only recorded on one occasion, giving rise to concern as to how many species had not been found. Recent advances in non-parametric statistical procedures offer some hope of addressing this problem. The presence/absence quantitative estimate of Chao (*in* Colwell & Coddington, 1994) is based on the number of species that are recorded on one (unique species) or two (two occasion species) samples or visits. The jackknife procedure (Heltshe & Forrester, 1983) only depends on the unique species. The software to carry out the statistical procedures is provided by Pisces Conservation Ltd. The statistical procedure takes 1, 2, etc. samples at random 16 times (i.e. the number of samples), each time calculating a mean estimate of the potential number of species with a measure of the error of the estimate. With a small number of samples the estimates are erratic, but as more samples are selected the estimates may stabilise giving confidence in them.

Since the estimates for the Chao (Fig. 1) and Jackknife (Fig. 2) procedures more-or-less stabilise and the final estimates based on all 16 samples for the two procedures (Table 3) are very similar, there is confidence that there are on an average nearly 80 potential species of solitary wasps and bees for the three sites. Just over 70% of these potential number of species have been found by the author. Another 20-22 species remain to be found.

TABLE 3

Non-parametric estimates of species richness of solitary wasps and bees based on the Archer sample from Cornelian and Cayton Bays with Osgodby Point.

	Chao estimate	Jackknife estimate
No. species – recorded	57	57
– estimated	79	77
95% confidence limits	57-100	67-87
% species recorded of estimate	72.2	74.0

COMPARISONS WITH OTHER YORKSHIRE SITES

Another problem in the study of any site is the difficulty of knowing when the species list is sufficiently complete so that comparisons with other sites may reasonably be carried out. One way to resolve this problem is the use of the species-area relationship, where the number of species and the area of sites, both expressed as natural logarithms (ln), can show a positive relationship (Usher, 1986). If the number of species in relation to the area of a site falls within the range of other sites which show a statistically significant species-area relationship, then the site may reasonably be compared with other sites. If the number of species in relation to the area of the site falls below the values of the other sites than this could indicate either more species could be found at that site, or that the site consists of habitats which are particularly unfavourable for aculeate wasps and bees.

The dot for the current site (either the smaller area of the Archer sample or the larger area of all recorders) falls within the range of 19 sites from the north and north midlands of England (Archer, 1999) and so the species list from the current study site can be considered sufficiently complete to make valid comparisons with other sites.

CLEPTOPARASITIC LOAD

The cleptoparasitic load (CL) is the percentage of aculeate species that are cleptoparasites (or parasitoids) on other host aculeates. Wcislo (1987) showed that parasite behaviour among aculeate Hymenoptera correlated with geographical latitude.

Thus the parasitic rates are higher in temperate regions as host populations are more

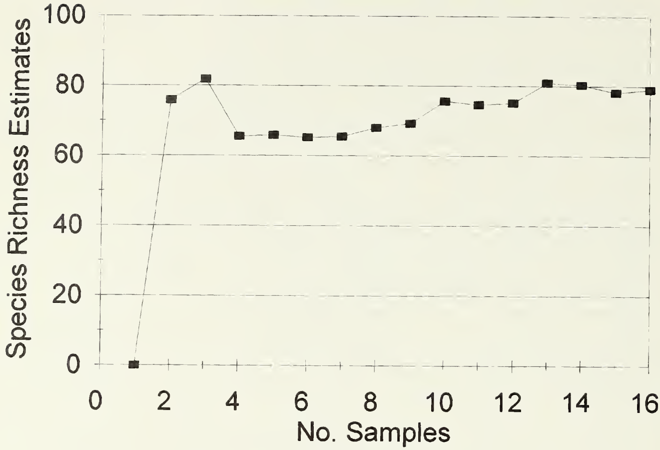

FIGURE 1
The Chao presence/absence estimate of species for Cornelian and Cayton Bays with Osgodby Point.

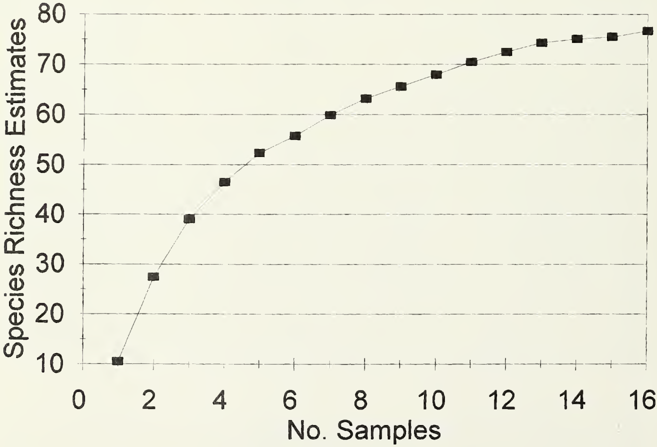

FIGURE 2
The Jacknife estimate of species for Cornelian and Cayton Bays with Osgodby Point.

synchronised in their life-history characteristics. This finding probably does not hold for desert regions where the occurrence of rainfall would tend to synchronise life history characteristics. From a review of the literature Wcislo found that the CLs for bees in Europe varied between 16% and 33%, with a range of 17%.

Archer (1999) found that the CLs for the solitary bees from north and north midlands sites of England vary between 22% and 37%, with a range of 15% which is similar to the range found by Wcislo. The CL for the solitary bees from the current study site (Table 4) falls within this range.

Wcislo gives no CLs for solitary wasps but Archer (1999) found that the north and north midlands of England CLs vary between 10% and 22%, with a range of 12%. The narrow range of this variation indicates that the argument Wcislo developed for the bees also applies to the solitary wasps. The CL for the solitary wasps from the current site (Table 4) falls within this range.

Archer and Burn (1995) discussed why the CLs for the solitary bees are higher than the CLs for the solitary wasps. They argue that it is probably a consequence of food-chain relationships.

All the social species are host species, except for the *Psithyrus* species, which are social parasites on the *Bombus* species.

TABLE 4

The relative frequency of the cleptoparasitic (or parasitoid) species among the solitary species from Cornelian and Cayton Bays with Osgodby Point.

	No. hosts (H)	No. cleptoparasites (C)	Cleptoparasitic Load CL = 100 x C/(H+C)
Solitary Wasps	31	5	13.9
Solitary Bees	17	6	26.1

Aerial nester frequency

The aerial nester frequency (AF) is the percentage of host aculeate species that have aerial nest sites. The aerial nesters used old beetle burrows in dead wood, hollow stems, e.g. bramble, crevices in mortar walls or old snail shells. Subterranean nesters nest in the soil, usually in burrows dug by themselves, but sometimes holes and crevices are used after being altered.

Archer (1999) found that the AFs for the solitary wasps from the north and north midlands vary widely between 0% and 84% while the AF for British species is 46%. The AF of the solitary wasps from the current study site (Table 5) falls within this range but is higher than the British percentage. Archer (1999) found that the AFs for the solitary bees from the north and north midlands of England vary less widely – between 7% and 23% – while the British percentage is 18%. The AF of the solitary bees for the current study site (Table 5) falls within this range but is lower than the British percentage. In summary the current study site is relatively rich in aerial nesters for solitary wasps but relatively poor in aerial nesters for the solitary bees. Since the study site is rich in aerial nesting sites the small number of aerial nesting solitary bees was not expected. Perhaps more aerial nesting solitary bee species will be found with more sampling, or maybe their habitat requirements are not all present for their continued existence.

Of the species of social wasps *Vespula rufa* and *Paravespula vulgaris* are mainly subterranean nesters and *Dolichovespula sylvestris* and *D. norwegica* are mainly aerial nesters. A nest of the social wasp, *Dolichovespula sylvestris*, was found in a hollow of the boulder clay cliffs. Males of the social wasp, *Vespula rufa*, were once found in a mating swarm on the tops of the shrubs. The host species of the bumble bees are mainly or entirely subterranean nesters, although *Bombus pratorum* has been found in aerial situations such as old bird's nests.

TABLE 5
The nesting habits of the host solitary species recorded from Cornelian and Cayton Bays with Osgodby Point

	No. aerial nesters (A)	No. subterranean nesters (S)	Aerial nester frequency AF = 100 x A/(A+S)
Solitary Wasps	17	14	54.8
Solitary Bees	2	15	11.8

THE CONSERVATION VALUE OF THE SITE

Two Yorkshire rarities have been found: *Priocnemis cordivalvata* which is at the northern edge of its range in Yorkshire and *Coelioxys rufescens* which is found in England, Wales and southern Scotland. Four species are nationally rare or scarce according to Shirt (1987) and Falk (1991): *Priocnemis cordivalvata, Ectemnius ruficornis* and *E. sexcinctus* which are at the northern edge of their ranges in Yorkshire, and *Priocnemis schioedtei* which is found in England, Wales and Scotland. Recent work by the Bees, Wasps and Ants Recording Society indicates that the statuses of *P. schioedtei, E. ruficornis* and *E. sexcinctus* should be downgraded. Within a national context these three species have an Archer Widespread status (Archer, 1999), and within a Yorkshire context a Frequent Status (Archer, 1993).

Giving each solitary species a regional status, a regional quality score and species quality score (RSQS) (Archer, 1993) can be calculated (Table 6). Four species are given a national Archer Scarce status: *Chrysis viridula, Priocnemis cordivalvata, Anoplius concinnus* and *Diodontus tristis.* The RSQS for the study site at 2.6 is similar to those calculated for Allerthorpe Common (2.7) and Keswick Fitts (2.7) so qualifying the study site as important in a Yorkshire context.

TABLE 6
The regional and Archer national quality scores of the solitary wasps and bees from Cornelian and Cayton Bays with Osgodby Point.

Scores	Status value (A)	No. species (B)	Quality (A x B)
Regional Status			
Common	1	36	36
Frequent	2	12	24
Occasional	4	7	28
Rare	8	0	0
Nationally scarce	16	4	64
Total (Quality Score)		59	152
	Species Quality Score 152/59 = 2.6		
National Status			
Universal	1	39	39
Widespread	2	16	32
Restricted	4	0	0
Scarce	8	4	32
Total (Quality Score)		59	103
	Species Quality Score 103/59 = 1.7		

Giving each species a national status, a national quality score and species quality score (NSQS) (Archer, 1999) can be calculated (Table 6). The NSQS for the study site at 1.7 is similar to those calculated for Skipwith Common (1.6) and Burton Leonard Lime Quarries (1.6). From a national perspective these sites could be considered to form a second tier of Yorkshire sites. Examples of Yorkshire first tier sites would be Strensall Common (2.5), Duncombe Park (2.2) and Crow Wood (2.5).

Conclusions

- The number of aculeate species recorded from Cornelian and Cayton Bays with Osgodby Point indicate that this is a good site.
- The estimates of the potential number of species that could be present are stable indicating that, on average, a further 20-22 species could be found.
- The site has the expected number of solitary species for its area, and so it can properly be compared with other sites.
- The site has similar cleptopasitic load to that of other sites as predicted by Wcislo (1987).
- The site has a higher than average aerial nester frequency (AF) for the solitary wasps but a lower than average AF for the solitary bees.
- The conservation value of the study site is important both in a national and regional context.

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Appendix

Chrysididae. *Chrysis angustula* Schenck, *C. impressa* Schenck, *C. ruddii* Shuckard, *C. viridula* Linn., *Trichrysis cyanea* (Linn.).

Pompilidae. *Dipogon subintermedius* (Magretti) (= *nitidas*), *D. variegatus* (Linn.), *Priocnemis cordivalvata* Haupt, *P. fennica* Haupt, *P. parvula* Dahlbom, *P. schioedtei* Haupt, *Arachnospila anceps* (Wesmael), *Anoplius concinnus* (Dahlbom).

Eumenidae. *Odynerus spinipes* (Linn.), *Ancistrocerus parietum* (Linn.), *A. scoticus* (Curtis).

Vespidae. *Dolichovespula norwegica* (Fab.), *D. sylvestris* (Scopoli), *Vespula rufa* (Linn.), *Paravespula vulgaris* (Linn.).

Sphecidae. *Trypoxylon clavicerum* Lepeletier, *T. figulus* (Linn.), *Crossocerus annulipes* (Lepeletier & Brullé), *C. dimidiatus* (Fab.), *C. elongatulus* (Vander Linden), *C. megcephalus* (Rossius), *C. podagricus* (Vander Linden), *C. pusillus* Lepeletier & Brullé (= *varus*), *C. quadrimaculatus* (Fab.), *C. tarsatus* (Shuckard), *Ectemnius cavifrons* (Thomson), *E. ruficornis* (Zetterstedt), *E. sexcinctus* (Fab.), *Psenulus pallipes* (Panzer), *Pemphredon inornatus* Say, *P. lugubris* (Fab.), *Diodontus tristis* (Vander Linden), *Passaloecus corniger* Shuckard, *Mellinus arvensis* (Linn.), *Argogorytes mystaceus* (Linn.).

Andrenidae. *Andrena chrysosceles* (Kirby), *A. clarkella* (Kirby), *A. fucata* Smith, *A. fulva* (Müller in Allioni), *A. haemorrhoa* (Fab.), *A. nigroaenea* (Kirby), *A. scotica* Perkins.

Halictidae. *Halictus rubicundus* (Christ), *Lasioglossum cupromicans* (Pérez), *L. fratellum* (Pérez), *L. nitiusculum* (Kirby), *L. punctatissimum* (Schenck), *L. rufitarse* (Zetterstedt), *L. smeathmanellum* (Kirby), *L. villosulum* (Kirby), *Sphecodes geoffrellus* (Kirby) (= *fasciatus*), *S. gibbus* (Linn.), *S. monilicornis* (Kirby).

Megachilidae, *Osmia caerulescens* (Linn.), *O. rufa* (Linn.), *Coelioxys rufescens* Lepeletier & Serville.

Anthophoridae. *Nomada goodeniana* (Kirby), *N. marshamella* (Kirby).

Apidae. *Bombus hortorum* (Linn.), *B. lapidarius* (Linn.), *B. lucorum* (Linn.), *B. pascuorum* (Scopoli), *B. pratorum* (Linn.), *B. terrestris* (Linn.), *Psithyrus bohemicus* (Seidl), *P. vestalis* (Geoffrey in Fourcroy), *Apis mellifera* Linn.

BOOK REVIEWS

Maggots, Murder and Men. Memories and Reflections of a Forensic Entomologist by **Zakaria Erzinclioglu.** Pp. 256. Harley Books, Great Horkesley, Colchester. 2000. £13.95 paperback.

The author, known to many naturalists as Zak, is widely respected not only for his forensic work but also for his contribution to entomology in general. As he states, forensic science is indeed "often very exciting, even exhilarating" – and this work proves just that. The author demonstrates through first-hand knowledge how the facts are gathered together during a criminal investigation and are transformed into the solution of the crime, stressing how "there is no substitute for deep thought, hard work and imagination". Although the author exemplifies his own work by many case studies, these are somewhat repetitive in terms of their underlying principles, namely where and when was the crime perpetrated; sometimes, however, such work can provide details of the circumstances of the death and indeed can occasionally point the finger at a particular individual. Nevertheless, the book contains a rich variety of fascinating cases, not only those personally investigated by the author, but also those explaining the deaths of important historical figures. As well as providing a most readable and entertaining book, to be dipped into rather than read at one sitting, the author shows his undoubted enthusiasm for the subject and his respect for the moral, legal and social implications of such sensitive work.

MRDS

Photographic Guide to the Butterflies of Britain & Europe by **Tom Tolman.** Pp. 320, 500+ colour photos, & colour distribution maps for each species. Oxford University Press, 2001. £35.00 hardback, £16.50 paperback.

This is a most attractive book with full colour throughout, and up to five colour photos to the page, plus very clear colour distribution maps covering the whole of Europe. Text and illustrations are usefully placed together, with brief notes on distribution, description, flight period, habitat and sometimes conservation.

Unfortunately, as far as Great Britain is concerned, the maps are not very accurate. Whilst it is appreciated that the relatively small size limits the detail which can be included, there seems little excuse for placing the northern limit of the Brimstone across the middle of Scotland, when it lies across northern Yorkshire! The odd error can be forgiven, but these maps contain many more, including the placing of Brown Hairstreak well into Yorkshire when it has never ever been recorded there. In addition the British element of the maps fails to take into account the many recent changes in butterfly distribution. The information appears to have been based on data collected 30 to 40 years ago.

However, the book is worth buying just for the huge collection of over 500 photographs. Many of them are quite stunning and some show extremely rare species. A few are so dark as to be almost useless in aiding identification. It is good that the country in which each photo was taken is clearly stated, as most species vary geographically in some degree. However, this does reveal that many of the pictures were taken in Greece (including the Small Tortoiseshell), which does not necessarily give the most typical colouration for those species which are widespread.

In spite of some shortcomings this is a valuable reference book. There are so many species to contend with in Europe and so few books that attempt to cover them all. This new guide would provide an excellent companion to the *Collins Field Guide to the Butterflies of Britain and Europe* by Tolman & Lewington (HarperCollins 1997), which uses paintings to illustrate the species. You could get the best of both worlds by comparing the photographs of the one with the paintings of the other.

HMF

The Butterflies of Pakistan by **T. J. Roberts.** Pp. 200 (large format *c*.20 x 28 cm), 47 colour plates, 9 figures, Oxford University Press, 2001, £9.99 hardback.

This is something of a landmark publication, being the first ever attempt to list and describe all 320 species of butterfly found in Pakistan. As such it will be of special interest to any UK naturalist visiting that part of the world as well as anyone wishing to be better informed about the world of butterflies in general.

This book includes introductory chapters covering life cycles, habitats and other general topics, including a brief, but very interesting, section on migration. The bulk of the book is taken up with species coverage and colour plates painted by the author. Unfortunately, the paintings are not to scale, but they are extremely detailed and possess a certain charm in their unsophisticated style. The information for each species includes a description, and notes on status. An additional and extremely interesting section on habitats is included where the information is available.

There are many seemingly unfamiliar species listed here, like the Sorrel Sapphire *Heliophorus sena*, the Common Crow *Euploea core,* and the Blue Pansy *Junonia orithya,* yet when you look at the pictures you realise that most of the family groups are totally familiar even though many of the species carry strange sounding names. So you have the Clouded Yellows, the Brimstones, the Fritillaries, the Vanessids, the Browns and the Blues. The Skippers include the Awls and the Flats, the Hoppers and the Darts. You may not have heard of these before, but the plates reveal that they simply extend the rather confusing array of similar-looking Skipper butterflies we have in Europe.

Pakistan is also host to many of our familiar butterflies like the three common Whites, the Brimstone *Gonepteryx rhamni,* the Red Admiral *Vanessa atalanta* and so on. It is interesting to compare their habits in Pakistan with those at home. The Large White *Pieris brassicae* for instance breeds on the northern plains in the coolest months and the offspring migrate into the Himalayas to produce successive generations in spring and summer.

At £9.99 this substantial hardback book is an exceptional bargain and deserves a place in every lepidopterist's library!

HMF

Biological Collections and Biodiversity edited by **B. S. Rushton, P. Hackney** and **C. R. Tyre.** Pp. x + 326, incl. numerous line drawing & b/w plates. Westbury Publishing, Otley, for the Linnean Society of London, 2001. £35.00 hardback.

This long-awaited volume, based on an Annual Regional Conference of the Linnean Society held in Belfast in August 1996, is a curious mix of papers, some rather dusty now in view of the lengthy gestation process and some on the fringe of or indeed outside the topic under review, a classic example of the latter being (to give it its full title) a "Checklist of marine phytoplankton in a subtropical lagoon system in Baja California Sur, Mexico, from 1980 to 1989".

Although one recognises the role that biological collections play in cataloguing and preserving biodiversity, in the reviewer's opinion 'Biological Collections' and 'Biodiversity' do not fit comfortably within this disparate collection of 33 (often short) papers and 32 abstracts of other papers and posters. As a participant in the conference, the reviewer can testify to its success in terms of enlightenment and enjoyment. The editors cannot be criticised for the resulting publication – they have made a valiant effort to portray it, but the wide-ranging topics covered fail to provide the in-depth treatment this subject requires, and the contents reflect only the viewpoints of those authors who chose to contribute. There is an underlying feeling of disheartenment conveyed through past and present devaluation of biological collections.

Despite these criticisms, the book contains a considerable amount of useful and interesting information, the contribution on "The monetary value of herbarium collections" being particularly thought-provoking, and the publishers are to be congratulated on the excellence of the finished project.

MRDS

Small Freshwater Creatures by **Lars-Henrick Olsen, Jacob Sunesen** and **Bente Vida Pederson.** Pp. 229 Oxford University Press. 2001. £12.50 hardback.

This book, a translation of a work in Danish, aims to introduce freshwater animals – in spite of the title not always small – to beginners, and is not designed specifically for the needs of British users. The front and back end papers portray silhouettes of adult and larval stages respectively of a wide range of animals and indicate the pages on which they are described, which is a good idea. More than 500 species, some identified only to genus, are illustrated and briefly, and not always accurately, described in what is taxonomically a somewhat curious sequence. Illustrations of large forms, such as dragonflies, are often attractive and helpful, but those of microscopic animals, with which describer and illustrator are obviously unfamiliar, are often crude and sometimes misleading. Many of the animals included are not found in Britain, and in some groups most, or even none, of the species shown occurs here. There is a miscellany of general topics (18 pages) at the end and a short glossary. The last entry begins "Zooplankton are very small animals . . . " thus perpetuating a grammatical horror apparently of trans-Atlantic origin. Zooplankton is a collective term for small open-water animals and is singular.

While its ease of use and generally attractive illustrations may whet the appetite of beginners, the shortcomings of this work are such that one can give it only a muted welcome.

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Notice to Contributors to 'The Naturalist'

Manuscripts (two copies if possible), typed double-spaced on one side of the paper only with margins at top and left-hand at least 2.5cm wide, should be submitted. Latin names of genera and species, but nothing else, should be underlined. S.I. Units should be used wherever possible. Authors must ensure that their references are accurately cited, and that the titles of the journals are correctly abbreviated. Volumes of *The Naturalist* for the years 1886 to 1975 have been retrospectively numbered 11 to 100 to accord with numbering before and after this period (see YNU *Bulletin* no. 3, pp. 21-22 1985); please cite these volume numbers in all references. Table and text-figures should be prepared on separate sheets of paper. Drawings and graphs, drawn about twice the linear size they are to appear, should be in jet-black Indian ink, and legends should not be written on the figures. **Publishable manuscripts not conforming to the above requirements will be returned for alteration.**

Photographic Plates

Readers of *The Naturalist* will have noticed that the number of photographic illustrations has increased in recent years. Good clear photographs, suitably captioned, to accompany articles or as independent features are always welcome.

To encourage this development, a long-standing member of the YNU, who wishes to remain anonymous, has most generously offered to make a donation, the income from which would finance the publication of a plate or equivalent illustration in future issues whenever possible. The editor, on behalf of the YNU, wishes to record this deep appreciation of this imaginative gesture.

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RED IN TOOTH AND CLAW: 1. STUDIES ON THE HISTORY OF THE WILD CAT *FELIS SILVESTRIS* SCHR. IN YORKSHIRE

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Doncaster Museum & Art Gallery, Doncaster DN1 2AE

Part 1 of the Presidential Address presented to the Yorkshire Naturalists' Union at Doncaster, 2nd December 2000

PREFACE

Inspirational teachers can have indelible effects on their charges leading to unexpected though rewarding quests in life. One such, Hilda Smith of Scarborough, would regale our year with fascinating stories which included the gory legend of a wild cat that savagely attacked a Knight Templar. Through the writings of Ted Hughes (1960) in his poem *Esther's Tomcat* the saga became particularly memorable:

A Tomcat sprang at a mounted knight
Locked round his neck like a trap of hooks
While the knight rode fighting its claws and bite . . .

A later mentor, Mike Clegg, then assistant curator at Scarborough's Wood End Natural History Museum, also revealed himself to be familiar with *T' Cat 'n' Man* legend. Decades later, on coming to live and work in South Yorkshire, I encountered the story on its native soil, for here the legend, Hilda Smith, Ted Hughes and Mike Clegg had their origins.

The numerous tellings and transmogrifications of the story (over 40 published examples collected to date) seem to spring from two root versions, a perfunctory form collected from the vernacular by the naturalist the Rev. William Bingley, published in his *Animal Biography* of 1802, and a lengthy 'gothic horror' version fabricated by the historian and journalist C. W. Hatfield in his *Village Sketches* published by the *Doncaster Gazette* in 1849.

The gist of the tale was that in 1455, Sir Percival Cressacre of Barnbrough Hall, returning on horseback from an encounter with the Franciscan Grey Friars of Doncaster, was attacked by a wild cat, which *issued forth* from the local woodland. A running battle ensued, culminating in Sir Percival taking refuge in the porch of St. Peter's Church, collapsing through loss of blood onto the cat; thus *t'man killed t'cat and t'cat killed t'man* (Twigg 1879). The physical evidence on which the legend has its basis are precised in the following rhyming couplets (Bingley 1802):

And still the tessellated floor
Shows traces of the purple gore,
Of both the baron and his foe –
At least tradition says 'tis so;
And on his marble tomb displayed,
Full length in effigy is laid;
While at his feet, lies large as life,
The cat which caused the mortal strife.

The '*purple gore*' is the iron oxide in the stonework of the porch in St. Peter's Church, Barnburgh. The '*cat which caused the mortal strife*' is actually a dog at the foot of the remarkable medieval life-size wooden '*effigy*' of a knight in armour, situated in the Cressacre tomb within the church. The Cressacre arms (on the exterior of the church tower) also feature a 'cat-a-mount' (cat of the mountains) as an heraldic device.

Puzzlingly, the truly fascinating folkloric interpretations of the saga are not included in any compendium of English folk tales and knowledge of the tale is largely confined to Barnbrough ('t cat 'n' man town) and the Dearne valley pit village communities. The faunal elements of the legend, which include wolves, owls and of course the wild cat, were rationalised by Victorian historians and naturalists such as James (1865), Hatfield (1849) and Harting (1890), who refer to the 'hercinian' forests which in unspecified times past were deemed to have clothed Pennine South Yorkshire and which were evidently populated by ravening beasts exemplified by wild cats.

Imbued with this early interest in cats ancient and modern, beasts which had largely eluded historians, had confused archaeologists and had been ignored by naturalists, a quest was undertaken to search for further evidence of the wild cats (Red in Tooth and Claw: part 1) and ultimately to investigate the 'wildlife' of their domestic conterparts in Yorkshire (Red in Tooth and Claw: part 2).

Historical evidence of the Wild Cat in Yorkshire

Despite an extensive and disparate body of literature from Quaternary, archaeological, topographical, local history and folklore studies, little is actually known of the history of the wild cat *Felis silvestris* Schr. or the introduced con-specific domestic cat *Felis catus* Linn. in Yorkshire (Howes 1984, 1985). This study seeks to assemble and review these sources and to add a substantial body of new research from place name and ecclesiastical archives, to refine our sketchy knowledge of its former distribution and decline.

Material from excavations at the Mesolithic site at Thatcham, Berkshire, carbon dated 10,050-9600b.p., revealed that even at this early date a modern warm temperate fauna including wild cat and seventeen other mammal species had already established itself in Britain (King 1962, Yalden 1982). Excavations at the Mesolithic seasonal hunting camp at Star Carr in the Vale of Pickering, North Yorkshire produced evidence that most of the Thatcham fauna was already established in Yorkshire by 9,500 b.p. (Fraser & King 1954). Although no cat remains were identified, the faunal composition and habitat evidence at Starr Carr strongly suggested that wild cat could have been part of the local fauna. In undated post-glacial deposits in Teesdale cave on the Durham side of Teesdale (Backhouse 1881) the remains of wild cat were found in association with wolf, pine marten, polecat, otter, badger, red and roe deer, all of which, apart from polecat and otter, were present in the Thatcham and Star Carr faunas. So by implication, despite the absence of direct proof, the wild cat may well have been established in the Yorkshire area by the Mesolithic period. In Yorkshire at Pifflehead Wood, Newtondale (SE/8395), further undated circumstantial evidence was a shelter identified by Simms (1972) as 'possibly being a wild cat den', containing amongst other prey remains the bones of a small beaver (*Castor fiber*). Beaver is known to have been present in Yorkshire from 9,600 b.p. at Star Carr (Fraser & King 1954) and place-name evidence suggests its presence into historic times, possibly up to the 10th century, so the den could have been occupied at any time between those dates.

The earliest positively dated wild cat evidence is a single bone from an early Iron Age village site dated 2,500-2,400 b.p. on Castle Hill, Scarborough (TA/0489) (Rowntree 1931, Rutter 1956). An atlas, a phalange and part of an immature lower jaw were excavated from the Iron Age village on the northern escarpment of the Wolds at Staple How (SE/8974) dated 2,560–2,450 b.p. (King 1963) and a femur and humerus were found at an Iron Age lakeside site on the northern shore of Lake Pickering at Thornton-le-Dale (SE/8382) a site thought possibly to have been under human occupation up to Roman times (Bate 1931).

From the Roman occupation the identification of wild cat from skeletal evidence becomes increasingly difficult, due to the introduction into Britain during the 1st or 2nd century of the domesticated cat, a form considered to have been derived by selective breeding from the north African race of the wild cat *Felis s. lybica* (Kolb 1977). To the difficulties implicit in identifying incomplete skeletal remains from archaeological sites are added the potential effects of hybridisation and evolutionary trends towards a smaller size (Kolb 1977).

Archaeologists have been understandably reluctant to differentiate cat material on the basis of structure and comparative measurements. Thus Bate (1931) judged Iron Age material from Thornton-le-Dale to be of wild cat solely on the grounds that the domestic form was not known in Britain at such an early date, and remains from Roman and later sites are generally recorded as domestic cat purely because of association with sites of human occupation.

Cats are recorded in relatively few archaeological excavation reports; this may reflect the primary interest of the archaeologist in mammals of economic importance, such as cattle, sheep etc., or may suggest infrequent occurrence. Indeed, where cat evidence is recorded, numbers are lower than species of economic value. Table 1 gives examples from the 2nd to the 17th century of cat skeletal remains in Yorkshire. As all the sites are of human occupation, these remains are likely by inference to be of *Felis catus,* although there is a possibility that hunted or trapped wild cats may be represented since remains of other wild species e.g. Roe Deer (*Capreolus capreolus*) have also been found in association with human occupation sites. Since Kitchener (1995) has identified reliable structural features in cat skull and jaws to enable differentiation between *F. sylvestris* and *F. catus*, it would be opportune to re-examine skeletal material from excavations in order to confirm late dates for *sylvestris* and early dates for *catus*.

TABLE 1
Cat remains from Roman and later archaeological sites in Yorkshire

Period	Locality	Cats (min. no. or status)	Material	Association speices	Source
2nd Century	Doncaster (Roman town)	1	Tibia	1, 5, 6, 8, 11, 13	Doncaster Mus. colln.
5th Century	Langton (well)	1	Jaw, scapula, limb bones 2 skulls (cranial fragments only)		Dell (1932)
11th-14th Century	Petergate, York	2	2 tibiae	1, 4, 6, 7, 8, 11, 12, 13	Ryder (1971)
1300-1450	Fangfoss	1	Mandible	1, 2, 6, 8, 13	Youngson (1978)
1350-ca. 1400	Chapel Lane, Staith, Hull	1	Humerus, ulna	15	Phillips (1980)
	Scale Lane, Lowgate, Hull			1, 2, 8, 11, 13, 15, 18	
1360-1380	(cesspit)	1	2 bones (unspecified)	21, 22	Phillips (1980)
				1, 6, 8, 11, 13, 15, 17	
Late 13th-early 14th Century	Chapel Lane, Staith, Hull	1	1 bone (unspecified)	20, 22	Phillips (1980)
				1, 2, 3, 4, 5, 7, 8, 9, 10	
13th-early 16th Century	Warram Percy	Common	(unspecified bones)	11, 13	Ryder (1974)
	Scale Lane, Lowgate, Hull			1, 8, 13, 14, 15, 16, 17	
2nd quarter of 14th Century	(garde-robe pit)	2	5 bones (unspecified)	19	Phillips (1980)
	Scale Lane, Lowgate, Hull				
16th Century	(well)	1	1 bone (unspecified)	1, 8, 13, 16, 17	Phillips (1980)
Late 17th Century	Bedern, York	?	?	?	Buckland (1974)

Key to species: 1 Cow; 2 Dog; 3 Fallow deer; 4 Goat; 5 Hare; 7 Mouse; 8 Pig; 9 Rabbit; 10 Rat; 11 Red deer; 12 Roe deer; 13 Sheep; 14 Blackbird; 15 Chicken; 16 Duck; 17 Goose; 18 Grouse; 19 House sparrow; 20 Mallard

Place Name Evidence

The term 'cat' often forms the first element in the names of topographical features and associated place names. Research into the origins of such names shows that some originate from the Old English 'catt' in the sense of 'wild cat' and therefore probably allude to the former association between the animal and the locality, while some may refer to a topographical structure which in some respect resembles a cat. Other etymological roots may bear a coincidental phonetic similarity to 'cat'; examples include Catterick, known to the Romans as 'Cataracta', meaning waterfall, although the present form refers to the Welsh 'cader', meaning 'hill fort'. The term 'Caty', as in Caty Well, is derived from an association with St. Catherine. Many place names however are derived from personal names such as the Old Danish 'Kate' or Old Norse 'Cada' and 'Kati' as in Cat Flatts and the Old English 'Catta' and 'Cada' as in Cat Foss.

By examining the fifteen (7th series) 1 inch to 1 mile Ordnance Survey maps which cover the Yorkshire area and the ten volumes of the English Place Name Society dealing with the three Yorkshire Ridings (Smith 1937, 1961-1963, 1969) some 80 examples of place names containing the element 'cat' have been found and are presented in Appendix 1. An analysis of these using Smith (*loc. cit.*) showed that 24 relate to personal names, five showed phonetic similarity to 'cat' but 29 are judged to allude to wild cat; the locations of all these are shown in Figure 1. Place names not located on Ordnance Survey maps but which appear in other documentary sources have been awarded map references centred on the main village or parish in which the place name is situated.

Figure 1 shows that the names associated with wild cats are exclusively distributed along the Pennines or Pennine foothills, mainly at altitudes above the 400 ft contour. Tantalisingly, the distribution of 19 of the 22 sites for which the etymological derivation is uncertain also shows a close correlation with the upland wild cat sites. This may provide the possibility of further circumstantial evidence of early wild cat occurrence.

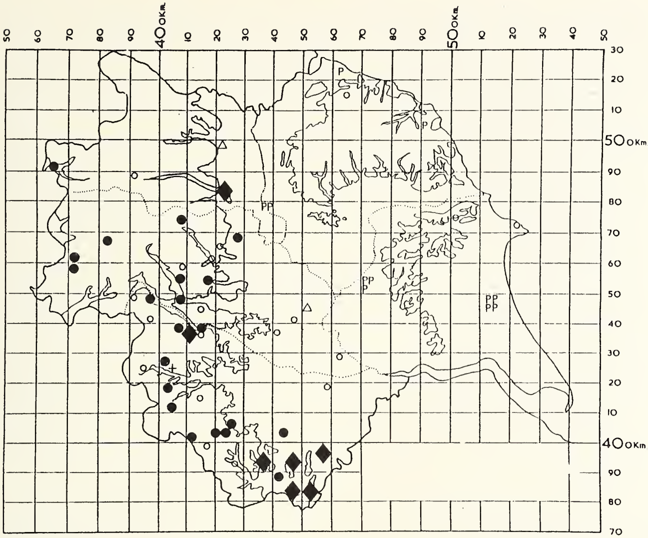
Places associated with personal name roots are chiefly connected with phases of Scandinavian settlement and are thus distributed along the east coast and in the rich lowland agricultural areas of Holderness and the Vale of York. Although unconfirmed, Wiley Cat Wood in the Cleveland uplands of north-east Yorkshire could imply the former existence of wild cats in the area, a possibility enhanced by allegation that the last wild cat in Yorkshire was also a resident of these north-eastern uplands.

The date at which a place or geographical feature is first named after the local occurrence of a wild cat, if indeed this was the reason for it being so named, potentially gives a clue as to when the species occurred in the district concerned. The earliest dates when these names appeared on manuscripts, maps etc. have been obtained where available from the relevant English Place Name Society volumes and are included in Appendix 1. Earliest documentary dates range from 1086 (Domesday Book) to the latest in 1866. That 63% of these fall in the mid-19th century probably reflects the fact that detailed maps giving minor place names (tithe, estate and Ordnance Survey maps) became more readily available during this period.

Licenses to Hunt Wild Cat from the 12th-17th Centuries

The granting of Royal licenses to hunt certain beasts of the chase, or to exterminate certain species regarded as vermin, frequently included the wild cat as potential quarry, thus providing indirect evidence of its past occurrence in certain counties, forests and manors. Miller (1804), Hunter (1828), Harting (1890) and Large (1954) collectively quote eleven examples of such documents dating from the reign of King John (1199-1216) up to 1630. Despite inferences to the contrary none of these actually concern Yorkshire, identifiable localities referring to Buckinghamshire, Essex, Huntingdonshire, Northamptonshire, Oxfordshire, Rutland, Sutherland and Perthshire.

Evidence of wild cats being hunted in Yorkshire does however exist. On the return of Edward 1st to England in 1274 from crusade in the east, it was decided, in consultation with his council, to investigate improper alienations or encroachments on royal lands and



● = Place name element attributed to Wild Cat.
○ = Place name element of uncertain origin.
P & + = Place name attributed to personal name.
△ = Place name element with phonetic resemblance only.
◆ = Parish where bounties were paid for Wild Cats.

FIGURE 1
Possible former distribution of Wild Cat in Yorkshire based on place name evidence and bounty payment records in Churchwardens' accounts.

privileges which had accrued during the previous reign. From 1274 to 1275, from 1279 to 1281 and again from 1293 to 1294 appointed Commissioners held 'sessions' in each administrative division ('hundred') (or 'wapentake' in Yorkshire) and jurors were called to give written verdicts on evidence of rights and privileges claimed by local landowners and clerics. Examples of claimed rights to hunt various specifically identified quarry animals provide circumstantial evidence of these species occurring in delineated parts of Yorkshire during the 13th century (English 1996).

The Abbot of St. Mary's, York claimed to have the chase through the whole of the forest of the king [in the region of] York for fox, cat, hare and badger (English 1996). In 1252-53 Roger Hardy was allowed to hunt with hounds for the wild cat, hare, fox and badger in the Forest of Pickering (Rimington 1956), and in 1338 Henry Percy claimed the right to hunt the wild cat, fox, badger and roe deer in the manor of Seamer within the Forest of Galtres (Gill 1852, Anon. 1906).

Fur Trade

Miller (1804), followed by Hunter (1828) and Gill (1852), showed that in addition to being hunted for sport and as vermin, cats were killed for their fur. The pelts of cats, along with those of rabbit, fox and lamb, were all locally obtainable but held a low prestige value, as evidenced in both ecclesiastical and civil laws of the medieval period. Archbishop William Corboyle's Canon of 1127 ordained that no abbess or nun could use more costly apparel than was made of lamb or cat skin. The 'Sumptuary Laws' of 1363 and 1532 stipulate that unlike the pelts of imported fur-bearing species such as sable (*Mustela zibellina)*, mink (*Mustela lutreola)*, lynx (*Felis linx)* and genet (*Genetta genetta)*, the use of which was restricted to the nobility and richer merchant classes, only cat, fox, rabbit and lamb could be worn by the lower orders of society, e.g. trades people owning more than 40 shillings worth of goods (Veals 1966). In the absence of statistical or anecdotal evidence, this low prestige value may be indicative of the abundance and accessibility of cats in the wild during this period.

Locally acquired wild cat skins could possibly have been used by members of the Skinners Guilds which existed in medieval York and Beverley, pelts being collected from trappers and villagers by travelling peddlers, as was customary at that time. Direct reference to cats being used for fur in Yorkshire comes from the Ordinances of the Skinners of the City of York of 1500, which stipulated a price for the preparation of 'catte skins' (Raine 1943). It is not possible to determine whether these were domestic or wild animals or both, and as beaver (*Castor fiber*) and mink were also mentioned in the Ordinances, neither is it possible to establish firmly whether they were collected locally, traded from other parts of Britain or indeed imported from elsewhere in Europe.

Bounty Payments for Wild Cats in Churchwardens' Accounts of the 16th-18th Centuries

In 1566 an Act for the 'Preservation of Grayne' came into force, its aim being to encourage the destruction of a wide range of what were regarded as 'ravening byrdes and vermyn'. Although forming a highly productive source of biological records from the late 16th to the early 19th centuries, the practice of paying head money declined rapidly from the first quarter of the 19th century and the Act was finally repealed in 1863.

With at least eleven literature references to wild cats in Yorkshire parish records (*viz.* Eastwood 1851 and 1862, Hatton & Fox 1880, Clarke & Roebuck 1881, Roberts 1882, Harting 1890, Wroot 1895, Grabham 1907, Denny 1910, Taylor 1956, Howes 1973), evidence would seem to abound. In fact these oft repeated references relate to only two parishes, Ecclesfield, where bounties were paid for wild cats in 1589 and 1626 and Shipley, where payments were made for two cats in 1676, one in 1678 and two in 1679.

For this study the churchwardens' accounts from some eighty-eight Yorkshire parishes have been examined and in seven of these records bounty payments for a total of seventy wild cat heads have been located. The 64 records additional to those already published relate to Masham in North Yorkshire (27 from 1653 to 1776) and four parishes in South Yorkshire, Thorp Salvin (34 cats from 1699 to 1769), Whiston (1 in 1710), Harthill (1 in 1773) and Wadworth, where payment was made for one as recently as 1788 (see Appendix 2). Figure 1, which also shows the distribution of the parishes where bounty payments were made for wild cats, serves to give a more realistic impression of wild cat distribution from the 16th to 18th century.

In counties to the south of Yorkshire records are scarce and relatively early, possibly signifying an early date of decline: for instance, in the parish of Worksop on the Nottinghamshire border with South Yorkshire, payments were made for two wild cats in 1585 and four in 1586 (White 1904). To the north of Yorkshire in Cumberland, MacPherson (1892) mentions the presence of wild cat in the ecclesiastical records from the parish of Martindale in 1739, and Watson (1886) notes bounty payments for twelve wild cats during the 1760s in the parish of Crossthwaite. Perhaps the most frequent records in parish accounts from the north of England, possibly reflecting relative abundance, were from the district of Corbridge near the Durham/Northumberland border, where bounty payments for at least 414 wild cats were recorded in the incomplete documents surviving for the period 1677-1724 (Nelson 1881).

With regard to abundance relative to other targeted carnivores, bounty payments for wild cat have only been located in the accounts of seven (8%) out of 88 parishes examined. This indicates their scarcity relative to fox, present in 34 (38%) parishes; otter, present in 13 (15%) parishes and badger, present in 12 (13%) parishes. Only Pine Marten was scarcer, being represented in only four parishes. To achieve a more refined comparison an analysis of all the 10,787 carnivore (and hedgehog) bounty payments from Yorkshire parish records showed that from 1550-1599 wild cats constituted 3% of bounties. This level fell to 0.3% of bounties from 1600-1649, accounted for 1% in 1650-1699 and 1% in 1700-1749, falling to 0.1% in 1750-1799 and was unrepresented during the 19th century (see Figure 2).

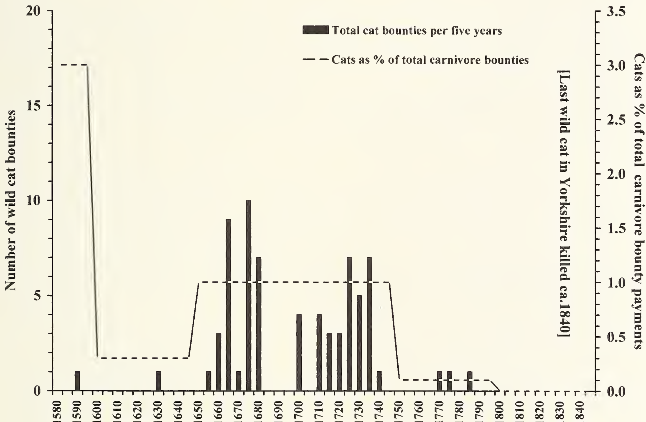


FIGURE 2
Numbers of Wild Cat bounties in 88 sets of churchwardens' accounts from Yorkshire parishes compared with cats as % of total carnivore and hedgehog bounty payments.

Although usually referred to as wild cats, there is no entirely certain way of distinguishing between wild and domestic animals from this archival source, though presumably churchwardens only knowingly paid for what they considered to be the former. Matheson (1940) sounds a note of caution by quoting a vestry minute from a Montgomeryshire parish, which showed that churchwardens had been deceived into paying for domestic cats. With significant financial inducement to defraud the system by substituting domestic cats, it could be said that the authenticity of the Yorkshire examples may rest on their early dates and infrequent occurrence.

Whereas the larger carnivores like badger (*Meles meles*), fox (*Vulpes vulpes*) and otter (*Lutra lutra*) generally commanded a bounty of 1 shilling, particularly through the 18th and early 19th centuries, this was only occasionally the case with wild cats during the 18th century (see Appendix 2 for examples from the parishes of Whiston in 1710, Harthill in 1773 and Wadworth in 1788). The smaller bounties (2d, 3d, 4d and 6d) often paid for cats during the 16th and 17th centuries are probably a reflection of contemporary monetary values and also perhaps the smaller size of cats and kittens. Since these sums were typically paid for the smaller mustelids, particularly in the 18th and 19th centuries, this raises the posibility that the term 'wild cat' as used in the accounts was merely an alternative vernacular name for weasel, stoat or polecat. However, when wild cat bounties appear, they are generally higher than for the smaller mustelids. The relative scales of the bounty tariff therefore gives useful indication that the 'wild cat' is genuine.

Gamekeepers' Records

From the 18th century, and probably up to the Second World War, cats which strayed into game preserves were regarded by game-keeping staff as vermin and killed, often in large numbers. These were probably all domestic and feral animals, though occasionally particularly large specimens were claimed to be wild cats, e.g. one at Northowram in 1830 (Johnson 1965).

Some estate archives contain reports of vermin killed on specific game preserves, though information on species and numbers is more frequently obtained by examining gamekeepers' gibbets or lines. Examples dating from 1866 to 1930 of vermin records which include cats have been located for six areas, details of which are given in Table 2. Although a small and variable sample, cats, as a percentage of the total vermin, appear to increase during this period. The only clear finding is that around the turn of the 19th century cats were relatively abundant on gamekeepers' gibbets, while today they are generally absent.

TABLE 2
Records of cats killed by gamekeepers 1866-1930

Locality	Grid ref.	Date	No. of Cats	Total head of 'vermin'	Cats as % of 'vermin'	Source
Hooton Pagnell	SE/40	1866-68	31	627	4.9	Ruston & Witney (1934)
Irton	TA/08	1885	Present	?	?	Slater (1885)
Irton	TA/08	1890	100	755	13.2	Gyngell (1905)
Suffield	SE/99	1904	1	53	1.9	Sheppard (1904)
Irton	TA/08	4.3 1905	31	240	12.9	Gyngell (1905)
Osmotherley	SE/49	1908	28	100	28	Booth & Fortune (1908)
Over Silton	SE/49	1908	3	4	75	Booth & Fortune (1908)
Market Weighton	SE/84	5.7.1930	A few	?	?	Booth (1930)

Allusions in 19th Century Topographical Accounts

During the 19th century there were several published allusions, both historical and contemporary, to wild cats occurring in Yorkshire. Some were merely general allusions used by authors attempting to illustrate the untamed nature of certain remote parts of the Yorkshire landscape in times past. However, it has been possible through this study to identify the basis of most of these statements. Gill (1852), referring to medieval times, describes the Forest of Galtres as 'abounding with wild cats', a claim based on the licence to hunt wild cats given to Henry Percy in 1338. Barker (1854) noted that after the Norman period, Wensleydale, to the west of Bainbridge and Askrigg, was a 'wild forest inhabited by the . . . wild cat'. Graves (1808) included the wild cat in his catalogue of Cleveland animals, thus supporting the likelihood of Wiley Cat Wood (NZ/6414) near Guisborough referring to this species. In Twist Wood, Northowram (SE/1126) a cat, allegedly a wild cat, was killed in late May 1830 (*Halifax Chronicle* 1830, Johnson 1965). The 23 lb animal, crushed by a 'Samson stone' set up by the local gamekeeper, was alleged to have caused great destruction amongst rabbits, poultry etc. In support of the Barnburgh 'Cat and Man Legend' which sparked off this entire investigation, Hunter (1828) commented that wild cats still haunted the woods of South Yorkshire and were spoken of as objects of terror. James (1865) in his '*Early History of Sheffield*' used the tenor of Hunter's 1828 account in describing the 'thick hercynion forests which covered the slopes and valleys of Hallamshire', which he says were roamed by the wild cat, 'then a formidable beast'.

Clarke and Roebuck (1881), later quoted by Denny (1910) and Fortune (1916), give what is regarded as the last record of wild cat in Yorkshire, one trapped by Mr John Harrison on his farm at Murton (SE/5388) near Hawnby, one winter around 1840. In addition, they claim that other testimony (not stated) confirms the opinion that the Hambledon Hills were the wild cat's 'latest' haunt. It is strange that no contemporary report of such a noteworthy record was published, even in the Yorkshire literature and despite Clarke and Roebuck both serving as editors of the *Naturalist* and being prolific contributors of notes and papers, the record was never published by them in its pages. Although Barker (1854) alluded to wild cats as being 'still occasionally found in the woods of Wensleydale', thereby post-dating the 1840 Murton record, Clarke and Roebuck (1881), though unable to verify Baker's allusion, conceded that in all probability wild cats once existed in the fells of the north west.

Distribution, status and decline

The preferred habitat of upland woodland, the borders of forest and open hilly ground where they hold territories of 60-70 ha (Kolb 1977) would, even by medieval times, have been restricted and fragmentary in much of Yorkshire, due to agricultural developments. This suggests that conditions may never have been suitable for them in the Vales and lowland of central and eastern Yorkshire, despite the various permissions of the 13th and 14th centuries to hunt wild cats in these areas. The Pennine distribution pattern which persuasively emerges from place name studies (see Figure 1) seems not to have survived into the 16th century according to negative evidence from ecclesiastical records, though allusions of former occurrence are still weakly echoed in 19th century topographical sources. However churchwardens accounts of the 16th to the 18th centuries provide robust evidence of an undocumented distribution along the wooded parishes on or adjacent to the Permian ridge from Masham in the north to Thorpe Salvin in the south.

On the information available, it is difficult to plot precisely the wild cat's decline in Yorkshire. Figure 2 shows the period during which bounty payments were made, with numbers peaking in the 1660s and 1670s and again in the 1720s and 1730s. Even during these periods, cats only represented 1% of total carnivore bounties, tailing off to 0.1% by the last half of the 18th century and vanishing altogether by the 19th century, a demise somewhat earlier than the claimed date of 1840 for the death of the 'last' wild cat in Yorkshire. Were even a residual population to have persisted after this time, wild cats would surely have featured, as did polecat, pine marten and otter, in the north regional natural history journals which proliferated during the mid- to late 19th century. Although plausibly argued by Langley and Yalden (1977) that the demise of the wild cat and the other rare carnivores in England came about by intensification of persecution through the 19th century boom in gamekeeping, it would seem likely from evidence presented here that in Yorkshire at least, its decline and ultimately the eradication of viable populations had realistically taken place a century earlier.

