January-March 1999 Number 1028
Volume 124

The Naturalist

A QUARTERLY JOURNAL OF NATURAL HISTORY FOR THE NORTH OF ENGLAND

Proceedings of the Yorkshire Naturalists' Union Spring Conference on the Magnesian Limestone, 1998

Published by the Yorkshire Naturalists' Union

Editor **M. R. D. Seaward,** MSc, PhD, DSc, FLS, The University, Bradford BD7 1DP

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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.

Subscriptions should be sent to:

Mr Richard Comley, 1 Highfield Rise, Stannington, Sheffield S6 6BS

All other YNU matters should be addressed to:

Mr John A. Newbould, Tapton House 30 Moorlands, Wickersley
Rotherham S66 0AT

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Institutions and Subscribers £20.00 Registered Charity No. 224018

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INTRODUCTION TO THE PROCEEDINGS OF THE Y.N.U. SPRING CONFERENCE ON THE MAGNESIAN LIMESTONE, 1998

A. HENDERSON
Department of Biology, University of Leeds, Leeds LS2 9JT
and
J. A. NEWBOULD
Tapton House, 30 Moorlands, Wickersley, Rotherham S66 1AT

On February 28th, 1998, the Yorkshire Naturalists' Union held its Spring Conference on the Magnesian Limestone at the Swallow St George Hotel, Harrogate. The conference, chaired by the Union's President, Dr Margaret Atherden, had an attendance of 110, members of the Union and guests, members and staff of the Yorkshire Wildlife Trust Ltd, and representatives of English Nature and of local authorities with responsibility for parts of the Magnesian Limestone Natural Areas. Participants first assembled in the hotel's Wharfedale Suite.

The Magnesian Limestone Natural Areas, the natural history status of which the conference was to study and discuss, were defined on the Character Map of England, produced in 1996 by English Nature and the Countryside Commission, in consultation with English Heritage. The Natural Areas delineated on this map are based on the natural, cultural and ecological dimensions of the English landscape and are intended as a format for the organisation of nature conservation policy grounded on natural features rather than on traditional local government boundaries. The aim of the Y.N.U. conference was to apply the expertise available from conference participants in the examination and assessment of the unique combination of geophysical features, animal and plant life, land use, economic and conservation opportunities and issues presented by the Southern and Northern Magnesian Limestone Natural Areas, the southern running in a narrow belt from Nottingham into north-east England just north of Ripon, and the northern situated within County Durham. To address this range of subject matter as fully as possible, the conference programme was composed of three main lectures, two in the morning session and one in the early afternoon, after which participants divided into three separate seminars: Seminar A on Vegetation chaired by A. Henderson; Seminar B on Invertebrates chaired by R. Crossley; and Seminar C on Vertebrates chaired by M. Thompson.

Dr R. A. Ixer of Birmingham University opened the lecture sequence with a lively and probing account of the origin and development of the Magnesian Limestone's geophysical framework, an account particularly welcome as geology is frequently the Cinderella in the priorities of today's natural history societies. Professor J. P. Grime of Sheffield University then addressed the issue of suspected losses in plant diversity in the Southern Magnesian Limestone Natural Area, believed to be more advanced here than in the Carboniferous Limestone of North Derbyshire. A computerised database from extensive vegetation surveys by a Sheffield team over *c.*2400 km^2 in north-central England makes possible the identification of the distinctive plants of the Magnesian Limestone's woodlands, grasslands, wetlands and wastelands, and of their rare and threatened habitats and species. The third main lecture was given to the full conference by D. Wood of Rotherham Planning Service on the mapping of the Magnesian Limestone conservation sites, focussing on how future recording and assessment procedures on the part of the several bodies and individuals involved may be successfully co-ordinated and the wealth of available computerised and other data most efficiently put to use. The major problems considered were: selection of sites; accuracy of recording; mapping of existing data; and concentration on key species and habitats.

The Vegetation Seminar was opened by Dr O. L. Gilbert of Sheffield University, who re-examined data and conclusions from the lichen survey he conducted of numerous sites throughout the Magnesian Limestone Natural Areas from 1980 to 1983. Dr A. Headley of Bradford University considered distributional and ecological work carried out on the Thistle Broomrape in Yorkshire: a full account of this work appeared in *The Naturalist* **123:** 49-98 (1998). C. Newlands of English Nature, Wakefield, then presented a searching evaluation of the habitats and rare plants of the southern Magnesian Limestone.

Talks in the Invertebrate Seminar concentrated on the Southern Magnesian Limestone Natural Area: A. Norris of Leeds City Museum treated the distribution and status of the mollusca of the Yorkshire Magnesian Limestone; followed by R. Morris and W. A. Ely, each of whom looked at aspects of the Area's invertebrate interest.

The Vertebrate Seminar was given a detailed up-to-date review of bat studies in the Don Valley Gorge by A. C. Lane and C. Howes. The latter then turned the attention of the seminar to the intriguing subject of the threshold fauna of caves and tunnels in the gorge, followed by an overall review of the present state of knowledge on the mammals and herptiles of the Southern Magnesian Limestone Natural Area.

With the full conference reassembled in the Wharfedale Suite, reports were presented on the talks and subsequent discussions in each seminar (Vegetation: T. Kohler; Invertebrates: R. Morris; and Vertebrates: J. Lunn). After some final discussion, the conference closed with acknowledgements of all who had assisted in the organisation and success of the day's events.

THE MAGNESIAN LIMESTONE: A BASIC FRAMEWORK

ROBERT A. IXER
Email: R.A.F.Ixer@bham.ac.uk
School of Earth Sciences, University of Birmingham, Edgbaston, Birmingham B15 2TT

ABSTRACT
The Magnesian Limestone comprises three sequences of dolomitized limestones (dolostones) that make up a narrow band of rocks running from Nottingham to Newcastle upon Tyne. They are marine carbonates formed in a shallow, tropical basin – the Zechstein Sea – that underwent cyclic evaporation in the Upper Permian. The rocks have been quarried for bulk aggregates and, although this use is declining, they remain important aquifers.

The unusual chemical composition of the Magnesian Limestones and their overlying soils, the interaction of the rocks and local groundwaters and the presence of abandoned quarries, exert powerful controls on the flora and fauna associated with them.

INTRODUCTION
Limestones and chalk are common and familiar carbonate rocks, with large outcrop patterns stretching across the British Isles; for example, the Carboniferous Limestone forms the Carboniferous core to the Pennine and Mendip Hills as well as large areas of north and south Wales. In Ireland its outcrop pattern is even larger as it forms the centre of that island.

Calcite ($CaCO_3$) is the main constituent of limestone and chalk and since the mineral is highly reactive it readily alters to dolomite $(CaMg)CO_3$ if it comes into contact with magnesium-bearing fluids. This process is called dolomitization and limestones that are extensively dolomitized are called dolostones. In Britain much dolomitized Carboniferous Limestone is associated with lead-zinc-baryte-fluorite mineralization as examplified by the many deposits in the Northern Pennine Orefield (Dunham 1990; Dunham & Wilson 1985; Ixer & Vaughan 1993). Indeed, in more extreme cases dolomite becomes an essential part of the mineralization, as for example in the copper-dolomite association ores that were exploited by Bronze Age miners at the Great Orme, Llandudno (Ixer & Davies 1996). However in all such cases the dolomitization is secondary and takes place a long time after the lithification of the limestone.

Less commonly, dolomitization is an early event associated with limestone-seawater/modified seawater interactions and it is this form of dolomitization that produced the Magnesian Limestone. The Magnesian Limestone (normally shortened to the Mag. Lime.) is, therefore, an unusual carbonate and this uniqueness is reflected in the degree and extent of its dolomitization. This in turn is a result of the unusual conditions prevailing in northeastern England at the end of the Palaeozoic – namely the partial evaporation of a shallow marine basin in Upper Permian times.

Seawater contains approximately 3.5% dissolved salts dominated by sodium and chloride ions and if it is evaporated to dryness these salts will precipitate out in a set sequence. Calcium carbonate is the first but it is only after the evaporation of 80% of the seawater that calcium sulphate in the form of anhydrite ($CaSO_4$) or gypsum ($CaSO_{4}.2H_2O$) appears, followed after 90% evaporation by sodium chloride in the form of halite ($NaCl$) and finally, after the loss of 96% of the water, the highly soluble potassium and/or magnesium salts. Within the stratigraphical record the complete, or more often, partial, evaporation of seawater is recorded as a sequence of chemical sediments called evaporites. These rocks are uncommon as by their very nature they are highly soluble and commonly are redissolved soon after formation. If they escape this, many sequences are dissolved at some later time by the passage of groundwaters. However, where they occur, and especially if they contain great volumes of halite and potassium salts, they form the geological foundation to major chemical industries.

Hence the experimental evaporation of seawater suggests that the evaporation of a marine basin should produce limestones as their earliest evaporite but in many sequences dolomite is present instead of, or in addition to, these limestones. This is because the initial limestones have interacted with magnesium-rich fluids (often partially evaporated seawater) to form dolostones, as happened in the Zechstein marine basin.

The Stratigraphy and Geology of the Magnesian Limestone

The Magnesian Limestone should be seen within its context, namely the history of an ancient marine basin – the Zechstein Sea – that produced some of the more unusual rocks in Britain. Figure 1 summarises this history in the form of a generalised stratigraphy for northeast England from the end of the Carboniferous to the Upper Permian. In Europe the youngest Carboniferous rocks are the Upper Coal Measures of Stephanian age but in Britain these rocks are absent, so that for us the youngest rocks are the Lower Coal Measures of Westphalian age. The absence of the Stephanian is explained partly by the folding, faulting and earth movements associated with the major mountain building of the Hercynian Orogeny which reached its climax at the end of the Carboniferous, but more so by the erosion that followed it. However, by the beginning of the Permian, the Carboniferous rocks of northeast England had been reduced to a low peneplane – a flat, arid surface covered by huge sand dunes. These dunes, called draa, have been preserved as major cross-beds within poorly cemented sandstones known as the Basal Permian Sands (or the Durham Yellow Sands in County Durham) that unconformably overlie the Carboniferous. These sandstones vary in thickness; where they have infilled hollows in the original topography they can reach up to 45m but elsewhere they are absent, and a thin, basal breccia, just a few metres thick, is present instead. Locally, where the sandstones are thick enough they have been quarried for high quality sand.

This 'English' desert landscape was part of a major intracontinental basin that had been eroded to below sea level and approximately 240Ma ago, the Permian ocean broke through its defences and flooded in. The ocean covered much of northwest Europe including northeast England up to the Pennines, Holland, Denmark, northwest Germany and northern Poland as the Zechstein Sea, a shallow, semi-euxenic, tropical sea, in an event that is believed to have been catastrophic and taken only a handful of years. More than two hundred million years later, at the beginning of the Pliocene, a similar event took place when the Atlantic broke through the Straits of Gibraltar to form the 'world's greatest waterfall' and flooded the Mediterranean Basin to create the Mediterranean Sea. The

UPPER MARLS	Cyclic evaporation
UPPER MAGNESIAN LIMESTONE	and recharge of the
MIDDLE MARLS	shallow Zechstein
LOWER MAGNESIAN LIMESTONE	Sea
MARL SLATE	Initial flooding
BASAL PERMIAN SANDS	Desert Conditions
Unconformity	
CARBONIFEROUS ROCKS	

FIGURE 1
An overview of the Permian in the Yorkshire Province.

Zechstein was a shallow, restricted sea only connected to the open ocean via a narrow north-south channel and, due to its tropical position, was subjected to intense evaporation. Periodically this evaporation was interrupted by the introduction of fresh seawater from the northern ocean, itself the result of global sea level rises. As the Zechstein seawater salinity changed because of the periodic recharge of oceanic waters, so did the resulting sediments and, for northwestern Europe, the Upper Permian is a record of the salinity of this unusual, indeed bizarre, sea.

The initial lithology formed in the Zechstein Basin was the Kupferschiefer, a clastic sediment covering an area of *c.* 4×10^5 km^2 and representing the initial flooding phase (Smith 1975). The Kupferschiefer is a base metal-rich (lead, zinc, copper and a little silver), finely laminated, dolomitic shale/organic-rich, argillaceous, calcareous siltstone. Although the Kupferschiefer was mined in Poland until very recently for its copper content, the name is a bit of a misnomer for it carries more lead and zinc than copper, and the rock has too high a carbonate content to be a shale. The mineralization of the Kupfershiefer is unusual, for it and the Precambrian Zambian Copper Belt are the only important representatives of a major class of sedimentary copper deposit – deposits associated with the initial stages of the evaporation of a restricted marine basin. In England the Kupfershiefer is called the Marl Slate and was neither thick enough nor rich enough to be mined for its metal content. It is normally less than one metre in thickness, forming a thin covering over the Basal Permian Sands and does not crop out in Yorkshire.

As the Zechstein Sea deepened over northern England the initial detrital component of the sedimentation diminished in importance, and so the Marl Slate passes up into the main cyclical evaporite sequences of the Upper Permian. In total there were five cycles in the English Zechstein designated EZ1-EZ5 with each cycle beginning with an influx of oceanic seawater. When fully developed the sedimentation belonging to each cycle produced a thin marl (representing the influx of water and a little sediment) followed by the deposition of carbonates followed by sulphate and/or halite (representing the evaporation sequence) before the next influx of water 'reset' the salinity of the Zechstein closer to that of normal oceanic seawater, so as to begin the next evaporite cycle.

The Upper Permian succession is most complete and more diverse within the Durham Province which includes all the outcrop running from just east of Newcastle upon Tyne to Catterick (Middleton Tyas) (Fig. 2). Here all three units of the Magnesian Limestone – the

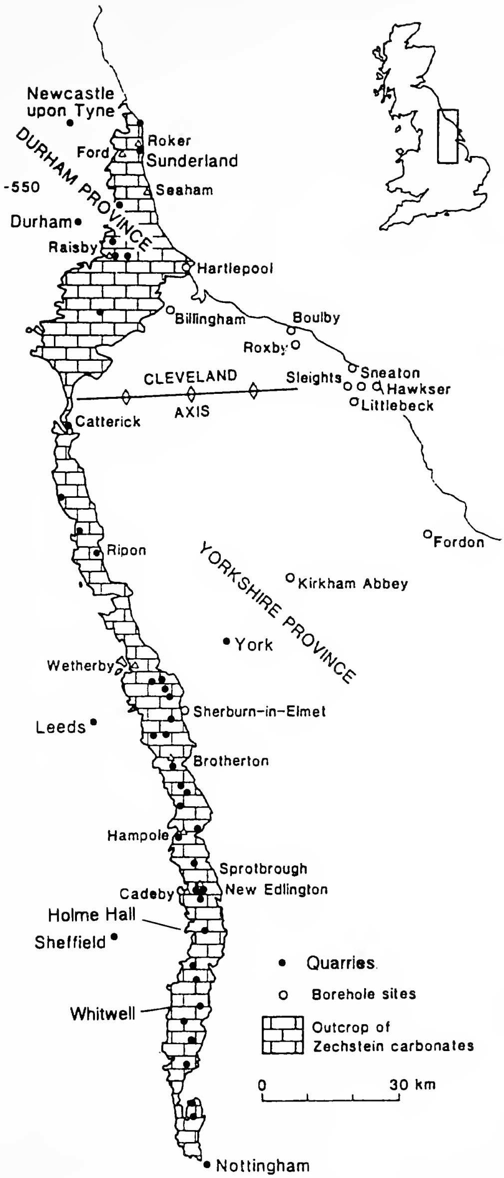

FIGURE 2
Outcrop map for the Magnesian Limestone showing the location of recently or currently active, large quarries (black dots), based on the British Geological Survey (1996) map.

Lower (EZ1), Middle (EZ2), and Upper (EZ3) are present, locally associated with the development of extensive reefs and the area where the Middle Limestone forms the world-famous Cannon-ball Rock. In the Central Subprovince (from Ripon to Wetherby) and Southern Subprovince (from Doncaster to Mansfield) that together make up the Yorkshire Province, only the Lower Magnesian Limestone is of major importance as the Middle is missing and the Upper Magnesian Limestone is thin or, as in Nottinghamshire, absent. As Figure 2 shows there are major differences in outcrop width within the Magnesian Limestone outcrop between the two provinces. The outcrop is 20-30 kilometres wide in the Durham Province but narrows to about one kilometre before widening to 10 kilometres for most of the Yorkshire Province.

The cause of these differences, indeed the reason for the two provinces, was the presence of an east-west trending ridge of high ground passing through Middleton Tyas in north Yorkshire, which was the surface expression of the Cleveland Axis, a major anticline (Fig. 2). This ridge formed a physical barrier in Upper Permian times, so that to the south of it there was far more restricted contact with the changing conditions in the main Zechstein Basin than in the Durham Province to the north. Hence two separate depocentres were formed, so creating a complex stratigraphy to the north but a simpler one to the south.

The detailed stratigraphy for the Upper Permian in Yorkshire of both the condensed sequence at outcrop and the thicker sub-surface sequence (as proved in boreholes) where the more soluble rocks have escaped dissolution is given in Table 1. It shows that, at outcrop, the Lower Magnesian Limestone, now called the Cadeby Formation, is separated from the Upper Magnesian Limestone, now called the Brotherton Formation, by the Middle Marls, now the Edlington Formation.

In the Yorkshire Province the Cadeby Formation of the Yorkshire Province is subdivided into the lower Wetherby and upper Sprotbrough Members. The Wetherby Member is up to 40m thick and formed in shallow lagoonal conditions. It comprises carbonate mudstones at its base passing up into dolostones and calcitic dolostones (dolomitic limestones) and is locally shelly. It is separated from the Sprotbrough Member by a set of thin dolomites and mudstones called the Hampole Beds (Smith *et al.* 1986). The overlying Sprotbrough Member, also up to a maximum of 40m in thickness, comprises cross-bedded dolostones that locally are oolitic or algal and also formed in shallow, lagoonal conditions.

The Upper Magnesian Limestone belongs to EZ3 cycle (the Middle Magnesian Limestone of the EZ2 is missing in the Yorkshire Province) but, at 8-12m thick at outcrop, is far thinner than the Lower Magnesian Limestone, and south of Worksop is missing. It comprises cross-bedded calcitic dolostones and is locally fossiliferous. Unlike the Lower Magnesian Limestone outcrops that have uniform shallow easterly dips, the Upper Magnesian Limestone outcrops are disturbed with locally very variable dips, some of which are quite steep, up to 30°, associated with small, angular, open folds. This disturbance is due to foundering of the dolostone as a result of the dissolution of evaporites within the underlying Middle Marls, a series of calcitic mudstones and siltstones interbedded with highly soluble evaporite beds.

Economic uses of the Magnesian Limestone

In 1995 approximately 18 x 10^6 tonnes of dolomite were mined in Britain, 15 x 10^6 for the construction industry and 3 x 10^6 for agricultural or industrial uses (British Geological Survey, 1997) much of this coming from the Magnesian Limestone. Indeed, the British Geological Survey's Industrial Minerals Resource Map (1996) shows the locations of over forty active or recently active large quarries including major ones at Raisby, Thrislington, Holme Hall and Whitwell. These quarries form a northern cluster about Raisby in County Durham and a string of fairly evenly spaced quarries stretching from Leeds to Beeston in Nottinghamshire (Fig. 2).

The warm yellow colour and relative softness of dolostone led to its initial use as a dimension (building) stone as proved by its incorporation into the Roman walls of York, into the fabric of Beverley and York Minsters and most famously in the present Houses of

TABLE 1
Stratigraphy of the Upper Permian strata from the Yorkshire Province, after Smith *et al.* (1986).

Cycle	**YORKSHIRE PROVINCE** (outcrop)	**YORKSHIRE PROVINCE** (subsurface)
EZ5	ROXBY FORMATION (Upper Marls) Mudstone and gypsum	ROXBY FORMATION (Upper or Saliferous Marls) LITTLEBECK FORMATION (Top Anhydrite) SLEIGHTS (SILTSTONE) FM
EZ4		SNEATON (HALITE) FORMATION (Upper Halite & Potash) SHERBURN (ANHYDRITE) FM (Upper Anhydrite) UPGANG FORMATION CARNALLITIC MARL FM
EZ3	BROTHERTON (MAGNESIAN LIMESTONE) FORMATION (Upper Magnesian Limestone)	BOULBY (HALITE) FORMATION (Middle Halite & Potash) BILLINGHAM (ANHYDRITE) FM (Billingham Main Anhydrite) BROTHERTON (MAGNESIAN LIMESTONE) FORMATION (Upper Magnesian Limestone)
EZ2	EDLINGTON FORMATION (Middle Marls) Calcitic mudstone Gypsum	FORDON (EVAPORITE) FM KIRKHAM ABBEY FORMATION
EZ1	CADEBY (MAGNESIAN LIMESTONE) FM (Lower Magnesian Limestone): SPROTBROUGH Mbr (Upper Subdivision); WETHERBY Mbr (Lower Subdivision)	HAYTON (ANHYDRITE) FM CADEBY (MAGNESIAN LIMESTONE) FORMATION MARL SLATE FORMATION

Parliament. Air pollution and acid rain have now restricted this use to restoration and repair work.

Its chemistry and most especially its high magnesium content has led to the use of high grade dolostones for agricultural lime, in the manufacture of specialist cements and mortars, metallurgical fluxes, heat resistant refractory bricks and even as a source of magnesia using the seawater magnesia process (Smith 1994; British Geological Survey, 1997). However, in tonnage-terms, these are minor or very minor applications as between 80-85% of all exploited Magnesian Limestone is used as a bulk aggregate where its relative hardness and porosity make it a cheap sub-base in road making – but only if locally available. With the decline in major road building and loss of heavy industry, especially iron and steel, in the north of England over the last couple of decades, the Magnesian Limestone has seen a decline in its relative share of the total UK production of limestone and dolomite from 13.7% in 1977 to 11% in 1996 (British Geological Survey, 1996). This has forced the closure of many quarries.

However, as elsewhere, these abandoned quarries have become an economic resource; quite a number, especially in the northern half of the Magnesian Limestone outcrop are used as landfill sites for domestic rubbish, and one at Wormsley has been used for waste coal mining slurry. Other uses for redundant quarries include conversion into a mobile home park at Bunkers Hill in Knaresborough and flooding to make a centre for watersports (Queen Mary's Dubb) at Ripon. In a few cases the quarries have been left 'intact' with the rocks and/or their present day flora and fauna being the amenity; South Elmsall for example is a SSSI and Quarry Moor to the south of Ripon is a centre for a nature group. Epigenetic lead, zinc, barium and copper mineralization, mainly in the form of galena, sphalerite, baryte and malachite is present along the whole outcrop of the Magnesian Limestone. Although these minerals often form good crystals, infilling small vughs that have formed during the reduction in volume that takes place when limestone is dolomitized, nowhere are they found in sufficient quantities to be exploitable ores.

The Magnesian Limestone is permeable at the surface due to the dissolution of the minor evaporite content in the dolostones and so is the source of many springs like those around Boston Spa and Knaresborough (including Mother Shipton's Cave). However, it is sealed at depth, and it is this combination that makes it such an important aquifer. Around Thirsk, for example, approximately $10^6 m^3$ of water are abstracted from the Permian, with a quarter being for public supply and the rest for agricultural or industrial use (Powell *et al.* 1992). Throughout the Magnesian Limestone outcrop its water is hard with a 'high' sulphate content; this makes it especially good for beer production. Hence the famous breweries in Sunderland, Castle Eden and Tadcaster are situated on the Magnesian Limestone and abstract the local waters.

Ecological aspects of the Magnesian Limestone

The Magnesian Limestone contributes to the ecology of Yorkshire in a number of quite disparate ways and on both a local and regional scale. Regionally it acts as a corridor, for it forms an eastward dipping/facing, low but almost continuous north-south ridge, linking Nottinghamshire to the Northumberland coastline – a total length of approximately 230kms. Within this narrow corridor, only 10km wide along most of its length, the carbonate rocks are fairly uniform and their overlying fertile soils are free draining and light, supporting a well-known, well-loved and distinctive array of plants and insects.

By contrast, in detail the situation is quite different, for the Magnesian Limestones are part of the complex Upper Permian stratigraphy comprising carbonates, evaporites and clays (marls). These rock types have quite separate hydrogeological properties, ranging from the water-bearing aquifers of the Magnesian Limestones to the soluble evaporite sequences and to the impermeable marls. The juxtaposition of these lithologies, often over a few metres or tens of metres, has created an extremely complex, local groundwater flow regime with many perched water tables. This complexity is often reflected in local topographic hollows where soluble rocks have been sandwiched between less soluble or impermeable rocks, so giving isolated, wet, shady conditions within higher and drier areas. It is this interplay between the Magnesian Limestone and the local groundwater, creating as it does many different micro-environments, that is perhaps the most important ecological control. Since the underlying cause of this ecological diversity, namely the local groundwater flow, is not immediately visible, this is the most vulnerable part of the Magnesian Limestone system and the one that should be most carefully monitored.

Finally, exploitation by mankind has led to the opening, working and then abandonment of small and large quarries. Their importance in increasing the range of habitat sites associated with the Magnesian Limestone has been recognised by their local, regional and even national status and the protection that goes with them.

CONCLUSIONS

It should be no surprise that the ecology associated with the Magnesian Limestone is distinctive, for so are the rocks and their soils. The carbonates formed approximately 240 million years ago under unusual conditions, have a special chemical and unusual mineralogical composition and they interact with local ground waters to give special fluids. With this in mind and with a glass of a good Yorkshire beer in hand, it would be appropriate to raise a toast to the Mag. Lime. – to its unique past, its benefits to mankind and to its continued future as an economic and environmental resource.

ACKNLOWLEDGEMENTS

I should like to thank Liam Foster for creating the foundations of this account in his B.Sc. dissertation and the Yorkshire Naturalists' Union for a very pleasant and informative day in Harrogate. C. R. Ixer is thanked for providing the diagrams and for her computer skills.

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THE MAGNESIAN LIMESTONE ECOSYSTEMS OF NORTHERN ENGLAND: WHAT IS THEIR FUTURE IN THE 21ST CENTURY?

PHILIP GRIME
Unit of Comparative Plant Ecology, Department of Animal & Plant Sciences, University of Sheffield, Sheffield S10 2TN

INTRODUCTION

For many years the pages of *The Naturalist* have provided abundant evidence of the unusually rich diversity of plants and animals (many surviving, some now extinct) associated with the narrow strip of Magnesian Limestone that extends from Sunderland in County Durham to the vicinity of Nottingham (Figure 1). My first encounter with this geological formation and its denizens occurred in the summer of 1954 when, as an undergraduate student, I attempted a survey of surviving fragments of ancient Magnesian Limestone grassland. Although the scope of this survey was limited by pedal power and the reach of public transport from Sheffield, in common with many other ecologists who had gone before, I was immediately impressed (Grime, 1955) by the distinctive character of the plant communities of the Magnesian Limestone and their many differences from the vegetation of the limestone areas of North Derbyshire.

Subsequently, there have been many other studies and reports recording the flora and fauna of the Magnesian Limestone and these include some quite extensive surveys of grasslands (Lloyd *et al.* 1971; Langridge & Dargie 1989) and woodlands (Phillips 1973; Sydes 1981) that permit vegetation classification and an assessment of conservation priorities in a national context.

In this short essay the purpose is not to review in detail existing knowledge of the natural resources of the Magnesian Limestone, but to comment briefly on some of the issues likely to affect their fate in the next century and to tentatively explore the opportunities that an ecological perspective provides for safeguarding the viability of Magnesian Limestone ecosystems. In particular, I will draw upon a programme of ecological surveys and experimental work (Grime & Lloyd 1973; Grime *et al.* 1988) conducted by the Unit of Comparative Plant Ecology (UCPE) on the 2400km^2 area around Sheffield over the period 1961 to the present with the objective of investigating the interplay between geology, soils, climate, vegetation and human impacts in North Central England.

Most of the information that we use as ecologists, taxonomists and recorders deals with species but this paper is quite deliberate in its use of the word 'ecosystems' in text and title. This is in recognition of the fact that even when the focus of our concern is a particular species, the science and practical management needed for its protection or control is likely to require an understanding of many aspects of the environments it inhabits. I offer no apology either for the strong emphasis here on vegetation. Approximately 99% of the living matter of an ecosystem consists of plants and it is these organisms that to a large extent control the food materials and shelter exploited by mammals, invertebrates and micro-orgamsms. Usually it is the vegetation that provides the first and most obvious clues to changes in ecosystem 'health'. By monitoring vegetation we can be alerted to effects of pollution or to impacts of changing land use or climate. Moreover, when the creation of a particular vegetation type is specified as one of the objectives in a conservation, reclamation or management plan, it is relatively easy to recognise and quantify success or failure, when the plan is implemented.

THE CURRENT SITUATION

A general impression of the state of ecosystems on the Magnesian Limestone can be gained from studies that involve returning to sites which were the subject of surveys conducted earlier this century. In 1990, staff of UCPE revisited and resurveyed ancient grasslands that had been first described in 1965. The sampling and recording methods were the same and

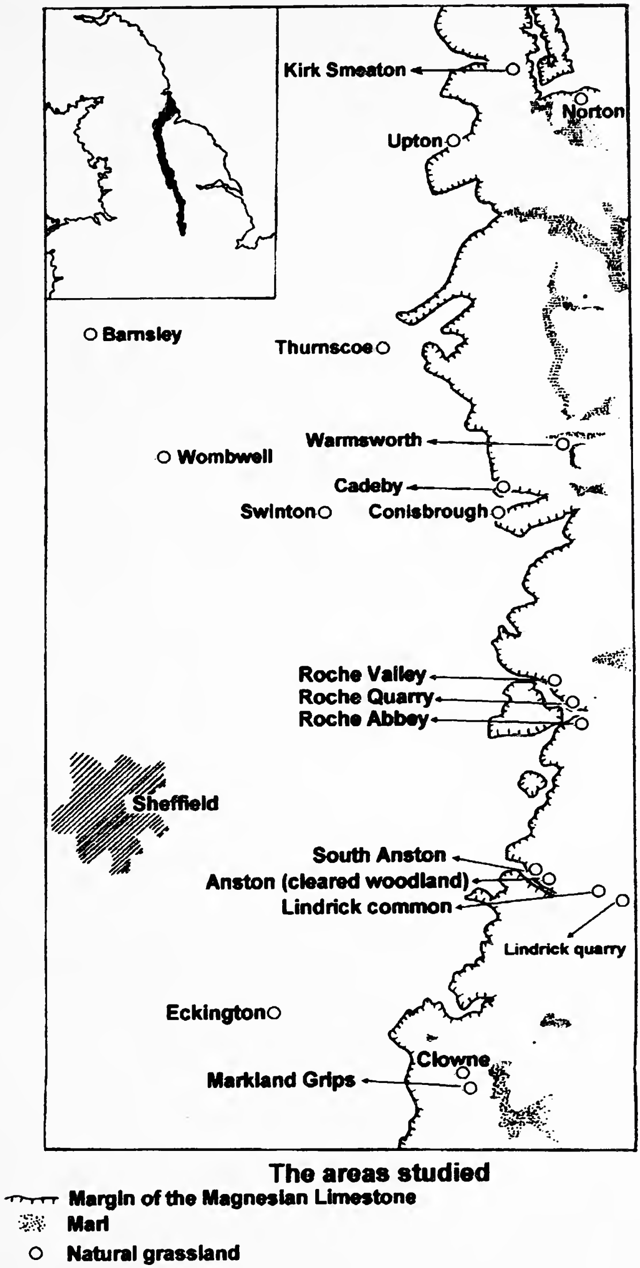

FIGURE 1
Magnesian Limestone in northern England.

comparability was also assured by the fact that two of the recorders took part in both surveys. The sites were distributed over a large area in South Yorkshire and North Derbyshire and included grasslands on five major geological strata, including the Magnesian Limestone.

The most striking feature of the results of the 1990 survey was the strong disparity in the fate of grasslands situated east and west of Sheffield. Whereas the majority of the Pennine grasslands remained in existence, many of the surveyed sites in the eastern lowlands were no longer occupied by grassland. On the Coal Measures, Magnesian Limestone and Bunter Sandstone of South Yorkshire, there was widespread evidence of the disappearance of old grasslands as a consequence of changes in land use such as conversions to cereal arable or earth-moving operations. Further disparity was observed when floristic differences between the 1965 and 1990 data were examined at the surviving grassland sites. To a remarkable extent, the majority of the North Derbyshire grasslands had remained similar in structure and species composition (with some notable exceptions however where grazing had been abandoned and scrub invasion was in progress). In marked contrast, strong 'functional shifts' were detected in the character of many of the surviving grasslands east of Sheffield. Incursions by fast-growing, weedy species were often observed, indicating either physical disturbance or eutrophication through groundwater or atmospheric pollution.

It is a sad reflection of current research and funding priorities that the results of the 1990 survey have not been fully analysed and remain unpublished. However, on the basis of a preliminary review of the data it is possible to draw some inferences concerning processes of change now affecting grassland ecosystems on the Magnesian Limestone. In common with sites on other geological strata to the east of Sheffield, those on the Magnesian Limestone tend to be small in size and many are geographically isolated and surrounded by landscapes subject to the polluting or disruptive impacts of intensive agriculture or urban development. It is clearly much more likely that such small parcels of grassland adjacent to fertile agricultural land or near human settlements will face extinction or substantial change in character. It is tempting to speculate that a similar logic may be applied in predicting the fate of the scattered, small areas of ancient woodlands and wetlands remaining on the Magnesian Limestone.

THE FUTURE

Through the actions of statutory authorities, conservation organisations, local councils, sympathetic landowners and dedicated individuals much has been achieved in efforts to arrest the processes of ecosystem destruction and decline on the Magnesian Limestone. However, such local successes should not be allowed to obscure the continuous attrition that is taking place and the challenge this presents for the next century. The approach of the year 2000 is prompting reviews in many different aspects of human affairs and I see no good reason why such deliberations should exclude the fate of the Magnesian Limestone ecosystems! Accordingly, the concluding part of this short paper draws upon a conservation philosophy specifically attuned to heavily impacted, overpopulated countries (Grime 1971) and identifies three key issues likely to determine the quantity and quality of the natural resources surviving on the Magnesian Limestone in the next century.

(1) Recognising the problems

Already, under the preceding heading it has been suggested that the main threats to the remaining fragments of seminatural countryside on the Magnesian Limestone are arising from changing land use. This conclusion agrees closely with that of Hodgson (1986) who investigated the mechanisms responsible for the decline in flowering plant diversity in the Sheffield region; his study recognised that many of the plants of rare or declining abundance on the Magnesian Limestone (e.g. *Campanula glomerata, Carex montana, Cirsium acaulon*) were long-lived, slow-growing species which were incapable of surviving in the disturbed, fertile habitats created by modern forms of landuse and in consequence were now restricted to small populations surviving in pockets of infertile soil in ancient habitats. This diagnosis of the conservation problems of the Magnesian Limestone flora is broadly compatible with larger-scale studies of the role of changing land use in Britain (Ratcliffe 1984) and in Western Europe as a whole (Thompson 1994).

In the next century, changes in climate are likely to bring further complications to the task of managing ecosystems in Britain (Grime 1997), and from experiments conducted in this region (Buckland 1994, MacGillivray *et al.* 1995; Buckland *et al.* 1997; Grime 1998) we can anticipate additional threats to the fragmented populations of animals and plants on the Magnesian Limestone. These are likely to arise from the increased frequency of extreme events (e.g. severe droughts, late frosts, floods) which can lead to population extinctions in circumstances where population size is small. As the climate warms, some of these losses may be compensated by an ingress of southern species but it is inevitable that most of these colonisers will be common, mobile weedy species such as *Lactuca serriola* (Carter & Prince 1981). It is extremely unlikely that rarer species of animals and plants, particularly those of low reproductive potential, will successfully 'hop' northwards along the chain of isolated and small suitable habitats surviving on the Magnesian Limestone strip.

(2) Identifying conservation priorities

At the end of this paper it is suggested that the long-term solutions to the problems of conserving natural resources on the Magnesian Limestone will involve some ecosystem reconstructions and rehabilitations of species. However. it is essential that such initiatives are not seen as an alternative to providing effective protection for the distinctive ecological heritage of this part of Britain. There are two main reasons why nature reserves remain vitally important. First, it is essential to preserve some relatively *large* areas even where, as in the case of Edlington Wood (Phillips 1973), some parts have deteriorated; only large reserves can provide the habitat mosaics and sizes of territory necessary to support many of the larger predators, to buffer plant and animal populations against extreme events and to provide 'stepping-stones' for species migrating in a changing climate. Second, it is necessary to preserve examples of ecosystems that are now rare in this region, are poorly-understood or about which we still have insufficient understanding to consider attempting reconstructions; examples here include the complexes of grassland habitats at Warsop Vale, Maltby Low Common and Markland Grips. Despite the many difficulties that follow from the close proximity of these sites to centres of human habitation, such sites remain valuable not least as the potential sources of both the information and the plant genetic materials required for future restoration projects on the Magnesian Limestone.

Reference has been made already to the numerous cases where rare species have a precarious status on the Magnesian Limestone and it is necessary that such plants and animals should be monitored and that their continued presence should provide one of the criteria for conservation measures. However, it is important to recognise the limitations that can arise when conservation relies too heavily upon information relating to rare species. Recent studies on the Magnesian Limestone and elsewhere in the Sheffield region (Wilson 1998) have revealed that the persistence of a rare plant species can give quite misleading signals about the state of an ecosystem and the prospects for survival of the plant species concerned. Many of the most vulnerable plants on the Magnesian Limestone are extremely long-lived and it is not uncommon for them to persist as venerable individuals long after site conditions have become unfavourable for establishment of their seedlings. In such cases it may be more informative to monitor the changes taking place in the abundances of the dominant species in the plant communities; often it is these plants that respond first to changed conditions and give early warning of impending threats to rarer species.

(3) Creative conservation

Naturalists often disagree about the wisdom of habitat restorations and species reintroductions. It is sometimes difficult to trace with certainty the exact origins and genetic 'authenticity' of surviving populations in circumstances where such manipulations are carried out. However, I believe that a balanced perspective on the future prospects for the Magnesian Limestone ecosystems should recognise the massive habitat devastation and loss of biodiversity that has already taken place in past centuries as a consequence of intensive agriculture, industrialisation, urbanisation and the pollution of soils, atmosphere and aquatic systems. I submit that the challenge for the next century is not merely to do our best to protect surviving sites but also to use every opportunity to reconstruct natural and seminatural ecosystems on ex-industrial or ex-agricultural land throughout the length of the Magnesian Limestone. Some of this work can only be attempted by regional or national organisations but there is also plenty of scope for effective contributions by schools, local organisations and individuals with small areas of land under their control.

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RECORDING NATURAL AREAS: MAPPING THE CONSERVATION "SITES" OF THE MAGNESIAN LIMESTONE

DAVID A. WOOD
Rural Environment, Nottinghamshire County Council, Trent Bridge House, Fox Road, West Bridgford, Nottingham NG2 6BJ

INTRODUCTION

Until recently, the main thrust of national nature conservation policy has focused on site protection. Many naturalists have grown up thinking that rare species were the most important and that the best way to protect them was by concentrating on certain special sites. However, since 1900 over 100 species are believed to have become extinct in Britain, and many species which were common 25 years ago are now themselves rare.

In 1994, the Government published the first UK Biodiversity Action Plan. Following this, *Biodiversity: The UK Steering Group Report* was published in 1995 and accepted by Government in May 1996. These documents explain a fundamental change in approach in nature conservation and set out national targets for the species and habitats that are under threat or in serious decline.

Consequently there is understandable confusion and misapprehension in the minds of many amateur naturalists – the collectors of the raw data on which local, regional and national nature conservation policy is often based. While most can support the shift in emphasis, does this mean that the way they have collected data in the past was wrong? Will biodiversity action plans (BAPs), natural areas, key habitats or key species be any more successful than former approaches?

Many of these concerns were clearly expressed at the 1997 YNU Conference, and many of those questions remained unanswered. That does not mean they were ignored. A great deal of progress has been made in the last twelve months. In part, therefore, the purpose of this paper is to report back on progress made and help to provide some objective clarification. However, its main object is to focus discussion on how future activities need to be coordinated.

That is not to say that work has begun on the Southern Magnesian Limestone Area only in the last twelve months. Phase 1 Habitat Surveys of South Yorkshire, carried out between 1979 and 1982, provided much information on the scarcity of some specific habitat types. In Rotherham this information was digitised and in a computer database by 1988, and formed a significant part of the analysis for the *Rotherham Countryside Study Review Document*, published in 1989. This review demonstrated that the south-eastern third of Rotherham Borough had more ecological, environmental, landscape and social similarities with parts of Nottinghamshire and Derbyshire than with the rest of Rotherham. Incidentally, the techniques used were essentially the same as those used much later in the Countryside Character Programme.

Consequently, networking and partnership working in the southern third of the Southern Magnesian Limestone have been directed at the "Natural Area" for some considerable time. Indeed, the *Creswell Limestone Strategy (CLS)* Subject Study Leaflet was published in 1995, well before the UK Steering Committee Report or the publication of *The character of England* map at the end of 1996. The CLS Subject Study Leaflet identified the location of known sites of interest within the Natural Area, but immediately generated concerns that many suitable sites had been overlooked. A comprehensive audit was therefore begun, starting with collation of existing site information.

As part of this partnership, co-operation between the County Councils and Wildlife Trusts in Derbyshire and Nottinghamshire has provided considerable amounts of site data. I am indebted to Bill Ely at the Rotherham Biological Records Centre, as well as officers of these organisations for their time and interest. These data form a useful basis for analysis and demonstration, particularly as the different sources have had to employ different methods of data capture. Analysis has identified inadequacies in the data handling and enabled action to be taken to correct these problems. By referring to the details of the process, I wish to offer a constructive illustration to help others avoid repeating the same mistakes – it is not meant to ridicule or be in any way critical of individual data sources.

PROBLEM 1 SELECTING SITES WITHIN THE NATURAL AREA BOUNDARY

Much discussion at last year's conference centred on disagreement over the area within which data should be collated – the current counties or Council administrative areas, the Watsonian Vice-County, the natural areas, etc. If all the current recorders are to be able to contribute to conservation on the basis of biodiversity action plans or natural areas, this issue must be resolved.

Experience from the CLS Partnership suggests that disagreement stems from the level of difficulty the recorders experience in selecting their relevant data. Where selection is difficult, any change of area of search immediately generates difficulties. Where selection is simple, the "boundary problem" becomes insignificant. So, with recent developments in computer databases and systems, this is one problem that should be relatively easy to eliminate through technology.

In Nottinghamshire, a manual search technique was adopted. Unfortunately, while the natural areas boundary could be provided, for technical reasons this boundary could not be printed on an ordnance survey base map. Therefore the first task was to manually transcribe the natural areas boundary onto a paper copy of the map base. Once completed, sites falling within the boundary were identified and the data copied onto a computer spreadsheet. Only location grid references could be provided and actual site boundaries were not available. The workload involved amounted to over 3 weeks work, and much of the work will need to be repeated every time additional sites are added to the inventory. When collated with other area data, however, the selected sites did not show a good correlation with the actual natural area boundary. 27% of sites identified were outside the natural area boundary (34 out of 123 sites). Errors appear to have been introduced by the process of manually transcribing the boundary.

In Derbyshire, sites of natural history interest are recorded on a Geographic Information System (GIS) but this is a bespoke system developed for Derbyshire County Council. While the sites were logged and agreed between the County Council and the Wildlife Trust, the problem lay in the computer software. Only rectangular areas could be searched and externally generated boundary files were not readily imported into the system. So while the Natural Area boundary could be provided in computer readable form, it could not be added into the database and sites could not be searched for presence within or outside a particular boundary. Copies of files were provided on disk and, once translated, the data was incorporated into the Rotherham Database. The whole process took about five days, and it would take about 3 days to update files with new data. The first attempt identified too small a rectangle for the search area and approximately 30% of the sites falling within the natural area were omitted.

The development of the Countryside Database in Rotherham was covered at last year's conference (Wood 1997). Like Derbyshire's database, it was a bespoke system requiring special hardware and software. In the last 12 months, development of a commercial GIS has enabled much of the original Countryside Database to be converted to run on a PC. As the system is essentially the same as that used by English Nature, the Environment Agency and many other similar organisations, there is considerable compatibility between end users. Extracting the sites data took under half an hour and data updating only requires the individual records to be changed – all analysis based on that data is updated automatically. Searching a different area, like any administrative area, district or county, is now simply a matter of entering the new boundary line (or amending one) and using the system to search for all records within that area. The boundary of any area of search, for example any Natural Area, can be used to select the relevant data.

Derbyshire's problems were only resolved by copying all the sites onto the modern GIS and letting the technology sort which sites are appropriate for consideration.

Nottinghamshire's problem can only be resolved by providing GIS correlated maps which remove the manual transcription errors. Even then, the manual sorting method will need to be applied to the new boundary and also applied again if any alternative boundaries are proposed. How much simpler for Nottinghamshire to provide the boundaries of all their known sites and let the GIS select the ones which are relevant.

So, with the available technology, the problem for the amateur naturalist would also evaporate. The conclusion seems clear: do not select data that you think will fit the natural area – provide all the data and let the biodiversity partnership correlate data to boundaries.

PROBLEM 2 ACCURACY OF RECORDING DATA

Again this was a topic of much discussion at last year's conference. Over the last year I have looked at developing a practical method for increasing the accuracy with which data is referenced. To demonstrate this I needed a readily available dataset where the site locations were both fixed and could be located accurately. I therefore used light trap data for Lepidoptera already on the RECORDER database for Rotherham. Light trap sites should be point locations and therefore should be able to be given a very accurate grid reference.

A total of 10,497 records were assessed, based on 191 different locations. Of these, only 106 locations (55.5%) were recorded to 6 figure grid references or better, and two of the sites were given entirely wrong 6 figure grid reference. This actually means that 8507 (81.0%) of the records were accurate to 6 figure grid references.

6 figure references mean that the location can be plotted to the centre of a hectare so the maximum error should be 70 metres (distance from the centre point of the hectare square to one of the corners). However, many records were given exactly the same site name but different grid references (41 duplicated names in the 106 "accurate" locations, or 38.7%). Are they truly different locations or observer error or typing error, or some other error? There may well be legitimate reasons and explanations, but if the data is to be used objectively to argue a legal case, such uncertainty seriously undermines its strength. Yet only 6505 (62.0%) of these light trap records are currently defensible on the basis of locational accuracy. The serious risk remains that conclusions drawn from such data will be scientifically questionable.

So what can be done?

The hard work has been done in collecting the data, and in recording the results within a Biological Records Centre. Grid references are easy to update physically; indeed if the exact location of the site is known, the GIS system can update the database of grid references (and to 10 figure grid reference precision). The key issue must be the establishment, by whatever means are appropriate, of the exact location of the records/site – and in this case the most reliable method is to mark the location on a map. Anyone can then translate that map point into appropriate figures but there will always be a physical map, linked to the data, which can be checked to ensure the location information is accurate.

PROBLEM 3 MAPPING EXISTING DATA

Where there is a lot of existing data, where does one start in mapping boundaries and increasing the locational accuracy? When considerable data are to be amalgamated, particularly from a number of different sources, one of the big problems is that each recorder will tend to give a particular location either a different name, a different boundary, or even a different grid reference. Even the same site recorded by the same observer may subtly change on different days – very rarely will records refer to exactly the same physical area. The consequence is often a proliferation of site references, all for essentially the same area. These are difficult to aggregate with confidence because minor changes to the area of search can have major implications on the detailed records which are included or excluded. Arbitrary replacement of one boundary definition with another may invalidate much of the original data, or may even attribute data to entirely the wrong site.

This is an issue that has taxed the minds of many recorders; but viewed from the perspective of a GIS database, the problem is relatively simple to resolve. Over the last year this has been checked and tested on a range of sites, but by way of example I will concentrate on RECORDER data for Hail Mary Hill and Falconer Woods in Rotherham.

Although not on the limestone, this example is typical of the habitats studied. It is not large, extending to 22.7 ha in size, and is a deciduous woodland about 1 kilometre long and 250 metres across at its widest point. It is not particularly diverse or scientifically important, but is regularly visited by naturalists. 4259 records are logged for the wood, under 113 different site names/site descriptions!

74 of the site names each refer to less than 10 records, while over 50% of the records are attributable to only 4 of the site names. So the obvious way to map boundaries is in order of magnitude of the number of records attributed to each named site. In this way a significant proportion of data becomes available to GIS analysis for relatively little effort. Taking the above example, 60% of records become available when only 6 boundaries are mapped, 70% with 10 boundaries, 80% with 16 boundaries, and 90% with 27 boundaries.

PROBLEM 4 RETHINKING "SITES"

The collation of existing site information is only the start – but it is sensible to start with readily available information rather than beginning again from scratch. Most of the sites have already been graded in some way, since the starting point is usually the list of "second tier sites" which are defended as part of the statutory planning system. Statutory sites, like National Nature Reserves or Sites of Special Scientific Interest, are often referred to as first tier sites, so second tier sites are synonymous with "the best of the rest" — the best natural history sites which do not get statutory protection. The Derbyshire sites collated as part of this exercise, for example, only include selected second tier sites.

However, is this what we want? It is certainly better than nothing, but second tier sites do not involve a standardised grading or selection process – the criteria for one area's second tier sites are likely to be different from all its neighbours.

The shift to biodiversity action planning means that we should be rethinking this past approach and refocus attention on key species and key habitats. Sites then become the "home" of those species or habitats and the importance of one site is not arbitrarily more important because of a subjective grading system. The importance of any particular site is an objective measure of the contribution that site makes to the survival and wellbeing of the key species or key habitats present. This is the approach partly taken by the Nottinghamshire site data, and has been the approach advocated by the Rotherham Heritage Sites Database for the last ten years. In its simplest form, recorders are asked to submit information on all the sites considered to be valuable, not simply an arbitrary selection of "the best".

A key species list has been published for Rotherham based on objective criteria. Currently this list identifies 808 individual species, or around 10% of all the species recorded in the area. At the same time, the Heritage Sites database records accurate locations of natural history sites within Rotherham. Each Heritage Site now registers the number of key species present within the site. Two maps of the "density" of key species have been produced; one of these colours each Heritage Site according to the number of key species present, and the other maps the background number of key species in each kilometre square.