The wild cat's fate in Yorkshire probably followed the fate of its preferred habitat, though its final extermination could possibly have been brought about by persecution, isolation of populations and hybridisation with domestic (house) cats. That cats were killed by gamekeepers during the 19th and early 20th centuries is not in dispute, though with the relative frequency of culled cats increasing through this period (see Table 2) it is likely that keepers were trapping wandering farm and feral domestic cats rather than wild cats.

In Britain today, wild cats are confined to remote areas of Scotland north of a line between Edinburgh and Glasgow (Easterbee *et al.*, 1991), normally occurring at relatively low altitudes. The estimated total pre-breeding population was calculated in 1995 to be about 3,500, with population density gradients evidently increasing from west to east and from north to south (Harris *et al.*, 1995). With such a small and sparse population, accidental mortality through snares, road casualties etc. as well as natural causes could be critical, though the progressive hybridisation with domestic cats is believed to pose the major threat to the long term survival of the species in Britain (Harris *et al.*, 1995).

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Appendix 1:
'Cat' as an element in Yorkshire place names

Key to etymological roots:
C = cat, P = personal name, PH = phonetic resemblance, ? = uncertain origin

English Place Name Society volume reference:
W = West Riding, E = East Riding, N = North Riding

Place name	Grid ref.	English Place Name Soc. vol. & page		Etymological root	Earliest date
Cat Babbleton	SE/6228	W4	7	?	
Cat Babbleton	TA/0074			?	
Cat Beeston	SE/2830	W3	217	P	
Catcliffe	SK/4288	W1	179	C	1086
Cat Clough	SE/1101	W1	232	C	1841
Cat Clough (Thurlstone)	SE/2303	W1	341	C	1843
Cat Crag (Aldfield)	SE/2669	W5	194	C	1841
Cat Crag (Dacre)	SE/1960	W5	140	?	
Cat Craggs (Blubberhouses)	SE/1650	W5	121	C	
Cat Crags (Hazelwood)	SE/0958	W5	74	?	

Place name	Grid ref.	English Place Name Soc. vol. & page		Etymological root	Earliest date
Cat Moss (Stutton)	SE/4711	W6	26	?	
Cat Flats (Marske)	NZ/6322	N	154	P	
Catfoss Grange	TA/1448	E	67	P	
Catfoss Hall Farm	TA/1446	E	67	P	
Catfoss Manor	TA/1447	E	67	P	
Catgate (Thornton-in-Craven)	SD/9048	W6	33	?	
Catgill	SE/0654	W6	63	C	1539
Catgill (Carleton)	SD/9749	W6	30	C	1843
Cat Hill	SE/4203	W1	96	C	1841
Cat Hill	SE/2405	W1	308	C	1605
Cathill Plantation (Barwick)	SE/4037	W4	110	?	
Cat Hole	SE/0937			?	
Cat Hole (Rishworth)	SE/0318	W3	73	C	
Cat Hole (Todmorden)	SD/9324	W3	180	?	
Cat Holes (Bowland)	SD/65	W6	213	?	
Cat Holes (Bradfield)	SK/2692	W1	232	?	
Cat Holes (Marsden)	SE/0411	W2	278	C	1850
Cat Holes	SD/6590	W6	266	C	1603
Cat Holes Ings (Marsden)	SE/0411	W2	278	C	1850
Cat Holes (Nesfield)	SE/0949	W5	69	C	1847
Cat Not (Bowland Forest)	SD/65	W6	210	?	
Cat Knot	SD/7159	W6	210	?	
Cat Lane (Balne)	SE/5819	W2	15	?	
Cat Loup Dub (Dacre)	SE/16	W5	143	C	
Catlow Fell	SD/7060	W6	210	C	1665
Catlow Low Laithe	SD/7158	W6	210	C	
Catlow Gill (Carleton)	SD/9749	W6	30	C	
Cat Moss (Rishworth)	SE/0318	W3	73	C	1775
Cat Nab	TA/2173			P	
Catrigg	SD/8367	W6	155	C	
Catrigg Barn	SD/8368	W6	155	C	
Catrigg Beck	SD/8367	W6	155	C	1858
Catrigg Force	SD/8367	W6	155	C	
Catriggs	SD/9089			?	
Catshaw	SE/2003	W1	341	C	1647
Catshaw Cross (Thurlstone)	SE/2003	W1	341	C	1843
Catstones (Baildon)	SE/1539	W4	159	C	
Catstones	SE/0638	W4	165	C	1849
Catstones	SD/9640	W6	13	?	
Catstones (Mytholmroyd)	SE/0126	W3	164	C	1866
Catstones (Rishworth)	SE/0318	W3	75	C	
Catstones (Shipley)	SE/1437	W3	267	?	
Catstones (Todmorden)	SD/9424	W3	180	?	
Catstone Wood (Hartwith)	SE/2165	W5	146	?	
Cattal	SE/4454	W5	17	P	
Cattal Grange	SE/4355			P	
Catall Lodge	SE/4553	W5	17	P	
Cater Croft (Almondbury)	SE/1515	W2	259	Ph	
Catterick	SE/2299	N	242	Ph	
Catterick Bridge	SE/2397	N	242	Ph	

Place name	Grid ref.	English Place Name Soc. vol. & page		Etymological root	Earliest date
Catterson (Almondbury)	SE/1515	W2	259	?	
Catterton	SE/5145	W4	236	Ph	
Catterton Beck	SE/5046	W4	236	Ph	
Catton	SE/3778	N	183	P	
Catton Moor	SE/3878			P	
Catton Park	SE/7352			P	
Catton Wood	SE/1545	W4	197	P	
Catwick	NZ/9005	N	118	P	
Catwick	TA/1245	E	73	P	
Catwick Grange	TA/1246			P	
Catwick House	TA/1245			P	
Caty Well (Warley)	SE/0525	W3	126	P	
Caty Well Wood	SE/0525	W3	126	P	
High Catton	SE/7153	E	186	P	
High Catton Grange	SE/7352	E	272	P	
Little Catwick	TA/1244			P	
Little Cattall (Goldsborough)	SE/4454	W5	17	P	
Low Catton	SE/7053	E	186	P	
Low Catton Grange	SE/7150			P	
Near Cat Clough	SK/1799			?	
Wiley Cat Wood	NZ/6414			?	

Appendix 2:
Bounty payments for 'Wild Cats' in Churchwards' Accounts from Yorkshire Parishes

Bradford (Hatton & Fox 1880, Roberts 1882, Wroot 1895, Taylor 1956)

Date	Record	£.	s.	d.
1676/77	Allowed to the churchwardens of Shipley for 6 urchanes [hedgehogs] a grey [Badger] and 2 Wild Cats.	-.	2.	4.
1678/79	Allowed to the churchwardens of Shipley for 6 urchanes hedgehogs] & for a Fox head & for a Wild Cat.	-.	2.	2.
1679	To the churchwardens of Shipley for 2 hedgehogs & a Wild Catt.	-.	-.	6.

Ecclesfield (Eastwood 1851, 1862, Clarke & Roebuck 1881, Harting 1890, Grabham 1907, Denny 1910).

Date	Record	£.	s.	d.
1589	Item for Catte head.	-.	-.	4.
1626	A Wylde Catte head.	-.	-.	2.

Harthill (Sheffield City Archives PR 47/61)

Date	Record	£.	s.	d.
4.6.1773	To 1 Wild Cat to Thos. Pitchfork.	-.	1.	-.

Masham (NTCRO PR//MAS 3/1/1 Microfilm no. 995)

Date	Record	£.	s.	d.
1652	To John Thwaite for 7 Fox heads & 1 Wild Cat head.	-.	8.	-.
1656	To Richd. … for 1 Fox head, 2 badger heads & 2 Wild Cat heads.	-.	4.	-.
1659	[Account book too tightly bound for microfilm to show amount paid].			

1659	Marmaduke … for 1 Wild Cat head			
1662	To Robt. Pickersgill for 1 Fox head, 1 Fowmard [pole cat] head & 1 Wild Cat head	-.	1.	6.
"	To Saml. Beckwith for 1 Wild Cat head.	-.	-.	3.
"	To Geo. Beckwith for 1 Wild Cat head.	-.	-.	3.
1663	To Robt. Pickersgill man for 1 Wild Cat head.	-.	-.	4.
1664	To Saml. Beckwith for 1 Badger head & 2 Wild Cat heads.	-.	2.	-.
"	To Robt. Pickersgill man for 1 Wild Cat head.	-.	-.	6.
1665	For 1 Wild Cat head to … Beckwith.	-.	-.	6.
"	To … for 2 Badger heads & 1 Wild Cat head.	-.	2.	3.
1667	To … Beckwith man for 1 Wild Cat head.	-.	-.	6.
1671	To John Parker for 1 Wild Cat head.	-.	-.	4.
1673	Item Robt. Johnson for 1 Wild Cat head.	-.	-.	6.
	Item to Marmaduke Cross's man for 2 Fowmard heads & 1 Wild Cat head.	-.	1.	-.
"	Item to Thomas Jackson for 2 Fowmard heads & 1 Wild Cat head.	-.	1.	-.
"	Item to Squire Beckwith man for 14 Fox heads, 1 Wild Cat head & 1 Fowmard head.	-.	14.	9.
"	Item to Thos. … for 3 Wild Cats heads & 1 Badger head.	-.	2.	6.
"	Item to Robt. Thompson of Swinton for 2 Fowmard heads & 1 Wild Cat head.	-.	1.	-.
1776	Item to Wm. … for 6 Fox heads & 1 Wild Cat head.	-.	6.	6.
"	Item to Robt. Aiscough for 1 Wild Cat head.	-.	-.	6.
"	Item to … for 1 Wild Cat head.	-.	-.	6.

Thorp Salvin (Sheffield City Archives MD/1236/1-64, 65-107; 1238/24, 30)

Date	**Record**	**£.**	**s.**	**d.**
1699	Pd. to Henry Foster for 1 Wild Cat head.	-.	-.	4.
4.7.1700	Pd. to Jo. Turner for 1 Wild Cat head.	-.	-.	4.
"	Pd. to Jo. Turner for 1 Wild Cat head.	-.	-.	4.
"	Pd. to Robt. Barker for 1 Wild Cat head.	-.	-.	4.
20.5.1707	Pd. Jonathon Horwoods for 5 Badger heads & 1 Wild Cat head.	-.	5.	4.
"	Myself for 1 Wild cat head.	-.	-.	4.
"	Jonathon Horwoods for 1 Fox heads & 1 Wild Cat head.	-.	1.	4.
9.4.1711	Pd. John Horke for 1 Wild Cat head.	-.	-.	4.
5.11.1711	Pd. to Robt. Dunston for 1 Wild Cat head.	-.	-.	4.
12.12.1713	Pd. to Ed. Alin for 1 Wild Cat head.	-.	-.	4.
21.3.1718	Pd. to Arthur Barlow 1 Wild Cat head.	-.	-.	4.
26.10.1718	Pd. Harry Foster for 1 Wild Cat.	-.	-.	4.
12.1720	Pd. to John Alin for 1 Wild Cat.	-.	-.	4.
10.9.1722	Pd. to Thos. Wildsmith for 1 Wild Cat head.	-.	-.	4.
2.11.1724	Pd. to Ed. Alin for 1 Wild Cat head.	-.	-.	4.
13.1.1725	Pd. to Jas. Crawshaw for 1 Wild Cat head.	-.	-.	4.
23.1.1725	Pd. to Jas. Crawshaw for 1 Wild Cat head.	-.	-.	4.
3.3.1725	Pd. to Jas. Crawshaw for 1 Wild Cat head.	-.	-.	4.
6.8.1725	Pd. to Jas. Crawshaw for 2 Badger heads, 1 Fox head & 2 Wild Cat heads.	-.	3.	8.
3.3.1727	Pd. to Saml. Booth for 1 Wild Cat head.	-.	-.	4.
14.1.1729	Pd. for 2 Wild Cat heads & 1 Pole Catt head.	-.	1.	6.
29.6.1727	Pd. to Jas. Ryall for 1 Fox head & 1 Cat head	-.	2.	-.
1732	Pd. to Anthony Barlow for 6 Wild Catts.	-.	2.	-.
1733	Pd. to Anthony Barlow for 1 Wild Cat head.	-.	-.	4.
1737	Pd. to John Berry for 1 Wild Cat head.	-.	-.	4.

Date	**Record**	**£.**	**s.**	**d.**
6.5.1769	Pd. for 1 Fox & 1 Wild Cat.	-.	1.	4.

Wadworth (Doncaster MBC Archives P21/3/B2-3)

Date	**Record**	**£.**	**s.**	**d.**
23.5.1788	To a Wild Cat head.	-.	1.	-.

Whiston (Sheffield City Archives PR 37/43)

Date	**Record**	**£.**	**s.**	**d.**
1710-1711	Given to Robert Natoris man by ye Townes Consent for killing ye Wild Catt.	-.	1.	-.

BOOK REVIEW

Guardians of the Salmon by **Gordon H. Bielby.** Pp. 144, with b/w historical photographs. Halsgrove, Tiverton. 2001. £16.99 hardback.

The literature of angling is vast, but apart from one or two classics such as Walton's *Compleat Angler,* few fishing books are appreciated by naturalists. This book is different for it is not a book about angling and is written by a non-angler. As th author says "It contains nothing about how, when and where to go angling for salmon" (or indeed any other species). Gordon Bielby is a Yorkshireman born in Scarborough; except for a short spell in Canada with *Alberta Fish and Wildlife,* he has spent his whole career on the environmental side of river management in the southwest of England.

For all who are seriously interested in river conservation this book is a must. The research has been painstaking and extensive, complemented by annual reports, newspaper archives and museum records. There are hundreds of personal reminiscences and anecdotes from long departed netsmen, water baliffs and poachers.

The anecdotes are presented in the form that make reference easy, with a dry wit which seems to indicate the author's disapproval of some of the methods of 'conservation'. The slaughter of 'predators' on a vast scale, including cormorants, shags, herons, seals, otters, even large brown trout and eels, is recorded in a chapter entitled "Predators must Die".

It was a foolish bird, seal or porpoise which strayed into the southwest river catchments. Three shillings (15p) was the reward for the head and stomach of a seal! All these efforts were in the interests of conserving the Atlantic Salmon. The illustrations show the scale of slaughter of the salmon by the netsmen. Of course this was a period in which the mystery of the salmon's journeys in the seas had not been solved.

Even today pressure is being put on the EC to agree to the culling of cormorants which frequent gravel pits and open water in Britain. Human predators were severely dealt with; even transportation was proposed. The many stories of encounters with the poachers and their nefarious methods reflect the hard times in which the rural population lived.

Our new and thriving biodiversity industry has suddenly become concerned with preserving the genetic strains of wild salmonids. It will be hard to ignore the fact that millions of salmon ova of Scottish origin were planted in southwest rivers between 1864 and 1950.

This is a book that should give food for thought for the modern day conservationists and their misguided allies who are recommending similar methods of eradication in the interests of individual species.

LM

AQUATIC PLANTS AT NORTH CAVE WETLANDS, A NEW YORKSHIRE WILDLIFE TRUST RESERVE COMPRISING FORMER GRAVEL WORKINGS

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INTRODUCTION

North Cave Wetlands, also known as the John Dealtry Reserve, comprise approximately 40 ha of former sand and gravel workings (GR: SE 883 331) situated about 1 km north-west of the village of North Cave, East Yorkshire. The site, comprising six large pits (Fig. 1) which were excavated in the 1980s and 1990s (Table 1), was acquired by the Yorkshire Wildlife Trust in late 2000 (Anon., 2001). The following account is based on visits to the reserve made during June and July 2001.

Pits 1, 2, 3, 5 and 6 have become flooded, forming lakes that are, in places, many metres deep. The lake margins are generally sand or gravel. There are trees and shrubs along the western sides of Lake 1, parts of the eastern and western sides of Lake 2, and the southern side of Lake 3; otherwise there is little shading. There are some wet, flushed, areas of shore where there is up-welling of ground water, most notably at the south west corner of Lake 5 and at the north east corner of the irregularly-shaped eastern section of Lake 5. Lake 5 is linked to its eastern section by a water-filled channel, 3-5 m wide and at least 2 m deep (Fig. 1). This eastern section of Lake 5 is joined to Lake 6 by a shallow neck of water. There is a pipe through which water flows from Lake 2 into Lake 1. Lake 1 has an outflow pipe on its north side that discharges into the deeply-excavated drainage channel, Black Dyke, that runs along the northern boundary of the site. The water was very transparent in all five lakes and all had similar pH and conductivity; on 6 July, measurements made with appropriate meters showed a pH range of 6.6 to 6.8 while that for conductivity was 929 to 1002 $\mu S\ cm^{-1}$.

Pit 4 was not water-filled. It was a large excavation the bottom of which was several metres below the water level in the adjacent Lake 1. On the bottom of Pit 4, in its north-west corner, there was a small (longest side about 30 m), shallow (depth <1 m), triangular pond. There were also muddy areas, other shallow pools and flooded scrapes, and ditches that were filled by seepage water from Lake 1, from which water was pumped back into Lake 1. During summer 2001 this pit was being back-filled with subsoil and rubble.

The reserve is an important site for waterfowl. Ducks and geese were abundant on the lakes and had heavily grazed some of the shore vegetation. Between the lakes, the site is mostly open grassland, with areas of bare, recently-worked ground; there are few trees.

In this study aquatic macrophytes at North Cave Wetlands were recorded to provide a base line for reference as the site matures. Aquatic plants within 1 km beyond the site boundary were also recorded as these neighbouring plants are potentially responsible for past and and future colonisation.

AQUATIC PLANTS AT NORTH CAVE WETLANDS

Aquatic macrophytes were recorded during June-July 2001 in and around the margins of the five lakes. The eastern section of Lake 5 (henceforth referred to as Lake 5e) was treated as being part of Lake 6, with which it is continuous. Recording was done by walking around the circumference of the lakes and by grapnel hauls. Aquatic macrophytes in the ponds and wet places at the bottom of Pit 4 were also recorded. The checklist used was that of aquatic plants that occur in England and Wales (Palmer & Newbold, 1983) except that all *Juncus* species and charophytes were included. Nomenclature follows Stace (1997) for vascular plants and Moore (1986) for charophytes.

Twenty-six species of aquatic macrophyte were recorded. Their distribution is shown in

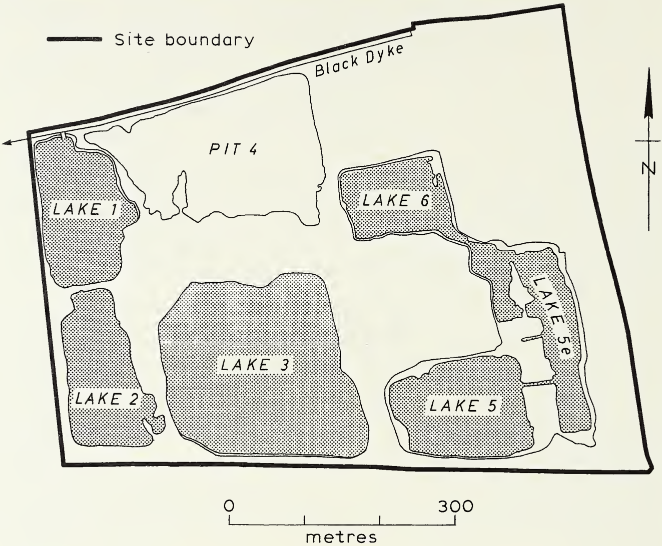

FIGURE 1
Map of North Cave Wetlands. Stippling indicates the area of water in August 2000; the water levels are higher in winter.

Table 1 with an indication of their abundance. The number of species per lake ranged from ten in Lake 2 to 17 in Lake 5e/6. The older lakes (1-3) supported no more species than the newer ones.

The most frequently found submerged species was *Potamogeton pusillus* which was present in all the lakes and abundant in all except Lake 3. *Zannichellia palustris* was also found in all the lakes. Otherwise, the submerged species showed notable between-lake variation. *Chara vulgaris* was abundant in Lakes 1, 3, 5 and 5e/6 but was not recorded in Lake 2. Furthermore, there may be varietal differences between the lakes: *Chara vugaris* var. *vulgaris* and var. *longibracteata* were found in Lakes 1 and 5e/6 while var. *papillata* was found in Lakes 3 and 5. *Myriophyllum spicatum* was abundant in Lakes 1-3 but was unimportant in Lake 5e/6 and was not recorded in Lake 5. *Potamogeton crispus* was abundant in Lake 3 but was not found in the other lakes, while *Potamogeton pectinatus* was recorded only in Lakes 2, 3 and 5e/6.

The aquatic plants at the lake margins also showed between-lake variation. Only *Agrostis stolonifera* and *Ranunculus sceleratus* were found around all five lakes. *Apium nodiflorum* was found only by Lake 5e, *Phragmites australis* only by Lakes 3 and 5e, *Typha latifolia* only by Lakes 2, 5 and 5e, *Veronica anagallis-aquatica* only by Lakes 5 and 5e/6, and *Veronica beccabunga* only by Lakes 1, 2, 5 and 5e/6. The importance to the marginal plants of the limited areas of wet, flushed, shore with upwelling groundwater was very apparent. The flushed area at the south-west corner of Lake 5 supported luxuriant

TABLE 1
Aquatic plants at North Cave Wetlands; June-July 2001

	Lake 1 1983	Lake 2 1987	Lake 3 1990	Lake 5 1994	Lake 5e/6‡ 1995/1996	Pit 4 1999
Submerged plants						
Chara vularis†	+++	–	+++	+++	+++	–
Myriophyllum spicatum	+++	+++	+++	–	+	–
*Potamogeton crispus**	–	–	+++	–	–	–
*P. pectinatus**	–	++	++	–	+	–
P. pusillus	+++	+++	++	+++	+++	+++
Zannichellia palustris	+	++	+	+++	+++	+
Plants growing around margins and in muddy places						
Agrostis stolonifera	++	++	+	+	+	++
Apium nodiflorum	–	–	–	–	+	–
Callitriche sp.	–	–	–	–	–	+
Eleocharis palustris	–	–	+	–	–	++
*Equisetum fluviatile**	–	–	–	–	–	++
Juncus articulatus	+	–	–	++	+	+++
J. bufonius	+	+	–	++	++	+++
*J. conglomeratus**	+	–	+	+	–	+
J. effusus	+	–	–	+	+	+
J. inflexus	+	–	+	++	+	+
Mentha aquatica	–	–	+	–	–	–
Phragmites australis	–	–	+	–	++	+
*Ranunculus aquatilis**	–	+	+	–	–	+
*R. peltatus**	–	–	–	–	–	+
R. sceleratus	++	+	+	++	++	+++
Rorippa nasturtium-aquaticum	–	–	–	++	+	++
*Samolus valerandi**	–	–	–	–	–	+
Typha latifolia	–	++	–	+	++	+
Veronica anagallis-aquatica	–	–	–	++	++	++
V. beccabunga	++	+	–	++	+	++

The lakes are arranged in age order; approximate dates when excavation was completed are shown.
*Indicates species that were not also found within 1 km outside the Wetlands site boundary.
†Charophytes were determined by P. J. Cook and included *Chara vulgaris* var. *vulgaris* (Lakes 1 and 5e/6), *C. vulgaris* var. *papillata* (Lakes 3 and 5) and *C. vulgaris* var. *longibracteata* (Lakes 1 and 5e/6).
+ = Plants sparsely or locally distributed in small patches; ++ = plants frequent around the margins, or forming local patches of a few square metres in area; +++ = plants abundant around margins or forming substantial submerged beds; – = not recorded.
‡The eastern section of Lake 5 is included with Lake 6.

vegetation which included *Juncus articulatus, J. bufonius, J. effusus, J. inflexus, Ranunculus sceleratus, Rorippa nasturtium-aquaticum, Typha latifolia* and *Veronica anagallis-aquatica*. Similarly, the flushed areas around the north-east corner of Lake 5e supported *Apium nodiflorum, Juncus articulatus, J. bufonius, J. inflexus, Phragmites australis, Ranunculus sceleratus, Rorippa nasturtium-aquaticum, Typha latifolia, Veronica anagallis-aquatica* and *V. beccabunga.*

More aquatic species (20) were recorded in the non-flooded Pit 4 than in any of the lakes. Species found only in Pit 4 were *Callitriche* sp. on mud, *Equisetum fluviatile* and

Samolus valerandi (three plants only) in muddy areas with up-welling seepage water, and flowering stands of *Ranunculus peltatus* in the small triangular pond.

Aquatic plants within one kilometre of North Cave Wetlands

Aquatic macrophytes at sites outside the reserve, but within 1 km of its boundary, were recorded during July-August 2001. Most of the ponds and watercourses shown on the 1:25000 scale OS maps within 1 km of the site were visited.

Standing-water sites were: (1) the ornamental fishing lake (SE 897 328), immediately north of the church and just within 1 km east of the Wetlands boundary, which was mentioned in 1769 and probably dates from the mid-18th century (Kent, 1979); (2) two ponds at SE 890 325, about 600 m south-east of the Wetlands boundary, which possibly originated as medieval fish ponds (May & May, 1999); (3) a gravel-pit pond at Crosslands (SE 879 322), 500 m south of the Wetlands site, excavated in the 1970s, (4) a gravel-pit pond in North Cave village (SE 888 321), 700 m south of the Wetlands boundary, excavated in the 1980s.

Stream sites were along much of North Cave Beck from the head of the fishing lake downstream almost to the dismantled railway line (SE 889 320), about 1.75 km of watercourse. The beck is a clear-water, spring-fed, calcareous stream with silt and gravel bed; much of its course is artificially aligned and is tree-shaded. At its closest, the beck is within about 500 m of the Wetlands boundary.

Dykes that drain the low land, altitude <10 m, to the west of North Cave include Black Dyke and Ings Drain. Black Dyke forms the northern boundary of the Wetlands site; aquatic plants in the dyke along this boundary were recorded in two 100 m lengths, one upstream and one downstream of the outflow from Lake 1. Two further 100 m lengths of Black Dyke were surveyed adjacent to the Dryham to Hotham Common farm road (SE 874 331) about 500 m west (downstream) of the Wetlands site. There was an appreciable flow along the dyke but most of this water originated as the discharge from Lake 1. Water plants in Ings Dyke were recorded along about 300 m of the watercourse, eastwards from Dryham (SE 876 326) to within about 125 m of the Wetlands boundary. There was little flow in this dyke.

Aquatic plants in a wet horse pasture (SE 891 325), adjacent to North Cave Beck and about 600 m south east of the Wetlands site were also recorded.

Thirty-four species of aquatic macrophyte were recorded within 1 km of the Wetlands boundary, i.e. plants on the Palmer and Newbold (1983) checklist plus all *Juncus* spp. and charophytes. Many of these neighbourhood plants, 15 species, were not found on the Wetlands site (Table 2). Also found at neighbourhood sites, but not on the checklist, were the aquatic moss, *Fontinalis antipyretica*, in North Cave Beck, and the Galingale, *Cyperus longus*, an obvious introduction in the Crosslands gravel pit. Some of the neighbourhood plants, shown in Table 2, are also likely to be recent introductions: e.g. *Typha angustifolia* and perhaps *T. latifolia* and *Iris pseudacorus*, again at the Crosslands gravel pit; *I. pseudacorus* and varigated *Glyceria maxima* at the gravel pit in North Cave; *I. pseudacorus* and *T. latifolia* in the beck where it flows at the bottom of gardens. Water lilies, still in pots, at the gravel pit in North Cave are not shown in Table 2.

There were also seven species of aquatic macrophyte that were recorded at North Cave Wetlands but not at neighbourhood sites (Table 1).

Discussion

The aquatic-plant species richness in the gravel pits at North Cave Wetlands was around the middle of the range found for other ponds formed by mineral extraction in East Yorkshire. The mean number of taxa per pit, including the non-flooded Pit 4, equalled 14.5 (range 10-20). This may be compared with other East Yorkshire ponds: i.e. means of 13.8 (4-23) for 11 gravel-pits, 15.8 (8-26) for nine clay-pits, and 14.4 (2-25) for ten borrow-pits alongside railway lines (Linton & Goulder, 2000).

The between-lake variation in the distribution of the submerged species (Table 1) may

TABLE 2
Aquatic plants recorded within 1 km of North Cave Wetlands; July-August 2001

	Ponds	Streams	Dykes	Wet pasture
Agrostis stolonifera	+	+	+	–
*Alisma plantago-aquatica**	–	+	–	–
Apium nodiflorum	–	+	+	+
Callitriche sp.	+	–	–	–
*Caltha palustris**	–	+	–	+
*Carex acutiformis**	–	–	+	–
*C. riparia**	+	+	+	–
Chara vulgaris	+	–	–	–
Eleocharis palustris	+	–	–	+
*Glyceria maxima**	+	+	–	+
*G. notata/fluitans**	+	–	+	+
*Iris pseudacorus**	+	+	–	–
Juncus articulatus	+	+	–	+
J. bufonius	+	–	+	+
J. effusus	+	+	–	–
J. inflexus	+	+	+	+
*Lemna minor**	–	–	+	–
Mentha aquatica	+	+	+	–
*Myosotis scorpioides**	+	+	–	+
Myriophyllum spicatum	+	–	+	–
*Phalaris arundinacea**	+	+	–	–
Phragmites australis	+	–	+	–
Potamogeton pusillus	+	–	+	–
*Ranunculus circinatus**	+	–	–	–
R. sceleratus	+	–	+	–
Rorippa nasturtium-aquaticum	+	+	+	–
*Solanum dulcamara**	+	+	–	–
*Sparganium erectum**	+	+	+	–
*Typha angustifolia**	+	–	–	–
T. latifolia	+	+	–	–
Veronica anagallis-aquatica	–	–	+	–
V. beccabunga	+	+	+	+
*V. catenata**	+	–	–	–
Zannichellia palustris	+	–	–	–

*Indicates species that were not also found on the North Cave Wetlands site.
+ = Present; – = not recorded.

reflect the chance element in plant dispersal. The variation was also potentially related both to the age of the lakes and to competition between species. Thus *Myriophyllum spicatum* was abundant in the older Lakes 1, 2 and 3 but was relatively sparse in Lakes 5e/6 and was not recorded in Lake 5. Furthermore, the relative scarcity of *Zannichellia palustris* in Lakes 1, 2 and 3, which contrasted with its abundance in Lakes 5 and 5e/6, may be related to its being out-competed by *M. spicatum*. It will be interesting to see whether *M. spicatum* extends its range and replaces *Z. palustris* in Lakes 5 and 5e/6.

The greater importance of marginal plants in Lakes 5 and 5e/6 (Table 1) was probably due to the presence of flushed areas at their margins. Also, extensive erosion faces around the margins of the older Lakes 1, 2 and 3 tended to make them less hospitable habitats.

The presence of more aquatic plant species, largely plants of muddy places, in Pit 4 than in any of the lakes (Table 1) probably reflected the greater habitat diversity of Pit 4, although plant propagules may have arrived at Pit 4 along with back-fill material.

None of the aquatic vascular plants found at North Cave Wetlands (Table 1) have outstanding conservation value. None are rare or threatened in Britain: i.e. known from 15 or fewer 10-km squares. Nor are any of them among the scarce species: i.e. known from 16-100 10-km squares (Preston & Croft, 1997). From a regional perspective, Palmer and Newbold (1983) reported them all as being frequent in the then Yorkshire Water Authority area. At the local level of East Yorkshire, however, some of the plants do have conservation interest. Crackles (1990) regarded *Ranunculus aquatilis* as uncommon (i.e. believed then to occur at between 12 and four localities) although probably under-recorded. She also regarded *Potamogeton pusillus* and *Samolus valerandi* as uncommon. These too, however, are probably under-recorded; both were found in several out of thirty-five 100 m lengths of dyke in the Hull Valley by Goulder (2000). Also, some of the other water plants in the North Cave pits were considered to be infrequent in East Yorkshire by Crackles (1990): i.e. *Potamogeton pectinatus* (in Lower Derwentland, which includes North Cave, although frequent in the Hull Valley) and the probably more scarce *Ranunculus peltatus*. There are also few records from East Yorkshire of the charophytes that were found at North Cave Wetlands. Moore (1986) has no post-1960 records for *Chara vulgaris* var. *vulgaris*, and has only single post-1960 records, in the extreme north east of the county, for *C. vulgaris* var. *longibracteata* and *C. vulgaris* var. *papillata*. Charophytes are, however, probably extensively under-recorded or in the case of *C. vulgaris* agg. not determined to varietal level; recent critical determinations have shown var. *papillata* and var. *longibracteata* to be the most frequently encountered taxa in south east Yorkshire (P. J. Cook, *pers. comm.*).

The large size of the lakes at North Cave Wetlands, relative to the size of most standing waters in East Yorkshire, gives botanical conservation value to the reserve. There are extensive stands of submerged hydrophytes, especially of *Potamogeton pusillus* and *Chara vulgaris*, which are unusual in the county. Furthermore, there is the potential for further colonisation and the long-term development of a more diverse freshwater flora; larger ponds may develop greater species richness (Helliwell, 1983). Also, the water plants are probably an important food resource for the waterfowl that are the principal wildlife interest at the site. Species of *Potamogeton*, and *Chara vulgaris* can be important components of waterfowl diet (Preston, 1995; Knapton & Petrie, 1999). Such grazing may, to some extent, suppress vegetation but is sustainable in larger water bodies (Jupp & Spence, 1977; Mitchell & Wass, 1996; Strand & Weisner, 2001).

Aquatic plants in general are surprisingly mobile and utilise diverse and effective dispersal strategies (Cook, 1987; Barrat-Segretain, 1996; Preston & Croft, 1998). Thus up to 26 taxa (Table 1) have managed to arrive at North Cave Wetlands over roughly twenty years since extraction of gravel began. Most of them were probably not originally present on the site as it was formerly arable land and because there are no water bodies shown on the pre-excavation 1:50000 scale OS map apart from the northern boundary ditch (Black Dyke) which is species poor: i.e. in July 2001 this ditch where it runs alongside the reserve contained only six aquatic species – *Lemna minor, Myriophyllum spicatum, Potamogeton pusillus, Ranunculus sceleratus, Rorippa nasturtium-aquaticum* and *Veronica beccabunga.* Of these, the plants of *M. spicatum* and *P. pusillus* were loose shoots that had clearly come through the discharge pipe from Lake 1, while *L. minor* was not found in the pits.

Mechanisms used by water plants to reach the site probably included wind dispersal and carriage by waterfowl. *Phragmites australis* and *Typha latifolia* produce wind-dispersed seeds, and both occur within the neighbourhood (Table 2). Seeds and vegetative propagules of vascular plants are carried on feathers and feet or in the guts of waterfowl (Proctor, 1968; Vivian-Smith & Stiles, 1994). Preston (1995) notes that species of *Potamogeton* are rapid colonisers of new habitats such as gravel pits, and considers that the carriage of their seeds in the guts of birds is a significant dispersal mechanism. Similarly, charophytes, which are also often early colonisers of new waters, may be transported as oospores and vegetative fragments in the guts of waterfowl (Moore, 1986).

Many of the water plants recorded at North Cave Wetlands probably originated from freshwater sites in the immediate neighbourhood. Nineteen of the taxa found on the site were also present within 1 km of the site boundary (Table 2). Some of these species were especially abundant at neighbourhood sites; e.g. *Apium nodiflorum* in Ings Drain and *Myriophyllum spicatum* in the fishing lake near to North Cave church. Thus they provided a rich source of propagules potentially available for colonisation of the newly-dug pits. Proof of place of origin is not available, although verification of the source of clonal species should be possible using molecular genetic fingerprinting techniques as used, for example, with the Flowering-rush *Butomus umbellatus* by Fernando and Cass (1996). Since there were also 15 species that were recorded in neighbourhood waters but not at North Cave Wetlands (Table 2), there remains scope for further colonisation from local sites.

The seven species recorded at the Wetlands but not at neighbourhood sites (Table 1) may have come from further afield. Proctor (1968) showed that viable seeds are retained by ducks and geese for over 24 hours and so may be carried for long distances. It is also possible that some plants have arrived from further afield and, having colonised the Wetlands, have later spread to neighbouring waters. For example, *Potamogeton pusillus* was found rooted in Black Dyke about 500 m downstream of the site boundary. Thus, although *P. pusillus* does occur in some East Yorkshire dykes (Goulder, 2000), its origin here may have been the loose shoots which reach the dyke in the discharge from Lake 1.

Management of the Wetlands by the Yorkshire Wildlife Trust will influence the development of the aquatic plant flora. The Trust's proposals are described in its planning application to the East Riding of Yorkshire County Council (01/04197) which was approved by the authority in November 2001. After back filling, Pit 4 will be flooded to create a reed-bed habitat with water depth of about 20-60 cm. By January 2002 the back filling had buried some aquatic plants which, in summer 2001, were found only in Pit 4, especially *Equisetum fluviatile, Ranunculus peltatus* and *Samolus valerandi.* However, these species might reappear since the plans for the whole site include the creation of several small shallow ponds, and some reprofiling of Lakes 5 and 6 to form shallow foreshore and marshy areas. Ideally, the relatively floristically-rich flushed areas on the margins of Lake 5 and its eastern extension will be incorporated into the re-profiling scheme.

The plants of *Phragmites australis* required to establish the reed bed in Pit 4 will best be grown from locally gathered seed. The final layer of fill into which the reeds are planted may need to be of soil. Thus new aquatic species might be introduced if they are part of the seed bank in this soil. Otherwise, the existing dispersal mechanisms, which have so far brought a diversity of plants to the site, can be expected to continue.

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BOOK REVIEW

The Fever Trail. The Hunt for the Cure for Malaria by **Mark Honigsbaum.** Pp. xviii + 333 (incl. 5 maps), plus 16pp. b/w & colour plates. Macmillan, London. 2001. £18.99 hardback.

Until it became known in the mid-17th century that the bark of the Cinchona tree could stave off fevers, no one was safe from the scourge of malaria. Two-thirds of this book documents the search for this miraculous bark and the quinine it contains; it honours the men who risked their lives for it, including Richard Spruce (1817-1893), the famous Yorkshire botanist and explorer who spent 15 years in the Amazon and Andes. Whilst in Ecuador, Spruce collected 100,000 seeds and 600 seedling plants of Cinchona which were successfully shipped to England; it was from these shipments that the Cinchona plantations in and industry of S.E. Asia were developed. Despite all the endeavours of such men, so vividly described by the author, malaria still kills up to three million people each year. Thoroughly recommended, not only to those concerned with ethnobotany and medical history, but also to those with wider natural history interests. MRDS

DISTRIBUTION OF THE BANDED DEMOISELLE *CALOPTERYX SPLENDENS* ALONG THE RIVER DERWENT, NORTH YORKSHIRE

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The Banded Demoiselle *Calopteryx splendens* (Harris, 1782) is a lowland riparian species with a preference for relatively unpolluted, slow flowing rivers with silt beds. In Yorkshire the main population appears to occur along the River Derwent and other tributaries of the Ouse in the Vale of York, for example the River Wharfe. In west and south Yorkshire it is relatively scarce, probably as a result of pollution of the main rivers from the traditional heavy industries that dominated this part of the county. However, it has been recorded from the River Dearne in Barnsley, the Don at Doncaster (SE/5603) and the Torne catchment at Potteric Carr (SE/6000) and Torne Bridge (SE/6703 to 6903).

This paper reports on the results of a survey undertaken in 1999 and 2000 to determine the distribution of the Banded Demoiselle along the Derwent.

The Derwent rises on Fylingdales Moor from whence it passes 5 km to the west of Scarborough. At Mowthorpe Farm the Sea Cut has been constructed to channel excess water directly to the North Sea at Scalby Mills. Between its source on the North York Moors and East Ayton the river is swift flowing with a stony bottom and is therefore far from optimal for the Banded Demoiselle. At East Ayton the river enters the Vale of Pickering, a wide expanse of intensively farmed arable countryside, where along much of its course it has been extensively straightened and has the appearance of a canal, with opportunities for surveying restricted to a few road bridges. Approximately 5 km north of Malton the Derwent meets the River Rye, after which it flows between Malton and Norton, down towards Stamford Bridge and into the Vale of York. The Lower Derwent Valley has been designated as a SSSI and through much of this the river passes meadowland which extensively floods in the winter. Eventually at Barmby the Derwent meets the Ouse which is tidal at this point. However, the construction of the Barmby Barrage almost eliminates any effect of the tide in the lowest sections of the Derwent.

METHODOLOGY

The Derwent and a small part of the Rye at Ryton (SEM96754) were surveyed by walking along the river bank and counting the number of Banded Demoiselle seen. The areas around Elvington Bridge, Cottingwith and Wheldrake Ings were surveyed on 9 June 1999. The area around Stamford Bridge was surveyed on 10 June 2000, the section between Kirkham Priory and Howsham on the 11 June, around Malton, including the Rye at Ryton, on the 16 June and the section between Bubwith and the confluence with the Ouse on 27 June. Unfortunately, due to time constraints and lack of public access along parts of the riverbank, the whole course of the river was not surveyed. In addition, a small section of the Derwent at Brompton Ings (SE/954794) was surveyed from the bridge and the Sea Cut at Mowthorpe Farm, near Scarborough (SE/983884) was also surveyed.

RESULTS

Calopteryx splendens was recorded from almost all 1 km squares surveyed between the confluence of the Derwent with the Ouse to just below that with the Rye above Malton. The few 1 km squares where the species was not recorded were generally those in which the river only passed through the square for a short distance and/or where the river was obscured by tree cover. It was not found above grid reference SE8072 or seen at the recording stations at Brompton Ings in the Vale of Pickering, the Rye at Ryton, at the Sea Cut at Mowthorpe Farm or in the Forge Valley. All records of the Banded Demoiselle are given in Appendix 1 below and the distribution of records is shown in Figure 1.

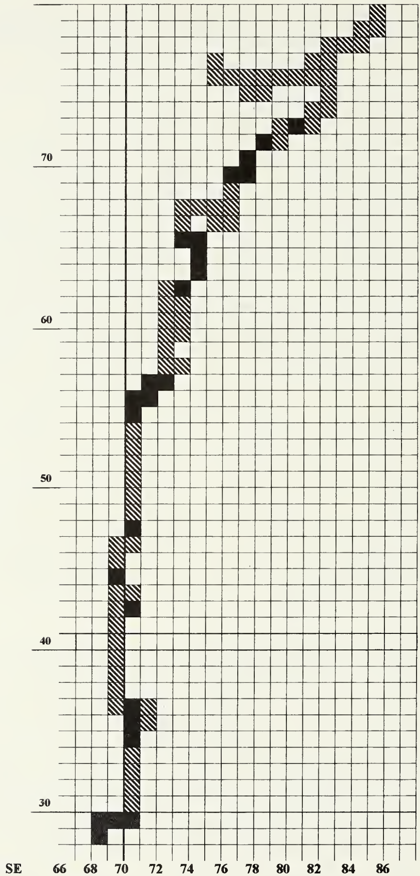

FIGURE 1
The Distribution of Records of the Banded Demoiselle *Calopteryx splendens* on the River Derwent, North Yorkshire 1999-2000.

Hatched areas indicate 1 km squares through which the Derwent passes; areas shaded black indicate 1 km squares in which the Banded Demoiselle was recorded. Northings are the lines below the number in the extreme left-hand column. The first record of the Banded Demoiselle in the south-west corner is therefore SE/68-28.

The Banded Demoiselle was found to be most abundant where the bank-side and adjacent land was dominated by rank grassland and/or scrub, and reasonably so in arable areas when it was seen settling in fields of wheat to the north of Stamford Bridge. The species appeared to be least abundant where the bankside vegetation had been grazed by cattle.

Discussion

The Banded Demoiselle appears to be common and widespread between the confluence of the Derwent with the Ouse and the Rye respectively. Given the range of situations and bank-side habitats in where it was found, including wooded banks, marsh/tall herb communities and arable fields, it is likely to be encountered in most of the 1 km squares of this stretch of the river. Above the confluence of the Derwent with the Rye the situation is less clear. Its apparent absence may merely reflect the poor public access and consequent difficulty in recording. However the river does change its character in the Vale of Pickering, where it has been straightened, appears to have a swifter flow and the surrounding countryside is dominated by intensively farmed arable landscapes, probably subjected to insecticide sprays. Above East Ayton the river becomes very fast flowing and with a rocky bottom appears unsuitable for this species. The upstream limit of the Banded Demoiselle would therefore appear to be somewhere between the confluence of the Derwent with the Rye and East Ayton, which poses the question: what are the determining physical and biotic factors that limit the upstream range of this species?

Given the serious floods along the Derwent during November 2000, including the flooding of Malton, Norton, Stamford Bridge, and Barlby, it is probable that pressure will be exerted on the Environment Agency to implement extensive flood defence schemes along parts of the river system. As this may have a negative impact on the population of the Banded Demoiselle, identification of the factors affecting the Banded Demoiselle distribution is therefore of crucial importance.

At the other extreme at Barmby the Banded Demoiselle was not found during a quick survey of a short part of the Ouse, although it was found within 100 m of the Barmby Barrage on the Derwent with a total of 75 recorded in grid SE 69-29. The apparent absence of the Banded Demoiselle along the Ouse may reflect either the relative lack of recording or the tidal nature of the Ouse, which may prevent the successful colonisation of this species.

Conclusion

The River Derwent supports a healthy population of the Banded Demoiselle and indeed this species has been recorded from its confluence with the Rye down to the Ouse. The status of this species in the Vale of Pickering is less clear, but it is certain that somewhere between the Rye and East Ayton the river is unable to support populations of this species. The factors determining this are currently unknown.

Appendix 1
Records of the Banded Demoiselle along the River Derwent 1999-2000

Date	Site Name	Grid Reference	Number of Adults	District
09/06/99	Derwent (Elvington Bridge Section)	SE706477	29	Selby
09/06/99	Pocklington Canal (East Cottingwith Section)	SE702427	1	Market Weighton
09/06/99	Derwent (Wheldrake Ings Car Park)	SE694445	3	Selby
10/06/00	Derwent (Stamford Bridge)	SE71-55-	4	Stamford Bridge
10/06/00	Derwent (Stamford Bridge)	SE70-55-	49	Stamford Bridge
10/06/00	Derwent (Stamford Bridge)	SE70-54-	25	Stamford Bridge
10/06/00	Derwent (Stamford Bridge)	SE71-55-	8	Stamford Bridge

Date	Site Name	Grid Reference	Number of Adults	District
10/06/00	Derwent (Stamford Bridge)	SE71-56-	36	Stamford Bridge
10/06/00	Derwent (Stamford Bridge)	SE72-56-	2	Stamford Bridge
11/06/00	Derwent (Howsham Wood)	SE74-63-	5	Malton
11/06/00	Derwent (Kirkham Priory)	SE73-65-	5	Malton
11/06/00	Derwent (Kirkham Priory)	SE74-65-	8	Malton
11/06/00	Derwent (Howsham Bridge)	SE73-62-	4	Malton
11/06/00	Derwent (Kirkham Priory/Howsham Wood)	SE74-64-	7	Malton
16/06/00	Derwent (Old Malton)	SE80-72-	28	Malton
16/06/00	Derwent (Malton)	SE78-71-	4	Malton
16/06/00	Derwent (Malton)	SE77-70-	13	Malton
16/06/00	Derwent (Malton)	SE77-69-	18	Malton
16/06/00	Derwent (Malton)	SE76-69-	28	Malton
27/06/00	Derwent (Upstream from Barmby)	SE70-29-	23	Selby
27/06/00	Derwent (Derwent Bridge, Bubwith)	SE70-36-	16	Selby
27/06/00	Derwent (Breighton)	SE70-34-	34	Selby
27/06/00	Derwent (Breighton)	SE70-35-	5	Selby
27/06/00	Derwent (Barmby Barrage)	SE68-28-	3	Selby
27/06/00	Derwent (Barmby)	SE68-29-	1	Selby
27/06/00	Derwent (Upstream from Barmby)	SE69-29-	75	Selby

BOOK REVIEW

The Flora of County Cavan by **P. A. Reilly.** Pp. iv + 177 (incl. 2 maps), plus 8 pp. colour plates. National Botanic Gardens, Glasnevin, Dublin. 2001. 17.00 (including postage and packing), available from National Botanic Gardens, Glasnevin, Dublin 9, Ireland, paperback.

Although less elaborate than many other recently published county Floras of Britain and Ireland, this is a valuable contribution to our knowledge of a large inland county (746 square miles) of Ireland, all too often ignored in the past by botanists in their desire to study oceanic environments. The Flora covers the charophytes and vascular plants, their distribution based on only five districts, the topography of which are elaborated in the introductory matter; the latter also reviews the physical landscape, including geology (the accompanying map unhelpfully inserted), landscape history and botanical exploration (which contains some particularly useful biographical information). Statistical treatment of the number of taxa found up to 1898 is provided, but the current number of taxa found in the county, recent extinctions, etc. are less apparent. The work also contains almost 50 pages of most useful appendices and indexes on such topics as plant lists previously published or occurring as annotations in books, other documentary and bibliographic sources, areas of scientific interest and a topographical index. All in all, a most useful guide to accompany the field botanist and an important source of background information to past and present botanical activity.

MRDS

COLEOPTERA REPORT FOR 1995-2001

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This report deals with the Coleoptera excluding the family Carabidae and the sub-family *Aleocharinae*, and is the first report to be presented since that which appeared in *The Naturalist* **116**:101-106 (1991). Prior to that paper, the late John Flint produced periodic *Coleoptera* reports in this journal.

The records that follow are the substance of annual Coleoptera reports presented to the Entomological Section of the YNU at their indoor meetings during the years 1995-2000, plus additional records for 2001. These reports included new county and vice-county records and other records worthy of note. There are several coleopterists working actively on the beetles of the county, including M. L. Denton, W. R. Dolling, W. A. Ely, M. Hammond, P. Kendall, F. E. Kenington, R. Merritt and E. J. Smith, and my thanks are due to these gentlemen for their dedicated efforts, and to all others who have submitted records to me. The initials used in the following pages are those of K. N. A. Alexander, E. W. Aubrook, L. Auckland, H. Britten, J. D. Coldwell, J. Cooter, H. H. Corbett, M. L. Cox, R. Crossley, J. Denton, M. L. Denton, T. Dixon, W. R. Dolling, W. A. Ely, G. N. Foster, E. F. Gilmour, A. Godfrey, M. Hammond, P. M. Hammond, D. G. Hemingway, J. B. Job, C. Johnson, P. Kendall, F. E. Kenington, R. Lawson, A. Lazenby, B. Levey, C. H. C. Lyal, R. J. Marsh, D. Maude, R. Merritt, M. G. Morris, A. Parker, K. G. Payne, P. A. Seccombe, P. Skidmore, E. J. Smith, T. Stainforth, R. R. Uthoff-Kaufmann, G. B. Walsh and P. F. Whitehead. I express my gratitude to Mike Denton who allowed me to extract data from his card index for Calderdale, which contained many records not on the YNU database, and for offering critical comments on the draft of this manuscript, and to Colin Howes who permitted me to extract data from the Coleoptera records held on record cards at the Doncaster Museum. The thanks of the Yorkshire Naturalists' Union are due to the many individuals, landowners and organisations that have permitted access to their properties for the purposes of coleopterology during the period.

Until 1990 all Coleoptera records were held and maintained by John Flint using a system originally begun by W. J. Fordham and continued by E. G. Bayford, G. B. Walsh, W. O. Steel and others. These records were kept on loose sheets on a species-by-species basis, but owing to the increasing volume of, and detail within, them, this methodology clearly could not be maintained especially when site details were required. After 1990, all these records were transferred to a computerised database system, completed in 1994, and employing RECORDER 3.3, developed by Dr Stuart Ball of JNCC. This site-based system allows an extensive range of rapid information retrieval, of which the old 'paper' system was totally incapable.

In the list that follows, species nomenclature generally follows that of Kloet and Hincks (1977). I am aware of the nomenclatural changes, particularly within the genus *Apion,* where the family name Brentidae is gaining acceptance (Gonget, 1997), and the subgenera of *Apion* listed in Kloet and Hincks (1977) which have now been elevated to generic rank, and I have adopted these changes in this report. Morris (1993) gives corrections to his *Handbook* (Morris, 1990) and a revised checklist. Morris (1991) also puts forward a ceutorhynchine checklist as a supplement to and modification of that in Kloet and Hincks (1977). Johnson (1990) summarised the known distribution of the Ptiliidae of Yorkshire. Responsibility for any errors or omissions with respect to the list that follows rests entirely with the author.

National Status is included where appropriate and the definitions of status categories (JNCC, 1992) are as follows:

RDB1 – endangered – taxa in danger of extinction and whose survival is unlikely if causal factors continue operating.

RDB2 – vulnerable – taxa believed likely to move into the Endangered category in the near future if the causal factors continue operating.

RDB3 – rare – taxa with small populations that are not at present Endangered or Vulnerable, but are at risk.

Notable A – species which do not fall within the RDB categories but are thought to occur in 30 or fewer 10 km squares of the National Grid, or for less well-recorded groups, within seven or fewer vice-counties.

Notable B – species which do not fall within the RDB categories but thought to occur in between 31 and 100 10 km squares of the National Grid.

The following recording symbols are used: # New county record; * New vice-county record; "recent" = post-1980.

HALIPLIDAE

Haliplus heydeni Wehncke – Notable B – (*61) Burton Constable Park (TA1836) 8/5/1999, MH. (*62) Old Malton Moor (SE8174) 9/8/1987, RM det GNF. (*65) Garsdale Head (SD7894) 18/5/1992, RM det GNF. Recent extensive surveying by RM and MH has yielded many new records for the county.

DYTISCIDAE

Hydroglyphus pusillus (F.) – Notable B – (*61) Dunnington (SE6753) 9/10/1997, MH. (*62) Rawcliffe Meadows (SE5755) 18/5/1998, MH. Recent surveying by MH and RM has yielded many new county records.

Coelambus nigrolineatus (von Steven) – Notable A – (*61) North Duffield Carrs (SE6938) 3/11/1999, MH). (*63) Rother Valley (SK4581) 31/7/1995, RM. (*65) Nosterfield (SE2779) 11/9/1998, MH.

Copelatus haemorrhoidalis (F.) – (*62) Strensall Common (SE6459) 8/4/1998, MH det MLD. (64) Cawood (SE5737) 23/4/1998, MH, being the first vice-county record since Askham Bog in the 1930s (GBW).

Rhantus suturalis (Macleay) – Notable B – (*62) Rawcliffe Meadows (SE5755) 7/10/1997, MLD. Before 1997, this species was very rarely recorded in the county. Extensive survey work by MH and RM has greatly extended the knowledge of the species in Yorkshire.

GYRINIDAE

Gyrinus distinctus Aube – RDB3 – (*61) Leven Canal (TA1045) 24/4/2000, WRD. Welton Waters (SE9525) 24/4/2000, MH. (#63) Beighton Ponds (SK4483) 9/6/1978, WAE. Catcliffe Flash (SK4288) 1995, RM. (*64) Barlow Common (SE6328) 28/4/2000, MH.

HYDROPHILIDAE

Helophorus strigifrons (Thomson) – Notable B – (*61) Bubwith Bridge (SE7036) 16/4/1990, MLD. (*62) Strensall Common (SE6459) 29/3/2000, MH. (*63) Scout Dike (SE2305) 20/6/1995, JDC. Until 1995 very rarely recorded, but now there are numerous records due to the efforts of MH and RM.

Enochrus affinis (Thunberg) – (*61) Skipwith (SE6537) 28/8/1995, RM. (*62) Strensall (SE65) 1997, MH. (#63) Upperhead Dike (SE1301) 24/4/1985, DM det MLD. (*64) Askham Bog (SE5748) 26/7/1998, MH. As a result of a species split (Foster, 1982) and confusion with *E. isotae* Hebauer, the records of *E. affinis* in Yorkshire prior to 1995 (i.e. those dating back to 1908) have to be regarded, in the absence of voucher specimens, as *E. affinis* sensu lato. Authenticated records of *E. affinis* sensu stricto therefore are those given above.

Cymbiodyta marginella (F.) – (*62) Strensall (SE6362) 5/9/1997, MH det MLD. (*63) Potteric Carr (SE5900) 1981, GNF. This hydrophilid remained largely unrecorded in Yorkshire since the early captures by Hey and Fordham, with very few other records, until much recent survey work by MH, RM and others has produced many records from all VCs except 65, possibly demonstrating an increase in range and frequency.

HISTERIDAE

Sphaerites glabratus (F.) – RDB3 – (62) Garbutt Wood (SE5083) 25/4/1999, LA. Duncombe Park (SE68) 6/8/2000, MLD. A rare northern species of decaying fungi and dung. Five records only on the YNU database and unrecorded in the county since 1938.
Abraeus granulum Erichson – Notable A – (#63) Worsborough (SE30) 1/1997, DG det JDC (Coldwell, 1997). Rivelin (SK38) 1/9/1998, EJS. The only county records. An indicator of ancient woodland, particularly in red-rotted heartwood of old oaks.
Gnathoncus nannetensis (Marseul) – (61) Skipwith Common (SE63) 7/9/2000, DGH det MLD. (62) Helmsley (SE58) 6/8/2000, MLD. (64) Brayton Barff (SE53) 8/9/2000, AG det MLD. A local species from bird nests, carrion, and bracket fungi. Very few records, and unrecorded since 1966.
Gnathoncus nanus (Scriba) – (*61) Welwick (TA32) 10/9/1999, FEK det RJM, in mealhouse debris at a farm. (*63) Margery Wood (SE20) 2/7/1988, MLD, in carrion. Another very local beetle of carrion and bird nests. The only other county record is from Pannal Ash in 1937 (RRUK) when the species was taken from carrion-baited pitfalls.
Saprinus aeneus (F.) – (63) Hatfield Moor (SE70) 1992, PS. There are only six other, very old (pre-1928), records of this supposedly common species for the county.

HYDRAENIDAE

Hydraena testacea Curtis – Notable B – (*61) Hornsea Mere (TA1947) 26/10/1996, RJM teste CJ. There has been a marked increase in recent records especially from VC61, being due to the collecting efforts of RM and MH.

PTILIIDAE

Nossidium pilosellum (Marsham) – Notable B – (#61) Danthorpe (TA2432) 31/7/2001 WRD teste CJ. In bracket fungi on a tree stump.
Ptenidium intermedium Wankowicz – (*61) Bubwith (SE7036) 14/5/1988 (RJM). Wheldrake (SE7044) 7/9/1989, RJM. (61) Hornsea Mere (TA1947) 26/10/1996, RJM det CJ. This very local and scarce species may be found in well-established good quality wetlands. It has since been found at several sites in VC61.
Euryptilium gillmeisteri Flach – (#64) Fountains Abbey (SE2768) 3/9/1995, RJM det CJ. This is the first British record (Johnson, 2001).
Acrotrichis sanctaehelenae Johnson – (#62) Rawcliffe Meadows (SE55) 10/1997, RJM det CJ. Collected from plant refuse at the margin of a pond, and described as new to Britain on specimens from Essex collected in 1985 (Johnson, 1987).

LEPTINIDAE

Leptinus testaceus (Müller, P. W. J.) – (*63) Treeton Wood (SE4487) 22/9/1997, EJS. T. P. Wood (SE1317) 13/8/2001, MLD. This species is parasitic in the fur of voles and other small rodents and probably under-recorded.

LEIODIDAE

Triarthron maerkeli Markel – Notable B – (#62) May Moss (SE89) 7/1996 and 9/1996, LA det MLD. On both occasions in flight interception trap. A leiodid of probably subterranean fungi, and very rarely recorded nationally (Cooter, 1996).
Leiodes obesa (Schmidt) – (*63) Eggborough Power Station (SE5824) 3/6/1983, RJM det JC, one specimen on a windowpane in a power station outbuilding. Thorne Moor (SE7415) 10/8/1990, RJM teste JC, a single specimen in a pitfall trap. Associated with subterranean fungi, this species is almost certainly greatly under-recorded owing to its obscure lifestyle.
Leiodes triepkii (Schmidt) – (#63) Frickley Park (SE4608) 8/6/1985, RJM det JC, by sweeping vegetation in woodland ride in the early evening; again, associated with subterranean fungi.
Agathidium rotundatum Gyllenhal – (*63) Wintersett (SE3714) 29/4/1999, MLD. Bole Edge, Strines (SK29) 4/6/2000, EJS. Very rarely recorded, and associated with rotting wood.

Nemadus colonoides (Kraatz) – (*61) Skipwith Common (SE6437) 7/9/2000, DGH det MLD, being unrecorded since Waterhouse's 1871 record from Studley (VC64). Typically an insect of bird nest debris in rotting trees.

Catopidius depressus (Murray) – Notable B – (#63) Hatfield Moor (SE60) 1992, PS. This is the only county record.

SILPHIDAE

Dendroxena quadrimaculata (Scopoli) – Notable B – (63) King's Wood, Elsecar (SK3999) 1997, Coldwell, 1999. Seckar Wood (SE3314) 16/5/1998, MLD. The first county records for 50 years.

STAPHYLINIDAE

Micropeplus tesserula Curtis – (*65) Catterick (SE1697) 19/5/2001, WRD, found by beating fungoid sticks over a sheet. This species is known in the county from only two other records, Sandall Beat (VC63) and Bishopwood, Selby (VC64).

Phyllodrepa puberula Bernhauer – Notable A – (*63) Crosland Moor, Huddersfield (SE1214) 16/11/2000, MLD. This, a single specimen found on a window pane in a house, constitutes the only record other than an early 1900's record from Saltburn.

Omalium exiguum Gyllenhal – Notable B – (*63) Melton Wood (SE5103) 1/5/1987, RJM. Blackmoorfoot (SE0912) 21/8/1999, MLD. These are only the second and third county records.

Micralymma marina (Strom) – (*61) North Ferriby (SE9826) 12/6/1999, MLD, WRD. A local staphylinid of intertidal shorelines and estuaries where it may be found in cracks in rocks.

Ochthephilus andalusiacus (Fagel) – (#62) Helmsley (SE6183) 13/6/2000, RJM det PMH. This is the first Yorkshire record for this inhabitant of riverbanks, particularly in shingle.

Ochthephilus omalinus (Erichson) – (*62) Hutton Common (SE7088) 14/8/1993, MLD. Helmsley (SE6183) 13/6/2000, RJM teste PMH, and in company with *O. andalusiacus.* (*63) Elland Gravel Pits (SE1362) 19/4/2000, MLD. (#64) High Batts (SE3076) 8/4/1993, JBJ det MLD.

Platystethus nodifrons (Mannerheim) – (*62) Duncombe Park (SE6082) 29/5/1997, RJM. (*64) Cawood (SE5737) 4/1990, KGP det MLD. Breary Marsh (SE2541) 7/1999, RJM. All the other 20 or so records on the YNU database emanate from several localities in the Lower Derwent NNR in VC61.

Stenus solutus Erichson – (*61) Bubwith Bridge (SE7036) 30/12/1989, MLD. (*62) Rawcliffe Meadows (SE5755) 18/4/1998, WRD. All known Yorkshire records are post-1982, with only a very few records to date.

Stenus umbratilis Casey – (*65) Mickle Fell (NY8319) 19/8/2000, WRD. Taken beside a peaty bog pool amongst sedges and previously recorded in Yorkshire only from Malham Tarn in VC64.

Leptacinus formicetorum Märkel – (63) Hardcastle Crags (SD9630) 1990, RC det MLD. Green Wood (SE2108) 28/5/1998, MLD. The first county records since 1948. There are no other recent records for this associate of the ants *Formica rufa* and *F. lugubris.*

Neobisnius villosulus (Stephens) – (*62) Helmsley (SE68) 28/6/2000, MLD. Taken by sieving riverbank shingle deposits and only the second county record.

Philonthus rubripennis Stephens – (64) Fountains Abbey (SE2768) 8/2000, RJM. The first record for this vice-county since an early Studley record dated 1871 (EAW), and is a species, at least in Yorkshire, apparently restricted to riverside shingle deposits.

Philonthus spinipes Sharp – (#63) Wharncliffe Wood (SK3094) 7/2000, EJS teste MLD. The third known British locality for this species, which was noted as new to Britain in 1997 (Allen & Owen, 1997) and subsequently reported from Warwickshire (Lane & Mann, 1999).

Platydracus fulvipes (Scopoli) – Notable B – (#62) Staxton (TA0279) 20/5/1998, LA det MLD. The only known county record for this large predatory species.

Ocypus fuscatus Gravenhorst – Notable B – (*63) T. P. Wood (SE1317) 7/2/1981 (MLD). Elland Gravel Pits (SE12) 7/5/1983, MLD. These are the first county records of this rare species since Fordham's Bubwith record of 1911.
Heterothops praevius Erichson – (*61) Elstronwick (TA2332) 14/9/1999, WRD. The first for the vice-county and the first county record since 1967. The other two county records are pre-1900.
Mycetoporus despectus Strand – Notable B – (#63) Boothroyd Wood (SE1812) 1/6/1980 (MLD). Blackmoorfoot (SE1010) 2/4/1999, MLD. (*64) Breary Marsh (SE2541) 9/6/1999, MLD. This recently described species has hitherto been confused with the common *M. lepidus*. The specimen standing as *M. lepidus* from Boothroyd Wood near Huddersfield, collected in 1980 (MLD), was in 1997 re-examined by MLD and found to be the new species, and the first authenticated record for the county.
Mycetoporus punctus (Gravenhorst) – Notable B – (*62) Jugger Howe Wood (SE9399) 8/8/1993, LA det MLD. Fylingdales Moor (SE8897) 8/1996, PMH. Marsh (1991:105) noted that a record of this species from (VC61) Thornton Ellers in 1987 was apparently a new vice-county record. Since then it is noted (Denton, 1995:41) that the species was recorded from Spurn on 15/6/1947 and this latter therefore constitutes the first VC61 record.
Sepedophilus immaculatus (Stephens) – (61) Halsham (TA2827) 20/3/2000, WRD, the first VC61 record for 50 years. This follows a spate of recent records in VC63 for this hitherto rarely recorded species.
Lamprinodes saginatus (Gravenhorst) – Notable A – (*63) Blacker Dam (SE2804) 9/3/1996, JDC. Gypsy Marsh (SE4102) 30/3/1996, JDC. A species very rarely recorded in the county.
Tachinus lignorum (L.) – Notable B – (63) Cawthorne (SE2808) 1986, EJS. The first county record since 1931.

SCARABIIDAE

Aphodius zenkeri Germar – Notable B – (#61) Allerthorpe Common (SE7657) 5/8/1989, RJM. (*63) Hatfield Moor (SE6906) 1991, PS. These remain the only known county records for this species, said to be associated particularly with deer dung (Jessop, 1986).
Hoplia philanthus (Fuessly) – (*63) Brodsworth Hall (SE5007) 23/6/2001, PAS det RJM. Several specimens of this scarabiid were seen around flowers and shrubs. There are only eight other county records, from VC62 and VC64.

SCIRTIDAE

Elodes tricuspis Nyholm – (#64) Breary Marsh (SE2541) 9/6/1999, RJM. This species, only recently described (Nyholm, 1984), was swept from streamside vegetation. The species has only been recognised from a half dozen or so specimens nationally (Allen, 1993).
Prionocyphon serricornis (Müller, P. W. J.) – Notable B – (62) Duncombe Park (SE6082) 2/9/1994, AG, bred from tree rot-hole debris. (#63) Cusworth Park (SE5403) 8/6/1994, AG teste MLD. Bretton Lakes (SE2812) 12/1995, AG, both records again bred from rot-hole debris. Brodsworth Hall (SE5007) 26/6/2000, RJM, swept from ivy at base of old ash. Recent studies of the invertebrate fauna of tree rot-holes by AG have yielded a number of records of this hitherto virtually unknown species in the county. Previous to these studies, there was only a single, unconfirmed, 19th century record from Scarborough. The larvae develop in water-filled rot-holes in various deciduous tree species.

DRYOPIDAE

Dryops luridus (Erichson) – (*61) Howden (SE7528) 7/1985, PK. Pocklington (SE8049) 9/8/1997, RJM det CJ. (*62) World's End Plantation (SE6659) 10/1998, MH. (#63) Thrybergh (SK4796) 12/6/1980, WAE.

BUPRESTIDAE

Agrilus laticornis (Illiger) – Notable B – (62) Rawcliffe Meadows (SE5755) 7/6/1997, MLD. The first county record since 1942, and associated with oak, willow and hazel.

ELATERIDAE

Fleutiauxellus maritimus (Curtis) – Notable A – (*61) Spurn (TA4112) 17/6/1986, MLD. (64) Grass Wood (SD9865) 11/6/1995, JDC. Usually found in shingle beds by rivers, this is a species with a northern and western distribution.

Oedostethus quadripustulatus (F.) – Notable A – (62) Rawcliffe Meadows (SE5755) 1997, MLD. The first VC62 record since Fordham's 1919 capture. Most records are recent ones from VC61, and this is a declining species mainly owing to the loss of its riverside wet meadow habitat.

EUCNEMIDAE

Epiphanis cornutus Eschscholtz – (#62) Deepdale (SE9291) 7/2000, LA det WRD. Widely distributed nationally but extremely scarce, and associated with spruce logs, this constitutes the first known county record and was taken in a flight interception trap.

ANOBIIDAE

Ochina ptinoides (Marsham) – (*63) Brodsworth (SE5007) 26/6/2000, RJM. This rare species occurs in ivy, in which it bores the stems, on old trees. There are only four other county records.

Hemicoelus fulvicornis (Sturm) – (61) Escrick (SE6343) 17/7/2001, RC det RJM. (*62) Duncombe Park (SE6082) 26/6/1993, MLD. (63) Bretton Lakes (SE2812) 5/6/1999, RJM. (64) Coburnhill Wood (SE4535) 20/7/2001, RJM. These are the first Yorkshire records since 1955 for this mainly southern insect.

Dorcatoma flavicornis (F.) – Notable B – (*61) Leven Canal (TA0945) 30/7/1999, WRD, one specimen reported from *Salix* sp. (*62) Beech Wood (SE5982) 6/8/1995, KNAA. Beningbrough Park (SE5357) 20/7/1999, KNAA. (*63) Hatfield Moor (SE6906) 1992, PS. High Hoyland (SE2509) 30/7/2000, EJS. Of the ten Yorkshire records, eight are post-1977.

Anitys rubens (Hoffmann) – Notable B – (*62) Beech Wood (SE58) 6/8/1995, KNAA. (*63) Hatfield Moor (SE60) 1992, PS. There are only three other county records.

MELYRIDAE

Dolichosoma lineare (Rossi) – Notable B – (#61) Spurn (TA4112) 29/6/1991, MLD, (Denton, 1995). Welwick Saltmarsh (TA3419) 6/8/1999, WRD. A saltmarsh and tidal creek species with a hitherto Kent to Lincolnshire coastal distribution.

NITIDULIDAE

Meligethes planiusculus (Heer) – (*63) Orgreave Common (SK4286) 19/7/1995, AL. Treeton Wood (SK48) 4/10/1997, AL. Associated with *Echium vulgare* Viper's Bugloss. The only other known county record is that from Mulgrave Woods (VC62) in the 1930s (HB).

Cryptarcha strigata (F.) – Notable B – (63) Bretton Lakes (SE2821) 9/6/1986, MLD. The first VC63 record since 1910. (*64) Brayton Barff (SE5830) 19/7/2000, AG det MLD. A subcortical species and associated with the Goat Moth *Cossus cossus* (L.).

Cryptarcha undata (Olivier) – Notable B – (#64) Brayton Barff (SE5830) 23/7/1996, AG det PFW. The same habitat comments apply to this species as with *C. strigata (see above).* Specimens have been found on several occasions since 1996 at the same site (AG) and this constitutes the only known Yorkshire locality.

SPHINDIDAE

Sphindus dubius (Gyllenhal) – Notable B – (*63) Haw Park (SE3615) 12/5/1999, DGH teste MLD. New to the vice-county and the second Yorkshire record, otherwise being known only from Scarborough around 1900 (recorder unknown).

CUCUJIDAE

Pediacus dermestoides (F.) – (62) Duncombe Park (SE6482) 26/6/1993, PK. The first record for VC62 since 1951. (*63) Bretton Lakes (SE2812) 14/4/1996, JDC. (*64) Fountains Abbey (SE2768) 2/9/1995, MLD. There are now only five county records.

SILVANIDAE

Oryzaephilus surinamensis (L.) – (61) Welwick (TA3421) 10/9/1999, FEK. This introduced species of stored products was found in mealhouse debris at a farm site, and was previously only recorded from Hull in 1922 (GBW).

Psammoecus bipunctatus (F.) – (61) Hornsea Mere (TA1947) 13/6/1996, RC det RJM and also in 1998 (RJM). Last recorded from this site in 1977, then a new county record. Hornsea remains the only Yorkshire site now known to harbour the species, which may be found in marsh litter and between the stems of *Typha* and *Phragmites*. There is an old Doncaster record dated 1911 (HHC), and the species was found in Bronze Age peat deposits on Thorne Moor (PS).

CRYPTOPHAGIDAE

Telmatophilus schoenherri (Gyllenhal) – (*63) Rushy Moor (SE5712) 14/7/1982, PS. Worsborough (SE3403) 1985, JDC. Rockley Dike (SE3042) 14/7/1985, WAE. These constitute the only known Yorkshire records.

Cryptophagus saginatus Sturm – (*61) Welwick (TA3421) 13/9/1999, WRD det RJM. Found in mealhouse debris at a farm. (*63) Thorpe in Balne (SE5911) 10/4/1987, RJM det CJ, in piles of roadside mowings. Blackmoorfoot (SE0912) 16/8/1999, MLD det CJ.

Micrambe lindbergorum (Bruce) – (61) Haverfield Quarry (TA32) 16/8/1996, WRD teste CJ. Keyingham (TA2325) 21/8/1999, WRD teste CJ. On both occasions the insects were found on dead thistles, and are the first county records since 1963.

Atomaria lohsei (Johnson & Strand) – RDB3 – (*62) May Moss (SE89) 27/7/1996, LA det CJ. (*63) Haw Park (SE3615) 15/8/1992, RJM det CJ. Langsett (SE1900) 9/3/1998, EJS det CJ. A recent arrival in Britain and associated with conifers, either under bark or in wood debris, or in flight interception traps as at May Moss.

Atomaria pusilla (Paykull) – (63) Owston (SE5511) 27/7/2000, RJM. Very rarely recorded in the county, and apparently declining with only three post-1970 records.

EROTYLIDAE

Tritoma bipustulata (F.) – Notable A – (63) Hatfield Moor (SE60) 1991, PS. Only three other county records, all pre-1966.

PHALACRIDAE

Phalacrus substriatus Gyllenhal – (*63) Langold Holt (SK5685) 14/7/1984, EJS det CJ. Blackmoorfoot (SE0912) 22/2/1987, MLD. Associated with rusts and smuts on various *Carex* species, there is an old unsubstantiated record from Scarborough around 1900 (RL).

CORYLOPHIDAE

Sericoderus lateralis (Gyllenhal) – (*61) Elstronwick (TA2332) 3/10/1997, WRD. (*63) Whitley Bridge (SE5620) 2/11/1990, RJM. (*64) High Batts (SE3076) 24/6/2000, RJM. Until the Whitley Bridge capture there was only one county record of this minute inhabitant of compost heaps, that from Scarborough in 1960 (EWA). The insect can be very numerous when found.

Corylophus cassidoides (Marsham) – (61) Hornsea Mere (TA1947) 10/1996, RJM. A Yorkshire rarity of marshland ground litter, this species was last recorded from the same site in 1915 (TS), and has been found in Bronze Age peat deposits on Thorne Moor (PS). There are no other county records.

COCCINELLIDAE

Stethorus punctillum Weise – (*62) Forge Valley (SE9886) 8/6/2000, RJM. (#63) Warren Vale (SK4397) 12/7/1996, AL. This minute ladybird is said to feed on *Psilacotes* mites, and is reputedly common in the south of England, these being the only known county records.
Scymnus schmidti Fursch – Notable B – (61) Haverfield Quarry (TA3220) 15/5/1999, WRD det RJM. Last recorded at Spurn in 1950 (WDH) and only the second county record.

LATRIDIIDAE

Aridius australicus (Belon) – (#63) Thorne Waterside (SE6714) 14/8/1982, PS. An introduction (as *Lathridius norvegicus* Strand) to the British Isles (Allen, 1952), this appears to be the only known Yorkshire record.
Enicmus brevicornis (Mannerheim) – Notable B – (#61) West Newton (TA1937) 24/8/1999, WRD. Elstronwick (TA2332) 11/9/1999, WRD. (*63) Blackmoorfoot (SE1010) 3/9/1999, MLD. Found variously by general sweeping in woodland and by sieving piles of twiggy garden refuse. These are the only county records.

CISIDAE

Cis setiger Mellié – (*63) Hatfield Moor (SE6906) 1992, PS. Only two other county records are known.

COLYDIIDAE

Aglenus brunneus (Gyllenhal) – (#63) Armthorpe (SE6305) 6/8/1966, PS. This, the only known county record, appears to be hitherto unpublished as such, although the insect is included in Skidmore (1983).

TENEBRIONIDAE

Alphitophagus bifasciatus (Say) – (61) Howden (SE7724) 6/7/1992, PK. The first VC61 record since 1949. (63) Kettlethorpe (SE3216) 9/7/1999, MLD. The first VC63 record since the 1930s.

MELANDRYIDAE

Abdera flexuosa (Paykull) – Notable B – (62) Helmsley (SE68) 5/6/2000, RJM. Forge Valley (SE9886) 8/6/2000, RJM. Rarely recorded in the county, the first VC62 records since 1935 and usually associated with fungi on old willows and alders.
Hypulus quercinus (Quensel) – RDB2 – (#62) Helmsley (SE68) 6/2000, RJM and MLD. This saproxylic rarity is restricted to four widely separated localities in Britain, and there is a sub-fossil record from the peat deposits on Thorne Moor.

MORDELLIDAE

Mordellistena neuwaldeggiana (Panzer) – (*63) Blaxton Common (SE6801) 8/7/2000, PK det BL. (#64) Bishopwood (SE5633) 1/8/1992, PK det BL.

OEDEMERIDAE

Oedemera lurida (Marsham) – (61) Haverfield Quarry (TA3219) 27/6/1998, WRD. The first VC61 record for over 100 years. (*63) Tingle Bridge (SE3901) 9/6/1993, JDC. Since 1993 there has been a flood of records of this insect, which is clearly extending its range and increasing in frequency.

CERAMBYCIDAE

Arhopalus rusticus (L.) – (#61) Wheldrake (SE7044) 1/8/1996, TD det MLD. A specimen, probably emanating from a nearby conifer plantation, was found in a bird-watching hide on a reserve area. The species is associated with pine plantations in the south of England and in Scotland.
Agapanthia villosoviridescens (Degeer) – (#63) Little Moor (SK5287) 10/6/2000, WAE.

Potteric Carr (SE6000) 7/2001, AP teste RJM. These would appear to be the most northerly records for this longhorn. Twinn and Harding (1999) in their BRC Atlas show a record for grid square SE08 in VC65 – this is an error.
Saperda scalaris (L.) – Notable A – (*63) Little Don Valley (SE1900) 27/6/1995, JDC. Previously known in the county only from old woodland sites in VC62, the species is mainly northern and western in the British Isles.

BRUCHIDAE
Bruchus rufimanus Boheman – (63) Thrybergh (SK4796) 5/12/1992, AL. This record was the first for the county since 1951 but since 1992 the species has been frequently reported.

CHRYSOMELIDAE
Oulema melanopus (L.) – (#63) Pollington (SE6119) 5/1998, RJM. (*64) Bishop Monkton Ings (SE3166) 9/1998, WRD. Owing to confusion with *O. rufocyanea* (see comments under the following entry) all previous records of this species, in the absence of voucher specimens, must be viewed with caution.
Oulema rufocyanea (Suffrian) – In a recent paper (Cox, 1995), this species was brought forward as British and distinct from *O. melanopus*, both species being confused in collections. All Yorkshire captures of *'melanopus'* are now examined critically as a matter of course, and in consequence, the first authenticated Yorkshire specimens of *O. rufocyanea* may be recorded from the following vice-counties: (*61) Kelsey Hill (TA2326) 19/8/1994, WRD. (*62) Forge Valley (SE9886) 7/9/1996, RJM. (#63) T. P. Wood (SE11) 3/12/1980, MLD. (*64) Bishop Monkton (SE3166) 5/9/1998, MLD. Virtually all Yorkshire *'melanopus'* specimens taken in the field prove to be *O. rufocyanea.*
Crioceris asparagi (L.) – (#63) Rossington (SK6298) 7/6/2000, RJM. A pest of cultivated asparagus in some parts of the south of England, this is apparently the first Yorkshire record. The specimen was swept in grassland near allotment gardens where asparagus was being cultivated.
Chrysolina oricalcia (Müller, O. F.,) – Notable B – (*63) Falthwaite (SE3003) 19/6/1996, JDC. Handsworth (SK4186) 10/6/2000, AL. There are very few recent records for the county.
Chrysomela aenea L. – (*64) High Batts (SE3076) 21/6/1992, MLD, PK. (*63) Canklow Wood (SK4391) 28/5/1990, WAE. Most records for this conspicuous alder *Alnus glutinosa* feeder are from VC62 and the great majority are post-1979. The species appears to have become much more frequent throughout the county during the last decade.
Calomicrus circumfusus (Marsham) – Notable A – (#63) Denby Dale (SE2108) 8/8/1998, MLD. A species associated with *Ulex* and *Cytisus.*
Longitarsus anchusae (Paykull) – Notable B – (63) Hatfield Moor (SE6906) 11/8/2000, PS. Associated with *Echium* species, this is the first recorded occurrence in the county since 1914. There is also an undated Doncaster record (EGB).
Longitarsus exoletus (L.) – (61) Hedon (TA2129) 15/6/1999, WRD det MLC. The first VC61 record since the 1930s. (63) Lindrick Dale (SK5482) 9/8/1986, WAE. The first VC63 record since the 1920s. (*64) High Batts (SE3076) 24/6/2000, WRD det MLC. A little recorded species on *Echium vulgare.*
Longitarsus ganglbaueri Heikertinger – Notable A – (*63) Hatfield Moor (SE60) 1992, PS. The first county record for over 60 years.
Longitarsus kutscheri (Rye) – (*61) Wintringham (SE87) 23/8/1976, WRD det MLC. Beverley (TA0139) 13/10/1999, WRD det MLC. The first VC61 records for this species which is associated with *Plantago.*
Longitarsus reichei (Allard) – (*61) Brandesburton (TA0947) 24/7/1999, WRD det MLC. (#63) Fan Field (SK5381) 13/9/1980, WAE. A little recorded species in the county.
Lythraria salicariae (Paykull) – Notable B – (*63) Hatfield Moor (SE60) 1995, PS. There is only one other (unsubstantiated) county record, dated 1879, from the Whitby area.
Psylliodes chalcomera (Illiger) – Notable B – (#63) Elland Gravel Pits (SE1121) 7/6/1990,

MLD. Associated with thistles *Cirsium* species, this remains the sole county record.
Psylliodes laticollis Kutschera (= weberi Lohse) – (*61) Roos (TA3030) 18/4/1999, WRD. (*62) Rawcliffe Meadows (SE5755) 22/2/1997, MLD. (*63) Hipperholme (SE12) 9/5/1980, MLD. All county records are post-1980 with most being post-1997.

ANTHRIBIDAE

Anthribus fasciatus (Forster) – Notable A – (#63) Medge Hall (SE7412) 8/6/1976, PS. This is the only county record of this species and appears not to have been published previously.
Rhynchites cavifrons Gyllenhal – Notable B – (#62) Appleton-le-Moors (SE7387) 25/5/1985, KGP. (*63) Seckar Wood (SE3314) 16/5/1998, MLD. Apparently only five county records for this, one of the "leafroller", species; it is mainly southern English in its distribution.
Rhynchites interpunctatus Stephens – Notable B – (#63) Blaxton (SE6803) 11/6/1968, PS. Thrybergh (SK49) 7/7/1985, WAE. Thrybergh (SK4695) 1986, EJS. These remain the only known county records, the Blaxton record not, apparently, having been published previously. The species is another "leafroller", recorded from oak, and again southern English in distribution.
Rhynchites tomentosus Gyllenhal – Notable B – (63) Hatfield Moor (SE70) 1992, PS. The first county record since 1966.

BRENTIDAE

Pseudapion rufirostre (F.) – (*61) Patrington Haven (TA3021) 3/8/1997, WRD. (*63) Angler's Country Park (SE3715) 10/5/2000, MLD. According to Morris (1990) this species is locally abundant on *Malva* species as far north as Durham, although there are only three Yorkshire records.
Protapion dissimile (Germar) – Notable B – (#63) Blaxton Common (SE6801) 8/7/2000, RJM det MGM. A species apparently restricted to *Trifolium arvense.*
Ischnopterapion modestum (Germar) – (#63) Gypsy Marsh (SE4102) 15/8/1995, JDC teste MGM. A species associated with *Lotus uliginosus.*
Protopirapion atratulum (Germar) – (*65) Catterick Garrison (SE1697) 19/5/2001, WRD. Most records are from the south of the county.
Hemitrichapion reflexum (Gyllenhal) – Notable A – (#62) Yedingham (SE8979) 2/1951, EFG. (*63) Potteric Carr (SE6000) 24/5/1968, PS. A species feeding on Sainfoin *Onobrychis viciifolia.*

CURCULIONIDAE

Sitona cambricus Stephens – (#64) Bishopwood (SE5633) 19/6/1981, RC. (*63) Hatfield Moor (SE6906) 1992, PS. Hatfield Moor (SE6906) 9/9/2000, PS. A scarce Sitona in Yorkshire, associated with *Lotus uliginosus.* These are the only records.
Limobius borealis (Paykull) – Notable A – (*61) Howden (SE7528) 28/7/1987, PK. (64) High Batts (SE3076) 21/6/1992 (MLD), and the first VC64 record for 60 years. A declining species with very few recent records, on various *Geranium* species.
Dorytomus hirtipennis Bedel – Notable A – (*61) Wheldrake (SE6944) 4/9/1997, MLD. (#63) Thorpe in Balne (SE5911) 6/7/1976, PS. Associated with *Salix alba*, this species may be declining nationally.
Sirocalodes mixtus (Mulsant & Rey) – Notable B – (#61) North Cliffe Wood (SE8637) 11/7/1998, WRD teste MGM. A very local, southern insect on *Fumaria officinalis.*
Neophytobius quadrinodosus (Gyllenhal) – Notable A – (#62) Deepdale (SE9291) 16/5/1998, LA det CHCL. The first authenticated county record – there is an old, unsubstantiated record from Scarborough around 1900 (RL).
Anthonomus bituberculatus Thomson – (*61) Hollym Carrs (TA3224) 20/5/1995, WRD. (*64) Bishop Monkton (SE3465) 14/6/1997, RJM. Very few county records exist for this species owing to confusion with other members of the genus. Morris (1977) clarified identification within the group. This species develops in flower buds of *Crataegus monogyna.*

Curculio rubidus (Gyllenhal) – Notable B – (*63) Hatfield Moor (SE6906) 9/9/2000, PS. Very scarce nationally, associated with *Betula* and only the second county record, previously from Goathland in 7/1939 (RRUK).
Sibinia primitus (Herbst) – Notable B – (#63) Hatfield Moor (SE6906) 9/9/2000, PS. Associated with *Spergularia rubra* and possibly others of the genus. The foodplant is quite widely distributed in the south of the county, in sandy areas, but this is the only known county occurrence of the weevil.
Miarus graminis (Gyllenhal) – Notable B – (*63) Hatfield Moor (SE70) 1992, PS. The only other county record is that from Pannal Ash dated 5/1936 (RRUK).
Scolytus rugulosus (Muller, P. W. J.,) – (#61) Oak Hill (SE7122) 16/6/1987, PK. Elstronwick (TA2332) 3/8/1996, WRD. (*64) Thorpe Arch (SE4446) 25/10/1999, JD. High Batts (SE3076) 24/6/2000, WRD. These remain the only county records. The species is subcortical, mainly on old fruit trees.

SCOLYTIDAE

Phloephthorus rhododactylus (Marsham) – (63) Lindrick (SK58) 1986, EJS. Hatfield Moor (SE6906) 9/9/2000, PS. These records are the first for the county since 1935.

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BOOK REVIEW

Butterflies of Europe by **Tom Tolman** and **Richard Lewington.** Pp. 320, with 104 colour plates and numerous distribution maps. Princeton University Press, Princeton. 2002. $26.95, laminated covers.

This book is a re-issue for the American market of the Collins Field Guide *Butterflies of Britain and Europe,* published by HarperCollins in 1997 as a successor to the classic work by Higgins and Riley, A Field Guide to the Butterflies of Britain and Europe, which was published in several editions. The author begins with a tribute to the memory of Lionel Higgins and Norman Riley which is followed by an introductory chapter outlining general butterfly anatomy, the geographical limits covered, life, history, behaviour and conservation of butterflies.

The main part of the book follows the style adopted by Higgins and Riley but the text dealing with the description of each species is generally much reduced and even absent for some, much more reliance being placed on the illustrations to effect an identification. In particular no indication of the size of each species of butterfly is given in the text, the reader being informed in the introduction that "the best indication of approximate size is provided by the illustrations". In contrast, the biological details are much more extensive and includes much useful information, particularly on larval foodplants. The book concludes with a check list of species, glossary and bibliography. The hybrid origin of this publication is emphasized by an interesting anomaly: although the use of the English spelling "colour" is consistent throughout the text, this becomes the North American equivalent "color" on the verso of the title page and back cover.

The colour plates, from paintings by the renowned entomological illustrator Richard Lewington, are a delight and the book is well worth having for these alone, although the British reader may prefer the original HarperCollins edition. The underside illustrations are of butterflies depicted in a resting position rather than as "set" specimens and so will greatly aid identification of insects in the field. Despite some shortcomings this is currently the standard general identification guide to European butterflies, with updated distributional information and the inclusion of recently separated taxa, but the reviewer regrets the reduced descriptive content.

HEB

OBITUARY

DR LEWIS LLOYD-EVANS (1916-2001)

Born on the 31st of March 1916 at Tenbury, Lewis Lloyd-Evans, 'Lloyd', was the son of a GP and grew up in rural Lincolnshire, in the Louth area, and enjoyed country pursuits. He studied medicine at Edinburgh in the years spanning the start of World War 2; he had a fine memory for factual detail, excelling in subjects like anatomy, at which he topped his class. Lloyd enjoyed the company of those who shared his interests and willingly passed on his expertise. He enjoyed his student years. One summer he took a trawler to Iceland to visit Lake Myvatn and on a trip to Dublin met his future wife, Maudie, Maudie, who predeceased him by 10 years, was the daughter of an Anglican minister in a rural parish in the Lough Corrib area of Co. Galway, where she too enjoyed a country childhood – riding, boating and fishing with her two brothers. She was working as a secretary at the Guinness Company in Dublin when they met.

World War 2 started whilst he was at Edinburgh and when he qualified he was drafted into the Army Medical Corps. Here he trained in the then experimental technique of blood transfusion, which he put to use after D-Day as he moved across Europe with the advancing allied armies.

Lloyd and Maudie married in neutral Eire whilst he was in the Army, and had to borrow friends as his own were not allowed to attend due to the fear of desertion. She moved around southern England with his various postings and whiled away spare time in the countryside enjoying its wildlife. After the war Lloyd became a GP in a practice in Ware, Hertfordshire, and their son Trevor was born. They lived over the surgery, in The Old House in the High Street; it was difficult to get away from work, so at every opportunity the family would go off into the countryside to explore its natural history. They joined the Hertfordshire Natural History Society, which brought them into contact with other enthusiastic naturalists, notably 'Snaily' Stratton, who triggered an interest in Mollusca, and John and Chris Dony whom they ferried about Hertfordshire doing fieldwork for the botanical atlas of the county. This further developed Lloyd's botanical expertise whilst birds, dragonflies and fungi were other special interests he developed about this time. In this period too, he wrote an authoritative paper on black rats in Hertfordshire (*Trans. Herts. Nat. Hist. Soc* **25**: 4-6). Summer holidays about this time were usually taken camping in Wales, where they added to the list of Welsh dragonflies.

In the early 1960s the family 'discovered' the recently formed bird-ringing group at Rye Meads and bird-ringing at Rye Meads became a major preoccupation of the family and led son Trevor to become a professional ornithologist. During the Rye Meads years almost all free time was spent there and when birds were scarce attention was turned to the other wildlife of the area. After a long day in the field, we would all be invited back to The Old House for warming coffee, sherry and conversation round the fire and then Maudie cheerfully produced dinner for the assembled company. Often Lloyd enjoyed supervising the preparation of some special dish for dinner and colourful fungi often featured on the menu.

During the same period Lloyd took up the study of bird parasites, especially the Mallophaga, Fleas, and Ticks on birds caught for ringing. At home this involved a 'production line' of specimens being processed through a succession of clarifying agents, dyes, and mountants in preparation for examination under the microscope. This fitted in well with surgery hours and, in later years, the interest in microscopy led on to the dissection of critical species of Mollusca; he also commenced his study of plant rusts. In the 1960s he also adopted Heteroptera, helping Dr Bernard Nau to map the aquatic Heteroptera of Herts. Another major interest in the 1960s was fieldwork for the Conchological Society's 1976 Mollusc atlas. He became a member of the Society in 1965.

The family remained in Ware until June 1968, when they moved to Holmfirth in Yorks, when Lloyd took up a post in the local schools medical service. They soon became involved with the Yorkshire Naturalists' Union and, later, Sheffield's Sorby Natural History Society, regularly attending their field meetings of these societies. This led to new interests in yet more groups, notably plant galls and rusts, and renewed interest in others. His Presidential Address to YNU in 1974 was entitled 'The biogeography of snails in Yorkshire'. He was also a very active member, and ex-President, of the Yorkshire Conchological Society. Normally, however, he studiously avoided formalities and purely social events.

Summer holidays at this time were often taken camping in France and the Spanish Pyrenees, enjoying the many unfamiliar species. Then, in the early 1970s, his son Trevor took up an ornithological post in Massachusetts, USA, which led to a series of holidays exploring the birds and wildlife of various regions of that country.

Over the ten years following Maudie's death, poor circulation and then deteriorating vision gradually restricted his fieldwork; then a stroke, from which he largely recovered, prompted him to move to a nursing home near his sister in Caterham on the Hill in Surrey. By then he could not manage a walk of more than a few hundred yards but he still enjoyed car trips with visitors into the countryside, visiting such sites as the Ashdown Forest, Stodmarch, and the Isle of Sheppey. To the end he kept his mind exercised by completing the daily large crossword puzzle in the *Guardian* newspaper. He was looking forward to a forthcoming family holiday in Cornwall when he died in his sleep on 14th May 2001.

Lloyd was elected to the Union at the AGM in Sheffield held on the 6th December 1969, and I met him and his wife Maudie in the early autumn of the same year, having had advance notice of his intended semi-retirement to Yorkshire. One of the very last of the all round naturalists, Lloyd will be missed by all who knew him. I personally have lost not just a friend in Lloyd but a second family in which Maudie took centre stage, and one in which I always remember the hospitality and kindness given to me over the years.

I would like to thank Dr Bernard Nau for much of the above biographical information and Lloyd's son Trevor for forwarding the picture of Lloyd and Maudie on one of their trips to the USA.

A. Norris

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BOOK REVIEW

Pennak's Freshwater Invertebrates of the United States. Porifera to Crustacea. Fourth edition by **Douglas Grant Smith.** x + 638 pp. New York. Wiley. 2001. £85.95 hardback.

New editions of Pennak's 'Freshwater Invertebrates of the United States' 1952 appeared in 1978 and 1989. The third omitted the insects. This fourth edition, revised by D. G. Smith, omits the Protozoa, but is still a substantial volume.

A somewhat idiosyncratic but useful introduction deals with freshwaters in general, and their invertebrates, embraces a miscellany of topics, and includes much interesting information and a few errors. Here, although there is a separate section on distinctive larval stages, an accompanying table omits the unique larvae of the branchiuran *Chonopeltis* and the various remarkable larvae of mutelid bivalve molluscs. The anomopod branchiopod labelled as *Streblocerus* is in fact *Lathonura*, and a table listing anabiotic stages omits the remarkable African mutelids of the genera *Aspatharia* and *Spathopsis.* The latter can firmly close and hermetically seal the shell valves, and regularly withstand complete desiccation of the habitat, and high temperatures throughout the dry season. Unionids may survive drought for a time, as mentioned in the relevant section, but are not specialised for this, and sometimes suffer mass mortality when the habitat dries out.

The bulk of the work deals with the many groups of freshwater invertebrates and provides keys to the genera recorded in the U.S. A general, often substantial, account helpful to students everywhere introduces each group: the keys are specific to the U.S. It should hardly be necessary to say that these should not be used to identify animals elsewhere, but N. American works have been so used in the past, especially when it was believed that many small freshwater animals were cosmopolitan. This leads to confusion. The generously illustrated keys strikingly reveal how much richer is the N. American freshwater fauna than our own; for example, the U.S. boasts no fewer than 81 and 57 genera of gastropod and bivalve molluscs respectively, 12 genera of crayfishes that include more than 300 species, about 130 isopods, and 150 amphipods. It is often unfair to refer to omissions as the author may have made a conscious decision to omit some particular point, but one such is surprising. No mention is made of the amazing imitation fish formed from the mantle and marsupium of some bivalve molluscs of the genus *Lampsilus* that not only look like a fish, complete with eye, but undulate like one. This attracts real fishes that receive from the mollusc a discharge of glochidia larvae which, if they can, attach themselves and become parasitic. The key does say that the female "displays from a partially buried position" and a plate, one of a set new to this edition, actually shows an imitation fish (not a particularly good example) but makes no mention of this amazing mimicry.

There are occasional mis-spelled or incorrect names, the ostracods *Heterocypris incongruens* and *Cyprinotus incongruens* are the same animal, and an update which tells us that in the 1990s crayfish in Louisiana occupied about 46,000 hectares is immediately followed by a statement that in that state they occupy about 7,000 hectares. English readers will know what is meant when they read that ostracod valves are "united on the dorsal margin by an elastic band" but the phraseology is unfortunate. Illustrations are abundant, almost always clear and helpful, and now include photographs taken via scanning electron microscopy, but sometimes give no indication of size. The book is beautifully produced, will be a boon to North American users, and a means of broadening the knowledge of students everywhere.

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Notice to Contributors to 'The Naturalist'

Manuscripts (two copies if possible), typed double-spaced on one side of the paper only with margins at top and left-hand at least 2.5cm wide, should be submitted. Latin names of genera and species, but nothing else, should be underlined. S.I. Units should be used wherever possible. Authors must ensure that their references are accurately cited, and that the titles of the journals are correctly abbreviated. Volumes of *The Naturalist* for the years 1886 to 1975 have been retrospectively numbered 11 to 100 to accord with numbering before and after this period (see YNU *Bulletin* no. 3, pp. 21-22 1985); please cite these volume numbers in all references. Table and text-figures should be prepared on separate sheets of paper. Drawings and graphs, drawn about twice the linear size they are to appear, should be in jet-black Indian ink, and legends should not be written on the figures. **Publishable manuscripts not conforming to the above requirements will be returned for alteration.**

Photographic Plates

Readers of *The Naturalist* will have noticed that the number of photographic illustrations has increased in recent years. Good clear photographs, suitably captioned, to accompany articles or as independent features are always welcome.

To encourage this development, a long-standing member of the YNU, who wishes to remain anonymous, has most generously offered to make a donation, the income from which would finance the publication of a plate or equivalent illustration in future issues whenever possible. The editor, on behalf of the YNU, wishes to record this deep appreciation of this imaginative gesture.

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FINDING FUNGI

GILLIAN M. BRAND

Presidential address presented to the Yorkshire Naturalists' Union at Ripon, 1st December 2001

Yorkshire has an outstanding and continuing record of achievement in the study of its fungi. The pioneer studies of James Bolton in the second half of the 18th century preceded the formation of the Yorkshire Naturalists' Union and, at a meeting in Selby in 1896, the founding of the British Mycological Society. Over the years, the YNU has sponsored books on Yorkshire fungi by Massee and Crossland (1905), Mason and Grainger (1937), and Bramley (1985). A key to the continuity of mycological studies in the YNU has been the handing on of the torch of knowledge from generation to generation right up to the present day.

Although born and brought up in Yorkshire, I have spent much of my life in exile in Warwickshire and have been involved in the Warwickshire Fungus Survey since its conception in 1965. My aim here is to describe some experiences in trying to find and record fungi at the levels of vice county, site, habitat and species and to extract from these some of the special features of the natural history of fungi.

Vice County

The Warwickshire Fungus Survey was set up at the time of completion of the field work for mapping the distribution of flowering plants in the county, which led to the pioneer use of computer technology for map production (Cadbury *et al.,* 1971). The initial aim was to map the distribution of fungi similarly. At that time, and with some notable exceptions including in Yorkshire, fungal studies tended to be neglected by local naturalists. One major reason for this neglect was the lack of comprehensive identification books for almost all groups of fungi. Taxonomic work continues and there is much more literature now (Brand *et al.*, 2001). Recently, mostly in the 1990s and still continuing, there has been a national explosion in the formation of local fungus recording groups. Together with already existing groups a large part of the UK is now covered by at least 36 groups. Most of these are connected with the development by the British Mycological Society of a national database of fungal records. This has huge potential for increasing our understanding of fungal distribution but at present its national coverage is patchy, due not only to absence of records from some areas but also to logistic problems in database entry.

The basic ground rule of the Warwickshire Fungus Survey was that every new county record in the survey must be supported by a herbarium specimen with field and descriptive notes. These specimens were scrutinized by a local panel and difficult species were sent to national experts. Identification of species was, and continues to be a major problem and the help of experts, at the national botanic gardens at Kew and Edinburgh and elsewhere, has been crucially invaluable. The introductory courses revealed a hard core of more than a dozen enthusiasts who stayed with fungal recording and together covered a good range of taxonomic groups. Table 1 shows the numbers of species of non-lichenized fungi recorded after 12 years, when preparation for publication of *The Fungus Flora of Warwickshire* (*ed.* Clark, 1980) began. In the absence of comprehensive and up to date national check lists for most groups of fungi the best evaluation of coverage is comparison with well-recorded regions. In comparison with S.E. England, the favoured collecting area of workers at Kew, and Yorkshire, the numbers of species in most taxonomic groups were substantial but there was a weakness in recording microfungi. This was largely attributable to the absence of accessible identification literature until the publication of *Microfungi on Land Plants* (Ellis & Ellis, 1985). Despite the limited range of ecosystems in an inland county with no land above 260 m, further work in Warwickshire since the 1980 publication has resulted in a continued increase in the number of species recorded, with an overall increase of nearly 20% up to the year 2000 (Table 1, records of the Warwickshire Fungus Survey).