The GIS can select the Heritage Sites falling within the Southern Magnesian Limestone Natural Area. From this an accumulated list of key species can be generated from the lists of species for each site. While not a complete list, it should go a long way towards providing one. In fact this method attributes 482 species to sites in the Southern Magnesian Limestone, and 421 to sites in the Coal Measures, while of these 234 species occur in both. A sites-based Key Species list for Rotherham would therefore contain 655 species or 81% of the full list.

Of the 267 key species for Rotherham which occur on more than three sites, only ten species can be identified which are recorded on the Coal Measures (9 of these are birds), while 8 species are recorded exclusively for sites in the Southern Magnesian Limestone (only one bird).

Returning to the issues raised in the introduction, this analysis gives a picture of the number of key species found in the different designations of sites. Only 25% of Rotherham's key species are found in statutory sites (202 in SSSIs) – i.e. three quarters of the threatened and declining species in Rotherham occur outside top tier sites. Similarly, only 43% of key species are included if graded first and second tier sites are considered. As we have seen above, even if all of the borough's 673 Heritage Sites are included, 19% of key species are found outside recognised sites. There is no reason to believe that the situation in Rotherham is anything but typical.

Conclusions

At the 1997 YNU Conference, I proffered my "Five Rules for a Biodiversity Recorder" and concluded with the motto: "Don't just record it, map it" (Wood 1997). Sufficient progress has been made to allay at least some of the concerns expressed at that conference. The availability of geographic information systems can be shown to provide a structured solution to the problems of selecting information, achieving accuracy in location recording, and the priorities for mapping existing data.

Natural Areas, key species and key habitats all require the introduction of a new way of looking at the data which drives policy and conservation priorities. However, it is clear that what is needed is not a new recording methodology, record card or similar system inflicted on the amateur recorder. There is a vast amount of information already available, but dispersed in so many different sources and of such variable accuracy that answers inherent in the data remain unappreciated and under-used.

The message for the statutory agencies and professional conservationists is equally clear. The fact that only 25% of Rotherham's key species are recorded within Statutory Sites gives tangible support and credence to the need to move away from focussing on the current statutory site protection system. Equally the fact that 75% of key species can be shown to occur outside statutory sites, and 19% outside any recognised or designated site, underlines the scale of the chasm that a new approach will open up.

It is clear that if the new strategies and policies are to be more successful than their predecessors, it is essential that the professional agencies and authorities provide the amateur recorders with the technical support necessary to remove the practical problems addressed in this paper. It is technically possible and feasible. There is a danger that data are incorrectly selected, wrongly located, or simply too vague, yet is being used to drive future policy and action.

The work of the amateur recorder is an important, but limited resource. It is not the best use of that resource either to expect the recorder to spend time checking the correct data selection or to provide data that remains unused. It would be a clear indictment on us all if we ignore the evidence that is to hand and rely on subjective opinion simply because we cannot provide the mechanisms to support and improve the existing work of the amateur recorder.

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LICHENS OF THE MAGNESIAN LIMESTONE

OLIVER GILBERT
42 Tom Lane, Sheffield, S10 3PB

The lichens of the Magnesian Limestone were fully investigated in the early 1980s and the results published (Gilbert 1984). Those wishing to read a detailed description and analysis of the flora are referred to this paper which is still up-to-date as little subsequent work has been undertaken. The following account summarizes the main findings.

The lichen capital is present in three main habitats; natural outcrops which are mainly overhanging cliffs beside rivers; in long disused quarries; and on field walls, in villages and in churchyards. Over 50 sites, stretching from Pleasley Vale, Nottinghamshire, north to Sunderland, were surveyed, and these produced 106 lichen taxa.

Steep, dramatically overhanging cliffs are not a favourable habitat for lichens, being too dry, shaded, often ivy-covered and soily. A few species such as *Dirina massiliensis* f. *sorediata* and *Leproplaca chrysodeta* which can survive on atmospheric humidity alone are frequent. The richest communities are found at the top and the base of the cliff where the rock gets wetted. The average cliff supports 30 to 40 lichens. Reef knolls of hard de-dolomitised limestone form occasional hill-top exposures and these are richer. Examples were surveyed at Wood Lee Common, Maltby and Tunstall Hills on the outskirts of Sunderland, and produced 52 and 53 species respectively. Lichens such as *Acarospora glaucocarpa, Caloplaca lactea* and *Toninia sedifolia* were only found associated with reef knoll limestone. Tabulated data from 11 natural outcrops, including the reef knolls, can be found in Gilbert (1984).

Quarries are often still active, used for land fill, or overgrown with scrub. Those that are still good for nature conservation have little lichen interest on the rock faces or ledges, but their floors, especially when composed of soft, yellow magnesian-rich subsoil, can hold exciting terricolous communities. Patches of bare ground beside paths and vehicle tracks or where the soil is compacted hold species such as *Collema bachmanianum, Lempholemma chalazanum, Sarcosagium campestre* and in Burton Leonard quarry the minute pale fruits of *Vezdaea rheocarpa* were abundant.

The best place to see the saxicolous lichen flora of the Magnesian Limestone is on churchyard memorials where they form large colonies that are easily identified. Sixty-seven species were found in churchyards, many of them lichens with a decidedly eastern distribution in Britain e.g. *Caloplaca teicholyta, Candelariella medians*, *Rinodina teichophila* and *Xanthoria calcicola*. A crustose sorediate lichen that could not be named in the field was repeatedly found on walls; this entity was eventually described as a new taxon, *Lecanora campestris* subsp. *dolomitica* with its type locality a wall near Creswell Crags.

Conclusion

The lichen flora of the Magnesian Limestone shows the following characteristics:

1) It is dominated by weakly calcicolous species e.g. *Lecania erysibe.*
2) Strong calcicoles are found only on the reef-knolls.
3) The flora is influenced by a widespread, low-grade eutrophication which favours species of the Physciaceae.
4) Some species of unusual abundance e.g. *Caloplaca isidiigera, Lecanora campestris* subsp. *dolomitic*a may be favoured by the high magnesian content of the rock.
5) A few species, e.g. *Protoblastenia rupestris,* were scarcer than expected and may be sensitive to high levels of magnesium.
6) The phytogeographical relationships of the Yorkshire province are with southern Britain, those of the Durham province with northern Britain.

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HABITATS AND RARE PLANTS OF THE DURHAM AND SOUTHERN MAGNESIAN LIMESTONE NATURAL AREAS, WITH REFERENCE TO THE SSSI SERIES

COLIN D. NEWLANDS
English Nature, Humber to Pennines Team, Bullring House, Wakefield, WF1 3BJ

The Natural Areas Approach

The term Natural Area may be a new one, but the concept of ecologically distinct areas has long been recognised by botanists, and is recorded in the pages of county floras and other writings. Natural Areas provide a meaningful context in which to interpret and evaluate the wildlife and natural features of England, and allow characteristic habitats and species to be looked at critically across their natural range.

In *Guidelines for selection of biological SSSIs* (1989), the former Nature Conservancy Council stated that biogeographical zones are the best basis for site selection, although at that time no formal mechanism existed for this to happen, and sites were evaluated within 'Areas of Search', which broadly corresponded to county boundaries. In 1993 English Nature first produced a new map of England dividing the country into areas which held a widely shared 'sense of place', especially in terms of their wildlife and natural features. Natural Areas were seen as an effective context for national and local objective setting in *Biodiversity: The UK Action Plan* (1994).

English Nature has published profiles for each of the 120 Natural Areas. These include descriptions of the area, its habitats, species and earth science interest, together with issues and objectives which will influence their future. It is intended that these profiles will inform the preparation of Local Biodiversity Action Plans, and achieve consistency and integration between these, in order that local action will safeguard important habitats and species throughout their range.

The Natural Areas of the Magnesian Limestone

The Magnesian Limestone extends as a narrow belt from Nottingham in the south, due north until it reaches the coast in East Durham and Tyne and Wear, where it forms the only sea cliffs of this type in Britain. Whilst the Magnesian Limestone itself is the defining feature which links Nottinghamshire to the north-east coast, there are two distinct Natural Areas associated with it, the Durham Magnesian Limestone Natural Area (DMLNA), and the Southern Magnesian Limestone Natural Area (SMLNA).

The DMLNA is 44,200 hectares in extent and encompasses East Durham and south-east Tyne and Wear. The Southern Magian Limestone Natural Area SMLNA is 136,400 hectares in size and falls partly within Nottinghamshire, Derbyshire, South Yorkshire, West Yorkshire and the Vale of York. There are a number of similarities between the two:

1. They are essentially agricultural in character, with a significant proportion of the total area under intensive farming.
2. They lie close to, and incorporate, large urban areas.
3. The limestone has been widely quarried for industrial and building use.
4. As a consequence of the above, the remaining semi-natural habitats of value for wildlife are fragmented and scattered throughout the Natural Areas, although there are important local concentrations.

Habitats and Plants of the Natural Areas

The belt of Magnesian Limestone extends some 150 miles from north to south, and covers *c.* 1.5% of mainland Britain. However, drift deposits overlie in excess of 90% of the solid geology. Therefore, only 0.15% of mainland Britain is covered by surface outcrops of Magnesian Limestone on which vegetation directly influenced by the parent rock can develop. Most are found on steep slopes which are difficult to improve agriculturally, and support woodland, or where this has been cleared, have been traditionally used for pasturing of stock. Most of these outcrops and the majority (about, two-thirds) of unimproved calcareous grassland is to be found in the DMLNA, particularly on the western escarpment and along the coast.

The main interest of the Magnesian Limestone is the fact that it forms a bridge between the lowland limestones of the south and east, and the upland limestones of the north-west. This means that a suite of plant species can be found in the two Natural Areas which give the Magnesian Limestone a special character and value for nature conservation. For instance, species typical of the upland Carboniferous Limestones, such as blue moor grass *Sesleria albicans*, bird's eye primrose *Primula farinosa*, and dark red helleborine *Epipactis atrorubens*, meet on the Magnesian Limestone with species whose main strongholds are on the southern Chalks and Jurassic Limestones, such as tor grass *Brachypodium pinnatum*, upright brome *Bromus erectus*, woolly thistle *Cirsium eriophorum* and dwarf thistle *Cirsium acaulon*. It is the further differences in plant communities found on the northern and southern limits of the Magnesian Limestone that help to define the two Natural Areas.

Notified under the 1981 Wildlife and Countryside Act, the network of Sites of Special Scientific Interest (SSSI) within the two Natural Areas encompasses much of the variety in remaining semi-natural habitats within each area. This is summarised in Table 1 (with a further break-down for the SMLNA shown in Table 2), and discussed below.

TABLE 1
Main botanical habitats within SSSI series on Magnesian Limestone.

Durham Magnesian Limestone Natural Area	Southern Magnesian Limestone Natural Area
Unimproved Magnesian Limestone grassland on escarpment and plateau (CG8)	Unimproved Magnesian Limestone grassland (CG3, CG5)
Unimproved Magnesian Limestone grassland on coastal cliffs (CG2)	Unimproved neutral grassland (MG4, MG5)
Unimproved neutral grassland (MG5)	Semi-natural ancient woodland (primarily W8)
Semi-natural ancient woodland on wooded Denes (primarily W8)	Wetlands (open water, mires, flushes)
Wetlands (open water, mires, coastal flushes)	

Note: text in brackets refers to principal NVC communities for each broad habitat type.

a) Limestone grassland

Magnesian Limestone grassland is a nationally scarce habitat. Approximately 280 hectares are included within the SSSI series, of which 182 hectares are in the DMLNA and around 98 in the SMLNA. Of the DMLNA resource approximately 55 hectares is the National Vegetation Classification (NVC) community CG8 blue moor grass *Sesleria albicans* – small scabious *Scabiosa columbaria*. This community is unique to the Natural Area, and is probably the rarest lowland limestone grassland type in Britain, with less than 65 hectares remaining in total. Almost all the CG8 grassland resource lies within 20 SSSIs, with the best and most extensive remaining example lying within Thrislington Plantation National Nature Reserve (NNR). In the SMLNA SSSIs the limestone grassland is predominantly of the NVC community types CG3 upright brome, and CG5 upright brome – tor grass. The extent of these communities in the SMLNA is a combination of suitable soil and climatic conditions, together with a reduction or absence of stock grazing, favouring the spread of the above, more vigorous grasses.

TABLE 2
SSSIs in the Southern Magnesian Limestone Natural Area by broad habitat type.

Habitat	Area (ha)	No of SSSI
Calcareous and neutral grassland	163.77	18
Woodland/grassland mosaic	174.03	7
Semi-natural broadleaved woodland	417.08	14
Wetland	379.29	5
Geological	144.02	12
Total	1278.19	56

Issues for the conservation of Magnesian Limestone grassland include the following:

1. The high degree of fragmentation of the remaining resource.
2. Most sites are very small and often inaccessible, set amidst intensively farmed land, on the urban fringe, in a mosaic with woodland and scrub, on post-industrial sites (e.g. quarries), or in the DMLNA significantly on the coast.
3. Neglect and lack of positive management.
4. Lack of grazing and subsequent scrub invasion. Cutting is rarely an adequate replacement for grazing.
5. Lack of land managers keeping suitable stock, especially on the urban fringe where public recreational pressure may conflict with ideal management practices.

b) Woodland

Woodland represents the most extensive remaining semi-natural habitat in the Natural Areas. The NVC community W8 ash *Fraxinus excelsior* – field maple *Acer campestre* – dog's mercury *Mercurialis perennis* is the predominant type, although the presence of alder *Alnus glutinosa* woods and oak *Quercus* woods pick out changes in soil type and topography. Particularly good examples are to be found at Castle Eden Dene NNR on the DMLNA and at Roche Abbey Woodlands SSSI and Anston Stones Wood SSSI on the SMLNA.

c) Other habitats

The two Natural Areas also contain habitats not directly related to the Magnesian Limestone, but which are influenced by drift deposits or arise from particular human activity. For example:

1. Acid grassland and heath on sands and marls.
2. Subsidence lakes and flashes following deep coal mining (i.e. at Fairburn and Newton Ings SSSI), and more typically a feature of the Coal Measures Natural Area.
3. Ings meadows

d) Rare and scarce plants

The division of England into natural Areas has provided an opportunity to analyse the distribution of species and habitats in a new context, and English Nature has published a series of Research Reports on this subject. Nationally rare and nationally scarce vascular plants and bryophytes are the subject of Research Report 267. As an example, using data held by JNCC and BRC, the report lists 29 rare and scarce vascular plants recorded from the SMLNA. These are shown in Table 3. The report defines each Natural Area in terms of its botanical importance, using the categories some, notable, significant, considerable and outstanding. The SMLNA is considered 'significant'. This means that in nature conservation temms, botanical objectives should be regarded as an overall medium priority within the Natural Area, although certain species, in particular international or scheduled, or assemblages of species, may require higher priority.

TABLE 3
Occurrence of nationally rare and scarce vascular plants of the Southern Magnesian Limestone Natural Area.

Species	Status	Species	Status
Aconitum napellus	NS (I)	Hordelymus europaeus	NS
Actea spicata	NS	Limosella aquatica	NS
Apera interrupta	NS (I)	***Linum perenne ssp anglicum***	NS
Apera spica-venti	NS	***Minuartia hybrida***	NS
Campanula patula	NS (I)	Orchis ustulata	NS
Carex digitata	NS	**Orobanche reticulata**	8
Carex ericetorum	NS	Persicaria laxiflora	NS
Carex montana	NS	Potamogeton coloratus	NS
Cicuta virosa	NS	***Potentilla neumanniana***	NS
Daphne mezereum	NS (I)	**Pulsatilla vulgaris**	NS
Epipactis atrorubens	NS	***Ribes alpinum***	NS
Epipactis phyllanthes	NS	***Silene nutans***	NS
Epipactis youngiana	8 EE	Tilia platyphyllos	NS
Fritillaria meleagris	NS (I)	Vulpia ciliata ssp ambigua	NS (I)
Helleborus foetidus	NS (I)		

8 Nationally rare species listed under Schedule 8, 1981 Wildlife & Countryside Act
NS Nationally scarce
I Introduced to Natural Area
EE English endemic

In order to use this information effectively in setting priorities within the SMLNA, it is my view that the list has to be looked at critically; for instance, it includes a number of species introduced to the Natural Area (denoted by the status (I), such as monk's-hood *Aconitum napellus*, and stinking hellebore *Helleborus foetidus*. It also includes species which are widespread in their distribution, and found in a number of the adjacent Natural Areas, such as large-leaved lime *Tilia platyphllos*. When these are taken into consideration, it is possible to highlight a smaller group of species that begin to show the special significance of the SMLNA.

In Table 3, the species in bold type are those which I consider of primary significance, and includes plants at the very north or south of their native range in Britain, such as baneberry *Actea spicata*, soft-leaved sedge *Carex montana* and pasque flower *Pulsatilla vulgaris*. It also includes two Schedule 8 species, thistle broomrape *Orohanche reticulata* and Young's helleborine *Epipactis youngiana*, the former being almost entirely confined to this Natural Area. The species in Table 3 that are in italics and bold form a secondary group that, although well represented in other Natural Areas in England, are native to the SMLNA, where the population is geographically important in terms of their British range, such as rare spring sedge *Carex ericetorum*.

The future for the Magnesian Limestone Natural Areas

It is clear that there are both ecological and practical reasons to look at our natural heritage in terms of Natural Areas. This new focus may be used to inform other initiatives aimed at safeguarding the wildlife and natural features of England, such as the development of Local Biodiversity Action Plan objectives. Through their knowledge, enthusiasm and ability, all Yorkshire Naturalist's Union members have a role to play in taking this process forward, and achieving the following priority objectives for the Magnesian Limestone Natural Areas:

1. Safeguarding existing sites from potentially damaging development, particularly those which contain key habitats and species, and minimising further fragmentation and isolation.
2. Achieving favourable management for important sites to maintain or enhance their natural community diversity (utilising environmental land management schemes where appropriate).
3. Increasing and enhancing the characteristic semi-natural habitats by habitat re-creation around primary areas (particularly SSSIs). Incorporating remaining fragments into larger units to allow practical management, especially grazing.
4. Continuing audit of resource (re-survey and monitoring of habitats and rare/scarce species).
5. Pooling resources to achieve the above.

The theme of this YNU Spring Conference gives me great hope, because it shows that the Natural Areas concept has been widely accepted by naturalists. I feel that it will continue to be the framework within which we can all best focus our efforts.

A REVIEW OF MAMMALS AND HERPTILES OF THE SOUTHERN MAGNESIAN LIMESTONE NATURAL AREA

C. A. HOWES
Doncaster Museum & Art Gallery DN1 2AE

Introduction

The following account, based largely on reviews of widely scattered published sources, the analyses of confidential biological records and unpublished survey data, provides an introduction to what is clearly a considerable subject worthy of further investigation by conservation managers and naturalists.

Although no native mammal or herptile species currently occurring in the Yorkshire and North Nottinghamshire region has its distribution specifically confined to the Southern Magnesian Limestone Natural Area, this review identifies certain qualities of the Permian ridge which are highly important to a range of species, the exercise identifying major features of conservation significance.

The only mammal species whose north British distribution was known to have been confined to the dry warm slopes of the Southern Magnesian Limestone Natural Area, was the greater horseshoe bat (*Rhinolophus ferrumequinum*). Its sub-fossil remains have been located at Creswell Crags on the Nottinghamshire/Derbyshire border and the limestone grassland, ancient woodland and limestone crags of the Roche Abbey area probably represented its most northerly 19th century extension in Britain (Howes 1985a). Thus, in common with various plants and invertebrates, conditions afforded by the Permian ridge enabled this highly specialist insectivore to extend much further north than its core distribution. Since the late 19th century the species has undergone a disastrous decline, its current populations restricted to a few sites in the southwest of England and South Wales.

Biodiversity changes

Species like the greater horseshoe bat, lesser horseshoe bat (*Rhinolophus hipposideros*), pine marten (*Martes martes*), polecat (*Mustela putorius*) wild cat (*Felis silvestris*) and red squirrel (*Sciurus vulgaris*) were historically present in appropriate habitats on the Southern Magnesian Limestone Natural Area but are now extinct (Howes 1984, 1985). The introduced European midwife toad (*Alytes obsetricians*), grey squirrel (*Sciurus carolinensis*), American mink (*Mustela vison*) and the Chinese muntjac deer (*Muntiacus reevesi*) have entered the scene this century, the latter within the last few years. The roe deer (*Capreolus capreolus*), absent since the Tudor period, is back in abundance. Although red deer (*Cerrus elaphus*) herds have historically been maintained in parks and more recently on venison farms, free-range populations are present probably for the first time since the Saxon period. More problematical as denizens of the Permian ridge are dormouse (*Muscardi avellanarius*), which may still survive and yellow-necked mouse (*Apodemus flavicollis*), whose presence, though claimed, awaits confirmation.

Amphibians

The rash of flushes and springs, associated with the outcropping bands of impervious calcareous marls along the western and particularly the eastern edges of the Permian ridge, provide a hitherto unrecognised but significant series of amphibian sites where all three newt species (smooth (*Triturus vulgaris*), palmate (*T. helveticus*) and great-crested (*T. cristatus*)), have been recorded (Howes 1973b; Deaton 1986; Lunn 1993). Following the recent discovery by Jeff Lunn of a palmate newt population on the eastern outskirts of Leeds, correspondence and discussions between the author and Mr Lunn revealed a hitherto unrecognised palmate distribution pattern along the eastern edge of the Permian ridge from Lotherton south through Balby, Edlington and Tickhill in the Doncaster region and down to Worksop in Nottinghamshire.

Sadly, landfill, as at the major great-crested newt site at Bilham, and angling development as at the Ruddle ponds at Hickleton, is symptomatic of the reduction and isolation of Permian marl amphibian sites. Though these losses are regrettable and relatively simple to identify, the massive industry involved in the widespread (seemingly universal) drainage of arable land has removed countless such sites. Examination of pre-1960s 1:2500 scale Ordnance Survey maps gives an alarming indication of the scale of this habitat removal. Further research is recommended on this theme to quantify the scale of this environmental change and highlight its conservation consequences.

The only herptile within the Yorkshire and north Midlands region evidently confined to the Permian ridge is the European midwife toad. Introduced from Bedfordshire into a garden in Woodsets near Worksop in 1947 (Howes 1973b), it has survived and spread with several thriving colonies established in gardens around the village (Ely 1985).

Reptiles

During the 19th century the adder (*Vipera berus*) was known from a range of sites along the Permian ridge (Howes 1989), a critical examination of records suggesting an association with habitats on outcrops of marl rather than limestone. None are known to survive today, though dangerously isolated populations seem to persist on widely separated sites on the adjacent coal measures sandstone to the west and Triassic (Sherwood) sandstone to the east.

The grass snake (*Natrix natrix*) was traditionally associated with the flood meadows and marshy habitats where the river systems of South and West Yorkshire bisect the limestone ridge. Excessive river corridor management and the widespread conversion of grazing meadows to intensive and well drained arable has reduced the importance of these riverside regions. However, due to urban expansion the availability of allotment gardens, and more recently ornamental garden ponds are significant havens.

The slow-worm (*Anguis fragilis*) was already highly localised during the late 19th century; its highly dispersed remnant populations on the limestone are now tiny and may no longer be sustainable without special conservation programmes. Scattered sites are known in the Nidd Valley downstream to Knaresborough, with occasional records around Ripon (Deaton 1986). Populations were known from the Went Vale and Stapleton Park areas during the late 19th century and at Brockadale up to 1965. It was present in the Askern area in the 1840s and Skelbrooke Rein in the 1950s and 1980s. In the 1960s it was known on the limestone heights overlooking Denaby Ings Nature Reserve. In the Don Gorge at Cadeby Cliff evidence was found in kestrel pellets in 1979. Later a specimen was caught in a butterfly net during the 1990s (Ted Rimington *pers. comm.*), and two were seen near Pot Riding Wood in 1982. South of the gorge at Conisbrough a good population existed on the limestone escarpments through the 1950s to the 1970s, specimens being offered for sale in a Doncaster pet shop (Howes 1986). Sadly there has been no subsequent evidence from the south side of the Don Gorge. The most southerly Yorkshire records appear to be from Tickhill during the 1950s and Maltby Common and Roche Abbey in 1896 and 1913, though further south on the limestone, they have been recorded from a quarry near Creswell Crags in 1903, Whitwell Wood during the 1960s, Loscar Wood in 1970, Dinnington 1971, Worksop in 1989, Shireoaks *ca.* 1991, Langwith Nature Reserve in 1991 and Manor Lodge, Rodesia in 1997 (Whiteley 1997).

The viviparous lizard (*Lacerta vivipara*) also has a highly localised and fragmented distribution on the Permian ridge with records from Brockadale, the Don Gorge, notably on Cadeby Common (Howes 1973b), Tickhill, Maltby Crags and Common, Lindrick Common and Quarry, the railway between Clowne and Creswell, and Markland Grips (Whiteley 1997). It is likely that railway cuttings in the limestone areas have assisted their spread and specimens are also known off the Permian ridge on railway embankments constructed from Magnesian Limestone, as at Potteric Carr.

Mammals (Insectivora)

According to 1km and tetrad scale distribution maps compiled by the YNU (Howes 1983; Delany 1985) the broad acres of Watsonian Yorkshire would appear to be bristling with hedgehogs (*Erinaceus europaeus*). A system pioneered by the Mammal Society, which records road casualty frequency along logged daytime journeys of over 20 miles, enabled the casualties to be expressed as an index of numbers of hedgehogs per 100 miles of transect (Morris & Wroot 1991). By this method the YNU's Flat Hedgehog Survey was able to compare the results of road transects in the various Natural Areas of the Yorkshire region (Howes in prep. a). The frequency index for transects within the Southern Magnesian Limestone Natural Area was a mere 1.88 per hundred miles. This was below the 7.22 for the adjacent coal measures of the South and West Yorkshire conurbations, below the 5.19 for the adjacent Humberhead levels and much less than the 10.4 for the adjacent northern Vales of York and Mowbray. The conclusion that hedgehogs, according to road journey transects, are relatively 'thin on the ground' on the Magnesian Limestone is something of a conundrum since calcareous soils are allegedly rich in the soil invertebrates on which hedgehogs feed. Perhaps the relative frequency of badgers (see later), known hedgehog predators, may be part of the answer, but a more realistic explanation of apparent scarcity may be the sparse distribution of their favoured village and suburban habitat mosaics and the extensive areas of hedgeless intensively arable landscapes, lacking in suitable cover.

Similarly, distribution mapping of the mole (*Talpa europaea*) on 1km and tetrad scales shows the species to be present wherever there are naturalists to record them (Howes 1983; Delany 1985). However, a series of transect surveys on a field by field basis, in the various 'Natural Areas' within Watsonian Yorkshire (Howes in prep. b) revealed wide differences in levels of occurrence as indicated by mole hill and mole run activity. On the Magnesian Limestone soils, mole activity was observed in 73.3% of permanent grassland. This was above the mean of 59% for pastures across Watsonian Yorkshire; it was also substantially higher than in pastures on the acid Millstone Grit to the west and more than twice that recorded for the clay warp of the Humberhead Levels to the east. Since permanent pasture only represented 26% of field types surveyed on the limestone ridge, these high levels of activity were actually only confined to isolated pockets. This isolation is placed in clearer perspective when one notes that only 7% of cultivated fields on the limestone exhibited mole activity and that arable fields made up over 73% of fields surveyed. Because of their relatively huge sizes compared with pastures, mole-poor arable landscapes probably represented nearer to 80-90% of agricultural land in this zone.

Trapping and owl pellet studies have produced substantial and long term information on common shrew (*Sorex araneus*), pygmy shrew (*S. minutus*) and water shrew (*Neomys fadiens*) in woodland and farmland sites on the Southern Magnesian Limestone Natural

Area, mainly in the Castleford, Doncaster, Harrogate, Knaresborough and Ripon areas. References to these studies are listed in (Howes 1998a, 1998b).

MAMMALS (CHIROPTERA)

The high conservation importance of the Magnesian Limestone's 'mass movement caves' and other subterranean features for hibernation and roosting sites for at least four species of bat is dealt with elsewhere in these proceedings (see Howes 1999; Lunn *et. al.* 1999).

The series of 18th century and earlier historic country parks situated along the length of the Permian ridge provide a significant refuge for ancient and over mature trees important as breeding and hibernation sites for noctule bat (*Nyctalus noctula*) colonies (Howes 1985). Situated in historic wood-pasture settings, these parks also represent invaluable survivals of ancient timber and permanent grassland habitats which provide food resources for the larger bat species. In addition, the cultural heritage of grottoes, ice houses, walled gardens with heating flues and varieties of ruins and follies, provide important concentrations of bat sites, the Fountains Abbey complex being a classic example (Deaton 1989).

MAMMALS (LAGOMORPHA)

Although the significance of mammalian grazers, notably rabbit, brown hare, small rodents and deer, on limestone grassland, scrubland and woodland is frequently discussed, there is little critical research on this fundamental subject, particularly with respect to habitat and landscape change.

Over the past two centuries, major changes in the status of rabbit and to a lesser extent the brown hare have taken place to the extent that limestone vegetation has been significantly modified. Rabbits, originally managed in commercial warrens, largely in acid sandstone areas adjacent to the Permian ridge, only developed substantial wild populations from the mid-18th century when changes in agriculture, largely associated with the 'enclosure of the commons' created favourable habitats (Harris *et al.* 1995). Conveniently for the rabbit, its liberation into the wider countryside and its colonisation of limestone grasslands coincided with the intensive control and indeed extermination of predators, brought about by the rise of sporting estates which proliferated along the Permian ridge. The extermination of the native polecat may have been particularly advantageous to rabbit populations, though it is likely that the stoat (*Mustela erminea*) exploited this vacated food resource niche.

Over the past century, three events have affected the fortunes of lagomorphs on the Permian ridge. The first World War (1914-18) which largely removed a generation of game keepers, estate and agricultural workers and led to the collapse of numerous country estates, substantially removed human culling or harvesting pressure on lagomorph populations. Grazing pressure would again have increased, keeping sward development short, suppressing shrub development on grassland and preventing any significant coppice regeneration or seedling growth in the many woodlands which had been clear felled for the war effort. Work in progress by the Doncaster Naturalists' Society on tree girth studies in Doncaster woodlands is beginning to show how woodland regeneration was effectively suppressed for at least three decades. The second World War (1939-45) evidently had different effects. With wartime food shortages, rabbits were heavily culled for human consumption and the population fell. Regeneration of woodland was able to proceed, if very slowly, and brown hare populations temporarily rallied in the absence of competition from rabbits (Howes in prep. c).

The northward spread of myxomatosis up the Permian ridge commenced in 1954 and was virtually complete by the end of 1955, effectively removing rabbit grazing pressure from grassland and woodland alike. The effects on natural vegetation and predator prey relationships were profound and despite some revealing anecdotal evidence gathered by the YNU and its affiliated societies, this episode in landscape history is even now only sketchily researched and documented. Although much of the current hawthorn-dominated scrub woodland on limestone grassland is likely to have developed in the wake of myxomatosis, much quantifiable evidence of this continuing grassland loss remains to be extrapolated from photographic sources, notably of aerial photography of the pre- and post-1950s. The Doncaster tree girth studies mentioned above are revealing a veritable explosion of regeneration within the local woods at this time; indeed, some woods were found to consist of a small number of 19th century parent trees, the rest being post-mid-1950s (grazing respite) colonists (Howes in prep. c). Evidence from gamekeepers' lines at some limestone estates showed that stoat populations, evidently heavily dependent on rabbits as a prey resource, collapsed and weasels (*Mustela nivalis*), probably in the absence of competition from stoats, rallied (Howes 1977a). Anecdotal evidence and game bag records show that hare numbers also increased markedly at this time, probably in response to reduced competition for grazing (Harris *et al.* 1995; Howes in prep. c).

MAMMALS (RODENTIA)

Red squirrels were ubiquitous in the woodlands of the Permian ridge up to the end of the 19th century. A major national population collapse in the first two decades of this century was accompanied by the spread of the introduced grey squirrel (Tonkin 1985). The cause of the decline is still uncertain but in contemporary opinion it resulted from hard winters, disease and loss of habitat (Tonkin 1985). Populations had all but gone by the 1950s though odd remnant populations survived till the early 1970s at Stainton and Womersley.

The North American grey squirrel colonised the Southern Magnesian Limestone Natural Area from introductions during the first two decades of this century. Populations moved north from release sites in the Midlands, colonising the South Yorkshire limestone region by the mid-1930s, the first record being of one at Wilsic Hall in 1935. The species became common in all the limestone woods around Doncaster and Rotherham by 1958 and by the 1960s was perceived as a significant pest on country estates with up to 100 corpses displayed on the keepers' lines at Sandbeck Park in 1963 (Howes 1973a; Stables 1974). In North and West Yorkshire liberations took place at various locations including Scampston Park in 1906, Bingley in 1914, Hebden Bridge in 1921 and there was a specific liberation onto the northern end of the Southern Magnesian Limestone Natural Area at Bedale in 1913 (Howes 1984, Critchley 1985). The subsequent expansion from these centres led to the coalition of these pioneer populations and a progressive southward spread, eventually meeting up with the northerly moving 'Midland' population front. The species is still very abundant throughout the hedgerows and woodlands of the natural area, with between 84% and 99% of the naturally harvested hazelnut crop being taken by this species (Howes unpublished).

Though dormouse populations are not positively known to have survived within the study area, it is revealing to note that of the 95 locations where this rapidly declining rodent was recorded in Yorkshire, 20% were distributed along the narrow ridge of the Southern Magnesian Limestone Natural Area. Since this strip forms rather less than 10% of Watsonian Yorkshire, there would seem to be a correlation between this highly reclusive coppice woodland specialist and this restricted area. Since long cycle coppice management of species-rich deciduous woodland produces the optimum conditions for dormouse survival (Harris *et al.* 1995), the cessation of this form of land-use in Yorkshire from the late 19th century, coincided with its regional decline (Howes 1984, 1985c). However, ancient species-rich deciduous woodlands and associated hedgerows are a feature of the Magnesian Limestone, particularly in southern Yorkshire. Here, the presence of a high diversity of fruiting shrub species would provide a continuity of food throughout the summer and autumn feeding period of the dormouse. This gives the prospect that residual populations may still be present, albeit in numbers too small to be easily detected. Interestingly, at one of the candidate locations, Edlington and Wadworth woods, 'two or three' specimens collected by the woodman were examined by YNU members during the excursion in 1891 (Howes 1984, 1985c). Post-1950 records to hand are of one caught at Fountains Hall during the 1950s and a possible nest collected during the 1980s (Ron Deaton, *pers. comm.*), one seen in the hazel coppice at Pot Ridings Wood, Sprotbrough in the 1950s (Joan Buckland *pers. comm.*), and one seen in Hooton Pagnell Wood by T. T. Seago in 1960 (Howes 1984).

With research indicating that the potential distribution pattern of the yellow-necked mouse in Britain should include ancient species-rich woodlands on dry soil types in areas of low rainfall, enjoying a February mean temperature above 1.4°C., there is a theoretical possibility of populations existing within the Southern Magnesian Limestone Natural Area. This makes plausible the claim of an occupied nest near Conisbrough Castle in 1956 (Howes 1986b).

Trapping and owl pellet studies have produced substantial and long term information on other small rodents, including bank vole (*Clethrionomys glareolus*), field vole (*Microtus agrestis*), water vole (*Arvicola terrestris*), wood mouse (*Apodemus sylvaticus*) and harvest mouse (*Micromys minutus*) in woodland and farmland sites on the Southern Magnesian Limestone Natural Area, mainly in the Castleford, Doncaster, Harrogate, Knaresborough and Ripon areas. References to these studies are listed in Howes (1998a, 19987b).

MAMMALS (CARNIVORA)

During the 18th and 19th centuries many of the celebrated Yorkshire badger (*Meles meles*) setts were located on the Permian ridge and badgers were regularly obtained from the limestone country to supply the sport of badger baiting (Howes 1988).

Richard Paget and Adrian Middleton (1974) in their monumental treatise on the badgers of Yorkshire and Humberside highlight the Southern Magnesian Limestone Natural Area as being of particular significance for badgers. This narrow strip contained some 14.7% of all setts known to exist in North, West and South Yorkshire and the then North and South Humbersides. It also harboured some of the largest setts known in the Yorkshire region, together with the parishes containing the greatest number of setts.

In order to refine Paget and Middleton's (1974) comments regarding the limestone for this study, an examination of badger sett data for North Yorkshire showed that the 10km squares situated largely on the Magnesian Limestone contained a mean of 8.5 setts per square, with a maximum of 23 setts, whereas those on the carboniferous rocks immediately to the west of the Permian ridge supported a mean of 4.5 setts per square and those to the east in the vales of York and Mowbray a mean of 2.7 setts. Further refining this interpretation and using data for South Yorkshire, only 3.5% of 1km squares across the Westphalian (coal measures) region to the west of the Permian ridge had records of badger setts; the frequency rose to 13.1% where the coal measures became overlaid by the Magnesian Limestone, peaking at 17.9% of squares on the limestone ridge itself. Frequency declined markedly to 6.3% in the zone where the limestone dipped below the Triassic sandstone, bottoming out at 1.6% of squares across the Triassic lowlands to the east of Doncaster. This geologically determined distribution not only reveals a marked preference for the limestone ridge, it shows that the western escarpment with its access to the basal Permian sand is preferred to the gentle eastern dip slope.

Three factors were identified by Paget and Middleton (1974) as influencing the abundance of setts and relative density of populations. These were, firstly, ready access to natural fissures and outcrops in the series of steep-sided river-cut gorges, notably the Don, Went and the Nidd and the abundance of old, now wooded, quarries and small pits which enable access to the fractured limestone; secondly, the occurrence of basal Permian sand which enables badgers to excavate with ease beneath the protective limestone; and thirdly, the limestone woodland and grassland soils' relatively high productivity of earthworms, the badgers' preferred food.

MAMMALS (ARTIODACTYLA)

Following the re-discovery of roe deer in Yorkshire in the 1930s after an apparent absence of some four centuries, this territorial species reached the species-rich woodlands and hedgerows of the Permian ridge by the 1950s. Early expansion by wandering males penetrated south to the Nottingham border at Hawk Wood in 1972 (Howes 1977b, 1984), though consolidation and the establishment of breeding populations took till the late 1980s. The return of this native browsing ungulate to woodlands and grasslands of the Magnesian

Limestone is worthy of monitoring for its effects on vegetation and woodland structure. Certainly in areas of long-term presence, browse-lines are discernible on woodland foliage and canopies.

Red deer, whose native populations were managed from Norman times in enclosed parks such as that at Conisbrough, are still maintained, perhaps the most celebrated herd being at Studley Royal Park. Escapees from the herd have formed a feral, though controlled, population (Howes 1984; Deaton 1986). The species also features in venison ranches as at Burghwallis and the failed example at Edlington, escaped animals from which have formed the basis of a thriving free-range breeding population at large between Wadworth and the Rotherham border. Interestingly, these animals represent the first red deer to roam the Conisbrough Parks area since medieval times (McCarthy *et al.* 1996). Regularly frequented parts of Wadworth wood now exhibit quite discernible canopy browse lines.

Chinese muntjac deer, which first reached Magnesian Limestone woodlands in Yorkshire in 1993 by progressive expansion north from the midlands and by artificial introduction onto shooting land (Howes 1993; McCarthy *et al.* 1996), have potentially presented the species-rich ground flora of SSSI limestone woodlands with a significant conservation problem. Studies showing profound denudation of dog's mercury (*Mercurialis perennis*) (Cooke *et al.* 1995), wild arum (*Arum maculatum*) (Diaz & Burton 1996), bluebell (*Hyacinthoides non-scripta*) (Cooke 1997), and damage to coppice re-growth (Cooke & Lakhani 1996) with possible suppression of woodland regeneration, indicate that significant biodiversity reductions may be predicted. In the Doncaster district alone, muntjac, evidently emanating from sporting introductions, are already present in two SSSI woodlands and a further three of conservation status. Paradoxically, the legislation which outlaws the translocation of the alien midwife toad remains silent on the assisted spread of the muntjac for sporting purposes.

ACKNOWLEDGEMENTS
I would like to thank Ron Deaton for kindly loaning the YNU the Mammal Society's North Yorkshire badger sett files and Mike Dyson for providing 1km distribution data for badger setts in South Yorkshire for analysis in this project.

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VERTEBRATES OF THE SOUTHERN MAGNESIAN LIMESTONE

JEFF LUNN*, COLIN HOWES, TONY LANE, JOHN DREWETT
AND MICHAEL THOMPSON
**English Nature, Genesis 1, Science Park, Heslington, York YO1 5DQ*

BACKGROUND

Two workshops on birds and other vertebrates of the Southern Magnesian Limestone (SML) started with the assumption that the SML was not particularly special for any species or species group.

For birds, suggestions were made, based on records from the Sorby Natural History Society, that Corn Buntings *Miliaria calandra* appeared to be associated with the SML in southern Yorkshire. However, whilst the species had contracted its range in parts of Yorkshire in line with other parts of the country, and had recently been lost to the Huddersfield and Halifax areas (*per* John Dale), other commentators confirmed that the species was still to be found in the Hatfield, Doncaster and Barnsley areas – in the Coal Measures and Humberhead Levels, and also along the lower Vale of York and parts of the coast. Factors other than the SML *per se* were thought to be significant in those areas favouring the species such as farming regimes. Marsh Tit *Parus palustris* and Nuthatch *Sitta europea* were also suggested as being found more frequently on the SML, possibly associated with woodland features.

In a survey of mammal road casualties across the county, fewer Hedgehogs *Erinaceus europaeus* were found than in neighbouring areas. Dormice *Muscardinus avellanarius* used to be found on sites on the SML and the extinction of the coppice wood industry as charted through the reduction of wood products sold by merchants in Leeds, Rotherham and Doncaster could implicate its demise (Howes, unpublished). Deer, particularly Roe *Capreolus capreolus* and Muntjac *Muntiacus muntiacus* however, had colonised many woodlands recently. Badgers *Meles meles* were still frequently found on parts of the SML, and were often associated with the natural crags and caves in the river gorges, since perhaps the setts were easier to dig in the basal Permian sands of the formation.

Of most significance appeared to be the presence of good bat populations on the SML. Detailed studies in the Don Valley Gorge from Sprotbrough to Conisbrough from 1990 by the Don Gorge Bat Group found that natural caves supported hibernacula for four species – Brown Long-eared *Plecotus auritus*, Daubenton's *Myotis daubentonii*, Whiskered *M. mystacinus* and Natterer's *M. natterii*, and that two other species – Pipistrelle *Pipistrellus pipistrellus* and Noctule *Nyctalus noctula* were found feeding over the Gorge's woodland and wetland features (Howes, 1993; 1997). The Don Valley has 23% of recognised Magnesian Limestone caves (Brook *et al.*, 1988). Further north, other bat populations were found in caves in gorges in the Harrogate area, most commonly Brown Long-eared but also Daubenton's, and sites such as Fountain's Abbey supported Daubenton's, Natterer's, Noctule and Pipistrelle. Wetlands such as Fairburn Ings were also notable for feeding populations.

Reptiles and amphibians were also found on the SML. Slow-worms *Anguis fragilis* were formerly recorded in the Conisborough/Cadeby area and may still be there – remains were recently found in a Kestrel *Falco tinnunculus* pellet, and Common Lizard *Lacerta vivipara* and Grass Snake *Natrix natrix* occurred at Lindrick (Drewett, 1998) and Sprotbrough. Some flooded quarry sites were known to support amphibians such as Great Crested Newts *Triturus cristatus*, but perhaps the most unusual feature was the presence of Palmate Newts *T. helveticus* at some sites e.g. at Lotherton (Lunn, 1993) and some records from Permain Limestone spring-lines in the Doncaster area. This species is normally associated with upland or acidic areas of Britain.

DISCUSSION

No particular species of vertebrate appeared to be exclusively associated with the SML. However some interesting features emerged from the discussion. The limestone ridge had inherent qualities and a long history of settlement and exploitation that appeared to have produced some characteristic features. These in turn were thought to support some species or populations which are more frequent or abundant on the SML than elsewhere.

The area had been the first to be tilled because of good soils etc. (Hey, 1986) and present agricultural practice favoured extensive arable systems which possibly linked to the presence of farmland bird communities. It was suggested that some of the declining farmland bird populations such as Corn Bunting could have retreated to areas of the SML where conditions may be more favourable than elsewhere.

Inherent features of the limestone itself were also associated with certain species. The basal sands under the limestone formations were possibly favoured by Badgers for digging their setts. Extensive cave systems were used by Badgers and as a hibernacula for at least four species of bat (as well as other fauna). Natural spring lines gave rise to wetland features supporting Palmate Newts. Other features such as quarries or remnant grasslands also supported other vertebrates (although probably no differently from neighbouring areas).

Small and medium sized parklands associated with country houses appeared to be frequent on the SML and the abundance of these, coupled with other features such as gorge woodlands, were considered to make the area of particular note for associated species. Bats, and birds such as Marsh Tit. Nuthatch, and Hawfinch *Coccothraustes coccothraustes* (and possibly others) used old trees for resting/breeding and neighbouring woodland and wetlands (especially in the gorges) for feeding. The woodlands themselves supported Dormouse in the past and may still do so.

The legacy of industrial exploitation had also given rise to features which had been exploited by some species. Quarries, disused lime kilns and railways trackways were favoured by bats and amphibians.

In addition to the wildlife features of the SML, discussion also touched upon the future conservation of features of wildlife value. Increased recreational pressures such as motor cycling, caving and walking, and developments such as landfill and housing development had been experienced in the Don Gorge as well as direct vandalism on conservation work (e.g. damage to bat grilles at Nearcliff Wood tunnel gate). The need for better information to assist in debates and decisions concerning land-use and development was clearly needed. Some of the hypotheses and suggestions concerning particular species arising out of the discussion also warranted further investigation.

Conclusions

Whilst the Southern Magnesian Limestone did not appear to hold unique species of vertebrate, certain features of the area appeared to favour some species or species groups. Three broad features – agricultural practice, inherent natural characteristics of the limestone (sands, spring-lines and caves), and historical human settlement and exploitation patterns (parklands, woodlands and industrial legacies) appeared to have favoured certain vertebrate groups, and in particular some birds, mammals and amphibians. Evidence for these associations was variable, but some warranted further investigation and the importance of better information was highlighted. Some conservation issues were also identified.

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NOTES ON THRESHOLD FAUNAS IN CAVES AND TUNNELS WITHIN THE MAGNESIAN LIMESTONE OF THE DON GORGE

C. A. HOWES
Museum and Art Gallery, Doncaster DN1 2AE

INTRODUCTION

The Don Gorge, which slices through southern Yorkshire's Magnesian Limestone ridge from Conisbrough and Cadeby in the west to Sprotbrough and Warmsworth in the east, contains a considerable number of subterranean sites which harbour specialist assemblages of organisms referred to in the speleological literature as 'threshold faunas'.

Sites are of a wide range of types, including potholes and fissures up to 88 m in length, two major railway tunnels each in excess of 250 m long, a water pipe tunnel over 1 km in length with some four vertical air shafts, some thirteen quarry 'tramway' tunnels and four railway bridge archway tunnels up to 42 m in length, which run beneath the massive limestone embankment of the main Doncaster to Sheffield railway line, and a number of disused hearths and flues of 18th and 19th century limekilns. The natural voids and fissures constitute features known to geologists and speleologists as 'mass movement' structures and the various forms of tunnels, being man-made, are probably more correctly termed 'hypogea'.

Though 'walk-in show caves' in the sense of those at nearby Creswell Crags on the Nottinghamshire-Derbyshire border are not a feature of the Don Gorge, perhaps removed if they ever existed by a history of quarrying dating back to Roman Doncaster and Norman Conisbrough, many subterranean sites of significance still survive. Rock shelters and Pleistocene fissure deposits which have produced deer and hyena-gnawed rhinoceros bones (Corbett 1906) are still present and are as yet totally unresearched; indeed, additional examples have been revealed by quarrying, tunnelling and the excavation of deep railway cuttings.

With such a high concentration and diversity of subtertanean sites, including some 23% of Yorkshire's Magnesian Limestone caves (Gibson *et al.* 1976; Brook *et al.* 1988), the Don Gorge is probably unique in lowland eastern England and justifies becoming a major focus of interest within the Southern Magnesian Limestone Natural Area. The purpose of this account is to draw attention to the on-going studies on the Don Gorge and to highlight the area's considerable conservation value and potential as a laboratory for subterranean ecological and palaeontological studies.

THE THRESHOLD ENVIRONMENT

Whilst not experiencing the peculiarly constant or uniform environmental conditions typical of classic deep cave systems, conditions in the Don Gorge subterranean sites are substantially more buffered and stable than in above-ground or epigean situations. The threshold environment is unique in harbouring elements of both above-ground (epigean) and subterranean (hypogean) faunas which can be examined at the extreme ranges of their environmental tolerance.

Paradoxically the significant characteristic of these rare and isolated situations is not their environmental stability but the ecological tensions caused by the steep gradients of light, temperature and humidity between the highly volatile epigean environment and the relatively buffered and stable hypogean domain. Furthermore, these gradients are not constant but oscillate markedly according to daily and seasonal cycles, and indeed, in the cases of temperature and humidity, can reverse direction. Light intensity declines significantly with distance from the cave or tunnel portal but the gradient virtually disappears at night. Temperatures, relative to outside readings, vary with distance from the portal, decreasing in summertime and increasing in the winter, the steepness of the thermal gradient varying in accordance with the extremes of external temperatures.

Subterranean sites in the Don Gorge can also influence adjacent epigean microhabitats.

During very hot humid summer days, relatively much cooler air, emerging from the Nearcliff Wood water pipe tunnel (SK/526992) and confined within a deep limestone ravine, condenses into a thick chill fog, creating constantly damp conditions which suits the dominant lush growths of bryophytes and ferns, notably the hart's tongue fern (*Phyllitis scolopendrium* (L) Hewman). Although, probably similar to bryophyte and pteridophyte communities at the mouths of a spring or adjacent to water falls, this condensation community is independent of spring, stream or river and forms a highly localised phenomenon within a relatively dry, lowland rain-shadow region of Yorkshire. During still, frosty conditions in winter, relatively warm moist air rising from the upper entrance of the Nearcliff Wood Rift (SK/527995) condenses into a plume of mist which, under appropriate conditions, gives rise to icicles on surrounding rocks and shrubs. This cave is known locally as the 'banana cave' due to the curved nature of its inner structure and the 'dragon's cave' due to the emergence of steam in cold weather.