TABLE 1
Numbers[1] of fungal species, including recognized varieties, recorded in different regions

Region	Survey period	Taxonomic group[2]				
		Basidiomycetes	Teliomycetes	Ascomycota	microfungi	Myxomycota
Warwickshire (Clark, 1980)	1965-1980	1090	110	900	230	160
Warwickshire	1965-2000	1340	130	1030	312	170
S.E. England (Dennis, 1973)	up to 1973	1730	190	980	750	140
Yorkshire (Bramley, 1985)	up to 1985	1790	200	1300	580	170

[1] Numbers rounded to the nearest 10, as arbitrary acknowledgement of variations in species concepts between different sources.

[2] Taxonomic groups as in *Dictionary of the Fungi* (9th ed. Kirk *et al.*, 2001).
The equivalents in Bramley (1985) are:
Class Basidiomycetes: Hymenomycetes, Hymenomycetous Heterobasidae and Gasteromycetes.
Class Teliomycetes: Urediniomycetes (rust fungi) and Ustilaginomycetes (smut fungi).
Microfungi: a non-taxonomic aggregation of the anamorphic fungi (Hyphomycetes and Coelomycetes) with the Plasmodiophoromycetes, Mastigomycotina and Zygomycotina.

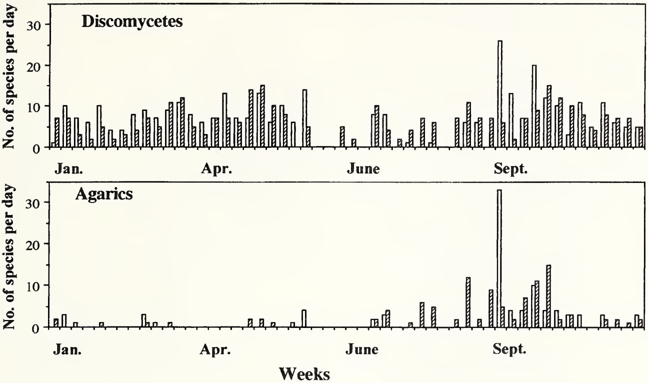

FIGURE 1
Mean number of species of Discomycetes and agarics (Agaricales, Boletales, Russulales and Cantharellales) recorded per day by Malcolm Clark in 1976 (open columns) and in 1977 (hatched columns). There were no recording days in weeks 24, 25, 28 and 35 in either year.

Limiting factors in regional recording include the problem of surveying a large area, and searching at the correct time of year, when the fungi are fruiting. Traditionally most fungus forays were held in the autumn but sample data from the late Malcolm Clark's mycological diaries for 1976 and 1977 illustrate the number of species that he found and identified microscopically throughout the year (Figure 1). His special interest was Discomycetes but he also recorded other ascomycetes and agarics. He looked for fungi on an average of 2.5 days every week except when abroad on holiday. There is a marked difference between the all-year-round occurrence of Discomycetes and the sporadic, mainly autumnal fruiting of agarics in the litter habitats in which he searched. This pattern was evident in both years although they had very different rainfall profiles. 1977 was overall a wet year with 688 mm rain, 42% more than in 1976, but with two dry months on either side of torrential rain in September. This sort of experience has stimulated much more year-round recording (Legg, 1989) and is especially important for species which do not fruit in the autumn season.

Regional studies can be combined to look at the national distribution of individual species and Figure 2 shows the post-1965 distribution of two species at the level of vice county. The British Mycological Society's Fungus Record Database (BMSFRD) shows only positive records and lack of a record could be due either to deficiencies in recording or to absence of the fungus. *Geopora* (= *Sepultaria*) *sumneriana* is a large, spring-fruiting Discomycete which is associated, possibly mycorrhizal, with *Cedrus*. Fruit bodies occur particularly on bare loose soil under *Cedrus* and we have found it at the same locations in Warwickshire in successive years. The original version of Figure 2 suggested that this is a southern species with its northern limit in the Warwickshire area. However, after this address was given, Alan Legg told me that the fungus has occurred annually since 1981 in Darlington West Cemetery, Co. Durham (Legg, 1995). Further enquiries at the national herbaria at Kew and Edinburgh have confirmed that they have no specimens from Scotland or Wales and that the Darlington site is the only one in the north of England. This

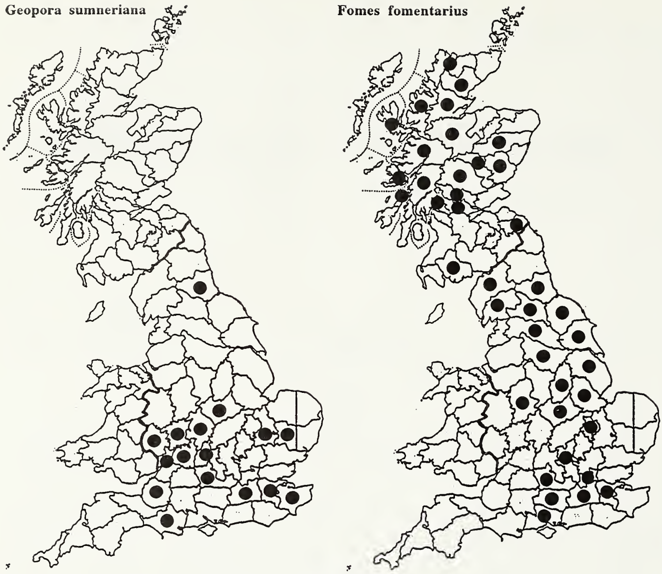

FIGURE 2
Post-1965 records of *Geopora sumneriana* and *Fomes fomentarius* in vice counties, based on the BMSFRD, with additions from Tom Hering, Alan Legg and Kerry Robinson.

Darlington find greatly extends the known distribution of *G. sumneriana* and suggests that it would be well worth looking for it in Yorkshire, under cedar trees in the springtime.

Fomes fomentarius is a polypore which grows on upright and fallen trunks, especially of *Betula* and *Fagus*. For recording it has the advantage that the perennial fruit bodies can be seen at all times of year. It is widely distributed in northern Britain and records from midland and southern regions are mainly in the east (Figure 2). It occurs on both major hosts throughout its range but is more common on *Betula* in highland Scotland and on *Fagus* in south-east England. In Yorkshire it occurs at widely scattered sites and has been recorded from prehistoric sites (Watling, 1978). However, searching in Warwickshire and nearby counties to the west (Herefordshire, Shropshire, Worcestershire, personal communications with members of local fungus groups) has failed to find it, suggesting a puzzling south-westerly limitation on the occurrence of this fungus.

Single Site

Earlswood, Warwickshire is a large site (*c*.35 ha) on acid soil of *Quercus* woodland with *Ilex* and *Betula* and containing streams and marshy areas with *Alnus*, *Betula* and *Corylus*. There are also mature planted *Fagus* and *Castanea*. This has been one of the favourite sites for the Warwickshire Fungus Survey's annual weekend courses tutored by national experts, with a visit in late September or early October in almost every year. The procedure was for

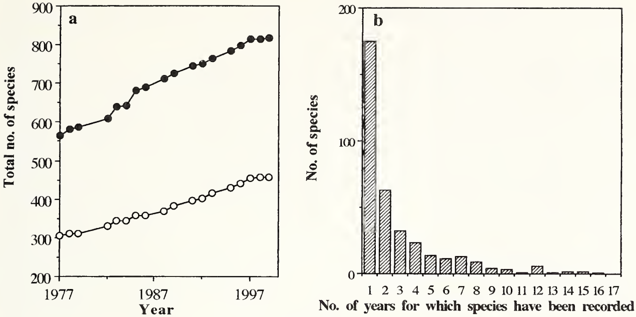

FIGURE 3
Records of fungi from Earlswood 1977-1999: (a) accumulation of species records, including recognized varieties, and (b) yearly frequency of Basidiomycete species. Solid circles, all species; hollow circles, Basidiomycetes.

individuals to roam freely, searching for the diversity of fungal species ('wandering sheep technique') for 2-3 h and then to spend several hours on identification in the laboratory. Although there had been 12 forays before publication, subsequently there was a continuing increase in the number of species recorded from the site, with a 45% increase between 1980 and 1999, of which approximately two-thirds were new species of Basidiomycetes, the most intensively studied taxonomic group (Figure 3a).

Inspection of the species and participant lists provides anecdotal evidence of possible explanations for this continuing increase. There are human factors, including different search routes. *Bovista plumbea* was restricted to the cindery ground of railway property through which the site was entered in the early years. It was recorded in most of these years but not afterwards, when the site was entered from another side. Most people, with a few notable exceptions, have difficulty in seeing certain fungi such as the small pale stalk-like *Macrotyphula junceus*. The only year in which this was recorded at Earlswood was that in which our specialist spotter of this species was amongst the participants. New literature for identification progressively becomes available. Thus four species in the *Armillaria mellea* complex have been distinguished at the site since publication of the Warwickshire Flora. New management activities can introduce new species. Wood chippings imported for path maintenance provided the substrate in 1996 for *Stropharia aurantiaca*, one of the species characteristic of this material (Shaw & Kibby, 2001). The most important human factor was the presence of the expert tutor. Although the taxonomic group selected for special study on each course was rarely present in abundance at the particular time, many species in this and other groups were confirmed by the experts.

Fungal factors in the continuing increase in species numbers over time, e.g. rarity, are more difficult to discern. The large fruit bodies of *Xerocomus* (= *Boletus*) *parasiticus* are readily seen but have rarely been recorded in either Warwickshire or Yorkshire. The species is unmistakable since its fruit bodies are always found attached to those of *Scleroderma citrinum*. Although *S. citrinum* was recorded at Earlswood on 10 out of 17 post-publication visits, *X. parasiticus* has only been found in one year.

A more objective way of describing frequency is to present the data in terms of the number of years in which each species has been recorded at the site. Over the 17 years since 1978 in which forays have been held at Earlswood, the frequency of Basidiomycete species takes the form of a hollow curve (Figure 3b) in which a large proportion, i.e. 46% of the total of 338 species, were found only once and less than 2% were found in three-quarters or more of the years. These common species were *Piptoporus betulinus*, *Mycena galericulata*, *Russula ochroleuca*, *Amanita rubescens*, *Paxillus involutus* and *Lactarius quietus*. Although the Earlswood data are subject to limitations in species identification as well as to sampling deficiencies, similar results have been obtained in other investigations. After 21 autumn seasons of recording by means of walk surveys in a Caledonian pinewood by an expert taxonomist, the total species accumulation curve over successive years was still continuing to increase, with no indication of levelling off (Tofts & Orton, 1998). Out of 502 species of agarics and boleti recorded, 34% were found only once and less than 3% were found on at least three-quarters of the annual visits. Straatsma *et al.* (2001) worked in five fixed plots, each of $300m^2$, in a mixed broad-leaved and conifer forest in Switzerland and recorded every fruit body of every species of ground-living macromycete every week from May to December (weeks 21-50) for 21 years. This rigorous weekly sampling of the plots yielded a similarly shaped annual frequency curve in which 37% of the 408 species were only recorded once. However, the weekly samples resulted in a greater proportion of species (10%) being found in at least three-quarters of the years. Eight species were recorded every year, i.e. *Lactarius blennius*, *Russula cyanoxantha*, *R. fellea*, *R. fageticola*, *R. ochroleuca*, *Xerocomus badius*, *Collybia butyracea* and *C. dryophila*.

The immediate conclusion is that it takes many years to record the total mycota of a site, or, to put it another way, there is endless fascination in looking at the diversity of fungi at one site. This conclusion exposes the problems involved in mapping species distribution and in determining the conservation value of a site from one or a small number of visits. The inconstancy of fruiting of many larger fungi explains the experience of the Warwickshire Fungus Survey, and others, that trying to map fungi by intensive recording during a single visit to each km square is unrewarding because of the low number of species 'hits' per visit. For site assessment and comparison adequate measurement of ecological diversity is important (Magurran, 1988) but is difficult for fungi. However, it is now recognised that fungi are crucial to the functioning of ecosystems. The first report on important fungus areas in the UK (Evans *et al.*, 2001) uses four criteria for selecting areas, i.e. the occurrence and abundance of rare species, the recorded species richness, the importance for fungi of the habitat type and views on the special potential of nominated under-recorded sites. There is currently much debate amongst mycologists about the most efficient method of evaluating the fungal diversity of a site.

Single site data raise questions about the complex meaning of rarity in fungi. The first problem is that the vegetative part, the mycelium, within the substratum is difficult to see. The actual substratum may be difficult to pinpoint and the extent of individuals in both space and time is rarely observable. Molecular methods have been used to solve this problem in a few economically important species. In *Armillaria bulbosa* (= *A. gallica*) and *A. ostoyae*, which attack roots of trees and spread underground as rhizomorphs, clonal individuals have been shown to extend over large areas of ground, up to 15 ha (Smith *et al.*, 1992; Dettman & van der Kamp, 2001). From studies of rhizomorph extension rates it has been estimated that the largest individual is 1500 years old. On the other hand, experimental studies have shown that *Trametes* (= *Coriolus*) *versicolor* colonizes stumps and branches by airborne basidiospores, each successful colonizer being a new sexually generated individual, often with a distinctive colour pattern on its fruit bodies (Rayner & Todd, 1978; Williams *et al.*, 1984).

The second problem concerns the occurrence of fruiting on mycelia. How long does it take a growing mycelium to reach a fruiting state? How often and for how long is it capable of producing fruit bodies? How long do individual fruit bodies last? What is the effect of environment on all these phases? The detailed data of Straatsma *et al.* (2001) show that both the number of species fruiting and the abundance of fruit bodies of all species varied dramatically from year to year. There was a ten-fold difference between the lowest and highest number of species fruiting per year (mean 101, s.d. 52) and the range of fruit body abundance per year was almost 50 times (mean 3392, s.d. 2528). There is much to find out about the reproductive strategies of individual species.

SINGLE HABITAT

Grassland supports a different range of fungi from woodland. Bond (1981) details the occurrences of 83 species of macrofungi on mown grassland in his garden. A distinctive assemblage of species, including the often brightly coloured waxcaps i.e. *Hygrocybe* spp., occurs on unimproved grassland, i.e. that which has not been ploughed and to which no fertilizers, other than faeces of grazing animals, has been added. There is good evidence that many species of unimproved grassland are lost on addition of fertilizers; for example, Arnolds (1989) showed that annual addition of an artificial fertilizer containing NPK and $Ca(NO_3)_2$ and also liquid manure to a study site resulted in an immediate and permanent loss of 10 species of larger fungi, whereas some other species increased in abundance. This loss of certain fungal species occurred earlier than the loss of flowering plant species. In Nordic countries these sensitive fungi have been used as indicators of the conservation value of grassland sites on the basis of two criteria, firstly the number of species of *Hygrocybe* s.l. and secondly the range of indicator species in the taxa *Hygrocybe* s.l., Clavariaceae, *Leptonia* (now part of *Entoloma*) and Geoglossaceae (Rald and Nitare respectively, both cited in Boertmann, 1995).

During and since World War 2 there has been a massive loss of unimproved grassland in Britain, especially in the south and in 1996 a UK "waxcap" survey was begun (Rotheroe *et al.*, 1996). Preliminary information from this survey indicates that Britain is relatively rich in sites of high conservation value (Holden, 2000; Rotheroe, 2001). Good sites include not only upland hay meadows and pastures but also long established mown grassland e.g. at some National Trust properties, and in graveyards (Fortey, 2000). The distinctive pink species, *Hygrocybe calyptriformis*, was placed on the provisional UK red data list of fungi (Ing, 1992) as 'vulnerable'. We now know that it is widespread, especially in northern Britain. The species is very rare in much of Europe (Henrici, 2001) and Britain is a major repository of it. It appears to fruit sporadically so that information on the times and abundance of fruiting in relation to site management will be particularly useful for conservation.

The grassland in our garden is a much more modest site, the cumulative total of six species of *Hygrocybe* s.l., including one recognized variety, placing it in the 'of local interest' category on Rald's scale. However, the laying of turf on some former borders in 1992 has enabled a comparison to be made between the fungi occurring on newer and older grassland areas. The garden was established on former arable land on heavy clay soil overlying Liassic deposits and grass seed was sown between 1955 and 1958. Until about 1970 treatments (fertiliser, weedkiller, lawnsand etc.) were applied to maintain a high standard of garden lawn. At that time all lawn treatments ceased and subsequently the grassland has been mown lightly and infrequently with a rotary mower and the mowings collected. This old grassland consists of separate north (180 m^2, including a large bush of *Juniperus communis*) and south (64 m^2) areas adjacent to the house. The borders, which were turfed in 1992, are located adjoining two sides of the north area (each 20 m^2) and as a separate east area (58 m^2). The bought-in turf was initially herb- and moss-free, suggesting that it had been treated with chemicals, including weedkiller, but after ten years under the same mowing regime it resembles the older grassland areas in consisting of a moss- and herb-rich grassland community. The pH of the surface soil is 6.4 and that of the imported turf was initially 7.2 and by now is not appreciably different from that of the older grassland. The areas have been scanned for fungal species richness during routine garden surveys throughout the year, with more frequent recording in the tenth year.

The older grassland contains a diversity of fungal species (Table 2), including in 2001 six species in *Hygrocybe* s.l. and five other indicator species. The most abundant *Hygrocybe* was *H. psittacinus*, with a maximum per recording day in 2001 of 90 (north) and 29 (south) fruit bodies. Many of the other species are characteristic of grassland,

TABLE 2

List of basidiomycete species in different ecological categories recorded in old and turfed grassland in north (N), south (S) and east (E) locations in a garden 1992-2001 (nr: location not recorded)

Category	Old grassland	Location	Turfed grassland	Location
Indicator species				
Hygrocybe s.l.				
	Dermoloma cuneifolium	N S		
	Hygrocybe chlorophana	N		
	H. conica	N S		
	H. psittacinus	N S		
	H. virgineus	N S		
	H. virgineus var. *ochraceopallida*	S		
Clavariaceae				
	Clavaria acuta	N S	*Clavaria acuta*	E
	C. incarnata	N		
	C. rosea var. *subglobispora*	N		
	Clavulinopsis fusiformis	nr		
	C. helvola	N		
	C. laeticolor	N		
	Ramariopsis kunzei	N		
Entoloma (*Leptonia*)				
	Entoloma sericellum	N S		
Other species associated with grassland				
	Arrhenia retiruge	N	*Conocybe rickeniana*	N E
	Bolbitius vitellinus	nr	*Coprinus auricomis*	E
	Calocybe carnea	N		
	Camarophyllopsis schultzeri	N		
	Clitocybe fragrans	N		
	C. rivulosa	N		
	Conocybe rickeniana	N S		
	C. tenera	S		
	C. vexans	nr		
	Coprinus friesii	S		
	C. leiocephalus	N S		
	C. plicatilis	S		
	C. rhombisporus	S		
	C. xantholepis	S		
	Crinipellis stipitarius	N		
	Entoloma sericeum	N S		
	Galerina clavata	N S		
	Marasmius graminum	N		
	Mycena aetites	N S		
	M. filopes	N S		
	M. flavoalba	N S		
	M. leptocephala	N S		
	Panaeolus foenisecii	S		
	P. olivaceus	S		
	Rickenella fibula	S		
	R. setipes	S		
	Vascellum pratense	N S		
Species with other associations				
	Hebeloma crustuliniforme	N	*Armillaria mellea*	E
	Tubaria confragosa	N	*Coprinus atramentarius*	E
	T. conspersa	N	*C. comatus*	E
	T. furfuracea	N	*Hebeloma crustuliniforme*	N
			Telamonia sp.	N

TABLE 3
Numbers of species in different categories (see text) occurring on old and turfed grassland in successive years

Years	Old grassland			Turfed grassland		
	All	Indicator	*Hygrocybe*	All	Indicator	*Hygrocybe*
1992	11	6	4	0	0	0
1993	6	4	1	1	0	0
1994	10	2	2	0	0	0
1995	5	3	2	1	0	0
1996	4	1	1	1	0	0
1997	18	8	4	2	0	0
1998	14	8	3	2	0	0
1999	13	6	3	2	0	0
2000	10	5	2	2	0	0
2001	28	11	6	6	1	0

occurring on humose soil, grass and other herbaceous debris, amongst bryophytes or on dung fragments (Arnolds, 1989). A few are associated with trees, either mycorrhizal or growing on woody debris (Table 2). On the older grassland there is little if any evidence of progressive change in the occurrence of indicator species over the ten years. On the other hand, the turfed areas have been virtual mycological deserts for ten years (Table 3). All of the earlier-occurring species on these areas are not true grassland species. *Coprinus comatus* is characteristic of disturbed ground and *C. atramentarius* grows from buried wood. *Hebeloma crustuliniforme* is a mycorrhizal species, which has fruited since 1997 as an expanding 'tethered' ring (Gregory, 1982) in association with the outer margin of the root system of a tree of *Tilia cordata* which was planted near the edge of the grassland in the late 1980s. Of the species first recorded in the tenth year, *Telamonia* is also mycorrhizal and *Armillaria mellea* was growing in the roots of a tree stump, whereas *Conocybe rickeniana* and *Clavaria acuta* are grassland species and also occur on the older grassland. *C. acuta* is a member of the Clavariaceae, one of the groups indicating unimproved grassland. So far it has only been found on the east turfed section, which is not in physical contact with any other grassland.

There are serious design deficiencies if this is regarded as an experiment since the plot sizes and positions are not consistent between the two treatments. However, the species differences between the older grassland and the turf, both that adjoining the north grassland and the separated east patch, are very large and consistent over years. These observations indicate the long time span taken for grass turf to acquire a diverse fungus community. The fruiting of mycorrhizal and wood decomposing species suggests that the turf is not toxic to fungi and focuses attention on the nature and availability in this community of minerals and substrates for these sensitive fungi.

Management policy is a major challenge for those responsible for wildlife reserves. For woodland, Kirby (1998) advocates monitoring the results of procedures such as coppicing in order to improve our understanding and decision making. Since many fungi grow on plant and other debris, there is a need for recording the effects of management procedures on the fungal component of different communities.

Single Species

Studies of the occurrence of fruit bodies of an individual species are useful both for understanding their mode of life and as a prelude to mapping their distribution. There is much variation between species, from the perennially-growing brackets of e.g. *Ganoderma* *adspersum* to the very short-lived toadstools of *Coprinus friesii*, which expand overnight from the button stage, shed their spores and are beginning to collapse by the following morning. These features are not always obvious to casual observation. The apparently fragile fruit bodies of *Sarcoscypha austriaca* have been observed to grow from the same fallen 40 mm diameter branch of *Populus* every year for, so far, seven years. Each year the same individual fruit bodies persist for three months (late December to March).

The species selected for special consideration here is a rust fungus, a member of the Urediniomycetes. The rust fungi are parasitic on living tissue of green plants and are unusual amongst fungi in that individuals, i.e. individual infections, can often be seen and counted, which is useful for analysis. The YNU has a long tradition of vice county field meetings bringing together people interested in all types of living organisms. In Warwickshire, 'Rings', a network for all naturalists, was set up only recently. It was at the very first joint field meeting of 'Rings' on 5 July 1997 that a fungus growing on living leaves and fruits of *Crataegus* was drawn to our attention by John Robbins, a plant gall expert. This fungus was new to us.

The infections could be seen on the upper sides of leaves as red spots up to 5 mm across each with a yellow margin and gradually blackening from the centre, where tiny dark swellings could be seen with a hand lens. From the underside of leaf infections and on developing fruits there were finger-like projections more than 1 mm long. The first problem with a strange fungus is identification. The size and wall ornamentation of the spores in the projections showed that it was a rust fungus. In Britain this group of fungi is well documented (Henderson, 2000). They often have complex life cycles forming up to five successive spore types which in many species alternate between two different types of host plant. The finger-like projections on the Warwickshire find are characteristic of the aecia of the genus *Gymnosporangium* (Table 4). According to Wilson and Henderson (1966) two species of this genus occur on *Crataegus* in the Britain. *G. clavariiforme* is

TABLE 4
Host ranges of *Gymnosporangium* species (Henderson, 2001)

Species	Aecial host	Telial host
G. clavariiforme	*Crataegus* spp.	*Juniperus communis*
G. confusum	*Crataegus* spp. *Cydonia oblonga* *Mespilus germanicus*	*J. sabina* cult.
G. cornutum	*Sorbus aucuparia* *S. sargentiana* *S.* x *thuringiaca*	*J. communis*
G. sabinae	*Pyrus communis*	*J. sabina* cult.

frequent and completes its life cycle by forming telia on *Juniperus communis*, whereas the alternate host of the rare *G. confusum* is the garden plant *Juniperus sabina*. Our specimen had diagonal ridges of wall ornamentation on the peridial cells enclosing the aecia, a diagnostic feature for *G. confusum.*

Plowright described *G. confusum* in 1889 after carrying out infection experiments in which inoculations with germinating teliospores from *J. sabina* resulted in aecial infections on *Crataegus monogyna*, *C. laevigata*, *Cydonia oblonga* and *Mespilus germanica*. He did not report finding the aecial stage in nature. There are a very few authenticated records from Britain, mainly from the south of England, and the most recent previous record was in 1944. Moore (1945) described the aecia of *G. confusum* on *Mespilus* and telial infections on *J. sabina* in 1943 and 1944 at a location in East Malling Research Station from which

Wormald had observed the fungus on *Mespilus* in 1928. In Yorkshire there are recent records of *G. clavariiforme* and *G. cornutum* on both their aecial and telial hosts (Yeates and Legg, personal communications). However, the only records of *G. confusum* and *G. sabinae* (= *G. fuscum*) date back to Massee at the beginning of the 20th century. Massee recorded the aecial stage of *G. confusum* on *Crataegus* in Sedbergh cemetery in 1912 (Yeates, *pers. comm.*), having previously recorded the other species, *G. clavariiforme*, on *Crataegus* before 1905 in the Scarborough area (Massee & Crosland, 1905).

After the initial discovery in Warwickshire, *G. confusum* was found in the same year on *Crataegus* in our garden hedge in Stratford-upon-Avon and also near Rugby, where it had been photographed in 1994 by Peter Cook. Infections on *Crataegus* have been found during early summer in every subsequent year and were abundant in the year 2000, when a distribution survey was carried out. In Warwickshire *Crataegus* is widespread in older mixed hedgerows as well as in recently planted quickthorn hedges and fragments of older hedges persist around the town of Stratford-upon-Avon. The infections were best seen on long unclipped flowering shoots at the time when the fruits were swelling and such shoots were the basis of the sampling procedure. The survey aimed to cover all km squares containing flowering *Crataegus* in the urban area of Stratford-upon-Avon and more distant sites in different compass directions from the town. The individual infections are conspicuous, visible at a distance of 0.5 m, and at each sample site, usually a hedge, the plants were inspected from a maximum of ten positions beside the bushes. Failure to see any infections in that sample would have given a negative score. In fact there were no

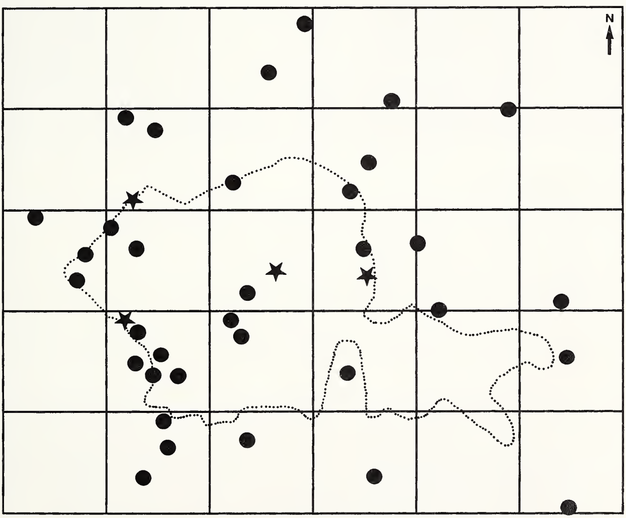

FIGURE 4

Distribution of the aecial stage of *Gymnosporangium confusum* on *Crataegus* in and around the urban area of Stratford-upon-Avon in 2000. The urban area is enclosed by a dotted line and star symbols mark ‘hot spots’. Scale: 1 square = 1 km x 1 km.

negative scores and the fungus was found at every one of 32 sites situated in the 16 one km squares encompassing the urban area of Stratford-upon-Avon (Figure 4) as well as at 48 more distant sites in Warwickshire and in the borders of neighbouring counties (Oxfordshire, Staffordshire and Worcestershire). Infections were found on ornamental garden *Crataegus* and also on medlar (*Mespilus germanica*), which conveniently grows in a public place in Stratford-upon-Avon, the Shakespeare tree garden.

This widespread distribution emphasised the need to find the source of the infections on *Crataegus*. The aeciospores cannot re-infect *Crataegus* and instead infect the alternate host, *Juniperus sabina*. The telia are said to be formed in the spring but searches on accessible *J. sabina* in our own garden and elsewhere had failed to find them. Mapping the density of infections, which is a reflection of the density of spores deposited on host plants, can be used to indicate the likely locations of the spore source on the alternate host. The pattern of dispersal and deposition of airborne spores, including those of rust fungi, has been much studied and in a more or less uniform topography characteristically takes the form of a hollow curve, with the majority of spores being deposited close to the source (Ingold, 1971). If the source is distant there will be very little difference in infection frequency between nearby sites, although the density of infections could be very high if the distant source is massive. However if the major source is local there will be a steep gradient in infection frequency between nearby susceptible hosts.

During the Warwickshire survey it was observed that individual infections seemed to be much more abundant at six locations (described as 'hot spots') than elsewhere. At one of these, Bishopton Lane, infrequently clipped remnants of the old field hedge containing hawthorn still exist whilst 33 prostrate conifer bushes, possibly *J. sabina*, were discernible through the hedge in adjacent gardens and amenity plantings. The number of infections per 300 mm length of overwintered hawthorn shoot, including all leaves and fruits growing from this length and its new shoots was counted in June. There were sometimes significant differences in the abundance of infections on adjacent bushes, but these were small in comparison with the differences between more distant bushes (Figure 5). The gradient of change in infection frequency was steep near the position of maximum score (the 'hot spot') and fell to scarcely discernible at greater distances. Such analysis enabled likely

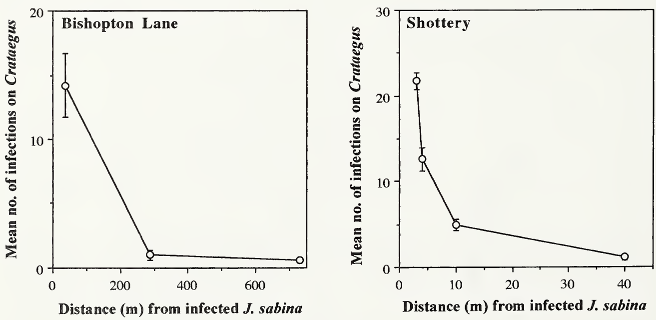

FIGURE. 5
Mean number of infections of *Gymnosporangium confusum* on shoots of *Crataegus* at different positions near 'hot spots' at Bishopton Lane and Shottery. The vertical bar shows the s.e.m. of the mean for five bushes in the hedge (with five shoot lengths per bush), except at the two positions of high density at Shottery, each of which was a single large bush.

positions of source *J. sabina* to be pinpointed. Permission to search was obtained for four out of the 6 'hot spots' and in every case telia were found in April 2001. After rain the telia appeared as triangular gelatinous masses up to 1cm long protruding from spindle-shaped swellings on the twigs. These telia readily dropped off, or in dry conditions dried to tiny horny black masses. One hot spot was initially puzzling, in a garden-free industrial estate in the centre of Stratford-upon-Avon, until it was realized that a large container planting consisted of *J. sabina*, which was infected.

It thus seems that the fungus is completing its life cycle locally and that the local climate has been suitable for its persistence for at least four and probably seven or more years. Last spring we appealed in the journal *Field Mycology* (Brand & Brand, 2001) for people to look out for it elsewhere, but we have not heard of any other finds.

The species is said to be introduced in Britain (Henderson, 2000) and the origin of its current occurrence in Warwickshire is puzzling. It occurs widely in Europe, extending as far south as north Africa and eastwards into Asia (from Iran to India) and has become established in California (Laundon, 1977). This suggests that England is at the northern limit of its range. There is no obvious connection between the current occurrence in Warwickshire and the last recorded finding in the south of England more than 50 years ago. The prostrate forms of *J. sabina* have been popular garden plants since World War 2, being advertized as slow-growing ground cover plants. With diminishing garden sizes and changing fashions this rather aggressively spreading conifer is seen less in gardens but continues to be used in amenity plantings. There has also been widespread destruction of old hedgerows. The suburban parts of Stratford-upon-Avon may be unusual in the close proximity between remnants of infrequently clipped hawthorn and *J. sabina*, which permits successful completion of the life cycle of the fungus. The size of some of the spindle-shaped swellings on the stems of *J. sabina* suggests that they have persisted for at least several years. Henderson and Bennell (1979) report that *Gymnosporangium sabinae*, another uncommon introduced species, was found in an Edinburgh garden in 1974 on a plant of *J. sabina* which had been acquired from a nursery in the south of England. It is tempting to speculate that the Warwickshire population of *G. confusum* similarly had its origin in infected nursery stock of *J. sabina*.

Conclusion

These examples show that there is so much to find out about the natural history of fungi, both about the diversity of fungi in regions or sites and about the activities of individual species. Interesting fungi can be found in urban as well as rural areas (Legg, 1995; Yeates, 1999). Your past President and professional mycologist, Professor Roy Watling, has written recently about the role of amateurs (Watling, 1998). This has always been important. However, today, with the progressively diminishing number of professionals, the activity of amateurs is becoming crucial. A theme throughout this address has been the value of continuing studies over years. Most professional contracts are for a maximum of three years so that the ability of amateurs to continue observations over longer periods is important. Long may the YNU maintain the continuity of mycological studies in Yorkshire.

Acknowledgments

I am indebted to all past and present members of the Warwickshire Fungus Survey team, and especially the late Malcolm Clark, for their records. I am grateful to staff at the Royal Botanic Gardens at Edinburgh and Kew and to officials and members of the British Mycological Society, the Yorkshire Naturalists' Union and local fungus recording groups for much helpful information. I thank my husband Bert Brand for his unfailing encouragement, and all the many people who have shared with us their interest in fungi.

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BOOK REVIEWS

Dictionary of the Fungi edited by **P. M. Kirk, P. F. Cannon, J. C. David and J. A. Stalpere.** Pp. xii + 655, incl. 40 figures (line drawings). CAB International, Wallingford. 9th edition. 2001. £49.95 hardback.

Although this latest edition has only 39 more pages more than the 8th edition published in 1995, it contains about 500 new entries and many revisions to keep pace with the rapidly expanding knowledge of these organisms; these include a refined classification of fungal phyla based on the latest molecular evidence, including a major revision of the Ascomycota, complete integration of anamorphic genera in the classification, and a revised synopsis of the proposed classification. Entries provide the most complete listing available of generic names of and terms used to describe fungi. Extended entries (occasionally supported by line drawings) are provided for a wide range of topics, such as conservation, lichens, literature, media, molecular biology, mycorrhizae, numbers of fungi (currently given as 80060 spp.), phylogeny, soil fungi and spore discharge. Most entries cite bibliographical sources for further information. An essential handbook for all those who work on fungi, lichens and slime moulds.

MRDS

Fungal Conservation. Issues and Solutions edited by **D. Moore, M. M. Nauta, S. E. Evans** and **M. Rotheroe.** Pp. x + 262. Cambridge University Press. 2001. £65.00 hardback.

This is an interesting collection of papers on a group of organisms, excluding lichens (which are not covered in this book), which have hitherto received little attention in terms of their conservation. The book has a breadth of coverage, but, as with most multi-author works, the overall structure and direction are not clear; furthermore, although it purports to provide 'constructive guidance for the management of nature in ways beneficial to fungi', recommendations for such are hard to find, and even practical conservation doesn't figure highly in most contributions – so all-in-all, the content does not reflect the title. The work is supported by a rather weak index. However, there is a much to be gained from this work, and although much is based on European experiences, contributions on Cuba, Kenya, Ukraine and China provide a global context, in some cases highlighting the decline in wild fungal populations due to the increase in commercial harvesting. Those employed in conservation will require something more practical for guidance, and those interested in conservation, who should be encouraged to read this book, will be appalled at the price.

MRDS

The Lichen Flora of Devon by **B. Benfield.** Pp. 102, incl. numerous maps & 1 p. colour plates. Privately published. 2001. £10.00 paperback (A4 format), plus £1.00 postage, available from Glyn Benfield, Plymtree, Cullompton, Devon XE15 2JY.

This is a welcome contribution to our knowledge of the lichen flora of Devon, especially since the last comprehensive list for this large and lichenologically rich county appeared as long ago as 1883. The present flora covers more than 900 species, those with interesting distributions complemented by computer generated maps; notes on changes in occurrence are also provided for some species. Introductory matter includes sections on the history of lichenology in Devon, its climate, geology and topography, as well information on major habitats, the dyeing industry, and lists of red data and ecological continuity lichens. Maps (including 8 national distributional ones of rare species), a page of colour plates and a gazetteer add to the usefulness of the volume. The work concludes with a list of references, but the citations are incomplete.

MRDS

Protocols in Lichenology edited by **I. Kranner, R. F. Beckett** and **A. K. Varma.** Pp. xvi + 580, incl. numerous figures. Springer-Verlag, Berlin. 2002. £74.00 softcover.

This practical guide pulls together a corpus of useful methological material from a wide variety of sources. Thirty-two chapters, contributed by specialists in their fields, provide detailed descriptions of one or more protocols necessary for the experimental lichenologist. The contributions are of variable quality and mainly for laboratory-based work. The sub-title to this work, "culturing. biochemistry, ecophysiology and use of biomonitoring", is patchily addressed: the first two subject areas are very well covered, and the third reasonably well (although only one chapter is devoted to on-site measurements, and the pioneering work of Otto Lange is given scant attention), but the fourth is poorly covered. Two of the three chapters on biomonitoring are related to radionuclide and heavy metal pollution, while the third, on sulphur dioxide pollution, is rather out-dated (*vide* the references provided) and misses recent developments, more particularly in respect of decreasing levels of this pollutant. One or more chapters on monitoring other pollutants which for some countries are more influential than sulphur dioxide would have been a valuable addition. (To redress this, the recent *Monitoring with Lichens – Monitoring Lichens* edited by P. L. Nimis *et al.* published in the NATO Science Series by Kluwer should be consulted.) On the other hand, there are some very useful chapters, not implicit in the sub-title, on macrophotography, herbarium management, computer-aided identification systems and on-line documentation of lichen biodiversity.

An unfortunately large number of typographical errors, particularly in bibliographical citations, have been noted, and the short index does not do justice to the contents.

Despite these misgivings, the volume under review contains a wealth of practical advice (in terms of materials, procedures and trouble-shooting, often supported by extensive lists of references), some of which will have wider relevance beyond the lichenologist's requirements. Although only in paperback, the flexi-covers are reasonably robust and the book conveniently opens flat for laboratory use. Unfortunately, at this price, there will be few copies dedicated to this use and using copies from libraries (which are strongly recommended to purchase this work) will be inconvenient.

MRDS

RED IN TOOTH AND CLAW: 2. STUDIES ON THE NATURAL HISTORY OF THE DOMESTIC CAT *FELIS CATUS* LIN. IN YORKSHIRE

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Part 2 of the Presidential Address to the Yorkshire Naturalists' Union at Doncaster, 3rd December, 2000

PREFACE

The massed ranks of our household pets have become a hugely significant though as yet little studied ecological influence in our man-made environment. Pet bedding and regular sleeping places can harbour a range of ectoparasites, the ubiquitous cat flea (*Ctenocephalides felis*) perhaps being the most obtrusive. Dried pet foods in pellet or biscuit form can attract a menagerie of invertebrate 'pests' of stored foods (Munro 1960). Exotic seeds imported for the pet and wild bird food market have given rise to a fascinating flora of aliens and adventives (Wilmore 2000). The daily product of tonnes of surface deposited dog or shallowly buried cat faeces is the focus of coprophagous beetle and fly faunas and attracts an interesting fungal mycota. Endoparasites such as the tape worms (cestodes) *Taenia taeniaeformis* and *Dipylidium canium* occur in 3% and 2% of cats respectively, the former introduced via a rodent element in the diet (Lewis 1987) and the latter via its intermediate host the cat flea. Roundworms (nematodes) *Toxocara cati* and *Toxiascaris leonina* occur in the intestines of 20% and 1% of cats respectively (Tabor 1983). Eggs picked up and ingested from handled faeces develop into larval stages which can migrate to organs such as the eyes or brain of a human host. The protozoan *Toxoplasma gondii* which in Britain occurs in common rat (*Rattus norvegicus*), wood mouse (*Apodemus sylvaticus*) and bank vole (*Clethrionomys glareolus*) and whose final host is the domestic cat (Cox 1987) is the causal agent of the condition in humans known as Toxoplasmosis. Oocysts excreted in cat faeces can be transmitted to those of us who potter in gardens where cats defecate; the Communicable Diseases Surveillance Centre monitored some 621 cases in 1978 (Southam 1981). There is also the matter of 'what the cat brought in', the succession of small mammals, song birds and other vertebrates harvested from local habitats when the domestic cat's latent behavioural drive to hunt is aroused. Under these circumstances, even the neighbour's goldfish and the family hamster can fall as prey.

Cats in domesticated form (*Felis catus* Lin.) are with us in very substantial numbers (see Table 3) as household pets or companion animals, as semi-domestic 'working' cats in farms, factories etc., and as free-living feral cats, famously around dockyards (Dards 1981), hospitals and other public institutions (Rees 1981, Howes 1985). Curious to know something of the natural history, population structure and predator-prey relationships of free-range cats in Yorkshire, a series of questionnaire surveys were designed to investigate domestic cats on farms and in town centre, suburban and rural situations. The first to be presented here concerns an investigation into Yorkshire's farm cats.

A SURVEY OF FARM CATS IN YORKSHIRE

"We rat catchers might raise our fees,
Sole guardians of a nation's cheese!"
The Rat-catcher and Cats John Gray (1733)

METHODS

With the enthusiastic assistance of members of the Yorkshire and Humberside Federations of Young Farmers' Clubs, a survey of farm cat populations throughout the Yorkshire regions was conducted from September to December 1979. Using a standard questionnaire sheet, volunteers recorded the type and size of the farm, the number of cats kept there and, where known, their age, sex and whether they had been neutered. Methods of rodent control and reasons for keeping cats on farms were also recorded. Most of the farms surveyed were the homes of the volunteer surveyors or the homes of their friends or neighbours.

In order to detect local variations in the size and structure of cat populations in such a large and geographically varied region as Yorkshire, the resultant data were divided for separate analysis into the following areas according to topographical and agricultural characteristics: Pennines, Vale of Mowbray, Southern Vale of York, Humberhead Levels, and the North York Moors, Vale of Pickering, Wolds and Holderness.

Results

Appendix 2 shows the numbers of farms surveyed, frequencies of various farming practices, farm acreages, number of cats, reasons for their presence, methods of rodent control and perceptions as to the effectiveness of cats for this. Appendix 1 provides statistics on gender and rates of neutering, and for those cats for which age data was provided, Appendix 3a classifies intact and neutered males and females into age classes.

Frequency, size and density of farm cat populations

Of the 239 farms surveyed, 226 (95%) had one or more cats. The numbers of cats per farm is shown in Figure 1 and varies from one to an alleged thirty. The most frequent colony sizes were from two to five cats (on 58% of farms), the county mean being 4.8.

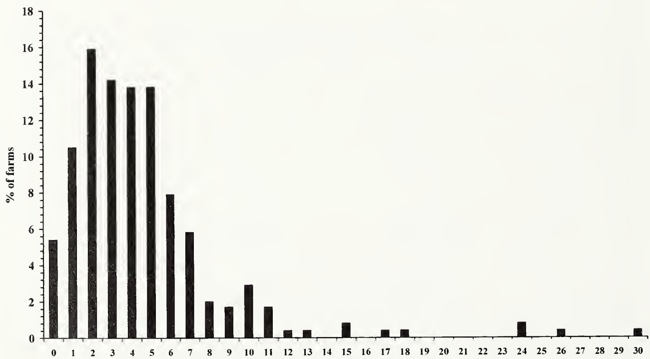

FIGURE 1
Cat colony sizes on 239 Yorkshire farms.

Figure 2, which compares the mean colony sizes across Yorkshire farming regions, shows marked variations and indicates an intriguing progressive increment of colony size from south and west (3 on Pennine farms) to north and east (7 on the farms of the North York Moors). By comparing the numbers of cats with the declared farm acreages, a mean farm cat population density was shown to be one cat per 52.7 acres (21.3 ha). Again, Figure 2 shows marked variations, the smaller mixed or stock rearing farms of the North York Moors and the Pennines recording one cat to 21.3 acres (8.6 ha) and 40.5 acres (16.4 ha) respectively, compared with the situation on the huge arable farms of the Humberhead Levels and the Wolds recording one cat per 76.2 acres (30.8 ha) and 78 acres (31.6 ha) respectively.

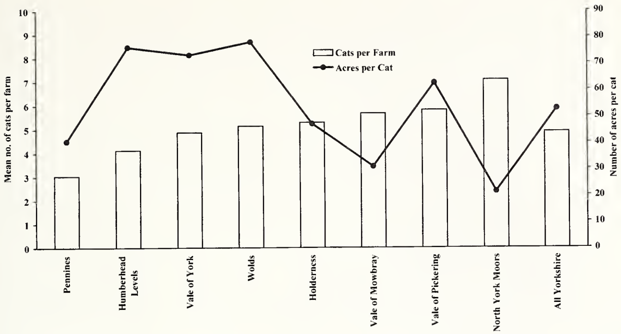

FIGURE 2
Mean population sizes and population densities of cats on Yorkshire farms.

AGE RANGES

The ages of 558 cats (48% of the total sample) for which gender and neutering information was available are shown in Appendix 3a and form the basis of Figure 3a. The oldest individuals were two neutered females, both reportedly fifteen years old, though the most elderly farm cat in the survey, claimed to be aged seventeen years old, was omitted from this sample owing to lack of information on either gender or neutering status.

Since these are essentially not pet cats in the sense of most domestic house cats, a detailed knowledge of cat age may be imprecise, particularly in the larger colonies and for the older cats. The accuracy of declared cat ages can only be regarded as approximate and the resultant mean and survivorship calculations should be regarded with caution. The most frequent claimed age was two years, making up 21% of the sample. Assuming cats of less than one year to be 6 months old, the mean age for the entire sample was 3.3 years. The numbers of intact and neutered males and females are given separately for each year age category in Appendix 3a and provide the basis of mean age calculations showing that for intact females this was 3.3 years, compared with 3.0 for intact males. For neutered cats, mean ages were substantially greater, with 5.0 years for females and 4.7 for males. The under-representation of cats under one year old is no doubt due to the absence from the survey of dependent unweaned kittens, though other anomalous depressions in the survivorship curve (Figure 3a) (at years one, seven and eleven) could be due to intermittently low recruitment into the population during epizootics of cat flu or feline enteritis (John Jack *pers. comm.*).

GENDER AND NEUTERING RATES

> *"Continual wars and wives are what*
> *Have tattered his ears and battered his head."*
> *Esther's Tomcat* Ted Hughes (1960)

Statistics on the 971 cats for which gender and neutering data were available have been assembled into Appendix 2 from which % frequencies have been calculated for the regional sub-sets and for the county sample as a whole. Males made up 36.6% of this sample, a lower rate than for pet cats in rural, suburban and urban areas (see Figure 7) fitting in with the popular concept of intact adult 'tom' cats having 'harems' of females.

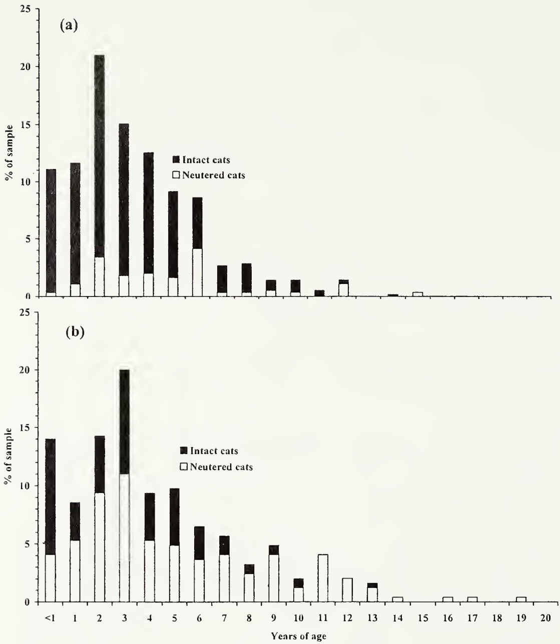

FIGURE 3a & 3b
Survivorship pattern of (a) 588 cats on Yorkshire farms (b) 245 domestic house cats.

105 animals (10.8%) had been neutered, again a markedly lower rate than for pet cats, even those in rural areas (see Figure 6). Neutering rates differed between the sexes, accounting for 15.2% of males and only 8.3% of females.

Although undertaken partly as a means of controlling colony size, the necessary veterinary expenses incurred, particularly in neutering female cats, may be regarded as unjustifiable in the context of the overall farm budget. The wide regional variations in neutering rates possibly provides evidence for this interpretation, with the small mixed farms of North York Moors recording a neutering rate of 3.8% whereas the huge farms from the arable (probably wealthier) regions recording 13% (Humberhead Levels), 14.8% (Holderness) and 18.7% (Wolds).

THE ROLE OF THE FARM CAT

In an attempt to evaluate the practical role of cats on farms, enquiries were made as to whether cats were kept for rodent control, as pets or for any other reasons (see Appendix 2). Cats were partially regarded as pets on 39% of farms but were kept for rodent control on 86% of them. This compared favourably with other methods of control such as poisons 65%, traps 17%, firearms 6%, dogs 5% and ferrets 0.5%. Of the perceived effectiveness of cats in farm rodent control, they were regarded as playing an effective anti-rodent role on 90% of farms: indeed, on 21% of these, farm cats were claimed to be the only form of rodent control necessary. Attitudes and experience varied somewhat, with 10% of farmers regarding cats as of little or no use in rodent control and, according to annotations on returned forms, on 7.6% of farms they were positively not welcome, farmers claiming that their presence was due to an inability to get rid of them.

Interestingly, footnotes on several returned forms maintained that the presence of cats on farms generally suppressed the build-up of rodent pests or kept populations below levels where it became necessary to employ commercial rodent control contractors. It was also felt that they prevented or delayed re-colonisation after major infestations had been dealt with. These impressions were borne out by experiments monitored by Elton (1953).

Discussion and general observations

Farm cat populations were found to be largely self-perpetuating, although colonies eradicated by cat flu (one colony of ten cats died out during the course of the survey) and in one case by road casualties, were re-established by introductions of young cats from neighbouring farms. 7.6% of farms harboured colonies which were claimed to be unwanted and untended. The tenacity of the colonies was evidenced by some farmers not sympathetically disposed towards cats, claiming that populations had become established through strays taking up residence (5% of colonies were of purely feral origin), or that colonies had persisted despite attempts to discourage them. Colony size was claimed to be partially under the control of the farmer in that unwanted kittens, if located early enough, were frequently destroyed or given away to either neighbouring farms or as domestic pets. Although neutering was employed as a means of population management, this practice was relatively marginal, affecting only 10.8% of the sample.

At mean population densities such as one cat per 78 acres (31.6 ha) on the Wolds or even one cat per 21 acres (8.5 ha) in North-east Yorkshire, it may seem unlikely that farm cats would have any significant effect on small vertebrate populations in the wider countryside: indeed, Elton (1953) showed that cats had little effect on field rat populations. However, these densities seem high compared with some wild predators, Harris *et al.* (1995) estimating a post breeding density for stoats (*Mustela erminea*) in unimproved grassland and arable land as being 2 per 1 km^2 or a maximum of 1 fox (*Vulpes vulpes*) social group (1 adult male and a breeding female) per 1 km^2. As cats, particularly females and immature males, generally remain in the vicinity of the farm buildings (Macdonald 1981), it is highly likely that here they could exercise a more focused and effective control over synanthropic species such as house mouse (*Mus musculus*) and common rat (*Ratus norvegicus*). However, Elton (1953) demonstrated that even here they had little effect on well established rat infestations, though they were found to be very efficient at preventing rats (perhaps unfamiliar with the terrain) from re-colonising after premises had been cleared of rodents.

Field observations on arable (root crop) farmland on the Hatfield Levels in the southern Vale of York showed that cats seasonally congregate for hunting around field-side root crop stores (clamps) established hundreds of metres from the nearest buildings. Foxes are also attracted to these field-side stores, their diets, studied from scat analysis (Howes in prep.) consisting largely of young common rats. It is reasonable to assume that the same quarry also attracts the cats. Cats are also known to move to newly mown hay meadows and fence lines overlooking recently dredged ditch networks, to prey on rodents made vulnerable by disturbance and removal of cover. Under such circumstances farm cats in the USA have been shown to compete successfully for prey against wild predators, Pearson (1964) showed that cats alone had reduced a rodent population by 88% and George (1974) gives an example of cats competing effectively for small mammals against birds of prey.

Clearly, farm cats only represent one component of the total rural cat population, others being feral animals not part of the farm-orientated populations and pet cats kept on adjacent domestic premises. Since the days of Elton's (1953) studies, urban development in rural communities has proceeded apace and the effect of cat predation on small mammals and competition with other mammalian predators must be considerably greater than in the 1950s.

Two characteristics of domestic (pet) house cat populations are that males (for whatever reason) tend to outnumber females (see Figure 7) and that the population is subject to a relatively higher rate of neutering (see Figures 6 and 8). Using data from Appendix 2 as an index of 'petness', Wolds farm cats exhibit the highest level of 'petness' in the Yorkshire region. Here, males, which make up 47.6% of the population (mean Yorks. = 36.6%) are more frequent than in any other farming region, also with 25.3% of the Wolds farm cat population being neutered (mean Yorks. = 10.8%), this is also the highest level in the region. The role of cats on Wold farms may be providing pointers towards changes in the status of farm cats generally. Perhaps the poetic idea of farm cats being purely *guardians of a nation's cheese* could be changing, cats adding the therapeutic role of 'companion animal' to their repertoire of benefits.

A Survey of ownership levels and the population structure of Domestic House Cats in Yorkshire

"*For every house is incomplete without him . . .*"
For I will consider my cat Jeoffry Christopher Smart (1760s)

Questionnaire surveys undertaken by the YNU and Doncaster Museum were used to gather information on the population densities, sex ratios, neutering rates and age structure of pet cat populations in urban, suburban and rural areas of Yorkshire. Although preliminary data were used extensively and humorously in Roger Tabor's excellent book *The Wildlife of the Domestic Cat* (Tabor 1983) and referred to in *Ecology of Urban Habitats* (Gilbert 1989), this occasion provides an opportunity to present the final results of these unpublished surveys.

Methods

With the indefatigable assistance of members of the YNU affiliated societies throughout Yorkshire and groups of school children, particularly in the Doncaster region, a questionnaire survey was conducted from September to December 1980. Surveyors recorded the numbers and, where known, the ages, sexes and neutering status of cats from ten domestic properties adjacent to (but not including) their own home. In addition, housing types were recorded, as were a range of habitat types and land-uses. The general nature of the sampling area was allocated to categories described as urban/town centre, suburban and rural.

Results

Three hundred and seventy-one survey sheets were completed, the resultant data on housing types, adjacent habitats and land-uses and cat ownership levels being summarised in Appendix 4. Statistics on gender and rates of neutering are summarised in Appendix 5 and for those cats for which age data was provided, Appendix 3b categorises intact and neutered males and females into age classes.

Housing types and habitat availability

How the housing types and the habitat and land-use availability varied across the three district categories is illustrated in Figures 4a-c and Figures 5a-c respectively. Of the housing type analysis (monitoring the relative frequencies of flats, terraces, semi-detached and detached properties) the most significant feature, which increased along with cat population density, was the detached properties with a surrounding garden 'territory',

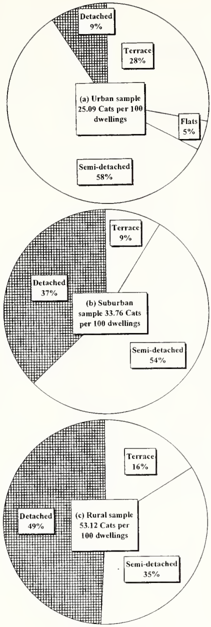

FIGURE 4a-c
Housing types in (a) Urban (b) Suburban and (c) Rural areas.

which increased from 9% of properties in town centre and urban areas to 37% in suburban districts to 49% in rural areas.

Of the habitat and land-use availability analysis, the relative frequencies of larger gardens of above 150 yd^2 and access to adjacent arable and pasture land seemed to be most significant, large gardens being represented in 5%, 16% and 19% of urban, sub-urban and rural districts respectively and agricultural land being represented in 0%, 17% and 47% of urban, sub-urban and rural districts respectively. Curiously, the availability of parks, sports fields and allotments seemed to be negatively related to the presence of cats; thus it could be said that from a cat's point of view, these municipal provisions are no compensation for the absence of rural open space and protected large gardens.

Population densities of domestic cat populations

"Not long ago this phenomenal Cat
Produced seven kittens right out of a hat!"

Mr Mistoffelees T. S. Eliot (1939)

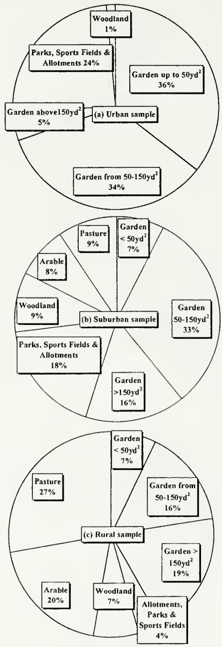

FIGURE 5a-c
Adjacent Habitat/Land-use types in (a) Urban (b) Suburban and (c) Rural.

From the 3,710 properties surveyed some 1,401 cats were recorded, giving a mean population level of 37.76 cats per 100 households. The levels of ownership varied substantially according to housing region, the fewest, at 25.09 cats per hundred properties, being recorded in town centre and urban areas, rising to 33.76 in suburban districts, with the highest ownership level of 53.12 in rural areas. These statistics are of considerable significance when considering aspects of predatory pressure and may in some cases have a bearing on the sustainability of populations of certain prey species and of other native wild predators (see Table 4).

Neutering rates and gender ratios

Figure 7, based on the amalgamation of data from the farm cat study with that from the domestic cat gender and neutering survey (see Appendix 1 and 5), shows that sex ratios vary substantially according to rurality and housing regions. Male cats on farms and in rural properties represent 36% and 44% of their respective populations, whereas males in suburban and urban/town centre regions represent more than half their populations, making up 54% and 51% respectively.

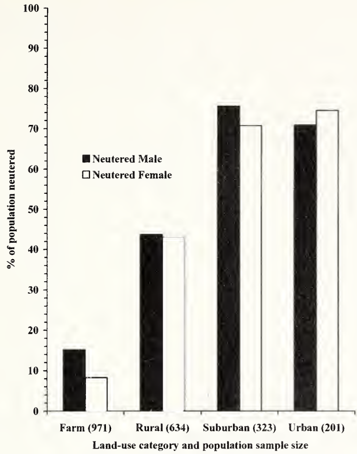

FIGURE 6
Neutering rates of cat populations on farms and in rural, suburban and urban regions in Yorkshire.

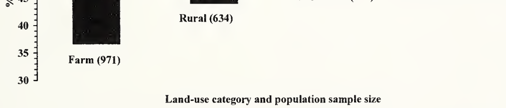

FIGURE 7
Males as % of populations on farms and in rural, suburban and urban regions in Yorkshire.

Two factors which may be at work here are (a) disproportionate mortality rates for males and (b) gender preference in domestic cat ownership. Taking mortality first, causes of mortality which may affect males to the extent that sex ratios are tipped in favour of females could be (a) intact males wandering in search of mates and therefore being subject to mortality through road traffic accidents or being killed or injured by dogs or in 'vermin' traps and (b) injury through fights with other intact males for access to mateable females.

If wandering and fighting are characteristic behaviours of intact males and if these

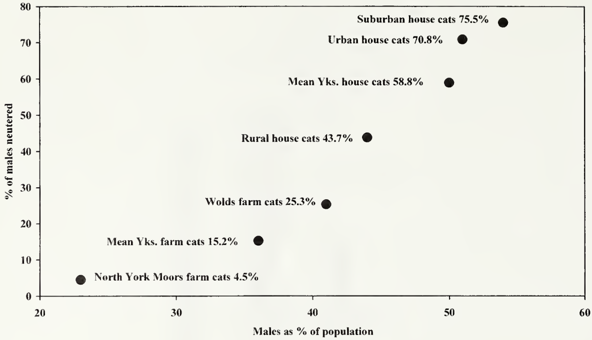

FIGURE 8
Relationship between male neutering and males as % of population.

behaviours are suppressed or absent in males which are neutered (pre-maturity), then the proportion of males in a population could be a function of the rate of male neutering within that population. Interestingly, Figure 8 shows that the % frequency of males in a population does indeed rise as male neutering rates increase.

According to anecdotal input to this study, evidence for gender preference being a major influence in domestic cat population composition seems to be contradictory. On one hand there are owners who claim to prefer male cats on the basis that a males will not themselves become pregnant and are cheaper to have neutered; on the other hand there are those who, despite the higher cost of neutering, prefer females on the basis that they don't 'spray' or 'caterwaul' and are less likely to wander and be killed. If cost of neutering was a significant factor affecting choice, then one would expect the less affluent urban and town centre areas to have a higher incidence of males and for the more affluent suburban sample to have a higher incidence of females. Figure 6 shows this is not the case.

Statistics on gender ratios and neutering rates are available from some cat ecology and behavioural studies (Dards 1981, Macdonald 1981, Rees 1981, Tabor 1983, Churcher & Lawton 1987, Soulsby & Serpell 1988). However, since neutering levels are regarded as being central to the management of a range of cat-related animal welfare and public health issues (Hammond 1981, Jackson, 1981, Remfrey 1981) it is surprising how few surveys have been undertaken. The Yorkshire study appears to be unique in revealing patterns of variation across different land-use and housing type categories.

Figure 6 shows that major differences occur in cat neutering levels according to land-use and housing areas, with below 15% on farms, below 45% in rural areas but over 70% in both suburban and urban areas. Although the farm and rural neutering levels are particularly low, even the Yorkshire suburban and urban figures are relatively low compared with the 82% of males and 90% of females recorded for the London suburb of Romford (Tabor 1983). Differences in neutering rates between the sexes however, show relatively little variation in the pet cat samples. The situation with the farm cat ratio is discussed above.

Age structure

The ages of 245 cats (17.5% of the total house cat sample for which gender and neutering information was available) are shown in Appendix 3b and form the basis of Figure 3b. The oldest individuals were a neutered male and female of 17 years and a neutered female of 19 years of age respectively.

Since these animals were generally not the pets of the surveyors, the accuracy of declared cat ages can only be regarded as approximate and the resultant mean and survivorship calculations should be regarded with caution. The most frequent claimed age was three years, making up 20% of the sample. Assuming cats of less than one year to be 6 months old, the mean age for the entire sample was 4.3 years. The numbers of intact and neutered males and females are given separately for each year age category in Appendix 3b and provide the basis of mean age calculations, showing that for intact females this was 3.9 years, compared with 2.9 for intact males. For neutered cats mean ages were substantially greater, with 4.7 years for females and 4.8 for males. As with the farm cat study, the under-representation of cats of less than one year of age is no doubt due to the absence from the survey of dependent unweaned kittens, though other apparent anomalies in the survivorship curve (at years one, two, eight and ten) could, as was observed in the farm cat study, be due to intermittently low recruitment into the population during epizootics of cat flu or feline enteritis (John Jack *pers. comm.*). In that this census was undertaken in 1980, a year later than the farm cat survey, it is interesting to note that anomalies in the survivorship pattern in Figure 3a are shifted on a year in Figure 3b, indicating that the relatively unmanaged farm cat populations and the cosseted house cat populations are subject to the same epidemiological cycles and survivorship trends.

What the Cat Brought In: a study of the predatory ecology of domestic cats in Yorkshire

"... and tell me all thy frays
Of fish and mice and rats and tender chick."
To Mrs Reynold's Cat John Keats (1818)

Introduction

Amid the artificial garden and backyard eco-systems, there lurks the scourge of fish, fowl and flesh – the domestic cat. This obligate carnivore, which has little dietary need to hunt, still harbours a potent behavioural drive to ambush, attack and kill (Turner & Meister 1986).

Anecdotal accounts of cat prey items (be they birds, mammals, herptiles or fish) gathered by various natural history societies have periodically thrown light on the taxonomic range, relative frequency and seasonality of prey taken by domestic cats. Mead's (1982) analysis of cat-killed ringed birds submitted to the British Trust for Ornithology (BTO) bird ringing scheme perhaps provided the earliest critical insight into the hunting strategies of cats and indicated which bird species are most likely to fall victim.

Investigations into the predatory activities of domestic cats in Britain received an unexpected boost during the compilation of *An Atlas of Yorkshire Mammals* (Howes 1983) when in 1978-79, after mammal trapping and bird pellet analysis had been exhausted as sources of data, a questionnaire survey entitled *What the Cat Brought In* was designed as a ploy to garner records of small mammals from unrecorded areas. This exercise, which began to reveal fascinating insights into the predatory behaviour and impact of domestic cats, was continued in order to provide further information on this little studied aspect of cat ecology. Initially launched through the YNU and Doncaster Museum it involved cat-owning members of YNU affiliated societies and ultimately the general public in monitoring for a year the prey items caught by their cats. Preliminary reviews of results were published in the *Yorkshire Naturalists' Union Newsletter* (Howes 1979a, 1981a) which served to stimulate further interest.

Following the success of the Yorkshire prototype, a series of promotional and feed-back articles in the Mammal Society's *Youth News* (Howes 1979b, 1980a, 1981b) and the RSPB's Young Ornithologists' Club's *Bird Life* (Howes 1980b, 1981c), assisted by extensive press coverage, succeeded in developing the *What the Cat Brought In* project into a major national survey and placed on record some of its preliminary results. Together with substantial assistance from the Mammal Society, the RSPB, regional support groups of the Cat's Protection League, RSPCA and a range of County Wildlife Trusts, the project succeeded in monitoring the annual predatory activities of *c.*1000 domestic cats throughout Britain.

The survey's methodology provided a basis for the now celebrated work of Paul Churcher on the predatory impact of cats in a Bedfordshire village (Churcher & Lawton 1987). Batches of unprocessed prey records have been used in various undergraduate research projects and also by Professor Tim Birkhead and his student Ian Massie of Sheffield University for comparison with the predatory activities of magpies (*Pica pica*) (Birkhead 1991). Though light-heartedly summarised in Howes (1990, 1992), the full range of data has never been fully analysed; however, the raw data archive has been passed to Professor Stephen Harris and his team at Bristol University for comparison and merging with the Mammal Society's recent (1997) re-run of the project (see http://www.abdn.ac.uk/mammal.catkills1.htm). There is currently a vigorous worldwide interest in the food ecology and predatory impact of domestic cats, the now extensive literature (though not including the Yorkshire component) being reviewed in Fitzgerald (1986), Turner and Meister (1986), Bradshaw (1992), and Pearre and Maass (1998).

This occasion provides an opportunity to present the results of the survey of the predatory activities of domestic cats in Yorkshire.

Methods

The *What the Cat Brought In* questionnaire survey was designed to monitor the prey items caught by individual domestic cats living in rural, suburban and town centre areas for a year. To increase the likelihood of prey items being correctly identified, the survey was targeted primarily at the cat owning members of local natural history and ornithological societies.

In addition to recording the name, age, sex and neutering status of each cat, the questionnaire forms recorded the address of the surveyed cats, the prevailing housing types and nearby habitat and land-use types. The date of receipt and return of the form was noted, followed by the date and identification of each successive prey item. As an index of palatability, those items which were eaten or partially eaten were indicated.

Results

The predatory activities of 180 cats (84 from rural, 70 from sub-urban and 26 from urban and town centre areas of Yorkshire) were each monitored for a year. Monthly and annual totals of prey types are categorised separately for taxa of mammals (16), fish (3), herptiles (2), birds (35) and invertebrates (7) in Appendix 6. The numbers of prey types recorded varied substantially according to hunting areas, Figure 9 showing that biodiversity of prey taxa generally increased from the lowest level in urban/town centre areas to the highest in rural areas. Of the vertebrate prey items recorded in the overall sample, mammals made up 69.1%, birds 30.5% and other vertebrates (herptiles and fish) constituted 0.4, however, Table 1 reveals substantial regional variations.

Capture rates

Some 5,205 vertebrate prey items were recorded, giving a mean annual prey capture rate of 28.91 per cat. However, a wide variation in rates of predation was evident across the housing regions, Table 4 showing a mean annual rate per cat rising from 7.88 in town centre and urban areas to 37.51 in rural districts. Table 1 shows the relative compositions of birds, mammals and other vertebrates across the three hunting areas, revealing the general principal that birds constitute the highest proportion (72.2%) of vertebrate prey in urban areas, declining to the lowest level (22.3%) in rural areas, whereas mammals constitute the

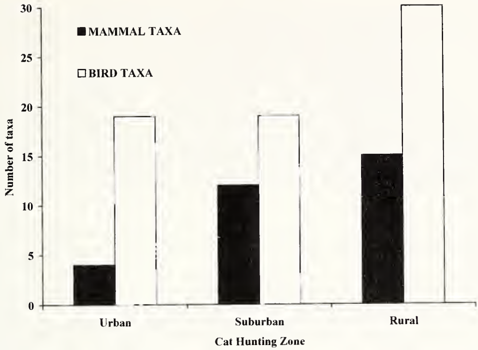

FIGURE 9
Diversity of predated species in different hunting zones.

highest proportion (77.6%) of vertebrate prey in rural areas, declining to the lowest level (27.8%) in urban areas. Interestingly, this demonstrates a similar predatory trend as observed in the analysis of tawny owls (*Stryx aluco*) prey in Greater London where high levels of bird predation were linked with the inner London Boroughs and the higher levels of mammal predation were encountered in the outer more rural districts (Bevan 1965).

TABLE 1
Recorded annual predation rates on birds, mammals and other vertebrates in different housing areas of Yorkshire

Housing/ Land-use Type	Cat Sample size No.	Birds No.	%	Mean	Mammals No.	%	Mean	Other vertebrates No.	%	Mean	Total vertebrates No.
Town centre/											
Urban	26	148	72.2	5.69	57	27.8	2.19	0	0.00	0.00	205
Suburban	70	735	39.8	10.50	1,095	59.3	15.62	17	0.92	0.24	1,847
Rural	84	703	22.3	8.37	2,448	77.6	29.14	2	0.06	0.02	3,153
TOTAL	**180**	**1,586**	**30.5**	**8.81**	**3,600**	**69.1**	**19.98**	**19**	**0.36**	**0.10**	**5,205**

* Mean = mean per cat per year.

By linking the mean prey capture figures per cat in Table 1 with cat population density levels in Appendix 4 and Figure 4a-c, it becomes possible in Table 2 to estimate separately the predation levels of prey types per 100 households respectively in town centre, suburban and rural housing/landuse areas.

Again, this emphasises an increase in predation levels the more rural the hunting habitat becomes. Interestingly, although relatively token, the rate of predation on herptiles and fish in the suburban sample is probably a reflection of the frequency of ornamental garden ponds.

TABLE 2.
Estimated mean annual cat predation levels on birds, mammals and other vertebrates per 100 households in different housing areas of Yorkshire

Housing/ Land-use type	Birds	Mammals	Fish & Herptiles
Town centre/Urban	142.8	54.9	0.00
Suburban	354.5	527.3	8.10
Rural	444.6	1,546.3	1.06

SEASONALITY

Monthly totals of reported prey for all housing regions, provided in Appendix 6, have been used to generate Figure 10 which shows relative % composition of mammals and birds vertebrate prey for the entire sample throughout the year. This shows that mammals outnumber birds in each month, exceeding 60% of vertebrate prey in the ten months from July to April, and exceeding 80% in October and November. Predation on birds reaches a peak in the months of May and June when rates exceed 40% of vertebrate prey, followed by an isolated peak of above 35% in January.

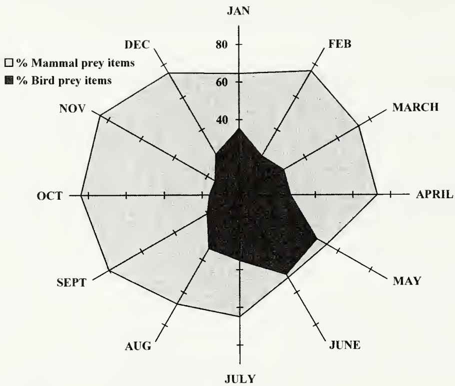

FIGURE 10
Monthly variations in the percentages of 5,205 mammal and bird prey items caught by 180 cats.

By separating the seasonal vertebrate prey data according to housing regions, Figure 11a-c demonstrates the increasing significance of birds as prey items in the suburban and urban samples, emphasising their exploitation during breeding season, exceeding 40% of vertebrate prey from May to August in the suburban sample and exceeding 80% from May to September in the urban sample. The suburban and urban samples also emphasise the winter predation of birds that peaks in December and January. It is likely that this phenomenon is a consequence of birds being artificially attracted during periods of hard weather into urban cat territories to feed on well-stocked bird tables.

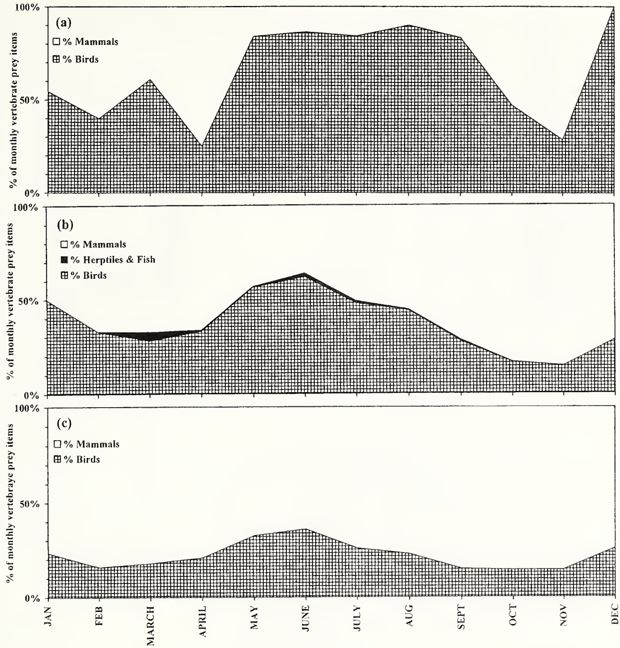

FIGURE 11
Monthly variations in vertebrate prey types taken by (a) 26 cats in Urban/Town Centre, (b) 70 cats in suburban and (c) 84 cats in Rural areas of Yorkshire.

MAMMAL PREY CASE STUDIES

Considerable variation in the composition of the mammalian prey faunas in the urban, suburban and rural hunting zones is illustrated in Figures 9 and 12, both of which show that taxonomic diversity increases from urban to rural hunting zones. Figure 12 shows that murids (mice and rats), which accounted for 97% of mammals in the urban sample and only 58% in the rural sample, were the most frequently taken mammal prey group across the regions. Although the incidence of voles, shrews and other mammals increased with rurality, it was interesting to note token evidence of both shrew and vole occurrence in urban areas.

Figure 13, based on records in Appendix 6, shows specifically identified mammal species placed in order of frequency, with the wood mouse (*Apodemus sylvaticus*) accounting for 56% of the sample.

The following review deals with mammals in family order. Only eight bats were represented in the survey, though their presence from June to October and the fact that

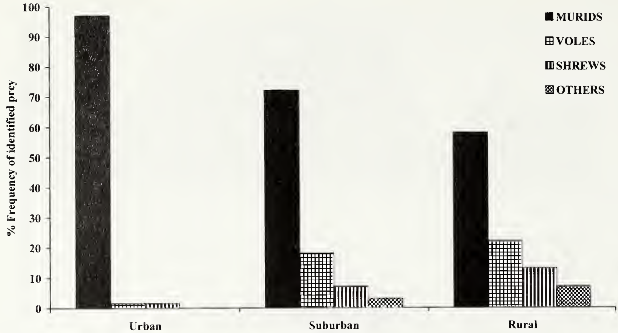

FIGURE 12
Variations in MAMMAL prey taken in different habitats.

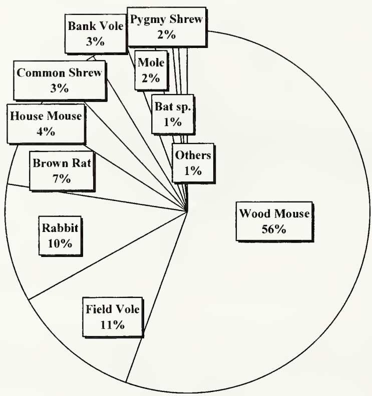

FIGURE 13
% frequency of identified prey types: Mammals.

recorders described them in terms of 'half inch' and later 'three quarter inch' bats suggested that these were likely to be newly fledged young pipistrelle bats (*Pipistrellus pipistrellus* s.l.). In addition, anecdotal information and *WTCBI* recording sheets submitted by correspondents elsewhere in Britain (Howes 1981a, 1981b) showed a pronounced peak of captures in May which coincided with the formation of summer nursery colonies. Since colonies are largely associated with domestic property, bats at this time are vulnerable to cats attracted to windowsills, dormer roofs etc. by the activities and ultrasound emissions of the aggregating bats. None of the bats were reportedly eaten.

The usually subterranean mole (*Talpa europaea*) is generally safe from cat predation; indeed, the 25 moles recorded in this survey represent only 0.7% of mammal prey items. The occurrence of moles above ground tends to vary according to prevailing soil moisture conditions, typically in times of flood or drought. Interestingly, the peak of 15 captures in June and July of 1979 coincided with one such drought period. None of the moles were reported to have been eaten.

All three species of shrew were reported and although occurrences were monitored throughout the year, there was a pronounced peak in July and August (see Appendix 6). With 409 reported captures, shrews represented the third most frequent mammal prey group, though significantly none were reported as having been eaten. This may be associated to unpalatability, Macdonald (1977) demonstrating by feeding experiments that foxes (*Vulpes vulpes*) would only resort to eating shrews when particularly hungry.

All three species of vole were reported with the 630 captures, most of which were eaten, representing the second most frequent mammal prey group. Of those specifically identified, 78% were field voles (*Microtus agrestris*), 21% were bank voles (*Clethrionymus glariolus*), and only 1% (2 specimens) were water voles (*Arvicola terrestris*). Although significant numbers are taken through the year, numbers rose markedly in July, remained high through the late summer and early autumn and peaked in October (see Appendix 6). The sudden rise in vole predation in July may have been a response to field voles made vulnerable after the removal of grass crops. The autumnal peak in predation is probably due to the aggregations of new generations of voles with breeding continuing through the summer and early autumn.

"Such appetite he hath to eat a mous"
The Maunciple's Tale Geoffrey Chaucer (14th century)

Three species of mice were reported, with the 2,160 captures, most of which were eaten, representing the most frequent mammal prey group. Of those specifically identified, 93% were wood mice (*Apodemus sylvaticus*), 6.5% were house mice (*Mus musculus*), and only 0.1% (1 specimen) was harvest mouse (*Micromys minutus*). Seasonality of occurrence as prey was similar to that in the voles, with fewest captures in February, rising to a late summer peak in September, a month earlier than for the voles (see Appendix 6).

"Cats I scorn, who sleek and fat,
Shiver at a Norway Rat;"
A True Cat Anna Seward (1810)

Although much discussed by correspondents, common rat (*Rattus norvegicus*) was recorded on only 103 occasions and represented 7% of identified mammal prey items. Since specimens were frequently described as 'young' or 'small', this would indicate that adult rats tend to be avoided. Like the other rodent groups there was a marked September and October peak, probably representing aggregations of new generations, with breeding continuing through the summer and early autumn.

"I know a Cat, who makes a habit
of eating nothing else but rabbit,"
The Ad-dressing of Cats T. S. Eliot (1939)

Rabbits (*Oryctolagus cuniculus*), often described as 'young', were recorded on 159 occasions and represented 10% of identified mammal prey, all kills being reported in rural areas. Since they were taken throughout the year, some of those caught would certainly have been fully-grown. A significant peak of kills recorded in August may have been in response to the appearance on the surface of newly independent young of the year or animals made vulnerable through the harvesting of cereal crops.

Grey squirrels (*Sciurus carolinensis*) were caught on three occasions within the survey but cat owners in suburban areas adjacent to community woodlands anecdotally reported frequent kills. In addition, one suburban and four rural weasels (*Mustela nivalis*) were reported in the survey.

Other mammals, which though caught in Yorkshire were caught outside the survey period, included brown hare (*Lepus europaeus*) and stoat (*Mustela erminea*). Notable historical cat kill records include one of the last red squirrel to be recorded in the Barnsley area, ambushed by two Siamese cats in March 1967 in the grounds of the Northern College, Stainborough (I. Mackerness *pers. comm.*), a black rat (*Rattus rattus*) from the premises of R. Wade & Co. Hull 10.2.1901 (Specimen in Hull Museum) and a dormouse (*Muscardinus avellanarius*) killed on the banks of the Hodder in Bowland during the 1860s (Anon. 1884).

Bird prey case studies

Birds featured significantly as prey items but despite extensive negative comments by correspondents on what was regarded as this unacceptable behaviour, the 1,586 kills represented only 30.5% of reported vertebrate prey items.

Considerable variation in the composition of the avian prey faunas in the urban, suburban and rural hunting zones is illustrated in Figures 9 and 14, both of which show that taxonomic diversity increases with rurality. Figure 14 shows that house sparrow (*Passer domesticus*), which accounted for over 70% of birds in the urban sample and less than 30% in the rural sample, was the most frequently taken bird species across the regions. Curiously, like the house sparrow, the blackbird (*Turdus merula*) also exhibited an urban orientation, declining slightly in the suburban and rural samples. By contrast, the starling (*Sturnus vulgaris*) and song thrush (*Turdus philomelos*) exhibited a suburban orientation, declining in both urban and rural samples.

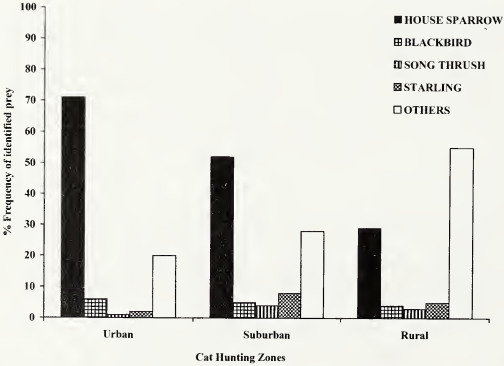

FIGURE 14
Variations in BIRD prey taken in different habitats.

Figure 15, based on records in Appendix 6, shows the ten most frequently identified bird species placed in order of frequency, with house sparrows accounting for 62% of the total sample, the next most frequently predated species being starling, blackbird and song thrush, representing 9, 7 and 5% respectively.

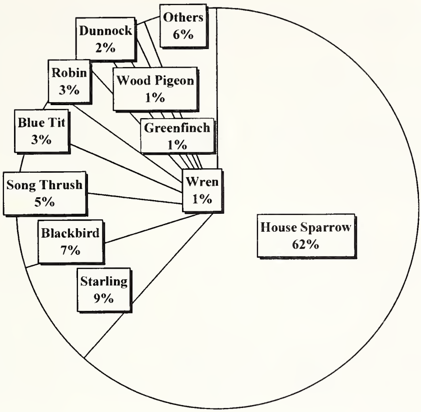

FIGURE 15
% frequency of identified prey types: Birds.

Although 35 taxa of identifiable birds are indicated in Appendix 6, the ten most frequently taken species (see Figure 15) are generally similar to the cat-killed species of ringed birds identified by Mead (1982). All of the frequently taken prey species either regularly feed or breed in domestic gardens and are therefore likely to live in close proximity to cats. However, the most likely criterion of vulnerability is that house sparrow (*Passer domesticus*), starling (*Sturnus vulgaris*), blackbird (*Turdus merula*), song thrush (*Turdus philomelos*), robin (*Erithacus rubecula*), dunnock (*Prunella modularis*) and wren (*Troglodytes troglodytes*) are essentially ground feeders, often feeding close to shrubs and vegetation which cats can use for purposes of ambush. Although blue tits (*Parus caeruleus*) are normally canopy feeders and are therefore out of reach of cats, they are regular visitors to bird tables and garden feeding stations and frequently breed in nest boxes erected in sites vulnerable to house cats. Greenfinches *(Carduelis chloris*) are also generally arboreal feeders, though Mead (1982) points to their habit of feeding terrestrially on food debris dislodged from bird tables or nut feeders, making them particularly vulnerable to cat attack.

Seasonality of most prey species was closely associated with breeding period when adults were nest building and particularly when young were fledging. This is particularly noticeable in the blackbird with most casualties in May and June, song thrush with most casualties in May, June and July, robin with a peak in June and July and dunnock with a peak in July. The prolonged breeding period of the house sparrow is reflected in high levels of predation from May to August. With this slow flying species nesting almost exclusively under the same roofs, so to speak, as their house cat predators and in feeding terrestrially in gardens, frequently on household scraps, it is understandable why this species constituted over 60% of all identified bird prey.

Of the migrant species, redwing (*Turdus iliacus*) (1 in January) was the only winter visitor, summer migrants being chiffchaff (1 in April), willow warbler (2 in July and 1 in August), house martin (*Delichon urbica*) (2 in June and 4 in July), and swallow (*Hirundo* *rustica*) (1 in July and 1 in September). Although the two hirundine species frequently inhabit the same premises as house cats, their frequency as prey species is minute, presumably reflecting their aerial feeding behaviour and aerobatic skills. However, anecdotal information from correspondents and evidence in Mead (1982) suggests that by waiting on windowsills or roofs, individual cats contrive to catch birds as they leave or return to their nests.

Although the vast majority of prey species were small to medium sized passerines, larger species like black-headed gull (*Larus ridibundus*) (1), moorhen (*Gallinula chloropus*) (3), collared dove (*Streptopelia decaocto*) (7), street pigeon (*Columba livia*) (3), wood pigeon (*Columba palumbus*) (16) and even pheasant (*Phasianus colchicus*) (1) were also taken, though most of those reported were rescued and liberated by the cat owner.

Fish and herptile prey case studies

Correspondents frequently referred to incidents where cats had regularly removed fish from garden ponds; however, actual evidence in the survey was sparse, producing records of six specimens of three species (see Appendix 6). Similarly, stories of cats catching large numbers of frogs during spawning season, were not corroborated, the survey producing records of only eleven frogs and two newts. Small though this sample was, it identified an early springtime (March) seasonality in the suburban sample (see Figure 11b). Although not included in this survey, additional anecdotal records include a grass snake (*Natrix natrix*) caught in Harthill in July 1975 (W. Ely *pers. comm.*) and a viviparous lizard (*Lacerta vivipara*) caught at the Crown and Anchor, Kilnsea in July 1976 (J. Harrup *pers comm.*).

Invertebrate prey

According to correspondence and annotations on the recording forms, invertebrates were substantially under-recorded for reasons of difficulty with identification and, more particularly, in monitoring this activity from which there would be few if any remains and which did not seem to engender the behaviour of 'presenting' the prey. However, of the 116 items recorded, Appendix 6 shows a peak of activity from June to October. Anecdotally, recorders mentioned the indoor autumnal activity of their cats catching and eating the large *Tegenaria* spiders, the mature males of which nocturnally wander around the ground floors of domestic property in search of occupied female webs. Of the butterflies, large white (*Pieris brassicae*), green-veined white (*Artogeia napi*), red admiral (*Vanessa atalanta*) small tortoiseshell (*Aglais urticae*) and peacock (*Inachis io*) were listed, the latter two featuring in early spring when warm days in March and April brought specimens which had hibernated indoors fluttering to sunlit windows where they were easily caught by sunbathing cats. The same strategy also led to the demise of larger muscid flies and bumble bees (*Bombus* spp.) in summer and, in late summer, the 'Drone flies' (*Eristalis* spp.). In addition there were anecdotes of cats catching large *Aeschna* dragonflies and bringing home the larvae of the elephant hawk moth (*Deilephila elpenor*).

Predatory rate according to age

> *"He was a mighty hunter in his youth"*
> *The White Cat of Trenarren* A. L. Rowse (1967)

In counting the numbers of vertebrate prey items recorded for cats in each age group it has been possible to assemble Figure 16, which reveals that predatory activity rapidly builds to a peak of 43.5 vertebrate prey items per year at two years of age, numbers of prey items caught declining thereafter. Broadly, cats up to four years old catch a mean of 31 vertebrate prey items per year. This falls to a mean of 20 for cats between five and nine years of age and only 15 for cats of ten years and above. That cats up to four years of age catch prey in excess of the sample mean of 28.91 may be related to the natural life expectancy of cats as

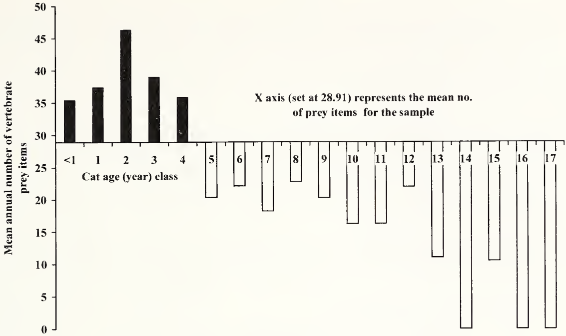

FIGURE 16

Changes in levels of predatory actvity with age: illustrated by mean annual number of vertebrate prey items caught per cat (5,205 prey items caught by 180 cats).

a species, the survivorship graphs of both farm and house cats (Figures 3a & 3b) showing substantial diminution in the proportion of the population of cats over four years of age.

Discussion

Being generally well fed, the domestic cat is probably fitter to go hunting than its untended feral counterpart. In receiving a food source independent of the productivity of their 'wild' environment, domestic cat populations, unlike those of wild predators, are not controlled by prey availability. They are therefore potentially in a position to a) severely deplete or eradicate wild prey populations and b) unfairly compete with native terrestrial carnivores.

These aspects together with the sheer number of cats in Britain, could be having detrimental effects on vertebrate faunas around our towns, suburbs and rural villages; indeed, where localised or rare prey species are involved, this could be of conservation significance.

Soulsby and Serpell (1988) showed that the domestic cat population in Britain increased from 4 million in 1963 to 6.2 million in 1988, and the JNCC review of British mammal populations (Harris *et al.* 1995) estimated that this would rise to around 8 million by the year 2000. In addition, Harris *et al.* (1995) considered that to this could be added an estimated 813.000 feral cats.

Table 3 reveals that these numbers are extremely high compared with estimated totals of all other British terrestrial mammalian predators, domestic cats outnumbering the entire estimated population of wild terrestrial carnivores by 2.6 to 1.

The survey found that on average each cat brought in some 29 prey items a year which by simple extrapolation would suggest that Britain's eight million domestic cats could be killing some 232 million vertebrates per year. Since the largest sample of cats (46.6%) in the survey was from the predatorily successful rural sample (see Table 1), this blanket figure gives a misleadingly high impression. Having organised the Yorkshire cat prey and cat population surveys on the basis of distinct housing, habitat and land-use regions, this very crude global figure has been refined in Table 4 to predict a potential annual predatory pressure by domestic cats per 100 households, giving figures in the order of 1,992, 890 and 197 in rural, suburban and town centre areas respectively.

TABLE 3
Population estimates of terrestrial and riparian carnivores in Britain compared with domestic and feral cat *Felis catus* (data from Harris *et al.* 1995)

Hedgehog	1,555,000
Stoat	462,000
Weasel	450,000
Badger	250,000
Fox	240,000
American Mink	110,000
Polecat	5,000
Otter	7,350
Pine Marten	3,650
Wild Cat	3,500
Feral Ferret	2,500
Total	**3,099,000**
Domestic Cat	8,000,000
Feral Cat	813,000
Total	**8,313,000**

TABLE 4.
Estimated mean annual vertebrate predation rates by cats in different housing areas of Yorkshire

Housing type	+Mean predation rate per cat	*Cat density per 100 households	Estimated mean predation rate of cats per 100 households
Town centre/Urban	7.88	25.09	197.7
Suburban	26.37	33.76	890.3
Rural	37.51	53.12	1,992.5

+based on Table 1; *based on data in Appendix 4 and Figure 6a-c.

Cat Predation Management

In providing a statistical rather than a purely anecdotal review, this study usefully reveals that the predatory activities of cats vary substantially with:

a) Age – predatory activity declining substantially after year 4 (see Figure 16).
b) Housing/land-use/habitat districts – annual predatory success (or perhaps opportunity) declining from 37.5 vertebrate prey item per cat in rural areas to 7.9 in town centre/urban areas (see Table 1).
c) Season – the majority of garden birds are taken in winter (December and January), presumably when attracted to bird tables, and during the nesting season (notably in May and June) when fledglings are vulnerable (see Figures 10 & 11a-c).

The restriction of nocturnal and crepuscular activities of the more numerous and more predatory younger cats would therefore achieve significant reductions in small mammal and bird predation and in turn would reduce competitive pressures on wild carnivore populations, particularly if this prohibition were exercised on rural and suburban cats. If excessive predation on garden birds is perceived to be a problem, then the restriction of diurnal access to gardens during peak winter feeding and summer breeding periods would certainly reduce this effect. Whether the fitting of cats with a sonic (e.g. collar and bell) or optical (e.g. reflective collar) warning device could significantly reduce predatory success, would require experimental verification. Similarly, an examination of the camouflage/predatory efficiency of cats may show that certain coat colour/pattern morphs may be less efficient as predators and therefore more desirable as 'animal welfare-friendly' pets.

In our reportedly stress dominated and progressively dysfunctional lives, where cats evidently play an important role as therapeutic companion animals (Soulsby & Serpell 1988), the simple reduction of pet cat populations as a means of controlling predatory pressure would not seem to be a straightforward option. Intriguingly, a progressive substitution of domesticated carnivores by domesticated herbivores as companion animals may overcome a range of perceived animal welfare and predator-prey difficulties, but would set in train a range of quite different dynamic trends in our urban ecology.

Yorkshire cats and their owners have contributed substantially to our knowledge of the population structure and ecology of the domestic cat in Britain. The studies have given cat owners added interest in their free-range charges but with the various discoveries, revelations and conservation implications, the project has indicated the need for more fieldwork on the 'wild life' of the domestic cat.

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APPENDIX 1:
NEUTERING RATES OF FARM CATS IN YORKSHIRE

	ALL CATS			FEMALES				MALES			
YORKSHIRE REGION	**Number of Cats***	**Recorded as Neutered**	**% neutered (all sexes)**	**FEMALE**	**Intact Female**	**Neutered Female**	**% females neutered**	**MALES**	**Intact Male**	**Neuterd Male**	**% males neutered**
VALE OF MOWBRAY	119	**5**	**4.2**	83	80	3	**3.6**	36	34	2	**5.6**
VALE OF YORK	127	9	**7.1**	101	94	7	**6.9**	26	24	2	**7.7**
HUMBERHEAD LEVELS	100	13	**13.0**	57	49	8	**14.0**	43	38	5	**11.6**
VALE OF PICKERING	20	0	**0.0**	13	13	0	**0.0**	7	7	0	**0.0**
PENNINES	332	37	**11.1**	212	194	18	**8.5**	120	101	19	**15.8**
WOLDS	166	31	**18.7**	87	76	11	**12.6**	79	59	20	**25.3**
HOLDERNESS	54	8	**14.8**	31	28	3	**9.7**	23	18	5	**21.7**
NORTH YORK MOORS	53	2	**3.8**	31	30	1	**3.2**	22	21	1	**4.5**
TOTAL	**971**	**105**	**10.8**	**615**	**564**	**51**	**8.3**	**356**	**302**	**54**	**15.2**

* of the 1,169 cats, gender and neutering data was only provided for 971.

APPENDIX 2: YORKSHIRE FARM CAT SURVEY

YORKSHIRE REGION	NO. OF FARMERS SURVEYED	FARMING PRACTICES							ACREAGE	NO. OF CATS	REASON FOR HAVING CATS			ARE CATS EFFECTIVE IN RODENT CONTROL?		OTHER METHODS OF RODENT CONTROL				
		Arable	Cattle	Pigs	Sheep	Goats	Horses	Poultry		No. of Cats	Pets	Rodent Control	Feral	Effective	Ineffective	Poisons	Traps	Guns	Dogs	Ferrets
HOLDERNESS	14	11	6	6	1	0	0	1	3,480	74	2	13	1	13	0	10	1	1	0	0
HUMBERHEAD LEVELS	26	23	11	10	2	0	0	3	8,149	107	7	20	2	25	0	17	4	1	1	0
NORTH YORK MOORS	16	6	6	6	8	0	0	4	1,965	92	1	12	0	12	0	11	2	1	0	0
PENNINES	88	17	76	14	54	3	4	18	16,283	402	47	72	7	80	4	54	20	4	4	1
VALE OF MOWBRAY	21	13	20	0	8	0	0	1	3,668	119	8	20	1	20	0	15	3	4	1	0
VALE OF PICKERING	5	4	2	1	4	0	0	1	1,821	29	1	3	0	5	0	3	0	0	0	0
VALE OF YORK	31	24	13	12	13	0	0	1	11,043	151	13	31	0	27	1	16	5	3	4	0
WOLDS	38	37	13	8	25	0	1	5	15,223	195	14	34	1	33	1	29	6	1	1	0
TOTAL	**239**	**135**	**147**	**57**	**115**	**3**	**5**	**34**	**61,623**	**1,169**	**93**	**205**	**12**	**215**	**6**	**155**	**41**	**15**	**11**	**1**

APPENDIX 3a:
AGE STRUCTURE OF CAT POPULATIONS ON YORKSHIRE FARMS

AGE	Total Population	Intact Female	Neutered Female	Intact Male	Neutred Male
<12 months	62	32		28	2
1	65	37	3	22	3
2	117	68	8	30	11
3	84	45	6	29	4
4	70	42	7	17	4
5	51	17	3	25	6
6	48	16	10	9	13
7	15	9		4	2
8	16	8	1	6	1
9	8	4	1	1	2
10	8	6			2
11	3	3			
12	8	2	3		3
13					
14	1	1			
15	2		2		
16					
17					
18					
19					
20					
Totals	**558**	**290**	**44**	**171**	**53**

APPENDIX 3b:
AGE STRUCTURE OF DOMESTIC CAT POPULATIONS

AGE	Total Population	Intact Female	Neutered Female	Intact Male	Neutred Male
<12 months	27	9	7	8	3
1	21	4	6	4	7
2	35	4	11	8	12
3	49	15	14	7	13
4	23	4	7	6	6
5	24	5	7	7	5
6	16	4	6	3	3
7	14	4	4		6
8	8	2	2		4
9	6	1	1	1	3
10	5	2	2		1
11	4		2		2
12	5		2		3
13	4	1	1		2
14	1		1		
15					
16	1		1		
17	1				1
18					
19	1		1		
20					
Totals	**245**	**55**	**75**	**44**	**71**

APPENDIX 4:
DOMESTIC CAT REGIONAL HABITAT AND OWNERSHIP SURVEY

District Category		Housing Type				Habitats								Cat Population		
	SAMPLE SURVEYS (Each sample consisted of 10 adjacent properties)	**Terrace**	**Flats**	**Semi-detached**	**Detached**	**Garden to 50y²**	**Garden from 50-150²**	**Garden above 150y²**	**Allotments**	**Parks & Sports Fields**	**Woodland**	**Arable**	**Pasture**	**PROPERTIES CENSUSED**	**Number of Cats**	**Mean Cats per 100 household**
Urban	108	31	5	64	10	53	51	7	9	36	2	0	0	1,080	271	25.09
Sub-Urban	138	14	0	84	58	21	91	45	12	51	27	23	27	1,380	466	33.76
Rural	125	23	0	50	71	21	46	56	7	12	21	56	82	1,250	664	53.12
Totals	**371**	**68**	**5**	**198**	**139**	**95**	**188**	**108**	**28**	**71**	**50**	**81**	**109**	**3,710**	**1,401**	**37.76**

APPENDIX 5:
CAT GENDER AND NEUTERED RATES

Housing Category	All Cats			Females				Males			
	Number of Cats*	Recorded as Neutered	% neutered (both sexes)	**FEMALE**	**Intact Female**	**Neutered Female**	% females neutered	**MALE**	**Intact Male**	Neutered Male	% males neutered
Urban	201	146	**72.6**	98	25	73	**74.5**	103	30	73	**70.8**
Sub-Urban	323	237	**73.4**	147	43	104	**70.7**	176	43	133	**75.9**
Rural	634	275	**43.4**	355	202	153	**43.1**	279	157	122	**34.7**
Totals	**1,158**	**658**	**56.8**	**600**	**270**	**330**	**55.0**	**558**	**230**	**328**	**58.8**

* of the 1,401 cats, gender and neutering data was only provided for 1,158.