Recent Studies on Threshold Faunas

Since 1990 members of the Don Gorge Bat Study Group have made regular visits to these sites in search of winter hibernation and summer nursery and roosting sites for bats. Examples of the invertebrate fauna have been collected or noted and there has been significant monitoring of temperature and relative humidity regimes (Howes 1993, Howes 1996, 1997; Howes & Lane 1998).

Invertebrates

By far the most frequent dipteran is the mosquito *Culex pipiens* L; large numbers of females are encountered in dense 'roosts', particularly in the damper areas at the rear of blocked off tunnels or on wet surfaces within caves in autumn and winter. 283 were counted on 1 square foot of a wet and glistening flowstone boulder at the rear of a tramway tunnel on 8th February 1998 (H. Kirk & P. Seccombe *pers. comm.*). Evidently the inseminated females of the autumn generation of the rural race of *C. pipiens* move into subterranean sites from about September to April to hibernate and undergo an ovarian diapause. On emergence they take a blood meal and lay egg rafts on the surface of still water. The next two or three generations through the summer are able to reproduce without a diapause or recourse to caves (Jefferson 1983).

The crane-fly *Limonia nubeculosa* Meigen is regularly encountered in small numbers during the summer months within the first 20 metres in the north-facing tramway tunnels between Levitt Hagg Wood and Farcliff Wood.

Small numbers of the Heleomyzid fly *Heleomyza serrata* (L.) have been found in winter near the first airshaft in the Nearcliff Wood tunnel. Other local sites on the Magnesian Limestone are at Bilham Quarry and Cusworth Park. It is known to occur underground throughout the year; copulation has been observed and populations occur far beyond the threshold zone (Jefferson 1983).

An empty puparium of a bat-fly (Nycteribiidae), probably *Nycteribia kolenatii* was encountered in a stonework ventilation tunnel of the 19th century limekiln at Levitt Hagg. This rarely recorded wingless spider-like ectoparasite is usually (probably exclusively) associated with Daubenton's bats (*Myotis daubentoni*) (Howes & Skidmore 1993), roosts and hibernacula of which have so far been located in five subterranean sites in the Don Gorge. Unlike other members of the cave fauna, the conditions afforded by the threshold environment are secondary to the presence of the host species.

The drone fly (*Eristalis tenax* (L.)) is encountered hibernating in winter, singly or in groups of up to five, wedged tightly into crevices between stonework usually at or within the first 10 metres of the north-facing tunnel entrances. Although they endure humidity regimes ranging from 66% to 93% Rh., they seem to prefer relatively dryer sites than other threshold occupants, the mean of measurements taken at the locations of 15 individuals being 79.6%. Active specimens can be seen abundantly feeding on ivy (*Hedera helix*) flowers in the autumn prior to hibernation and freshly emerged specimens feed on grey willow (*Salix cinerea*) flowers in April.

Hibernating herald moths (*Scoliopteryx libatrix* L.) occur singly or in groups in the darker and damper zones of most sites, preferring humidity levels in excess of 75% Rh., with specimens often being covered by droplets of condensation. Its high frequency in local subterranean sites may be explained by the abundance in the Don Gorge of its foodplants, various *Salix* and *Populus* species. In late summer and autumn, newly emerged adults move directly to sheltered sites such as caves by orienting towards any dark area in their visual field. The purpose of this migration and subsequent hibernation, at least for females, is for them to undergo an ovarian diapause which seems necessary for the production of viable eggs (Jefferson 1983). Specimens are occasionally taken as prey by the cave spider *Meta menardi*.

A single specimen of the tissue moth (*Triphosa dubitata* L.), apparently a scarce species in lowland Yorkshire and the first Doncaster record, was photographed in one of the tramway tunnels by John Gardner in winter 1992. Two other geometrid moths seen in the tunnels subsequently, but which evaded capture, were probably of this species. Unlike the herald moth, *T. dubitata* remains relatively active underground in autumn and winter and indeed has been observed mating in Yorkshire caves in October (Dixon 1974). Its foodplants, buckthorn (*Rhamnus cathartica*) and blackthorn (*Prunus spinosus*), are present in the Don Gorge near to the tunnels so a viable population may exist.

Although considerable overlap of hibernation sites exist in terms of distance from entrances, and humidity regimes, peacock butterflies *Inachis io* L. tend to be in slightly dryer zones than are preferred by cave spiders and herald moths with a relative humidity range from 66% to 74% with a mean of 70.7%.

Of 130 hibernating lepidoptera counted in February 1998, the herald moth was marginally the most frequent with 73 (56.2%) specimens compared with 54 (41.5%) peacock butterflies. Curiously the abundant small tortoiseshell (*Aglais urticae* L.), which frequently hibernates in relatively dry sheds, garages and attics, was only encountered underground on two occasions.

The spiders *Tegenaria duellica* Simon, *T. agrestris* (Walck.) and the woodlouse-devouring *Dysdera crocata* C.L. Koch have been encountered under the dry limestone rubble and stonework at tunnel and cave entrances and in dry situations under masonry associated with the disused limekilns. The tunnel-wed spider *Amaurobius simils* (Bl.) appears to take over in a relatively narrow zone, in crevices and under loose masonry perhaps within the first metre of the entrance and perhaps tolerating slightly higher levels of humidity than the previously mentioned species. *Meta merianae* (the portal spider), perhaps the first true threshold spider amongst these, tends to be encountered in the zone within the first 30 metres of the tunnel or cave entrance. Although they endure humidity regimes ranging from 64% to 93% Rh, they seem to prefer relatively dry situations, the mean of five sites being 73.4%. *Meta menardi* (the cave spider) tends to take over beyond the first 20 metres of the entrance, evidently preferring the zones of total darkness and higher humidity. Levels of humidity occupied by this large and rather spectacular spider have ranged from 73% to 97%, the mean of sixty sites being 88%. Adults, sub-adults and their large cotton-wool ball egg cocoons are present at all times of the year and freshly hatched spiderlings have been seen dispersing in January and February. Although adult males appear to be rarely encountered, of 48 adults counted in February, 1998, eight (16.6%) were males. Since *M. menardi* webs are constructed most frequently within the preferred hibernation zone of the large numbers of mosquitoes and herald moths, it is assumed that these form a significant prey; indeed the remains of both have been found in webs, so too have the snake millipede *Cylindroiulus sp.* and the flat-backed millipede *Polydesmus sp.*

Isopoda and diplopoda appear to be subject to a humidity and light dependent zonation with *Procellio scaber* Lat. under the dryer limestone rubble and stonework at tunnel and cave entrances and in dry situations under masonry associated with the disused limekilns. *Philoscia muscorum* (Scop.), abundant in the vegetation and humus surrounding the tunnel or cave portals, tends not to extend beyond the zone where vascular plants are shaded out.

Glomeris marginata occasionally visits the walls of the damper tunnel entrances and *Oniscus asellus* L. frequently enters the damper tunnels though seldom venturing much beyond the zone where light is insufficient to support algal growth. By contrast, the so-called Rosy Woodlouse (*Androniscus dentiger* Verh.) is however capable of existing well beyond this, in areas of total darkness.

Vertebrates

At least four species of bat regularly use the sites for winter hibernation, summer breeding, roosting and as feeding perches. An analysis of data in Howes (1993, 1996, 1997) and Howes and Lane (1998) shows that positively identified and often handled bats have been recorded from some thirteen sites. Five sites are used by one species, six sites by two species, one of the tramway tunnels has three species and the the Nearcliff water pipe tunnel is used by four species. Whiskered bat (*Myotis mystacinus*) is known from one site, Natterer's bat (*Myotis nattereri*) and Daubentonu bat (*Myotis daubentoni*) have each been encountered in five sites, and Brown long-eared bat (*Plecotus auritus*) in eleven sites. These figures are based on sample torchlight surveys rather than emergence counts and therefore represent a substantial underestimation of numbers and possibly of species.

The extraordinary spectacle of the entire silt and loam-covered floor of a 20 m long tramway tunnel being overturned by mole (*Talpa europaea*) activity was encountered in August 1998. Flood water to a depth in excess of 1 m had flushed considerable volumes of humus and organic debris from the adjacent steep woodland floor into the tunnel. This evidently periodic phenomenon has over time produced a deep moist humus soil which is opportunistically worked for invertebrates by local moles.

Footprints in water-deposited silt, indicated that brown rats (*Ratus norvegicus*) visited those Don-side tramway and railway bridge archway tunnels which are regularly inundated, in search of edible river flood debris.

The nest of a wren (*Troglodites troglodites*) was located in February 1998 below ground level and in darkness inside the derelict hearth of a disused 19th century limekiln.

Conservation Implication

Threats to subterranean sites and their highly specialist and localised faunas in the Don Gorge, are considerable and relentless. A series of fissures, one an occupied badger sett, succumbed to landfill during the 1970s and 1980s. In the few years since these studies were instigated, survey evidence has had to be mobilised in defence of two tunnels threatened by landfill development, four rock fissures from roadworks, five tramway tunnels from infilling (sadly two tunnels were infilled before the engineering works could be halted), and the portal of the Nearcliff Wood pipe tunnel which was to be concreted up is now grilled and recognised as a bat site by its owners, Yorkshire Water plc.

Acknowledgements

Thanks are due to Tony Lane of the Yorkshire Bat Group and members of the Don Gorge Bat Study Group, particularly D. Allen; A. and L. Hill; H. Kirk; P. and T. Seccombe for their unflagging assistance over the years.

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BAT STUDES IN THE DON GORGE

A. C. LANE

East Yorkshire Bat Group, 7 Orchard Road, Skidby, Cottingham HU16 5TL

The River Don has cut through the Magnesian Limestone ridge to form the spectacular winding ravine known as the Don Gorge which extends from Conisbrough (SK5199) to Sprotbrough (SK5401). The Gorge boasts an abundance of natural and man-made habitats. Many of the important geological and natural history sites fall within the English Nature-designated Sprotbrough Gorge SSSI. Since 1990 volunteer batworkers and local natural historians (comprising the informal assembly calling itself the Don Gorge Bat Group) under the aegis of Colin Howes, have systematically surveyed the area to establish the importance of particular features with regard to Britain's endangered bat species. The urgent need for field studies has been prompted by the Gorge attracting an increasingly large number of people enjoying a wide range of leisure pursuits including boating, angling, walking, cycling, motor cycling and caving. Also, planning proposals for extensive landscaping (for example the Cadeby Earth Centre), landfill (for example the Levitt Hagg site), creeping housing development, engineering and quarrying operations threaten scarce habitats and the area's biodiversity. The Don Valley has 23% of recognised Magnesian Limestone caves (Brook *et al.* 1988). A third of those in the Don Gorge have been destroyed in recent years due to unsympathetic landfill developments. Surviving caves provide a unique and irreplaceable habitat for invertebrates and at least four species of hibernating bats (*Plecotus auritus, Myotis daubentonii, Myotis mystacinus* and *Myotis nattereri*). Two additional species of bat (*Pipistrellus pipistrellus* and *Nyctalus noctula*) not usually noted for over-wintering in caves, have been recorded feeding over the Gorge's woodland and water features (Sprotbrough Flash, YWT Nature Reserve). Other structures in the Gorge known to be important for over-wintering bats include disused limestone kilns and railway tramways, relics of Magnesian Limestone abstraction. The technology exists to protect vulnerable underground sites by means of bat grilles which prevent unauthorised disturbance but allow bats flighted access. Experience with the Nearcliff Wood tunnel gate, fitted by Yorkshire Water, suggests that vandalism is rife in the Gorge. Interim reports have been published by the Group (Howes 1993, 1997) and the findings have proved of value in local government planning deliberations.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the host of volunteers, too many to mention individually here, who have given freely of their time and skills over the years. With such

an extensive area to cover, much of the invaluable accumulated data would not have been possible without their dedication.

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LOST AND FOUND: THE MOLLUSCA OF THE MAGNESIAN LIMESTONE OF YORKSHIRE

ADRIAN NORRIS

Senior Curator Natural Sciences and Ethnography, Leeds Museums & Galleries

The Magnesian Limestone is best known for a selected number of very localised species of land snails, plus a number of others which due to unknown factors are declining throughout the district. Ever since the earliest days of recording in the county, the molluscan fauna of the Magnesian Limestone was identified as one of those areas in which a detailed study would pay dividends. Our interest in the Magnesian Limestone was not confined to a limited number of specific localities, but how the limestone affects the molluscan fauna of the area as a whole, including the rivers and streams found throughout the area. However, in this paper I will concentrate on the land snails recorded from the limestone, both in the past and now.

Within the land mollusca we have a number of species which are specifically noted as being calcicoles. Boycott in his paper (Boycott, 1934) listed nine species which he considered to be obligatory calcicoles. Of these nine, four are found on the Magnesian Limestone of Yorkshire. He listed a further eleven species which he believed fell into this category, seven of which also occur. The Boycott's final category lists those species which preferred lime; from this final group I have selected a further five species which I consider to be of interest. The Magnesian Limestone of Yorkshire is noteworthy for a further four species of land snails, which I will also discuss in this paper. This brings the list to twenty, as detailed below. The nomenclature follows Kerney, Cameron and Jungbluth (1983); Boycott's nomenclature is listed as a synonym.

Calcicole species

Pomatias elegans (O. F. Muller, 1774)
(= Cyclostoma elegans)
Caecilioides (Caecilioides) acicula (O. F. Muller, 1774)
Cernuella (Cernuella) virgata (Da Costa, 1778)
(= Helix virgata)
Helicella (Helicella) itala (Linnaeus, 1758)
(= Helix itala)

Species listed by Boycott as probable calcicoles

Pupilla (Pupilla) muscorum (Linnaeus, 1758)
(= Pupa marginata)
Cochlodina (Cochlodina) laminata (Montagu, 1803)
(= Clausilia laminata)
Candidula intersecta (Poiret, 1801)
(= Helix caperata)

Candidula gigaxii (L. Pfeiffer, 1850)
(= Helix heripensis)
Monacha (Monacha) cantiana (O. F. Muller, 1774)
(= Helix cantiana)
Trichia (Trichia) stiolata (C. Pfeiffer, 1828)
(= Helix striolata)
Helix (Cornu) aspersa (O. F. Muller, 1774)

Species which prefer limestone
Azeca goodalli (Ferussac, 1821)
(= Azeca tridens)
Pyramidula rupestris (Draparnaud, 1801)
(= Helix rupestris)
Lauria (Lauria) cylindracea (Da Costa, 1778)
(= Pupa umbilicata)
Ena (Ena) obscura (O. F. Muller, 1774)
Helicigona lapicida (Linnaeus, 1758)
(= Helix lapicida)

Additional Species
Truncatellina cylindnca (Ferussac, 1807)
Vertigo (Vertigo) pusilla O. F. Muller, 1774
Vertigo (Vertilla) angustior Jeffreys, 1830
Deroceras (Agriolimax) agreste (Linnaeus, 1758)

Within the area defined by the Magnesian Limestone are a number of well known locations, such as the Brockadale Nature Reserve situated in Went Vale. This reserve like many of the other sites is very well recorded, but this is only part of the overall story.

If we look at the best and most important of these locations in detail we find a number of simliarities as indicated below:

1. Very few freshwater species are recorded.
2. The sites usually have good mixed woodland.
3. The limestone rocks are usually damp and covered with moss.
4. The sites are often situated on the sides of river va1leys or steep banks.
5. The streams and rivers have very few molluscan inhabitants.

A SHORT SELECTION OF THE MAIN IMPORTANT MOLLUSCAN LOCALITIES OF THE MAGNESIAN LIMESTONE

I do not intend to list the various locations on the Magnesian Limestone which we as conchologists consider important, but I should mention at least two because of their exceptional status.

Went Vale, VC63
The Wentbridge area generally has several very interesting and important sites, some of which are very small, some long gone to pollution and changes in land management. However, the main area, now known as the Brockadale Nature Reserve, is very important to the maintenance of the limestone as a good molluscan habitat. Several rare and important species have been recorded from this valley, not least of which is the rarest British snail *Truncatellina cylindrica* (Ferussac, 1807).

Little Stones Wood near Anston Stones VC63 (43/525838)
The area of Little Stones Wood and Anston Stones Wood is very important for the rich variety of mollusca recorded from the area and in being the only locality on the Magnesian Limestone for the slug *Deroceras (Agriolimax) agreste* (Linnaeus, 1758), as well as one of the few remaining sites for *Helicigona lapicida* (Linnaeus, 1758).

Several other areas may be mentioned, such as around Boston Spa VC64 (SE44/4246), Jackdaw Crag near Tadcaster VC64 (SE44/4641), or Sherburn Willows (SE44/4832).

The Magnesian Limestone has produced many molluscan records of specific importance. Two species in particular, the Land Winkle, *Pomatias elegans* (O. F. Muller, 1774) and the Health Snail *Helicella (Helicella) itala* (Linnaeus, 1758), have been the object of much study and discussion.

Drainage from the limestone has helped to combat the effects of pollution and agricultural run-off, although within the richer and more important sites on the limestone the freshwater molluscan fauna is poor. Many of the streams surrounding the limestone areas hold a rich and varied molluscan fauna long after similar locations in other parts of the county have become almost barren of life.

ANNOTATED LIST OF SOME OF THE MORE IMPORTANT RECORDS FROM THE MAGNESIAN LIMESTONE OF YORKSHIRE.

Pomatias elegans (O. F. Muller, 1774)
This species is at the northernmost extent of its European range in Yorkshire. Susceptible to winter frosts, it can only survive in the more sheltered valleys. On the limestone most of the records centre around the areas of Magnesian Limestone close to Wetherby and Boston Spa, in particular Jackdaw Crag (SE44/4641), where it was first recorded by John W. Taylor in 1870.

Truncatellina cylindrica (Ferussac, 1807)
The site for this species in Brockadale, South Yorkshire, is very well known (Norris, 1976 & 1978). It is one of the rarest of our native snails, and one that is on the very edge of extinction in Britain.

Vertigo (Vertilla) angustior Jeffreys, 1830
The recording of a single specimen of this very rare snail from Went Vale amongst numbers of *Vertigo (Vertigo) pusilla* O. F. Muller, 1774 by Charles Ashford in 1854 is thought to be an error and due to contamination within his collection. It should be noted, however, that *V. pusilla* has not been recorded from Went Vale since that date. Charles Ashford could not have made an identification by mistake as both *pusilla* and *angustior* are characterised by the fact that they have a left-handed spiral to their shells. The specific locality from which he took his sample is unknown. This is a classic case of insufficient data making it impossible to assess the accuracy and validity of a record.

Deroceras (Agnolimax) agreste (Linnaeus, 1758)
The only record of this slug from the Magnesian Limestone is from the grassland above Little Stones Wood near Anston Stones (43/525838) recorded by myself in 1985. A specimen of this species had been collected some years previously by temporary staff of the Rotherham Museum, but unfortunately the locality data was lost.

All the other Yorkshire records are from the high altitude mountain limestone of West and North-west Yorkshire.

Candidula gigaxii (L. Pfeiffer, 1850)
Found mainly on dry limestone or lime-rich sandy areas, this snail is scarce in Yorkshire. First recorded by A. H. Lowman Newstead from Boston Spa in 1890 (SE44/44), it has since been recorded on the Magnesian Limestone from Knaresborough, banks of the River Nidd (SE44/364564) in 1971, and at Sherburn Willows (SE44/4832) in 1973, both by the author.

Helicella (Helicella) itala (Linnaeus, 1758)
First recorded from the county by Dr Martin Lister in 1674 this used to be very common on

the Magnesian Limestone throughout the area. Over the years many of its known localities have gone due, it is thought, to changes in agricultural practices, but climatic changes cannot be ruled out as the cause.

Helicigona lapicida (Linnaeus, 1758)
A species of limestone cliffs and walls this snail is mainly confined to the mountain limestone of West and North-west Yorkshire. It has been recorded from several sites on the Magnesian Limestone, but most of the records result from locating dead shells.

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INVERTEBRATES OF THE SOUTHERN MAGNESIAN LIMESTONE

W. A. ELY

INTRODUCTION

The Natural Areas concept is a framework within which we can develop any number of extra 'modules'. English Nature has already done that by preparing documents which deal with birds (Grice *et al.* 1994), flowering plants and bryophytes (Porley & McDonnell 1997), freshwater wetlands (Gardiner 1996) and lowland grassland (Jefferson 1996), for example. These documents are national in scope but include a list of examples from each Natural Area. The guiding principle seems to be that significant aspects of an area's wildlife need to be taken into account when decisions which could affect them are being made, and these reviews present that significance in an easily digested form for non-specialists to use. Politicians and planners, the staff of English Nature, the Countryside Commission, MAFF, DETR and the Environment Agency, as well as landowners large and small, are making decisions that will affect the biodiversity of each Natural Area and need to be aware of significant wildlife interests.

The invertebrate discussion meeting was used to float the suggestion that entomologists, arachnologists and conchologists within the YNU should attempt something similar for the invertebrates though, as this meeting focused on the Southern Magnesian Limestone Natural Area, this suggestion was similarly restricted.

OUTLINE

Naturalists are well aware that the Southern Magnesian Limestone Natural Area is important for wildlife and contains many significant wildlife sites. Invertebrates contribute much of the special character of the Natural Area and form a significant part of the biodiversity of individual sites as well as of the Natural Area as a whole. Although naturalists and ecologists may be very familiar with this significance and understand that these animals need to be taken into account when decisions are being made, these factors are not necessarily very apparent to those who are less closely involved. It is our

RED DATA BOOK INVERTEBRATES OF THE SOUTHERN MAGNESIAN LIMESTONE

	Status	10km	pre-1900	1900-1950	post 1950
Mud snail *Lymnaea glabra* (Muller)	RDB2	SK58			1985
		SE50			1960s
whorl snail *Truncatellina cylindrica* (Ferussac)	RDB2	SK58	1885		
		SE41/51	1887		
featherwing beetle *Acrotrichis lucidula* Rosskothen	pRDBk	SK58			1990
rove beetle *Atheta puberula* (Sharp)	pRDBk	SK58			1989
waterpenny beetle *Eubria palustris* Germar	RDB3	SK58			1990s
leaf beetle *Ochrosis ventralis* (Illiger)	pRDB3	SK58			1977
Large Tortoiseshell *Nymphalis polychloros* Linnaeus	RDB1	SK59	1884		
Tawny Wave *Scopula rubiginata* (Hufnagel)	RDB3	SK58/59	1896		
cranefly *Nephrotoma crocata* (Linnaeus)	RDB3	SK58		1947	
cranefly *Tipula hortorum* Linnaeus	RDB3	SK58			1985
cranefly *Limonia masoni* (Edwards)	RDB3	SK58			1977-1991
		SE50			1986
cranefly *Orimarga virgo* (Zetterstedt)	RDB3	SK58			1989-1990
cranefly *Gonomyia abbreviata* Loew	pRDB3	SK59			1984
		SE50			1986, 1988
cranefly *Erioptera nigripalpis* Goetghebuer	RDB3	SK58			1977
fungus gnat *Mycomya ornata* (Meigen)	RDB3	SE50			1960s
dance fly *Platypalpus infectus* (Collin)	RDB3	SE50			1991
dance fly *Platypalpus interpolus* (Collin)	RDB3	SE50			1989
dance fly *Platypalpus unicus* Collin	pRDB3	SE50			1978, 1988-1991
dance fly *Bicellaria halterata* Collin	pRDB3	SE50			1989
		SK58			1982
dance fly *Rhamphomyia aethiops* Zetterstedt	RDB3	SK58/59		1941	
dolichopodid fly *Argyra grata* Leow	RDB3	SE			1988
gall fly *Platyparea discoidea* (Fabricius)	RDB2	SK58			1977
		SE50			1986
silver fly *Chamaemyia paludosa* Collin	RDB2	SK58			1988
chyromyid fly *Aphaniosoma propinquans* Collin	RDB1	SE50			1960s
snail-killing fly *Dichetophora finlandica* Verbeke	RDB3	SK59			1986
		SE50			1960s, 1988-1991
cereal fly *Opomyza punctella* Fallen	RDB3	SK59			1982
muscid fly *Phaonia bitincta* (Rondani)	pRDB3	SE50			1991
sawfly *Pamphilius gyllenhali* (Dahlbom)	RDB3	SK58			1980
sawfly *Hartigia xanthostoma* (Eversmann)	RDB3	SK58			1989
sawfly *Empria parvula* (Konow)	pRDB3	SK59			1991
sawfly *Pontania vesicator* (Bremi-Wolf)	pRDB3	SK58			1985
cuckoo bee *Nomada lathburiana* Kirby	RDB3	SE34			1979-1981

responsibility, and in our own interests, to bring this significance to the attention of decision-makers. In order to do this we need to produce something concise yet compelling.

The suggestion presented to the discussion meeting was that the YNU should compile a list of Red Data Book (RDB) invertebrates with an outline of their distribution throughout the Southern Magnesian Limestone Natural Area in time and space. RDB species were suggested because, being rare, there would be very few records for the YNU recorders to extract but, being indisputably the rarest and most vulnerable species in Britain, they would have to be taken seriously and no-one could contest their importance. Maximum impact for minimum effort was the aim.

The results reflect the returns received so far: South Yorkshire is well represented, thanks to the efforts of the Rotherham and Doncaster Biological Records Centres; the rest of Yorkshire is less well represented and the records here are the results of the efforts of the

Union's invertebrate recorders. No information has been provided from Derbyshire or Nottinghamshire. I doubt that SK58 (17 species) and SE50 (12 species) are outstandingly better than the 10km squares to the north and south; rather I suspect that they indicate the sort of result that would be obtained more widely if all available information could be trawled in.

The information is presented at a deliberately coarse scale to avoid breaching confidentiality and to keep it to a strategic level where it can be accessed by decision makers. If a record cannot be dated to a particular year then a vague date is given; a date range (e.g. 1988-1991) indicates that there are several records but they do not necessarily imply that a record exists for every year within the range.

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INVERTEBRATE INTEREST OF THE SOUTHERN MAGNESIAN LIMESTONE: REPORT OF THE INVERTEBRATE SEMINAR SESSION

ROGER K. A. MORRIS

MORNING SESSION

This first session concentrated on an excellent presentation by Adrian Norris on the molluscan fauna of the Southern Magnesian Limestone in Yorkshire, a full account of which is published in this issue of *The Naturalist.* From this presentation, it was clear that whilst the Southern Magnesian Limestone does not appear to support any species which are entirely specific to the Natural Area, the fauna includes at least four obligatory calcicoles and a further seven probable calcicoles. Within the Natural area, the rarest species is *Truncatellina cylindrica*, one of the rarest British snails, which is on the verge of extinction. Most species recorded from this Natural Area also occur elsewhere in Yorkshire, either on the Chalk of the Yorkshire Wolds or on the Mountain Limestone to the west.

AFTERNOON SESSION

Bill Ely opened this session with a discussion of the importance of the Magnesian Limestone in Rotherham. From this, he concluded that the Southern Magnesian Limestone has a considerable impact on the distribution of wildlife in Rotherham, being botanically and entomologically richer than anywhere else. In terms of influencing decision-makers, Bill suggested that a case could be made to emphasise that the Southern Magnesian Limestone is important, using invertebrates and by examining the range of Red Data Book (RDB) and Nationally Scarce species. From the floor, it was suggested that locally important species should also be considered. Given the numbers of species involved, an initial stab at the list of nationally important species for the Natural Area was thought a practical option.

The debate which followed concluded that, whilst the Southern Magnesian Limestone was important for a range of calcicole species, in general these were represented on other Chalk and Limestone formations. One key point is the lower altitude of the Natural Area against, for example, that of the Mountain Limestone. This is likely to influence the assemblage of species which it supports. Even within the Natural Area there are a number of species which are highly localised; for example, the Double Kidney Moth *Ipimorpha retusa* and the soldier beetle *Cantharis fusca* seem to be confined to the Ripon area and do not occur either to the east or west.

Much of the debate centred on the purpose of identifying species typical of or restricted to the Southern Magnesian Limestone. Some recorders emphasised the need to consider the natural history interest and not just the conservation interest, and also recognised that interest existed outside this Natural Area. There remains much uncertainty about why such information is needed, one reason mentioned being to help set conservation objectives for the Natural Area as a foundation for local Biodiversity Action Plans.

There was debate about the possible need for a Red Data Book, either for this Natural Area, or for Yorkshire. The use of the term Regionally Notable was also debated and its merits were apparent in a local context. Overall, there was agreement that a list of key species as far as Regionally Notable was desirable, and some support for a Red Data Book, possibly using Natural Areas as the basis for what to include.

BOOK REVIEW

Provisional Atlas of the Ground Beetles (Coleoptera Carabidae) of Great Britain by **Martin L. Luff**. Pp. 194, with 348 species distribution maps. Biological Records Centre, Institute of Terrestrial Ecology, Monks Wood, Abbots Ripton, Huntingdon. Copies obtainable from Publication Sales, Institute of Terrestrial Ecology, Merlewood Research Station, Grange-over-Sands, Cumbria LA11 6JU. Price £7.50 including postage & packing.

The list of contributors to this publication reads like a roll-call of British entomologists past and present, for many a novice cut his entomological teeth on ground beetles, and as the recording scheme which has resulted in this *Atlas* began in 1974, a few of the early recorders are sadly no longer with us.

Each species map is accompanied by a distribution overview and notes on habitat preferences and autecology, and, where appropriate, comments on taxonomy. The Editor is to be hugely congratulated on this valuable production, not least for his tenacity in overseeing the work for the past 24 years! Although only 'Provisonal', this *Atlas* will be a standard work of reference for years to come, and hopefully an impetus to fresh recording which will soon make some of the maps out of date. This is a worthy addition to the growing number of distribution atlases now available for the British fauna and it deserves a place on the shelves of all natural historians, whether entomolgists or not. At this price it is a bargain.

RC

Printed in Great Britain by Titus Wilson & Son, Kendal ISSN 0028-0771

April-June 1999

Number 1029
Volume 124

The Naturalist

A QUARTERLY JOURNAL OF NATURAL HISTORY FOR THE NORTH OF ENGLAND

Published by the Yorkshire Naturalists' Union

Editor **M. R. D. Seaward,** MSc, PhD, DSc, FLS, The University, Bradford BD7 1DP

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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.

Membership enquiries and subscriptions should be sent to:

Mr Richard Comley, 1 Highfield Rise, Stannington, Sheffield S6 6BS

All other YNU matters, including missing copies of publications, all general correspondence and all matters regarding institutional subscriptions should be addressed to:

Mr John A. Newbould, Tapton House 30 Moorlands, Wickersley
Rotherham S66 0AT

Please note change of address as from 31st July 1999: Stonecroft, 3 Brookmead Close, Sutton Poyntz, Weymouth, Dorset DT3 6RS

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RANKING THE NATURE CONSERVATION IMPORTANCE OF SITES: AN INVESTIGATION OF PONDS IN NORTH-WEST ENGLAND

DAVID M. WILKINSON
Biology and Earth Sciences, Liverpool John Moores University, Byrom Street, Liverpool L3 3AF
JOHN BOOTHBY AND ANDREW P. HULL
Pond Life Project, Liverpool John Moores University, 15-21 Webster Street, Liverpool L3 2ET

ABSTRACT
Data collected from an extensive survey of 271 ponds in North-west England are examined. Using information relating to species in each pond (for amphibians, plants, and invertebrates) examination of the correlations between species totals is undertaken. Analysis shows that (i) plant species richness is a relatively poor predictor of a pond's invertebrate or amphibian species richness; (ii) submerged plant species richness is slightly better as such a predictor than total plant (emergent + submerged) richness; and (iii) ponds with high submerged plant richness tend not to have high emergent plant richness (and vice versa). Additionally, water beetle species richness correlates poorly with total invertebrate richness. These results suggest that where possible full species lists should be prepared for ponds rather than using rapid biodiversity survey methods such as assuming invertebrate species richness correlates with plant species richness. In this pond sample, hotspots for different taxa do not strongly overlap.

INTRODUCTION
Many commentators now consider the preservation of biodiversity to be a major aim of applied ecology (Gaston & Spicer 1998; Leakey & Lewin 1996; Quammen 1996; Wilson 1992). In the short to medium time-scale (e.g. decades) a major approach to this problem has been to develop networks of nature reserves, however, on a longer time-scale, continuing climate change, both natural and anthropogenic in origin, makes such an approach problematic (Hunter *et al.* 1988; Huntley 1994). Moreover, when comparing sites for possible reserve status, it is not uncommon to find that some of the relevant data are not available. While species lists for the better studied taxa (e.g. vascular plants, birds or butterflies) may be available, information on many other groups (e.g. most invertebrates, fungi, protozoa) is often patchy or completely absent. In such cases it would be useful if relationships could be established that would allow sensible decisions to be made based on these imperfect data (Dobson *et al.* 1997; Oliver & Beattie 1996; Prendergast *et al.* 1993) for example, are sites that are rich in plant species usually rich in invertebrate species? If so, then selecting species-rich plant sites as reserves would also tend to select species-rich invertebrate sites. Selecting sites on the basis of high species richness could be a poor conservation strategy, however, if important rare species are found only in species-poor sites (Hambler & Speight 1995; Wilkinson 1998a).

There are two main reasons for investigating such ideas in the context of farmland ponds. Firstly, they are small systems with easily defined edges which are relatively easy to sample. Secondly, they are declining features in the British landscape due to drainage and infilling as well as successional processes (Boothby *et al.* 1995; Jeffries 1991; Rackham 1986). Studies of ponds are thus of direct conservation interest. This study uses data from north-west England, collected as part of a larger pond conservation project (Boothby *et al.* 1995). This region has remained unusually rich in ponds, with about 30,000 extant. Most of these are old farm ponds which are being lost to agricultural and other changes (Boothby & Hull 1997; Brian *et al.* 1987); the parameters of biodiversity in these habitats are only just beginning to be established in detail (e.g. Boothby 1997; Guest 1997).

This paper examines the correlations between species richness of different groups for a large (n = 271) pond data set, to investigate if some groups (e.g. plants) could be used as a surrogate for data on other groups such as invertebrates.

Methods

The ponds (n = 271) were visited in the spring and summer seasons of 1995. Ponds were selected either (i) as a stratified random sample within areas of high pond density (as defined by Grayson 1994) or (ii) purposely, as sites known to be under threat or for which management information was required. For reasons of both access and efficiency, clusters of ponds on selected farms were chosen for survey.

At each pond, all plant species rooting below winter high water level, aquatic invertebrates, and amphibians (egg, larval, and adult stages) were recorded, as were bankside vegetation and the composition of the wider terrestrial landscape.

The physiographic characteristics of the ponds were noted, sketched, and photographed. Water samples were taken for later analysis, though only a portion of these was processed. Species totals for the vegetation data distinguish between submerged and floating species on the one hand (referred to as 'aquatics' in this paper), and emergent species on the other (Rodwell 1995). *Sphagnum* bog-mosses were identified to species level because of their ecological significance; the hair-moss *Polytrichum commune*, aquatic liverworts *Riccia fluitans* and *Ricciocarpus natans* were recorded but no other bryophytes. Filamentous and planktonic algae were recorded where these were a conspicuous component of the vegetation. Submerged and aquatic lower plants, including stoneworts, were included in the species totals for each pond. Table 1 gives summary information on ponds and species totals.

TABLE 1
Some characteristics of sampled ponds and species.

	n	Min.	Mean	Maximum	Note
Pond are [m^2]	269	12.0	918	1170	[a]
pH	78	3.55	8.80	10.05	
Altitude [m]	271	10.0	47.0	130	
Maximum water depth (m)	254	<0.5: n = 42		<0.5 n = 212	
Silt depth (m)	259	<0.5: n = 88		<0.5 n = 171	
Species per pond [n = 271]					
Aquatic plants		1	2.6	8	
Emergent plants		4	15.1	23	
Invertebrates		0	23.0	59	
Amphibians		0	1.2	5	[b]

a: 'pond' defined as >1m^2 & <2.0 ha (Pond Action, 1994).
b: no Natterjack Toad ponds included in surveys; the region has six native amphibians. Modal value is 1 species per pond.

Results and Discussion.

Spearmans rank correlation coefficients between species richness of different taxa are given in Table 2. This shows a wide range of statistically significant correlations; examination of the size of the correlation coefficients suggests, however, that these relationships are of limited use as predictors; for example, the highest correlation between number of aquatic plant species and number of invertebrate species is quite modest (r_s = 0.46). Therefore in these data aquatic plant species richness predicts only around 20% of the variation in invertebrate species richness (r^2 = 0.21). The key point is that within this large (n = 271) data set species richness of any one taxonomic group (e.g. plants) is a poor guide to the species richness of other taxonomic groups. A slightly higher correlation (r_s = 0.612) has been found between plant species richness and invertebrate richness for upland ponds in mid-Wales (Wilkinson and Slater, 1995). However in this study the sample size was much smaller (n = 27) and not all the invertebrates were identified to species level. Friday (1987) obtained a correlation of 0.622 for a small set (n = 16) in Dorset, UK. In these studies, even with their higher correlation coefficients, plant species richness only explains around 35% of the variation in invertebrate richness. Though as Learner *et al.* (1990) pointed out, 'it is generally assumed that the consevation status of the flora and fauna are axiomatically related'; our results suggest otherwise. They also reached similar conclusions based on their studies of the biodiversity of river corridors in Wales.

TABLE 2

Spearmans rank correlation coefficients between species richness of different taxa.

	r_s	Significance	n
Total plant species/Total invertebrate species	0.412	***	271
Aquatic plant species/Total invertebrate species	0.460	***	271
Emergent plant species/Total invertebrate species	0.334	***	271
Aquatic plant species/Emergent plant Species	0.361	***	271
Beetle species/non-beetle invertebrates	0.360	***	271
Total plants/Total amphibians	0.313	***	266
Emergent plants/Total amphibians	0.260	***	266
Aquatic plants/Total amphibians	0.326	***	266
Total invertebrates/Total amphibians	0.335	***	266

* = p<0.05   * = p<0.01   *** = p<0.001

When total plant species richness is sub-divided into aquatic plants and emergent plants, then aquatics are found to be more highly correlated with both invertebrate and amphibian richness than with either total plant richness or with emergent plant richness. Therefore, although still a poor predictor, species richness of aquatic plants is better as a predictor of other groups than using total plant richness. A low correlation (r_s = 0.334) was found between emergent plant richness and aquatic plant richness. Sites which are rich in emergent plant species tend not to be species-rich aquatic plant sites. A similar result has been obtained by Wilkinson (1998a) in a reanalysis of the data set of plants in Welsh lakes compiled by Seddon (1972). In this case there was a very poor correlation between species richness of aquatic and emergent plants (r_s = 0.144, not significant; n = 54).

The poor correlation between water beetle species richness and other invertebrate richness (r_s = 0.36) confirms similar results found by Wilkinson and Slater (1995) for Welsh upland ponds (r_s = 0.40, P< 0.05, n = 27). This illustrates that invertebrates can not be treated as a unified group, for example, conditions that are good for Coleoptera may be poor for Trichoptera. Similar conclusions were reached by Oliver and Beattie (1996) from Australian forests; there was no significant positive correlation found between ant, beetle and spider species richness, and a strong negative correlation between ant and beetle richness.

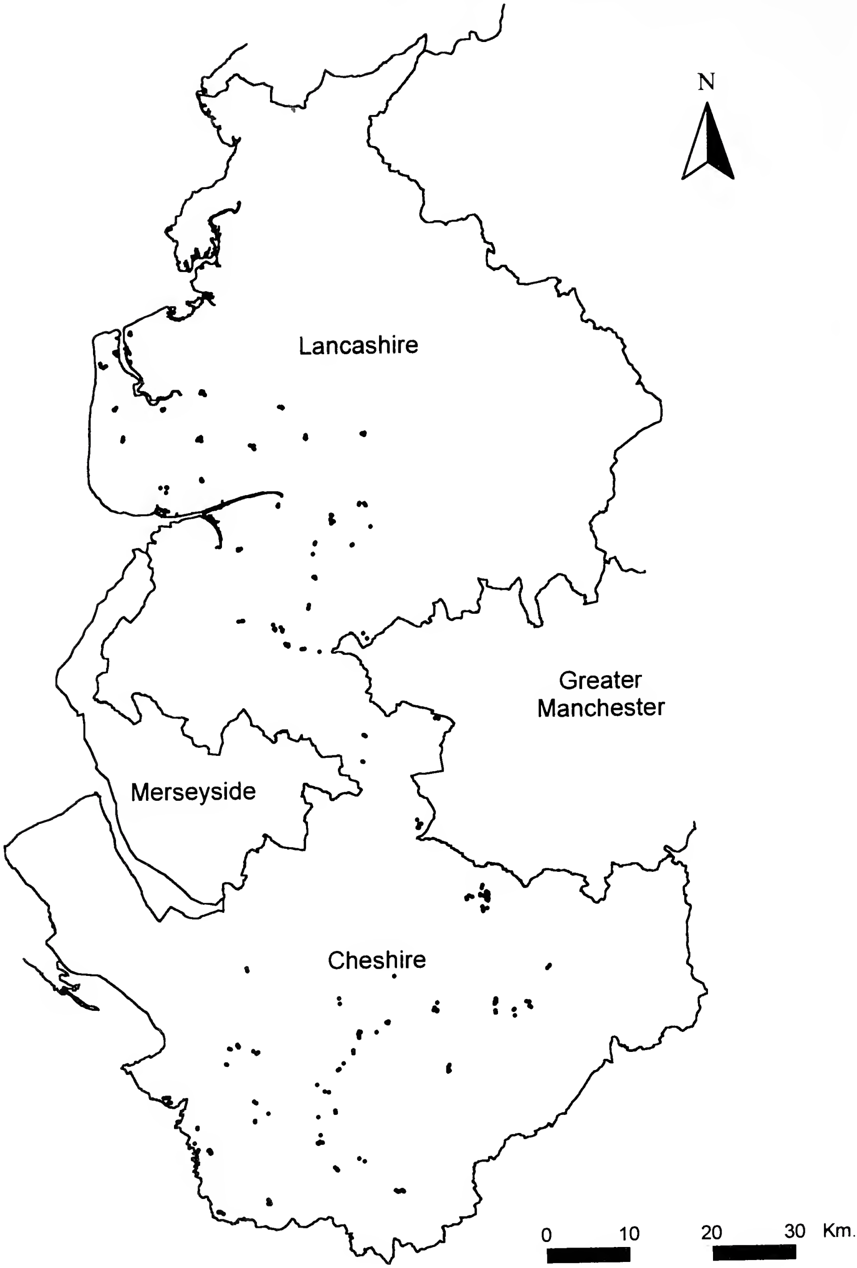

FIGURE 1
Ponds surveyed in the study area.

Attempts to designate sites as protected areas using imperfect information would be easier if "(i) habitats that are species rich for one taxon are also species rich for others; and (ii) rare species occur in, and therefore benefit from the conservation of, species rich habitats' (Prendergast *et al.* 1993). In many instances the second condition seems a reasonable approximation: examples are reviewed by Gaston (1994); Wilkinson (1998a) suggests caveats. This study is concerned with the first question. At the national scale (Prendergast *et al.* 1993 – Britain; Dobson *et al.* 1997 – USA) it has been found that 'hot spots' for different groups rarely overlap. At larger scales (e.g. Europe or larger) there is evidence for substantial coincidence between 'hot spots' for different taxa (Gaston & David 1994). Our study of a network of sites at a regional scale reaches similar conclusions to the analysis of Prendergast *et al.* (1993) for all of Britain: a species-rich plant pond is often not a species-rich invertebrate or amphibian pond. Correlations between 'hot spots' for different taxa appear to be more common at larger spatial scales.

The implications are significant. If information is required on a given invertebrate group then that group should be studied directly rather than relying on plant diversity, although the latter is more easily recorded. Unfortunately, in most habitats invertebrates are often hard to survey, requiring a diversity of collecting methods to give comprehensive results (Casson & Hodkinson 1991; Disney *et al.* 1982), they are also very species-rich (May 1988). It thus seems likely that the knowledge base on which biodiversity planning is erected is probably deficient, at least in the detail of the presence and distribution of local species, and especially for invertebrates. In spite of being very species-rich and ecologically important, invertebrates have often been under-represented in both nature conservation and academic ecology (Wilkinson 1998b; Wilson 1987).

It is becoming accepted that, as a habitat, ponds are exceptionally diverse; it follows that detailed habitat management should proceed on a pond-by-pond basis, each site being judged by its strengths (Biggs *et al.* 1994). It is a strength of pond-rich areas such as north-west England that a diversity of ponds has survived and that, given appropriate mechanisms, can be sustained.

Acknowledgements

Species data used in this study were collected for the Pond *Life* Project by ecological surveyors led by Jonathan Guest and David Bentley. Assistance in identification was provided by Dr Garth Foster (water beetles); John Bratton (JNCC: reed beetles); Dr Michael Kerney (Natural History Museum: molluscs). Other assistance was provided by Martin Drake (English Nature), Deborah Proctor (JNCC), Steve Garland and staff (Bolton Museum Biological Records Centre). Boundary data for Figure 1 are copyright O.S. Strategi, held under CHEST licence.

The Pond *Life* Project is supported by the *Life* Programme of the EU and a partnership of organisations in North-west England, Netherlands, Belgium and Denmark.

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ACTINIANS (SEA-ANEMONES) BEACHED IN LARGE NUMBERS ON THE SOUTH LANCASHIRE COAST

NORA McMILLAN

The Nook, Uplands Road, Bromborough, Wirral, Merseyside L62 2BZ

"Wrecks" (i.e. severe environmental mortality) sometimes occur on the south Lancashire coast, the usual components being lamellibranch molluscans and echinoderms. What seems to have been a mass catastrophe for actinians is worth recording.

On the 20th September 1998 an extraordinary occurrence, found by Mr Chris Felton on the Ainsdale beach, south Lancashire (SH2612), of large numbers of the actinian *Sagartia troglodytes*, many *Alcyonidium*, some crabs, the usual suite of molluscs, quantities of the echinoderm *Echinocardium cordatum*, and two jellyfish (*Rhizostoma octopus* and *Chrysaora hysoscella*). The full list of species noted is as follows:

JELLYFISH	*Chrysaora hysoscella* (L.)
	Rhizostoma octopus (L.)
ACTINIAN	*Sagartia troglodytes* (Price) very numerous
CRABS	*Corystes cassivelaunus* (Pennant)
	Portunus depurator (L.)
MOLLUSCA	*Natica catena* (da Costa)
	Neptunea antigua (L.)
	Cerastoderma edule (L.)
	Spisula subtruncata (da Costa)
	Mactra corallina (L.)
	Donax vittatus (da Costa)
	Ensis siliqua (L.) very common
	Cultellus pellucidus (Pennant)
	Pharus legumen (L.)
	Barnea candida (L.)
BRYOZOAN	*Alcyonidium diaphanum* Lamouroux numerous
ECHINODERM	*Echinodermata cordata* (Pennant) common

Actinians are notoriously difficult to identify when preserved, but Dr J. C. den Hartog (Leiden) identified the south Lancashire one as *Sagartia troglodytes*, a species which according to him is regularly washed up on beaches in The Netherlands. The bryozoan was definitely identified as *Alcyonidium diaphanum* and it was pointed out that both actinians and the *Alcyonidium* require a hard substrate; so where in this part of Liverpool Bay do such conditions obtain?

I have not traced any previous records of actinians being beached along the Lancashire coast. Lingwood's (1976) regular observations of the beached fauna of this coastline were continued over some years but yielded no such collection as Felton found, nor have other observers (Orson 1929; Williams 1939; Grensted 1956; McMillan 1975) found actinians.

Samples of the material collected have been deposited in Liverpool Museum.

I am grateful to my Liverpool Museum colleague Mr Chris Felton who collected this enigmatic material, and to Dr J. C. den Hartog (Leiden), Dr P. F. S. Cornelius (The Natural History Museum) and the authorities of the Port Erin Marine Biological Station for their help in its identification.

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BOOK REVIEW

British Fungus Flora: Agarics and Boleti. 8/ *Cantharellaceae, Gomphaceae* and amyloid spored and xeruloid members of *Tricholomataceae* (excl. *Mycena)* by **Roy Watling and Evelyn Turnbull.** Pp. 189, with 134 line drawings. Royal Botanic Garden, Edinburgh. 1998. Price £12.50, soft-backed.

This eighth part of this important series covers 31 genera and 114 species. It follows the format of previous parts with keys, detailed anatomical descriptions, and line drawings of diagnostic features.

The treatment of the cantharelloid fungi comes hard on the heels of the account by Drs D. N. Pegler, P. J. Roberts and B. M. Spooner *(British Chanterelles and Tooth Fungi,* Royal Botanic Gardens Kew, 1997) which has first-rate colour photographs. There are, however, two important differences in the taxonomic treatment adopted. Watling and Turnbull do not include *Cantharellus cinereus* in *Pseudocraterellus* on the basis of developmental and molecular differences, and retain *C. ferruginascens* as distinct from *C. pallens* because of its colour, changes on bruising, and habitat.

Most of the species treated here have not been considered in depth in the British Isles before or for many years and the modern presentations are especially welcome. Inevitably there are some changes in names familiar to field mycologists: *Clitocybe gigantea* to *Leucopaxillus giganteus, Collybia fusipes* to *Gymnopus fusipes,* and *Oudemansiella radicata* to *Xerula radicata.* Such changes reflect an improved knowledge of the anatomy of the fungi concerned, something sadly neglected by many earlier mycologists.

The authors regrettably appear to find the application of the "sanctioning" provisions of the *International Code of Botanical Nomenclature (Tokyo Code)* (Koeltz Scientific Books, Königstein, 1994) confusing. The dates and places of publication they cite are generally those of the sanctioning author and not the person who originally described the species. *Gomphus* is even indicated as "sanctioned" by S. F. Gray, although Gray's works do not have any status regarding sanctioning. At the species level, some citations are given to the places of sanctioning and not to the place of valid publication of the names (e.g. *Cantharellus cinereus, Delicatula integrella, Panellus stipticus).* It would also have been of interest to have an explanation as to why *Cantharellus is* attributed to "Adanson: Fries", while in Pegler *et al.* this is "Juss.:Fr.", and in *Names in Current Use* (1993) it is simply "Fr.". Such uncertainties 17 years after such changes in the *Code* were made make clear that there is a need to simplify these evidently still confusing rules.