APPENDIX 6:
RANGE OF PREY AND SEASONALITY IN PREDATORY ACTIVITY OF DOMESTIC CATS IN YORKSHIRE (ALL AREAS)

SAMPLE SIZE: 180 Cats; Total vertebrae prey items: 5,205; Mean vertebrate prey items per cat: 28.91

PREY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
INVERTEBRATES													
Bee/Wasp				1		1	1	1	3				**7**
Beetle					3					1			**4**
Butterfly			1	4	3	7	7	19	8				**49**
Fly		2			3	1	5	2	5	3	1		**22**
Moth		1	1	1		2	2	5	2	4	1	1	**20**
Spider		1				1	1	2	1	3			**9**
Worm						1	1			3			**5**
Sub-total (invertebrates)		**4**	**2**	**6**	**9**	**13**	**17**	**29**	**19**	**14**	**2**	**1**	**116**
MAMMALS (indet)	4	5	3	9	8	8	12	7	18	14	4	5	**97**
BAT sp. (indet)						2	2	1	2	1			**8**
Mole	1		1	1	1	10	5	2		3		1	**25**
SHREW sp. (indet)	3	7	11	15	33	24	71	47	56	27	19	6	**319**
Common Shrew	1			2	8	7	10	14	2	2	2	3	**51**
Pygmy Shrew					1	5	14	11	5	1			**37**
Water Shrew								2					**2**
VOLE sp. (indet)	25	18	30	23	30	20	46	37	52	52	44	33	**410**
Bank Vole		1	1	1	2	5	5	3	3	12	7	6	**46**
Field Vole	19	12	3	3	3	8	32	11	27	22	21	11	**172**
Water Vole					1		1						**2**
MOUSE sp. (indet)	69	47	63	98	79	92	141	121	174	452	121	96	**1,253**
Harvest Mouse											1		**1**
House Mouse	6	4	4	9	3	2	5	5	5	7	6	3	**59**
Wood Mouse	30	44	59	65	56	87	85	81	151	111	52	26	**847**
Brown Rat	2	2	4	5	5	7	4	8	25	26	12	3	**103**
Grey Squirrel						2				1			**3**
Hamster					1								**1**
Rabbit		2	3	13	19	27	23	42	15	10	3	2	**159**
Weasel		1							2		2		**5**
Sub-total (mammals)	**160**	**143**	**185**	**244**	**250**	**306**	**456**	**392**	**537**	**441**	**294**	**195**	**3,600**
FISH													
Goldfish		1				1		1					**3**
Roach			1			1							**2**
Stickleback			1										**1**
HERPTILES													
Frog			3	1		1	3	1	2				**11**
Newt sp. (indet)					1	1							**2**
Sub-total (herptiles & fish)		**1**	**5**	**1**	**1**	**4**	**3**	**2**	**2**				**19**

PREY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
BIRD sp. (indet)	15	6	10	30	67	83	62	71	44	25	19	27	**459**
Blackbird	6	5	4	2	16	19	7	5	4	1	1	4	**74**
Black-headed Gull										1			**1**
Blue Tit	3	2	1	2	3	6	4	2	1	6	5	4	**39**
Budgerigar			1				1						**2**
Bullfinch			1			1							**2**
Canada Goose (gosling)							1						**1**
Canary								1					**1**
Chaffinch					1	1		1				2	**5**
Chicken (chick)									1				**1**
Chiff Chaff				1									**1**
Collared Dove	1				1	3			1	1			**7**
Dunnock	2	1	1	1		3	9		6				**23**
Goldcrest												3	**3**
Goldfinch						2	5		1	1	1		**10**
Great Tit					2	2							**4**
Greenfinch	1	2	2	1	1	3	1	1		2		1	**15**
House Martin						2	4						**6**
House Sparrow	46	20	32	34	87	129	116	86	67	35	20	23	**695**
Linnet	1												**1**
Mallard (duckling)							2						**2**
Meadow Pipit									1				**1**
Moorhen	1							1				1	**3**
Pheasant						1							**1**
Pied Wagtail								2					**2**
Redpoll							1						**1**
Redwing	1												**1**
Robin	2	3	2	2	2	6	7	5	3	1		2	**35**
Song Thrush	3		1	2	7	18	9	5	1	5		3	**54**
Starling	2	5	10	12	28	8	9	7	4	3	2	7	**97**
Street Pigeon	1						1		1				**3**
Swallow							1		1				**2**
Willow Warbler							2	1					**3**
Wood Pigeon	3		1	1	3	2	1	1		3	1		**16**
Wren					1	3	2	3	1		1	1	**12**
Yellow Hammer					1			1			1		**3**
Sub-total (birds)	**88**	**44**	**66**	**88**	**220**	**292**	**245**	**193**	**137**	**84**	**51**	**78**	**1,586**
Sub-total (mammals)	**160**	**143**	**182**	**244**	**250**	**306**	**456**	**392**	**537**	**441**	**294**	**232**	**3,600**
Sub-total (herptiles & fish)		**1**	**5**	**1**	**1**	**4**	**3**	**2**	**2**				**19**
Sub-total (birds)	**88**	**44**	**66**	**88**	**220**	**292**	**245**	**193**	**137**	**84**	**51**	**78**	**1,586**
Total Vertebrates	**248**	**188**	**253**	**333**	**471**	**602**	**704**	**587**	**676**	**525**	**345**	**310**	**5,205**

BOOK REVIEWS

Mammals of Europe by **David W. Macdonald** and **Priscilla Barrett,** Pp. 312, with over 600 colour illustrations & 200 b/w line drawings. Princeton University Press, Princeton. 2002. $24.95 softback.

First compiled by F. H. van den Brink under the familiar title *Collins Field Guide to the Mammals of Britain and Europe*, its English translation by Hans Kruuk and H. N. Southern was published by HarperCollins in 1967. Van den Brink's text and Paul Barruel's colour illustrations gave stout service to generations of naturalists, helping in no small way to encourage the subsequent revolution in European mammalian studies.

This new fund of information, expertly marshalled by Professor Macdonald, and the fresh portfolio of artwork by Priscilla Barrett, has achieved a brilliant overhaul of this valued and trusted volume. The 64 colour plates include over 600 of Barrett's excellent paintings of the animals and sketches of their tracks, nests, burrows, field signs, teeth and young. Over 200 distribution maps are significantly updated from the 1967 edition.

This is an impressively comprehensive contribution to the Princeton Field Guide series, reviewing and comparing the descriptions, habitats, breeding, behaviour and field signs of more than 200 mammals occurring in Europe and its surrounding seas. Having delectably wallowed through Professor Macdonald's 4.5 kg *New Encyclopaedia of Mammals*, I can report that this handy pocket-sized volume (130 x 195 x 25 mm) is a masterpiece of précis.

An advantage of compression is that series of similar species are illustrated together, enabling subtle differences to be highlighted. I particularly draw attention to the excellent series of bat illustrations, prepared with advice from Dr Bob Stebbings, which alone justifies the acquisition of this book. Interesting additions are tables comparing the hydrophore call, clicks and moans of cetaceans and bat detector ultrasound pulses of bats.

The acknowledgements to numerous contributing experts, including M. J. A Thompson, past President of the YNU, testify to this book's technical rigour.

CAH

Birds of the Harrogate District by **John R. Mather.** Pp. 310. 90 b/w line drawings Harrogate and District Naturalists' Society, Harrogate. 2001. £10 softback, available from: Mrs J. McClean, 6 Rossett Park Road, Harrogate HG2 9NP.

With an enthusiastic forword by Ian [D.I.M.] Wallace, this book forms a complete but concise historical review of some 288 bird species shown to have occurred in the Harrogate area from the 18th century to the present. Line drawings in the form of miniature vignettes, contributed by Ray G. Hawley, D. I. M. Wallace, M. Whorley and the author himself help to punctuate the systematic list. Also included is a fascinating account of the geography, topography and habitats of the Harrogate region, a potted history of the Harrogate and District Naturalists' Society (the local ornithological recording body) and a history of ornithologists and their investigations of the local avifauna. There is a glossary of ornithological terms, an extensive bibliography and a useful map of the Harrogate recording area.

The compact (A5) format of this tome conceals a mighty work, corpulent with carefully researched and critically evaluated detail and laced with the phraseology and personality of the author: you've heard Johnny Mather lecture, you'll be able to hear him performing the script as you read.

Out of the Thomas Nelson mould of ornithological writers, every historical source has been tracked down and every record woven into a meaningful review by an author steeped in local knowledge born of a lifetime of enthusiastic hands-on involvement in natural history.

John Mather's book is an essential work of reference for Harrogate naturalists in general and Yorkshire ornithologists in particular, and many will enjoy and benefit from this historic compilation, but more than this, it stands as a masterly and collectable example of a faunal review, the calibre of which few have been capable since the time of the Victorian and Edwardian naturalists. The investment of effort, dedication and craftsmanship necessary to create a work of this eminence is impressive and the acquisition of two copies, one to use and one to archive is certainly justifiable here.

Hopefully, the advent of the new millennium will encourage the production of equivalent biodiversity reviews around the Yorkshire region. *Birds of the Harrogate District* will certainly stand as a model in this respect, though I suspect that in our abbreviated email, text message and internet world of communication, skilfully used words are likely to give way to skilful statistics and computer graphics.

CAH

Alfred Russel Wallace: a Life by **Peter Raby.** Pp. xii + 340, incl. 2 maps & numerous illustrations, plus 16 pp. of b/w plates. Chatto & Windus, London/Princeton University Press. 2001. £20.00 hardback; Pimlico. 2002. £12.50 paperback.

At long last Wallace, to judge by the number of books recently or in the course of being published on him, is receiving the due attention he so rightly deserves as co-founder of the theory of evolution. This latest contribution is both readable and well researched, tracing Wallace's modest background, early career, self-education, his passion for biology realized by his exploration of the Amazon and Malay Archipelago, and the circumstances surrounding the presentation of his and Darwin's papers on natural selection at the famous Linnean Society meeting in 1858. Wallace never begrudged Darwin's pre-eminent role in the dissemination of the theory, and according to Raby ". . . seemed genuinely relieved that he had not been compelled to write . . ." *The Origin of Species*.

Upon his return to England in 1862, Wallace, despite ill health and financial problems, commenced work on *The Malay Archipelago*, a milestone in natural history published seven years later. Following this, his interests greatly diversified, and some of his enthusiasms, such as his defence of spiritualism, were heavily criticized. Nevertheless, his *Island Life*, published in 1880, received due acclaim, and he continued to be honoured in terms of a Civil List pension, medals, degrees, Order of Merit, etc. In later life his mind remained ever active, particularly in respect of social and political compaigns, and his published output never ceased, with books and articles on a wide variety of subjects (including anti-vaccination, land-laws, state endowment of education) continuing right up to his death in 1913. According to Raby, "Wallace, in the twentieth century, was not only the popular exponent of the previous century's scientific achievement, but represented the living embodiment of its changes and developments. His steady stream of books, and his articles and letters in the intellectual and popular press, kept his name in the public eye".

Of particular interest to Yorkshire readers will be the numerous references to Richard Spruce: it is remarkable to think that three of the greatest naturalists of their time, Bates, Spruce and Wallace, were working on the same relatively short stretch of the Amazon. Wallace was undoubtedly influenced by the character and work of Spruce, his closest scientific friend, whose extensive journals (and correspondence) he painstakingly edited – a true act of homage; these were subsequently published in 1908 as *Notes of a Botanist on the Amazon and Andes.*

Although Raby shows his non-scientific background, he is to be congratulated on his rich and powerful portrayal of Wallace and for justifiably raising the profile of a truly remarkable man.

MRDS

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Manuscripts (two copies if possible), typed double-spaced on one side of the paper only with margins at top and left-hand at least 2.5cm wide, should be submitted. Latin names of genera and species, but nothing else, should be underlined. S.I. Units should be used wherever possible. Authors must ensure that their references are accurately cited, and that the titles of the journals are correctly abbreviated. Volumes of *The Naturalist* for the years 1886 to 1975 have been retrospectively numbered 11 to 100 to accord with numbering before and after this period (see YNU *Bulletin* no. 3, pp. 21-22 1985); please cite these volume numbers in all references. Table and text-figures should be prepared on separate sheets of paper. Drawings and graphs, drawn about twice the linear size they are to appear, should be in jet-black Indian ink, and legends should not be written on the figures. **Publishable manuscripts not conforming to the above requirements will be returned for alteration.**

Photographic Plates

Readers of *The Naturalist* will have noticed that the number of photographic illustrations has increased in recent years. Good clear photographs, suitably captioned, to accompany articles or as independent features are always welcome.

To encourage this development, a long-standing member of the YNU, who wishes to remain anonymous, has most generously offered to make a donation, the income from which would finance the publication of a plate or equivalent illustration in future issues whenever possible. The editor, on behalf of the YNU, wishes to record this deep appreciation of this imaginative gesture.

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BARN OWLS (*TYTO ALBA*) IN CHURCHWARDENS' ACCOUNTS OF THE 17th AND 18th CENTURIES: AN INDICATION OF PAST ABUNDANCE IN EAST YORKSHIRE

C. A. HOWES
Doncaster Museum & Art Gallery DN1 2AE

. . . and it shall be an habitation of dragons, and a court for owls.
Isaiah **34**: 11-15

Introduction

Investigation into long term distribution and status changes of Britain's vertebrate fauna is severely hampered by the paucity or absence of accessible data sources earlier than the 19th and 20th centuries. A particularly fruitful but seldom used source of documentary evidence, however, is the series of 'vermin' bounty payments contained in the yearly accounts of churchwardens and other parish or township officials relating to the period from the late 16th to the early 19th centuries. These documents, hand-written and often on vellum, are generally housed in Local Authority Archives or Records Offices. Though somewhat laborious to locate, decipher and extract, the particular value of these sources lies in their meticulous, statistically based and long term nature.

Beverley Churchwarderns' Accounts

An examination of the churchwardens' accounts for the parish of St. Mary's, Beverley, which date from 1593 to 1831, show that between 1642 and 1736 six pence per head was paid for at least eighty-five owls (see Appendix 1).

Figure 1, which gives the yearly distribution of owl bounty payments, shows that from one to seven owls were killed per year. Figure 2, which examines the number of owls killed at any one time, shows that although on most (thirty-one) occasions only single owls were killed, on seventeen occasions between two and five owls were killed.

The Identity of 'Church Owls'

There are no precise descriptions in the Beverley archive as to which species of owl was involved and why they were being killed; however, clues to both are to be found in account entries (see Appendix 1).

On many occasions bounties for the killing of owls were linked with payments for work which was probably done within the church, for example mending locks in 1663, making locks in 1670 and for supplying candles in 1674. The washing of clerics or chorister's surplices and church linen featured with killing owls in 1674, 1680, 1687 and twice in 1693. References to the killing of 'birds' specifically within the church come in two 1711 entries for 'For powder and shot for killing birds in the church'. Specific mention of owls being killed within the church again comes from 1711 and 1712 entries. It may be significant that these entries follow those for the payments for powder and shot. Circumstantial evidence of owls being encountered in the bell tower comes in entries for 1674, 1675, 1678 and 1679 when payments were also made for work on the bell chamber or the bells themselves.

Since the owl most closely associated with buildings is the barn owl and from the 17th century the term 'church owl' was an accepted vernacular synonym for the barn owl (Nelson 1907), the target species is therefore likely to have been the barn owl *Tyto alba*.

Cultural Attitudes and Possible Reasons for Killing Owls

Geoffrey Chaucer in *The Parlement of Foules* (written between 1372 and 1382) refers to *The oule, that of deth the bode bringeth* and is perhaps one of the earliest of a long series of literary figures to dwell on a perceived sinister and unearthly quality of owls.

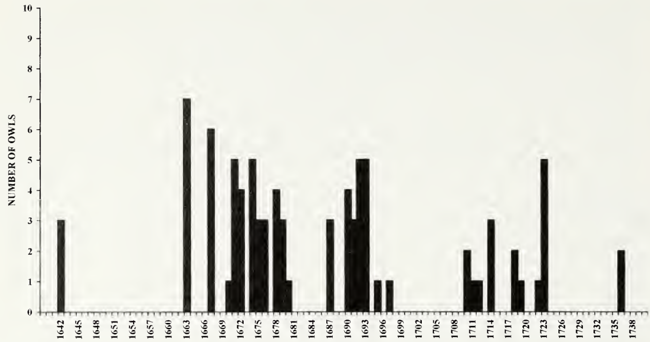

FIGURE 1
Annual records of bounty payments made for owls in the Parish of St Mary's, Beverley during the 17th and 18th Centuries.

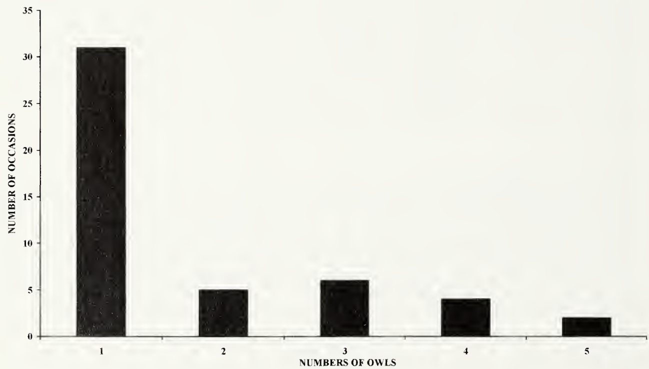

FIGURE 2
Numbers of Owls presented for bounty payments on individual occasions.

The various biblical references, notably in the books of Isaiah (**14:** 20-21 and **34**:11-15) and Leviticus (**11**: 13-17), imply that owls were 'an abomination' and 'unclean' and were associated with destruction, desolation and ruination.

This authoritative doctrine, together with the owl's eerie nocturnal hoots and shrieks was probably the basis of a widespread superstitious fear and folkloric prejudice against these birds.

Despite this weight of cultural negativity, in a rural agricultural context, notably in grain producing regions, owls were sympathetically regarded due to their rodent control capacities. Farm buildings of the 18th and 19th centuries were frequently constructed with 'owl holes' in their gable apexes to enable Barn owls to enter and breed (Jones 1972).

Quite why the public purse in the form of parish rates should have promoted the killing of owls is not immediately clear, though the examination of the numbers and periodicity of kills at Beverley and a comparison with evidence from parishes elsewhere in England and Wales provide an interpretation.

References to bounties being paid for killing owls are very rare and one may conclude that the rodent pest controlling virtues of owls were probably widely recognised. Decisions as to which species were to be regarded as 'vermin', and the levels of bounty tariff were parochial prerogatives. In practice, the vicar and churchwardens decided in the light of prevailing circumstances, and records of such decisions can occasionally be found in vestry minutes. The frequency and levels of payments for given 'vermin' species can therefore reflect a species' perceived 'pest' status within a given parish at a given time.

Significantly there is no mention of owls in the extensive surveys of churchwardens' accounts from seventy-nine Bedfordshire parishes (Elliott 1936) or from twenty-two Hertfordshire parishes (Oldham 1931a). In Yorkshire, the accounts of some eighty-eight parishes studied to date (Howes *in prep.*) have only produced evidence from Beverley.

Generally, the owls for which bounties were paid were those which were actually inhabiting the church itself. Ticehurst (1935) in reviewing the copious numbers of birds brought to the churchwardens of Tenterden, Kent between 1626 and 1712 only encountered one reference to owls where, in 1646-7 a shilling was paid for killing two 'owles which doe use in the churche'. Similarly, Oldham (1931b), investigating the bounty payments made by the churchwardens of Llanynys in the Vale of Clwyd in the years 1635-63, 1738-69 and 1788-1838, only encountered a single entry, for sixpence paid in 1769 for the killing of an owl in church. In 1759 two pence was paid for bird lime to catch owls in the church of St John's, Chester. Preventative methods were also used by church officials; hence in 1711 at Redenhall, Norfolk, three shillings and six pence was paid for 'work and stuffe and nails in stopping out ye owles at ye church' (Bunn *et al.* 1982).

In St. Mary's, Beverley, the groupings of records, often in two to four year periods (see Figure 1), indicate successive concerted attempts to remove owls. The frequency of multiple specimens (from two to five) being collected at any one time (see Figure 2), strongly suggests that the clearing of occupied owl nesting sites could well have been the purpose of these actions. The considerable debris of droppings, pellets, discarded corpses of prey items etc., particularly in the vicinity of an occupied nesting site, could understandably have been deemed unacceptable in a holy place, evoking the passage in Isaiah **14**, 20-21 '. . . their houses shall be full of doleful creatures; and owls shall dwell there . . .'.

Earliest Yorkshire Records and an indication of former abundance

In the absence of palaeontological or archaeological evidence, the earliest indication of the barn owl occurring in Yorkshire has long been held to be from Willoughby's *Ornithology* of 1678 and refers to Mr Ralph Johnson alluding to the 'Church Owl'. Since Johnson corresponded with Willoughby from Brignall near Greta Bridge (then in Yorkshire), this is taken as evidence that the allusion referred to Yorkshire (Nelson 1907). The Beverley sample, dating from 1642, provides a slightly earlier set of dates and is from a guaranteed provenance.

More importantly, the Beverley accounts, itemising at least eighty-five owls between 1642 and 1736 with up to seven being recorded per year, is unparalleled in parishes elsewhere in Britain. This study therefore provides evidence of a persistent and evidently robust barn owl population in the Hull valley from the mid-17th to the mid-18th centuries. Interestingly this period pre-dates the widespread drainage of the Hull valley region which commenced in the 1760s (Sheppard 1958). Thus, in addition to the managed post-medieval mosaic of pasture, meadow and arable fields, the owls would have had access to extensive areas of wetland to hunt over.

ACKNOWLEDGEMENT

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APPENDIX 1

Details of owl bounty payments in the Churchwardens' accounts of the Parish of St. Mary's, Beverley 1593 to 1831 (East Riding County Records Office Ref. PE 1/51 to 126)

Year	Entry	Bounty payment £. s. d.
1642	Item paid . . . Johnson for killing 3 Owls in the Wood Hall Closes which he did testify to belonging to the church	–. 1. 6
1663	Paid for killing 5 Owls	–. 2. 6
1663	Item paid for mending locks . . . and killing 1 Owl	–. 2. –
1663	Item paid for working on Mondays and Tuesdays and killing 1 Owl	–. 2. –
1667	Paid for killing 5 Owls	–. 2. 6
1667	Pd. for killing of old Fox and cub & 1 Owl	–. 1. 4
1670	Item paid for work and making locks and for killing 1 Owl	–. 4. 6
1671	Pd. for mending lock and killing 1 Owl	–. 1. –
1671	Pd. for killing 3 Owls	–. 1. 6
1671	Pd. for killing 1 Owl	–. –. 6
1672	Pd. for killing 1 Owl	–. –. 6
1672	Pd. for two baskets and killing 1 Owl	–. 1. 6
1672	Pd. for killing 1 Owl	–. –. 6
1672	Pd. for killing 1 Owl	–. –. 6
1674	Item for . . . and staples for the bells and killing 2 Owls	–. 3. 6
1674	Item to . . . nails and killing 1 Owl	–. 1. 6

Year	Entry payment	Bounty £. s. d.
1674	Item to Robert Thompson for your work about the church and killing 1 Owl	–. 2. –
1674	Pd. for candles used on November 14th and washing surplice and killing 1 Owl	–. 2. 8
1675	Item for 7 yds of matting for bell chamber . . . and for killing 3 Owls	–. 3 10
1676	Pd. for 1000 of . . . 1 bushells of coal and for killing 3 Owls	–. 5. 2
1678	For work about the bells and killing 4 Owls	–. 5. –
1679	For . . . and killing 1 Owl	–. 2.10
1679	For killing [2] Owls . . . bells and other work	–. 5. 6
1680	For washing surplices and killing 1 Owl	–. 2. 6
1687	For killing 2 Owls and working	–. 1. 4
1687	For washing surplices and killing 1 Owl	–. 2. 6
1690	Spent at . . . ground and for killing 4 Owls	–. 3. –
1691	For sack and killing 3 Owls	–. 2. 3½
1692	To John Tuting for killing [4] Owls	–. 2. –
1692	To Richard Tuting for killing 1 Owl	–. –. 6
1693	To washing linen and killing 4 Owls	–. 4. –
1693	To washing surplices and killing 1 Owl	–. 1. 6
1695	To John Tuting for an Owl	–. –. 6
1697	For killing 1 Owl	–. –. 6
1710	Pd. to John Tuting for 1 Owl killing	–. –. 6
1710	Pd. 1 Owl killing	–. –. 6
1711	For powder and shot for killing birds in the Church	–. –. 4
1711	For powder and shot for killing birds in the Church	–. –. 4
1711	To John Tuting for killing 1 Owl in the Church	–. –. 6
1712	For killing 1 Owl in the Church	–. –. 6
1714	For [1] Owl killing	–. –. 6
1714	For 1 Owl killing	–. –. 6
1714	Pd. to John Tuting for 1 Owl	–. –. 6
1718	For 2 Owls killing	–. 1. –
1719	To John Tuting for killing 1 Owl	–. –. 6
1722	An Owl killing in the Church	–. –. 6
1723	Pd. John Tuting for killing an Owl	–. –. 6
1723	Pd. for sand 6d. and Pd. John Tuting for 3 Owls killing	–. 2. –
1723	Pd. John Tuting for killing 1 Owl	–. –. 6
1736	Pd. for killing [2] Owls	–. 1. –

BOOK REVIEWS

A Field Guide to the Mammals of Australia by **Peter Menkhorst,** illustrated by **Frank Knight.** Pp. x + 269, with 116 colour plates, numerous line drawings & 380 maps. Oxford University Press, South Melbourne, Australia. 2001. £15.95 softback.

This guide covers all 379 mammal species, indigenous and introduced, living in Australia and its adjoining seas. The introductory chapters include details of how to use the guide, field techniques, a checklist and extensive identification keys. Throughout these chapters the reader is supplied with numerous simple line drawings to assist with field observation. The main habitat types are described through the use of twelve colour plates.

The main account follows. Here the left page provides details of each species – its description, range, distribution map, habitat, status, voice, behaviour etc – and on the opposite page a high quality colour illustration. By using a small, but very readable print, the text includes a remarkable amount of useful ecological information, often supplemented with small drawings highlighting diagnostic identification characteristics.

The book is compact and readily transportable in the field, with a format that makes for quick and easy identification of the more conspicuous mammals. The guide will certainly enable identification of the smaller species such as dunnarts, bats and rodents but inevitably these will need to be close at hand. This is an excellent, inexpensive field guide, essential for any naturalist visiting Australia.

MJD

The Nature of Mediterranean Europe: an ecological history by **A. T. Grove and Oliver Rackham.** Pp. 384, with 123 b/w illus. + 245 colour plates. Yale University Press, 2001. £45.00 hardback.

This substantial book represents the fruits of several research programmes funded by the EU over the past two decades. It is based on fieldwork by the authors and their collaborators in many parts of Mediterranean Europe and includes a large number of detailed case studies. The coverage is very wide, from geology and climate to erosion and water resources. The first thirteen chapters cover the physical geography, ecology and ecological history of the region. The last seven chapters focus on the specific issues of erosion and desertification. The major theme is that many previous writers have assumed Mediterranean landscapes to be the result of human mismanagement – the 'Ruined Landscape Theory'. Much of the book is aimed at showing this theory to be unfounded and revealing the intricate balance between geology, climate, vegetation, soils and land-use. The authors find little evidence to support the notion that the area is currently undergoing desertification or suffers from a major problem of soil erosion. They discuss the role of deluges, both in historical times and at the present day, and show these unpredictable events to be a major force in shaping the landscape.

The book is written in an accessible style with a minimum of technical jargon. The bibliography is impressive, including many historical sources, and there are good footnotes throughout the book. It is lavishly illustrated with superb photographs and numerous useful maps and diagrams. The standard of presentation is very high. This is a weighty tome and on the pricey side, but it is a mine of fascinating information for naturalists, geographers and historians. The authors have, perhaps, overstated their case against 'Ruined Landscape Theory', references to which occur throughout the book with tedious frequency. However, the refreshing, field-based approach makes for stimulating reading, even though at times it leads to sweeping statements and over-generalisation. Not everyone will agree with the authors' conclusions but this is certainly a book that should be read by all serious scholars of Mediterranean Europe.

MAA

Scotland's Nature & Wildlife by **Kenny Taylor.** Pp. 224, with full colour illus. 2002. Lomond Books, Edinburgh. £15.00 hardback.

Lovers of nature will find much to interest and instruct them in this book. Scotland is a country with many different types of habitat and a rich diversity of wildlife. Kenny Taylor, with decades of experience behind him, first discusses what to look for, covering plants, birds, mammals, insects and amphibians, when to find each species seasonally, and where you might best expect to see them. The wildlife of eight regions of Scotland is described individually, and the text is supported by clear maps and, where appropriate, further notes on sites of special significance. While not a field guide, it is one of the most comprehensive popular guides to Scotland's wildlife. The book is lavishly illustrated throughout with stunning photographs by some of the country's leading wildlife photographers. It is an attractive book to browse through, and an instructive reference and travelling companion.

DAC

THE DAWN CHORUS AND HOW ITS SINGERS ARE CONDUCTED

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That the species of birds which contribute to the dawn chorus do not all begin to sing at the same time has long been known, and the sequence in which they do so has been referred to in various places. An example is provided by the work of the Leeds Naturalists' Club, some of whose members spent a night in the Washburn Valley in 1935 recording the times at which different species began to sing or call. The results of their observations were reported in *The Naturalist* by Grist (1935). It was particularly noted that the chorus was not made up of all species singing simultaneously but that, for the most part, the various species replaced each other sequentially. Moreover, as Armstrong (1963) noted in his remarkable book *A Study of Bird Song*, in spite of the inevitable variations and anomalies, "the order in which different species sing in the morning remains remarkably constant". The Sky Lark, *Alauda arvensis,* which of course is a contributor only in suitable habitats, is an early riser (as the Leeds Naturalists found) and Common Redstart, *Phoenicurus phoenicurus,* Blackbird, *Turdus merula,* Song Thrush, *T. philomelas,* Wood Pigeon, *Columba palumbus,* Robin, *Erithacus rubecula*, Wren, *Troglodytes troglodytes*, House Sparrow, *Passer domesticus*, Common Bullfinch, *Pyrrhula nesa*, and Common Chaffinch, *Fringilla coelebs*, generally begin to sing in that sequence. Armstrong drew attention to the fact that vermivorous and insectivorous species were early risers (was the coiner of the saying 'the early bird catches the worm' aware of this?) and, apart from pigeons, grain-eaters tend to be late risers. The explanation involves the acuity of vision and the behaviour of the prey of the early risers, some components of which are most readily available early in the morning. In essence, it implies that the order in which species begin to sing is related to differences in their ability to see at low light intensities. There is no point in a bird becoming active before it can see well enough to perform essential tasks effectively, though it may be advantageous to begin to sing while light intensity is still too low to enable it to forage profitably. By so doing it may be able to advertise, or indulge in vocal defence of, its territory for a short period without impinging on the time devoted to those vital activities for which vision is essential.

Armstrong noted that "the times when birds arise and roost, and consequently are first heard in the morning and last heard in the evening, are related to their foraging behaviour as well as to light intensity". He then went on to make the remarkably perceptive observation that "So closely related is the relative size of some birds' eyes to the length of daily activity that in some instances one might make a fair estimate by looking at its eyes as to whether the bird sings early or late in the dawn chorus". He cited as examples that the early rising Common Redstart, Black Redstart, *Phoenicurus ochruros,* and Robin have larger eyes than the late rising House Sparrow, and noted that these early risers are insectivorous and adapted for foraging in dim light. The Sky Lark is to some extent an exception in that it eats both invertebrates, especially in summer, and vegetable matter. As Armstrong says in a different context, "There are few principles of bird behaviour to which some species do not conform"!

Thomas *et al.* (2002) have now tested the relationship between the times at which different species begin to sing and visual capability at low light intensities – which is related to eye size – and have confirmed the validity of Armstrong's belief. Both visual sensitivity (the ability to detect light at low intensities) and visual resolution (the ability to distinguish detail at a given light intensity) can be enhanced by an increase in pupil aperture, in combination with other changes that need not concern us here. An increase in pupil aperture can be achieved by an increase in eye size. The larger an eye, the larger can be the diameter of its pupil.

Thomas *et al.* (2002) confined their study to passerine birds. The times at which different species began to sing was ascertained from 40 sets of observations on bird communities at seven sites, five in England or Wales, one in Portugal, and one in Switzerland. The number of species involved at a site ranged from 8 to 23. At two sites ambient light intensity was measured throughout the singing period. Maximum pupil diameter was estimated by measuring the diameter of the exposed eye surfaces, which could be done by dial callipers to an accuracy of 0.1 mm. As the relationship between eye size and body size is important, body mass was also recorded by simple weighing. Although the sequence in which the species began to sing was not reported for any site, it was found that, as Armstrong had observed, species with large eyes began to sing at lower light intensities, i.e. earlier, than those with small eyes. The relationship was stronger when differences in body size were allowed for by statistical procedures. As the authors say in the precise but arid language of science, the results "provide robust support for the hypothesis that visual capability at low light levels influences the time at which birds start to sing at dawn". To the naturalist, their comment that "our results do not necessarily imply that large eyes have evolved to allow a bird to start singing earlier at dawn" seems self-evident, and unnecessary. Known examples of echo location (the Oil bird and Cave Swiftlets) notwithstanding, vision is the key sense in birds, without which they would be helpless. The time at which they begin to sing at dawn, while probably of some selective significance, must surely be a secondary exploitation of more important advantages of a particular eye size that operate throughout every day of the bird's life. Moreover, singing is predominantly a male activity.

The contrast between Armstrong's observation and its testing almost 40 years later throws into relief some of the differences between inspired, well-informed, natural history and modern science. He used no technical apparatus, made no measurements, conducted no experiments, and was able to make his deductions single-handedly because of his intimate familiarity with the animals concerned; the recent study, which is in no way denigrated, was carried out by seven collaborators from five institutions, who set out to test a specific hypothesis, used technical apparatus, and had recourse to statistical tests involving such things as regression coefficients – and confirmed what Armstrong had already concluded. The latter's observational skills and insight were both impeccable. This does not mean that testing them was not necessary. It does, however, show that, in essentials, insight and the approach of the naturalist can sometimes be just as revealing as elaborate scientific tests.

Thomas *et al.* (2002) revealed the interesting fact that small birds begin to sing at lower light intensities than large birds of equivalent eye size. Among possible explanations is that an early start to the day's activities in small species may reduce the risk of night starvation. Small birds often lose 5-10% of their body weight overnight, and even more during long, cold, winter nights, though they are not usually singing much at this time, and require larger energy reserves, relative to body mass, than do larger birds. The need to devote the maximum amount of time to foraging in order to build up fat reserves to carry them through the following night is therefore particularly important in small species, and is helped by early rising.

As a footnote to the timing of the dawn chorus it might be noted that, not surprisingly (though it has interesting physiological and evolutionary implications), nocturnal birds react to light intensity in the opposite way to diurnal species. As long ago as 1769, Gilbert White, writing to Thomas Pennant (in a letter included in *The Natural History of Selborne*) referred to the European Nightjar, *Caprimulgus europaeus,* as being "most punctual in beginning its song exactly at the close of day; so exactly that I have known it strike up more than once or twice just at the report of the Portsmouth evening gun, which we can hear when the weather is still". Although the time at which the Europaean Nightjar begins its song in fact varies considerably according to the intensity of the light, beginning later on moonlight nights (Ashmore, 1935), this was a perceptive observation. Was it the earliest relating to the matter?

Edward Armstrong (1900-1978) was a splendid example of the scientifically minded amateur naturalist, and indeed one of the long line of parson-naturalists. In 1942, while ministering in parishes in industrial Yorkshire, he produced a book on bird display, of which an enlarged edition appeared five years later under the title *Bird Display and*

Behaviour. This was sufficiently appreciated to be re-published with revisions and a new foreword as a Dover edition in 1965. This and his book on bird song were but two of his many contributions to ornithology. Although he reproduces his father's portrait in a recent book on parson-naturalists, his son is modest about his achievements (Armstrong, 2000). Edward Armstrong was, however, a first rate naturalist and an outstanding student of birds, whose understanding of what determines the sequence of singers in the dawn chorus was but one example of his abilities.

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Y.N.U. BRYOLOGICAL SECTION: ANNUAL REPORT 2000-2001

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Excursions

The spring meeting in 2001, which had been planned for Upper Teesdale, had to be cancelled because of the outbreak of foot and mouth disease. The remaining sectional meetings were held as follows:

Spring 2000: Roulston Scar and Caydale (VC62), 6 May (JMB)

A party of five assembled at the White Horse car park on a fine sunny day. The morning and early afternoon were spent on Roulston Scar with the agreement of Forest Enterprise, and in the afternoon the upper end of Caydale was visited, also with the permission of the owner, to whom we extend our thanks.

Roulston Scar. The purpose of the visit was to examine the steep slopes below the limestone cliffs. The area was visited by the British Bryological Society in 1967 and it was hoped to refind many of the species seen on that occasion. We were soon examining the rocks by the forestry track below the scar. Besides common species such as *Bryum capillare* and *Mnium hornum*, the calcicoles *Ctenidium molluscum, Eurhynchium pumilum, Hypnum lacunosum* var. *lacunosum* and *Neckera complanata* were present. The tiny moss *Seligeria recurvata* was growing in sizeable patches here with its distinctive curved seta.

The slopes were accessed from the path which rises diagonally from the forestry track. The vegetation was well advanced and we were hampered in places by bramble thickets. The slopes had an excellent covering of bryophytes with large patches of *Ctenidium molluscum, Dicranum majus* and *D. scoparium, Eurhynchium striatum, Thamnobryum alopecurum, Thuidium tamariscinum*, and the three species of *Rhytidiadelphus, R. loreus, R. squarrosus and R. triquetrus. Mnium stellare* and *Tortella tortuosa* were also present.

Shaded limestone high up on the slopes produced the best finds. Tom Blockeel spotted *Leiocolea alpestris*, a liverwort recorded in only two sites before in North East Yorkshire, in the Osmotherley and Kepwick areas in 1967. Close by *Tritomaria quinquedentata* was seen in small quantity on rocks, only the second sighting in the vice-county.

Some time was spent comparing *Neckera complanata* with *N. crispa. Eucladium verticillatum* was growing on damp limestone and the liverworts *Aneura pinguis, Apometzgeria pubescens, Frullania tamarisci, Porella platyphylla, Riccardia chamedryfolia* and *Scapania aspera* were seen. The few elders on the slopes had *Orthotrichum affine, O. diaphanum* and *Zygodon viridissimus* var. *viridissimus*.

The area should repay a further visit, perhaps in late winter before the vegetation has developed.

Caydale. The afternoon was spent in the upper part of Caydale. This is also a limestone area with a stream flowing along the valley bottom fed from springs in Limperdale and King Spring Gills. In and by the stream three varieties of *Paulstriella commutata (Cratoneuron commutatum)* were seen, var. *commutata,* var. *falcata* and var. *virescens*, the last of these being only the fourth sighting in the vice-county. The marshy areas higher up had *Plagiomnium elatum, Bryam pseudotriquetrum* and *Drepanocladus cossonii.* King Spring at the western end of the valley was very rewarding, the limestone rocks and tufa producing *Bryam pallens, Didymodon fallax, Eucladium verticillatum, Leiocolea badensis* and *Preissia quadrata*.

This was a most rewarding day, with a total of 123 species recorded.

Autumn 2000: Brockadale, Wentbridge (VC63), 14th October (TLB)

Brockadale is one of the premier botanical sites in South-west Yorkshire, and a number of interesting bryophyte records were made here in the 1970s. The aim of the present visit was to assess the current status of the flora.

The visit began from the Leys Lane car park. By the footbridge over the R. Went, a large waterside tree produced *Syntrichia (Tortula) latifolia* and *Leskea polycarpa*, two characteristic riparian species growing in the flood zone. Damp woodland nearby was interesting for its epiphytic species on *Salix*. These included plentiful *Orthotrichum affine* and *O. diaphanum*, and smaller amounts of *Ulota bruchii* and *U. phyllantha*. The *Ulota* species were unknown in this district in the 1970s, and the *Orthotricha* very rare. They have clearly recovered in recent years with improvements in air quality. Also noted as epiphytes were *Dicranum tauricum* and *Bryum laevifilum (B. flaccidum).*

Some time was spent examining the limestone outcrops in the wooded parts of the valley. Among the species recorded were *Jungermannia atrovirens, Plagiochila asplenioides, Fissidens gracilifolius, Tortella tortuosa, Trichostomum brachydontium, Gymnostomum calcareum, Tortula marginata, Mnium marginatum, M. stellare, Plagiomnium cuspidatum, Eurhynchium pumilum and Taxiphyllum wissgrillii.* Several of these species are regionally rare, and the *Gymnostomum* is nationally scarce. On the north side of the valley, bare earth in the grassland near Brockadale Plantation produced some tiny ephemerals, including the delightful *Microbryum rectum (Pottia recta)* and *M. davallianum (P. starckeana* ssp. *conica)*. The exposed south-facing crags in the Plantation are noted as a station for the tiny moss *Gymnostomum viridulum*, a southern species growing here near its northernmost limit in Europe. It was refound in rather small quantity on thin soil on rock slabs. *Aloina aloides* was associated with it. Other species on the rocky slope included plentiful *Trichostomum crispulum* and some *Pseudocrossidium revolutum (Barbula revoluta).*

78 species were recorded within the YWT Reserve, and it was pleasing to find that many of the noteworthy bryophytes of the valley are still present. Although some of the previously known species were not seen, this is hardly surprising in such an extensive area and it would be premature to conclude that they have disappeared.

Autumn 2001: Morton Wood and Reynard Clough, Hepworth (VC63), 13th October (TLB)

The excursion to these sites near Hepworth were prompted by two notable discoveries made here recently by Mr R. A. (Bob) Finch. Morton Wood is a linear stretch of woodland along a stream bank on shale and grit. The flora is calcifuge, and the richest places were by the stream. Among the species growing in and near the water were *Racomitrium aciculare, Brachythecium plumosum* and *Hyocomium armoricum*. Small quantities of *Heterocladium heteropterum* and *Scapania nemorea* were present on one boulder. In places there are low cliffs of shale/grit, and here we found *Pohlia annotina* and *Jungermannia pumila*. Following Bob Finch's directions, we were easily able to locate the two boulders which support *Hygrobiella laxifolia,* a very slender liverwort, growing here in a alga-like form on the moist surface of the grit rock. When found here in 1999, it was a new species for the vice-county. It is known from a few places in the High Peak of Derbyshire, but may be overlooked elsewhere in the South Pennines. We recorded in the wood until lunchtime, noting 43 species.

Reynard Clough is situated on the moorland edge, 3 km south-west of Hepworth. It is bordered on both sides by conifer plantations, and in the absence of grazing the vegetation is becoming rather overgrown. *Jungermannia sphaerocarpa* was by the stream, and a tuft of *Orthotrichum pulchellum* was seen growing on a sallow bush. The north-facing sides of the clough are damp, and have cushions of *Sphagnum rossowii* and *S. fimbriatum*. There were several good patches of *Calliergon stramineum* mixed in with the grass and dwarf shrubs, and some *Dicranum majus*. An unexpected find in this habitat was a small patch of *Rhytidiadelphus loreus*, a very rare species in the South Pennines. *Barbilophozia atlantica* and *Pogonatum urnigerum* were noted on thin soil on an open shale bank. In the upper part of the clough, near the footbridge, we searched for *Lepidozia pearsonii*, the second of Bob Finch's notable discoveries. We found several patches, on damp ground under heather and bilberry. *L. pearsonii* is a more slender plant than the common *L. reptans*, and it may be passed over as an etiolated form of that species. However it is distinguished by the presence of male inflorescences on lateral branches, and these were subsequently confirmed in the material that we found. *L. pearsonii* has a strongly 'Atlantic' distribution, and before its discovery at Reynard Clough it had not been seen in the South Pennines for more than a century. It is likely that it has been overlooked and that it will be found in further sites. We recorded 56 species in the clough and on the walls at its foot.

Records

There has been an increasing influx of records, especially from South Yorkshire, providing further evidence for the recovery of epiphytic species following reductions in the levels of SO_2 pollution. Particularly notable in VC63 are the first known records for *Orthotrichum lyellii*, and the first for *Cryphaea heteromalla* since 1860. In VC64 *Syntrichia papillosa* has been refound after an interval of more than a century.

During 2000 and 2001 all the known stations for *Tortula cernua* (*Desmatodon cernua*, the flamingo moss) have been surveyed as part of Plantlife's *Back from the Brink* project. This nationally rare moss is a specialist colonist of lime waste, and it has decreased from loss (and lack of renewal) of its habitat in quarries and near lime-kilns. Although it has gone from many of its old sites, there are seven surviving populations in VC63, and one just across the Derbyshire border in VC57. These are the only sites known to be extant in Britain.

The list below includes new vice-county records and other records of note. An asterisk indicates a new or updated vice-county record. Recorders' initials: TLB = T. L. Blockeel; JE = J. Egan; HL = H. Lake.

Aloina aloides: (61) 54/02 steep chalk bank, Hessle Chalk Pits, TLB, 10th November 2001.

Aloina ambigua: (63) 43/58 bare disturbed ground, Lindrick Common, TLB, 28th October 2000; 43/59 disturbed calcareous ground, old railtrack, west end of Conisbrough Viaduct, TLB, 3rd November 2000; (64) 44/43 stony soil, levelled ground on Magnesian Limestone, Peckfield Lane, Micklefield, TLB, 17th November 2000.

Amphidium mougeotii: (63) 43/28 dripping rocks, streamside cliff, Rivelin valley, TLB, 9th December 2000.

Brachythecium glareosum: (63) 43/58 old spoil heap, old Magnesian Limestone quarry, Lindrick Common, TLB, 3rd November 2000.

Bryum algovicum* var. *rutheanum: (63) 43/58 low limestone wall, Roche Abbey, TLB, 19th May 2001.

Bryum radiculosum: (61*) 54/02 mortar of brick wall, Hessle, TLB, 10th November 2001.

Cephaloziella rubella: (63) 43/28 gritstone clough, Wyming Brook, HL, 11th February 2000.

Conardia compacta (Amblystegium compactum): (63) 43/58 ledge on rock cutting, edge of Moses Seat Wood near Monk Bridge, Lindrick Common, TLB, 28th October 2000.

Cryphaea heteromalla: (63*) 43/38 on elder by sheltered stream, Porter Brook, near Hanging Water, Sheffield TLB, 25th March 2001; 43/29 Underbank Reservoir, HL, 31st June 2001, 43/38 on willow, Shire Brook, Hackenthorpe, HL, 11th June 2001; 44/50 on *Salix*, bank of R. Don, near Sprotbrough Bridge, TLB, 24th November 2001; the only previous record of this pollution sensitive epiphyte in VC63 was made in 1860! (64) 44/36 on elder, long disused limestone quarry, Quarry Moor, Ripon, TLB, 12th October 2001; 44/26 on elder, stream bank, Fountains bridge, TLB, 24th July 2000.

Didymodon acutus (Barbula acuta): (64) 44/43 stony calcareous ground, quarry margin, Newthorpe Quarry, Micklefield, TLB, 17th November 2000.

Distichium capillaceum: (63) 43/58 on low wall, Roche Abbey, TLB, 19th May 2001.

Distichium inclinatum: (63*) 43/58 seasonally wet ground, old Magnesian Limestone quarry, Lindrick Common, TLB, 28th October 2000.

Ditrichum flexicaule s. str.: (63*) 43/58 rock ledge, old shallow quarry, Lindrick Common, TLB, 28th October 2000.

Fissidens adianthoides: (63) 43/58 about springs, old quarry on Magnesian Limestone, Brancliffe Lime Works, TLB, 18th November 2000.

Frullania dilatata: (63) 43/38 Shire Brook, Hackenthorpe, HL, 11th June 2001; 43/38 tree bole, wooded stream banks, Limb Valley, HL & JE, 28th December 2001; 43/58 on ash, canal banks, Kiveton Park, TLB, 24th November 2001.

Jungermannia hyalina: (63) 43/28 stone in wooded stream, Royd Clough, HL, 26th May 2000.

Leiocolea alpestris: (63) 43/58 overgrown quarry face, woodland on Magnesian Limestone, Hawks Wood, TLB, 25th November 2000.

Lophozia perssonii: (64) 44/43 stony soil, levelled ground on Magnesian Limestone, Peckfield Lane, Micklefield, TLB, 17th November 2000.

Metzgeria fruticulosa: (63*) 43/38 tree bole, wooded stream banks, Limb Valley, HL & JE, 28th December 2001; (64) 44/26 on elder, stream bank, Fountains bridge, TLB, 24th July 2000.

Microbryum curvicolle (Phascum curvicolle): (64) 44/43 stony soil, levelled ground on Magnesian Limestone, Peckfield Lane, Micklefield, TLB, 17th November 2000.

Microbryum rectum (Pottia recta): (63) 43/59 disturbed calcareous ground, old railtrack, west end of Conisbrough Viaduct, TLB, 3rd November 2000; (64) 44/43 stony soil, levelled ground on Magnesian Limestone, Peckfield Lane, Micklefield, TLB, 17th November 2000.

Orthotrichum lyellii: (63*) 43/29 tree branch 2-3 ft above water, reservoir margin, Broomhead Reservoir, HL, 31st January 2001; 43/29 on *Salix*, Underbank Reservoir, HL, 31st August 2001; 43/58 on ash, canal banks, Kiveton Park, TLB, 24th November 2001.

Orthotrichum pulchellum: (63) 43/28 on *Sambucus niger*, stream valley on millstone grit, Wyming Brook, JE, 25th May 2001; (64) 44/26 on elder, stream bank, Fountains bridge, TLB, 24th July 2000.

Orthotrichum stramineum: (64) 44/26 on elder, stream bank, Fountains bridge, TLB, 24th July 2000

Pohlia camptotrachela: (63) 43/29 Underbank Reservoir, HL, 31st August 2001; 43/29 Damflask Reservoir, HL, 5th September 2001; 43/29 Broomhead reservoir, HL, 11th September 2001; 43/29 Agden reservoir, HL, 17th October 2001.

Pohlia drummondii: (63) 43/29 exposed mud, Damflask Reservoir, HL, 5th September 2001.

Ptychomitrium polyphyllum: (63) 43/29 on wall, Midhope, HL, 9th November 2001; 43/29 on wall, Ewden Bridge, HL, 11th September 2001.

Scapania aspera: (63) 43/58 rock ledge, old shallow quarry, Lindrick Common, TLB, 28th October 2000.

Scapania nemorea: (63) 43/28 on grit boulders near stream, Black Brook, Rivelin valley, TLB, 9th December 2000.

Schistidium platyphyllum (S. alpicola* var. *alpicola): (63) 43/29 reservoir overflow, Morehall Reservoir, HL, 4th October 2000.

Syntrichia laevipila* var. *laevipila (Tortula laevipila* var. *laevipila): (64) 44/36 on elder by disused magnesian limestone quarries, Burton Leonard, TLB, 12th October 2001; (64) 44/26 on elder, stream bank, Fountains bridge, TLB, 24th July 2000; **var. *laevipilaeformis:*** (63*) 43/59 on *Salix*, subsidence flash, R. Don, Cadeby, TLB, 22nd September 2000.

Syntrichia papillosa (Tortula papillosa): (64*) 44/36 on elder by disused magnesian limestone quarries, Burton Leonard, TLB, 12th October 2001; last recorded in VC64 in 1895!

Tortula cernua (Desmatodon cernuus): (63) 43/58 weathered lime waste, old quarry on Magnesian Limestone, Brancliffe Lime Works, TLB, 28th October 2000; 43/58 bare alkaline waste, old Magnesian Limestone quarry, Lindrick Common, TLB, 28th October 2000; 43/59 weathered lime waste, old quarry on Magnesian Limestone, Nearcliff, eastern end of Conisbrough Viaduct, TLB, 15th December 2001.