Although irksome to a pedant, such nomenclatural niceties should not in anyway detract from the taxonomic presentations and keys which are the essential components of this work which can be warmly commended to all who endeavour to identify these groups of fungi. I look forward to future parts . . .

DLH

ENTOMOLOGICAL REPORT 1993-1997
HYMENOPTERA: SYMPHYTA

J. D. COLDWELL

The appreciable slackening of interest in the sawflies noted in what sadly proved to be John Flint's last report to *The Naturalist* has shown little sign of reversal and were it not for an excellent batch of records submitted by Andrew Halstead from Dipterists Week which took place in Yorkshire in 1996 and a few odd specimens sent to me from elsewhere, the new recorder would be in the unacceptably isolated position of reporting only on his own discoveries. John's long illness, which rendered any feedback from him or his wife Tim to fellow sawfly enthusiasts very difficult, no doubt contributed in part to the lessening of interest over the past few years. This, therefore, may now be a good opportunity to urge anyone with present or future records to submit them to the new recorder.

John also commented on the particular neglect suffered by the Nematine sawflies; whilst this is still generally true, at least a few *Pristiphora* species are recorded here for Yorkshire for the first time.

The species listed are either new county or vice-county records. A few others are neither but are so infrequently encountered as to merit inclusion. Thanks are due to those who have contributed records: Austin Brackenbury (A.B.), Andrew Halstead (A.J.H.), John Coldwell (J.D.C.), Derek Whiteley, Alan Lazenby and Dennis Giggal. The usual symbols are used to denote new county (+) and vice-county (*) records.

Cephalcia lariciphila (Wachtl)	(*62) Scugdale Beck (NZ4900), 17/7/96; per AJH.
Neurotoma saltuum (L.)	(*63) Manvers, 15/6/95; JDC. Very rare in the north, this specimen swept from *Populus* constituting the first 20th century Yorkshire record.
Pamphilius histrio (Latreille)	(*63) Tingle Bridge, nr. Hemingfield, 31/5/94; JDC. Only previously reported from Allerthorpe.
Sterictiphora geminata (Gm. in L.)	(*63) Tingle Bridge, 21/5/95; JDC. Scarce. Only previously from Ashberry.
+*Arge ochropus* (Gm. in L.)	(63) Brockadales (SE5017), 9/8/97; JDC. A southern species.
A. pagana (Panzer)	(61) Allerthorpe Common and Bishop Wood in 1993; JDC. These are the only two previously known sites in the county apart from Holgate in the Victoria County History.
Strongylogaster xanthocera (St.)	(*61) Wheldrake Wood (SE6647), 14/7/96; per AJH. (*62) Strensell Common (SE6559), 17/7/96; per AJH.
Heterarthrus ochropoda (Klug)	(*63) Manvers (SE4501), 16/6/95; JDC. Just one specimen swept from *Populus*. Second Yorkshire record.
Athalia scutellariae Cameron	(*64) Askham Bog (SE5748), 14/7/96; per AJH. (*61) Hornsea Mere (TA1846), 15/7/96; per AJH.
Monostegia abdominalis (Fab.)	(64) Askham Bog (SE5748), 14/7/96; per AJH. Recorded from same site in the Victoria County History. Also Spurn in 1947.
Allantus cingulatus (Scopoli)	(*63) Falthwaite (SE3003), 11/6/94; JDC.
+*Periclista albida* (Klug)	(63) Bretton Lakes (SE2712), 8/5/93; JDC.
+*Messa hortulana* (Klug)	(63) Manvers, 27/6/96; JDC. A rare, southern species.
+*Tenthredo amoena* Gravenhorst	(63) Wombwell Ings (SE4203), 12/7/97; JDC. A few on umbels.
T. mandibularis Fab.	(*63) Bretton Lakes, 16/6/96; JDC. One swept from an extensive bed of *Petasites*.

+*T. obsoleta* Klug	(62) Ashberry Pastures, 23/7/95; JDC. (*63) Langsett, 3/7/96; JDC. Very similar to the common *T. mesomelas* and possibly overlooked on that account.
Hemichroa crocea (Geof. in Four.)	(61) Allerthorpe Common, 8/6/94; JDC. Not recorded since 1958 from Malham
+*Pristiphora aquilegiae* (Vol.) (= *alnivora* (Hartig))	(61) Escrick (SE6342), 15/7/96; per AJH.
P. bifida Hellen	(63) Manvers, 6/96; JDC.
+*P. cincta* Newman (= *truncatus* (Benson))	(61) Skipwith Common, 20/7/96; per AJH.
+*P. coniceps* Lindqvist	(63) Manvers, 29/7/93; JDC.
+*P. erichsonii* (Hartig)	(63) Langsett (SE1900), 9/6/96; JDC. (*62) Hayburn Wyke, 18/7/96; per AJH. A former pest of Larch plantations.
+*P. geniculata* (Hartig)	(63) Tin Mill Dam, Deepcar, 5/96, AB.
P. pallidiventris (Fallen)	(*63) Hugset Wood, 12/5/96; JDC.
P. subbifida (Thomson)	(*63) Tingle Bridge, Hemingfield, 21/5/96; JDC.
P. wesmaeli (Tischein)	(*61) Wheldrake Wood (SE6647), 14/7/96; per AJH. Second Yorkshire record.
Nematinus abdominalis (Panzer)	(*63) Bretton Lakes, 10/7/96; JDC.
N. willigkiae Stein	(63) Manvers, 6/6/96; JDC. Second Yorkshire record.
Pontania tuberculata (Benson)	(*63) Manvers, 14/5/96, JDC. Third Yorkshire record.
Nematus nigricornis Lepeletier	(*63) Hugset Wood, 21/4/96; JDC. (63) Gypsy Marsh (SE4501), 29/4/96; JDC.
Pachynematus vagus (Fab.)	(*62) Strensell Common (SE6660), 17/7/96; per AJH. (*63) Wilthorpe Marsh (SE3308), 19/8/97; JDC.
Pachyprotasis variegata (Fallen)	(64) R. Wharfe, Grass Wood, 2/7/96; JDC. Uncommon. Last recorded at Ellerburn in 1973.

BOOK REVIEW

Provisional Atlas of the Ground Beetles (Coleoptera Carabidae) of Great Britain by **Martin L. Luff**. Pp. 194, with 348 species distribution maps. Biological Records Centre, Institute of Terrestrial Ecology, Monks Wood, Abbots Ripton, Huntingdon. Copies obtainable from Publication Sales, Institute of Terrestrial Ecology, Merlewood Research Station, Grange-over-Sands, Cumbria LA11 6JU. Price £7.50 including postage & packing.

The list of contributors to this publication reads like a roll-call of British entomologists past and present, for many a novice cut his entomological teeth on ground beetles, and as the recording scheme which has resulted in this *Atlas* began in 1974, a few of the early recorders are sadly no longer with us.

Each species map is accompanied by a distribution overview and notes on habitat preferences and autecology, and, where appropriate, comments on taxonomy. The Editor is to be hugely congratulated on this valuable production, not least for his tenacity in overseeing the work for the past 24 years! Although only 'Provisonal', this *Atlas* will be a standard work of reference for years to come, and hopefully an impetus to fresh recording which will soon make some of the maps out of date. This is a worthy addition to the growing number of distribution atlases now available for the British fauna and it deserves a place on the shelves of all natural historians, whether entomolgists or not. At this price it is a bargain.

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THE REVEREND THOMAS HINCKS FRS (1818-1899) AND HIS FAMILY: THEIR YORKSHIIRE CONNECTIONS AND CONTRIBUTIONS TO NATURAL HISTORY

R. A. Baker
School of Biology, University of Leeds, Leeds

The Hincks family is an important dynasty of naturalists, some of whom were Dissenting Ministers belonging to the Unitarian Church. This article describes the life and work of Thomas Hincks and his father, William Hincks and concentrates on their contribution to natural history during the time they were in Yorkshire. Thomas Hincks's family came from Cheshire, England. His grandfather, Thomas Dix Hincks (1767-1857), became minister at the Old Dissenting Presbyterian Chapel at Princes Street in Cork and was the major figure in the establishment and early development of the Royal Cork Institution (note 1), the forerunner of University College, Cork. He did much to promote science in Ireland, both in Cork and later in Belfast where he was involved in the Belfast Natural History Society and the British Association for the Advancement of Science.

Thomas's father, William Hincks (1794-1871) was born in Cork trained at the Dissenting Academy in York and after ministries in Cork, Exeter and Liverpool, where he continued his botanical interests, returned to York as Tutor at Manchester College, York. Desmond (1977), gives biographical details and lists some of Hincks' publications.

From a scientific point of view, York was an interesting place to be in during the early part of the nineteenth century. As Orange (1973) has shown, 'York . . . was intellectually better endowed than most towns and cities of comparable size, commanding, as the centre of the county, a concentration of educational, medical, ecclesiastical and charitable institutions which over the years brought men of high calibre to the place'. When William Hincks arrived in 1827, the Yorkshire Philosophical Society was five years old and the British Association met for the first time in York just four years after his arrival. Work had begun on building a new Yorkshire Museum which opened in 1830 and developed large collections in geology, archaeology and natural history. Although it is still not entirely clear why York was chosen as the place to establish the British Association, it may well have been because of the individuals or the Institutions present in the city and the fact that York was half-way between Edinburgh and London (Russell, 1983). Manchester College, York had moved from its original home in Manchester to York in 1803, and was under the charge of Charles Wellbeloved (1769-1858) when Hincks arrived (note 2). Hincks came to teach natural philosophy and mathematics and was the fourth tutor to be appointed. His arrival in the city came at a crucial time and he became one of the influential 'inner circle' of members (later an honorary member) in the early days of the Yorkshire Philosophical Society. Over forty years later in Canada, he recalled those days – 'the truest enjoyment to evenings spent at the Yorkshire Philosophical Society, where Mr. Vernon Harcourt, Professor Phillips, Mr. Allis . . . Mr. Wellbeloved . . . and Mr. Kenrick . . . with other able men, gave a never flagging interest to the Society's meetings' (note 3).

Manchester College, York was a direct descendant of the Dissenting Academy at Warrington (1757-1786), and was mainly a training ground for Unitarian ministers, although other 'lay' students not training for the ministry were admitted for a general education. The curriculum was much broader than at the existing universities and included the teaching of science (note 4). Under Wellbeloved the College was able to attract a number of scholars of high distinction to its teaching staff, including William Turner jr, and John Kenrick. In addition to his teaching at Manchester College (note 5), from 1834 William Hincks lectured in botany at the York School of Medicine and was from 1828, the first Curator of botany in charge of the Yorkshire Philosophical Society's herbarium (Wilkinson, 1917). Hincks was also closely involved in the botanical garden at York and for a time, when little money was available, donated the fees from his lectures to help to maintain it (Orange,1973).

Hincks began to make his own collections of plants, and developed a special interest in 'vegetable abnormalities'. When he later applied for the foundation Chair in Botany (later changed to Natural History) at Cork in 1845, he referred to his earlier experiences and to these collections – 'engaged in botanical pursuits from early youth for thirty years and . . . taught it publicly and privately for about twenty years . . . knowledge of collections of dried plants, fruits, seeds, sections of wood . . . besides a remarkably rich and valuable collection of vegetable anomalies: with drawings, diagrams and prints adapted for public teaching, brought together with much time, labour and expense' (quoted by Pettit, 1973).

William Hincks became a full time professional biologist when he took up the Chair in Natural History at Cork in 1849. He moved again in 1853, at the age of 59, to become the first Professor of Natural History at University College, Toronto, Canada where he lived until his death in 1871.

William, although not in the first rank of naturalists in the nineteenth century, was a competent botanist, administrator and teacher who remained a creationist to the end of his life. Speaking as President in 1870 to the Canadian Institute he remarked that 'I am obliged to confess that if my reason compelled me to adopt the Darwinian hypothesis, its opposition, as I understand it, to cherished and valued sentiments respecting creative wisdom and goodness, and a perfect divine plan for nature, would cause me great pain' (note 6).

By this time, William Hincks had been a Fellow of the Linnean Society for 45 years, since his days in Liverpool in the 1820s; in the Society's obituary notice (note 7), he was described as a 'philosophical radical' in his political views and a man whose characteristics were his 'love of truth, his intellectual honesty, and his fearless trust in freedom'.

Thomas Hincks was born in Exeter, educated at Manchester New College and through a recently developed connection, graduated BA from London University in 1840. Thomas Hincks had his most important ministry at Mill Hill Unitarian Chapel in City Square, Leeds where he spent fifteen years, serving the church and developing his scientific interests. Prior to illness, he was 'a conspicuous example of the type of naturalist, common in this country, who earn for themselves distinction during the leisure spared from the performance of other duties' (Harmer, 1899a).

By the time Thomas arrived in Leeds in 1855, the 17th century meeting house, where Joseph Priestley, 'father figure and radical hero' (Raymond and Pickstone, 1986) of early Unitarian scientists had an earlier ministry (1767-1773), had been replaced by the elegant Gothic building of 1848. Fitzpatrick (1989) records that at Leeds Hincks gained a reputation for leadership and 'his zeal and unselfish labours' were the result of a 'quick fertile mind'. During his ministry, new schools were built and he started *The Record*, a leaflet with news of the district, extracts from poems and sermons of interest to Unitarians. However, in 1868 he became seriously ill, lost his voice and was unable to continue with his ministry. He wrote to a scientific colleague, 'Since I have lost my voice I shrink from meetings of all kinds' (note 8). About the time of his resignation, he wrote to Alfred Merle Norman from Leeds, 'My health, I am sorry to say, has not improved as I had hoped; and the years rest . . . given me by my congregation [has not allowed me] . . . to resume my duties [I will] . . . resign my pulpit . . . I have not yet formed any plans for the future but shall probably move to some place in the South, where I have the benefit of a more genial climate. I fear I shall be fit for very little work . . . it is impossible to speak with any confidence as to the future. I must 'trust and wait' (note 9). This enforced withdrawal from public life in 1869 was a blessing in disguise for science because for the next thirty years in his 'retirement' he continued unabated with his scientific work. What had begun as a mere part-time interest became an important lifetime pursuit in Natural History.

During his time in Leeds, Thomas was active in the Leeds Philosophical and Literary Society, where his 'extraordinary activity' (Kitson Clark, 1924) as Honorary Curator of the Zoology Museum was noted. He served the Society as President from 1862 to 1865 and was described by Sir Clifford Allbutt, who was a member of the Society during the same period as for many years one of the most learned and influential members . . . (with) . . . a high reputation for his researches' (Kitson Clark 1924). Before his illness he was also active in the local lecture circuit, giving Natural History talks to learned societies. In one of these, at Bradford in December 1865 to the reconstituted Bradford Philosophical Society, he spoke about 'Life in some of its lower forms', which he illustrated with specimens and drawings of 'Zoophytes' (note 10). His opening remarks indicate his views about biological pursuits at this time: 'Although of late years there seemed to be a great deal of popular interest taken in Natural History, yet the study was not prosecuted with really scientific accuracy or interest. It was only the superficial and entertaining parts of the study which were at all followed up'. Hincks then proceeded to give the audience 'an accurate and thorough' account of Zoophytes, describing reproduction in Hydra, then discussing jellyfish and the colonial forms within this group, ending by advising all to study this unusual branch of Natural History which made a 'visit to the sea shore doubly interesting'.

Although his collecting instincts were strong and his interests in natural history broad, extending world-wide in his specialist groups, Thomas worked on the then little known groups of marine invertebrates, the Phylum Cnidaria (Class Hydrozoa) and the Phylum Bryozoa (=Polyzoa). He is perhaps best known for two major works on these – *A History of the British Hydroid Zoophytes* (1868) and *A History of the British Marine Polyzoa* (1880), both volumes being illustrated by his own camera lucida drawings. His earlier papers show an almost equal interest in both groups but he gradually became more of a specialist in the Polyzoa, writing in the mid-1870s that 'I am *not* working systematically with the Polyzoa yet . . . But I am glad to change my ground to gain the relief of variety' (note 11). He described these groups as belonging to 'one of the most charming branches of Natural History' which as Hincks could testify from his own experience, 'is an unfailing source of delight, and affords the most welcome relief and refreshment amidst the cares and harder duties of life' (preface, Hincks 1868).

Later writers acknowledged the value of these works. One obituary writer described his work as 'careful and lucid in description, skilful in drawing, well read, diligent and candid' (Miall, 1900). Harmer (1899b) believed that 'every page bears the impress of accuracy and sound judgement' and described his works as of 'inestimable value'. A more recent assessment by a world specialist on the Polyzoa (Ryland, 1969), refers to the importance of Hincks's 'great work' in which so many of to-day's genera and types have been based on his descriptions, it is 'a source book to workers on Polyzoa all over the world, it remains the most comprehensive text for biologists wishing to identify marine Polyzoa in western Europe'. The two books, each in two volumes, give detailed descriptions of species, systematics and classification of the groups together with Hincks's drawings but he did not neglect other aspects of their general biology, all the result of the 'pleasant labours of many years' (Hincks, 1880). Hincks recognised the help of others and the 'unselfish devotion to the interests of science . . . still the prevalent characteristics of the naturalist' (Hincks, 1880). It is mere speculation but the efforts in producing the first of these works may have led to his illness and it is noteworthy that his incapacity came in the same year as the publication of the book on Zoophytes. In 1868 he was encouraged to take a year's absence from his church work but was forced to resign a year later, no longer being able to address a congregation.

Hincks left Leeds in 1869 and moved to the west country, spending time in Somerset and Devon and finally settling in Brisol. The enforced withdrawal from public life did not prevent him from working and publishing. Between 1851 and 1883, Hincks contributed no fewer than 48 original manuscripts, publishing mainly in the *Annals and Magazine of Natural History* and the *Journal of the Microscopical Society*. Recovery from illness gradually took place and he eventually became President of the Bristol Naturalists' Society. After his death, many of his collections were deposited in the Bristol City museum by his wife and these illustrate the breadth of his interests. Until his illness, he was a worker and reporter for the British Association for the Advancement of Science and at the meeting in Leeds in 1858, he acted as one of the local Secretaries.

Thomas Hincks corresponded with some of the leading naturalists of the day (note 12). In letters held at the Natural History Museum in London, he exchanged lists, asked for duplicate specimens and information on species, wrote about his illness and complained about some of the work of others. Other letters illustrate how helpful he was to friends and to people he didn't know but who asked for help. The University of Leeds holds a copy of a letter from Hincks in reply to an enquiry about Polyzoa (note 13). Writing from Torquay in 1880, Hincks offers any help required and adds, 'I hope you may find my 'History' a help to you in your work and that the pursuit may give you as many pleasant hours as it has given me'.

It is not altogether clear why Thomas Hincks specialized in natural history and in the difficult and relatively unknown marine groups he chose to work on. His father seems to have inspired 'all his children with a love of the study of nature' (note 14). There is also the crucial aspect of his upbringing and training as a Dissenting Minister of the Unitarian church, in which science formed an important element. The influence of his close friends, George Busk (1807-1886) and Professor George James Allman (1812-1898) could have been crucial in directing him towards marine invertebrates.

George Allman was born at Bandon, County Cork and received his early training in Belfast where natural history thrived both at his school and in the Belfast Natural History Society. He was on the liberal side of Irish politics and initially studied for the Irish Bar. Abandoning law as a young man, he studied at the Royal College of Surgeons. By the time he was thirty years of age. he was closely associated with the Dublin Natural History Society and this became a turning point in his life. In 1840/41, this Society received a collection of Zoophytes from a Mr Hassell (Bronte Gatenby, 1960) which Allman worked on and he eventually became a world expert on the group. In 1844 he was appointed Professor of Botany at Trinity College, Dublin and moved to Edinburgh in 1856 as Professor of Natural History. There is no direct evidence so far, to suggest Allmann's influence on Thomas Hincks but they were life-long friends and it is significant that Hincks produced his first paper on Zoophytes in 1851, ten years after Allman began to study them.

Early Unitarians came to science with enthusiasm. Following the teachings and philosophy of Joseph Priestley, science became of fundamental importance to many Unitarians and several became leaders of a provincial or local science culture, especially in northern England. Highly educated Unitarian ministers, well informed about science, were active in local scientific societies. Natural Science was part of a philosophy whose progress was, 'central evidence of the unfolding of divine purpose' and 'The nature of God's creation was evident through science' (Raymond & Pickstone 1986). Thomas's father William, raised in the old Priestleyan tradition, believed that 'if the facts were correctly observed and the generalisations carefully done, Science could not possibly be in opposition to Revelation' (note 15). Some ministers preached about it, others dabbled in it and some, like William and Thomas Hincks, became authorities in their own fields. There were however schisms in the first half of the nineteenth century which divided the church into an 'old' and a 'new' Unitarianism which led some clergy away from the full time ministry.

When Thomas Hincks received his Fellowship of the Royal Society in 1872, his citation recorded that he was 'Distinguisted for his aquaintance with Natural History' (note 16). He was supported by amongst others Charles Darwin, Thomas Henry Huxley and William Benjamin Carpenter. Carpenter (1813-1885), like Hincks, came from an important family of Unitarians and scientists and members of both dynasties included clergymen naturalists. William Benjamin Carpenter's work centered on physiology, marine studies and zoology and amongst his best known books is one on microscopy.

Hincks died on the 25th January 1899 at his home, Stokeleigh, Leigh Woods, Bristol in his 81st year. In an obituary, Harmer (1899a) referred to Hincks' principal publications on systematic zoology which 'may be of very doubtful benefit in unskilful hands; but of Mr. Hincks' work it can only be said that he enlightened all that he touched'. Miall (1900), a friend and colleague at Leeds (Baker & Bayliss 1983), described him as an 'unselfish, generous and disinterested friend with nothing of the selfishness of the baser sort of collectors'. Of Hincks' two major works in marine zoology, Miall wrote that they 'incorporate the best systematic knowledge of the age with respect to these large and difficult groups'.

Although he is now largely forgotten in Leeds, Thomas Hincks' books remain in the Leeds Libraries, some of his collected material is in the Leeds City Museum collections (note 17), his deeds are recorded in the history of the Leeds Philosophical and Literary Society and his name is on the roll of past ministers at the Mill Hill Chapel. He was without doubt a clergyman naturalist of the first order and amongst the foremost zoologists of his generation.

ACKNOWLEDGEMENTS.
My thanks for help in the preparation of this article go to Jennifer Coggon, Gina Douglas, Sam Hallett, Andrew Hill, Elizabeth Jeffery, Linda Noble, Margaret Sarosi and John Thackray.

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Notes.

For other biographical information and publications of Thomas Hincks see – *Science* (1899) **9:** 268 and *Proceedings of the Royal Society*: (1905) **75:** 39-40. An incomplete but useful list of the publications of Thomas and William Hincks can be found in the *Royal Society Catalogue of Scientific Papers* (1800-1863) **3** and (1884-1900) **15** compiled by the Royal Society of London. Scarecrow Reprint Corporation, New Jersey 1968. A catalogue of the library of Thomas Hincks is held at the Marine Biological Laboratory, Plymouth. The library was purchased from his wife in May 1899 and the books and papers were added to the MBA library.

1. The Royal Cork Institution, founded in Cork in 1803 was the first and only provincial scientific society in early ninteenth century Ireland. In addition to other subjects, staff conducted public lecture courses in natural philosophy. The Institution had a science library, a collection of minerals and biological specimens, a botanic garden and a collection of scientific apparatus.
2. For details on Charles Wellbeloved (1769-1858) see *Dictionary of National Biography* (1965) **20**: 1076-1078. He became minister at St. Saviourgate Chapel in York in 1801 and Principal of the College two years later.
3. The President's Address to the Canadian Institute in *The Canadian Journal*, New Series (1869) **68**: 102.
4. For details of this college see John Seed (1982).
5. At York, there was a complaint about his teaching in mathematics and in Canada, a former student referred to his teaching in natural history – 'his methods of teaching left much to be desired' and his ideas were thought to be 'antiquated' (see Zeller, 1987).
6. The President's Address to the Canadian Institute in *The Canadian Journal*, New Series (1870) **71**: 357.
7. Obituary notice in the *Proceedings of the Linnean Society of London*, 1871-1872: lxv-lxviii.
8. Letter from T. Hincks to H. T. Stainton dated August 6th 1872. The Stainton letters are in the Entomology Library at the Natural History Museum, London.
9. Letter from T. Hincks to A. M. Norman dated March 27th 1869. Letter no. 645 in the Alder and Norman correspondence at The Natural History Museum, London.
10. Hincks' lecture was reported in the *Bradford Review*, 9th December 1865, page 4.
11. Letter from T. Hincks, date not clear but 1875/6. Letter no. 650 in the Alder and Norman correspondence at The Natural History Museum, London.
12. Information provided by John Thackray, Archivist at the Natural History Museum, London. They include 3 letters to H. T. Stainton and 19 to J. Alder and/or A. M. Norman.
13. Letter held in the Zoology Museum, School of Biology, University of Leeds.
14. Quoted by Miall (1900) from a statement by Elizabeth Hincks, the wife of Thomas Hincks.
15. Quoted by Webb (1990): 130-131. The original is from *William Hincks, Illustrations of Unitarian Christianity*, London, 1845.

16. The citation for Thomas Hincks from *The Royal Society's Printed List of Candidates*, 1872, Royal Society, London.
17. These collections include Carboniferous fossils from Llandudno, North Wales (ident. 11357), and hydroids and land shells from Britain (lit. reference only ident. 0164 YH). The Leeds City Museum also contains plant material, fossils and minerals attributed to William Hincks (see Hartley *et al.*, 1987).

ALIEN GRASSHOPPERS ACRIDIDAE IN YORKSHIRE

MARTIN LIMBERT
Museum & Art Gallery, Chequer Road, Doncaster, DN1 2AE

In Britain, casual introductions of alien orthopteroid insects have mainly involved the Tettigonioidea – especially pseudophylline bush-crickets – and cockroaches Blattodea. Specimens of imported Acrididae are far less frequent, although locusts Cyrtacanthacridinae/Oedipodinae – also noted as true migrants – are often reared, and may escape or be released. Of the non-migratory grasshoppers, the most regularly imported is the Egyptian Grasshopper *Anacridium aegyptium* (L.). The first British record of this species was obtained from Yorkshire, where one was captured in Huddersfield during September 1891, from a box of oranges (Briggs 1896; Burr 1897). This species has continued to be introduced with foodstuffs and other goods from Mediterranean countries (Ragge 1965; Marshall & Haes 1988), including additional Yorkshire examples. The most recent of these latter was given alive to me in January 1995, having been found in furniture imported to Doncaster from Italy. It is a female, which accords with Ragge's (1965) assertion that most of the specimens that arrive here are females. The Egyptian Grasshopper is a relatively large and imposing insect, the Doncaster individual measuring 55mm from the vertex to the tip of the folded wing.

A second adventive grasshopper in Yorkshire is *Aiolopus strepens* (Latr.). A female was captured in Doncaster in 1991 (further details unavailable), which appears to be the first record for the county. It is principally a species of the Mediterranean and western Asia (Harz 1957). It is not listed by Marshall and Haes (1988), and the only record known to the Orthoptera Recording Scheme for Great Britain and Ireland is of a female found in Cheltenham in May 1991. There is evidence to suggest that this particular specimen had been accidentally transported with camping equipment from southern France. Notwithstanding this, the coincidence of year with the Doncaster example is intriguing.

Both Yorkshire specimens have been donated to Doncaster Museum, and placed in the collection there.

ACKNOWLEDGEMENT
I am grateful to J. P. Widgery, organiser of the Orthoptera Recording Scheme, for confirming my identification of the *Aiolopus*, and for checking the Scheme's database for any records of it.

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BOOK REVIEWS

Magical Mushrooms, Mischievous Molds by **George W. Hudler**. Pp. xvi +248 (incl. b/w illus.), 8pp. colour plates. Princeton University Press, 1998.

This book covers similar material to that in previous semi-popular books such as *Mushrooms and Toadstools* (J. Ramsbottom), *Molds and Man* (C. Christensen) and *The Advance of the Fungi* (E. C. Large). The later chapters in *The Fifth Kingdom* by B. Kendrick also provide an excellent account of applied mycology. This new title does not match any of these in readability or quality of the information provided, but it is more readily available than the first three books mentioned and does contain a good bibliography to semi-popular books on fungi and lichens. The book also has an eye-catching cover!

The prose style of *Magical Mushrooms, Mischievous Molds* is frequently conversational, e.g. "I know, I already said this once"; "before we leave the issue of molds"; "First you must have the right equipment". As a reader, I find this rather tiresome. Statements are often overblown: "As chestnut blight raced across North America, another catastrophic tree disease raised its ugly head as a killer of elms in war-torn Holland". The text illustrations are rather few with 16, in colour, in the centre of the book. The legend for two of these plates, 3a and 3b are transposed. There are also misconceptions: for example, Robert Hooke did not live in the 19th century, but was a contemporary of Antoni (not Antony) van Leeuwenhoek. Neither Hooke or others improved on the Leeuwenhoek microscope which was a single lens device. It was Hooke's microscope with its two lens arrangement that provided the basic design for later development. The book contains very little about lichens, though two of the plates illustrate these plants. The space taken up by the epilogue, which adds little, could have been better allocated to a more comprehensive treatment of lichens.

In summary, semi-popular books on natural history are always to be welcomed. In spite of its shortcomings, this book will enhance interest in fungi among students and amateurs, and should also find a place on the shelf of professional mycologists if only to be loaned annually as a means of fending off seasonal enquiries about edible and poisonous mushrooms, the subject of one of the book's 14 chapters.

DHSR

Plant Crib 1998 by **T. C. G. Rich** and **A. C. Jermy**, with the assistance of **J. L. Carey**. Pp. vii + 391, with numerous line drawings and tables. Botanical Society of the British Isles. 1998. £20.50 paperback.

Plant Crib 1998 was produced specifically for the purpose of enabling recorders to distinguish between similar species and subspecies for the B.S.B.I.'s *Atlas 2000* project. It updates and extends the information supplied in its two predecessors: *Guide to the Identification of some Difficult Plant Groups* by M. J. Wigginton and G. G. Graham and *Plant Crib* by T. C. G. Rich and M. D. B. Rich and it is meant to be used alongside the Stace "Bible" and the B.S.B.I. handbooks.

As well as keys and descriptions of easily confused plant species, there are tables and invaluable line drawings illustrating the diagnostic characters. The book has convinced me that, for example, my putative *Agrimonia procera* was indeed that species and not the more common agrimony, *A. eupatoria*; and that, on the other hand, my putative *Dryopteris oreades* was actually a small male fern, *D. filix-mas*. Guidance is given on what characters to look for in the critical genera *Hieracium* and *Taraxacum*; there is a revised key for *Rosa* and a key to the sections of *Rubus*.

Any amateur or professional botanist or ecologist who wishes to identify flowering plants and ferns accurately will find this work immensely helpful.

PPA

A COMPARISON OF SAPROXYLIC BEETLE ASSEMBLAGES OCCURRING UNDER TWO DIFFERENT MANAGEMENT REGIMES IN SHERWOOD FOREST

Derek Lott
Leicestershire Museums Service, County Hall Glenfield, Leicester LE3 OTB

Introduction

Sherwood Forest in Nottinghamshire is of international importance for saproxylic invertebrates which are mainly found on veteran oaks and, to a lesser extent, mature birch. Saproxylic species are those associated with the decay of wood. The Birklands and Bilhaugh SSSI contains about 1,600 ancient oaks and is designated, in part, to protect this interest. Forest Enterprise manage approximately 100ha of woodland adjacent to the SSSI. This contains around 500 veteran oaks in a matrix of commercial conifer plantation established since 1935. The Birklands Oakwood Project (BOP) aims to restore this area to native oak woodland with a structure and composition similar to the Sherwood Forest remnant within the SSSI. Accordingly, a management plan has been implemented which includes the thinning of conifers to create glades of between 10 and 25 metres around each veteran tree.

Two indices based on saproxylic beetle assemblages have been developed for site assessment in Britain. Harding and Rose (1986) allocated saproxylic beetles to three lists according to their strength of association with lowland ancient woodland and parkland sites with a continuity of deadwood habitats. These three lists have been used to assign habitat quality indicator scores to individual species (Harding & Alexander 1994). Their Index of Ecological Continuity (IEC) can be calculated by summing the individual species scores recorded at a site and has been used to rank sites of importance for saproxylic beetles in lowland Britain.

A Saproxylic Quality Index (SQI) was devised by Fowles (1997) who used national conservation status as designated by Hyman (1992, 1994) instead of ancient woodland indicator status to allocate species scores. Fowles also calculated his site index by averaging species scores instead of summing them in order to remove a dependency of the index on sampling effort. Eyre (1998) has criticised the use of national conservation status because of the inadequacy of the data on which it is based. Current work includes the development of a list of saproxylic beetles to be used in site evaluation together with a review of their national conservation statuses (Fowles *in litt.*).

Nearly all work on saproxylic assemblages in Britain has concentrated on site evaluation of conservation interest, although it could be argued that this can be achieved quite comfortably on the simple presence or absence of rare or threatened species. In order to manage sites effectively for conservation, a preliminary analysis of species assemblages in terms of habitat requirements is needed. Unfortunately, there has been very little work on the ecology of saproxylic assemblages and what little is published refers mainly to Scandinavian coniferous forest (e.g. Vaisanen *et al.* 1993, Siitonen 1994, Okland *et al.* 1996). Consequently, there is a need to explore ways of describing saproxylic assemblages in order to inform management strategies.

Methods

A survey area was selected and divided into four compartments. Two compartments, labelled A and B are in the plantation area covered by the Birklands Oakwood Project. Compartments C and D are in the part of the SSSI managed as a country park by Nottinghamshire County Council. Most of the oaks in compartments A and B are veterans and almost half of them have died presumably as a result of overtopping by conifers. The conifers in compartment A were thinned in the year previous to the survey, but those in compartment B were thinned in June during the survey. Compartment A had a dense ground cover of bracken and bramble during the period of survey. The oaks in the SSSI compartments have a much more even age structure. Compartment C is relatively densely wooded, while compartment D is more open and has the highest density of birches of all compartments in the survey area.

The sites were visited on five occasions in 1998 (29th April 1st June, 23rd June, 4th July and 12th August). These dates were chosen to co-incide with good weather and the periods of emergence of the bulk of deadwood species which are significant for conservation. Five sampling methods were employed as follows:

1. beating dead branches and foliage using a beating tray,
2. sieving fungal fruiting bodies onto a sheet,
3. sieving of grass traps made from mouldy grass cuttings usually wrapped around lamb bones and placed in tree cavities These traps are effective for catching species associated with hole-nesting birds and tree-nesting ants.
4. extraction from under the loose bark of dead trunks and branches,
5. extraction from samples of rotten wood using a Tullgren Funnel.

All adult beetles with habitats associated with dead wood were identified down to species. In addition, larvae of the families Elateridae (click beetles) and Dermestidae were also identified to species where possible. Species were assigned to an ecological sub-assemblage related to the microhabitat that each employs for larval development, as advised by personal experience and information in Koch (1989-1992) and other literature sources. These sub-assemblages are listed in Table 1.

TABLE 1

Classification of ecological sub-assemblage according to microhabitat.

Physical resource employed for larval development	Sub-assemblage symbol
bark	B
fungal fruiting bodies	F
rotting heartwood and tree hollows in trunks and large boughs	H
other types of dead wood in branches and stumps	W

A series of assemblage indices were calculated for each compartment and these are described in Tables 2 and 3.

RESULTS

100 broad-leaf associated saproxylic beetle species were recorded plus *Cryptocephalus querceti* which is probably a phytophagous species whose association with ancient trees has led to its use in the calculation of the Index of Ecological Continuity. These species are listed in the appendix. They include eight provisional red data book species and 23 nationally scarce species. Two further saproxylic species, *Cryptophagus angustus* and *Salpingus castaneus* were also found, but because they are normally associated with conifers, they are not included in the analysis.

According to a manuscript list of Sherwood beetles compiled by Sheila Wright (1998 unpublished), six of the species found in the survey had not previously been recorded from Sherwood Forest. Of these, three (*Microscydmus nanus*, *Pyrochroa coccinea* and *Abdera quadrifasciata*) were found in the SSSI area, one (*Cryptophagus angustus*) was found in the plantation area and one (*Atomaria morio*) was found in both areas. Furthermore, this survey produced the first modern Sherwood records for six species: *Neuraphes plicicollis*, *Agrilus laticornis*, *Cryptarcha strigata* and *Conopalpus testaceus* from the SSSI area and *Malthinus frontalis* and *Anaspis septentrionalis* (= *A. schilskyana* Csiki – see Levey 1996) from the plantation area.

TABLE 2
Derivation of indices calculated for each compartment.

Index	Abbreviation	Description
Species richness	S	total number of saproxylic species recorded
Index of Ecological Continuity	IEC	sum of individual species scores based on association with ancient woodland sites
Saproxylic Quality Index	SQI	mean individual species score based on national conservation status (see table 3)
Heartrot species richness	S(H)	number of species associated with rotting heartwood or tree hollows in trunks, boles and large branches
Wood decay species richness	S(W)	number of species associated with the decay of sapwood, boughs and stumps
Bark species richness	S(B)	number of subcortical species
Fungess species richness	S(F)	number of species associated with fungal fruiting bodies
Heartrot Quality Index	SQI(H)	SQI calculated for species associated with rotting heartwood or tree hollows in trunks, boles and large branches
Wood decay Quality Index	SQI(W)	SQI calculated for species associated with the decay of sapwood, boughs and stumps
Bark Quality Index	SQI(B)	SQI calculated for subcortical species

TABLE 3
Derivation of species scores used to calculate Saproxylic Quality Index (SQI).
(following Fowles 1997)

National conservation status	Abbreviations	Species score
Red Data Book species (lists 3 & I)	R3, RI	24
Red Data Book speces (list K); nationally scarce (grade a)	RK, Na	16
nationally scarce (grade b & ungraded)	Nb, N–	8
local	L	2
common/naturalised	C	1

The values of the various species assemblage indices are given in Table 4. The most significant difference between the SSSI and plantation areas was found to be in species richness which was higher in the SSSI areas. This difference was mainly due to the higher number of subcortical species and, to a lesser extent, general dead-wood species in the SSSI.

No marked differences between the two areas are apparent for the conservation indices, IEC and SQI. The dependence of IEC on sampling effort is illustrated by a total IEC which is much higher than the IECs of individual compartments. The total SQI is also higher than those of individual compartments, but this would be expected, if species of high conservation interest were more locally distributed within the site than more common species. In other words, species which are rare on a large scale also tend to be rare at a smaller scale.

The SQI based on heartrot species is much higher than SQIs based on species in other ecological categories, illustrating the conservation value of many heartrot species which are dependent on mature trees for the completion of their life cycle. SQI(H) was higher in the two plantation compartments, while SQI(W) was higher in the SSSI compartments.

TABLE 4
Values of species assemblage indices (see table 2 for definations of indices).

Index	Compartment: BOP plantation A	BOP plantation B	SSSI (Notts C.C.) C	SSSI (Notts C.C.) D	Total Survey area
S	37	37	56	53	100
IEC	14	13	20	11	42
SQI	378	432	389	374	474
S(H)	7	10	9	16	24
S(W)	15	13	16	16	30
S(B)	11	11	23	17	33
S(F)	4	7	7	4	12
SQI(H)	757	660	478	588	783
SQI(W)	320	362	419	413	450
SQI(B)	255	264	335	188	321

Discussion

All areas have similar values for SQI. The plantation area appears already to have a conservation value equivalent to that of the SSSI. Although a lower species richness was recorded in the plantation area, species diversity ih saproxylic beetle assemblages has sometimes been found to be a poor indicator of conservation value (Vaisanen *et al.* 1993). The observed difference in species richness could be due to a greater range of microhabitats linked to the more even age structure of the trees in the SSSI area. Alternatively, the lower density of fallen branches in the plantation area, may have reduced sampling efficiency, especially for subcortical species.

The finding that SQI was higher for the whole area than each individual compartment has important implications for its proposed use in ranking sites (Fowles 1997). A false ranking will be achieved unless the whole site is surveyed. SQI values depend on where boundaries are drawn and if there is no true boundary between sites and the surrounding countryside, a meaningful numerical evaluation may be impossible.

Total species richness was found to be the most sensitive management indicator in the present survey, according to the observed differences in species assemblage indices between the SSSI and the plantation. Similarly, Okland *et al.* (1996) found in Norwegian secondary spruce forest that species richness both of all saproxylic beetles and of ecological sub-assemblages was significantly correlated with environmental gradients at scales of 1 sq. km. and 4 sq. km. However, species richness can only be used for comparing sites which have received equal sampling effort. Its sensitivity to sampling effort (Southwood 1966), weather conditions and competence of the surveyor makes it impractical for general use.

The poor state of knowledge of habitats and life histories of many saproxylic species makes it difficult to assign them to ecological sub-assemblages with any confidence. Much of the information published in reviews such as Koch (1989-1992) and Hyman (1992, 1994)is unsourced and published details of observations on larval habitats (e.g. Mendel & Owen 1990) are rare. The association of *Aderus oculatus* with rotting heartwood, for example, is based on speculation (Buck 1954, Allen 1969). Further research may necessitate a reclassification of individual species, but is unlikely to materially affect the relative values of sub-assemblage indices.

Use of the SQIs of ecological sub-assemblages has potential for understanding how management operations can affect conservation value. Unfortunately, they are based on small species lists and probably lack robustness. This makes them vulnerable to poor sampling efficiency. A larger data set is required to test their utility. Nevertheless, a comparison of SQI(H) suggests that high conservation value heartrot species appear to have survived well in the plantation area, as would be expected from the high density of relict ancient trees on which they depend.

The short term benefits of the current BOP management programme will probably be expressed in a higher quality assemblage of species associated with the bark and dead wood of attached branches in the crown. At present, a comparison of SQI(W) suggests that this sub-assemblage may be of lower conservation quality in the BOP area than the SSSI area. These species may benefit from the removal of shade caused by overtopping conifers and consequent higher temperatures for development in the crown. Heartrot species which live in an environment of relatively constant temperature and humidity inside the boles and trunks of ancient trees are less likely to benefit from reduced shade, unless they require higher temperatures to disperse. The benefits for this sub-assemblage will be longer term and arise from the increased longevity of ancient oaks rescued from competition with conifers.

ACKNOWLEDGEMENTS
The survey was commissioned by Forest Enterprise. I am grateful to Nottinghamshire County Council for access to the country park, to Paul Barwick for information about the site and its management and to Sheila Wright for providing details about records of nationally scarce beetles at Sherwood Forest.

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APPENDIX – list of species recorded in 1998 survey (see tables 1 and 3 for explanation of symbols).

Species	National conservation status	Presumed larval habitat	A	B	C	D
Carabidae						
Dromius agilis (Fab.)	L	B			1	1
Dromius quadrimaculatus (L.)	C	B	1		1	1
Dromius quadrinotatus (Zenker)	C	B	1		1	1
Histeridae						
Plegaderus dissectus Er.	Nb	H		1		1
Gnathoncus nannetensis (Marseul)	L	H		1		1
Ptiliidae						
Ptinella aptera (Guer.)	L	H		1		1
Ptinella errabunda Johnson	C	H		1	1	1
Pteryx suturalis (Heer)	L	H			1	1
Leiodidae						
Anisotoma humeralis (Fab.)	L	F			1	
Scydmaenidae						
Neuraphes plicicollis Reitt.	N–	H				1
Microscydmus minimus (Chaud.)	R3	H		1		
Microscydmus nanus (Schaum)	N–	H				1
Scaphidiidae						
Scaphisoma agaricinum (L.)	L	H			1	
Staphylinidae						
Hapalaraea pygmaea (Payk.)	L	H		1		
Phloeonomus punctipennis Thoms.	L	B			1	1
Coryphium angusticolle Steph.	L	B	1			
Phloeocharis subtillissima Mann.	L	B		1	1	
Atrecus affinis (Payk.)	C	W			1	
Gabrius splendidulus (Grav.)	C	B	1		1	1
Quedius xanthopus Er.	Nb	H	1			1
Sepedophilus marshami (Steph.)	C	W	1			
Placusa pumilio (Grav.)	L	B				1
Anomognathus cuspidatus (Er.)	C	B			1	
Leptusa fumida Kr.	C	B	1		1	1
Bolitochara obliqua Er.	C	F			1	
Dinaraea linearis (Grav.)	L	B			1	
Phloeopora corticalis (Grav.)	N–	B		1	1	1
Phloeopora testacea (Mann.)	C	B		1		
Oxypoda recondita Kr.	N–	H				1
Pselaphidae						
Euplectus nanus (Reich.)	RI	H				1
Euplectus piceus Mots.	C	H			1	1
Euplectus punctatus Muls.	R3	H			1	
Batrisodes venustus (Reich.)	Na	H	1			
Buprestidae						
Agrilus laticornis (Ill.)	Nb	B			1	
Elateridae						
Ampedus balteatus (L.)	L	H	1	1	1	1

Melanotus villosus (Four.)	C	H	1	1	1	1
Stenagostus rhombeus (Ol.)	L	B			1	1
Denticollis linearis (L.)	C	B			1	
Cantharidae						
Malthinus flaveolus (Hbst)	C	W	1			
Malthinus frontalis (Marsh.)	Nb	W	1			
Malthinus seriepunctatus Kies.	L	W			1	1
Malthodes fuscus (Waltl)	L	W		1		1
Dermestidae						
Megatoma undata (L.)	Nb	B	1	1		
Ctesias serra (Fab.)	Nb	B	1			
Anobiidae						
Hemicoelus fulvicornis (Sturm)	C	W	1	1		
Dorcatoma chrysomelina Sturm	L	H			1	
Ptinidae						
Ptinus fur (L.)	C	H				1
Cleridae						
Thanasimus formicarius (L.)	L	B	1	1		
Melyridae						
Dasytes aeratus Steph.	L	W			1	1
Nitidulidae						
Soronia grisea (L.)	L	B			1	
Cryptarcha strigata (Fab.)	Nb	?			1	
Glischrochilus hortensis (Four.)	C	B				1
Rhizophagidae						
Rhizophagus bipustulatus (Fab.)	C	B		1		1
Rhizophagus dispar (Payk.)	C	B		1	1	1
Cryptophagidae						
Henoticus serratus (Gyll.)	L	W	1	1	1	
Cryptophagus dentatus (Hbst)	C	F			1	1
Atomaria morio Kol.	RK	H		1		1
Cerylonidae						
Cerylon ferrugineum Steph.	L	B			1	1
Cerylon histeroides (Fab.)	L	B			1	1
Latridiidae						
Aridius nodifer (Westw.)	C	F	1			1
Enicmus rugosus (Hbst)	N–	F		1	1	
Enicmus testaceus (Steph.)	L	F		1		
Dienerella elongata (Curtis)	C	F	1			
Corticaria longicollis (Zett.)	RK	H	1			
Corticaria serrata (Payk.)	L	H	1			1
Cisidae						
Cis alni Gyll.	L	F				1
Cis bilamellatus Wood	C	F	1		1	
Cis festivus (Panz.)	Nb	W		1	1	1
Cis nitidus (Fab.)	L	F			1	1
Cis vestitus Mellie	L	W	1	1	1	1
Colydiidae						
Bitoma crenata (Fab.)	L	B				1

Tenebrionidae						
Eledona agricola (Hbst)	Nb	F	1	1		
Corticeus unicolor Pill. & Mitt.	R3	B			1	
Cylindronotus laevioctostriatus (Goeze)	C	W	1	1	1	1
Mycetochara humeralis (Fab.)	Nb	W			1	1
Salpingidae						
Vincenzellus ruficollis (Panz.)	L	B			1	
Rhinosimus planirostris (Fab.)	C	B	1	1	1	1
Rhinosimus ruficollis (L.)	C	B	1	1	1	
Pyrochroidae						
Pyrochroa coccinea (L.)	Nb	B			1	
Melandryidae						
Abdera quadrifasciata (Curtis)	Nb	W			1	1
Conopalpus testaceus (Ol.)	Nb	W			1	1
Scraptiidae						
Anaspis frontalis (L.)	C	W	1		1	1
Anaspis humeralis (Fab.)	C	W				1
Anaspis maculata Four.	C	W	1	1		1
Anaspis regimbarti Schilsky	C	W		1	1	1
Anaspis rufilabris (Gyll.)	C	W	1	1	1	1
Anaspis septentrionalis Champion	R1	W		1		
Aderidae						
Aderus oculatus (Payk.)	Nb	H?	1	1	1	
Cerambycidae						
Rhagium bifasciatum Fab.	C	W		1		
Strangalia maculata (Poda)	C	W	1			
Phymatodes testaceus (L.)	L	W			1	
Clytus arietis (L.)	C	W		1		
Leiopus nebulosus (L.)	L	W	1	1	1 1	
Saperda scalaris (L.)	Na	W	1			
Chrysomelidae						
Cryptocephalus querceti Suffr.	R2	?	1			
Curculionidae						
Magdalis cerasi (L.)	Nb	W	1			
Phloeophagus lignarius (Marsh.)	L	W			1	1
Trachodes hispidus (L.)	Nb	F			1	
Scolytidae						
Scolytus intricatus (Ratz.)	L	B	1	1	1	1
Xyloterus domesticus (L.)	L	W	1			
Dryocoetinus villosus (Fab.)	L	B		1		

THE ACULEATE WASPS AND BEES (HYMENOPTERA: ACULEATA) OF HOLMEHOUSE WOOD, NEAR KEIGHLEY, IN WATSONIAN YORKSHIRE, INCLUDING A JACKKNIFE STATISTICAL PROCEDURE FOR ESTIMATING SPECIES RICHNESS

Michael E. Archer

Holmehouse Wood, near Keighley, is a very good locality for aculeate wasps and bees, having 83 recorded species, four species of possible national importance and eight of regional importance. The area, about 15 hectares, is situated to the west of Keighley, West Yorkshire (VC 63, SE0340). The locality is a mixed deciduous valley woodland on a clay soil around the North Beck stream. The wood is mainly oak and birch with some elm and sycamore. Open grassy areas are rich in shrubs, e.g. bramble and broom, and herbs, e.g. dandelion and lesser celandine, which provide important food sources for the aculeates. The nesting areas of the aculeates are in the open sunny parts of the wood. The subterranean nesters mainly nest in bare ground or ground with a short vegetation cover, often on slopes. The aerial nesters use upright and horizontal dead wood and dead plant stems such as bramble.