Tortula lanceola (Pottia lanceolata): (63) 43/58 spoil heap, old quarry on Magnesian Limestone, Brancliffe Lime Works, TLB, 18th November 2000.

Ulota phyllantha: (63) 43/38 Shire Brook, Hackenthorpe, HL, 11th June 2001; 43/58 dead Salix bark, South Anston, JE & HL, 25th April 2001; 43/28 on *Sambucus*, Black Brook, Rivelin valley, TLB, 9th December 2000.

Zygodon conoideus: (64) 44/26 on elder, stream bank, Fountains bridge, TLB, 24th July 2000.

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BOOK REVIEWS

The Origin of Plants by **Maggie Campbell-Culver.** Pp. 260, incl. numerous colour plates. Headline, London. 2001. £25.00 hardback.

This rather ambiguous title, clarified by the subtitle 'The People and Plants that have shaped Britain's Garden History since the year 1000', is an evocation in words and illustrations of plants introduced to this country. An anthology of garden history, it traces the provenance of many of the plants we take for granted; on a century-by-century basis, the author demonstrates, with the aid of contemporary paintings and modern photography, the enrichment of our botanical heritage. An introductory chapter touches on such subjects as early treatises on plants, the slow development of our indigenous plants for food and medicine, the rapid importation of plants through trade and exploration, and the creation of botanic gardens. Each chapter, including one entitled "Setting the Scene" which covers the period prior to 1000 AD, closes with a fascinating chronological list of plant introductions. Comparisons will undoubtedly be drawn with John Fisher's *The Origin of Garden Plants* (Constable 1982), but that work lacks the attractiveness and more detailed content of Campbell-Culver's beautifully illustrated book which is strongly recommended not only to botanists and gardeners but also to those interested in the history of the British landscape.

VAH

Lichens of Antarctica and South Georgia. A Guide to their Identification and Ecology by **D. O. Ovstedal** and **R. I. Lewis Smith.** Pp. xii + 411 (incl. 48 b/w plates & line drawings), plus 32 pp. colour plates. Studies in Polar Research, Cambridge University Press. 2001. £70.00 hardback.

This unique terrestrial environment, dominated by non-vascular plants, has been extensively researched in recent years, and although much has been published on its lichens, guides to their identification are limited. Useful monographs by Lamb on some genera and by Lindsay on the macrolichens of South Georgia require updating, and Dodge's *Lichen Flora of the Antarctic Continent and Adjacent Islands* (1973) has been strongly criticized: although it covered 415 taxa, based on herbarium studies, more than half of these proved to be synonyms of species described from elsewhere. Redon's *Liquenes Antarcticos* (1985), also based on herbarium studies, contains limited original material and is less widely available.

The present work is therefore a most welcome identification guide covering 427 taxa (33.5% endemic to Antarctica), with keys to generic and specific level, the latter rather interestingly being easier to follow than the former. Taxonomic treatments, in alphabetical order, are sometimes accompanied by line drawings and black-and-white photographs, but the colour plates are of variable quality and do not do justice to the spectacular flora.

Although large areas of Antarctica have yet to be lichenologically explored, and some locally important crustose genera (e.g. *Lecanora, Lecidea* s. lat., *Rhizocarpon)* require more detailed treatment, the authors are to be congratulated on compiling not only a useful identification guide but also a rich source of biogeographical, ecological and bibliographical material on this unique environment. It is an absolute must for the polar lichenologist, but at this price many users will only be able to consult library copies.

MRDS

YORKSHIRE NATURALISTS' UNION EXCURSIONS IN 2000

Compiled by
A. HENDERSON AND JANETTA LAMBERT

BROUGH (VC61) 20 May (P. J. Cook)

Introduction (G. Morrell)

On the morning of the walk a little rain was forecast but the weather turned out sunny and quite warm. The group, numbering about 10, gathered at 10.30 a.m. as arranged at the Ferry Inn pub close to the River Humber. Before setting off, the different habitats to be found and the best routes were outlined, with emphasis on those preferential for various groups and individual interests. Just to the north of the village lies the southern tip of the Yorkshire Wolds with chalk grasslands and woodlands, but it was decided to take a circular 4-mile route around the southern side of the airfield towards the disused and flooded gravel workings which lie adjacent to the River Humber bank.

Accordingly, members headed together towards the River Humber, at which point the majority turned east along the bank whilst the coleopterists went west to search the brackish-water creeks. Soon each specialist was finding something of interest. A clutch of Mallard eggs was found on the end of a washed-up plank in the reed-bed, and, over the next few weeks, the author of this note, a local naturalist, was able to keep an eye on them, being rewarded by being there when the eggs hatched. As members moved further eastward, all sorts of flora and fauna were discovered: Annual Wall Rocket, Fallow Deer on Reeds Island, rare snails and insects.

Lunch was enjoyed sitting on the bank almost opposite Reeds Island, from where the Fallow Deer could be watched through a telescope. Afterwards members set off back along the track between the disused gravel workings before turning west along the northern side of the airfield.

The route back to the Ferry Inn pub and the tea meeting was through the village and alongside the railway line, the wall colonised by a species of polypody. After the welcome chips and sandwiches laid on at the pub, the day's foray closed with reports and discussion of the activities and finds of each section, with a number of the specimens collected during the day being passed around.

Mammals (C. A. Howes)

The Humber bank is an extremely popular dog-walk, the huge daily contributions of dog excrement providing a food substrate for coprophagous diptera, coleoptera and fungi, perhaps rivalling the estuary strand-line as a major ecological influence.

Grey squirrels were present in the trees and gardens of urban Brough. Mole hills were frequent in lawns and agricultural land. Drain banks and hedge bottoms held Rabbit warrens and Common Rat colonies. Bold and obtrusive Common Rats were much in evidence feeding on picnic scraps in the Brough Haven Car Park. Good views were enjoyed of Brown Hare sprinting across flooded grazing-land. Roe Deer secreted by day in copses were seen at a distance but were regular quarry to local shooters. Watercress beds in a briskly running chalk stream produced Water Shrew; Water Voles were evidenced by their droppings and the grazed lawns they had left behind them; a sluggish ditch adjacent to the aircraft factory held Three-spined Sticklebacks; and Common Frogs were in wet grassland.

Anglers at the local flooded clay pits were catching Bream, Chub, Eel, Flounder, Perch, Roach and Tench.

Ornithology (W. F. Curtis)

The ornithological members of this meeting concentrated their efforts along the Humber Estuary from the car park immediately to the west of the British Aerospace factory eastwards to Welton Water. The first stretch consisted of the raised river bank with a narrow fringe of reeds where Reed Bunting, Reed Warbler and Sedge Warbler were in evidence along with three species of finch. Small numbers of Shelduck were noted offshore, whilst a lone Grey Heron fished along the edge of the reeds. To the east of the factory the short-cut grass of the airfield attracted several corvid species together with Pied Wagtail, Yellow Wagtail and Lapwing. A nearby, small flooded area revealed a single pair of Moorhen with young. Towards the eastern end of the airfield a large (*c*.4 hectares) flooded area caused, according to a local resident, by the collapse of the field drains, held a veritable wealth of wildfowl. Amongst those recorded were three pairs of Great Crested Grebes, two with young; some four Little Grebes; several each of Garganey; Gadwall; Ruddy Duck; Pochard; Tufted Duck; Shoveler; Mallard; Grey Lag Geese, with goslings; Canada Geese; Mute Swan, with cygnets; and at least five species of waders including Black-tailed Godwit and Ruff. Arguably the crème de la crème was a Little Egret, still not a common bird in Yorkshire, though the Black Tern seen on the return walk must be a contender.

The area of bushes between the eastern boundary of the airfield and Welton Water produced a good array of passerines with five species of warbler plus Goldcrest, Long-tailed Tit and Song Thrush. In this same general area, Stock Dove and Kingfisher were observed whilst a Cuckoo was heard. Raptors reported were Sparrowhawk and Kestrel (and an Osprey recorded by a visiting bird-watcher). On returning to the car park some 25 Ringed Plovers were feeding on the mud exposed by the falling tide, together with a few Dunlin, Curlew and Redshank.

A total of 72 species was recorded.

CONCHOLOGY (A. NORRIS)

The molluscan records produced for the Brough area by John W. Taylor, W. Denison Roebuck, J. E. Crowther and William Cash on the occasion of the 1901 YNU visit to the area number 33 species. Most of these, however, came from the chalk wolds north of Brough. On this occasion we concentrated on the Humber foreshore, in particular the brackish pools, ditches and salt-marsh. The area only produced 20 species on the day, however, 10 of which do not appear in the 1901 list. It is interesting to note that, although the salt-marsh species would have been known to the 1901 party, they either did not look for them or they did not occur in that area at that time. The Dun Sentinel, *Assiminea grayana* and its associated species *Ovatella (Myosotella) myosotis* were both recorded from the River Humber at a later date. These two species were not known when Tom Petch produced his report, "The published records of the land and freshwater mollusca of the East Riding, with additions" (*Transactions of the Hull Scientific and Field Naturalists' Club* [1904]. A. Smith of York first recorded *Assiminea grayana* in the salt-marsh at Hessle on June 28 1950 (*Journal of Conchology* **23**(5): 134), where it was subsequently recorded as fairly common (A. Norris; March 28 1965 [TA54/005255]). A further search of the Humber bank produced a small colony on the salt-flats behind King George Dock, Marfleet, Hull on April 8 1966 (TA54/153285); no further colonies could be found. The original site at Hessle was destroyed in 1998-99 to safeguard the railway line that runs close to the shore at that point. A search on 10 April, 1999, of the area just east of Hessle (inaccessible in the 1960s as it was situated within the restricted area of the dock railway yards) produced a thriving colony of *Assiminea* and a few examples of *Ovatella.* Therefore when the opportunity arose to examine the salt-marsh east of Brough to see if these snails had extended their distribution further upriver, it was delightful to find that both species occurred, *Assiminea* in all three of the 1 km squares examined (44/9424; 9425 and 9326), and a single example of *Ovatella* in 9425. It would seem that these species are expanding up-river on the north bank of the River Humber. It would be interesting to know if the previously predicted changes in the tides within the Humber have made these habitats available, or if they have always been there in small numbers. It is hard to understand how the early collectors could have missed them.

Ovatella (Myosotella) myosotis is far more common and widespread, with a marine variety occurring on the east coast.

The main find on the landward side of the area was the first record for VC61 of the slug *Arion (Mesarion) flagellus*, which was found in the field being used as a landfill site.

LEPIDOPTERA (G. BOYD)

Butterflies and moths were not particularly abundant either in numbers of individuals or of species observed. Just six species of butterfly were seen, with the Green-veined White (*Pieris napi*), the commonest, followed by the Orange Tip *Anthocharis cardamines*. Three species of macro-moths and four species of micros were reported. Perhaps the most interesting record was a newly emerged specimen of the pyralid *Myelois cribrella* (Thistle Ermine) found by Miss J. Lambert. This used to be considered a south of England species, barely reaching Yorkshire, but in the last 20 years it has been recorded regularly from the county and indeed from as far north as Scotland. Whether this extension in range is real or apparent is not clear. Cleaner air or generally warmer weather could have induced the moth to spread northwards, but it may have been here all the time, overlooked because most lepidopterists have concentrated their attention on the larger moths.

HYMENOPTERA (M. E. ARCHER)

The species of aculeate wasps and bees recorded at Brough were graded as Common, Frequent, Occasional, or Rare, for Yorkshire.

These comprised five species of Bumble Bees, all Common: *Bombus lapidarius, B. pascuorum, B. hortorum, B. pratorum,* and *Psithyrus vestalis*; and four species of Solitary Bees: *Andrena scotica, A. haemorrhoa, Nomada marshamella*, all Common; and *Halictus tumulorum*, Frequent.

DIPTERA AND MISCELLANEOUS ORDERS (G. BOYD)

To invite a second-string lepidopterist to collect and collate field records for flies is rather like entering a cart-horse for the Grand National. Since it may well be another century before the Union visits Brough, the meeting co-ordinator decided that any records at all for this group would be preferable to complete silence. Perhaps she thought that, having recently retired from work, the recorder should be encouraged to do a little proper entomology rather than merely matching insects to pictures as many moth and butterfly men are alleged to do!

In the end the total list for the day (lodged with Miss Lambert) ran to 36 species from within seven insect orders. These included the damsel fly *Ischnura elegans*, the red and black leaf hopper *Cercopis vulnerata*, the common earwig and fifteen assorted species of fly. The two most striking specimens, circulated as members of the party enjoyed their sandwiches on our return from the field, were the lovely picture-winged fly *Euleia heraclei* and the large snipe fly *Rhagio scolopaceus*. (The latter was erroneously introduced to members as a vicious biting Tabanid; later determination proved it to be a perfectly innocuous beast, although in a closely related family.)

The diptera collected were almost all of species both widespread and common, the only exceptions being the hover-flies *Platycheirus fulviventris* and *P. immarginatus*. These are said to frequent, respectively, "lush open marsh" and "brackish marsh on the coast or along tidal reaches of rivers" (Stubbs & Falk, 1983). The habitat at Brough is clearly appropriate for both species. The species are superficially extremely similar and it was only after the two male specimens had been pinned and set so that the front legs could be examined under magnification that it was realised that they were not duplicates – which was particularly pleasing, neither having been previously taken.

PLANT GALLS (J. & K. G. PAYNE)

Mr A. Henderson found the gall-causing aecial stage of *Puccinia phragmitis* on *Rumex crispus* and of a *Phragmidium* (almost certainly *mucronatum*) on *Rosa* sp. Miss J. Lambert collected the terminal bud gall of the cecidomyid *Rhabdophaga rosaria* on *Salix* sp.

(Willow bushes by the Humber bank path at Brough).

The galls listed below were all found by Mrs J. Payne in the area of the Humber Bridge car parks (54/0126).

Most interesting was an abundance of sloes distorted by the fungus *Taphrina pruni*: hardly a single normal fruit was to be found. The whiteness of the distorted fruit was obvious at *c.*100 metres distant. Besides this there were *Puccinia punctiformis* on field thistle (plants spindly and pale green); *P. malvacearum* on a mallow (distorted leaf veins); *Podosphaera clandestina* on young hawthorn shoots; *Phytoptus avellanae* on hazel (swollen, mite-filled buds); and *Aceria stenaspis* on beech (narrow rolling of leaf edge).

ARACHNIDA (C. A. HOWES)

The windswept beds of *Phragmites* and *Agropyron* along the Humber shoreline produced only small numbers of *Clubiona phragmitis, Pachygnatha clercki* and *Bathyphantes concolor*. However, Lycosid (wolf) spiders were abundant, stalking insects settling on the Humber mud and strand-line flotsam. These included *Pardosa hortensis* and *pullata* on the higher shore, whereas the less vegetated mud subject to regular inundations produced the salt-marsh specialists *Pardosa purbeckensis* and *Xerolycosa miniata*. Tussocky vegetation in terrestrial situations in the lea of the flood embankment held good numbers of *Tetragnatha extensa* and *Larinioides cornutus*.

BOTANY (R. MIDDLETON)

Although the meeting in 1900 appears to have ranged further afield and into the Wolds valleys, it was decided that a perambulation of Brough Airfield would be more appropriate and would still sample several habitats. The waste places of Brough supported the usual mix of urban weeds although the members attending the 1900 meeting would have been unlikely to encounter either *Senecio squalidus* or *Lepidium draba*.

At Brough Haven the upper intertidal mud was dominated by a stand of *Bolboschoenus maritimus*. Along the upper shore to the east a good selection of halophytic species was found, including *Glaux maritima, Apium graveolens, Plantago maritima* and *Aster tripolium*. An unusual Scurvygrass was collected and later examined by Mr P. Cook who was of the opinion that it was a *Cochlearia x hollandica* backcross, resulting from hybridisation between *C. anglica* and *C. officinalis*.

Although full access to the extensive grassland of the airfield was not available, examination of its margins did reveal some of the plants that might have been expected – *Stellaria graminea, Lathyrus pratensis, Centaurea nigra, Carex hirta* and *Cynosurus cristatus*. Limited examination of the main body of grass, *via* the public footpath which bisects the field, proved rather disappointing, revealing that it had been much 'improved' and that the margins were actually a relic of an earlier state.

To the north of the airfield the light sandy soils provided a fine display of arable weed species including *Spergula arvensis, Viola arvensis, Anchusa arvensis* and *Amsinckia micrantha*. The latter taxon, although now a well established, widespread and often abundant element of the local cornfield flora, did not arrive in Britain until the early years of the 19th century or the vice county until the 1960s.

The final surprise of the afternoon was a superb display of the locally infrequent fern *Asplenium ruta-mutaria*, which had comprehensively colonised a south facing wall adjacent to Brough railway station.

MYCOLOGY (J. PAYNE)

The following non-galling fungi were collected by Mrs J. Payne: *Puccinia cnici* on *Cirsium vulgare*; *Entyloma ficariae* on *Ranunculus ficaria* and *Peronospera niessleana* on *Alliaria petiolata*.

LICHENOLOGY (A. HENDERSON)

The riverside walk along the airfield's southern boundary produced no lichenological surprises: some common *Cladonia* species with many squamulose patches; and a few crustose species on pebbles and stone banking, the most interesting being *Thelidium minutulum* with its very tiny immersed spherical pyrenocarps on harder calcareous substrates. *Xanthorion*, best seen here on the wooden pier, was to be a feature of the day's flora on fencing and in hedgerows. As we turned northwards on the track to Melton Common, *Rosa* branches were quite yellowed by invading *Xanthoria parietina*, *X. polycarpa* and *X. candelaria* on a background of grey *Physcia* and *Amandinea punctata*. Hedgerows and copse along the path east of the airfield had the *Xanthorion*-influenced *Parmelietum* now typical of such agricultural, suburban-outskirt areas, with occasional *Usnea subfloridana* and *Ramalina farinacea*. As the trackway to the north of the airfield crossed an old airfield path of concrete and asphalt, *Caloplaca crenulatella* was locally common. This species, only recognised as a distinct entity in this country in the last few years, appears to have one of its headquarters on disused airfield runways and tracks throughout Britain, often covering many square metres of runway. Moss-covered patches of such worn asphalt surfacing had *Collema tenax* var. *ceranoides* nestling almost hidden among spreading *Hypnum cupressiforme*. All in all, a day spent renewing acquaintance with lichens typical of our increasingly 'suburbanised' landscape.

OLDSTEAD (VC62) 10 June (J. M. Blackburn)

Introduction (J. M. Blackburn)

It was on a fine warm day that 28 members assembled on the grass verge of the track leading to Cockerdale Farm, Oldstead. Forest Enterprise had given permission to visit Cockerdale and Great Cockerdale Wood, whilst the fields surrounding Cockerdale Farm were all open access.

This meeting did not replicate a Union meeting in 1902, but it was a day for making comparisons. In 1902 the Union met at Coxwold station and walked from there on a day which provided one or two heavy showers. They reached Oldstead from a lane by Kilburn Thicket where the party divided into two groups, one party going up to Scotch Corner and Roulston Scar and the other up Oldstead Bank. The two groups merged again near Kilburn before returning to Coxwold. Our own party arrived at the start by car, of course, and Roulston Scar was not on the itinerary for the day.

The presence of pine and larch plantations is mentioned in the 1902 report but the present coniferous cover is extensive. This has inevitably affected the character of the area, creating acidic habitats in a predominantly limestone area.

Fields opposite the parking area were immediately visited. They were herb-rich and, in the marshy areas at the southern end, *Lychnis flos-cuculi* was in evidence, so good to see in a habitat much declining in the county and very much in need of protection. Oldstead Bank received due attention, with *Daphne laureola* and *Helleborus foetidus* noted, as they were in 1902. The central area of Great Cockerdale Wood was accessed by a permissive path leading to Mount Snever Observatory. This was visited by several members whilst others reached the observatory at the top of the scar. There was much bramble in the wood above the conifer level but progress was not unduly hampered and the initially acidic habitat, with birch, sycamore and oak, soon gave way to a calcareous zone, dominated by ash. Here the slopes were strewn with limestone boulders which had fallen from the limestone crag above. This area quickly repaid the attention it received. The marshy area and stream in the valley bottom was well covered, with mixed results. Some members did a circular walk by walking up the forest track round to Cocker Dale and crossing the fields to reach the top of Oldstead Bank and Scotch Corner.

Fifteen affiliated societies were represented by 23 members at the indoor meeting. The landlord of the Black Swan in Oldstead had kindly agreed to open for us and drinks and sandwiches were soon circulating. This was followed by a very lively meeting chaired by our President, Colin Howes. Apologies were received from Heather Walker, Alan Heaton and also from Andrew Grayson who had been unable to stay for the meeting. All sections had much to report and the chairman added to these by making comparisons with findings and remarks from reports on the visits to the area in 1902 and an earlier visit in 1893. Les Magee said that he had found no sign here of the disease affecting alders in some parts of the country. The trampling in the flushes and marshy areas was commented upon and duly noted. The chairman expressed his thanks to the Excursion Secretary, Divisional Secretary and the landlord of the Black Swan. Reports on our findings will be sent to Forest Enterprise and to Colin Furness of Cockerdale Farm, to whom we also extend our thanks.

MAMMALS AND LOWER VERTEBRATES (M. J. A. THOMPSON)

Compared to the Y.N.U. outing to Oldstead in 1902, the nine mammal species seen on the 2000 outing were similar in number, but there were species differences. Of the *Insectivora* on this occasion, beside numerous mole hills, a dead mole *Talpa europaea* was found on one of the woodland rides, whereas in 1902 a common shrew *Sorex araneus* was also recorded. Both rabbit *Oryctolagus cuniculus* and brown hare *Lepus europaeus* were seen, the latter being flushed near Cam Farm. Of interest, in 1902 the red squirrel *Sciurus vulgaris* was the resident squirrel, only to be replaced by the American grey squirrel *Sciurus carolinensis* a century later. The only other rodent record was the field vole *Microtus agrestis*, evidenced by numerous field vole runs and holes underneath some of the thick matted grass edging some of the meadows. Carnivora were represented by the badger *Meles meles*, with an active badger sett in one of the woods, along with numerous badger trails and footprints. A fresh fox *Vulpes vulpes* scat was found, but its contents did not indicate what other small rodents were in the area. No deer were recorded in 1902, but in 2000 both roe *Capreolus capreolus* and fallow *Dama dama* were present. A single roe deer was seen in one of the dense coniferous woods and there were both roe and fallow deer slots in the soft mud of the rides, with the larger fallow prints. The roe deer population explosion in this part of North Yorkshire occurred in the 1930s. A small number of fallow are known to be in the area.

At least 3 different individual common or viviparous lizards *Lacerta viviparus* were seen sunning themselves on the small rocky limestone outcrops overlooking the study area. One of them was a pregnant female.

ORNITHOLOGY (J. E. DALE)

The late morning was spent following the main track through Great Cockerdale Wood to the ridge near Cam Farm, and on the return following the edge of Cockerdale Wood before taking a steep descent past the farm to return to our car park.

Goldcrests and Coal Tits were abundant in the trackside conifers; Willow Warblers were in song in all parts of the area; Blackcaps were less common but at least six were heard during the morning and Chiffchaffs were located twice. In the relatively open area of scattered bushes at the head of Cockerdale a few Whitethroats, and at least one Garden Warbler were heard. Kestrel was hunting here and Spotted Flycatcher (two) and Redstart were near the Cockerdale Wood track. Curlew and Skylark were heard over farmland above the woods.

Part of the afternoon was spent on Modes Bank, and later the track was followed down the valley towards Oldstead. Other species added to the list were Swallow (five), House Martin, Song Thrush, Long-tailed Tit and Goldfinch.

Cuckoo and Linnet were reported by others during the tea-time discussions.

38 species compared favourably with the 45 recorded during the 1902 visit when rather more time was available. Noteworthy differences in 2000 were the lack of Wood Warbler which had been 'heard on all sides', presumably in natural hanging woods that in this area have probably been replaced by conifers, and the inevitable absence of Corncrake. Hooded Crows were present on a keeper's gibbet in the earlier visit, and although they had doubtless been shot before the spring months, are today quite rare in Yorkshire, and most likely to be seen near the coast. Goldcrest was very numerous during our visit whereas it was apparently treated as an interesting find in 1902.

CONCHOLOGY (A. NORRIS)

The field meeting reports for 1892 and 1902 record an interesting mollusca fauna for the area of Roulston Scar, Coxwold. In 1892 W. Denison Roebuck and F. W. Fierke recorded 38 species, and at the 1902 meeting the Rev. T. Ainsworth and J. E. Crowther listed 29 species, 8 of which had not been recorded in 1892. These two meetings produced a total list of 46 species, 8 of which are freshwater species. David Lindley and myself recorded 48 species, only 3 of which are freshwater species. The 1892 report states that a pond not far from the village of Wass produced the freshwater species but there is no specific report covering these in the 1902 report.

It can be seen from these totals that we recorded several species not seen on the previous meetings. Two of these are the freshwater snails *Potamopyrgus antipodarum* and *Lymnaea truncatula*, other additions being *Succinea putris, Columella edentula, C. aspera, Vertigo substriata, Arion subfuscus, Nesovitrea hammonis, Oxychilus draparnaudi, Monacha cantiana, Zenobiella subrufescens*, and the segregate species *Carychium tridentatum, Cochlicopa lubricella, Vitrea contracta* and *Euconulus alderi*. 6 of these would have been unknown to the early recorders. It is also interesting to note that 8 of the above are mainly recorded from marshes.

One of the highlights of the trip on both of the previous meetings was *Helicigona lapicida*. In the report for 1892 this species was reported as being found in a deep ravine above Wass village. The report for 1902 records dead specimens from Roulston Scar, and the circular for that meeting (the 164th meeting), reports that two dead specimens had been recorded from a hedge bank between Kilburn Village and the Scar. David Lindley also recorded two dead specimens from the cliffs of Roulston Scar on this occasion. A full survey of the area for habitats of *lapicida*, a species not recorded alive from this part of Yorkshire in over 100 years would be an interesting project for the future.

Other highlights recorded in the past and repeated on this occasion included very fine examples of the slug *Limax cinereoniger* and the very local *Azeca goodalli* (*A. tridens* in early reports), found in a marsh with *Vertigo substriata* and the two *Columella* species.

LEPIDOPTERA (J. PAYNE)

Owing to a late start and limiting circumstances the writer mainly recorded on the lower ground. However with the observations of L. and R. Aukland, P. Tannett, G. Wadsworth and others a very good list of butterflies and moths was compiled.

The only member of the *Hesperidae* seen was Small Skipper.

The *Pieridae* were much in evidence – Large, Small and Green-veined were in fair numbers. 3 male Orange-tip were seen and, even more pleasing, 3 Brimstone were reported. Two members of the *Lycaenidae* Common Blue and Small Copper were recorded.

It was noticeable that in the group *Nymphalidae* there was no sighting of Small Tortoiseshell. This species was scarce in 1999 and seems destined to be so again. Very pleasing was the report of 3 Comma and a single Painted Lady. Also reported was a single Peacock and a worn Red Admiral. The *Satyridae* showed up as Small Heath and a single Wall Brown making a magnificent total of 14 species.

Most of the moths recorded were members of the *Geometridae*: Yellow Shell, Clouded Border, Chimney Sweeper and Streamer were noted and there was an abundance of Silver-ground Carpet (a *Galium* feeder) no doubt because Goosegrass is flourishing again in the hedgerows.

The two noctuids recorded were the aptly named Beautiful Golden Y and the equally beautiful Angleshades in predominantly pink colouration.

ENTOMOLOGY (W. R. DOLLING)

Orthoptera: It was too early in the season for any of the true grasshoppers but an adult of the Common Groundhopper *Tetrix undulata* was swept in a ride.

Dermaptera: The Common Earwig *Fortificula auricularia* was everywhere.

Mecoptera: Scorpionflies, *Panorpa* species, were numerous but none were identified though *P. communis* was the most likely.

Neuroptera (s.l.): A single male snakefly *Raphidia xanthostigma* was swept in the valley bottom where we parked the vehicles; this species is said to be associated solely with willows.

Diptera: The only fly identified was the Rhagionid *Chrysopilus cristatus* in the valley-bottom flush.

Hemiptera-Homoptera: The black and red froghopper *Cercopis vulneraria* was noticed in several places. Leafhoppers (Cicadellidae) noted were: *Eupteryx signatipennis* on Meadowsweet and *Oncopsis avellanae* on Hazel. Planthoppers (Delphacidae): *Criomorphus albomarginatus, Stiroma affinis* and *Ditropis pteridis*, the last monophagous on Bracken. *Cixius nervosus* (Cixiidae) 1♂ in the flush.

Hemiptera-Heteroptera: Hawthorn Shieldbug *Acanthosoma haemorrhoidale*, one dead under conifer bark. The lygaeids *Cymus melanocephalus* on rushes in the flush and *Kleidocerys resedae* on Alder and Birch. *Anthocoris nemorum* was the only anthocorid. The remainder of the true bugs were Miridae, as follows: the grass-feeding *Stenodema holsatum, S. laevigatum* and *S. calcaratum*, all as overwintered adults, and nymphs of *Leptopterna dolabrata* and *Capsus ater*, grass-feeders that overwinter in the egg; adults of the new generation of three oak-associated species were already present: *Harpocera thoracica, Dryophilocoris flavoquadrimaculatus* and *Calocoris* (*Closterotomus*) *quadripustulatus; Monalocoris filicis* on ferns; *Macrolophus pygmaeus* (= *nubilus*) and *Dicyphus stachydis* on Woundwort; and *Calocoris alpestris* (= *major)* and *Lygus wagneri* on low plants in shady places.

Coleoptera: Collecting methods being confined almost wholly to working plants rather than sieving, grubbing etc., the list has few specimens in common with the list from a century ago which features mainly species from cryptic habitats. The widespread growing of Oilseed Rape in the vicinity was reflected in the presence of the Pollen Beetle *Meligethes aeneus* (the 'Rape Fly') and the weevils *Ceutorhynchus assimilis, C. floralis* and *C. pallidactylus*. The flea-beetles *Longitarsus parvulus* and *Aphthona euphorbiae* suggest that Linseed is also grown in the vicinity.

Undoubtedly the best aspect of the day's work was the finding of *Oedemera virescens* (Oedemeridae) in some numbers, coleopterists (Frank Kenington and W.R.D.) encountering several specimens. This species has the conservation rating 'vulnerable' (RDB2); although previously found also in Gloucestershire and Norfolk, since 1970 it has only been taken in NE Yorkshire.

Pollen beetles (in addition to the 'Rape Fly') were: *Meligethes brunneus* (on Woundwort), *M. morosus* (on White Dead-nettle), *M. atratus* (on Dog Rose), *M. carinulatus* (on Birdsfoot Trefoil) and *Brachypterus urticae* (on Nettle). Weevils were numerous with the following identified: *Deporaus betulae* (both adults and the characteristic leaf-rolls on Hazel, in which the leaf lamina is almost severed transversely, the dry, brown terminal portion hanging in a conical roll from the midrib of the intact, green, basal portion); *Apion ulicis* (on Gorse); *A. apricans* (on Red Clover); *A. ervi* (on Vetches); *A. loti* (on Birdsfoot Trefoil); *A. violaceum* (on Docks); *A. curtirostre* (on Sheep's Sorrel); *Anthonomus pedicularius* (on Hawthorn); *Curculio salicivorus* (on Willow, where it is an inquiline in sawfly galls); *Barypeithes pellucidus* (in leaf litter); *Strophosoma melanogrammun, Phyllobius glaucus, Polydrusus pterygomalis* (all mostly on Hazel); *Phyllobius pomaceus* (= *urticae*) (on Nettle) and *Polydrusus pilosus* (on Spruce). Leaf-beetles included *Oulema gallaeciana* and *O.? melanopa* (on grasses); *Gastrophysa polygoni* (on Dock); *Chrysomela aenea* (on Alder); *Phratora* (= *Phyllodecta*) *laticollis* (by sweeping, but supposedly associated with Aspen and White Poplar although here probably on *Salix*); *Galerucella lineola* (on *Salix*): *G. tenella* (on Meadowsweet); *Phaedon* *cochleatriae* (probably on Watercress); *Phytodecta pallida* (both the pale brown adults and the leaf-green larvae on the leaves of Hazel). Flea-beetles: *Altica lythri* (on Willowherb); *Chalcoides fulvicornis* (on Willow); *Longitarsus suturellus* (on Ragwort); *Phyllotreta undulata* (on crucifers); and the two linseed-associated species mentioned above. Ladybirds: *Calvia 14-guttata, Propylea 14-punctata, Coccinella septempunctata*. Click-beetles: *Aplotarsus* (or *Selatosomus) incanus, Agriotes pallidus, Denticollis linearis*. Rove-beetles: *Tachyporus nitidulus, Tachinus laticollis, Anthophagus caraboides* (the last on Rowan flowers). Longhorn (cerambycid) beetles: only *Rhagium bifasciatum* (also at Rowan flowers, but its larva bores in coniferous trees; it was found on one of the early excursions to the Coxwold area). Scraptiidae: *Anaspis rufilabris, A. frontalis* and *A. maculata*. Other odds and ends: *Cyphon coarctatus* (Elodidae), *Aphodius ater* (Scarabaeidae), *Atomaria linearis* (Cryptophagidae), *Cortinicara gibbosa* (Latridiidae), *Rhinosimus planirostris* (Salpingidae), *Byturus tomentosus* (Byturidae), *Malachius bipustulatus* (Melyridae), *Cantharis nigra* (Cantharidae – several other species present were uncollected) *Eupuraea melanocephala* (Nitidulidae, but not a pollen beetle like *Meligethes*) and two additional unidentified species of *Eupuraea*.

Plant Galls (J. & K. G. Payne)

As at our recent Brough meeting, sloes distorted by the fungus *Taphrina pruni* were much in evidence. Fine specimens, in fact, occurred exactly at the spot identified for members to meet. Miss Janetta Lambert collected the 'Knotting Gall' caused by the fly *Chirosia betuleti* on the Broad Buckler-fern and Field Maple leaves covered by the red pustules of the gall mite *Artachris cephalonea*. Growing right by the door of the Black Swan, where we had tea and the meeting, was Ground Elder with the swellings caused by the fungus *Protomyces macrosporus*. Most members will have noticed the dense covering of pustules on Alder leaves caused by the mite *Phytoptus laevis laevis*; also on Alder leaves were the swellings in the angles between midrib and veins caused by another mite, *Eriophyes inangulis*. In addition, J.P. noted the following: Red Campion with 'smut', *Ustilago violacea* on the anthers; Blackthorn with the leaf-edge galling of the mite *Phytoptus similis*; Dog Rose with the downwardly rolled leaf-edges of the sawfly *Blennocampa phyllocolpa*; Germander Speedwell with the hairy terminal pouch of the gall midge *Jaapiella veronicae* and Crosswort with the galling rust *Puccinia galii-verni*.

Botany (N. Sykes)

Although arable and pasture fields in the vicinity had been treated for maximum agricultural production, and ancient woodland on the surrounding hills had been largely re-planted with conifers, the area still retained pockets of near natural vegetation with interesting plant communities.

Seepage from hillside springs drained into a marshy area with *Juncus effusus*, *J. inflexus*, *Lychnis flos-cuculi*, *Angelica sylvestris*, *Valeriana dioica*, *Scrophularia auriculata*, *Lotus pedunculatus*, *Stellaria uliginosa*, *Cardamine pratensis* and *Menyanthes trifoliata*.

A nearby shallow streamside had *Chrysosplenium alternifolium, C. oppositifolium*, *Cardamine amara*, *C. flexuosa, Calamagrostis epigejos*, *Veronica beccabunga*, *Callitriche* sp. and several overhanging trees of *Salix pentandra* revealed by strong fragrance and shining leaves.

On drier patches were found numerous *Dactylorhiza fuchsii*, *Stellaria holostea*, *Rumex acetosella*, *Potentilla anserine*, *Briza media*, *Lathyrus pratensis*, *Alchemilla xanthochlora*, *Geranium robertianum*, *Myosotis discolor*, *Geranium molle, G. dissectum*, *Trifolium pratense T. repens, Ranunculus bulbosus, R. repens* and *R. acris*. *Medicago lupulina* and *Veronica chamaedrys, V. officinalis, V. serpyllifolia* and *V. montana* were scattered around.

A forest ride adjacent to Cockerdale beck was largely shaded by near conifers which doubtless served to check more vigorous plants as the trackside was carpeted with *Lysimachia nemorum* and *Ajuga reptans*) in flower. *Valeriana officinalis*, *Scrophularia nodosa*, *Anthriscus sylvestris*, *Arctium* sp., *Tamus communis*, *Geum urbanum* and

Vaccinium myrtillus also occurred.

A steep climb through the wood revealed limited ground flora but on level less shaded ground beyond the Observatory *Melampyrum pratense*, *Mercurialis perennis*, *Galium saxatile*, *Silene dioica* and *Ulex europaeus* eventually gave way to more acid ground dominated by bracken amongst which numerous *Trientalis europaea* were seen in full flower.

A grassy track climbing north-east up Modes Bank has long been known for its *Helleborus foetidus* which were seen in fruit. As well as the more common hedgerow plants were clumps of *Daphne laureola* also in fruit and large stands of *Campanula latifolia* not yet in flower.

Bryology (J. M. Blackburn)

The main thrust of the day was to spend time in the central area of Great Cockerdale Wood which seemed of great potential interest when the area was selected for this meeting. The interest was in the boulder-strewn slopes under the limestone crag. The limestone rocks here, where it is shaded and humid, are covered in mosses, with large quantities of *Ctenidium molluscum, Thuidium tamariscinum* and *Tortella tortuosa*. Some of these rocks had good-sized patches of the tiny moss *Seligeria recurvata*, proving to be frequent in the southern part of the National Park. Both *Neckera crispa* and *N. complanata* were present, with *Anomodon viticulosa, Mnium stellare* and *Campylium calcareum* in its only extant site in the vice county. *Eucladium verticillatum* was on some of the damper rocks. *Campylopus fragilis* was seen on a sloping bank in the wood, seen very infrequently in the vice county. The attractive thalloid liverwort *Apometzgeria pubescens* was present in several places. Three species of *Scapania* were found on the rocks, *S. irrigua, S. nemorea* and *S. umbrosa*, along with *Frullania tamarisci* and *Porella platyphylla*. In the more acidic parts of the wood *Mnium hornum* was present in large quantities and also *Atrichum undulatum* and *Plagiomnium undulatum*.

The marshy area by the stream was inspected but was not particularly rewarding. Elders had *Orthotrichum affine* and *O. diaphanum*, with cracks in the bark supporting *Zygodon viridissimus* var. *viridissimus*. A marshy area above Cockerdale Farm had a fine stand of *Climacium dendroides*. The acidic banks by the forestry track were rewarding, as expected, with all three of the common species of *Calypogeia, C. arguta, C. fissa* and *C. muelleriana, Cephalozia bicuspidata, Diplophyllum albicans* and *Lophozia ventricosa*.

This is proving to be one of the richest areas in northeast Yorkshire, due to the mix of habitats present. A total of 124 species was recorded.

Lichenology (A. Henderson)

Woodland to the north and east of the village had little other than a minimal *Parmelietum* with *Xanthorion* incursions on fencing and calcareous substrata. Tree bases and fallen boles among the denser woodland by the stream had occasional cover of the commoner *Cladonia* species. Patches of bright yellow *Leproplaca chrysodeta* illuminated a few darker recesses of bark and fencing. The doubtless much overlooked *Gyalideopsis anastomosans* with its flaky grey crust was noted on damp tree bases near the old disused observatory up the slope. The acid-loving *Foraminella ambigua, Hypogymnia physodes* and *H. tubulosa* were locally common here.

Lower down, on tracks and roads leading through and from the village, hedgerows were stippled with *Amandinea punctata* and *Cliostomum griffithii*. A roadside quernstone just north of the village had an attractive golden-yellow, black and brown, grey and white mosaic cover of 14 species including *Lecanora sulphurea, Catillaria chalybeia* and *Caloplaca decipiens*. A low asbestos-cement roof above a grassy roadside bank in the village had the most finely developed *Protoblastenia rupestris* seen during the day, among it some tiny patches of *Catillaria lenticularis*. Although the lichens of the area were nowhere resplendent, particularly in diversity, they nonetheless achieved a colourful presence here and there throughout the day.

FRESHWATER BIOLOGY (L. MAGEE)

A small stream, less than one metre wide in places, flowed southwards from springs on Oldstead Moor and Cockerdale. It was fast flowing, exceptionally clear with a marly-limestone bottom. The summer water depth was between 4 cm and 20 cm. The stream was unshaded until entering Knever Wood where there was dense tree cover. The stony bottom consisted of small cascades and pools but the pH 8.8 was constant throughout the length surveyed. Alders were examined for signs of damage from *Phytophthora* fungus, which is fatal to them and spreading in England. No damaged trees were seen. There was evidence that the stream overflows regularly into the adjacent meadows and woodland.

The aquatic freshwater shrimp *Gammarus pulex* was common but other species were present in small numbers.

The following were identified in the open stream: Annelid Worms (frequent); Mayfly larvae *Baetis rhodani* (few), *Ecdyonurus torrentis* (few), *E. venosus* (few); Stonefly larvae *Brachyptera risi* (few); Molluscs *Psidium* species (frequent); Beetles *Elmis* species (few); Caddis larvae (Cased) *Sericostoma personatum* (few) and *Agapetus fuscipes* (frequent on stones); and Crustacea *Gammarus pulex* (common). No fish were found.

The only invertebrates found in the woodland stream were *Gammarus pulex* and Chironomid larvae.

The only aquatic plant found was *Polygonum amphibium (Persicaria amphibia)* in a drain leading from the stream.

The OS map showed a small fire pond in the woodland but it was found to be completely silted, with a small stream of spring water flowing through. The only invertebrates found were small numbers of the aquatic beetle *Hydrobius fuscipes*.

Equisetum telmateia, a plant in decline in VC63 and VC64 was well established here, as well as in other wet flushes in the valley.

Several base-rich wet flushes on the slopes were difficult to investigate for larvae due to the dense vegetation but the recorded flora included: *Dactylorhiza fuchsii* (frequent), *E. telmateia* (frequent), *Lychnis flos-cuculi* (frequent), *Carex acutiformis* (frequent), *Scrophularia auriculata* (frequent) and *Glyceria declinata* (in two places on wet tracks).

LINDHOLME MOOR (VC63) 1 July 2000

Introduction (C. A. Howes)

Through the good offices of Mr Richard Lyon of Lindholme Grange the YNU was privileged to visit Lindholme Moor, private and isolated, a remarkable survival of ancient woodland, calcareous and acid grassland located on a glacial moraine and the adjacent, equally remarkable survival of uncut lowland raised mire, set in the central core of the extensive Hatfield Moors Site of Special Scientific Interest. A profound debt of gratitude is owed to the Lyon family, particularly the late Jack and Ethel Lyon of Lindholme Hall, for retaining these habitats in a wild and unexploited condition, and to their son Richard for returning adjacent arable to species-rich grassland and for managing habitats for wildlife conservation purposes. Acknowledgement is also due to English Nature for permission to visit adjacent areas of cutover peatland in the early stages of revegetation after being released from commercial peat extraction.

Over forty naturalists from fourteen societies, including a contingent from the British Arachnological Society who had travelled up from Nottinghamshire, Derbyshire and Essex, met on a cool slightly overcast day, though conditions brightened up in the afternoon, bringing clouds of butterflies on the splendid 'stewardship' grassland.

Members of the Doncaster Naturalists' Society acted as guides during the day and, later, provided a lavish buffet tea for the report meeting held in the Robin Hood and Little John Pub in the adjacent village of Hatfield Woodhouse. The YNU had visited the area on two previous occasions, 12th September 1887 (*Naturalist* **13:** 83-89) and 12th July 1952 (*Naturalist* **77:** 181-182), and extracts from these reports were read over tea. Detailed reviews of natural history studies on Hatfield Moors have been compiled by Martin

Limbert (*Naturalist* **110:** 103-110 and **111:** 59-60).

In the evening (9.30 p.m. to 1.00 a.m.) a group of stalwart members weathered a constant downpour to undertake the evening's moth trapping, bat and nightjar survey. The use of petrol generators, mercury vapour lamps, ultrasonic bat detectors and radio tracking devices was in telling contrast to the field equipment used by our 19th and mid-20th century forebears on their visits to the moor.

GEOLOGY AND LANDSCAPE (C. A. HOWES)

The morainic deposit forming the *c*.24 ha Island of Lindholme, which subtly protrudes above the surrounding peatland landscape (to *c*.4 m OD), is one of a series of low ridges occurring from Thorne in the north, through Bradholme, Tudworth Hall, Lindholme Hall and on to the village of Wroot in the south east. The current interpretation of its origin suggests glacial erratic debris from the west deposited along the edge of a transient ice sheet which surged south-eastwards from the lower Vale of York glacier into the late Devensian Lake Humber as far south as Wroot. Derek Allen and Colin Howes visited the quarry excavated into the morainic deposits adjacent to Lindholme Hall, locating pebbles of Permian Lower Magnesian Limestone, Triassic Sherwood Sandstone, Carboniferous (coal measures) Sandstone, as well as quartzite and flinty chert. A cryoturbation effect in the upper layers indicated the island had been part of the exposed periglacial surface and therefore subject to prolonged freeze-thaw conditions. The calcareous components within this deposit explain the ecological conundrum of calcareous grassland (managed to good effect in accordance with Countryside Stewardship practices by Richard Lyon) occurring within this otherwise lowland raised mire and sandy heath landscape.

The Island is surrounded and partly covered by blown sands and dune formations now overlain by peats which commenced formation a little over four thousand years ago. These sands, visible in the deep drainage networks of the surrounding 'peat fields' and revealed in places by commercial peat milling activities, are extensively quarried around the western and southern perimeter of the moor. Glacial erratics in the form of large cobbles of coal measures sandstone, extracted by quarrying, were used in the 'herringbone' stonework walls of cottages, now demolished, at the western end of Lindholme Bank Road. Interestingly the etymological allusion to Lime trees in the name Lindholme (Linden Island) is confirmed by the pollen record from basal peat which included *Tilia*, along with *Quercus, Corylus, Ulmus, Fraxinus, Pinus, Alnus* and *Betula* (Whitehouse *et al.* (2001) Lindholme Island. In *The Quaternary of East Yorkshire and Lincolnshire: Field Guide* (Bateman *et al.*, eds): 185-193. London: *Quaternary Res. Assn.*

The Lindholme Oaks *Quercus robur,* which still harbour woodland indicator invertebrates present here in the Bronze Age, have a long documented history, there being twelve oaks listed in a survey of 1607. During our visit the girths of sixty-four were measured, nine of the largest having circumferences at chest height of between ten to fourteen feet, some of the oldest dating to the building of the Lindholme Hall, erected as a shooting lodge in the 1840s.

The Lindholme Pines form one of the oldest surviving populations of *Pinus sylvestris* in Britain. Their remains were examined in the forest zone at the base of Bronze Age peat, and throughout the peat horizons. Documentary references to their occurrence in the 17th and 18th centuries suggest a continued presence on this site for over four thousand years.

A small number of mature pines and a population of seedlings were examined in the tall heather areas of the Lindholme Nature Reserve.

Encouraged by Joyce Payne's work (*YNU Bulletin* (1997) **28:** 1-5), interest was shown in the venerable Monkey Puzzles *Araucaria auracana* to the south of Lindholme Hall. Among the largest specimens in the Doncaster region, it is tempting to speculate their planting being an arboricultural 'pun' by Sir Thomas Birkin Bt., who owned the estate for a period after 1907 and received local celebrity in having monkeys roaming freely around the hall.

MAMMALS AND LOWER VERTEBRATES (C. A. HOWES)
Although extensive small mammal trapping, owl pellet and fox diet studies have been undertaken here (*Imprint*, 1996, **24**: 8-15; 1999 **26**: 38-42; *Hatfield Moors Bird Report 1997*), at this meeting species were recorded by tracks, trails, sounds and signs. A dead Wood Mouse and a dead Common Shrew were seen on the Lindholme Moor Nature Reserve where Roe-deer slots were present in damp peat along the ridings. Fox droppings, also found here, exclusively contained the remains of Rabbits.

Rabbits and their workings were abundant around the edges of arable, heathland and woodland areas of the moraine. Old disused badger setts, now occupied by Rabbit and Fox were examined beneath the rooting systems of the venerable oaks. Droppings provided evidence of Hedgehog on the shorter grassland of the moraine where prey included ground beetles of the genus *Pterostichus*. Water Voles were well represented along the adjacent Hatfield Waste Drain. Here, according to local resident Ben Craggs, Otters still occur and have allegedly bred in recent years. Presence was confirmed by an old spraint located beneath a plank bridge.

Bat detecting in the rain during the evening's moth trapping and nightjar session indicated that Pipistrelles (45 kh) and a *Mysotis* species were hunting along the tree-lined Sandy Lane and were also working the insects attracted to the security lighting around the gas terminal on Lindholme Bank Road.

Good fish stock, including Three-spined Stickleback, Roach, Bream and Perch, occurs in the Hatfield Waste Drain. Adders were encountered on Lindholme Moor Nature Reserve and a Grass Snake was in tall herbage on the moraine.

ORNITHOLOGY (J. SIMMONS & H. R. KIRK)
In total 36 species, most of them ubiquitous, were identified by sight, song or call. It was nice to encounter with key species such as Nightjar, confirming the value of purpose-cleared glades, and Tree Pipit on the real 'bit of bog'. Ten Acre Lake held typical waterbirds and provided a good feeding area for hirundines.

The Lyon family are to be thanked and congratulated for continued preservation of the real refugia in an area of corporate carnage.

ENTOMOLOGY (A. GRAYSON)
Upon arrival, the weather was dull, hazy and overcast, with a temperature of 16ºC. Shortly before 2.00 p.m. the sunshine began to break through the cloud, and the temperature rose to 19.5ºC. Upon the rise in temperature, females of the horsefly *Chrysops relictus* became increasingly active around the YNU members and their vehicles. *C. relictus* favours areas of low-lying land with ditches and drains, and it was no surprise to discover it abundant on Hatfield Moors.

The meadowland adjacent to Lindholme Hall contained an abundance of typical flower-loving and grassland insects, including the hoverflies *Episyrphus balteatus, Sceava selenitica, Syrphus ribesii, Cheilosia proxima, Eristalis pertinax* and *Myathropa floria.* Along Sandy Lane were, in the main, insects which prefer open, yet sheltered, habitat. Area 11 is the main area of lowland mire that has escaped the habitat-destroying peat-winning operations that run up to its border; it is, however, more reminiscent of semi-wet heathland, and is entirely afforested. The mosquito *Aedes punctor* was abundant here.

If Area 11 was a little disappointing then Ash Dump (Area 17) was a bonus. This land has been well worked for peat but is now recovering. Although Ash Dump will not recover to its former state, it still has great potential for insects which favour open areas and ponds and ditches surrounded by tall reeds, grasses and bushes. The damselflies *Lestes sponsa, Coenagrion puella* and *Enallagma cyathigerum* were found at Ash Dump, as was the dragonfly *Sympetrum danae*, which was fairly abundant.

LEPIDOPTERA (H. E. BEAUMONT)
It was a pity that rain curtailed fieldwork; it came to the stage that, with micros sticking to

sodden sheets, there was little value in continuing. The best moth recorded on a list for the day of 47 lepidoptera is Valerian Pug, the first VC63 record since the supplement to Porritt's list in 1904. A number of micros were interesting, among them *Phlyctaenia perlucidalis, Lozotaeniodes formosanus, Endothenia ericetana* and *Epinotia demarniana*, all of which are still local in Yorkshire although three of them are becoming more frequent.