Holmehouse Wood was recorded extensively from the 1910s until about the middle of the 20th century. The main collector was J. Wood whose undetermined specimens were found at Manchester University, Keighley and Leeds Museums (Wood sample). I am grateful to the curators of these museums, C. Johnson, M. Hartley and A. Norris, for permitting access to the Wood specimens. Between 1918 and 1951 I have been able to establish that Wood made 189 collecting visits to Holmehouse Wood, distributed throughout the year as follows: March (1 visit), April (9), May (53), June (46), July (33), August (27), September (17) and October (3).

Between 1988 and 1996, I made 15 visits distributed throughout the year as follows: April (1 visit), May (3), June (3), July (3), August (4) and September (1). One of the visits during August was unsuitable for recording aculeate wasps and bees because of poor weather conditions. During these approximately three-hour visits all species of aculeate wasps and bees were recorded (Archer sample) and usually collected with a hand-net for identification.

A comparison will be made between the Archer and Wood samples although the activities of these two recorders were not exactly the same, Archer being a specialist recorder of aculeate wasps and bees, whilst Wood was a generalist collector of many groups of free-living insects.

A few records were also found of R. Butterfield (collecting from 1916 until 1919) and an unknown collector (1918 until 1928). In addition I am grateful to J. Burn who found the dryinid *Anteon scapulare* taken at Holmehouse Wood at Manchester University museum.

In the following account, biological names are according to Kloet and Hincks (1978).

Species Present

A full list of the species recorded with their collectors is given in the Appendix. At the family level, Table 1 shows 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 families, Pompilidae and Sphecidae, and the solitary bee families, Andrenidae, Halictidae and Anthophoridae, are the dominant families either in terms of the number of species and/or number of records.

The recorded number of species from Holmehouse Wood is of a magnitude expected from its area in terms of species-area relationship for northern and north midlands of England (Archer 1995). Because the number of species is so related to the area of the

TABLE 1
The number of species and records of aculeate wasps and bees from Holmehouse Wood in the Archer and Wood samples and from all records.

	Archer		Wood		All	
	No. spp.	No. records	No. spp.	No. records	No. spp.	No. records
Solitary Wasps						
Dryinidae	0	0	0	0	1	1
Chrysididae	0	0	1	1	2	2
Pompilidae	3	19	4	40	5	60
Eumenidae	2	5	3	8	4	13
Sphecidae	10	27	13	35	18	63
Total	15	51	21	84	30	139
Solitary Bees						
Colletidae	1	8	0	0	1	8
Andrenidae	12	52	11	111	15	165
Halictidae	9	61	12	91	12	165
Megachilidae	1	1	0	0	1	1
Anthrophoridae	9	44	8	121	10	170
Total	32	166	31	323	39	509
Total Solitary Wasps & Bees	47	217	52	407	69	647
Social Wasps					5	
Social Bees					9	
Total Social Species					14	

locality, two further comments can be made. Firstly, the community characteristics of the species of aculeate wasps and bees of Holmehouse Wood can be compared with other northern and north midland localities of England. Secondly, species richness, or the number of species, of the clay locality of Holmehouse Wood is similar to the species richness of sandy localities. Traditionally, sandy localities have been considered to have a higher species richness than non-sandy localities.

Seasonal Progression of Species

June, July and August were the best months for recording species of solitary wasps with June and July the most productive months for new species (Table 2). The species most evident were the pompilids, *Priocnemis schioedtei* and *Arachnospila anceps*, and the sphecid, *Crossocerus pusillus*. These species are all subterranean nesters with the pompilids hunting spider prey and the sphecid small fly prey. The pompilids were particularly noticeable at the east end of the wood, flying rapidly over bare earth and short grass surfaces.

April until August were the best months for recording species of solitary bees with April the most productive month for new species (Table 2). The species most evident were the subterranean nesters with their cleptoparasites: *Andrena cineraria* with *Nomada lathburiana*, *A. haemmorrhoa* with *N. ruficornis*, *A. scotica* with *N. marshamella*, *A. saundersella* with *N. flavoguttata*, *Halictus rubicundus* with *Sphecodes monilicornis* or *S. gibbus* and *Lasioglossum calceatum* with *S. monilicornis*. The colonial nesting *A. cineraria* was particularly noticeable.

TABLE 2
The number of species and new species of solitary wasps and bees recorded per month at Holmehouse Wood.

	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
No. species								
Solitary Wasps*	0	0	0	15	23	14	4	2
Solitary Bees	1	22	26	27	23	16	9	1
No. new species								
Solitary Wasps	0	0	0	15	11	2	0	0
Solitary Bees	1	21	6	8	2	0	1	0

*No data available for *Anteon scapulare* and *Arachnospila spissa.*

Figure 1 shows the number of new species found each month. The spring fauna appearing mainly in April is clearly separated from the summer fauna appearing in June and July.

ARCHER-WOOD COMPARISON

Wood made nearly twice the number of records of solitary species than Archer (Table 1), but Archer, on average, made more records per visit (14.5 records) than Wood (2.2 records). Wood recorded more species of solitary wasps than Archer (Table 1) although only nine species (33%) were common to both samples. Archer and Wood recorded a similar number of species of solitary bees, with 24 species (62%) being common to both samples. Three solitary wasp species were recorded by neither Archer or Wood.

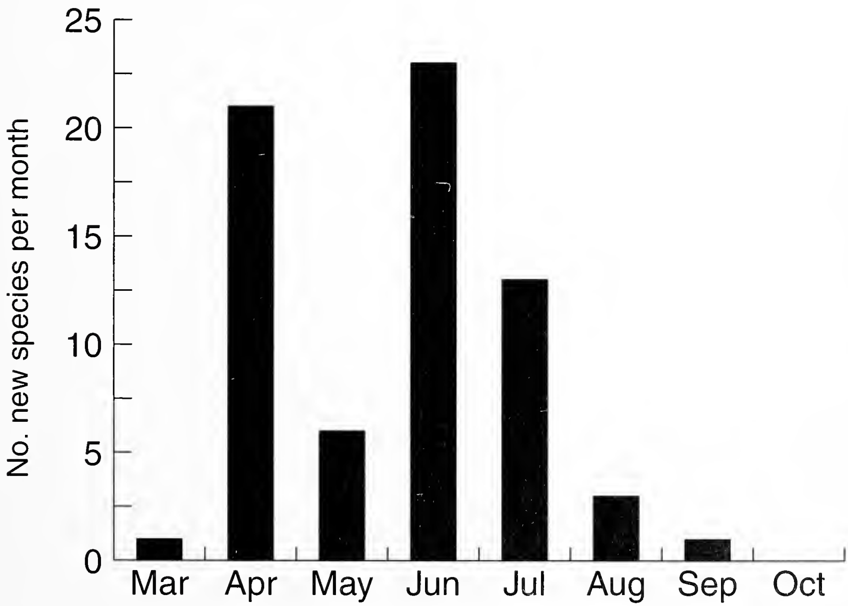

FIGURE 1
The number of new species of solitary wasps and bees recorded per month at Holmehouse wood.

Thirty-three solitary species were recorded by both Archer and Wood, 14 species only by Archer and 19 species only by Wood. These data can be compared by calculating similarity indices. Using the simple Jaccard index (Ludwig & Reynolds 1988), which depends upon the presence or absence of species, gives an index of 50.0%. The Morisita-Horn index, which uses quantitative information on the relative abundance of species, is relatively independent of sample size but gives more importance to the more abundantly occurring species (Magurran. 1988). Abundance was determined from the number of records of each species. The Morisita-Horn index is 75.8% which is higher than the Jaccard index. This indicates that the Archer and Wood samples are more similar to one another in terms of the more abundant species.

Quality Assessment of the Solitary Species

According to Shirt (1987) and Falk (1991), *Nomada lathburiana* is a nationally rare or "Red Data Book" species (RDB3) and is probably on the northern edge of its range in Yorkshire. Three species are nationally scarce (Falk 1991): *Andrena humilis* on the northern edge of its range in Yorkshire and *Priocnemis schioedtei* and *Crossocerus walkeri* which are widely distributed in Britain. Two species, *Crossocerus styrius* and *C. walkeri*, are Yorkshire rarities (Archer 1998a). Six species which have a local distribution in a Yorkshire context (Archer 1994) are indicated in the Appendix.

Current work being carried out by members of the Bees, Wasps and Ants Recording Society indicates that the status of *Priocnemis schioedtei* and *Nomada lathburiana* will need to be down-graded and lose their national status. In a Yorkshire or regional context *P. schioedtei* has a common status and *N. lathburiana* a frequent status (Archer 1993). In a regional context *Andrena humilis* has an occasional status.

By giving each of the 68 species of solitary wasps and bees a regional status (Archer 1993) a regional quality score of 139 and a regional species quality score of 2.0 (139/68) can be calculated (Table 3). Within Watsonian Yorkshire this regional species quality score is between those of Cave Wold (1.7), Swincarr Plantation (2.1) and Skipwith Common (2.2). The dryinid *Anteon scapulare* cannot be included in this analysis as insufficient information is available to give a status.

TABLE 3
The regional status scheme of the 68* species of solitary wasps and bees recorded at Holmehouse Wood.

Status	Status value (A)	No. species (B)	Status Score (A*B)
Common	1	41	41
Frequent	2	19	38
Occasional	4	5	20
Rare	8	1	8
Nationally Scarce	16	2	32

*Status of *Anteon scapulare* unknown.

Using a national status for each species (Archer 1998b) Holmehouse Wood has a national quality score of 101 (Table 4) and a national species quality score of 1.5 (101/68). In these calculations provisionally *Priocnemis schioedtei* is given a universal status and *Nomada lathburiana* a widespread status. Within Watsonian Yorkshire this national species quality score is between those of Cave Wold (1.2), Burton Leonard Lime Quarries (1.6) and Skipwith Common (1.6).

National quality and species quality scores have also been calculated for 14 Archer visits from April until September (Table 5). Table 5 also shows the overall quality and species

TABLE 4
The Archer national status scheme of the 68* species of solitary wasps and bees recorded at Holmehouse Wood.

Status	Status value (A)	No. species (B)	Status Score (A*B)
Universal	1	47	47
Widespread	2	19	38
Restricted	4	0	0
Scarce	8	2	16

*Status of *Anteon scapulare* unknown.

TABLE 5
The national daily quality scores of the solitary wasps and bees of the Archer sample recorded from Holmehouse Wood.

Date	No. spp.	Quality score	Sp. quality score
29 Apr. 1993	20	27	1.35
7 May 1989	10	12	1.20
11 May 1994	17	23	1.35
16 May 1992	17	21	1.24
11 Jun. 1992	25	39	1.56
12 Jun. 1998	9	10	1.11
17 Jun. 1989	14	18	1.29
6 Jul. 1990	12	14	1.67
17 Jul. 1991	9	18	2.00
29 Jul. 1992	12	15	1.25
1 Aug. 1995	10	12	1.20
14 Aug. 1994	8	9	1.13
25 Aug. 1991	6	9	1.50
15 Sep. 1996	9	9	1.00
Overall	47	65	1.38

quality scores of the Archer sample. Quality scores are likely to be greatly influenced by recording effort, but species quality scores should largely correct for variation in recording effort (Ball 1992; Foster 1996). Although recording effort was more-or-less constant for each Archer visit, the percentage variation of daily quality scores (433%) is greater than that for species quality scores (100%). The greater percentage variation of the quality scores is a consequence of the variation in the number of species recorded on each visit (varied from 9-25 species, % variation 278%). Thus species quality scores can correct, like variation in recording effort, for the variation in the number of species recorded.

Can a species quality score from one or two visits to a locality be used to give a relatively good prediction of the overall species quality score for the locality? To attempt to answer this question it is necessary to know the range of species quality scores for localities in Britain. For solitary wasps and bees, species quality scores have been found to vary from 1.2 to 5.5, although lower values down to 1.0 are possible. As such, three visits to Holmehouse Wood would probably be necessary to get a reasonable prediction of its national species quality score. The daily species quality scores (Table 5) fall within the 25% range (1.03-1.73) of the overall species quality score except for those of 17 July and 15 September.

Estimating the Potential Number of Species at Holmehouse Wood

Heltshe and Forrester (1983) described a jackknife statistical procedure to estimate species richness after a number of samples have been taken from a locality. The estimate is based on the observed frequency of species that are only observed on one occasion during sampling (=unique species). Krebs (1999) describes the statistical procedure in detail and Haeseler and Ritzau (1998) demonstrate its use with the aculeate Hymenoptera.

Based on the 14 Archer samples, with their ten unique species, the jackknife estimate of the potential number of species of solitary wasps and bees at Holmehouse Wood is 55 species with 95% confidence limits of 48-63 species.

This jackknife estimate is less than the total number (69) of species of solitary wasps and bees recorded from Holmehouse Wood. This underestimate of species could be a consequence of either the jackknife procedure tending to produce underestimates or suggest that Holmehouse Wood has lost some of the species recorded by Wood and earlier collectors. Heltshe and Forrester (1983) state that the jackknife procedure gives an over-estimate of species richness while Palmer suggest (in Krebs, 1999) a slight underestimate.

To try and resolve this problem the jackknife procedure was performed on data from Shipley Glen (Archer 1996) and Gibraltar Point NNR (Archer 1998c). Like Holmehouse Wood, the records from Shipley Glen were made by early collectors (mainly Wood) and current collectors (mainly Archer), while the records from Gibraltar Point NNR were all made by current collectors during the 1980s and 1990s. It is predicted that if the jackknife estimate of species richness is an underestimate then the estimates for Shipley Glen and Gibraltar Point NNR, based on the Archer samples, will both be lower than the number of species recorded from these localities. However, if there has been a loss of species recorded by the early collectors then the jackknife estimate for Shipley Glen should still be an underestimate, but that for Gibraltar Point NNR should be more-or-less correct.

The jackknife estimate of species richness of solitary wasps and bees for Shipley Glen is 64 species, with 95% confidence limits of 53-75 species, which is an underestimate of the 75 species recorded from Shipley Glen. The jackknife estimate for Gibraltar Point NNR is 88 species, with 95% confidence limits of 75-101 species, which is more-or-less similar to the 86 species recorded from Gibraltar Point NNR.

Thus, it can be cautiously concluded that there has been a loss of species from Holmehouse Wood and Shipley Glen since the time of the early collectors.

Cleptoparasitic Load

The cleptoparasitic load (CL) is the percentage of aculeate species that are cleptoparasitic (or parasitoids) on other host aculeates. The CL for the species of solitary wasps is about one-third of the CL for the species of solitary bees (Table 6). 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, CL for localities in Britain should have similar values.

TABLE 6
The relative frequency of the cleptoparasitic species among the solitary wasps and bees at Holmehouse Wood.

	No. hosts (H)	No. cleptoparasites (C)	Cleptoparasitic load CL = 100*C/(H+C)
Solitary Wasps*	26	3	10.3
Solitary Bees	26	13	33.3

**Anteon scapulare* not parasitic on an aculeate species.

In Watsonian Yorkshire the CL for species of solitary wasps varies from 13.2-20.0 (range 6.8). The CL for Holmehouse Wood is a little lower, so increasing the range to 9.7, probably because of the lack of chrysid species which are parasites on the eumenids.

In Watsonian Yorkshire the CL for species of solitary bees varies from 25.8-36.6 (range 10.8). The CL for Holmehouse Wood falls within this range.

Aerial Nester Frequency

The aerial nester frequency (AF) is the percentage of host aculeate species that have aerial nest sites. Holmehouse Wood is rich in aerial nesters for species of solitary wasps but poor in aerial nesters for species of solitary bees (Table 7).

TABLE 7
The nesting habits of the host species of solitary wasps and bees recorded from Holmehouse Wood.

	No. aerial nesters (A)	No. subterranean nesters (S)	Aerial Nester Frequency AF = 100*A/(A+S)
Solitary Wasps	14	12	53.8
Solitary Bees	2	24	7.7

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APPENDIX

Aculeate wasp and bee species recorded from Holmehouse Wood, near Keighley. *Yorkshire local species. Collectors: A = Archer, B = Butterfield, W = Wood, U = Unknown.

Dryinidae: *Anteon scapulare* (U).

Chrysididae: *Chrysis ignita* (U), *C. ruddii* *(W).

Pompilidae: *Priocnemis parvula* (A,W), *P. schioedtei* (A,W), *Arachnospila anceps* (W), *A. spissa* (B), *Anoplius nigerrimus* (A).

Eumenidae: *Ancistrocerus nigricornis* (W), *A. oviventris* (A,W), *A. parietinus* (A), *A. scoticus* (W).

Vespidae: *Dolichovespula norwegica, D. sylvestris, Paravespula germanica, P. vulgaris, Vespula rufa.*

Sphecidae: *Ectemnius cavifrons* (A), *E. cephalotes* (A), *E. lapidarius* (W), *Rhopalum clavipes* (A,W), *Crossocerus annulipes* (A), *C. dimidiatus* (A,W), *C. elongatulus* (A,W), *C. megacephalus* (W), *C. ovalis* (A), *C. pusillus* (A,W), *C. quadrimaculatus* (W), *C. styrius* (W), *C. tarsatus* (W), *C. walkeri* (W), *C. wesmaeli* (W), *Pemphredon lugubris* (A), *Nysson spinosus* (A,W), *Argogorytes mystaceus* (B,W).

Colletidae: *Colletes succinctus* *(A).

Andrenidae: *Andrena fucata* (A), *A. fulva* (A,W), *A. helvola* (W), *A. lapponica* (A,W), *A. scotica* (A,W), *A. angustior* (A), *A. cineraria* *(A,W), *A. haemorrhoa* (A,W), *A. nigroaenea* (A,B), *A. barbilabris* *(W), *A. chrysosceles* (A,W), *A. humilis* (A), *A. saundersella* (A,W,U), *A. subopaca* (A,W), *A. wilkella* (W).

Halictidae: *Halictus rubicundus* (A,W), *Lasioglossum cupromicans* (B,W), *L. leucopum* (A,B,W), *L. morio* (W), *L. albipes* (A,W), *L. calceatum* (A,W,U), *L. fratellum* (A,W,U), *L. rufitarse* (A,B,W), *Sphecodes geoffrellus* (=*fasciatus*) (A,W), *S. gibbus* (A,W), *S. hyalinatus* (B,W,U), *S. monilicornis* (A,B,W,U).

Megachilidae: *Megachile willughbiella* (A).

Anthophoridae: *Nomada fabriciana* (A,B,W,U), *N. flavoguttata* (A,B,W), *N. goodeniana* (A,B), *N. lathburiana* *(A,W), *N. leucophthalma* *(W), *N. marshamella* (A,W), *N. panzeri* (A,W), *N. ruficornis* (A,W), *N. striata* (A,W,U), *Anthophora furcata* (A).

Apidae: *Bombus hortorum, B. lapidarius, B. lucorum, B. pascuorum, B. pratorum, B. terrestris, Psithyrus bohemicus, P. vestalis, Apis mellifera.*

ENTOMOLOGICAL REPORT: DIPTERA (TIPULOIDEA AND EMPIDOIDEA)

ROY CROSSLEY

INTRODUCTION

An event of major significance for Yorkshire dipterology occurred in July 1996 when members of Dipterists Forum held their annual week-long field meeting in the county, based at Queen Margaret's School, Escrick. This superb co-operative effort has resulted in several thousand records covering many families of diptera, and only recently has it been possible to deal with these for the two Superfamilies covered in this report. A selection of the more significant ones is incorporated in the list which follows. In addition, Mr. J. H. Cole of Huntingdon has kindly sent records of crane-flies (Tipuloidea) amassed from his visits to Yorkshire over a period of about twenty-five years; these have included several additions to the county list and considerably increased our knowledge of the distribution of the Superfamily, especially in the far north-west of Yorkshire.

In 1990 I had an opportunity to revise part of the Diptera collection of Leeds City Museum, during the course of which I came across specimens of *Hilara angustifrons* and *H. primula* collected by C. A. Cheetham, for which there were no cards in the Y.N.U. records. They might have been misplaced in the intervening years, and these important records may, indeed, have been published at the time, but I am taking this opportunity, the first occasion since 1990 when a Diptera report includes records of Empidoidea, to publish them for the benefit of the present generation! I am obliged to Adrian Norris for making it possible for me to examine the collection, and for subsequent information about the specimens.

Chris Cheetham is a legendary figure in the history of the Yorkshire Naturalists' Union and it is a delight to publish his records from so long ago. He appears to have had regular contact with F. W. Edwards, a leading dipterist at the British Museum (Natural History), (now the Natural History Museum), and they had numerous joint collecting forays into the Yorkshire countryside in the 1930s, often, it is said, enjoying camping holidays in the process. Many of Cheetham's tipulid specimens were either identified or confirmed by Edwards. There was also contact with J. E. Collin of Newmarket, and both Cheetham and Dr W. J. Fordham of Barmby Moor referred empidid specimens to him for identification or confirmation. Collin, an amateur of private means, was arguably the most influential British dipterist of this century, with, in addition, a much respected international reputation.

In recent years there have been important revisions by continental authors of the dolichopodid genera *Sciapus* (Meuffels & Grootaert 1990), and *Achalcus* (Pollet 1996). The former has resulted in the true *Sciapus contristans* being correctly recognised in Yorkshire, whilst the latter has enabled two new species of *Achalcus* to be identified, and the identity of a third to be confirmed. In connection with the latter, I am obliged to Martin Limbert of Doncaster Museum and Art Gallery for making it possible for me to examine the specimen concerned.

A major event in dipterology occurred in 1998 with the publication of a new 'Check-List' of British Diptera (Chandler 1998); this magnificent work now supersedes the familiar Kloet and Hincks (1976) list which has served dipterists well for the past twenty years or so. In that time there have been huge developments in dipterology, both in Britain and internationally, and this timely and comprehensive revision will be the standard for many years to come. The revised classification and nomenclature of the new Check-List are followed here.

The 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 press) for Empidoidea.

The individual species reports below would not have been possible without masses of information submitted by fellow dipterists, many of whom are not resident in the county, and thanks are extended to the following colleagues (with apologies for any inadvertent omissions): P. J. Chandler, J. D. Coldwell, J. H. Cole, C. M. Drake, W. A. Ely, A. Godfrey, L. W. Hardwick, K. Merrifield, I. Perry, P. Skidmore, A. E. Stubbs, R. Underwood. Their records, together with those of the author, are indicated with initials following the individual records, as appropriate. New County records are indicated by †, and Vice-County records by *.

TIPULIDAE

**Nephrotoma submaculosa* Edw. (65) Nosterfield (gravel pit), 1/6/98 R.C.; (61) Sewerby Cliffs, Bridlington, 8/7/97 R.C. Apparently scarce in Yorkshire, previous records being Spurn (61) 1950 & 1964; Runswick Bay (62) 1975; Marton Wood and Hades (both 63) 1985.

Tipula (s.g. *Dendrotipula*) *flavolineata* Mg. (63) Clough Wood, Gunthwaite, 22/5/98 J.D.C.; Broadhead Clough, Mytholmroyd, 12/6/98 R.C. There are few records for this species; all of them are from the south and west of the county and the majority are pre-1947.

T. (s.g. *Schummelia*) *yerburyi* Edw. Nb. (63) Little Don Valley, 15/7/98 J.D.C. '1♂ swept around birch in a boggy clearing'. There is only one previous Yorkshire record:- Seckar Wood, Wakefield, 3/7/43 (? C. A. Cheetham).

T. (s.g. Yamatotipula) couckei Tonnoir in Goetg. & Tonnoir (61) Pocklington Canal (SE/78.45.), 27/4/98 R.C. The only previous v.c. 61 record for this apparently localised species is Millington, 1/8/36 C.A.C.

PEDICIIDAE

† *Dicranota* (s.g. *Lucidia*) *lucidipennis* (Edw.) Nb. (62) Raygate Slack, Newtondale, 16/7/98 (1♂), leg. R.C., det. J.H.C.

† *D.* (s.g. *Paradicranota*) *gracilipes* Wahlg. Nb. (65) Coverham, 5/10/85, (leg.?); Cotterdale 22/9/86, J.H.C.; (*62) Hawnby, 2/10/97 leg. R.C., det. A.E.S.

**Tricyphona* (s.g. *Trichyphona* s.s.) *schummeli* Edw. (63) New House Wood, Denby Dale, 1/6/98, J.D.C.; (*62) May Moss, 25/7/98 (1♂ & 1♀) R.C. The only previous Yorkshire record is from 'Pateley' (64), 23/6/24 (F. W. Edwards).

LIMONIIDAE

Molophilus (s.g. *Molophilus* s.s.) *ater* (Mg.) (62) May Moss, 8/6/98 R.C. The only previous record for v.c. 62 for this apparently scarce fly of moorland 'mosses' is 'Ryedale', 21/3/25 (C.A.C.), with no further details.

† *M.* (s.g. *M.* s.s.) *pusillus* Edw. (62) Duncombe Park, 17/7/96 L.W.H., det. A.E.S. (*63) Clough Wood, 1/10/97 and 9/9/98 ('in numbers') J.D.C.

M. (s.g. *M.* s.s.) *variispinus* Starý Nb (62) Mowthorpe Dale, 29/5/98 R.C. Previous records are Forge Valley Woods NNR (62), 1995, and Rowton Beck (65), 1981.

† *Tasiocera* (s.g. *Dasymolophilus*) *robusta* (Bangerter) (65) Clapgate Gill, Marske 19/7/78 J.H.C.

Eloeophila apicata (Lw.) Nb. (62) Kirkdale, (by Hodge Beck), 7/8/98 R.C. There are few records for this species in Yorkshire:- Cautley (65), 1927; Mulgrave Woods (62), 1937; Whitewell, 1957 and Greensagill, 1973 (both v.c. 64).

† *E. trimaculata* (Zett.) Nb. (65) Rake Beck, 9/6/76 J.H.C., Colsterdale, 3/6/79 W.A.E.; (*63) Stephen Wood, Denby Dale, 22/5/98, J.D.C. (*64) Timble Ings, 23/5/98 R.C.

Hexatoma (s.g. *Hexatoma* s.s.) *fuscipennis* (Curt.) (65) Nosterfield (gravel pit), 15/5/98 (1♂) R.C. This appears to be a very localised species in Yorkshire, with no records since 1953.

**Neolimnomyia* (s.g. *Neolimnomyia* s.s.) *batava* (Edw.) (61) North Grimston, 14/7/96 per L.W.H., Barmby Moor, 23/6/97, Newbald Becksies, 24/6/98; (*62) Deepdale, Dalby

Forest, 25/7/98; Seivedale Fen, Dalby Forest, 11/8/98; (64) Hetchell Wood, 20/6/98 all R.C. Previous Yorkshire records are Farnley (63), 1921, and Crag Wood (64), 1920.

**Paradelphomyia* (s.g. *Oxyrhiza*) *dalei* (Edw.) (61) Newbald Becksies, 14/8/98 R.C.; (*65) Aysgarth, by R. Ure, 2/9/80 J.H.C.

† *Pilaria scutellata* (Staeg.) Nb (63) Bentley Common, 23/6/76 P.S., Gypsy Marsh, Barnsley, 28/8/98 J.D.C. (*62) Throxenby Pond, Raincliffe Wood, 18/7/96 per L.W.H. det A.E.S.

**Achyrolimonia decemmaculata* (Lw.) (64) Askham Bog, 12/5/98 R.C. There are few Yorkshire records for this species, the majority being since 1980.

† *Dicranomyia* (s.g. *Dicranomyia* s.s.) *distendens* Lundst. Nb. (62) Troutsdale Fen, 7/7/98 (1♂) R.C. Most British records for this species are from upland areas of Scotland and North Wales, with about 15 known post-1960 sites (Falk, 1991).

D. (s.g. *Idiopyga*) *stigmatica* (Mg.) Nb. (64) Kingsdale Head, 23/8/77 J.H.C. The only previous Yorkshire records are 'Ilkley, Harrogate' (64), undated and Waldondale (65), 1956.

**D.* (s.g. *Melanolimonia*) *occidua* Edw. Nb. (62) Sand Dale, 15/7/96 J.H.C. Previously reported in the county from Austwick and Ingleton (64), in the 1920s and 30s, and Dent (65), in 1933.

**Limonia dilutior* (Edw.) (62) May Moss, 25/7/98 R.C. Previous Yorkshire records are Spurn, 1928 and Barmby Moor, 1997 (both 61); Lindrick Hill, 1986 and Dike Hagg, 1991 (both 63); Crummack Dale (64), 1983; Barnard Castle (65), 1980.

**Orimarga* (s.g. *Orimarga* s.s.) *virgo* Zett. RDB3. (62) Beast Cliff, 18/7/96 A.E.S. per L.W.H.; (*63) Lindrick Dale Quarry, 5/7/89 W.A.E. and Niblum Quarry, 16 & 23/6/90 A.G. det. A.E.S.; (65) Cotterdale, 24/7/74 J.H.C. Previous records are few, and all are from the far north-west of the county in the 1920s and 30s.

**Thaumastoptera* (s.g. *Thaumastoptera* s.s.) *calceata* Mik Nb. (62) Mowthorpe Dale, 29/5/98 R.C. Apparently a rare species in Yorkshire, where it reaches its northern limit (Falk, 1991); there are few previous records for the county:- Crag Wood (64), 1927; Gibbing Greave Wood,1977 per W.A.E., and Clough Wood, Gunthwaite, 6/7/97 J.D.C. (both 63).

HYBOTIDAE

**Oropezella sphenoptera* (Lw.) (62) Duncombe Park, 16/7/96 I.P. Only known elsewhere in Yorkshire from a cluster of sites in the south-east of v.c. 63.

† *Odealea ringdahli* Chvála RDB3. (62) Forge Valley Woods NNR, 10/7/95 (1♀), leg. R.C. det. A. R. Plant.

† *O. tibialis* Macq. (63) Denaby Ings, 13/6/87 R.C., Thorne Moors, 1990 per P.S.; (*61) Thornton Ellers (ex Malaise trap) -/7/96, The Moors, Burton Constable, 19/7/96, (both C.M.D.).

† *Trichina opaca* Lw. Nb. (64) Grass Woods, 6/6/88 R.C.; (*63) Pot Riding, Doncaster, 23/8/88 W.A.E.; (*65) Semerwater, 23/8/88, Nosterfield (gravel pit), 10/8/98 (both R.C.).

† *Chersodromia speculifera* Haliday in Walker Nb. (62) Runswick Bay, (under dry seaweed) 9/6/90 A.G. (reported in *Br.J.Ent.Nat.Hist.*[1991]4:36); (*61) Spurn, 19/7/96 J.H.C.

†*Crossopalpus minimus* (Mg.) (63) Rawcliffe Moor, Goole, 27/4/85 R.C., Langold Holt, 30/6/85 leg.R. J. Marsh. det. P.S.; (*61) Thornton Ellers (ex Malaise trap), -/7/96 C.M.D.

**Platypalpus praecinctus* (Coll.) Nb. (65) Nosterfield (gravel pit), 10/8/98 R.C. The first record was from Blacktoft Sands (63) in 1989, and since then it has been found at four sites in v.c. 61, including Haverfield Reserve near Patrington in 1990 (A.G.). Nationally it appears to be a very localised species, with about twelve widely scattered post-1960 records (Falk & Crossley, in press).

EMPIDIDAE

Empis (s.g. *Empis* s.s.) *prodromus* Lw. RDB3. (61) Barmby Moor, 23/6/97; 15/6/98 R.C. Prior to the discovery at Barmby Moor, there were only three known post-1960 sites nationally, these being Allerthorpe Common and North Cliffe Common (both v.c. 61 in 1989), and Mundford, Norfolk, 1977 (Falk & Crossley, in press). This is a poorly known species nationally, with what appears to be a very restricted distribution. The three Yorkshire sites are lowland heaths.

E. (s.g. *Euempis*) *picipes* Mg. Barmby Moor (61), 13/5-15/6/98 R.C. Previous Yorkshire records are:- Allerthorpe Common, -/6/26 (W. J. Fordham, det. J. E. Collin), and Potter Brompton, 21/6/86 R.C. (both sites in VC 61).

† *E.* (s.g. *Lissempis*) *nigritarsis* Mg. (61) Skipwith Common, 22/5/98 R.C. 1♂ in carr-woodland.

**E.* (s.g. *Pachymeria*) *tumida* Mg. (62) Clifton Backies, York, 22/7/98 & 22/8/98 R.C. First reported in Yorkshire from Barmby Moor (61), 2/8/28 (W. J. Fordham det. J. E. Collin), this stood as the only record until 1965 when it was found at Roche Abbey (8/7/65, P.S.). It was then taken at Nor Wood (63), in 1986 by S. J. Hayhow (det. W.A.E.). Since then it has been found on several occasions at Allerthorpe Common, Barmby Moor and Thornton Ellers, all these sites being in the same 10km square in v.c. 61.

† *Hilara angustifrons* Strobl (64) 'Pateley', 5/7/19, C.A.C. The single male specimen is in the Cheetham collection at Leeds City Museum (see introductory notes). (*62) Deepdale, Dalby Forest, 29/6/92; Troutsdale, 7/7/98 (both R.C.), Hawnby, 16/7/96 and Raincliffe Woods, 17/7/96 (both C.M.D.).

H. gallica (Mg.) RDB1. (61) Barmby Moor 8/6/97 (1♂) & 4/7/97 (1♀). Several of each sex were taken at the same site during 1998 at various dates from 13/5 to 15/6. The only previous record of this species in Britain was a single male taken at Allerthorpe by W. J. Fordham in June 1926 (precise location unknown); the specimen, having been presented to J. E. Collin, is now in the Verrall/Collin collection at the University Museum, Oxford, where I examined it in 1997. Not having been recorded in Britain since the original specimen was found in 1926 (*Naturalist* 1927, p. 335), it was considered possible that the species was extinct in this country (Falk & Crossley, in press). The Barmby Moor site is a small area of relict heathland which formed part of the once extensive tract that included what is now Allerthorpe Common.

† *H. primula* Coll. RDBI. (61) Skipwith, 18/5/24 C.A.C. Two males are in the Cheetham collection at Leeds City Museum (see introductory notes). This constitutes the only Yorkshire record.

† *Rhamphomyia* (s.g. *Holoclera*) *lamellata* Coll. Nb. (62) Castle Howard, 9/7/88 W.A.E. (*61) North Duffield Ings, -/6/95 P. Kirby (per English Nature, York).

† *Chelifera astigma* Collin RDBI. (62) Forge Valley Woods NNR, -/6/95 R.C., Seivedale, 14/7/96, Carr Wood, Hawnby, 16/7/96 (both C.M.D.).

DOLICHOPODIDAE

† *Achalcus melanotrichus* Mik (63) Daws Pantation, Bentley, 16/7/80 P.S. (teste R.C. 1999).

† *A. thalhammeri* Lichtwardt (61) Hornsea Mere, -/8/96, ex water traps in *Phragmites* bed, leg. R.C., det. C. E. Dyte.

† *A. vaillanti* Brunhes (61) Hornsea Mere, -/8/96, ex water traps in *Phragmites* bed, leg. R.C., det. C. E. Dyte.

† *Chrysotus laesus* (Wied.) (62) Haugh Rigg, 18/7/96 C.M.D.

† *Chrysotus suavis* Lw. (65) Nosterfield (gravel pit), 10/8/98 (2♂♂) R.C.

† *Melanostolus melancholicus* (Lw.) RDB3. (62) Sand Dale, 15/7/96 C.M.D.; (*61) Sewerby Cliffs, 8/7/97 R.C.

† *Dolichopus migrans* Zett. RDB3. (61) Barmby Moor, 25/5/98 (1♂), 22/6/98 (1♂ & 3♀♀) R.C. This appears to be a species of dry grassland on sandy soils, for which previous records are confined to the brecklands of Suffolk and Norfolk, and Risby Warren in Lincolnshire (Falk & Crossley, in press).

D. signifer Hal. (*61) Nb. Barmston Drain, 17/6/98 R.C. 2♂♂ swept ex vegetation on wet sand at the seaward end of the drain. The only previous Yorkshire record is of a single male collected at a post-industrial waste site at Manvers, Barnsley (63), 17/8/92 J.D.C., teste R.C.

† *D. strigipes* Verr. Nb. (61) Welwick salt marsh, (1♂) 19/7/96 C.M.D. A mainly coastal salt-marsh species with a distribution from Norfolk to Devon, this appears to be the first record for the north of England.

Hercostomus (s.g. *Hercostomus* s.s.) *chetifer* (Walker) (62) Kirkdale, (by Hodge Beck), 7/8/98 R.C. Previously reported from only four localities in the county, all of them since 1986, and typically occuring on heavily shaded watercourses. Hayburn Wyke, 1990 (R.C.) and 18/7/96 (I.P.), and Newtondale, 18/7/96 (C.M.D.) are the only other v.c. 62 records.

H. (s.g. *H.* s.s.) *chrysozygos* (Wied.) (*61) Thornton Ellers, 14/7/96 C.M.D. The only other county record is Campsall Park (63), 23/7/77 P.S.

† *Medetera micacea* Lw. (61) Thixendale, 14/7/96 J.H.C., Barmby Moor, 11/7/97 R.C.

† *Thrypticus divisus* Strobl Nb. (61) Skipwith Common, 16/7/96 A.G.

† *T. laetus* Verr. (63) Blackburn Meadows, Tinsley, 31/7/91 A.G. (*61) North Duffield, 23/7/92 R.C., Skipwith Common, 13/7/96 J.H.C., Burdale, 14/7/96 P.J.C.

**Rhaphium antennatum* (Carlier) (65) Nosterfield (gravel pit), 10/8/98 (1♀) R.C. This appears to be scarce in Yorkshire, previous records being:- Spurn (pre-1953), Wheldrake Ings and North Duffield, 1992 (both R.C.), North Ferriby, 19/7/96 L.W.H. (all VC 61); Mickletown Ings (63), 27/7/76, P.S.

† *Sciapus contristans* (Wied.) (63) Houghton Common, Barnsley, 22/7/91 (1♂) J.D.C. teste R.C. (*61) Barmby Moor, 2/7/98 R.C.

Chrysotimus molliculus (Fall.) (61) Wheldrake Woods (1♂), 3/8/96, Barmby Moor 1997 and 1998 in abundance at a small heathland site (all R.C.) The only previous Yorkshire record is Millington (61), 1/8/36.

† *Lamprochromus bifasciatus* (Macq.) (62) Sand Dale, 15/7/96 (1♂) C.M.D.

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OBITUARY

DUNSTAN HUGH ADAMS, BSc, FIBiol.(1914-1999)

Dunstan Adams, President of the Yorkshire Wildlife Trust, died at his home in York on 11th March, 1999. His death marks the end of an era in nature conservation, which started with the pioneers who founded the Yorkshire Naturalists' Trust in 1946.

Dunstan was born in Lydd, Kent, in May 1914. He attended Eye Grammar School, Suffolk, before becoming an undergraduate at Leeds University and taking a first class honours degree, graduating in Botany (with Zoology) in 1935. Following further study leading to a Diploma in Education, he joined the staff of Mundella Grammar School, Nottingham, where he became Head of Biology. Following war service in the Royal Artillery, he joined the staff of St John's College, York, in 1949 where he became Head of Biology. In 1974, on the merger of St John's College with Ripon College, forming the College of Ripon and York St John, he became Head of Maths and Science, subsequently retiring in 1976.

He joined the Trust in 1951 and was elected to its Council in 1969. Almost immediately he was appointed Honorary Conservation Officer, and he introduced one of the earliest schemes for site recording. Later, he became Chairman of the Executive Committee, a Vice-President and Chairman of the Business Committee, Chairman of the Scientific Committee, and then President for three years in 1981, also representing the Trust on numerous external committees including the NCC *Cypripedium* Committee. In 1959 he became a member of the Yorkshire Naturalists' Union at a meeting in Kirbymoorside.

He left the Trust Council in 1985 to serve on the Council of the Royal Society for Nature Conservation, becoming Chairman of their Executive Committee and their President from 1988 to 1991. In 1997 he returned to the Yorkshire Wildlife Trust Council as an elder statesman, succeeding Earl Peel as President.

Apart from his interests in nature conservation, he was a member of the Friends of York Minster and helped to found a York branch for the Society of the Book of Common Prayer. Lasting memories are of his unfailing courtesy and an intimate knowledge of the English language; in his later years he entertained many with votes of thanks at Trust corporate functions. His wife, Mary, pre-deceased him and he is survived by a daughter and two sons. A Requiem was held in the Choir of York Minister on 22nd March 1999, using the rites of the Book of Common Prayer.

John A. Newbould

BOOK REVIEW

Ticks: a lay guide to a human hazard by **G. Hendry** and **D. Ho-Yen.** Pp. 106. The Mercat Press, Edinburgh. £4.99 paperback.

This is a practical and very readable book. In the table of contents one is directed immediately to page 74 where instructions are given on how to remove a tick from the skin. This book deals with the ticks that humans may pick up at home and abroad and the chances of developing a tick-borne disease, such as Lyme disease. The text deals with the different species of ticks, their natural history and the diseases they carry, infection risks, symptoms and effects of tick-borne disease and how ticks might be controlled. The book is essential for people who work, or enjoy recreational activities, in the countryside.

MEA

Printed in Great Britain by Titus Wilson & Son, Kendal ISSN 0028-0771

July-September 1999

Number 1030
Volume 124

The Naturalist

A QUARTERLY JOURNAL OF NATURAL HISTORY FOR THE NORTH OF ENGLAND

Published by the Yorkshire Naturalists' Union

Editor **M. R. D. Seaward,** MSc, PhD, DSc, FLS, The University, Bradford BD7 1DP

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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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Institutions and Subscribers £20.00 Registered Charity No. 224018

THE YELLOW-NECKED MOUSE *(APODEMUS FLAVICOLLIS)* AT THE EDGE OF ITS NORTH-WEST DISTRIBUTION IN BRITAIN

AIDAN MARSH[1], PASCALE PRESUMEY[2], JANE WASHINGTON-EVANS[2] AND STEPHEN HARRIS[1]

[1]*School of Biological Sciences, University of Bristol, Woodland Road, Bristol BS8 1UG*
[2]*School of Applied Sciences, University of Wolverhampton, Wulfruna Street, Wolverhampton WV1 1SB*

ABSTRACT

Factors that may limit the distribution of the yellow-necked mouse *(Apodemus flavicollis)* at its north-west range border in Britain were investigated. Seventeen woodlands were surveyed along a north-south transect across the county border between Shropshire and Cheshire and the relative abundance of woodland rodents was recorded, as were woodland habitat features, degrees of woodland fragmentation and other landscape variables. Yellow-necked mice were only found in the southern part of the study area, confirming the border suggested by casual record collection. We suggest that their scarcity or absence from woodlands to the north may be attributable to a decrease in ancient woodland, an increase in woodland fragmentation and coniferous replanting of woodland, as well as a more saline geology supporting wetter soils and a lower diversity of ground flora. Further investigations are required at the edge of the yellow-necked mouse's range to assess the relevance of these findings in explaining the national distribution of this species.

INTRODUCTION

In Britain, the exact distribution of the yellow-necked mouse *(Apodemus flavicollis) is* a matter of some conjecture. Its range is seen to extend from south-eastern England, through southern counties and up into central and eastern Wales and the border counties with England (Corbet & Harris, 1991). The Shropshire/Cheshire border is considered to denote the north-westernmost point of its current range in Britain, although it is probable that the yellow-necked mouse was more widely distributed in the past (Yalden, 1999). The yellow-necked mouse is at the western edge of its European distribution in Britain and its restricted range in this country strikingly contrasts with the widespread distribution of its congener the wood mouse *(A. sylvaticus),* which is common throughout Britain. Species at the edge of their range often experience environmental or physiological constraints and one or more factors must be setting limits on the current geographical distribution of the yellow-necked mouse.

Previous work on the yellow-necked mouse in Britain has concentrated in areas at the heart of its range where local abundance is high (e.g. Corke, 1974; Montgomery, 1977, 1985; Marsh & Harris, *in press*) and little is known about populations of this species at its range borders. The yellow-necked mouse shows a strong association with woodland habitat, specifically mature deciduous woodland (Montgomery, 1978, 1985). However, the exact nature and importance of the habitat structure preferred by the yellow-necked mouse is more difficult to define. The species displays a preference for areas of good canopy cover (Montgomery, 1981) and diverse hard fruit/seed producing tree and shrub species (Marsh & Harris, *in press*). The occurrence of suitable woodland habitat, and patterns of woodland fragmentation, may help to determine the British distribution of the yellow-necked mouse, particularly given the affinity of the species for mature deciduous woodland (Bright, 1993). Alternatively, or in combination, other variables may also be important in shaping distribution, including dispersal, interspecific relationships, temperature, moisture or other physical or chemical factors (Krebs, 1985).

We set out to check the accuracy of this northern distribution boundary and to investigate the structure of yellow-necked mouse populations leading up to this range border. We examined a number of environmental and habitat factors that might be important to populations of yellow-necked mice near the edge of their geographical range.

In particular, we tested the hypothesis that changes in habitat structure and/or the level of woodland isolation to the north were important factors preventing the further range expansion of this species.

METHODS

Study Sites

Between 21st September and 23rd October 1998, 17 woodlands were surveyed along a broad transect line across the Shropshire/Cheshire border (Fig. 1). These woodlands were all at a similar altitude and positioned on broadly flat ground. Information on planting dates was collected but there were considerable differences in the quality of information

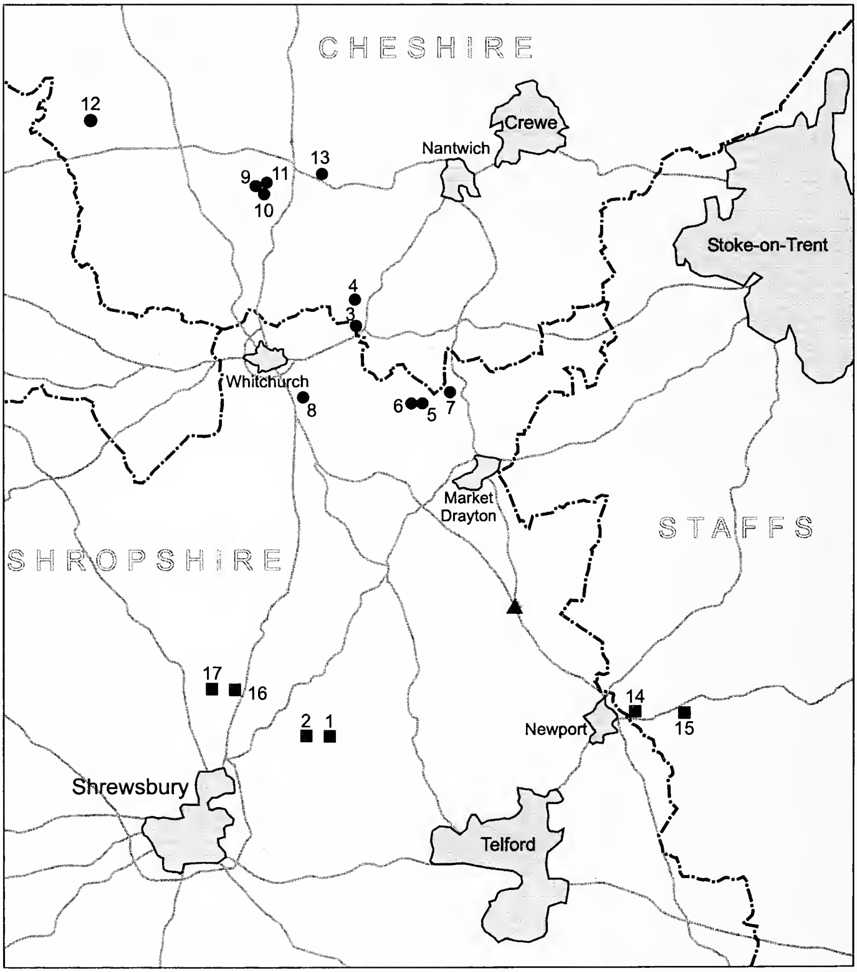

FIGURE 1
The survey area and 17 woodland sites
■ *A. flavicollis* found; ● *A. flavicollis* not found; ▲ Post-survey *A. flavicollis* record

available. Larger woodlands in the area were mainly under forestry management, with considerable replanting of older deciduous woodlands, usually with conifers. The Ancient Woodland Inventory (English Nature, 1988) was used to help identify woodland planted pre-1600 AD (Ancient Semi-Natural Woodland, ASNW), woodland planted pre-1600 AD but since replanted (Ancient Replanted Woodland, ARW) and woodland planted post-1600 AD (Recent Woodland, RW). However, considerable recent change to the woodland landscape was evident. Where possible, mature deciduous woodlands were selected as these were thought most likely to support populations of yellow-necked mice.

Survey Protocol

Each woodland was surveyed using 40 Longworth traps for 2 nights, except for two adjacent woodlands where only 20 traps were used in each wood. The traps were placed in pairs along 2 separate transect lines containing 20 traps each, with 15 m spacing between each trapping point. Transect lines were spaced at least 100 m apart from each other and away from woodland edges. Traps were checked once a day, early each morning. Data were collected on a range of woodland habitat and landscape variables for each woodland surveyed (Table 1). Woodland isolation variables were calculated from maps as the distance of each woodland to the nearest neighbouring woodlands >2 hectares (ha) and >20 ha in size. The total area of ASNW/ARW woodland, and the total area of all woodland types in the 24 1-km squares ringing the focal 1-km square in which each woodland site was centred, was also calculated.

TABLE 1
Variables measured at each site.

Variable	Data Type
Woodland Variables	
Woodland age category	Categorical (1-3)
NVC woodland class	Categorical
Woodland area (ha)	Continuous
Isolation Variables	
Total area of ASNW and ARW in the 24 1-km squares surrounding the 1-km square in which each wood was centred (ha)	Continuous
Total area of ASNW and ARW in the 24 1-km squares surrounding the 1-km square in which each wood was centred (ha)	Continuous
Distance to nearest wood >2 ha (m)	Ordinal (1-5)
Distance to nearest wood >20 ha (m)	Ordinal (1-5)
Habitat Variables	
Management levels	Ordinal (1-5)
Fallen timber (>10 cm dia.)	Ordinal (1-5)
Herb layer cover (%)	Ordinal (1-5)
Canopy cover (%)	Ordinal (1-5)
Understory density (%)	Ordinal (1-5)
Dominant tree species	Descriptive notes
Dominant shrub/understory species	Descriptive notes
Landscape Variables	
Surrounding arable land (%)	Ordinal (1-5)
Surrounding pastoral land (%)	Ordinal (1-5)
Geology and soil	Descriptive notes

Analysis

To examine the continuous data for woodland size and surrounding woodland area totals, these data were checked for normality and *t*-tests were then used to compare those woods where yellow-necked mice were or were not found. Mann-Whitney tests were used to explore differences between these woodland groups in terms of the ordinal isolation, habitat and landscape data collected. To account for the multiple *t*-tests and Mann-Whitney tests carried out the Bonferroni method was used to adjust the significant *P* value that was accepted (Altman, 1991).

Results

Yellow-necked mice were recorded in six of the 17 sites. These woodlands were all in the southern part of the study area (see Fig. 1). Small mammal capture numbers for each site are shown in Table 2, along with data on some of the isolation variables measured.

There was no significant difference in wood mouse abundance (*t*-test: $t = 0.29$, n = 17, NS) in woodlands found to contain yellow-necked mice compared to those woods where yellow-necked mice were not recorded. There was a significant difference between woodlands with and without yellow-necked mice in terms of the total area of ASNW and ARW in the 24 1-km squares surrounding the sites (*t*-test: $t = 4.09$, n = 12, $P < 0.01$). Yellow-necked mice were more likely to be present in woodlands surrounded by a greater quantity of woodland of ancient origin. There was no significant relationship between sites with and without yellow-necked mice in terms of the total area of all woodland in the same surrounding area ($t = 0.22$), or the size of the woodland itself (t = –1.56). The presence or absence of yellow-necked mice at a site was unaffected by either the distance to the nearest woodland >2 ha (Mann Whitney test; $U = 30.5$, n = 17, NS), or the nearest woodland >20 ha ($U = 27.0$). Whether the woodland site itself was of ancient origin (ASNW or ARW) or more recent (RW), was not important in predicting the relative abundance of yellow-necked mice ($U = 17.5$). None of the woodland habitat or landscape variables measured was found to show any significant difference between woodlands where yellow-necked mice were present and those where they were absent.

Nearly all the woodlands surveyed were mixed woodlands. In general, as well as containing introduced spruce and fir tree species, oak, ash, sycamore and birch all featured strongly in the woodlands surveyed, with hawthorn, hazel and rhododendron regularly recorded in the understorey. Many of the study woodlands displayed a relatively poor diversity of ground flora. The presence of yellow-necked mice did not appear to correlate with tree species composition. However, it was evident that there was a transition between the more natural and abundant deciduous woodland to be found to the south and the sparser coverage of generally more coniferous woodland on the Cheshire plains to the north. Soils varied from clays to sandy loams and most of the woodlands were quite boggy and wet in places, including those supporting populations of yellow-necked mice.

Discussion

Populations of the yellow-necked mouse were not found in Cheshire and our results are consistent with the range border proposed for northern Shropshire. However, populations of yellow-necked mice, including sub-adult animals and breeding adults, were found in northern Shropshire in woodland sites further north than previously recorded. Archaeological records (Yalden, 1999) and records from Cheshire earlier this century suggest a larger range. In the autumn following this survey, a yellow-necked mouse specimen was identified from a location to the north of the sites reported here (see Fig. 1) and the possibility of isolated populations of this species stretching up into Cheshire cannot be ruled out.

The presence of yellow-necked mice did not correlate with the oldest sites or those most similar to mature deciduous woodland, which they are supposed to prefer (Montgomery, 1978, 1985). Woodland size was not found to be a significant factor for predicting the presence, absence or abundance of yellow-necked mice and this supports similar results

TABLE 2
Small mammal capture numbers, areas of surrounding woodland cover and dominant woodland flora at each study site.
(Abundance indices representing the number of animals per 100 trap nights are shown in brackets).

Site No.	Area (ha)	Trap No.	Surrounding ARW & ASNW (ha)	Surrounding Total Woodland (ha)	*A. flavicollis*	*A. sylvaticus*	*C. glareolus*	Dominant Tree Spp.	Dominant Understory Spp.
1	9	40	29	45	4 *(5.0)*	20 *(25.0)*	3 *(3.8)*	1,2,3,4	16,18
2	23	40	49	127	5 (6.3)	32 *(40.0)*	3 *(3.8)*	1.2,3,4	16,19
3	15	40	7	152	0	41 *(51.3)*	1 *(1.3)*	1,2,5	16,17,19
4	50	40	7	142	0	40 *(50.0)*	4 *(5.0)*	1,3,6,7,8,9	17,20
5	56	40	20	196	0	19 *(23.8)*	1 *(1.3)*	1,2,3,5	17,19,20
6	9	40	20	196	0	16 *(20.0)*	6 *(7.5)*	1,4,8	16,18,19
7	26	40	39	142	0	8 *(10.0)*	2 *(2.5)*	2,6,8,10	18,19
8	12	40	*	8	0	14 *(17.5)*	0	1,3,4,5	17,19
9	36	40	0	133	0	12 *(15.0)*	2 *(2.5)*	1,3,5,6,7	19,20
10	94	20	0	153	0	8 *(20.0)*	1 *(2.5)*	1,5,6,7	19
11	4	20	10	142	0	14 *(35.0)*	2 *(5.0)*	1,3,5,8	16,18,20
12	5	40	*	46	0	30 *(37.5)*	0	1,3,6,13	16,18
13	9	40	*	51	0	29 *(36.3)*	0	1,2,4,11,12	16,18,19
14	3	40	*	103	10 *(12.5)*	24 *(30.0)*	0	2,4,5,15	16
15	7	40	*	89	6 *(7.5)*	7 *(8.8)*	0	1,3,4,5	19
16	11	40	65	208	11 *(13.8)*	11 *(13.8)*	1 *(1.3)*	1,4,5,6,15	
17	8	40	93	212	10 *(12.5)*	19 *(23.8)*	1 *(1.3)*	1,6,14,15	18,19,20

*Data not available

1. *Quercus* spp. **2.** *Corylus avellana* **3.** *Fraxinus excelsior* **4.** *Betula* spp. **5.** *Acer pseudoplatanus* **6.** *Fagus sylvatica* **7.** *Picea* spp. **8.** *Tilia* spp. **9.** *Castanea sativa* **10.** *Populus* spp. **11.** *Alnus glutinosa* **12.** *Pseudotsuga manziesii* **13.** *Sambucus nigra* **14.** *Larix* spp. **15.** *Pinus sylvestris* **16.** *Crataegus monogyna* **17.** *Ilex aquifolium* **18.** *Rubus fruiticosus* **19.** *Pteridium aquilinum* **20.** *Rhododendron* spp.

from elsewhere in its British range (Marsh & Harris, *in press).* Some of the smallest woodlands supported some of the highest comparative abundances of yellow-necked mice.

Woodland cover became generally more coniferous along the geographical transect line from south to north, and the populations of the yellow-necked mouse discovered declined in the same direction. The total area of ASNW/ARW in the 24 1-km squares surrounding the focal wood was significantly higher in woods found to contain yellow-necked mice than woods where the yellow-necked mouse was not found. However, the same was not true for the total area of all woodland types in the same catchment and this suggests that the presence of ancient woodland in an area may be of particular significance to yellow-necked mouse populations. Areas containing recent woodland alone may be suitable for yellow-necked mice and may act as soft barriers to range expansion. The isolation distances measured to the nearest neighbouring woodlands (>2 ha and >20 ha) did not relate to the presence or absence of yellow-necked mice populations, although these distances were generally small. Similar isolation distances to ancient woodland sites were not measured due to gaps in the Ancient Woodland Inventory (English Nature, 1988), but where estimation was possible these distances were clearly much greater. These results and observations suggest that woodland of ancient origin and the degree of fragmentation of such woodland may be important to the distribution of the yellow-necked mouse whereas the level of woodland cover *per se* may be of less importance.

Other potentially relevant geographical trends were also evident. Rocks such as Triassic marls and sandstone make up most of the northern Shropshire area, while to the north the Cheshire plains dominate, containing large salt deposits that may influence vegetation growth and diversity. However, yellow-necked mice have historically been found in these areas and in this study they were also found in areas of wet woodland, with poor soil drainage. Both factors appear to contradict suggestions that this species may select against wetter soils (Montgomery, 1978).

We suggest that woodland fragmentation, particularly that of ancient origin, in conjunction with a wetter geology and a decrease in mature deciduous woodland may all be important contributing variables in setting this north-western limit to the distribution of the yellow-necked mouse in Britain. The present study cannot define this exact range border but it does confirm the rapid decline in the abundance of yellow-necked mice across this area. In this exploration of distribution, it is relevant to note that the current distribution of the dormouse *Muscardinus avellanarius,* which also shows a broadly southerly range, has been shown to include a number of outlying populations, for example in Cumbria (Bright *et al.,* 1996). Old records of yellow-necked mice exist from sites as far north as Northumberland and indicate that isolated populations of this species cannot be discounted. More records are needed to define both the north-western border investigated in this study and similar borders elsewhere in the country, as well as to identify any outlying populations. Only through the collection and collation of such records will we be able to better understand the factors limiting the distribution of the yellow-necked mouse in Britain.

Acknowledgements

This research was funded by a Small Ecological Projects Grant from The British Ecological Society whose support we gratefully acknowledge. We are also grateful to the landowners who kindly granted us access to their land and to The Mammal Society for their collaboration with this research. Any future yellow-necked mouse records should be sent to The Mammal Society (15 Cloisters House, 8 Battersea Park Road, London SW8 4BG).

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BOOK REVIEWS

Amphibians and Reptiles of Northern Guatemala, The Yucatan, and Belize by **Jonathan A. Campbell.** Pp. 380 with 178 full colour photographs & 13 figs. University of Oklahoma Press. Price $29.95 soft-backed.

Although the title states that it covers the amphibians and reptiles of a much larger area, the introduction states that "In this work I have come to include most of the species known from Peten and Belize, taking in the Maya Mountains. Therefore, the Peten region, as treated herein, extends northward and westward through much of the Yucatan Peninsula, includes all but the littoral zones of Belize, and extends southward to the foothills of Alto Verapaz, Lago de Izabel, and the Rio Dulce". The volume excludes those species found in the littoral zones of Belize, montane species restricted to over 600 metres and the northern portion of the Yucatan Peninsula.

Ease of travel, in a world that is becoming increasingly small, has resulted in more and more tourists visiting areas which only a short time ago would have been difficult and even dangerous. The Mayan Temples of the Yucatan are now visited by thousands of tourists from many parts of the world. This has created a demand for information on the flora and fauna of the area. This volume, which covers the herpetofauna of the Peten region, covers a total of 160 species, including 2 caecilians, 6 salamanders, 36 frogs, 9 turtles, 36 lizards, 69 snakes and 2 crocodilians. The book is illustrated with 178 photographs, covering the 160 species, all in full colour, plus a further 13 black and white figures. Appendices A to F are keys to the various groups in both English and Spanish, for which I must compliment both the author and series editor.

My problem with this volume, like so many others, is that it is too large and heavy for use in the field. This will restrict its use by all but the most dedicated naturalist, and the specialist herpetologist. This is unfortunate as the information on each of the species is very comprehensive, and gives plenty of scope for any enthusiastic naturalist to make new and interesting discoveries.

AN

Marine Nature Conservation Review Sector 5. South-east Scotland and north-east England: area summaries by **Paul brazier, Jon Davies, Rohan Holt** and **Eleanor Murray**. *Seas of the United Kingdom – MNCR Series.* Joint Nature Conservation Committee. Obtainable from NHBS Ltd., 2-3 Wills Road, Totnes, Devon, TQ9 SXN. Price £40.00 plus £4.00 p.&p.

The *Marine Nature Conservation Review* (MNCR) was initiated by the Nature Conservancy Council in 1987 with the intention of extending knowledge of benthic marine habitats, communities and species in Great Britain and identifying sites of nature conservation importance.

Area summary Sector 5 covers the coast from North Berwick in Lothian to Flamborough Head in the East Riding of Yorkshire. Field surveys of the shores and near shore sub-tidal zone describe the marine habitats and communities (together referred to as biotopes); additional data from other organisations have been added to provide information on over 1000 sites within the area. Each of the 24 areas into which Sector 5 is broken down is described in standard format giving details of its physical and biological character, the marine biotopes present and their distribution, the sites surveyed, current nature conservation designations, main human influences and relevant literature. The sites surveyed and the marine biotope information are also presented as a series of maps, a summary of the biototopes defined and a list of species recorded.

The MNCR is a monumental task and both the JNCC and the authors of Sector 5 are to be congratulated on the results. Data from ICI, NRA, SOAID, Wimpey Environmental and the University of Newcastle upon Tyne are included, but the bulk of the records come from the JNCC survey. Marine biology has been a neglected aspect of amateur natural history since its Victorian heyday and the amount of information gathered by the professional biologists during this relatively brief survey period is astonishing.

Personal knowledge leads a reviewer to look for "missing" species in anyone else's list, but the survey found the red algae *Schottera nicaeensis, Calliblepharis ciliata* and *Halurus equilisetifolius* and the brown alga *Taunia atomaria* at their northern limit of distribution on the Yorkshire coast. The uncommon (in the north-east) Featherstar *Antedon bifida* also failed to escape their survey. There are two additional areas apart from the five found by the surveyors where the anemone *Sagartia troglodytes is* found, but I certainly didn't know that the Devonshire cup coral *Caryophyllia smithii* was to be found in Druridge Bay!

There are a very few typographical errors, a missing "is" on page 20 and a superfluous "is" on Page 38 and on Page 117 "extends reaches" suggests that one of the words would suffice. On page 127, "Read algae" caused me a moment's worry but I suppose that's what comes of leaving everything except scientific names to the "spellcheck".

As a guide to the distribution of marine organisms within the area covered, the book is invaluable and must be highly recommended for any naturalist's library. The only problem is that to cover the whole of the Yorkshire coastline it will also be necessary to purchase Area Summary 6, Inlets in Eastern England, which covers the east coast from Flamborough to south Kent at an additional cost of £55. If one is sufficiently interested in the subject to need the complete set to cover England, Scotland and Wales, then it would be necessary to purchase all 10 area summaries, which together with the two Foundation volumes and the two Biotope classification volumes would cost the princely sum of £555.00 plus postage!

EH-C

COLLECTION OF NEST MATERIAL BY THE COMMON SHREW *SOREX ARANEUS* L.

GEOFFREY FRYER
Elleray Cottage, Windermere, Cumbria LA23 IAW

Collection of nest material by the Common Shrew, *Sorex araneus* L. usually takes place among rough herbage or leaf litter where it is almost impossible to observe. Moreover, from what is known of its activity rhythms, it probably does so at least as often by night as by day, or even more frequently so. Not surprisingly, this activity appears to be virtually unknown. No information is given in any of the three editions of *The Handbook of British Mammals* (1964, 1977, 1991), nor have I been able to find any elsewhere. In captivity shrews build sleeping nests by reaching out and dragging material backward until a loosely connected ring has been accumulated. Into this further material is poked from within to form a ball-like structure (Crowcroft 1957). Nest-building activity by pregnant shrews is more intense. Crowcroft refers to the gathering of scattered material, again by captive individuals, but gives no details. Males have no role in the care of the young and presumably never collect nest material in the persistent manner reported here.

By good fortune what was obviously a female Common Shrew elected to construct a nest in a situation that enabled its comings and goings to be easily, if fleetingly, observed. The observations were made on July 29, 1998, at Windermere, Cumbria, on a fine dry day, as this individual collected material for a nest clearly destined to hold a litter.

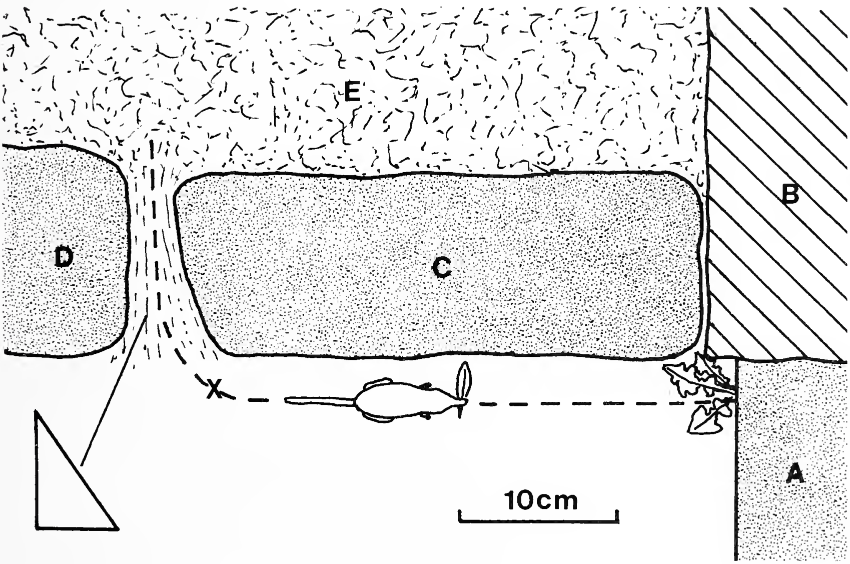

FIGURE 1
The route (dashed lines) followed to and from the entrance to its nest by a female Common Shrew. Plan view. The stone (C) abutting the house wall (B) is about 23cm (9in) high. The level of the ground above it (E), from which leaves taken to the nest were persistently collected, lies about 18cm (7in) above the asphalt path along which the shrew is shown running. The inset shows the approximate angle (but not the height) of the earth bank between the stones that granted access to the collecting ground. X indicates the approximate position of the animal illustrated in Fig. 2.

The nest, which could not be seen, was located at ground level beneath a step, or possibly within the wall of, the writer's house. This is constructed of local stone – Silurian Bannisdale Slates – and built in the traditional 19th century Lake District manner, which leaves many interstices between the stones. The entrance to the nest was near a corner where a shallow step (Fig.1, A) abutted the wall (B), leaving a small space beneath it. Near the corner so formed a stunted Wall Lettuce, *Mycelis muralis* (L), some 10 or 12 cm high, was managing to grow through the asphalt path that led to the step. From the house wall a flat stone (C) some 23cm (9in) high provided a barrier to one side of the entrance that extended for about 33cm (13in). Whenever it left, or returned to, the nest the shrew had to traverse the length of this stone along the asphalt path, and was fully, if briefly, exposed. Beyond this point a gap between the stone and an adjacent stone (D) gave access via a steep bank of soil to an unkempt flower bed (E) some 18cm (about 7in) above the path. Up this the shrew invariably made its way on every journey from the nest. The surface of the bank was of loose soil, the result in part of frequent comings and goings of the shrew.

Every departure from the entrance hole thus involved a conspicuous journey in the open before access to cover became available via the steeply sloping bank between the stones. This was achieved by making a 90° turn and scrambling up the bank, much of it at about 55°. This accomplished, mixed vegetation and leaf litter provided cover. Each return journey was by the same route and involved crossing the same open space. Many journeys, all undertaken at a rapid speed, were seen. On each return journey the shrew carried between its jaws a usually dry, brown leaf shed by an ornamental *Pyracantha* that grew against the house wall. These were hard and brittle and seemed a curious choice of presumed nest material but, save for an occasional green leaf of the same kind, they were the only objects seen to be carried. Dry beech leaves were available but were never collected.

FIGURE 2

Female Common Shrew carrying a leaf of *Pyracantha* to its nest. It has just descended the steeply sloping bank behind it, turned at right angles to the left, as is still betrayed by the angle of its tail, and is beginning to run at a high speed, parallel to the stone on its left, straight to the entrance hole. Its right forelimb is seen probably fully remoted and the hind limbs are ready to deliver the thrust that will propel it forward, during which phase of the cycle the fore limbs will leave the ground and be extended. Although most of the leaves collected were dry and brown, that being carried here was fresh and green.

Attempts to photograph this activity met with only modest success. The shrew moved at high speed and it was impossible to predict its position at any time. Fig. 2, enlarged from part of a colour transparency, is reproduced for its information content and not for its technical competence or artistic merit.

The frequent back and forth journeys were noticed by a neighbour (B. Wilson) and my wife more than an hour before I made my first observations shortly before 5.00 p.m. BST. Intervals between runs were irregular and were not timed precisely, but for the most part an outward journey and return carrying a leaf took place every few minutes during periods of observation. The shrew left the hole, dashed along the route described, and usually collected a leaf, of which many were available, no more than a metre from its point of entry to the collecting ground, and often less. This and the return journey usually took less than a minute. Only one leaf was collected on each sortie. Periods within the wall were a little longer than at the collecting ground. Here time was presumably devoted to incorporating the leaves into the nest. Leaves placed on the path along the route followed were collected only if the shrew actually encountered them, and not if they were a little off its route. Although handled just before they were encountered, such leaves evidently bore no objectionable odour. Sometimes a little difficulty was experienced in negotiating the narrow entrance hole while carrying a laterally projecting leaf.

Observations were made at intervals over the next few hours. Always the shrew was engaged in collecting leaves, and always it followed the same route. On one occasion it ventured further into the flower bed than usual and its presence could be detected by the disturbance caused as it rummaged among leaves and other litter for several minutes. The assumption was that it was feeding. For much of the time, however, it was expending energy and could hardly have collected any food. The last observations began after 10.35 p.m., by which time it was dark, but a conveniently situated outside light enabled it to be ascertained that leaf-collecting continued at the same brisk tempo. This activity therefore went on for more than six hours in both daylight and darkness. There was no sign of the shrew on the following morning. Because events were not carefully timed and the period involved in leaf-carrying is unknown, it is unwise to estimate the number of journeys made while so doing, but they must have exceeded a hundred, possibly by a wide margin.

Several features of the observed behaviour were unexpected. The Common Shrew usually sleeps for "about 1½ hours in every three" (Crowcroft 1957). Although periods of observation were intermittent, and some short periods of sleep could have been missed, the possibility that a period of as long as an hour was ever spent in sleep during the period involved can be ruled out, and it is unlikely that any three-hour period included a real spell of sleep. Using recording equipment, Crowcroft (1957) – whose book summarises results published in an earlier paper – followed the activity rhythm of captive Common Shrews for ten-day periods. He found that during each 24 hours there was a series of distinct periods of activity of from one to two hours duration, separated by comparable periods of rest. This was so in both sexes. Averaged over the entire period there was more activity by night than by day, the Common Shrew being "one and a half times as active by night as by day". Thus the energetic collection of nest material reported here not only took place during that part of the 24 hour cycle in which activity tends to be reduced, but evidently did so without the intervals of sleep that occur during other activities. However, Crowcroft made the interesting observation that shrews take "little naps" that are easily distinguished from true sleep. They stop, draw their feet together, and doze for a while. Such "naps" may be physiologically important. If they occurred during the collection of nest material reported here, they presumably did so under cover near the nest. They were certainly not seen, nor were individual excursions of sufficient duration to permit this.

While these are only opportunistic observations, they indicate that the collection of nest material is sufficiently important to enable a female Common Shrew to over-ride its normal prevailing rhythm and to allow it to indulge in intense activity for periods of several hours with little rest, and with little time devoted to feeding. The latter point gains in significance when it is appreciated that this species is estimated to eat some 80-90% of its own weight of food per day, and one and a half times its own weight when lactating *(Handbook of British Mammals,* Ed. 3). While the food has a high water content and often contains indigestible chitinous material, and its collection in such large quantities clearly requires much time and effort, it also has a high energy content. The presumed feeding interlude noted above was the only one seen, but there may have been others that were not. Even if this was the case, the proportion of time devoted to feeding must have been small in relation to that which usually prevails.

In mammals metabolic rate increases as size decreases, enormously so in very small forms such as shrews, in which there is a need for huge amounts of food that are collected to a considerable extent continuously. Nevertheless, although they have little resistance to starvation, it is easy to overlook the fact that shrews, like all mammals, must be able at times to survive periods, albeit short, without food. Some food items are rich in both fats and proteins and at least some reserves of fat must be carried at times, which can be used during periods when food intake is low and energy expenditure is high. The present observations demonstrate circumstances in which this appears to be the case. It would not be surprising if fat reserves were accumulated before breeding. In spite of their renowned prowess as continuous and voracious feeders, without at least some ability to manage without food for short periods, shrews would be ill-adapted and would hardly be the successful animals they are today, nor would the Soricidae have persisted since the Oligocene or *Sorex* itself since the Miocene.

A further deduction can be made from the observations. Common Shrews are born in one year, overwinter as immatures, breed in the following year, and die before what would be their second winter. The breeding season extends from May to October inclusive, but few litters are produced after August. All females, irrespective of age, produce young in May or June. The individual observed was therefore almost certainly breeding for the second time. As it is difficult to observe nests in nature, and almost impossible to follow the fate of a single female during the production of successive litters, it is very difficult to obtain information on whether a new nest is made for each litter. Captive breeding may involve atypical behaviour. The animal observed was clearly constructing a new nest as renovation of an existing nest would scarcely have required the large amount of newly collected material that was in fact used.

Reference

Crowcroft, P. (1957) *The Life of the Shrew.* Reinhardt, London.

BOOK REVIEW

Field Flora of the British Isles by Clive Stace. Pp. xvi + 736, with 27 pp of figures & end-paper maps. Cambridge University Press. 1999. £17.95 plastic flexi-covers.

It had to happen, and we didn't have to wait long – a more portable guide to embody the riches of the *New Flora of the British Isles* (see *The Naturalist* **121**: 40, 1996 & **123:** 14, 1998). Although an abridged version, it offers the same coverage of taxa, with detailed keys and generic descriptions: the reduction in size has been effected by the omission of textual descriptions of each taxa and many of the illustrations. No taxonomic changes or extra taxa have been incorporated. Essential illustrations have been retained, as has the glossary, but the index is rather meagre with Latin names only to generic level and no synonomy provided; however, some English names have been subdivided, for example Parsley: Cow, Fool's, Stone. Undoubtedly a boost to botanical recording and, through meaningful identification on site, a blessing to plant conservation. An essential tool for the field botanist.

MRDS

THE STATUS AND DISTRIBUTION OF *PISIDIUM TENUILINEATUM* STELFOX, 1918 (MOLLUSCA: SPHAERIIDAE) IN THE RIVER WHARFE

IAN J. KILLEEN[1] AND SIMON WILLIAMS[2]
[1]*Malacological Services, 163 High Road West, Felixstowe, Suffolk IP11 9BD*
[2]*Environment Agency, Coverdale House, Aviator Court, Amy Johnson Way, Clifton Moor, York YO3 4UZ*

INTRODUCTION

The fine-lined pea mussel, *Pisidium tenuilineatum* Stelfox, 1918 is believed to be one of Britain's rarest freshwater molluscs. It is classified in the British Red Data Book (Bratton 1991) as Category RDB3 Rare, and is included on the Biodiversity Action Plan (BAP) 'shortlist' (HMSO 1996).

The British distribution of *Pisidium tenuilineatum* is shown by Kerney (1999). The species is confined mainly to central southern England and sites along the Welsh borders. A record from the River Wharfe in Yorkshire in 1990 (Norris, 1993) represented a considerable range extension. The Wharfe record was based on a single, live-collected individual from a National Rivers Authority survey in May 1990 at Grassington (SD997639) (Norris, 1993). The specimen is in the collections at the City Museum, Leeds.

There is some evidence of decline of *P. tenuilineatum* during this century, with no post-1950 records from canals in the Midlands, although the Grand Union Canal sites have been searched (Kerney, 1999 & *pers. comm.*). *P. tenuilineatum* is widely distributed across the western Palaearctic from the Mediterranean to southern Sweden and eastwards to Russia (Kuiper, 1981; Wells & Chatfield, 1992, 1995). It is believed to be rare throughout its European range (Wells & Chatfield, 1992).

Early British accounts of the ecology of *P. tenuilineatum* suggest that it favours large rivers or canals, although there are post-1970 records from ponds in Sussex and Herefordshire. On the continent it is known from limestone springs. Although there are no living examples of the species in similar British habitats, it is known as a fossil from Post-glacial spring deposits in the Isle of Wight (Preece, 1979) and Kent (Bratton, 1991).

During sampling the species always appears to occur in low numbers, although in part this may be an artefact of collection owing to its small size (usually less than 2mm in length). However, in a survey by Ham & Bass (1982) of nine rivers in central southern England, *P. tenuilineatum* was recorded from only three of the 124 sites sampled. More recently, examination by one of us (IJK) of 100 *Pisidium* samples (several thousand individuals) collected by the Environment Agency Thames Region revealed only one live *P. tenuilineatum* (from the Thames at Buscot).

As lead partner for molluscs on the UK BAP, the Environment Agency has initiated and funded projects to address the first aims of the individual species' action plans. For *P. tenuilineatum* the first objective was to survey sites on selected rivers, from where the species had been recorded most recently in order to determine whether it was still extant at these locations and more widely (see Killeen, 1998). As part of this initiative, a survey has been carried out on a section of the River Wharfe to determine whether the river supported a population of *P. tenuilineatum* and to establish its distribution and abundance.

The contents of this paper are the views of the authors and do not necessarily represent those of the Environment Agency.

METHODOLOGY

The methods used were designed solely to obtain significant numbers of *Pisidium* specimens. Whilst at least 100 living specimens of *Pisidium* spp. were sought at each site, the nature of the habitat in addition to sparsity of individuals at some sites meant that this was not always possible. *Pisidium* are generally found in fine sediments at river margins, in areas of lower flow and amongst the base of aquatic weeds. Accurate discrimination between different habitats or depths of water during this survey were not attempted.

Sediment and suitable habitat was sampled using a robust, aluminium-framed pond net (handle and frame 2.4 m in length, equipped with a 0.5 mm nylon mesh bag). The samples were tipped into a bucket of water and elutriated to remove most of the dead leaves and organic detritus. The resultant sediment with molluscs was passed over a 0.5mm mesh stainless steel sieve to remove mud and fine particles. The mollusc-rich sediment was, in most cases, picked 'live' at the end of the day of collection using a stereo microscope at x10 magnification, although some were preserved in 80% alcohol until analysed. Most specimens of *Pisidium* were picked out and the species composition identified, although samples containing large numbers of juveniles were not picked exhaustively. Specimens of *P. tenuilineatum* were counted individually but other *Pisidium* species have only been analysed quantitatively from selected sites.

Site Selection and Descriptions

Samples were taken generally from points where there was easy access such as road crossings or footpath access from roads. A brief description of each site is given in Table 1. Fifteen samples were collected between Grassington and Harewood. The stretch above Grassington as far as Conistone was also investigated but no suitable *Pisidium* habitat could be located. In addition, samples of *Pisidium* collected during Environment Agency routine biological monitoring of two downstream locations at Boston Spa and Tadcaster were examined and the results included in this paper.

TABLE 1
Site descriptions (ds = downstream, us = upstream)

Site	Grid Ref.	Location	Description
1	SD999634	ds Grassington	Mud, silt and algae over concrete slabs in lee of old mill.
2	SE000633	ds Grassington	Sand and silt with *Elodea* in c. 1m depth.
3	SE001633	Linton	Confluence with Linton Brook. Mud and silt with algae/moss alongside *Sparganium* bed.
4	SE011629	ds Linton	Marginal *Carex acutiformis, Phalaris* and grasses with interstitial silt.
5	SE020626	Hebden	Marginal *Phalaris* and grasses with interstitial silt.
6	SE023625	Hebden	Marginal *Phalaris* and grasses with interstitial silt.
7	SE026624	Hebden rope bridge	Marginal *Phalaris* and grasses with interstitial silt.
8	SE029617	Burnsall	Marginal *Phalaris* and grasses with interstitial silt
9	SE052574	Barden	Marginal *Phalaris* and grasses with interstitial silt, also sand beneath trees.
10	SE072529	us Bolton Bridge	Similar to above but with muddy patches beneath trees and scrub.
11	SE083503	Addingham	Sand and silt with organic detritus in lee of mill/weir on west bank.
12	SE141483	SW of Denton	Silty mud and sand alongside *Phalaris* beneath trees on north bank.
13	SE166474	Burley	Sand along north bank below riffle section.
14	SE261460	Castley	Extensive area of silt and muddy sand on north bank with *Myriophyllum* and other macrophytes.
15	SE311460	Harewood	Cobble/shingle with marginal *Phalaris*, occasional *Typha.* Sand with dead shell and organic detritus.
16	SE432458	Boston Spa	Dominated by pebbles and cobble with smaller amounts of gravel and sand. Some *Ranunculus.*
17	SE485437	Tadcaster	Mainly sands and gravels with lesser amounts of cobble. *Myriophyllum* and other macrophytes.

Results and Discussion

The full results of the *Pisidium* faunal composition at each sample site are shown in Table 2. These show that *Pisidium tenuilineatum* still survives in the River Wharfe, being found at five of the 17 sites sampled. However, it appears to be restricted to sites between Grassington and Addingham. The Wharfe below Addingham does not seem to support *P. tenuilineatum*, an observation that is also confirmed by its absence in Environment Agency monitoring samples (examined by IJK) collected from sites downstream of Addingham as far as Tadcaster.

TABLE 2
Results – *Pisidium* species faunal composition

Site No.	Number	*Pis. tenui*	*Pis. amn*	*Pis. cas*	*Pis. pers*	*Pis. subt*	*Pis. nit*	*Pis. hen*	*Pis. sup*
1	400	**159**	40	84	76	24	16		
2	c.100	**0**	X	X	X	X	X		
3	c.75	**0**	X	X	X	X	X		
4	c.75	**1**	X	X	X	X	X		
5	c.50	**0**	X	X	X				
6	12	**0**		X	X	X	X		
7	50	**2**		10	8	10	20		
8	25	**0**		X	X	X	X		
9	26	**0**	X	X	X	X	X		
10	49	**1**	4	8	11	12	13		
11	100	**11**	5	23	8	30	23		
12	63	**0**		X	X	X	X		
13	45	**0**		11	1	18	11	4	
14	c.100	**0**		X		X	X	X	
15	27	**0**		4		8	12	3	
16	65	**0**		6		8	37	14	4
17	97	**0**		20		8	20	33	26

Key: *tenui* = *P. tenuilineatum; amn* = *P. amnicum; cas* = *P. casertanum; pers* = *P. personatum; subt* = *P. subtruncatum; nit* = *P. nitidum; hen* = *P. henslowanum; sup* = *P. supinum;* X = present.

For most Wharfe sites the results of this survey have reinforced the observation that *Pisidium tenuilineatum* usually occurs in low numbers. Of the approximately 1350 specimens of *Pisidium* spp. collected, 174 were *P. tenuilineatum*. The majority of these were collected at Site 1 below Grassington where 159 individuals were picked from the sample, representing 40% of the *Pisidium* specimens collected at the site. This represents one of the largest collections of *P. tenuilineatum* from a single site in Britain.

This survey has focused primarily on determining presence/absence of *P. tenuilineatum*. Due to the robust methodology very few conclusions can be drawn on the species' autecology. The samples were taken from a range of substrate types and, therefore, the precise substrate in which the animals were living has not been identified. The site description information is not sufficiently detailed to relate to the distributional data. However, much of the Wharfe in which *P. tenuilineatum* was found is fast flowing over a substrate of coarse cobble and pebbles. There are very few areas with quieter, more stable marginal habitat with finer substrate. It is notable that the two sites (1 and 11) which supported the greatest numbers of *P. tenuilineatum* were in the lee of mills where more extensive areas of finer substrate existed.

The differential distribution of *Pisidium* spp. in the Wharfe is shown in Figure 1. Three species, *P. casertanum, P. subtruncatum,* and *P. nitidum* were present throughout the river.

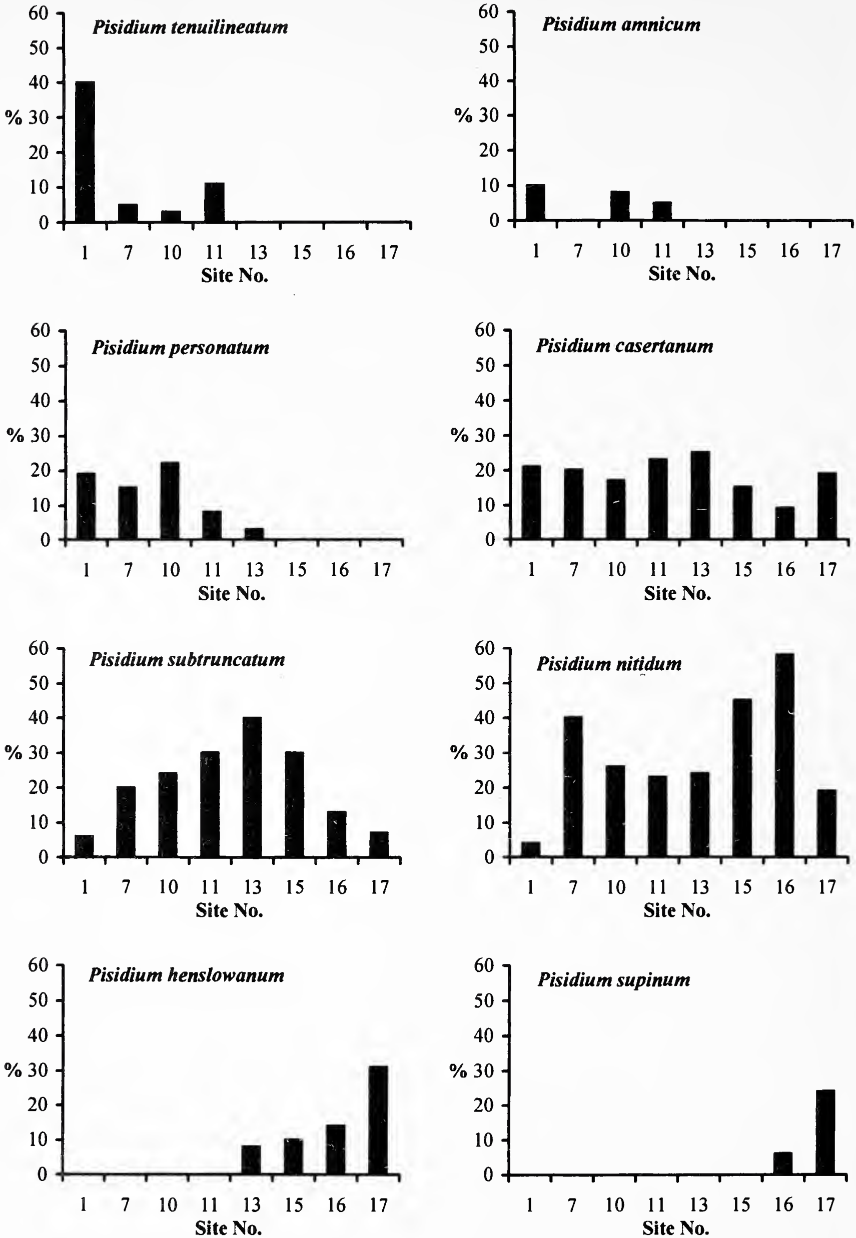

FIGURE 1
Differential distribution of *Pisidium* species in the R. Wharfe (y axis shows abundance of each species as % of the total number of specimens examined).

Pisidium personatum and *P. amnicum* were not found below Burley, but from where *P. henslowanum* first appeared and then increased in frequency down to Tadcaster. *Pisidium supinum* first occurred at Boston and by Tadcaster had significantly increased in abundance.

The associated mollusc fauna above Addingham was generally impoverished with only a few species occurring throughout: *Potamopyrgus antipodarum, Lymnaea peregra, Ancylus fluviatilis, Armiger crista* and *Gyraulus albus.* Downstream of Burley the mollusc fauna increased considerably in diversity.

Environment Agency hydrochemical analyses based on mean values from monthly monitoring samples taken over the period July 1993 to August 1998 have been examined to determine whether these data provide clues for the apparently restricted distribution of *P. tenuilineatum.* The analyses cover the stretch of river sampled although not all of the sites coincide with those from the mollusc survey. The results (Table 3) show that the water is base-rich with generally similar values for pH and hardness throughout. The Biological Monitoring Working Party (BMWP) scores show a general downstream increase in overall biological diversity as the Wharfe changes character from an upland to a lowland river. Total oxidised nitrogen (NO_3 + NO_2) increases at a more or less constant rate from Conistone (0.79 mg l^{-1}) to Tadcaster (2.57 mg l^{-1}). The increase in the levels of ortho-phosphate (PO_4) are significant. In the upstream section between Conistone and Hollins Raw Water (just below Addingham), PO_4 levels vary between 0.015 and 0.022 mg l^{-1}. At Denton the PO_4 was 0.070 and by Tadcaster had increased to 0.169 mg l^{-1}. This increase is largely a result of increased urbanisation around Denton and the associated discharges from sewage treatment works. As *P. tenuilineatum* was found only in the section of the Wharfe with very low levels, it is inferred that PO_4 content may be a critical factor in the quality of water inhabited by the species. This is also substantiated in studies by Kuiper (*pers. comm.*) on continental *Pisidium* populations which have shown that *P. tenuilineatum is* amongst the species least tolerant of pollution.

TABLE 3

Chemical data (1993-1998) and biological data (BMWP scores, 1990-1997) from River Wharfe sites (from Environment Agency monitoring samples).

Site No.	Grid Ref.	Location	pH	Hardness $CaCO_3$	PO_4 mg l^{-1}	Tox N mg l^{-1}	BWMP
A	SD979675	Conistone	8.24	139	0.015	0.79	118
B	SE032612	Burnsall Bridge	8.24	149	0.022	1.04	106
C	SE072528	Bolton Bridge	8.15	118	0.017	0.95	107
D	SE099483	Hollins Raw Water	8.18	125	0.018	1.23	114
E	SE137482	Denton Bridge	8.24	124	0.070	1.35	100
F	SE165474	Burley Weir	8.04	127	0.066	1.30	129
G	SE204461	Otley Weir	8.06	130	0.108	1.42	123
H	SE235456	Pool Paper Mills	7.97	128	0.112	1.51	–
I	SE257457	Sandbeds	8.12	132	0.104	1.60	121
J	SE312461	Harewood Bridge	8.15	135	0.124	1.67	150
K	SE432458	Boston Spa	8.10	148	0.166	2.18	147
L	SE485437	Tadcaster	7.95	182	0.169	2.57	130

Tox N = Total oxidised nitrogen, NO_3 + NO_2, BMWP = Biological Monitoring Working Party scores.

CONSERVATION

The River Wharfe population of *Pisidium tenuilineatum* is geographically distant from all other British populations and is, therefore, of national and local importance. However, it is restricted to a relatively short stretch of the river and is very patchy in its occurrence. On this basis the population must be considered vulnerable. Suitable habitat with quieter, more stable margins and finer substrate are sparse and may be lost through changes to the flow regime brought about by increased water abstraction or alterations to the bank structure. Evidence from the hydrochemical data suggests that increases in phosphate levels from domestic or industrial waste would adversely affect the population.

The local importance of *P. tenuilineatum* has recently been highlighted in the Yorkshire Red Data Book for land and freshwater Mollusca (Norris, 1998). As a result of this survey, it is recommended that the sites with the highest abundance of *P. tenuilineatum* should be monitored by the Environment Agency to allow any change in the population to be detected.

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BOOK REVIEW

Thorne & Hatfield Moor Papers, edited by **Martin Limbert.** Volume 5, pp. viii + 65. 1998. £5.00 paperback, plus £1.00 p.&p. from the Editor, Museum & Art Gallery, Chequer Road, Doncaster DN1 2AE.

The latest issue of the Thorne & Hatfield Moors Conservation Forum's journal on the ecology, palaeoecology, history and conservation of the Humberside Levels is devoted to "The natural harvest of Thorne Moors", an historical account of the use of their plants and animals for timber, peat, food, recreation, etc. The long and complex history of these uses is authoritatively detailed by Martin Limbert, the whole backed-up by excellent line-drawings, extensive references and notes, and species lists.

MRDS

RECENT DISCOVERIES OF *RUBUS* SPECIES FROM WITHIN THE WESTERN BORDERS OF WATSONIAN YORKSHIRE

D. P. EARL
The Herbarium, The Manchester Museum, University of Manchester, Oxford Road, Manchester M13 9PL

ABSTRACT
A significant number of the first vice-county records of members of the *Rubus fruticosus* agg. have been recorded from within the western borders of Watsonian Yorkshire since 1992. In view of such discoveries, this paper provides a detailed account of both the field locations and the whereabouts of herbarium specimens so as to aid further batological research within the Yorkshire vice-counties.

INTRODUCTION
The Pennine chain, 'the backbone of England', does of course act as a major biogeographical barrier. The bramble flora of north-west England (part of the Irish Sea Florula) is known to be significantly different in species composition to that of north-east England (part of the North Sea Florula) (Newton, 1980). It therefore seemed highly probable that those species which are characteristic of the hill districts of south and west Lancashire would also be present within the extreme western fringes of Watsonian Yorkshire. In addition, the West Pennine moors of Lancashire also act as a biogeographical barrier to a number of *Rubus* species, with the result that the bramble complexes to the north and south of the moors are significantly different in species composition.

Since 1991 two extensive programmes of systematic batological recording have been carried out by the author within the north-west of England. The first of the projects, 'The *Rubus* flora of the Liverpool and Manchester environs', involved recording within a small area of south-west Yorkshire (Watsonian VC63) which lies within the Oldham Brough of Greater Manchester. For the second project, 'The *Rubus* flora of Lancashire', some initial recording has been carried out within those parts of the Ribble Valley and Pendle districts which were in Yorkshire prior to the boundary changes of 1974. In addition, prelimary visits to the Wenning valley at Bentham during 1998 have produced results which clearly indicate the need to continue such explorations.

RESULTS
The details of the most significant Watsonian Yorkshire results obtained from the surveys are outlined in the account given below. The institutions at which representative specimens are housed are referred to by the abbreviations adopted by the International Bureau for Plant Taxonomy and Nomenclature as follows:

BM	British Museum (Natural History)
BON	Bolton Museum & Art Gallery
CMM	Bradford City Art Gallery & Museum
LIV	Merseyside County Museum
MANCH	Manchester Museum
NMW	National Museum of Wales
OLDM	Oldham Museum

South-West Yorkshire (VC63)

1. OLDHAM DISTRICT

As the Watsonian boundary of south-west Yorkshire VC63 extends across the Pennines to the Mossley area near Oldham (part of the Mersey basin) it is not at all surprising that several new Yorkshire records have been made within this area. In the case of some species original field observations were made prior to full development of panicles. A return visit was made to collect a representative series of specimens from the upper Medlock valley during 1998 for donation to **CMM** to complement the F. A. Lees *Rubus* herbarium.

Rubus accrescens Newton
Occurs in the Tame valley near Greenfield. First discovered in Yorkshire within a copse above a wall, Fir Lane, Tunstead SD/004.047 by D. P. Earl, J. Buckley-Earl and M. R. Pickles in 1992. A representative specimen was later collected in 1993 (**BON**). An additional locality was later found by D. P. Earl and E. Kearns along the Huddersfield Canal towpath by Brownhills Visitor Centre, Saddleworth 34/995.063. This species is a south-west Pennine regional endemic and is now known to occur in VC39, 57, 58, 59 and 63.

Rubus errabundus W. C. R. Watson
A small population of *Rubus errabundus* was found just inside VC63 along Thornley Brook, near County End SD958.043 in July 1995 (collected 23/08/1998, **CMM, OLDM**). This is some distance from the nearest major populations of this species about the southern slopes of Winter Hill in VC59.

Rubus cissburiensis W. C. Barton & Riddelsd
This species grows in great abundance in the woodland below Green lane, Strines Dale SD956.066 specimens collected 23/08/1998 (**BON, CMM, OLDM**). A locally common species of the south-east of England, conspecific populations of plants have also been discovered recently within vc 57, 58, 59, 60. It is known that this species which is occasionally grown on allotments readily escapes from cultivation and will rapidly colonise a woodland.

Rubus criniger (E. F. Linton) Rogers
A plant of this species was discovered growing against a dry-stone wall by Pastures Farm along Low Lane, Top o' th' Meadows 34/960.061 in July 1995 (collected 23/08/1998 **CMM, OLDM**). First Yorkshire record. On the return visit additional plants were also found about the adjacent lane-side stone walls at Top o' th' Meadows. Another population of *R. criniger* also occurs at Thornley Brook (**CMM**) where plants grows in association with *R. errabundus*.

Rubus distractiformis Newton
Though common in the Tame Valley to the north of Stockport this species is somewhat scarce in the upper reaches of the valley. Plants were however found at Bolt Meadow, Friezland Lane, Greenfield SD994.037 by D. P. Earl and D. Earl 2/09/1993 (**BON**). First Yorkshire Record. This species also occurs in the woodland below Green Lane (collected 23/0i/1998 **CMM**).

Rubus intensior Edees
A common bramble of hedgerows in the Stoke-on-Trent district of Staffordshire. Often to be found on railway embankments in East Cheshire and to the far east of South Lancashire. A few plants were found in the north-west corner of the woodland below Green Lane, by Strines Dale Reservoir SD956.066 in July 1995. Field record. First Yorkshire record. Collected 23/08/1998 (**BON, CMM, OLDM**).

'The Manchester Bramble'
This undescribed bramble is common along Waterworks Road to the west of Strines Dale Lower Reservoir. This is just within VC59 therefore it seemed highly probable that plants do actually occur in VC63. In fact this undescribed species may well have been seen in the wood below Green Lane growing with *R. intensior*; on the return visit it was discovered that most of the suspected plants growing within the woodland were *R. cissburiensis*

however a thriving population of 'The Manchester Bramble' occurs at the south-eastern corner of the woodland, and amongst the nearby hedgerows. Collected 23/08/1998 (**CMM, OLDM**).

2. Earby District

Rubus furnarius W. C. Barton & Riddelsd
A few plants of this species were discovered growing aginst the dry-stone walls just above the woodland along Standridge Clough lane, Earby SD919.464 by D. P. Earl and J. Buckley-Earl 12/09/1998 (**BON**). Confirmed A. Newton.

Rubus subtercanens W. C. R. Watson
First confirmed as present in Yorkshire from specimens collected along Waterloo Road, Kelbrook SD903.445 by D. P. Earl and J. Buckley-Earl 10/08/1995 (**BON**). Plants of this species are locally common along Stone Trough Lane and grow in association with *R. newbouldii* and *R. dasyphyllus*. It should be noted that a shade-grown specimen of a plant which may be this species had been collected somewhat further to the south from the canal towpath at Booth Bank, Slaithwaite SE069.134 by the author in 1993 (**BON**).