Compilers' Note:

During the day Gavin Boyd, who had travelled north to attend the meeting, noted the Marbled White Spot *Protodeltote pygarga*. Knowing the species as reasonably common in the south of England, only when back in Northampton did he realise from the literature that in Yorkshire it is rare. Concerned at first not to have obtained a voucher specimen, he later learned that several specimens had turned up during the evening trapping session he was unable to attend.

HYMENOPTERA

Aculeata (M. E. ARCHER)

The species recorded were graded as Common, Frequent, Occasional, or Rare for Yorkshire. In total 16 species were recorded: Solitary Wasp *Crabno cribarius* (Frequent); Social Wasp *Dolichovespula norvegica* (Common); Solitary Bees: *Andrena bicolor, A. haemorrhoa* (both Common); *Lazioglossum leucozonium, Sphecodes ephippius* (both Occasional), *Nomada fabriciana* (Common); Bumble Bees: *Bombus pascuorum, B. lapidarius, B. terrestris, B. leucorum, B. hortorum, B. pratorum, Psithyrus bohemicus, P. vestalis,* and the Honey Bee *Apis mellifera* (all graded as Common).

Symphyta (G. BOYD)

Strongylogaster luneata, Aneugmenus padi and the gall-forming *Nematus viridis* were recorded and a voucher specimen was retained. All the specimens were female.

COLEPTERA (W. R. DOLLING & R. MARSH)

Among the 100 species noted during the day, the following are particularly noteworthy:

From Compartment 11* (W. R. DOLLING)

Magdalis barbicornis: there are only two other known Yorkshire records for this Nationally Notable A weevil. *Cneorhynus plumbeus*: a weevil of litter in dry grassy places; there are only a dozen or so Yorkshire records for this Notable B insect, very few of them recent. *Cryptocephalus fulvus*: a very local heathland chrysomelid with a dozen or so records for the county. *Hippodamia variegata*: plenty of county records, nearly all in the south, for this heathland Notable B ladybird. *Olibrus liquidus*: there are only four confirmed records for this phalacrid, a beetle associated with smutted grasses; a member of a difficult group regarding identification and easily confused with other more common species.

From Compartment 15* (R. MARSH)

Quedius nemoralis: easily confused with one or two other more common species; about a dozen records, all post-1980. *Ernobius mollis*: this beetle develops in conifer cones and in the pith of conifer twigs; 24 records, nearly all pre-1970. *Conopalpus testaceus*: develops in the dead boughs of various deciduous trees, mainly oak; only two confirmed records for Yorkshire, Nationally Notable B. *Omiamima mollina*: a Nationally Notable A weevil; a dozen or so Yorkshire records, mostly post-1970. *Philopedon plagiatus*: common and very abundant in coastal dunes and sandy habitats all around the coasts of Britain, with a very few inland records from sandy biotopes where there is some degree of openness or disturbance; a recent record from Pot Hill (P. Skidmore) and a much older (H. H. Corbett) record from Barnby Dun. Finally, *Curculio venosus*: 16 or so Yorkshire records for this oak-dependent weevil, nearly all post-1970.

**Compilers' Note*:

Compartment 11 is an area maintained as a nature reserve by the Doncaster Naturalists.

Compartment 15 is a stretch of old oak – acidic heathland on glacial moraine.

HEMIPTERA, ETC. (W. R. DOLLING)

In the available time only two Compartments were worked: the old oaks and derelict arable in Compartment 15, and the birch wood on the dried-out peat in Compartment 11.

Dermaptera: *Forficula auricularia* in Compartment 15.

Orthoptera: *Tetrix undulata* in rides in Compartment 11; immature *Acrididae* in Compartment 15.

Hemiptera: these were, on the whole, unremarkable; the exception will be mentioned below. There was a good selection of the expected suite of oak species and also those of open grassland.

Compartment 11

Birch surprisingly yielded neither of the two shieldbugs associated with it but did produce adults and nymphs of *Pentatoma rufipes*, the so-called Forest Bug, which was on many kinds of trees in both Compartments, mainly old nymphs but a fair number of adults. The seedbug *Kleidocerys resedae*, associated with Birch (and Alder) was abundant as were the mirids *Lygocoris contaminatus* and *Psallus falleni* and the psyllid *Psylla hartigi*, all of them common birch specialists. Nymphs of the arboreal nabid *Himacerus apterus* were also present; this is a scarce species in Yorkshire. Heathery rides in this area produced two heathland bugs, the cicadellid *Ulopa reticulata* and the mirid *Nabis ericetorum*. A nymph of the predaceous shieldbug *Zicrona caerulea* was found under the heather. Sallow on the edge of this Compartment supported the big arboreal froghopper *Aphrophora costalis* (= *forneri, maculata*). (The presence of *Myrica* on the site suggested that a related species may well be present.) The delphacid *Dicranotropis pteridis* was numerous on Bracken. The most striking find of the day was the shieldbug *Neottiglossa*, of which Frank Kenington swept a single specimen in a ride in this Compartment. In a synopsis of the records in Stuart Foster's database as at October 1996, this species did not appear; it is perhaps new to Yorkshire.

Compartment 15

The old oaks had five Cicadellidae: *Alebra albostriella, Typhlocyba quercus, Thamnotettix confines, Eurhadina concinna* and *Jaisus lanio*; the *Eurhadina* was female only, so there is an outside chance that it was *E. ribauti*, rare in Yorkshire. The delphacid *Dicranotropis pteridis* was frequent on Bracken beneath the trees and the cixiid *Tachycixius pilosus* was also frequent in this part of the area. *Pentatoma rufipes* was, of course, present in numbers on the oaks along with several mirids: *Phylus melanocephalus, P. pallipes, Psallus varians, Calocoris quadrimaculatus* and *Cyllecoris histrionius*. Nymphs of *Himacerus apterus* were present on the oaks and also on the birches, as in Compartment 11.

The grassy, herb-rich, derelict arable fields had a substantial hemipterous fauna. Lygaeidae: *Nysius ericae, Peritrechus geniculatus, Stygnocoris fuligineus*. Nabidae: *Nasbicula flavomarginata*. Anthocoridae (or Cimicidae): *Anthocoris nemorum, Orius niger*. Miridae: *Hoplomachus thunbergi* (on *Pilosella*), *Plagiognathus chrysanthemi, Heterotoma merioptera, Orthocephalus saltator, Lygus rugulipennis, Capsus ater, Pithanus maerkeli, Notostira elongata, Leptopterna ferrugata, L. dolabrata*. Delphacidae: *Criomorphus albomarginatus*. Cicadellidae: *Aphrodes albifrons, Errastunus ocellaris*. Hawthorn in this area had the mirid *Psallus perrisi* and two shieldbugs: nymphs of *Acanthossoma haemorrhoidale* and an adult of the predator *Troilus luridus*. An oak here had the mirid *Psallus diminutus* (females only; so just possibly *P. mollis* but that would be a first for the county).

ARACHNOLOGY (D. CARR, P. HARVEY, T. FAULDS, H. WILLIAMS & T. HARRIS)
The nationally scarce *Philodromus praedatus* was collected off old oaks, its typical habitat. It is in fact rather common in Essex and other parts of the south-east. Identification of this group presents many arachnologists with problems, but it has been recorded as far north as Scotland so may well be under-recorded rather than genuinely scarce. Another interesting record was *Tetragnatha pinicola*, which is also rather widespread in Essex and easily misidentified by anyone unfamiliar with the species. As a mainly southern species it must be towards the edge of its range here. There were several species which are scarce in Essex. The possible *Araneus marmoreus pyramidatus* (in need of confirmation) is a very characteristic orb-web spider related to the garden spider; it is very local.

Compilers' Note:

Fortunately David Carr and Peter Harvey, Recorders of the British Arachnological Society, attended the meeting. They produced a list of 67 species of spider, 29 of them on woodland heath (Lindholme Nature Reserve: peat on podsol on sand); 53 on glacial cap (moraine); with 15 species common to both habitats.

An equally numerous list of spiders collected from the area by Tom Faulds, Howard Williams and Trevor Harris includes a further 32 spiders, giving an overall total of 99 species recorded.

PLANT GALLS (T. HIGGINBOTTOM)
After much leaf turning the Birch scrub in square SE6906 finally provided five interesting galls. However, the swelling on the stem of *Chamerion angustifolium* caused by the micro-moth *Mompha nodicollela* was one of two highlights of the day discovered in 1 km square SE7005. There was even greater delight with the discovery of the bud gall caused by the cynipid *Andricus callidoma* on *Quercus robur*. This was the recorder's third sighting of *A. callidoma* in Yorkshire. Each of these rather unusual galls were found by the disused quarry.

Few galls were discovered on the mature Oak in the area which was described as ancient woodland. The dense cover of Bracken made exploration of the woodland rather difficult but a future field meeting to the site would be an interesting prospect.

39 galls (12 cecid, 11 cynipid, 11 eriophyid, 1 gall fly, 1 lepidopteran, 1 psyllid and 2 rusts) were seen on 21 hosts during the day.

BOTANY (D. R. GRANT)
The area reported on is a very small piece of the original Hatfield Peat Moors. This relic area is covered with much Bracken and Silver Birch trees. Conservation workers are removing these and also have succeeded in raising the water table. This has encouraged *Sphagnum* mosses to become re-established. The open areas had a little *Calluna vulgaris, Erica tetralix* and both Cottongrasses, *Eriophorum angustifolium* and *E. vaginatum*. One part had a good stand of *Ceratocapnos claviculata*. Along the edge of the woodland *Rubus plicatus* was frequent, the plants being very tall due to the wet summer. Members were shown the very small colonies of *Myrica gale* and *Andromeda polifolia*. Adjacent set-aside fields had much *Filago germanica, Conyza canadensis* and *Anagallis arvensis*. The verges of the approach road near the gas well had *Rubus nemoralis, R. polyanthemus* and *R. plicatus*, again in quantity.

LICHENOLOGY (A. HENDERSON)
The haha-like low wall by Lindholme Hall had a mixed calcicole-acidophile crustose flora overgrown here and there by *Xanthoria* and *Phaeophyscia orbicularis*. Nearby oaks had invasive *Xanthoria polycarpa* and *Lecanora carpinea* on twigs and axils. Stones in the quarry had a mosaic of *Lecania erysibe, Catillaria chalybeia, Trapelia coarctata, Rhizocarpon reductum, Lecanora albescens, L. crenulata* and *Caloplaca holocarpa*. Sorediate *Peltigera didactyla* was very occasional here amongst a *Cladonietum* which had

inter alia well developed *Cladonia ramulosa, C. floerkeana, C. macilenta* and *C. pyxidata* on a black background of fruiting *Placynthiella icmalea.*

After lunch the wooded edges of the sandy ride south of Lindholme Bank Road repaid exploration with some fine patches of *Peltigera rufescens, Collema tenax* (v. *tenax* and v. *ceranoides*) and *C. crispum*, with a trace here and there of indeterminate (probably) *Vezdaea* thallus, often sprinkled among numerous scattered *Nostoc* globules (not *commune*) in the damper stretches.

Oaks in the wooded heath of Compartment 11 had a *Parmelietum* developed only as far as the fruticose elements, *Ramalina farinacea* and *Evernia prunastri. Cladonia* species in the understorey included *C. humilis, C. squamosa, C. subulata* and a little *C. parasitica. Physconia grisea* was seen once only on a pathside elder in a copse, when returning to the Hall. The constitution of the lichen flora seen during the day suggests that it will benefit most from the avoidance of significant anthropogenic interference.

WETHERBY (VC64) 22 July (J. Kendrew)

Introduction (J. Kendrew)

On a pleasant morning 24 members and friends met at the Old Wetherby Railway Station and welcomed visitors from Suffolk Wildlife Society, London Natural History Society and a student from Liverpool University. After a briefing about possible locations of interest, members dispersed to explore their individual specialisms. People explored Woodhall, Stockeld Park area, Ox Close Wood, the old railway lines (which have now been turned into cycleways), and areas in the town of Wetherby. Some of the countryside available in 1901 has been lost to industrial and housing development and the ensuing problems of litter and waste were particularly evident on some of the railway lines. Members met at Collingham Memorial Hall for the meeting where 19 affiliated Societies were represented. The President, Colin Howes, chaired the meeting and received apologies from Bob Marsh and Terry Dolan. The reports revealed that a good day had been experienced and members enjoyed a shared buffet during the proceedings. The meeting concluded by Colin Howes thanking the Divisional Secretary for organising an interesting day, at a venue which had been visited by a similar number of Union members 99 years ago.

MAMMALS & FISH (L. MAGEE)

One Mink was seen foraging close to anglers. These creatures are established throughout the river and no doubt their prey includes Rabbits, which were numerous around the Woodhall Estate. Badger and Deer tracks were seen at drinking points. There was no sign of Water Voles which were very abundant until about 25 years ago.

Coarse fish fry are usually abundant in backwaters during July but very few were seen during the day. A few minnows were captured among the Milfoil. Anglers confirmed the following species as present: Pike, Barbel, Chub, Perch, Brown Trout, Grayling, Dace, Bream and Stoneloach.

BIRDS (L. MAGEE)

Heron, Kingfisher and Goosander were seen, but very few hirundines or Swifts.

MOLLUSCA (A. NORRIS)

The report of the YNU's visit to the Wetherby area published in 1901 lists only 5 species of mollusc, 3 land and 2 freshwater species, and states that the "extreme heat and especially the dryness militated so much against the collection of land mollusca". Very hot, dry conditions can make it difficult to locate some species, particularly slugs, but I have never known conditions so bad that only 2 freshwater species could be found in a river like the River Wharfe. On this occasion David Lindley and myself visited 3 different 1 km squares along the old railway line running from Wetherby to Spofforth. In the first part of this walk (44/3948) we recorded 19 land species. The next square (44/3949) produced 18 and the last

(44/3849) 12 species: a combined list of 25 species. It was noticeable, however, that the most common species found were mainly garden pests and introductions, such as *Milax budapestensis, Arion flagellus* and *Boettgerilla pallens*. In the afternoon we visited the River Wharfe and its banks at Boston Spa to try and locate living examples of the land winkle *Pomatias elegans*. We were successful in that we found a few living in loose friable soil, close to the River Wharfe within 1 km square (44/4246). The River Wharfe produced some 14 species including large numbers of the freshwater nerite *Theodoxus fluviatilis* and the freshwater mussel *Pseudanodonta complanata*.

ENTOMOLOGY (G. BOYD)

Lepidoptera

On a generally overcast day few species of Lepidoptera were seen, although some were present in considerable numbers. Five common species of microlepidoptera were reported, five widespread butterflies and three ubiquitous species of the larger moths. It is perhaps of interest to highlight what was **not** seen; no Skipper butterflies, no Common Blues *Polyommatus icarus* or Small Coppers *Lycaena phlaeas*, no Vanessids apart from a clutch of Peacock *Inachis io* caterpillars spotted by Mrs Payne who also saw a Small Tortoiseshell. Even the common micromoths such as *Anthophila fabriciana,* usually abundant over nettle beds, were not observed. It was pleasing, however, to find Ringlet *Aphantopus hyperantus* abundant and reasonable numbers of Gatekeeper *Pyronia tithonus* – a butterfly which I never saw at all when I lived in Leeds ten years ago.

Mrs Payne reported Yellow Shell *Camptogramma bilineata* from Ox Close and Riband Wave *Idaea aversata* from Wood Hall. She saw Large Yellow Underwing *Noctua pronuba* by the former railway and this species was also seen by Mrs Abbot at SE 395493. A leaf mine on Herb Bennett caused by *Stigmella aurella* was seen by John Newbould on the disused railway near Knaresborough Road at 44/4940.

Hymenoptera

The Bumble Bee *Bombus pascuorum* and the Common Wasp *Vespula vulgaris* were recorded from the former Wetherby-Spofforth railway line.

Diptera

A mere eight species of flies were listed, all common, but including the handsome syrphid *Chrysotonum bicinctum*, a specimen of which was shown to those members of the Union attending the post-meeting get-together. Possibly the most interesting record was a female specimen of *Eristalis abusive*. This species is reported most commonly from coastal areas, but it is possibly widely overlooked inland among the hordes of "look-alikes" of the same genus.

PLANT GALLS (J. A. NEWBOULD)

During the morning session I searched along the disused railway track which is located in squares 44/3948 and 44/3949 before returning to the Knaresborough Road which is in square 44/4048.

Following the wet summer with little sunshine the NVC type W8 *Fraxinus excelsior – Acer campestre – Mercurialis perennis* woodland, dominated by Ash and Sycamore had few galls. The deep cutting was mostly in shade even on a hot sunny day. Even the numerous sycamore had no nail galls. However, a more open area where the track turns west towards Spofforth produced the gall *Taphrina prunii* on *Prunus spinosa* which seems to have exploded in Yorkshire and elsewhere this year. This fungal gall, which totally destroys the fruit, was on bushes also containing unaffected fruit. Towards Knaresborough Road the sawfly gall *Blennocampa pusilla* was observed. It rolls the leaflet upwards in a spiral from the midrib and was seen on both *Rosa canina* s.l. and on a rose identified by Mrs P. Abbott as *R. virginiana*.

Eriophyes laevis inangulis on Alder from Collingham (44/3946) and *Aceria erinea* on Walnut in Colingham churchyard were recorded by C. A. Howes. *Eriophyes galii* on

Goosegrass and *E. similis* on Blackthorn at Linton (44/3847) were recorded by Mrs J. Payne. *E. macrorhynchus* on Field Maple at Wetherby and Linton (44/4048 and 44/3847) was recorded by J. A. Newbould and Mrs J. Payne.

E. goniothorax typicus on Hawthorn at Wetherby (44/4048) and *Phytoptus tiliae tiliae* on Common Lane at Wetherby by the Wharfe car park (44/4047) were found by J. A. Newbould.

FLOWERING PLANTS (P. P. ABBOTT)

Most people started the day walking along the disused rail track. The banks of the cutting are now very overgrown with tall scrub so that the patches of typical limestone grassland plants were very few. However, *Clinopodium vulgare, Origanum vulgare, Centaureum erythraea* and *Scabiosa columbaria* were seen on the plateau between the tracks and *Knautia arvensis* and *Centaurea scabiosa* elsewhere. A puzzling knapweed with ray florets proved to be a rayed form of the common *Centaurea nigra*.

Introduced shrubs provided the main interest in this area. Everyone saw sprays of white flowers of *Stephanandra incisa* at the end of the car park. The bright pink, pleasantly scented rose, which occurred frequently along the paths above the rail track, was *Rosa virginiana*. Almost as frequent were the attractive, delicious cherry plums, *Prunus cerasifera*. Along the Boston Spa road the fruit harvest continued with damson, *Prunus domestica* ssp. *insititia* and *Malus domestica*.

In the afternoon most of the botanists went along to Ox Close Wood local nature reserve, where they were pleased to see the Yorkshire Red Data speciality *Orobanche reticulata*, the nationally scarce *Hordelymus europaeus* and the splendid, huge, old, small-leaved lime, *Tilia cordata*.

MYCOLOGY (J. PAYNE)

An interesting and spectacular bracket fungus *Pleurotus cornucopiae* was seen by Janetta Lambert in Ox Close. This tiered agaric was growing on a fallen tree-trunk, thought to be elm, which is its usual host.

Rusts were rather scarce but there was a widespread infection of *Puccinia chaerophylli* on *Myrrhis odorata* in the flood zone on the south of the footbridge. In Ox Close itself *Viola hirta* bore spores of the later stages of *Puccinia violae*. A different species of *Viola*, amongst which it was growing, was not affected. No rust was found on any *Epilobium* species and, although there was an abundance of *Lapsana communis, Puccinia lapsanae* was only found after a long search. *P. lapsanae* also occurred at Wood Hall and the Rose of Sharon planted near the chapel was affected by *Melampsora hypericorum*. Goat willow *Salix caprea* at Wood Hall and at the old station car park had a plentiful dusting of the golden spores of *Melampsora caprearum*. A specimen of Dogwood *Cornus sanguinea*, collected by J. A. Newbould, proved to be host to the powdery mildew *Microsphaera tortilis*.

LICHENOLOGY (A. HENDERSON & C. J. B. HITCH)

Before leaving the car park meeting place the shaded stepway leading up from its southwest corner was examined. 26 species, typical of such shaded suburban stonework, were listed from the steps, their wallsides and copings. *Physconia grisea* was, however, something of a surprise to find here. *Sarcopyrenia gibba*, noted for its dumbbell-shaped spores, was as ever a delight to come upon. On the roof felting of the adjacent garage were numerous thalli of *Physcia caesia*. The common *Physcia* species are no longer considered unusual occurrences on substrata with such a tarry or bituminous admixture, whereon they frequently form swollen, raised thalli, as if shunning close contact with the substrate.

The old railway track, curling away to the north-west, was then followed. Ground, stone and trees here are densely shaded, but in areas a little more insolated, trees and saplings had patches of *Amandinea punctata* and *Lecanora chlarotera* with some initial *Xanthorion* colonisation by *Phaeophyscia orbicularis, Xanthoria candelaria* and *X. polycarpa*.

Here and there near the foot of the cutting sides, shaded *Fraxinus* buttresses and boles had *Porina aenea* and *Opegrapha vulgata* with blotches of *Collema crispum* and *Placynthiella icmalea* on the damper earth. An exciting find here was the occurrence of a species of *Strigula,* growing on heavily canopy-shaded rock-facing, and apparently distinct from the three species in the British list. Nowhere here, however, were lichens easy of notice. They were more in evidence on wall copings towards the town centre, and on willows by the river which had a developing *Physcietum.*

After lunch, St. James' churchyard in mid-town was explored. Here a list of 31 species was considered a respectable total for a shady urban churchyard. *Baeomyces rufus* was prolific in places on the inner face and the coping of the south churchyard wall. *Rinodina pityrea*, recorded just inside the gateway, was the most unusual record, a species presumably overlooked in the past because unknown and unrecognised by many lichenologists. The occurrence on the inner face of this same wall of *Xanthoria ucrainica*, a species only recently recognised in the British flora, also deserves mention.

Freshwater Biology (L. Magee)

River Wharfe, Collingham Bridge to upstream of Woodhall Bridge. pH 8.4. The flora and fauna of the River Wharfe has been studied by naturalists for two centuries and there are extensive data on individual species. There is, however, much less accurate base line data on the changes in the ecology of the river over a long period. Important early ecological surveys by Union members, Percival, Whitehead and Butcher between 1928 and 1940. No species are known to have disappeared since then but there have been dramatic declines in the populations of the flora and fauna. There have also been explosions in newly established species. No species are known to have been lost but the future of some is precarious, e.g. Salmon, Water Vole, Daubenton's Bat and Water Crowfoot. The surveys of the main river and the Collingham Beck were confined largely to a comparison of the current situation with past and ongoing surveys.

The river was surveyed by wading and the area of plant cover recorded. A characteristic of the Wharfe has always been the development of shingle beds and islands. Since the droughts of the 1990s, small islands composed of silt and gravel have continued to grow in number and in some cases they have become very large (more than 100 m in length), with maturing *Salix* spp. Examples may be seen upstream and downstream of Pool Bridge. Some islands are protected and have an interesting flora and fauna. In this area, the former large stands of aquatic plants have decreased in recent years but several species still occur in the deeper water: Perfoliate Pondweed *Potamogeton perfoliatus*; Swedish Pondweed *P.* x *suecicus* which has a very restricted distribution in the British Isles, neither parent occurring in the Wharfe. (There are claims that *P. pectinatus* has been found in the past.); Cooper's Pondweed *P.* x *cooperi*, an uncommon and difficult hybrid; Stream Watercrowfoot, *Ranunculus penicillatus* spp. *pseudofluitans*, a dominant plant until 1975, since when it has steadily decreased, was seen in small patches during the day. It has been largely replaced by the Spiked Watermilfoil, *Myriophyllum spicatum*, first found on the Wharfe in 1968.

More than 80 species of caddis fly have been identified on the Wharfe. Larvae of the following taxa were noted on the day: *Brachycentrus subnubilis* (the angler's Grannom), *Rhyacophila dorsalis, Limnephilus lunatus, Silo nigricornis, Halesus digitatus, Psychomia pusilla, Agapetes fuscipes, Sericostoma personatum, Mystacides nigra, Hydropsyche* species, *Lepidostoma hirtum* and *Anabolia nervosa.*

Mayflies seen were: (larvae) Blue winged Olive, *Ephemerella ignita*, Large Dark Olive, *Baetis rhodani*, Iron Blue, *Baetis muticus*, Brook Dun *Ecdyonurus torrentis*, and one imago of *Rhythrogena semicolorata*.

Odonata: males of the Banded Demoiselle *Calopteryx splendens* were active throughout the afternoon.

Collingham Beck (Collingham Bridge to junction with the Wharfe)
In this stretch a pH reading was taken of 8.6. Three species of Mayfly were plentiful. There were a few larvae of the large Green Drake Mayfly *Ephemera danica* in deep silt. This species is uncommon on the mid-Wharfe, which has suffered from pollution in recent years. A search of a stony-bottomed part of the Beck did not produce any Crayfish.

MICKLE FELL (VC65) 19 August (Deborah Millward)

Introduction (D. Millward)
Considering the remoteness of the location and the previous 24 hours of heavy rain, which had yet to disperse, a surprising 19 members from 12 societies attended the meeting. The clouds lifted by the start of the excursion but bank-full streams and washed away footbridges deterred a sensible proportion from reaching the goal and these members concentrated their efforts on the area of shake holes south of Connypot Beck. The more intrepid shed boots and waded the beck only to be confronted by a second stream in full spate that was crossed on a submerged strand of wire fence with members hanging on grimly to the upper strand. An unexpectedly long slow trek across the blanket bog followed which, disappointingly, considerably reduced the time available for recording on Mickle Fell. However, an intrepid few made it to the high ground and back to the meeting in Brough in time. Two members made the sound and enviable decision to continue recording, taking advantage of the now beautiful evening and maximising their investment in the long hike. The return trip for all groups was blessed with much reduced stream crossings. It is perhaps no coincidence that the Union has not visited this site since 1910.

Thanks have been sent to the Strathmore Estate.

MAMMALS AND LOWER VERTEBRATES (M. J. A. THOMPSON)
On the 1889 excursion to Mickle Fell only two mammals were recorded, the common shrew and the mole. On the VC65 outing in 2000 four mammal species were recorded, namely, rabbit, mole, field vole and stoat. Both rabbit burrows and mole hills were abundant in the strips of limestone rock outcrops that surfaced above the heather. A single field vole was sighted, probably in an area of low population density due to moorland habitat. A dead adult stoat was found in a snapper trap set on a wooden pole across Force Beck, as part of 'vermin' control on a well-keepered grouse moor.

Both common frogs and viviparous lizard were seen by members.

ORNITHOLOGY (M. J. A. THOMPSON)
Comparison of the bird report in the 1889 *Naturalist* of the excursion to Mickle Fell (Sept. 1889) with that for the VC65 outing in 2000 has had its difficulties. Not only were more habitats covered in the earlier report but, also, on that occasion the excursion took three days. The ornithologists recorded 38 species in 1889 (25 residents and 13 migrants), whereas on the 2000 visit 15 species were noted (11 residents and 4 migrants). The birds in 1889 were listed at the end of the Union's report under the scientific names that were in use at that time. Since then, due to more accurate taxonomy, many of the generic and specific names have changed, so sorting out which species were which proved to be an interesting exercise. Listed below are the bird lists for both excursions (1889 classification in brackets):

		1889	2000
Grey Heron	*Ardea cinerea* (*A. cinerea*)	X	–
Teal	*Anas crecca* (*A. crecca*)	X	–
Buzzard	*Buteo buteo*	–	X
Kestrel	*Falco tinnunculus*	–	X
Red Grouse	*Lagopus lagopus* (*L. scoticus*)	X	X

		1889	2000
Black Grouse	*Tetrao tetrix* (*T. tetrix*)	X	–
Oystercatcher	*Haematopus ostralegus*	–	X
Golden Plover	*Pluvialis apricaria* (*Charadrius pluvialis*)	X	–
Lapwing	*Vanellus vanellus* (*V. cristatus*)	X	X
Dunlin	*Calidris alpina* (*Tringa alpina*)	X	–
Snipe	*Gallinago gallinago*	–	X
Curlew	*Numenius arquata* (*N. arquata*)	X	X
Redshank	*Tringa tetanus*	–	X
Common Sandpiper	*Actitis hypoleucos* (*Totanus hypoleucos*)	X	–
Wood Pigeon	*Columba palumbus* (*C. palumbus*)	X	–
Swift	*Apus apus* (*Cypselus apus*)	X	–
Kingfisher	*Alcedo atthis* (*A. ispida*)	X	–
Skylark	*Alauda arvensis* (*A. arvensis*)	X	–
Sand Martin	*Riparia riparia* (*Cotile riparia*)	X	–
House Martin	*Delichon urbica* (*Chelidon urbica*)	X	–
Swallow	*Hirundo rustica* (*H. rustica*)	X	–
Meadow Pipit	*Anthus pratensis* (*A. pratensis*)	X	X
Pied Wagtail	*Motacilla alba* (*M. lugubris*)	X	–
Grey Wagtail	*M. cinerea* (*M. melanope*)	X	–
Dunnock	*Prunella modularis* (*Accentor modularis*)	X	–
Robin	*Erithacus rubecula* (*E. rubecula*)	X	–
Redstart	*Phoenicurus phoenicurus* (*Ruticilla phoenicurus*)	X	–
Whinchat	*Saxicola rubetra* (*Pratincola rubetra*)	X	–
Wheatear	*Oenanthe oenanthe* (*Saxicola oenanthe*)	X	X
Blackbird	*Turdus merula* (*T. merula*)	X	–
Ring Ousel	*T. torquatus* (*T. torquatus*)	X	–
Song Thrush	*T. philomelos* (*T. musicus*)	X	–
Willow Warbler	*Phylloscopus trochilus* (*P. trochilus*)	X	–
Blue Tit	*Parus caeruleus* (*P. caeruleus*)	X	–
Dipper	*Cinclus cinclus* (*C. aquaticus*)	X	X
Rook	*Corvus frugilegus* (*C. frugilegus*)	X	X
Carrion Crow	*C. corone* (*C. corone*)	X	X
Raven	*C. corax* (*C. corax*)	X	X
Starling	*Sturnus vulgaris* (*S. vulgaris*)	X	X
House Sparrow	*Passer domesticus* (*P. domesticus*)	X	–
Chaffinch	*Fringilla coelebs* (*F. coelebs*)	X	–
Twite	*Carduelis flavirostris* (*Linota flavirostris*)	X	–
Linnet	*C. cannabina* (*Linota cannabina*)	X	–
		38	15

Thirteen of the species listed for 1889 would not (or only possibly rarely) be seen in a montane heathland habitat. Some summer migrants, such as the Swift, would have moved on by the time of the 2000 VC65 excursion in the third week of August. Black Grouse are still in the area, but not immediately local.

The presence of Buzzard is indicative of the continuing recovery of this raptor in north-west Yorkshire. Oystercatchers, as an inland breeding species, were first recorded in Yorkshire in 1936 (Mather 1986) and, therefore, would not have been seen in 1889. Although 5 bird species were seen in 2000 that were not recorded in 1889, namely Kestrel, Buzzard, Redshank, Snipe and Oystercatcher, there appears to have been a reduction in the total number of species, as well as the number of birds. Declines nationally have been recorded amongst Twite, Linnet, Dunlin, Golden Plover, Whinchat and Ring Ousel (Mead

2000), and some of these declines may account for their not being seen in 2000 and the differences in total numbers between the two excursions.

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Mead, C. (2000) *The State of the Nations' Birds.* Stowmarket, Suffolk: Whittet Books.

CONCHOLOGY (A. NORRIS)
It is no wonder that the Upper Teesdale National Nature Reserve on Mickle Fell has never been surveyed for snails before this date. The two-hour walk to the base of the crag, from the nearest point cars could be parked, over very rough and wet moorland, was hard enough. On top of this the trio concerned (David Lindley, Tom Blockeel and A.N.) had to cross several small rivers (in flood), a case of removing boots, etc., and wading through very cold water. The walk did produce at least two records, but not of mollusca. Over two of the rivers logs had been placed and pole traps set inside a wire tunnel. In both of these traps were freshly killed Weasels. Presumably the local Game Keeper had placed the traps on the logs.

The visit to the limestone crags proved to be very interesting from the point of view of the mollusca. Although David Dickinson and A.N. recorded only 22 species of mollusca from the reserve, all but two, *Arion ater* and *Pyramidula rupestris*, can claim to be new altitude records for the species in England. In most cases at least 1,000 feet has been added to the highest previous record for England. The crags have an average altitude at their base of 2,400 ft and 2,450 ft at the top. Contour lines run along the base and the top of the crags, for almost the full length of the limestone outcrop. All of the records come from between these two altitudes.

22 species in total were recorded from the Upper Teesdale National Nature Reserve, 8 species of mollusc from NY35/80–24–, 21 from NY35/81–24– and 8 from NY35/82–24–. Time was the main constraint on recording in the area. We felt that further species could and will be found in the area, given time. A number of calcareous flushes occur at the base of the cliffs, which in dryer weather could produce some very interesting records.

D.L. had to leave early, after only 2 hours on site. T.B. and A.N. recorded specimens from all three 1 km squares, before tackling the two-hour trek back – one hour into which the will to live was lost. The cars were finally reached at 6.30 p.m., too late for attendance at the indoor meeting.

The list of species found is as follows:

	80–24–	81–24–	82–24–	Previous Altitude Record
Lymnaea truncatula		X		1,350
Carychium minimum		X		?
Carychium tridentatum		X	X	1,550
Cochlicopa lubrica	X	X	X	1,400
Pyramidula rupestris	X	X	X	3,054
Columella aspera		X		?
Vertigo substriata		X		1,230
Lauria cylindracea	X	X		1,800
Discus rotunatus			X	1,400
Arion ater agg.	X	X	X	3,000
Arion circumscriptus		X		1,250
Arion internedius		X		1,325
Vitrina pellucida	X	X		?
Vitrea subrimata		X		?
Vitrea contracta	X	X	X	1,325

	80–24–	81–24–	82–24–	Previous Altitude Record
Nesovitrea hammonis		X	X	1,400
Aegopinella nitidula		X		1,400
Oxychilus alliarius		X		1,400
Deroceras leave		X		1,230
*Deroceras agreste**	X	X	X	?
Clausilia dubia		X		2,350
Arianta arbustorum†	X	X		2,400

Notes:

* All of the specimens of *Deroceras agreste* found proved to be young and therefore could not be confirmed by dissection. However, the identification is considered to be correct.

† Recorded from an altitude of 2,425 ft.

CRUSTACEA (G. FRYER)

Streams were in spate, making moorland crossings difficult. Small peaty pools at *c*.600 metres south of Mickle Fell revealed the expected paucity of micro-crustaceans, but collecting was desultory. Here the almost ubiquitous *Chydorus sphaericus* was accompanied by *C. ovalis*, a species often found in acidic habitats in the northern, but not the southern, Pennines. A rotifer *Keratella* sp. was plentiful, suggesting that such habitats merit attention from students of this currently neglected group.

BOTANY (D. MILLWARD)

Lune Head Moss and Philip Reed Moss supported the typical flora of a managed blanket bog with dominant *Calluna vulgaris* and *Eriophorum vaginatum* but not to the exclusion of other more significant species. All the usual "berries" were there with noticeably frequent *Rubus chamaemorus*, none of which bore fruit. *Vaccinium myrtillus*, *V. vitis-idaea*, *V. oxycoccus* and *Empetrum nigrum*, were more dispersed, the first being the most frequent. *Drosera rotundifolia* occurred on barer peat.

Closer to the summit where some calcareous influence ameliorated the very acidic conditions, *Viola palustris* and *Chrysosplenium oppositifolium* were recorded. As expected, once onto the limestone flanks of the fell, diversity increased dramatically. Search was concentrated on the southern edge of 35/8024 within the grazing enclosure where rabbits kept a close turf. Here *Saxifraga hypnoides*, *Cochlearia pyrenaica* and *Galium boreale* mingled with the commoner *Viola lutea*, *Alchemilla filicaulis* ssp. *vestita* and *Carex caryophyllea*. Sedges as usual were concentrated in the flushes where both *Carex viridula* ssp. *brachyrryncha* and ssp. *oedocarpa* flourished with pale *Myosotis stolonifera*, *Epilobium alsinifolium* and *Selaginella selaginoides*. Pteridophytes were uncommon throughout the day; only *Blechnum spicant*, *Cryptogramma crispa* and *Dryopteris dilatata* were seen on the acid ground, and *Cystopteris fragilis* and *Asplenium viride* on limestone rocks.

BRYOLOGY (T. L. BLOCKEEL)

The long and arduous walk to the summit of the Fell left only limited time for bryologising. Exploration was confined to parts of the south-facing slopes of the summit ridge. At the western end there was a small area of block scree with grit boulders, supporting plentiful *Andreaea rupestris* and *A. rothii* subsp. *rothii*, with *Barbilophozia atlantica* in the hollows. Further towards the summit, grit rocks had *Dicranum fuscescens* and *Lophozia incisa*.

The dry south-facing limestone was notable for the plentiful occurrence of *Pseudoleskeella catenulata*. *Schistidium* species were also plentiful, and they included *S. robustrum* and *S. trichodon*, the latter new to the vice-county but previously known from the Widdybank area of Teesdale. Other species on the limestone crags included *Frullania tamarisci, Scapania aspera, Porella cordaeana, Didymodon ferrugineus* and *Pohlia cruda*. Some boulders had quantities of *Barbilophozia barbata* associated with *Ditrichum flexicaule* s.str.

There are a number of springs and runnels below the crags. Particularly noteworthy here was a patch of the arctic-alpine moss *Cinclidium stygium*. Flushes supported *Dicranum bonjeanii, Hymenostylium recurvirostrum, Philonotis calcarea, Climacium dendroides* and *Palustriella commutata* var. *falcata*. One springhead had *Marchantia polymorpha* subsp. *montivagans*; this is new to the vice-county, and as subsp. *polymorpha* grew nearby, the two could be readily compared. 81 species were recorded along the summit ridge.

MYCOLOGY (C. S. V. YEATES)

Following the rather misleading information that it would only take "an hour or so" to walk to the top of the fell, the writer opted not to do the generally much more profitable slow, careful searching of a small area, but set off at a fast pace for the summit.

In the event, a combination of a shortage of time at the objective, highly grazed or very wet vegetation and an apparent paucity of fungi made for a frustrating time. From a mycologist's point of view the noteworthy plants around the top of the fell were disappointingly healthy. In the acidic rushy grassland the ivory-coloured discomycete *Hymenoscyphus herbarum* was frequent on dead *Cirsium palustre* stems; and, among a number of fungi recorded on rabbit pellets, another discomycete, the long-haired *Lasiobolus cuniculi* has few Yorkshire records, largely because the genus has been recently revised and earlier records cannot be redisposed without voucher material. The most interesting species by far was that found by Albert Henderson, about which the reader is directed to the lichen report.

LICHENOLOGY (M. R. D. SEAWARD & A. HENDERSON)

Although the two lichenologists did not make it to the top, being slow movers and deterred by a fast-flowing beck, there was much to claim attention. The juxtaposition of acid and alkaline habitats (*Callunetum*, acid grassland, gritstones and limestone outcrops), in addition to walls composed of a miscellany of stone types, provided a rich source of lichen records. In all well over 100 terricolous and saxicolous species were recorded.

Perhaps the most striking record from the long stretch of boundary wall was the lichenicolous fungus, *Zwackhiomyces coepulonus*, growing on *Xanthora parietina* on the northeast shoulder of mortar capping. This is the first British record for this species (det. C. J. B. Hitch, conf. D. L. Hawksworth), previously known only from Spain and the Canaries. The dark immersed or sessile perithecia have 1-septate, hyaline, finely verrucose spores, 16-20μ x 5-8μ (see *British Lichen Society Bulletin* **88** [2001]: 77 and *Nova Hedwigia* **51**: 283-360). Several lignicolous species were observed on old fence posts, marking this western boundary of our study area. *Lecanora aitema* (the only recent record from Yorkshire) was most notable here among the commoner lignicolous flora of *Lecanora conizaeoides, L. chlarotera, L. symmicta, Lecania cyrtella, Mycoblastus sterilis* and *Micarea botryoides*.

Of particular interest in the acidic heathland areas were many *Cladonia* species (at least 16), especially the fine show of *C. portentosa* on hummocks. Much of the wet peaty earth was stippled with dark green globuloid *Botrydina*-type crusts of *Omphalina*, nowhere seen fruiting and therefore indeterminate to specific level; as distinct from the squamulose *Coriscium*-type thalli of this genus which were occasionally found in fruit and determined as *O. hudsoniana*. Together these representatives of this agaricoid lichen genus constituted a quite significant element of the heathland surface cover; occasional well developed patches of the thick glaucous grey squamules of *Trapeliopsis glaucolepidea* were another interesting feature.

Limestone outcrops supported a reasonably diverse flora, although several lichens characteristic of this habitat, including the more colourful *Caloplaca* species, were noticeably absent; the associated soil in crevices of one exposed ridge at *c*.500 m was dominated by *Squamarina cartilaginea* (much less common now on Yorkshire limestone), and a few thalli of *Solorina saccata* (similarly disappearing due to habitat disturbance) were found upon a smaller outcrop at *c*.550 m. Some of the hardest limestone bore the immersed black perithecia of *Porina linearis*. *Acarospora glaucocarpa* was seen here and there on the shoulders and tops of outcrops, growing occasionally with *Staurothele caesia*. Shallow soils over limestone, heavily grazed by sheep and rabbits, provided another interesting habitat with mixtures of both calcicolous and acidophilous lichens, such as *Coelocaulon aculeatum/muricatum, Cladonia rangiformis, C. cervicornis* and *Peltigera* species; and at one roadside site, *P. leucophlebia*, a rare lichen in England (particularly in fruit, as here) was much in evidence over an area of *c*.1 m^2.

A short visit was also made to the spoil heaps of a former lead mine (35/834198), the stone waste supporting a lichen flora similar to but more luxuriant (particularly *Stereocaulon vesuvianum*) than that observed on local walls, with the addition of *Sphaerophorus globosus*; the mineral soil was equally rich, with such species as *Cladonia arbuscula, C. ramulosa* and *Coelocaulon aculeatum.*

* * * * *

EXCURSIONS IN 1999: ADDENDA

See: *Naturalist* 126: 41-48 (2001)

Leyburn Shawl Woods and Quarry (VC65) 24 July (J. A. Newbould)

ENTOMOLOGY (J. A. NEWBOULD)

In the absence of most of the Union's recognised entomologists, entomological recording was carried out by J. A. Newbould, C. S. V. Yeates and Helen Thornton in Leyburn Shawl, then through Warren Wood into the thicker shelter of Gillfield Wood. With temperatures at well over 20°C the south-facing slopes of Leyburn Shawl should have afforded an interesting day. Recording of lepidoptera was, however, made harder by a strong southwesterly which forecasters had said would be blowing at 25 mph, and which kept many species well hidden in sheltered places. The most common butterfly seen across the area was the Meadow Brown (*Maniola jurtina*). Not until Warren Wood was reached were other species recorded. Here Small Heath (*Coenonympha pamphilus*), Ringlet (*Apantopus hyperantus*) and Small Copper (*Lycaena phlaeas*) were added to the list, whilst in Gillfield Wood Green-veined White (*Artogeia napi*) and Small White (*A. rapae*) were also present.

Later at the meeting members reported Common Blue (*Polyommatus icarus*) and Small Tortoiseshell (*Aglais urticae*) in the area of Moor Quarry. Tim Flint reported seeing the dragonfly *Sympetrum striolatum* in the quarry area.

FLOWERING PLANTS (I. C. LAWRENCE)

The large quarry floor was the main focus of attention during the morning. Large areas were sparse in vegetation, the richer areas being around the pond and stream and hummocks at the western end which yielded two of the rarest plants of the day: *Orobanche alba* and *Gentianella amarella* subsp. *septentrionalis*. The wet areas had large quantities of *Myosotis scorpioides*, and *Veronica anagallis-aquatica* was locally common. In the pools there was *Hippuris vulgaris* along with *Myriophyllum spicatum, Potamogeton natans* and stands of *Typha latifolia*. Other plants of interest in the damper areas were *Carex viridula* subsp. *brachyrrhyncha, Dactylorhiza fuchsii* and the hybrid willow-herb *Epilobium parviflorum* x *E. montanum*. Other species included *Galium sterneri, Sagina nodosa* and the established *Sedum alba* and *S. rupestris*. Some 94 species were recorded in this area during the morning. The afternoon was spent in the nearby woodland and on the Shawl itself where another fine group of *Orobanche alba* was seen on the cliff edge. Here several calcicoles were noted including *Inula conyza, Arabis hirsuta, Filipendula vulgaris, Clinopodium vulgare* and *Listera ovata*. Other species of interest were *Plantago major* subsp. *intermedia* in the damp area of the quarry, *Minuartia verna* and *Agrimonia procera*.

Finally, we were shown a stand of *Sambucus ebulus* on the roadside leading to the council tip.

NB. At a further location for *Orobanche alba* in open woodland on Leyburn Shawl (44/096907), the following 2 metre square quadrat represents the position (measurements on the Domin scale):

Orobanche alba, 3 spikes	D1	*Linum catharticum*	D2
Thymus praecox	D3	*Cirsium vulgare*	D2
Hedera helix	D4	*Hieracium pilosella*	D2
Teucrium scorodonia	D2	*Fragaria vesca*	D2
Centaurea nigra	D2	*Helianthemum nummularium*	D6
Sedum acre	D3	*Achillea millefolium*	D2
Sangusorbia minor	D2	Bare ground	D5
Festuca ovina	D4	Limestone rock	D4
Senecio jacobea	D2		

(D10 = 91-100%, D9 = 76-90%, D8 = 51-75%, D7 = 34-50%, D6 = 26-33%, D5 = 11-25%, D4 = 4-10%, D3 represents many individuals, D2 several individuals and D1 few individuals).

DARNBROOK FARM, Malham Tarn Estate (VC64) 14 August

FRESHWATER BIOLOGY (CONTD) (D. T. RICHARDSON)

The most outstanding feature of the calcareous flushes was the presence of very large numbers of the freshwater triclad *Crenobia alpina*. It inhabits spring heads and small swiftly flowing streams at high altitudes, and is incapable of enduring temperatures of above 15°C for any length of time. The water temperature of these flushes was between 8°C and 10°C, a clear indication of their deep-seated origins.

Water Analyses (Streams in flood following heavy rain during the previous 24 hours):

		Darnbrook Beck	Cowside Beck	Thoragill Beck
Calcium+Magnesium	mgs $CaCO_3$ l^{-1}	56	172	130
Calcium	mgs $CaCO_3$ l^{-1}	52	166	124
Alkalinity	mgs $CaCO_3$ l^{-1}	46	162	118
pH		7.58	7.75	7.51
Water Temperature	°C	14	11	12

The low mineral content of Darnbrook Beck is a direct consequence of run-off of surface water from the moor.

Darnbrook Beck has its origins in the perennially wet raw peat bogs of Darnbrook and Fountains Fells. The bogs are separated from the underlying Yoredale and Lower Carboniferous Limestone rocks by a covering of Glacial Drift. Any precipitation which takes place results in immediate run-off and can cause flash floods. This also causes dilution of the mineral content of the water, which is demonstrated in the analytical figures given above. There was heavy precipitation the day before sampling the admixture of the run-off water reducing the calcium content of the water to about one third of that normally experienced.

Cowside Beck, whilst taking some water from the peat bogs of Fountains Fell, draws far more from the actual Carboniferous Limestone, and only in cases of extreme and prolonged precipitation is any degree of dilution obvious.

Thoragill Beck is completely different: it has deep-seated origins within the Carboniferous Limestone, drawing water from an extensive aquifer. Precipitation does not have an immediate effect on its mineral composition and several days pass before signs of dilution are apparent. This is because the water held back in the aquifer has to be displaced before the diluted water appears. The classic example of this phenomenon is the spring at the base of Kilnsey Crag where it takes 10 to 12 days before the effects of precipitation become apparent.

BOOK REVIEWS

Environmental Contamination in Antarctica. A Challenge to Analytical Chemistry edited by **S. Caroli, P. Cescon** and **D. W. H. Walton.** Pp. xiv + 406 (incl. numerous figures & tables). Elsevier, Amsterdam. 2001. 147.50 hardback.

This is a most valuable contribution to our knowledge of how and to what extent pollutants reach remote areas of the globe. Antarctica's once uniquely clean environment is clearly receiving a wide range of man-made contaminants; whilst many of these are present at low levels, they are nevertheless capable of being detected by present-day analytical chemistry, such measurements providing baseline data invaluable for time-space analyses.

Fifteen chapters covering many aspects of environmental chemistry and environmental monitoring of air, snow, ice, sea-water, sediments and ecosystems are provided by 36 (mainly Italian) authors. The use of plants as biomonitors receives relatively less attention, particularly, and rather surprisingly, lichens (rarely mentioned) and bryophytes (not mentioned) which have been extensively used in Antarctica for this purpose. The measurement and monitoring of radionuclides, so important for appreciating their global impact, has also been omitted.

Despite these reservations, this work should be consulted by all those involved in monitoring our environment. The stimulating text is supported by a wealth of reference material, complemented by extensive bibliographies (not alphabetic), author and subject indexes. Rather pricey for individual purchase, so recommend it to your library.

MRDS

Food: a History by **Felipe Fernandez-Armesto.** Pp. xvi + 287, plus 16 pp. b/w plates. Macmillan, London. 2001. £20.00 hardback.

A most readable and thoroughly enjoyable exploration of the global history of food, albeit somewhat sketchy, tracing its production, processing, preparation and ultimate consumption. This is a book on the history of science and society which touches on ecological and environmental issues of the past, current crises and future implications.

MJD

The Peak District Joural of Natural History and Archaeology edited by **Melvyn Jones** and **Ian D. Rotherham.** Volume 2, pp. 96, incl. colour & b/w plates, and line drawings. £5.00 plus £2.00 p.&p. from Wildtrack Publishing, P.O. Box 1142, Sheffield S1 1SZ.

This annual publication contains short articles on various aspects of the wildlife, conservation, history and archaeology of the Peak District National Park and surrounding areas. This volume (2000) includes several articles of natural history interest, particularly a paper on ancient coppiced woods in Derbyshire, a study of the slug *Limax cinereoniger*, and a case study of deer in the urban fringe. Articles are written in non-technical language and an accessible, very readable style – indeed, the one on deer is positively jocular in tone! The presentation is of a very high quality and the A4 format makes for easy reading, with large font, clear maps and diagrams, and a liberal quantity of high quality monochrome and colour plates. The glossy, full-colour cover is an attractive feature that should help to sell the journal. Whilst the content is obviously of primary interest to those working in the Peak District, several of the papers are of sufficient general interest to appeal to a wider audience. Each volume includes a featured local organisation – in this case, the Derbyshire Archaeological Society – plus a few book reviews and advertisements. I am confident that many members of the Yorkshire Naturalists' Union would enjoy reading it.

MAA

CONTRIBUTORS

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