Mid-West Yorkshire (VC64)

As the Watsonian vice-county of mid-west Yorkshire extends a considerable distance westwards to the Ribble and Hodder valleys, it follows that the composition of the *Rubus* flora of the western fringes of VC64 should not differ markedly from that of the eastern fringes of VC60 (west Lancashire). Several target species of *Rubus* (such as *R. silurum*) were eventually found within VC64. In addition a number of unexpected discoveries have also been made. Field work carried out during 1998 within the Lune valley catchment area at Bentham further demonstrates the continuity of the species distribution from vc 60 to within the north-western fringes of vc 64.

Rubus calvatus Lees ex Bloxam
First observed by the R. Dunsop, Dunsop Bridge SD659.503 in 1994 prior to flowering. A return visit was made, and a specimen was collected in 1996 (**BON**). This species also occurs at Rabbit Lane, Bashall Eaves SD687.446 (**CMM**) and at Dove Sike, Waddington SD731.452.

Rubus cumbrensis Newton
This species was first recorded for Yorkshire in 1996 along Rabbit Lane near Browsholme Hall SD687.446 (**BON, herb. A. L. Bull** & **CCM** 1997) where the plants grow in association with *R. calvatus* and *R. painteri*. Plants have also been found in a hedgerow by Back Wood, Back Lane, Bentham Sd638.711, 21/08/1998 (**CMM**).

Rubus errabundus W. C. R. Watson
First observed in Yorkshire on a bank by a woodland edge, close to the R Dunsop, Dunsop Bridge in October 1993 by D. P. Earl and J. Buckley-Earl SD659.503. A representative specimen was eventually collected in 1996 (**BON**). Further field observations of D. P. Earl (1993-98) and A. Newton (1997) indicate that this species is locally abundant in Gisburn Forest.

Rubus gratus Focke
Over the past few years several colonies of this species have been found in the Pendle Water district of VC59. It seemed logical to assume that plants of *R. gratus* might occur along the VC59/64 boundary to the west of Blacko. A good many plants were to be found along Wheathead Lane SD84.41 in 1997; however, all the lane-side plants observed occurred within VC59. Eventually a solitary under-developed plant was found just within

VC64 beneath a rowan tree on the banks of Claude's Clough Brook. It is possible that additional plants of this species might occur within Claude's Clough and it is hoped that permission may be obtained from the land owners to visit the Clough at a later date. A representative specimen was collected from Wheathead Lane in VC59 (**CMM**).

Rubus silurum (Ley) Ley
As specimens of this species had been collected from the Reed Barn locality which lies just within VC60 by E. F. Greenwood (**LIV**), E. S. Edees (**NMW**) and DPE (**BON**) it was thought that plants would eventually be discovered in Yorkshire from within the Hodder valley. A specimen of a convincing plant was collected from a lane-side at Bashall Eaves SD690.443 in October 1997 (**BON**) and was subsequently confirmed by A. Newton at the Reading BSBI exhibition meeting in November of that year. *R. silurum* is particularly common along the lane-sides about Wray, Lancashire and has been collected from Mewith Lane, Bentham SD650.677 by D. P. Earl and J. Buckley-Earl during 1998 (**CMM**). Several records have now been gathered for the Bentham area and it is thought that this species may well be a feature of the Wenning and Greta valleys.

Rubus cissburiensis W. C. Barton & Riddelsd. (Ribble Valley form). 'The Ribble Valley Bramble'
This bramble is locally abundant in the Ribble valley woodlands to the east of Preston and was discovered at Lees SD663.443 in October 1997 (**BON**). Several of Britain's leading batologists noted the close similarity of 'The Ribble Valley Bramble' to *R. cissburiensis* during the 1998 BSBI bramble meeting (based at Chorley). The flowering panicles of the two forms are indeed very similar, however the sepals of the fruiting panicles of the Ribble Valley bramble are patent with upturned tips (as opposed to reflexed) whilst the stems are consistently hirsute (as opposed to glabrescent). At present the Ribble valley plants are considered to be a reigonal form of *R. cissburiensis*. Typical plants may well occur within vc 64, especially within suburban woodland areas, or close by to allotments.

Rubus rhombifolius Weihe ex Boenn?
A bramble closely resembling R. rhombifolius which is locally frequent in the Lune valley (VC 60) also occurs along several lane-sides at Bentham. Specimens were collected from Dumb Tom's Lane SD664.711 by D. P. EArl and J. Buckley-Earl 21/08/1998 (**BON, CMM**).

Rubus rubitinctus W. C. R. Watson
First recorded for Yorkshire by A. Newton on a visit to Gisburn Forest in August 1997. Plants found at the edge of a car park/woodland in Waddington village SD729.437 by D. P. Earl and J. Buckley-Earl are probably of this species. Specimens from both locations were donated by the author to **CMM** in 1998.

Wheldon's Bramble
An undescribed member of series Rhamnifolii. This species is common in the lower reaches of the Ribble Valley and was first discovered in Yorkshire at the car park of the Three Fishes Public House at Great Milton SD715.390. Plants have also been found along Moor lane, West Bradford SD736.451.

Samuel Gibson's Bramble
This bramble which is frequent in the Calder Valley near Todmorden was found along a woodland edge at Lees SD662.440 in October 1997 (**BON**). It appears that this bramble is a regional undescribed endemic and has so far been found within VC59, 63 and 64. It would seem appropriate to name this species in honour of the Todmorden artisan botanist Samuel Gibson who did actually collect specimens of the local brambles, some of which are held at **MANCH**.

Rubus painteri Edees
First recorded for Yorkshire in 1996 from the mossland hedgerow along Rabbit Lane near Browsholme Hall, Bashall Eaves SD688.447 (**BON, herb. A. Newton** 1996 & **BM, CMM** 1997) where plants of this species are locally abundant in the adjacent woodlands. Also occurs along Cross Lane to the west of Waddington SD707.441 (**CMM**). A species of the hills of the Cheshire/Staffordshire border recently shown to be a charateristic species of the west Pennine moor *Rubus* flora, with the known distribution extending as far north as the Abbeystead district. It should be noted that the Yorkshire plants are characterised by longer petioles and petiolules (correlating with the features of other hill district species such as *R. furnarius* and *R. lindebergii*).

Rubus wirralensis Newton
First discovered along the lane to the west of Edisford Hall, near Clitheroe SD712.415. in 1994 as a field record. It is now known that *R. wirralensis* is a characterstic species of the Ribble valley, and Lower Hodder valley woodlands. Specimens have been collected from the road to Lower Hodder Bridge, Great Mitton SD707.394 (**BON**) and the road to Higher Hodder Bridge SD700.413 (**CMM**). Several field records have been made for the bentham district during 1998 and a representative specimen has been collected from Eskew Lane SD644.690 (**CMM**).

Rubus griffithianus Rogers
Disovered along a wooded lane-side above Cow Ark Brook SD672.453 (**BON**) in October 1997. This bramble often occurs in abundance along the lanes between Garstang and Chipping. After collecting and examining a series of specimens of this bramble, Edees eventually decided that although the specimens are very similar in appearance to true *R. griffithianus* Rogers, this bramble should be regarded as an undescribed plant (*per. comm.* A. Newton BSBI bramble field meeting 1998). However, following the results of recent studies A. newton has indicated that the Lancashire/Yorkshire plants are indeed *R. griffithianus*.

Rubus rudis Weihe
The features of this bramble were demonstrated by R. Randall in a Cotswold woodland on the BSBI *Rubus* meeting of July 1997 and as a consequence the plants of *R. rudis* which occur in relative abundance in the roadside woods adjacent to the R. Ribble, Mill Lane, Gisburn SD821.496 were immediately recognised a few days later. The plants grow in association with *R. anisacanthos* (a species collected from the Gisburn area by C. Bailey in 1889 (**LIV, MANCH**). A specimen of *R. rudis* was shown to A. Newton who was subsequently able to confirm the identity of the plants in a field situation. This locality was considered to be a new British northern limit for *R. rudis* and representative specimens are held at **herb. D. P. Earl, herb. A. Newton, BON, BM** and **CMM**; however, it has since been found that *R. rudis* is the identity of a bramble discovered by G.H. Ballantyne at North Queensferry 31/133.813 vc 85 (specimen determed by A. Newton). A. Newton has suggested that the Gisburn population of *R. rudis* may have originated from tree planting.

Rubus subtercanens W. C. R. Watson
Discovered along the wooded banks of the R. Ribble at Steep Wood, near Gisburn SD800.485 in October 1997 by D. P. Earl and J. Buckley-Earl (**BON**).

Rubus phaeocarpus W. C. R. Watson
Found along a forest ride off Bailey Lane, Gisburn Forest SD760.574 by D. P. Earl and J. Buckley-Earl 19/09/1998 (**BON, CMM**) confirmed by A. Newton. This is a most interesting record as the stronghold area for this species is Berkshire-Surrey-N. Hants-Sussex. Newton indicates that the mass plant of nursery stock from the south east of England could well account for the origin of the *R. phaeocarpus* plant at Gisburn Forest (see Bull, 1997).

Rubus intensior Edees
A few plants were found on a wooded bank by the R. Dunsop to the north of a row of cottages at Dunsop Bridge SD657.507 on 8/09/1998 by D. P. Earl and J. Buckley-Earl (**BON**), confirmed A. Newton. This isolated location is a new northern limit for this species.

The Lancashire Bramble
A very common but undescribed species of the coastal plain of Lancashire. Plants were eventually discovered in Yorkshire along Gisburn Road, Bolton-by-Bowland SD801.498 in 1997 (**BON, BM**).

Concluding Remarks

From the above account it is clear that most of the characteristic species of the Lancashire border districts have now been found within the Watsonian West Yorkshire vice-counties. However, there are over 70 tetrads within 'New Lancashire' and it is intended that most (if not all) of these tetrads will be visited in the near future. Thus a detailed knowledge of the distribution of *Rubus* species within the area will soon be evaluated and further details of the eastern distribution of members of the Irish Sea *Rubus* Florula obtained.

Recent studies within the Lune Valley catchment area (1998) indicate that the Wenning valley requires further exploration.

It is now known that two species characteristic of north Wales *R. silurum* and *R. griffithianus* are present in the extreme west of Yorkshire and it is possible that additional Welsh bramble species await discovery. In addition the possible accidental importation of bramble species with tree nursery stock illustrated by the *R. rudis* and *R. phaeocarpus* records is a factor to consider when conducting field work. There is indeed considerable scope for further batological research within 'England's largest county'. Further knowledge of *Rubus* plant geography is steadily emerging, particular as co-workers such as D. Grant and T. Schofield are also contributing substantially to Yorkshire batology.

It should be noted that much can be gained from studies of herbarium collections and work has commenced on the *Rubus* collection of F. A. Lees. It is intended that a revised account relating to the batological work of F. A. Lees and associates will appear in a future issue of *The Naturalist*. A database of Yorkshire specimens and historic records is also being compiled.

Acknowledgements

Many thanks to Alan Newton for the confirmation and determination of herbarium specimens, and to Margaret Hartley of Cliffe Castle Museum, Patricia Francis of Bolton Museum, G. H. Ballantyne, D. Grant and M. R. D. Seaward.

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LICHEN FLORA OF THE WEST YORKSHIRE CONURBATION – SUPPLEMENT VI (1994-98)

M. R. D. SEAWARD
Department of Environmental Science, University of Bradford
AND
A. HENDERSON
Department of Pure & Applied Biology, University of Leeds

Despite the undoubted improvement in urban air quality brought about by the Clean Air Acts of 1956 and 1968, the lichen flora of some areas in the West Yorkshire conurbation continues to experience stress. This and the considerable loss of suitable habitats through urban and industrial expansion, road sprawl and landscaping of areas which would have been conducive to lichen colonisation have rendered overall improvement of the lichen flora a faltering process.

Nonetheless, the adoption by lichens of the numerous man-made habitats noted in our previous supplements (Seaward & Henderson 1991, Seaward *et al.* 1994, etc.) has resulted in a steady increase of species presence in the West Yorkshire conurbation and in urban areas generally. Instances of this are to be observed in the colonisation of numerous trees and of wall-copings, still bearing their carbonaceous patinas, near some of the most densely trafficked and polluted roads (for example, along the Otley Road towards the city boundary in NNW Leeds), which support relatively diverse lichen floras with occasionally high cover values, mainly of the *Physcietum-Xanthorion* community.

Some urban wastelands and disused industrial sites have proved interesting for the study of lichens. Such habitats contain a diversity of substrata subject to a variety of environmental conditions suitable for lichen recolonisation. Old minespoil heaps, particularly where left to regenerate spontaneously, now harbour some of the most prolific *Cladonia* communities outside those of the conurbation's dwindling heathland areas. Even abandoned metalwork has proved a suitable substratum for lichens, particularly when influenced by nutrient-enrichment. Gravelled and asphalted car-parks and driveways as well as churchyard and parkland pathways provide acceptable habitats for the gelatinous species *Collema crispum* and *C. tenax* and, more surprisingly, *Leptogium turgidum;* could they have adopted a new niche since it seems unlikely that such extensive colonisation was overlooked in the past? On gravelled car-parks especially it is interesting to note that gelatinous species display an almost tumbleweed-like mobility, encouraged by intensive car movement.

Sites within 20 km of the centre of the West Yorkshire conurbation have received particular attention since the last supplement (Seaward *et al.* 1994) with studies of lichen reinvasion in the Halifax area, 1993-1995 (Henderson 1995a), and of the saxicolous flora of carved rocks on Rombalds Moor (Henderson 1995b). For comparative purposes, the interesting flora observed at the recent field meeting of the YNU held at Seckar Wood, just outside the periphery of the above-defined study area (Henderson 1999) is noteworthy. A more detailed investigation of the recolonisation of urban areas with particular reference to the West Yorkshire conurbation provided in Seaward (1997) demonstrates, for example, the significant changes in suburban floras; this study also provides an updated graphical interpretation of the relationship between lichen diversity and distance from the centre of the conurbation to compare with that provided in Seaward *et al.* (1994). A new checklist of Yorkshire lichens has also been published (Seaward 1994).

The following list of lichens includes additions to the flora over the past five years based on recording units given in Seaward (1978, Figure 1 & Table 1); recording units **A** to **S** are within urbanized areas of the conurbation and **T** to **W** are non-urbanized but within 20 km of the centre of the West Yorkshire conurbation (referred to hereafter as WYC). Collectors are abbreviated as follows: PME-B = P. M. Earland-Bennett, AH = A. Henderson, AN = A. Norris, CJBH = C. J. B. Hitch, FM = F. Murgatroyd, MRDS = M. R. D. Seaward, DHS =

D. H. Smith and PS = P. Stewart. Dr B. J. Coppins' (BJC) help in the determination of a few critical species is gratefully acknowledged.

Acarospora fuscata (Schrader) Th.Fr. add **K**
A. heppii (Naeg. ex Hepp) Naeg. ex Körber add **T**
Aspicilia calcarea (L.) Mudd add **E**, **W**
Bacidia arnoldiana Körber (as forma *corticola* Arnold) add **B**, **D**, **E**, **G**; new to WYC (first record MRDS 1981)
B.chloroticula (Nyl.) A.L.Sm. add **E**
Baeomyces rufus (Huds.) Rebent. add **D**
Buellia punctata (Hoffm.) Massal. add **D**, **E**
Caloplaca decipiens (Arnold) Blomb. & Forss. add **W**
C. flavescens (Huds.) Laundon add **U**
C. holocarpa (Hoffm.) Wade add **C**, **E**, **I**, **Q**
C. isidiigera Vezda add **T** (on sandstone churchyard wall, 1995, DHS & AH); new to WYC
Candelariella reflexa (Nyl.) Lettau add **H** (Red Beck, Shibden Valley, 1994, CJBH, AH & PS); new to urbanized area of WYC
Catillaria chalybeia (Borrer) Massal. add **B**
C. lenticularis (Ach.) Th.Fr. add **V**
Chaenotheca ferruginea (Turner ex Ach.) Mig. add **T**
Cladonia fimbriata (L.) Fr. add **D**
C. portentosa (Dufour) Coem add **M** (in *Betula* scrub on industrial spoil, Kirkstall, Leeds, 1995, MRDS); first modern record in urbanized area of WYC this century
C. rei Schaerer add **M** (on waste ground, Kirkstall Forge, 1993, PME-B, AH & AN; herb. E); new to WYC
C. squamosa (Scop.) Hoffm. add **B**, **Q**
C. subulata (L.) Weber ex Wigg. add **G**
Cliostomum griffithii (Sm.) Coppins add **G**, **H** (Red Beck, Shibden Valley, 1994, CJBH, AH & PS); new to WYC
Collema crispum (Huds.) Weber ex Wigg. add **Q**
C. limosum (Ach.) Ach. add **Q**
C. tenax (Sw.) Ach. var. *ceranoides* (Borrer) Degel. add **Q**
Dimerella pineti (Ach.) Vezda add **H**
Evernia prunastri (L.) Ach. add **C**, **D**, **E**, **H**; reinvading many areas of outer suburbia of WYC
Fuscidea cyathoides (Ach.) V. Wirth & Vezda add **G** (Mixenden, 1995, CJBH & AH)
Hypogymnia physodes (L.) Nyl. add **H**
H. tubulosa (Schaerer) Havaas add **C**, **G**, **H**, **K**
Lecania erysibe (Ach.) Mudd add **K**
Lecanora albescens (Hoffm.) Branth & Rostrup add **B**, **C**, **G**, **K**, **Q**, **V**, **W**
L. campestris (Schaerer) Hue add **E**, **W**
L. chlarotera Nyl. add **G**
L. crenulata Hook. add **B**, **T**, **U**
L. expallens Ach. add **G**, **H**, **T**
L. intricata (Ach.) Ach. add **G** (Mixenden, 1995, CJBH & AH), **K**, **V**
L. polytropa (Hoffm.) Rabenh. add **C**, **K**
L. saligna (Schrader) Zahlbr. add **D**, **G**, **H**, **U**
L. soralifera (Suza) Räsänen add **D**, **K**
L. stenotropa Nyl. add **K**
Lecidea fuscoatra (L.) Ach. add **B**, **K**, **V**
Lecidella elaeochroma (Ach.) M. Choisy add **E**, **G** (Mixenden, 1995, CJBH & AH); first records within urbanized area of WYC
L. scabra (Taylor) Hertel & Leuckert add **K**
Leproloma vouauxii (Hue) Laundon add **B**, **C**, **G**, **T**; new to WYC

Leptogium gelatinosum (With.) Laundon add **B**

L. turgidum (Ach.) Crombie remove brackets from **B**; add **Q** (on tarmac path, Oulton, 1995, AH & DHS); first records in urbanized area of WYC for many years

Micarea lignaria (Ach.) Hedl. add **G** (Mixenden, 1995, AH & CJBH); first record in urbanized area of WYC for many years

M. prasina Fr. add **H**

Parmelia caperata (L.) Ach. add **G** (on *Fraxinus & Salix,* 1993, FM & PS), **H** (Red Beck, Shilden Valley, 1994, CJBH, AH & PS), **V**; first modern records for WYC

P. exasperatula Nyl. add **H** (Red Beck, Shilden Valley, 1994, CJBH & AH); new to WYC

P. glabratula (Lamy) Nyl. add **G**, **H**, **K**, **T**, **U**, **V**; reinvading many areas of the WYC

P. glabratula ssp. *fuliginosa* (Fr. ex Duly) Laundon add **W**

P.revoluta Flörke add **H** (on *Salix,* Red Beck 1995, CJBH, AH & PS); new to WYC

P. saxatilis (L.) Ach. add **K**

P. subaurifera Nyl. add **D**, **E**, **G**, **H**

P. subrudecta Nyl. add **H** (Red Beck, Shibden Valley, 1994, CJBH, AH & PS), **T**; new to WYC

P. sulcata Taylor add **D**, **H**, **K**, **W**

Parmeliopsis ambigua (Wulfen) Nyl. add **T**

Phaeophyscia nigricans (Flörke) Moberg add **T**

P. orbicularis (Necker) Moberg add **H**

Phlyctis argena (Sprengel) Flotow add **U** (on sandstone churchyard wall, 1995, DHS & AH); new to WYC

Physcia adscendens (Fr.) H. Olivier add **D**, **E**, **I**

P. caesia (Hoffm.) Fürnr. add **I**

P. tenella (Scop.) DC. add **H**, **I**, **K**

Placynthiella dasaea (Stirton) Tonsb. add **G**

P. icmalea (Ach.) Coppins & P. James add **G**, **H**, **W**

P. uliginosa (Schrader) Coppins & P. James add **D**

Platismatia glauca (L.) Culb. & C. Culb. add **G**, **H**, **K**, **V**

Polysporina simplex (Davies) Vezda add **K** (on sandstone, 1995, DHS & AH; first record within urbanized area of WYC), **U**, **W**

Porpidia cinereoatra (Ach.) Hertel & Knoph add **D**

P. crustulata (Ach.) Hertel & Knoph add **K** (Calverley, 1995, CJBH & AH; first record in urbanized area of WYC for many years), **V**

P. macrocarpa (DC.) Hertel & Schwab add **D**, **K**, **W**

P. soredizodes (Lamy ex Nyl.) Laundon add **B**, **K**, **T**

P. tuberculosa (Sm.) Hertel & Knoph add **C**, **D**, **K**

Protoblastenia rupestris (Scop.) Steiner add **D**

Psilolechia leprosa Coppins & Purvis add **U** (adjacent to copper window grille and lightning conductor of two different churches, 1995, DHS & AH), **V**, **W**; new to WYC

P. lucida (Ach.) M. Choisy add **D**

Ramalina farinacea (L.) Ach. add **B**, **D**, **E**, **H**, **T**, **W**; reinvading many areas of WYC, but its status is tenuous and mature thalli rarely develop

Rhizocarpon obscuratum (Ach.) Massal. add **B**, **C**, **D**, **G**, **K**, **W**

Rinodina teichophila (Nyl.) Arnold add **I** (on sandstone churchyard wall, 1995, DHS & AH); new to WYC

Sarcogyne privigna (Ach.) Massal. add **T** (on sandstone in graveyard, 1996, DHS); new to WYC

S. regularis Körber add **D**, **W**

Sarcopyrenia gibba (Nyl.) Nyl. add **I** (on sandstone churchyard wall, 1995, AH & DHS), **L** (on marble slab); new to WYC

Scoliciosporum chlorococcum (Graewe ex Stenhammar) Vezda add **G**, **H**, **W**

S. umbrinum (Ach.) Arnold add **C**

Stereocaulon vesuvianum Pers. add **B**

Strangospora pinicola (Massal.) Körber add **E**, **G**
Trapelia coarcata (Sm.) M. Choisy add **C**
T. involuta (Taylor) Hertel add **K**, **V**
T. obtegens (Th.Fr.) Hertel add **K**, **V**
T. placodioides Coppins & P. James add **C**, **G** (first records within urbanized area of WYC), **U**, **V**
Trapeliopsis flexuosa (Fr.) Coppins & P. James add **G**; first record within urbanized area of WYC
Usnea sutfloridana Stirton add **H** (on *Fraxinus,* Red Beck, 1994, AH), **T**
Verrucaria baldensis Massal. add **W**
V. elaeomelaena (Massal.) Arnold add **G** (Mixenden, 1995, CJBH & AH); new to urbanized area of WYC
V. hochstetteri Fr. add **D**
V. nigrescens Pers. add **E**, **I**, **K**
Xanthoria candelaria (L.) Th.Fr. add **D**, **E**, **H**, **I**, **T**; reinvading into suburbia of WYC
X. elegans (Link) Th.Fr. add **M**
X. parietina (L.) Th.Fr. add **K**
X. polycarpa (Hoffm.) Th.Fr. ex Rieber add **D**, **M**; spreading into suburbia of WYC

As a consequence of the above work, the lichen flora of the West Yorkshire conurbation can be summarized as follows: 363 lichen taxa (cf. 800 for the county as a whole – Seaward 1994) have been reported from the area within 20 km of the centre of the conurbation, of which 5 are doubtful in the absence of supporting herbarium material and at least 30 are extinct in the area; 230 have been recorded during the present survey (October 1967-December 1998).

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YORKSHIRE NATURALISTS' UNION EXCURSIONS IN 1998

Compiled by

A. HENDERSON

SECKAR WOOD (VC63) 16th May (Janetta Lambert)

Approximately 20 people met on a beautiful sunny morning to explore this varied and interesting area. The afternoon meeting was held at Waterton Park Hotel, previously Walton Hall and the home of the naturalist Charles Waterton. The house and garden situated on an island in the lake made a delightful setting for our reports of the day's activities. The meeting closed with a toast to Charles Waterton proposed by Albert Henderson, and a vote of thanks to the hotel management, who now run this historic property.

ORNITHOLOGY (J. E. Dale)

The weather conditions were calm and fine giving a good opportunity to carry out a survey of singing males in the area. The southern half of the woodland and the whole of the heathland area were covered during the morning, and the remainder of the woodland was surveyed in the afternoon.

An endeavour was made to select routes that took the observer to within approximately 100 metres of any part of the site. Whilst it is certain that not all singing birds were located, the probability of duplication was relatively low.

Wren proved to be the most frequent species with 27 located, and other totals were: Robin 23, Willow Warbler 16, Blackcap 12, Blackbird and Chaffinch 7 each, Garden Warbler 5, Chiffchaff 4, and Dunnock and Song Thrush 1 each. In addition Tree Pipit, Linnet and Yellowhammer were present on the heathland, and Whitethroat along the woodland edge. Other species recorded: Mallard, Sparrowhawk, Kestrel, Pheasant, Moorhen, Wood Pigeon, Green Woodpecker, Great Spotted Woodpecker, Long-tailed Tit, Blue Tit, Great Tit, Treecreeper, Jay, Magpie, Jackdaw, Carrion Crow, Goldfinch and Bullfinch. In all a satisfactory day which gave us a reasonable picture of the woodland's bird populations.

CONCHOLOGY (A. Norris)

The discovery of *Zornitoides (Zonitoides) excavatus* (Alder, 1930) under a log within a few minutes of arriving emphasized the acidity of the woodland. A true calcifuge species *excavatus is* never found in areas that are base rich, and is usually an indicator of a species-poor molluscan community. It was a surprise, therefore, to record 28 species from within the woodland.

The most notable find of the day was *Physa acuta* Drap., 1805. This species is considered to have been introduced into Britain from Europe with water plants. It survives in a few scattered localities throughout Yorkshire, and would normally not be worth a mention. The colony that occurred in the upper pond was remarkable, however, for the minute size of the specimens found. The snails all looked to be adult and yet measured about one-third of the normal size for this species.

LEPIDOPTERA (J. A. Newbould)

We started our examination of Seckar Wood by looking at the NVC type W10 *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland to the west of the A61. This was typical woodland, although the oak was scarce and the *Betula pendula* was more common. The ground flora was dominated by *Holcus mollis.*

Generally, both moths and butterflies were scarce in the woodland, probably due to the cold wet weather which had preceded our visit. The leaves of the bramble had mines of the micromoth *Stigmella aurella* and some of the oak already had mines of the micromoth *Eriocrania sub-purpurella.* However, the late season was in our favour and both Mrs J. Payne and I recorded the Orange Underwing *(Archiearis parthenias),* confirming a 1978 record of the late Mr J. Flint, and we both recorded Argent and Sable *(Rheumaptera hastata)* – a moth for which there are only few records in VC63. Both these species inhabit birch woodland. Grey Birch *(Aethalura punctulata)* was also seen throughout the day. Large numbers of the micromoth *Adema remerella* were seen in numerous sunny places at the woodland edge. Moving westwards towards Wooley Moor, the woodland opened out to type H9 *Calluna vulgaris-Deschampsia flexnosa* heathland. Here moths such as Common Heath *(Ematurga atomaria)* and *Neofaculta ericetella* were found.

During the day, nine species of butterfly were recorded although numbers were low. A female Holly Blue *(Celastrina argiolus)* and the Comma *(Polygonia c-album)* were good finds confirming the regular appearance of these species, since 1990, in the West Riding, reversing the trend described in Sutton and Beaumont's *Butterflies and Moths of Yorkshire.* Other species recorded included: Green-veined White, Peacock, Small Tortoiseshell, Orange Tip (male), Small White, Large White, Common Carpet, Silver Ground Carpet and Brown Silver-lines.

COLEOPTERA (M. L. Denton)

The favourable weather conditions enabled the coleopterists to record a total of 69 species. Although most of these are commonly encountered species and were therefore to be expected, some are of a more notable nature and deserve comment. The small pond held the water beetle *Rhantus exsoletus,* a lowland species of acid ponds and old fenland which is locally distributed in Great Britain, there being 15 previous Yorkshire records. It was pleasing to record the presence of two Notable B weevils, *Rhynchites cavifrons* and *Curculio villosus. Rhynchites cavifrons* is a large (6.0-8.5 mm) metallic blue-green primitive weevil, the larvae of which develop in young twigs of oak and possibly birch and hazel. The species is mainly southern in distribution, Yorkshire (only three previous records) being on its northern limit. *Curculio villosus* is also associated with oak. Both sexes have a very long rostrum which culminates in powerful jaws, the female using this to penetrate acorns in which she lays eggs. The species is locally distributed but becomes rarer in the north, this being the tenth county record.

The most unexpected find of the day was the conspicuous 'carrion' beetle *Dendroxena quadrimaculata.* The species, which is afforded Notable B status, is an active predator of geometric caterpillars in oak foliage. There are 12 previous Yorkshire records, this being the first since 1950. Other interesting species, all of which are associated with fungi, included *Scaphidium quadrimaculatum, Anisotoma humeralis* and the Notable B *Scaphisoma boleti. Bitoma crenata,* a locally distributed species which is found under the bark of fungus-infested trees, was also located.

FLOWERING PLANTS (D. R. Grant)

Seckar Wood SSSI is situated 7 km south of Wakefield on the Coal Measures series of rocks represented here by sandstones and shales. These rocks give rise to an acid-loving flora. In the wet areas near the entrance there are several stands of sedges. *Carex pendula, C. paniculata* and C. *remota* grow with C. *laevigata.* The oak-birch woodland has the usual species associated with this habitat together with *Milium effusum, Viburnum opulus, Veronica montana, Lamiastrum galeobdolon,* with a little *Ceratocapnos claviculata.* There is an understorey of *Rubus dasyphyllus.*

The artificial ponds have recently been cleaned out and they are now covered with *Equisetum fluviatile* and *Potamogeton natans,* with *Elodea canadensis* in one part.

Drier parts of the open heathland have *Carex pilulifera, C. binervis* and *Rubus sprengelii.* This area also has a colony of *Genista anglica* which grows with *Ulex gallii.* On the north side of the heath the land falls away giving an area of marshy ground. Here are many of the usual bog plants with good colonies of *Equisetum sylvaticum.* It is in this area that *Pyrola rotundifolia* grows. This was searched for unsuccessfully, but as this was an early meeting the leaves would have been very small and hard to detect. There are other species of note here scattered about the woodland, such as *Sorbus aria, Prunus padus, Quercus cerris* and a few *Corylus avellana.*

MYCOLOGY (C. S. V. Yeates)

A total of 67 species was assembled during the day, the total for Seckar Wood itself (47 species) being complemented by a search of surrounding lanes and hedgerows. The downy mildew *Peronospora lamii* was found on two different species of *Lamium: L. maculatum* by Parson Lane and *L. album by* Barnsley Road; both are new hosts in Yorkshire for this infrequently recorded species. Another downy mildew seen, *Peronospora niessleana,* is restricted to *Alliaria petiolata.* Four other species (from various orders and all on dead stem bases) were also recorded on this host. They included the ascomycete *Leptosphaeria maculans* and the hyphomycete *Dendryphion nanum.* Another ascomycete with relatively few Yorkshire records but a species which should prove to be relatively common in time was *Stomiopeltis betulae* on *Betula* bark.

Discomycetes were surprisingly scarce but *Cudoniella clavus* was locally abundant in its classic habitat on dead twigs and stems in shallow slowly running water. A dead branch of *Calluna*, handed to me by Albert Henderson, proved to hold another discomycete, *Tapesia cinerella,* a third Yorkshire record.

Among the coelomycetes, *Discogloeum veronicae* was found on living leaves of *Veronica persica.* This was the fourth Yorkshire record of an under-recorded species and the first on this host (interestingly the three previous records are all on a different *Veronica* species). Hyphomycetes with few county records included *Didymaria kriegeriana,* a parasite of *Silene dioica* leaves. *Septonema seceders,* a species usually recorded, as here, on *Betula* bark, was last recorded in Yorkshire 45 years ago. *Cacumisporium capitulatum,* recorded only once before in Yorkshire (by Alan Legg in 1996 at Swinsty Reservoir, also in mid-May), was found here on damp *Betula* wood. Bud-blast of *Rhododendron* was found with its characteristic synnemata on dead leaf-spots on living leaves; as its vernacular name implies, it is usually found on mummified and aborted buds. The main stream through the wood was sampled for aquatic hyphomycetes; the most notable species recorded was *Tricladium castaneicola* with its elegant, branched conidia.

LICHENOLOGY (A. Henderson)

Trees in the generally densely canopied woodland were overall unproductive of foliose or fruticose lichens, a monotone of *Lecanora conizaeoides,* algae and *Lepraria incana* being the norm. The old, deeply shaded stone wall around the first pond from the roadside, frequently draped in *Lepraria incana,* had only expected species. *Thelidium minutulum* on the aggregate of the disused outbuilding by the pond was the most interesting saxicolous find here. A real pleasure, however, was to see on a very mature oak bole some extremely well developed thalli of *Gyalideopsis anastomosans,* the light grey, sterile crust crowded with abundant hyphophores, an unusual sight in this part of the county; sprinkled over the surrounding shady bark were numerous glossy white fruits of *Dimerella diluta.*

The open heathland beyond was scattered with patches of *Caladonia,* often incipient and considerably stressed. Just occasionally a sheltered reach of ground between *Calluna* clumps appeared to be the refuge for the remains of an earlier, richer *Cladonia* heath. One such area (2 m^2) held a mixture of *Cladonia chlorophaea, C. cornuta, C. diversa, C. floerkeana, C. humilis, C. macilenta, C. polydactyla, C. pyxidata, C. ramulosa, C. squamosa* and *C. subulata* (fertile). The axil of an old rough-cut stump close by had fruits of *Lecania cyrtella,* uncharacteristic in appearance under a coat of algal gelatine.

Apart from a fragmentary *Physcietum* on concrete fencing, the only foliose species encountered was *Parmelia saxatilis,* confined to a stretch of old drystone wall on the northern boundary of the woodland. Although the lichen flora is unprolific, the traces of a more vigorous *Cladonia* heath of old are suggestive of a history connected with rabbit-farming activity on the warren territory which existed on the northern reach of the

Woolley wastes in 'a place called The Rakes' until 1613 when the warren was removed to Staincross wastes.

FARNHAM GRAVEL PITS (VC64), 13th June (Jean Kendrew)

On a dull, damp morning 20 people gathered in the Bird Hide at Farnham Gravel Pits to be briefed about the site by June Atkinson, Chairman of the Scientific and Conservation Committee for Farnham South Lake. Despite the rain, which fell throughout the day, members pursued their individual interests as best they could. At the meeting in Scriven Womens' Institute Hall, the President, Margaret Atherden, thanked Harrogate and District Naturalists' Society and the Divisional Secretary, for arranging the visit, and the Slingford Trust for allowing access to the site. John Mathers gave special thanks to June Atkinson for her involvment before, and during, the day. Members were encouraged to contact her if they wished to return to the site for further recording in more favourable conditions. 18 Affiliated Societies were represented at the meeting.

MAMMALS

Although rabbits are a problem on the site, it was pointed out that nearby there is a site of an ancient warren, and a wood called 'Old Coney Garth Wood'. There was evidence of moles, and two toads and a juvenile newt were seen.

ORNITHOLOGY (J. Atkinson)

40 different species were noted, of particular interest were a Mute Swan with four juveniles, a Mallard with young (one albino), an Oystercatcher with one juvenile. Black-headed gulls were breeding on the site, as were a pair of Common Terns. A new wall for Sand Martins has recently been built, in memory of Michael Clegg, and it is thought that some of the birds may be using it for breeding. A spotted Flycatcher was seen near the entrance to the site.

CONCHOLOGY (D. R. Grant)

Those species noted were *Cochliocopa lubrica, Helix hortensis, Agriolimax agrestis,* and *Arion ater.*

LEPIDOPTERA (J. Newbould)

The temperature during the meeting was 12°C and few butterflies or moths were flying.

The Oak adjacent to the car park has the micro-moth *Eriocrania subpurpurella.* A small area of *Typha latifolia* on the northern shore of the southern lake showed larval feeding by the micro-moth *Limnaecia phragmitella.* Common Blue Butterfly and White Ermine Moth were also reported.

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

Specimens of galls on the following hosts were collected by J.P. in the rain: on *Alnus glutinosa, Eriophyes inangulis,* a gall mite causing upper-side pustules in the angles between the midrib and primary veins; on *Carpinus betulus,* a gall mite whose specific identity is uncertain, causing patches of abnormal hairs below the leaves; on *Corylus avellana, Phytoptus avellanae,* a gall mite causing leaf buds to fail to open and the internal leaves to thicken and become very hairy as a result of housing a mite population; on *Crataegus monogyna,* an aphid species causing longitudinal rolling of terminal leaves; on *Fraxinus excelsior, Psyllopsis* sp., usually cited as *P. fraxini,* causing downward rolling of leaf edges and a network of red colouration (it seems, however, that up to four *Psyllopsis* species may be involved); on *Glechoma hederacea, Lipothenes glechomae,* causing galls round 15 mm. diameter on the lower side of the leaves and containing the gall wasp larvae; on *Populus tremula, Phyllocoptes* sp., a gall mite causing 3-4 mm. diameter pustules on the upper sides of the leaves and an erineum of abnormal hairs below; on *Prunus spinosa,* *Eriophyes similis,* a gall mite causing a series of elongated and therefore often confluent lower side galls round the leaf edges (perhaps the most commonly seen of all plant galls), on *Quercus robur, Andricus curvator,* a sexual generation gall on lowest part of midrib of leaf and causing an acute bend in the leaf; *Andricus anthracina,* agamic generation early in producing 3 mm. galls on the leaf midrib; on *Salix cinerea, Iteomyia capreae,* causing 3 mm. upper surface pustules with a lower surface opening (the cecidomyid larvae had already left); on *Ulmus glabra, Kaltenbachiella pallida,* an aphid causing an 8 mm diameter gall on the leaf midrib and considerable distortion of the blade (the emerging larvae move to the subterranean parts of their secondary hosts, *Lamiaceae); Tetraneura ulmi,* an aphid causing a strange chimney cowl-shaped gall on the upper surface (the emerging aphids move to their secondary hosts, grasses); *Eriophyid* mites causing irregular shaped dark green pustules, 1-2 mm. high on the leaf upper surface, hairy inside and with an opening on the lower surface, (the mite species probably only determinable by a specialist).

FLOWERING PLANTS (D. R. Grant)

The gravel pits are situated on an area of river-borne detritus which is a mixture of sandstone and limestone pebbles. The gravel pits, which are not worked now, have been landscaped and this has resulted in large areas of silty soils and clay areas with only small areas of sand. The south lake has very little aquatic plant life at the present moment, *Myriophyllum spicatum, Chara vulgaris* and *C. virgata* being the only species present.

The northern margin has a broad band of *Crassula helmsii.* Other marginal plants were *Carex otrubae, Eleocharis palustris, Typha latifolia, Scrophularia auriculata* and *Lycopus europaeus.* Marshy areas had *Equisetum palustre, E. fluviatile* and *Bolboschoenus maritimus.* In areas where the pebbles were predominantly limestone, *Primula veris, Hypericum hirsutum* and *Anthyllis vulneraria* were found. In the protected grassland there were the orchids *Dactylorhiza fuchsii* and *Listeria ovata.* One open area had a few *Ophrys apifera.* The drier ground on the edges of the reserve had a few brambles represented by *Rubus dasyphyllus, R. tuberculatus, R. eboracensis* and *R. echinatoides.* Another area has some good colonies of *Hypericum perforatum* and *Centaurium erythraea.*

Two small ponds have been constructed and these had several introduced species, some examples being *Ranunculus lingua, Nymphoides peltata* and *Lagarosiphon major.* The perimeter areas have been planted with trees, both native and introduced species, typical ones being *Populus tremula, Sorbus aucuparia, Alnus incana* and *A. cordata,* the latter two species shedding viable seed and with young tree seedlings appearing near the taller mature trees.

MYCOLOGY (C. S. V. Yeates)

A total of 38 species was recorded on the day. This was a modest total but the weather was far from ideal for a bespectacled mycologist! Nevertheless, no fewer than three species new to the county were collected, and the reserve would doubtless repay study at other times of the year.

The find of the day was the minute white pleurotoid agaric *Cheimonophyllum candidissimum.* A downy species with globose spores, this was found on fallen decorticated twigs by a stagnant pond. Not far away in dense *Urtica* stands, *Calyptella capula,* an anomalous agaric which looks more like a discomycete, was abundant on standing dead stems. Another similar, but stalkless, pseudo-discomycete was also collected on the same stems; this remains to be named, but appears to be a species of *Lachnella.*

The other species of note belonged to the mitosporic imperfect fungi. The hyphomycete *Taeniolina centaurii* which occurs on dying leaves on living *Centaurium erythraea* plants, was new to VC64. The coelomycete *Phomopsis hyperici,* found on dead standing stems of *Hypericum hirsutum,* was new to Yorkshire. *Cytospora occulta,* another coelomycete, this time on dead attached twigs of *Alnus glutinosa,* was also new to the county.

LICHENOLOGY (A. Henderson)
Heavy rain had highlighted the strong cyanobacterial population of *Nostoc commune* littering the damper parts of the well grazed car parking area, and closer examination unsurprisingly revealed a frequent interlarding of *Collema crispum* and the neatly packed cushions of *C. tenax* var. *ceranoides.* Still more intensive study on uncomfortably wet ground produced the pleasing find of two thalli of the tiny crustose gelatinous species, *Leptogium biatorinum.* Old wooden posts around the carpark had at times well developed *Xanthorion,* and a few foliose species of this nitrophilous community were occasional, though never profuse, on trees and stone, with hopeful signs of incipient recolonisation in numerous young thalli of *Lecanora chlarotera* and *Xanthoria polycarpa* on several trees.

In the inclement weather only areas north and west of the South Lake were studied. The most interesting discoveries of the afternoon were both on soaking soil: *Thelidium minutulum,* rare on soil, occurred along the edge of an earthern lakeside path; and *Thelidium zwackhii,* a pioneer and transient coloniser of bare earth, on a patch of scraped soil in the carpark. Of the 32 taxa recorded, 9 were additions to the 122 already listed for the 10 km square, SE(44)/35. A visit in drier weather would no doubt lengthen this list considerably.

FRESHWATER BIOLOGY (L. Magee & A. Heaton)
The unseasonable weather proved to be a real deterrent to investigating the aquatic flora and fauna and to the emergence of adult insects. Most of the survey was conducted at the west side near the hide. Marginal plants were interesting and were typical of similar restored gravel pits in the north of England; a few species of untypical plants have occurred at other sites also. Their provenance is uncertain.

There appears to be a paucity of true aquatics but Watermilfoil *(Myriophyllum alterniflorum)* and the Stoneworts *Chara vulgaris* and *C. virgata* were frequent around the perimeter of the lake. The stoneworts, however, did not have the lush growth found in alkaline lakes such as Malham Tarn. Although the bottom of the lake appears to be mainly silica sand and silt, the pH value was 8.6, but a sample from shallow water was low in nutrients.

Brown Trout and Rainbow Trout are stocked regularly for angling and other coarse fish are stated to be present. The only fish seen on the day were Three-spined Sticklebacks *(Gasterosteus aculeatus).*

Species of the alga *Spirogyra* were frequent but not abundant.

Mollusca recorded were *Potamopyrgus jenkinse, Planorbis planorbis, Lymnaea peregra, L. auricularia* and *L. stagnalis.* Leeches seen were *Glossiphonia complanata* and *Helobdella stagnalis.* Coleoptera listed were *Haliplus* and *Dytiscus* species, with *Haliplus obliques* seen in *Chara* beds. Other invertebrates noted were juvenile Waterboatmen, *Calicorixa* species, *Nononecta glauca, Sigara* species, the Waterhoglouse *Asellus aquaticus,* and *Gerris lacustris.* Odonata encountered were larvae of *Coenagrion puella, Enallagma cyathigerum* and *Ischnura elegans.* Mayflies seen were *Cloeon dipterum* (larval) and *Caenis hororarium,* and only one unidentified cased Caddis larva was found.

This is a large lake so that a boat survey would certainly considerably increase the list of species. Swifts in some numbers were feeding throughout the day on chironomid midges which were emerging in deep water.

COTTERDALE (VC65), 4th July (Deborah Millward)
About 30 members from 20 societies, plus three guest members from the British Pteridological Society attended the excursion on a fine, short-sleeve sort of day. The majority of members avoided the more mundane acid grassland and concentrated their efforts on the West Gill, criss-crossing it frequently to explore the rich, wet shale-banks, those in wellingtons being at a distinct advantage.

Judith Allinson re-found *Juncus triglumis* and was the only person to make the watershed and record *Carex bigelowii.* Chris Yeates was thought to be lost and gone forever but returned an hour after the meeting to an anxious wife and a somewhat belated lunch. Those who made it to the limestone were rewarded with spectacular scenery, a colony of the biggest ever *Equisetum variegatum,* and a tally of 20 pteridophytes. Perhaps we should formally invite the Fern Folk to become affiliated. Freshwater biology was under-recorded: blackfly, mayfly and the dragonfly *Cordulegaster boltonii* were noted, with frog and brown trout amongst the meatier species. The bryologists, lichenologists and ornithologists had a very rewarding day, but black grouse remained as elusive as ever.

Our thanks must go to the owner Mr Cannon for access, and to Mr Metcalfe for the offer of the barn for the meeting, which proved unnecessary as members opted to sit on the bridge parapet instead.

MAMMALS AND REPTILES (M. Thompson & J. Lambert)
At least three Common Lizards *(Lacerta vivipara)* were seen in the area of West Gill. One attractively striped individual remained basking for several minutes in spite of the proximity of humans.

Active mole hills were noticed. Several rabbit were seen. Numerous vole runs could be found under tussocky grass containing droppings and food remains, and live voles were seen, one of which could definitely be identified as a Field Vole. According to the farmer there used to be Water Voles downstream from the farm but these were no longer to be found. Footprints seen under bridges were those of the Brown Rat. Tracks of deer were noticed in the woodland, Roe Deer are known to occur in the area.

ORNITHOLOGY (G. Alderson)
The area does contain a number of Black Grouse but none were seen on the meeting day. I had seen and photographed 6 males and 6 females on the fellside in October 1976. The expected list of common species was noted – many were feeding young. Rather uncommon species were Yellow Wagtail and Siskin.

A group of Black-headed Gulls flew over the S.W. Plantings and a pair of Buzzards circled. Common Sandpiper was seen, so was presumed to be breeding in the area. The pairs of Spotted Flycatchers had young – these were in the vicinity of the houses. A total of thirty two species were seen including Redstart, Grey Wagtail, Dipper, Lesser Black-backed Gull and Oystercatcher.

CONCHOLOGY (A. Norris)
The land and freshwater mollusca found in Cotterdale proved to be few and far between. The wet banks produced by the erosion of the Yoredale Shales produced the bulk of species found, the open grass and moorland being too acid for mollusca. The isolated areas of limestone rocks and the limestone gorge cut through by West Gill proved to be very poor, with a very limited molluscan fauna. Some of the more upland areas of limestone, beyond those visited on the day, may prove to have a richer snail fauna, but investigation of these areas will need to be undertaken on subsequent visits to the area.

Species found were: *Carychium minimum* (Muller, 1774), *Carychium tridentatum* (Risso, 1826), *Cochlicopa lubrica* (Muller, 1774), *Pyramidula rupestris* (Drap., 1801), *Lauria (Lauria) cylindracea* (da Costa, 1778), *Discus (Discus) rotundatus (Muller,* 1774), *Arion (Arion) ater* (Linne., 1758), *Arion (Mesarion) subfuscus* (Drap., 1805), *Arion (Carinarion) circumscriptus* (Johnston, 1828), *Arion (Kobeltia) intermedius* (Normand, 1852), *Vitrea (Crystallus) crystallina, Vitrea (Crystallus) contracta* (Westerlund, 1871), *Aegopinella pura* (Alder, 1830), *Aegopinella nitidula* (Drap., 1805), *Oxychilus (Oxychilus) cellarius* (Muller, 1774), *Oxychilus (Ortizius) alliarius* (Miller, 1822), and *Deroceras (Agriolimas) reticulatum* (Muller, 1774).

LEPIDOPTERA (J. Payne)
The writer spent the day near the village in the meadows, stream sides and woodlands. Five species of butterflies were seen or reported on the wing, notably Small White,

Green-veined White, Red Admiral, Common Blue and Small Heath. Small Heath was reported to be numerous in the higher West Beck area. Four groups of Small Tortoiseshell larvae and one of Peacock larvae were seen on isolated and exposed groups of nettles in the rougher meadows. The larvae were still in tight webbed groups probably in the third instar. Small Tortoiseshell are said to disperse after the fourth moult and Peacock even later.

Among the Geometrid moths were Chimney Sweeper, Common and Silver-ground Carpet and Common White Wave. The best observation of the day was made by B. and C. Caudwell who saw a member of the Arctiidae, a female Wood Tiger up West Beck. This colourful moth has bright red sides to its abdomen and orange and black 'mosaic' patterned fore and hind wings. This is the second time it has been observed at a Y.N.U. meeting in Wensleydale. Last time it was on the moor above Thornton Rust in 1991.

PLANT GALLS (J. Payne & K. G. Payne)
9 galls were found attributable to specific gall-causers and a list of these will be sent to the appropriate recorders. Probably the most interesting was the erineum caused by the mite *Eriophyes sorbeus* on rowan collected by J.P. The rather few previous records suggest that this may be a northern species in Britain, in Yorkshire found mainly in the western hilly areas.

FLOWERING PLANTS (D. R. Grant)
This dale is situated on the Yoredale Series of rocks of the Carboniferous Period. The rocks consist of limestones, sandstones and shales.

With the high rainfall in this part of the county, there is much leaching of the lime and the area tends to have an overall acid flora, which is interspersed with pockets of calcareous soils near the limestone outcrops. This variability shows in plants which require totally different conditions often growing almost side by side. There were many examples, such as *Calluna vulgaris* growing near *Primula vulgaris.*

Most members followed the West Gill to the waterfalls and limestone cliffs. The hillsides have many flushes which are the home for many sedges. In the alkaline ones *Carex panicea, C. flacca* and *C. pulicaris* were growing with other marsh plants, whereas *C. nigra* and C. *viridula* subsp. *oedocarpa* were in the acid ones. One very wet area had a large stand of *C. rostrata*. The drier hillsides had many plants of *C. pilulifera* and *C. binervis*. Other species of note were *Isolepsis setacea*, *Trichophorum cespitosum* and *Carex bigelowii.* The damp cliff faces had many interesting species *Rubus saxatilis* was growing with *Crepis paludosa* and many plants of *Pinguicula vulgaris*. Other species found on cliffs were *Asplenium trichomanes-ramosum, Cystopteris fragilis*, *Alchemilla glabra* and *Hypericum pulchrum.*

On some north-facing cliffs there were some large colonies of *Phegopteris connectilis* and a few plants of *Polystichum aculeatum.* The rare plant of the meeting was *Equisetum variegatum* which was discovered near the top waterfall. *Minuartia verna* and *Testuca vivipara* were also seen.

Below the farm, members reported from the meadowland many *Dactylorhiza fuchsii* and *Equisetum sylvaticum.* A colony of *Cirsium heterophyllum* was also in this area.

BRYOLOGY (T. L. Blockeel)
The route taken by the bryologists followed the banks of the stream in West Gill. Progress was customarily slow, and we advanced less than 2 km from the bridge in Cotterdale, finishing our exploration at a limestone crag by a spring in the Benton Close area. The rock on the banks of the stream showed varying amounts of base enrichment. The drier outcrops were generally more acidic. A fine fruiting population of *Diphyscium foliosum* on one outcrop was a particularly pleasing find near the start of the walk. *Barbilophozia atlantica* and *Racomitrium affine* were on the same crag. Some wet stony ground at the edge of the stream nearby produced *Pohlia drummandii,* a first record for VC65. Other calcifuge or weakly basicolous species noted along the banks of the stream were *Lophozia incisa,*

Scapania scandica, Ptilidium ciliare, Fissidens osmundoides, Funaria obtusa, Anomobryam filiforme, Plagiobryam zierii, Amphidium mougeotii, Heterocladium heteropterum and *Isopferygium pulchellum.* There were some magnificent patches of *Breutelia chrysocoma in* seepage areas, and other species indicative of a higher base content included *Leiocolea bantriensis, Jungermannia atrovirens, Preissia quadrata, Gymnostomum aeruginosum, Bryoerythrophyllum ferruginascens* and *Orthothecium intricatum.* Much the most significant find, however, was *Leiocolea gillmanii* on a flushed turfy rock ledge. This is a montane species which has scattered localities in central Scotland, but which had previously been recorded only once in England, at Ribblehead in VC64.

There were a number of flushed areas and mires along the stream banks, mostly oligotrophic. *Jungermannia exsertifolia* was seen at one spot, and some of the flushes had plentiful *Plagiomnium elatum* and *Cratoneuron commutatum* var. *falcatum. Philonotis calcarea* and *Drepanocladus cossonii* were seen in smaller quantity. *Fontinalis antipyretica* var. *gracilis* was submerged in the stream.

The crag near Benton Close was of much purer limestone and produced several of the characteristic calcioles of such habitats in the Dales: *Scapania aspera, Cololejeunea calcarea, Apometzgeria pubescens, Mnium marginatum* and *Plagiopus eodrianus.* The diversity of habitats in the small area examined gave a rich variety of bryophytes and an impressive total list of 132 species.

MYCOLOGY (C. S. V. Yeates)

The area to be investigated was not conducive to the study of fungi. The season was too early for the appearance of larger fungi, the chief exceptions being: *Suillus grevilli,* a bolete associated with larch (and hence an alien species); and *Tephrocybe palustris,* a common sphagnum associate, the latter present in considerable numbers. Overgrazing by sheep meant that there were few dead stems, and nearby coniferous plantations which were also investigated yielded little of interest, despite diligent searching. However, as is often the case, one or two finds added to our knowledge of the distribution of Yorkshire fungi. The discomycete *Lachnum controversum* on *Holcus mollis* was a second VC record. The hyphomycete *Mastigosporium muticum* on living leaves of *H. mollis was new to* VC65. The, most significant record was of the dematiaceous hyphomycete *Arthrinium morthieri,* a member of a genus found chiefly on dead grasses or sedges. Here it was found on dead leaves of *Carex viridula* ssp. *oedocarpa* and represents a first county record.

LICHENOLOGY (A. Henderson)

Morning and afternoon passed by apace, studying the lichens of West Gill along the banks and low grassland lying between Cotterdale Bridge and Dry Gill. The prolific flora on the copings and niches of the old drystone enclosure walls included frequent colonies of *Collema fuscovirens* and *Leptogium gelatinosum. Solenopsora candicans,* however, was seen at only one locality, fruiting minimally. Bright orange thalli of the aquatic *Hymenelia lacustris* speckled the boulders in the beck. Plentiful among over a dozen *Cladonia* species were *C. pocillum* and *C. uncialis* ssp. *biuncialis.* A diligent search of wall niches was rewarded by the discovery of *Polyblastia gelatinosa*; and densely fruiting *Parmelia glabratula* ssp. *fuliginosa* was a pleasure to see.

The basidiomycete lichen, *Omphalina hudsoniana,* with *Coriscium*-like thallus, was found by those who climbed to the upland area, and was among 12 additions to 175 taxa already listed from the 10 km square.

WELWICK SALTMARSH (VC61), 18th July (P. J. Cook)

This meeting was arranged at the request of the Yorkshire Wildlife Trust who had recently acquired some land and the riparian rights over most of what is regarded, at least by local naturalists, as the finest area of saltmarsh in the Humber estuary. The saltmarsh and adjacent relic dune has been the subject of intense study by local naturalists and a study of the Empidoidea by Roy Crossley was published in *The Naturalist* (**121**, 1996); he showed representative examples from his studies at the meeting.

Strong winds and an overcast sky kept most flying insects hidden out of view but a rising tide enabled good views of the wader roosts on the mud flats. The botanists, soon exhausted of floral diversity, extended their range into a nearby soak dyke with good results, while other groups strayed onto the nearby Haverfield Quarries Nature Reserve. Later in the day, the lichenologists moved to St German's Church, Winestead.

All re-assembled at the Hildyard Arms in Patrington where more than 30 people representing 18 affiliated societies took refreshment before reports were read. The meeting was led by the President, Dr Margaret Atherden. The Yorkshire Wildlife Trust and the organiser were thanked.

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

The main feature of ornithological interest is the shoreline along the saltmarsh which forms a significant wildfowl and wader roost, where counts for the Wetland Bird Survey are regularly undertaken by a local birdwatcher.

With the high tide at approximately 14.00 hours we had an opportunity to assess numbers at the roost. The best vantage point is from the raised bank to the south of the marsh immediately beyond Winestead Drain, but with limited time available we made our observations from the bank immediately north-east of the saltmarsh. Estimates made for the most numerous species were: Shelduck 500, Golden Plover 40, Dunlin 500, Curlew 200 and Redshank 200. Less numerous species noted from the bank as they flew upriver into the roost were: Oystercatcher and Grey Plover at least 10 each, Knot 4, Bar-tailed Godwit 1, Whimbrel 2, Spotted Redshank 1, and Greenshank 3; also two Common Terns followed the same flight line upriver. A few Mallard and Lapwing were also present in the saltmarsh.

Amongst the hedgerows along the banks and adjacent tracks Linnets were frequently observed; at least 4 Whitethroats and 3 Yellowhammers were in song, and Tree Sparrows were calling from hawthorns near our car park. Other species in a total of 41 recorded included Grey Heron, Sparrowhawk, Stock Dove and Skylark, with about 30 of the latter feeding in the saltmarsh.

LEPIDOPTERA (J. A. Newbould)

Strong south westerly winds made collecting lepidoptera extremely difficult. No micro-moths were collected due to the poor weather conditions.

On the track to the reserve the Magpie moth *(Abraxas grossulariata)* was beaten from an Elm hedge whilst nearby Hawthorn had the characteristic web of the moth *Yponomeuta padella.* Most members consistently reported seven butterflies during the day with good numbers of Gatekeeper *(Pyronia tithonus),* and a number of colonies of the Ringlet *(Adantophus hyperantus)* both seen in the dune slacks towards the northern boundary of the reserve.

N.B. I also collected a number of Common Field Grasshoppers *(Chorthippus brunneus),* a single Short-winged Conehead Bush Cricket *(Conocephalus dorsalis)* and a mirid bug *(Adelphocoris lineolatus)* from the dunes to the north-west of the site.

COLEOPTERA (F .E. Kenington *et al.)*

A total of 15 beetle species were recorded of which the Wharf Borer *(Nacerdes melanura)* occupying a piece of timber on the sideline proved interesting. In *Beetles of the Spurn Peninsula* (Denton, 1995) this is said to be frequent in the summer months in the Chalk Bank and Humber shoreline as far as the Crown and Anchor. Other records are Hull (1900), Bridlington (1904) and York (1948). Examination of tidal debris on the marsh revealed several members of the Carabidae including *Amara convexiuscula, Demetrius atricapillus, Dromis melanocephalus* and *D. linearis,* and the staphyklinids *Ocypus glens* and *Staphylinus ater.* Examination of tidal debris and sweepings also revealed the chrysomelids *Phaedon concinuus* (also noted by W. R. Dolling) and *Psylloides affinis.* Sweeping on the dune area revealed *Rhagonycha fulva* (Cantharidae) and *Lagria hirta* (Tenebrionidae). The chrysomelid *Sermylassa halensis* was seen on bedstraw. Other beetles noted were: *Harpalus rufibarbis, Pterostichus madidus, Cantharis nigra;* and *Polydrusus pulchellus* low on the marsh.

HYMENOPTERA (M. E. Archer)
The only species of note was the bumble bee *Bombus muscorum,* a Yorkshire rarity. This species has greatly declined in Yorkshire this century to just one previous 10 km square record in 1992.

DIPTERA (R. Crossley)
Several of the species reported in *The Naturalist,* mentioned above, were found. The only new species was *Hydrophorus praecox,* found both on the marsh and in the wet area behind the bank. Other flies found in addition to the Empidoidea species were the soldier-fly *Nemotelus notatus,* many of which were on the salt marsh, and masses of the tiny crane-fly, *Erioptera stictica.* The latter also occurred behind the bank where, in addition, the large crane-flies *Nephrotoma flavescens* and *Tipula fascipennis* were found. None of these species is uncommon.

FLOWERING PLANTS (D. R. Grant)
The large salt marsh is composed of *Spartina anglica, Puccinellia* and *Elytrigia atherica.* The area is dotted with colonies of *Aster tripolium* and *Limonium vulgare.* Very wet areas have *Triglochin maritimum, Plantago maritima, Juncus gerardii* and *Spergularia media.* In drier parts there were colonies of *Suaeda maritima* with *Atriplex prostrata* and *A. portulacoides.* At the foot of the banking was a strand line with *Puccinellia distans* and *Cochlearia anglica.* Damp areas on the landward side of the banking had *Carex otrubae, Glaux maritima, Spergularia marina* and *Bolboschoenus maritimus.* There is a narrow area of sand dune adjacent to the banking. This is the home of some rare species of clover, *viz Trifolium scabrum* and *T. striatum,* which were growing with *Aira praecox* and *Ammophila arenia.* In grassy places *Picris echoides, Carduus nutans* were associated with *Ononis repens, Allium vineale, Phleum bertolonii* and *Claytonia perfoliata.* The drainage dyke on the western edge of the reserve was completely colonized with the pondweeds, *Potamogeton pectinatus, Ruppia maritima* and *R. cirrhosa.*

Members who visited the open water reported *Stalicornia* species growing on the bare mud.

LICHENOLOGY (M. R. D. Seaward & A. Henderson)
Although saltmarshes do not support lichens, our visit was kept busy by our investigation of the marginal areas where fence posts and rails, cementwork and stones supported 28 species. A few sandy areas at the sides of pathways and a runner between dunes supported *Collema tenax* (vars. *tenax* and *ceranoides), C. crispum, Leptogium gelatinosum, L. schraderi* and *Agonimia tristicula,* and a small area of mature sand-dunes at the margin of Haverfield quarry (54/328195) provided an interesting terricolous habitat for several *Cladonia* and *Peltigera* species, growth of these lichens only possible in both these cases where short growth vegetation had been maintained by herbivorous animals and human trampling. In all, 42 species were recorded from the sites immediately adjacent to the saltmarsh, 20 of which were new to grid square 54/31. Our attention was then turned to churchyard recording and on the advice of, and in the company of, Peter Cook we visited Winestead (54/298236). Here we recorded 51 species (7 new to grid square 54/22) on calcareous and siliceous substrata, the most interesting being several thalli of *Ramalina farinacea* and *R.* cf. *lacera,* the former on the north, east and south walls of the church (one large specimen over the porch confirmed with the aid of a ladder) and the latter only on its east wall. A large *Acer* in the churchyard supported a reasonable coverage of *Opegrapha niveoatra.*

KIRKDALE (VC62), 8th August (J. M. Blackburn)

A party of 35 assembled in the field behind St Gregory's Minster with the kind permission of the owner, Major Shaw, and Mr Wood, the local farmer. Access to the dale beyond the field was granted by Lady Clarissa Collin. The day started dull but improved as it progressed. The area covered went up Kirkdale past Hold Caldron and included Skiplam Grange Wood. Hodge Beck, running through the valley, ran underground from below the bridge at Hold Caldron. This made the riverbed and its banks most accessible and this area was given considerable attention. Some members also visited Mell Bank Wood. The valley incises the Corallian Limestone and the vegetation of the area clearly reflects the underlying rocks. However, there has been some softwood planting, most particularly in Skiplam Grange Wood, which added interest with its acidic environment.

The indoor meeting, held in the village hall at Nawton, was attended by 28 members representing 21 affiliated societies. The president, Dr Margaret Atherden, chaired the meeting. After hearing the reports, thanks were expressed to the landowners and the local farmer, the trustees of the hall, and to the Divisional Secretary.

MAMMALS AND AMPHIBIANS (J. Lambert)

Common Toads *(Bufo bufo)* were seen as road casualties on the small road to Hold Caldron but live Common Frogs *(Rana temporaria)* were also seen.

Few mole hills were noticed and these were in woodland rather than in the pastures: The remains of a juvenile Common Shrew was found with own pellets under Larch trees. The Rabbit was by far the most noticeable mammal during the day and signs of its activities were widespread. It was interesting to see rabbit droppings even on the large boulders in the dry stream bed where there was little vegetation. A pellet indicated evidence of young rabbit in an owl's diet. Fewer signs were seen of the Grey Squirrel, but some food remains were noticed and a possible drey. No live squirrels were seen by the recorder. In the woodland numerous mouse holes indicated a good population of small mammals. A dead Bank Vole was seen. Signs of Badgers were noticed and there was a sighting of a live Fox. Tracks of deer were frequent in the woodland, the small prints indicating Roe Deer. These were very noticeable on the steep banks by Hodge Beck. Vegetation frayed by the bucks was also seen by some members.

ORNITHOLOGY (J. E. Dale)

August days in mature woodlands are not the most suitable for locating passerines, mostly silent now, unless one meets a feeding flock holding a variety of species. Such a flock in the upper part of the Mell Bank Wood consisted of about 20 each of Willow Warbler and Blue Tit with smaller numbers of Chaffinch, Coal Tit and Great Tit. A family party of Bullfinch were nearby, and a Siskin called from an area of mixed conifers. Song Thrushes, Marsh Tits (at three widely separated sites), Woodpigeons (numerous), Tawny Owl (heard once), Kestrel and Sparrowhawk, with young of the latter calling at two sites, were also in the woodlands east of Hodge Beck.

Viewing the Skiplam Wood heronry site from across the valley proved unsatisfactory and it was not possible to tell whether or not it had been occupied this season. House Martins (20+) and Swallows were particularly numerous around Sleightholme Dale Lodge and smaller numbers were at other farm buildings. The disused nest of Dipper was near the weir, and additional species lower down Hodge Beck included Kingfisher, a flock of about 30 Goldfinches, and a Spotted Flycatcher.

A total of 30 species was recorded.

LEPIDOPTERA (J. Payne)

In the open fields near the church and on the lane sides to the ford the wild flowers were past their best, so few butterflies were observed. Small Tortoiseshell were in small numbers on the thistles. Large and Green-veined White were flying but Small White was neither seen nor reported. A single Common Blue was reported from further up the dale. On moving to the lane above Mell Bank Wood in a short sunny period several Ringlets were seen visiting bramble flowers in an overgrown glade. Large and Green-veined White and Small Skipper were also there as was the geometric moth Shaded Broad-bar. On the flowery road verge near Fadmoor the same four species occurred. A small geometrid moth from the deeper woodland was the best capture of the day. Though in poor condition at this late date it proved to be Blomer's Rivulet. From alder in the dale Mr R. Comley brought in the rare and spectacular Alder moth larva in its final instar. This caterpillar is yellow and black with pairs of long clubbed black hairs spaced out along its body. Mr T. F. Medd had collected another showy larva, that of the Grey Dagger. The only micro noted was the Straw Belle *(Udea lutealis).* The writer knows these valleys in the North York Moors to be rich in lepidoptera but August is not the best month for searching!

So, with apologies to Matthew Arnold, "The bloom was gone and with the bloom go they".

Diptera (R. Crossley)

Sun-loving hoverflies were disappointingly scarce, but early August is well past the best time for these attractive insects and the season in general has been a poor one. Only half a dozen common species were noted, of which *Episyrphus balteatus* and *Eristalis pertinox* were present in large numbers throughout the valley.

The heavily shaded riverside produced the greatest variety of flies, including a male and female of the elegant dolichopodid *Hercostomus chetifer.* This tiny metallic beauty is scarce in Yorkshire, being reported from only four localities in the county, all of them since 1986, the only previous VC62 record being Hayburn Wyke, 1990; it is typically found on heavily shaded watersides. Twenty-eight other species of Empidoidea were recorded throughout the valley, all of them being common and widespread and calling for no comment. Fourteen species of tipulids were recorded, the most abundant, especially along the riverbank, being the mottled-winged *Limonia nubeculosa* Mg. It was the riverbank which produced the best finds of the day, the delicate and drab daddy long-legs *Limonia fusca* and the spotted-wing species *Limnophila apicata. Limonia fusca is* widely recorded throughout much of western and southern Yorkshire, but it is unknown in VC61, and in VC62 the only previous record is Mulgrave Woods in 1937, so its discovery in Kirkdale is noteworthy. *Limnophila apicata,* of which a single female was captured, is a Nationally Notable species, for which there are five previous Yorkshire records, the last being in 1973, and the only one for VC62 again being Mulgrave Woods, 1937.

Plant Galls (J. Payne & K. G. Payne)

Galls caused by 10 species of insects and 9 of mites were noted by the writers, and a list of these is being sent to the Y.N.U. and national (British Plant Gall Society) recorders. A clipped beech hedge by St Gregory's Minster was interesting in the great abundance of leaf-edge roll galls of the mite *Eriophyes stenaspis* and of the erinea of another mite *Aceria nervisequa.* A yew in the churchyard showed the swollen "artichoke" galls of the midge *Taxomyia taxi.* On *Rosa* species the rolled leaf galls of the sawfly *Blennocampa pusilla* were plentiful and the spiked pea gall of the cynapid *Diplolepsis nervosa* was seen. Robin's Pin Cushions were seen by several members. *Ulmus glabra* yielded the common galls of the aphids *Tetraneura glabra* and *Eriosoma ulmi.*

Flowering Plants (D. R. Grant)

The area visited is situated on the Jurassic limestone which gives the area a calcicolous flora. However the valley sides have the Oxford clay which together with a high rainfall results in some areas becoming acidic. One can find plants that like lime such as *Hypericum hirsutum* and *Origanum vulgare* growing near acid lovers like *Vaccinium myrtillus* and *Teucrium scorodonia.* Members followed the Hodge Beck northwards up to Sleightholme Lodge. The beck is tree-lined and relatively poor in species, but *Stellaria nemorum, Claytonia sibirica* and *Stachys palustris* were the most unusual plants present. A number of garden escapes had become naturalized on the beck sides; *Inula helenium Campanula lactiflora* and a *Lilium* species were noted. The field borders had *Agrimonia eupatoria, Rubus echinatoides Rubus caesius* and *Rosa arvensis.*

In the woodland several colonies of the rare grass *Hordelymus europaeus* were discovered. Other woodland plants were *Circaea lutetiana, Galium odoratum, Melica uniflora* with *Aquilegia vulgaris* and *Convallaria majalis* reported from Mell Bank. Rocky hillsides had *Solidago virgaurea* and *Hieracium oistophyllum.* In the acidic parts of the woodlands there were large colonies of *Luzula sylvatica* growing with *Rubus dasyphyllus* and *Melampyrum pratense. Equisetum telmateia* was found in Skiplam Wood. Two colonies of the rare bramble *Rubus pallidus* were found in Kirkdale Wood. This species is only present in this part of Yorkshire.

BRYOLOGY (J. M. Blackburn)

The area in and around Hodge Beck provided most of the interest in the dale. Both *Neckera complanata* and *N. crispa* were present on the limestone rocks in several places, along with *Ctenidium molluscum, Jungermannia atrovirens* and *Leiocolea turbinata.* Shaded limestone under Dixon Scar had *Barbula sinuosa Cirriphyllum crassinervium* and *Mnium stellare. Eucladium verticillatum* was growing on shaded dripping rocks here, but the find of the day, also on wet rocks, was a good patch of *Seligeria donniana.* This tiny plant was known many years ago from several places in the vice-county but its only other currently-known site is in a similar habitat in Riccaldale, though it can be easily overlooked. *Homalia trichomanoides* was found on a trunk by the beck.

Four *Fissidens* taxa were recorded, including *Fissidens pusillus* var. *pusillus* in the beck and *F. pusillus* var. *tenuifolius* on limestone away from the water. Other records from rocks in the stream included *Hygrohypnum luridum Brachythecium plumosum Fontinalis antipyretica* and *Chiloscyphus polyanthos* var. *polyanthos.* Several calcifuges were growing in places on the stream banks, possibly as a result of leaching: *Calypogeia arguta, Cephalozia bicuspidata* and *Diplophyllum albicans.* The attractive moss *Hookeria lucens was* found at Cogg Hole.

In a damp spot on the main track *Fossombronia pusilla* var. *pusilla* was growing in quantity and *Bryam algovicum* was seen near a field entrance. A total of 99 bryophytes was recorded on a very rewarding day.

LICHENOLOGY (A. Henderson)

Although walls and trees had an ample display of lichens, the *Parmelietum-Xanthorion* range of flora produced no real surprises. St Gregory's large graveyard has been well surveyed by members of the British Lichen Society's churchyard group, but during a sunny lunch under the superbly preserved Saxon sundial, three gelatinous taxa were added to their list: from a gravelled pathway, *Collema tenax* var. *ceranoides, C. crispum* and *Leptogium gelatinosum.* The afternoon was spent south of the ford and on the east bank of Hodge Beck, where trees along the bank in the roadside field, left unkempt for rough shooting, bore a *Physcietum*-type flora typical of such agricultural surroundings, younger twigs and branchlets sporting *Scoliciosporum chlorococcum, Micarea prasina* and *Lecania cyrtella.* Further downstream in thick copse and on the open bank, fallen boles and logs had a number of the commoner *Cladonia* species: *C. squamosum* with the podetia hidden under massed frilly squamules, and large blood-red fruits on *C. diversa* and *C. macilenta.*

FRESH WATER BIOLOGY (L. Magee)

The Hodge Beck is typical of several small streams that originate on acid moorland and flow southwards to join tributaries of the River Derwent. The Beck flows over and under beds of limestone and frequently dries up in times of low rainfall. This leaves a series of pools through which there is a flow of water so that the pools do not become stagnant. There is a sparse aquatic flora consisting of algae and mosses, because although the pH value is around 7.5, the water does not have high levels of nutrients. The Beck is also subject to severe flash flooding and the smooth limestone bottom has a sparse flora and fauna. A conchologist working upstream of the Minster did not locate any aquatic molluscs. Downstream of the viaduct only two species of molluscs were found, *Potamopyrgus jenkinsi* and *Lymnaea peregra.* Some pools had a thick carpet of the effluvia of an unidentified chironomid which had recently emerged. From the Welburn road bridge there was a steady flow of water and small brown trout were taking insects from the surface. There was a small hatch of the Mayfly *Ephemerella ignita* (The Blue Winged Olive). A pair of Kingfishers which had been seen earlier was feeding a brood of fledglings. One damsel fly *Coenagrion puella* was seen. An unidentified Dragon fly was probably *Sympetrum danae,* the Black Darter. Although not visited during the day, the Beck downstream of Welburn has a varied population of aquatic invertebrates. Mink are resident and the numerous rabbit population is their main prey. Four members of the section contributed.

BOTANICAL REPORT FOR 1998
FLOWERING PLANTS AND FERNS

Compiled by
D. R. GRANT
19 The Wheatings, Ossett, West Yorkshire WF5 0QQ

The recorders thank all those who have contributed records: P. P. Abbott (P.P.A.), K. & G. Beckett (K. & G.B.), D. M. Bramley (D.M.B.), B. Burrow (B.B.), B. K. Byrne (B.K.B.), E. Chicken (E.C.), P. J. Cook (P.J.C.), F. E. Crackles (F.E.C.), J. Dews (J.D.), T. Dolan (T.D.), W. R. Dolling (W.R.D.), S. Donaghy (S.D.), R. A. Eades (R.A.E.), E. Ellis (E.E.), S. Evans (S.E.), G. Granger (G.G.), D. R. Grant (D.R.G.), J. Greaves (J.G.), M. Hammond (M.H.), P. Jepson (P.J.), V. Jones (V.J.), S. King (S.K.), I. C. Lawrence (I.C.L.), J. Lucas (J.L.), L. Magee (L.M.), J. Martin (J.M.), T. F. Medd (T.F.M.), M. Middleton (M.M.), D. Millward (D.M.), R. Oxford (R.O.), M. Pilsworth (M.P.), M. Shields (M.S.), T. Schofield (T.S.), E. Thompson (E.T.), N. Thompson (N.T.), B. A. Tregale (B.A.T.), M. Wilcox (M.W.), G. T. D. Wilmore (G.T.D.W.), J. Wiseman (J.W.), P. Wood (P.W.), Mid-west York Plant Recording Group (M.Y.P.R.G.), Leeds Naturalists' Club (L.N.C.), Swarthmore Botany Club (S.B.C.), Wild Flower Society (W.F.S.) and Wharfedale Naturalists' Society (W.N.S.). 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.*

EAST YORKSHIRE (VC61) F. E. Crackles

Azolla filiculoides Barmston drain, Hull Bridge, near Beverley 54/04; W.R.D.
Ranunculus circinatus Kelsey Hill 54/22; W.R.D.
Atriplex laciniata Kilnsea Beacon area 54/41; P.J.C.
Cochlearia danica Spurn 54/41; G.G.
Crambe maritima Strand line Easington 54/41; M.P.
Oenanthe crocata Near lock gates, Albert Dock, Hull 54/02; R.A.E.
Rubus anglocandicans Haverfield Gravel Pits TA3220; E.C.
Rubus elegantispinosus Haverfield Gravel Pits TA3220; D.R.G.
Cynoglossum officinale Spurn 54/41; G.G.
Cichorum intybus Priory Yard Sidings 54/02; R.A.E. and M. M.
Filago minima Railway track near Hornsea 54/14; J.D.

Inula conyzae Priory Yard Sidings 54/02; R.A.E. and M.M.
Ruppia cirrhosa Scrape, Spurn 54/4 1; P.J.C. Ditch at Welwick 54/31; D.R.G.
Eleocharis acicularis Near Pulfin Bog 54/04; J.D.
Bolboschoenus maritimus Fosse Hill gravel pit 54/14; J.D.
Schoenoplectus tabernaemontani Scrape, Spurn 54/41; P.J.C.
Carex divisa Spurn 54/41; P.J.C.
Carex divulsa subsp. *ieersii* Railway cutting near Beverley 54/04; J.D.
Festuca rubra subsp. *commuta* Kilnsea Beacon 54/41; P.J.C.
Vulpia bromoides North of Warren, Spurn 54/41; P.J.C.
Poa angustifolia Disused railway track near Ottringham S4/22 and Swine 54/13. P.J.C.

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

Oreopteris limbosperma Hazel Bush (abundant) SE6657 M.H.
Atriplex littoralis Roadside A170, Sinnington SE7485 T.F.M.
Montia fontana Sand Hutton SE6758 M.H.
Stellaria palustris Strensall Common SE6559 M.H.
Sagina nodosa NZ61 I.C.L.
Spergularia marina Roadside, Wass-Ampleforth SE5778 K. & G.B.
Hypericum humifusum Strensall Common SE6658 M.H.
Salix caprea x cinerea = S. x reichardtii Raskelf SE4872 K. & G.B.
Samolus valerandi Strensall Common SE6659 M.H.
Rubus ulmifolius Saltburn Woods. NZ6620 YNU Bot. Sec. Excn. det. D.R.G.
R. newbouldii Saltburn Woods. NZ6620 YNU Bot. Sec. Excn. det. D.R.G.
R. echinatoides Buttercrambe Moor Wood SE7057 D.R.G.
R. echinatus Kirkdale SE6786 YNU Excn.
R. dasyphyllus Saltburn Woods NZ6620 YNU Bot Sec. Excn. det. D.R.G.
R. pedemontanus Buttercrambe Moor Wood .SE7057 D.R.G. conf. A. Newton.
R. eboracensis Saltburn Woods. NZ6620 YNU Bot. Sec. Excn. det. D.R.G.
Potentilla argenta Broughton SE7672 G.T.D.W.
P. anglica Boltby Mines woods NZ61 I.C.L.
Agrimonia procera Clifton Backies SE5954 M.H.
Rosa rubiginosa near Brotton NZ61 I.C.L.
Myriophyllum alternifolium Lockwood Reservoir NZ61 and Waupley Moor NZ71 I.C.L.
Epilobium obscurum and *E. ciliatum x E. obscurum* Loftus NZ71 I.C.L.
Lithospermum officinale Hildenley SE7471 R. Oxford. Confirmation of a very old record.
Stachys palustris x sylvatica = S. x ambigua Grinkle Lane. NZ71 I.C.L.
Scutellaria minor Strensall Common SE6559 T.F.M.
Mentha aquatica x arvensis = M.x verticillata Kirkdale SE6786 YNU Excn.
M. arvensis x spicata = M. x gracilis Egton Bridge (2 sites) NZ80 I.C.L.
Euphrasia micrantha Lingdale NZ61 I.C.L.
Galium mullugo near Thornaby NZ41 and Skinningrove NZ71 I.C.L.
Cicerbita macrophylla Roadside, Helperby SE4671 K. & G.B.
Hieracium oistophyllum Kirkdale SE6687 YNU Excn. det. V. Jones.
Baldellia ranunculoides Strensall Common SE6458 & SE6660 M.H. & T.F.M.
Potamogeton berchtoldii Scaling Dam NZ71 I.C.L.
Zannichellia palustris Strensall Common. SE6659 M.H.
Vulpia myuros Teesport NZ52 I.C.L.
Poa humilis Newburgh SE5476 and Mowthorp Dale SE6869 T.F.M.; Coatham Marsh NZ52 and Skinningrove NZ71 I.C.L.
Allium scorodoprasum Broughton SE7672 G.T.D.W.

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

Asplenium adiantum-nigrum Hightown, Castleford SE4225 S.K.
Asplenium adiantum-nigrum Nr. Kirkheaton Church SE1717 E.T.
Cochlearia danica A616 Nr. Langsett SE2200 D.R.G.
Cochlearia danica A642 Horbury, Wakefield SE2917 D.R.G.
Juglans regia Tip Nr. Sprotborough SE5525 D.R.G.
Sison amonum Clay Bridge, Sykehouse SE6315 D.R.G.
Sison amonum Small Hedge Rein, Sykehouse SE6115 T.S.
Foeniculum vulgare Edenthorpe, Doncaster SE6207 E.T.
Berula erecta Sprotborough SE5502 D.R.G.
Rubus scissus Luddenden Dean HX SE0229 T.S.
R. laciniatus Old Rly, Thurcroft SK5089 E.E.
R. rufescens Upper Cumberworth SE2108 D.R.G.
R. sprengelii Brierley Common SE4308 D.R.G.
R. infestus Upper Cumberworth SE2108 T.S.
R. ulmifolius Upton SE4714 T.S.
R. vestitus Lound Hill, Brodsworth SE4908 D.R.G.
Myriophyllum alteriflorum Redcar Tarn, Keighley SE0342 L.M.
Menyanthes trifoliata Bradley Park, Hudd. SE1621 J.L.
Centranthus ruber Old Rly, Sprotborough SE5502 J.G.
Adoxa moscatellina Stocksmoor, Hudd. SE1810 J.L.
Inula conyza Hampole SE5010 T.S.
Inula conyza Gale Common, Knottingley SE5321 M.H.
Filago minima Old Rly, Sprotborough SE5502 J.G.
Pilcris echioides Gale Common, Knottingley SE5321 M.H.
Orobanche minor Nevison, Pontefract SE4623 S.K.
Potamogeton obtusifolius Drain, Sandal Beat Wood, Doncaster SK6103 G.T.D.W.
P. pectinatus Torne Bridge, Hatfield Woodhouse SE6703 T.S.
Butomus umbellatus Canal, Linthwaite, Hudd. SE0914 J.L.
Lemna trisculca Canal, Slaitwaite, Hudd. SE0713 J.L.
Elegotion fluitans Drain, Nr. Sandtoft SE7208 T.S.
Juncus tenius Woodhall Quarry, Calverley SE1925 D.R.G.
Anacamptis pyramidalis Soothill, Batley SE2524 J.L.
Ploa compressa Wentbridge SE4817 D.R.G.
Catapodium rigdum Skelbrooke Rein, Hampole SE5011 E.T.
Chara vulgaris Old Quarry, Womersley SE5219 T.S.
Chara vulgaris Denaby Ings West SE4900 D.R.G.
Nitella flexilis L & L Canal, Rodley D.R.G.
Nitella flexilis L & L Canal, Armley T.S.

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

Huperzia selago Gisburn Forest SD7557 P.J.
Lycopodium clavatum Gisburn Forest SD7557 P.J.
Diphasiastrum alpinum Gisburn Forest P.J.
Equisetum variegatum Malham SD9165 B.B. & P.P.A.
Ophioglossum vulgatum Scarcroft SE3541 T.D.
Pilularia globulifera Winksley SE2371 P.P.A.
Gymnocarpium dryopteris Guise Cliff P.P.A.
Ceratophyllum demersum Grove Lane Pond, Meanwood L.N.
Arenaria norvegica ssp. anglica Ingleborough SD7/7 B.B.
Minuartia verna Winskill Stones SD8365 M.W.Y.P.R.G.
Rumex longifolius Malham SD9166 B.B. & P.P.A.
Rumex x pratensis Bewerley SE1564 S.B.C.

Draba muralis Gordale SD9163 P.P.A.
Coronopus didymus Harrogate SE3156 T.F.M
Samolus valerandi South Milford SE5031 J.L.
Sedum telephium Malham SD9364 W.N.S.
Rubus elegantispinosus A1/A63 Selby Fork SE4629 D.R.G. detd. A. Newton
Potentilla crantzii Malham SD9364 W.N.S.
Agrimonia procera Foxup SD8676 S.B.C.
Alchemilla minima Ribblehead SD77 P.P.A.
Hippocrepis comosa Winskill Stones SD8365; M.W.Y.P.R.G.
Lythrum portula Winksley SE2371 P.P.A.
Apium inundatum Winksley SE2371 P.P.A.
Myosotis stolonifera Hebden SE0566 P.P.A.
Scrophularia umbrosa Bracewell SD8548 P.P.A.
Orobanche minor Collingham SE3846 P.P.A.
Viburnum lantana Whitewell SD6546 P.P.A.
Filago vulgaris Woodside Quarry, Ireland Wood SE2538 M.W.
Antennaria dioica Winskill Stones SD8366 M.W.Y.P.R.G.
Baldellia ranunculoides South Milford SE5031 J.L.
Eleogiton fluitans Winksley SE2371 P.P.A.
Carex pseudocyperus Healaugh SE44946 P.P.A.
Carex capillaris Ingleborough SD77 B.B.
Polypogon monspeliensis Woodside Quarry, Ireland Wood SE2538 M.W.
Ornithogalum angustifolium Harewood SE3134 S.E.

NORTH-WEST YORKSHIRE (VC65) (T. F. Medd)
Equisetum variegatum Cotterdale (large colony) SD89 YNU Excn.
Geranium columbinum Nosterfield SE2779 D.M.
Limosella aquatica Nosterfield SE2779 D.M.
Filago vulgaris Nosterfield SE2779 D.M.
Elodea nuttallii Milby Cut, Boroughbridge SE3967 D.R.G. New VCR.
Juncus triglumis Cotterdale SD89 YNU Excn.
Carex bigelowii Cotterdale SD89 YNU Excn.
Festuca vivipara Cotterdale (abundant) SD89 YNU Excn.
Puccinella distans Roadside, A684 near Bainbridge SD9389 D.M.
Glyceria maxima Catterick village SE2497 D.M.
Epipactis helleborine Camphill SE38 D.M.

ALIEN RECORDS 1997/1998

Compiled by
G. T. D. WILMORE

Azolla filiculoides Meanwood, Leeds SE2826 L.N.C.
Azolla filiculoides River Aire, Shipley SE1238 B.A.T.
Chamaecyparis lawsoniana Gilstead Resr. Bingley SE1139 B.A.T.
Berberis darwinii Gilstead Resr. Bingley SE1139 B.A.T
Alnus cordata Otley SE2046 B.A.T
Amaranthus albus Albert Dock, Hull TA0927 J.D. confd. G.T.D.W.
Lychnis coronaria Woodside Quarry, Horsforth SE2538 L.N.C.
L. flos-jovis South Gare NZ5527 I.C.L.

Hypericum hircinum Woodside Quarry, Horsforth SE2538 L.N.C.
Alcea rosea Adjacent to Redcar trunk road NZ5723 I.C.L.
Fibigia clypeata Garden, West Ardsley Se2724 J.M. confd. T.C.G. Rich.
Coronopus didymus Harrogate SE3156 T.F.M.
Hirschfeldia incana Middlesbrough Indust. Est. NZ4821 I.C.L.
Rapistrum perenne Teesport NZ5522 I.C.L.
Gaultheria shallon Saltburn Valley Woods NZ6652 P.W.
Ribes odoratum Waggon Lane, Bingley SE1138 B.A.T.
Sedum hispanicum Pateley Bridge SE1466 W.F.S.
Darmera peltata Grey Towers, Nunthorpe NZ5313 I.C.L.
Acaena novae-zelandiae Ashdale Quarry, Helmsley I.C.L.
Chaenomeles japonica Old Rly, Thackley SE1738 B.A.T
Myriophyllum aquaticum Pond, Esholt Sewage Wks. SE1739 B.A.T
Oxalis corniculata Old Quarry, Skelding Moor SE2170 P.P.A.
Geranium endresii Churwell SE2629 J.M.
Nicandra physalodes Teesport NZ5522 I.C.L.
Forsythia suspensa Ferncliffe, Bingley SE1139 B.A.T.
Verbascum phlomoides Potteric Carr Nat. Res. SE5900 D.M.B.
Asarina procumbens Tanton, Stokesley NZ5210 I.C.L.
Campula poscharskyana Apperley Bridge SE1937 B.A.T.
Lobelia erinus Churwell SE2629 G.T.D.W.
Leycesteria formosa Saltburn Valley Woods NZ6620 P.W.
Echinops sphaerocephalus Marske sandhills NZ6422 P.W.
Erigeron annuus Indust. Est. Helmsley N.T. Detd. I.C.L.
Galinsoga quadriradiata Museum grounds, Middlesbrough NZ4919 I.C.L.
Lagarosiphon major Meanwood SE2836 L.N.C.
Polypogon monspeliensis Woodside Quarry, Horsforth SE2538 M.W.
Cortaderia sellonana Baildon SE1539 B.A.T.
Echinochloa colona Albert Dock, Hull TA0927 B.K.B.
Kniphofia uvaria South Gare NZ5626 P.W.
Lilium martagon Mosscarr, Pateley Bridge SE1466 W.F.S.
Scilla bifolia Spring Gardens Lane, Keighley SE0542 G.T.D.W.
Nectaroscordum siculum Miles Rough, Bradford SE1135 B.A.T.
Galanthus elwesii Beckfoot Lane, Bingley SE1038 B.A.T.
Iris germanica Coatham Sand Dunes NZ5925 I.C.L.
Crocus vernus Marske cliffs NZ6322 P.W.

BOOK REVIEWS

Woodland in the Landscape: Past and Future Perspectives, edited by Margaret A. Atherden and Robin A. Butlin. Pp. 203, including numerous b/w plates & line drawings. PLACE Research Centre, University College of Ripon & York St John, York YO3 7EX. 1999. £12.99 paperback, plus £1.00 p.& p. from the above address.

The latest publication from the recently-established Regional Centre for Research on People, Landscape and Cultural Environment at York, based on a conference held there in 1997. In all, there are 10 chapters contributed by wide-ranging specialists on such topics as post-glacial history, historic woodland, and woodland management and conservation, plus introductory and concluding chapters from the respective editors; an appendix contains a short contribution on four poster presentations. Many of the contributions are based in part or wholly on the interpretation of Yorkshire woodlands.

The book contains both useful and thought-provoking material, as would be expected from the specialist contributors: of particular interest to the reviewer was Oliver

Rackham's stimulating chapter on the past, present and future of woodland conservation.

I wish the PLACE Centre all success in its pursuit of environmental research and the dissemination of knowledge through its conferences and publications.

Landscapes – Perception, Recognition and Management: reconciling the impossible? edited by **Melvyn Jones and Ian D.Rotherham.** Pp. ix + 161, including line drawings & b/w plates. Wildtrack Publishing, PO Box 1142, Sheffield S1 1SZ, for The Landscape Conservation Forum and Sheffield Hallam University. 1998. £10.00 paperback (A4 format), plus £1.00 p.& p.

These Proceedings are the outcome of a national conference organised by The Landscape Conservation Forum in Sheffield, 2nd-4th April 1996. It brings together the views and opinions of leading practitioners involved in the recognition, management and conservation of landscapes, embracing such subjects as archaeology, ecology, biodiversity and sustainability. A keynote address on "Figures in the landscape" is followed by 16 papers and 19 abstracts under the three headings of perception, recognition and management of landscape. It will be of interest to a wide range of natural historians as well as environmental practitioners and specialists.

The Plants of Nottingham: a City Flora by Peter Shepherd. Pp. v + 76, including 3 maps & 5 pages of full colour illustrations. Wildtrack Publishing, PO Box 1142, Sheffield S1 1SZ, for the Nottingham Natural History Museum and the Nottinghamshire Wildlife Trust. 1998. £8.00 paperback, plus £1.00 p.&p., £15 hardback (limited, numbered edition of 200), plus £2.00 p.&p.

A valuable contribution to our knowledge of urban floras, the botany of many of our cities being as yet poorly studied. Such guides are of paramount importance for naturalists interested in urban environments, more particularly those involved in urban wildlife groups and schemes which have proliferated in the last two decades. The flora lists 700 native and naturalised vascular plant species, each provided with notes on their habitats and general distribution. Useful information on botanical recording in Nottingham from 1985 to 1996 (but it would have been nice to have extended this dateline to acknowledge the Howitts' lifelong work on the county's flora) and environmental background (climate, geology, soils and impact of urbanisation) is provided in introductory chapters.

MRDS

Melanism: Evolution in Action by Michael E. N. Majerus. Pp. xiii + 338, including numerous line drawings, b/w plates & tables, plus 8 pp. of colour plates. Oxford University Press. 1998. £23.95 paperback.

A worthy successor to H. B. D. Kettlewell's remarkable book *The Evolution of Melanism* published more than 25 years ago. Since that time there has been a plethora of published papers on this subject (as testified by the very extensive reference list of titles in the current work), but, in the reviewer's opinion, a disproportionately low number of these have actually advanced our knowledge of melanism. However, the author provides us with an authoritative appraisal of the diversity of the organisms manifesting melanism, the various evolutionary reasons for it, and the complex nature of the phenomenon. It is clear that what is viewed by many scientists as straightforward is far from the truth. This work will be of considerable interest not only to geneticists and evolutionary biologists, but also to entomologists, ecologists and natural historians who wish to extend their understanding of Darwin's evolutionary theory, more particularly of natural selection.

MRDS

Printed in Great Britain by Titus Wilson & Son, Kendal ISSN 0028-0771

October-December 1999

Number 1031
Volume 124

The Naturalist

A QUARTERLY JOURNAL OF NATURAL HISTORY FOR THE NORTH OF ENGLAND

Published by the Yorkshire Naturalists' Union

Editor **M. R. D. Seaward** MSc, PhD, DSc, FLS, The University, Bradford BD7 1DP

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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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Institutions and Subscribers £20.00 Registered Charity No. 224018

THE VEGETATION HISTORY OF YORKSHIRE: A BOG-TROTTER'S GUIDE TO GOD'S OWN COUNTY

MARGARET A. ATHERDEN

Presidential address presented to the Yorkshire Naturalists' Union at Sowerby, 5th December, 1998

INTRODUCTION

The presidential address on which this paper is based was the first in the Union's long history to encompass the vegetation history of Yorkshire, as revealed by pollen analysis (palynology). Yet the county abounds in sites where such studies have been pursued and some of the earliest work in Britain was carried out in Yorkshire, e.g. by Erdtman (1927, 1928) in the Huddersfield area, the Cleveland Hills, and Thorne and Hatfield Moors; by Woodhead (1929) and Godwin (1934) on the Pennines. The Yorkshire landscape offers many peat deposits, river floodplains, lakes and former lakes, which have acted as the archives for vegetation history over the years. Between them they not only tell the story of Yorkshire's past vegetation cover but also record the changing climate and degree of human impact over the millennia. From this evidence it is possible to reconstruct past landscapes and examine the role of humankind in modifying them. At a time of heightened awareness of human-induced climate change, it is perhaps appropriate to see what lessons can be learned from the past. This paper will begin with an outline of how pollen analysis is used to elucidate vegetation history. The main findings will be considered in three sections, corresponding with three phases in the development of palynology in Yorkshire. Finally, the relevance of the evidence will be discussed and suggestions will be made for future research priorities.

METHODS OF RESEARCH

The technique of pollen analysis was developed in Scandinavia and is usually credited to Von Post (1916). The technique is based on the recovery of sub-fossil pollen grains of flowering plants and spores of ferns and mosses from environments where they are preserved from decay. In Britain, most such environments are waterlogged, e.g. peat bogs and lake sediments, or acid, e.g. soils with pH below 5.5. Where the sediment is undisturbed and non-freely draining, comparison of the pollen content of different stratigraphic layers allows reconstruction of the vegetation history through time. There is an inherent bias towards the pollen of wind-pollinated plants, as opposed to those pollinated by insects or other means, and towards those plants which release their pollen/spores into the faster-moving air at canopy level rather than close to the ground surface. Preservation also differs, e.g. between the very short-lived pollen of rushes and the long-lasting spores of many ferns, which are extremely resistant to decay. Further complicating factors include weather conditions and topographic obstacles to pollen dispersal. Nevertheless, pollen analysis provides the most useful and consistent type of evidence for past vegetation.

The development of palynology as a major research tool for the study of British vegetation history was largely due to the work of Professor Sir Harry Godwin (1940). Using pollen diagrams from various sites, mainly in southern England, he used changes in the proportions of tree pollen (AP) as the basis for a division of the late- and post-glacial periods into eight zones (I–VIII) (Table 1). Radiocarbon dating later established a chronology for these zones. Godwin's model was based on the assumption that synchronous climatic changes across north-west Europe were the main driving force behind vegetation change. His zones were correlated to the broad climatic epochs (Boreal, Atlantic, etc.) recognised by Blytt (1876) and Sernander (1908) in Scandinavia. Until the 1970s, most pollen diagrams published in Britain were zoned according to Godwin's model, which provided an approximate dating tool for the changes observed. However, as the number of radiocarbon dates available increased, later workers began to question the synchroneity of Godwin's zones. Studies also revealed the significance of non-tree pollen (NAP), particularly as an indicator of human impact on vegetation, and this led to a realisation that many of the changes in vegetation were attributable to human impact. A model using three main 'chronozones' for the post-glacial or 'Flandrian' period was proposed by West (1970) and generally adopted from the 1970s onwards (Table 1). Pollen diagrams were zoned on the basis of local or regional 'pollen assemblage zones' and linked loosely to West's chronozones. More recently, the general term 'Holocene' has been used in preference to 'Flandrian', as British researchers have sought to correlate their pollen diagrams to data from other parts of the world.

TABLE 1

Date (years bp)	Climatic epochs (Blytt & Sernander)	Godwin's zones	West's chronozones
0			
1000			
	Sub-atlantic	VIII	
2000			
			Flandrian III
3000			
4000	Sub-boreal	VIIb	
5000			
6000	Atlantic	VIIa	Flandrian II
7000			
8000	Boreal	VI	
			Flandrian I
9000		V	
	Pre-boreal	IV	
10,000			
		III II I	Late-glacial

Fig. 1 shows a typical pollen diagram, from a site on the North York Moors which spans most of the post-glacial period. Each taxon with recognisable pollen is plotted as a separate graph, the figures being based on its percentage contribution to the pollen rain. Depth of sediment and time are represented by the vertical axis. Comparison of the graphs allows changes in the relative contribution of the different taxa through time to be assessed. For convenience, the diagram is divided into horizontal zones (FB1-FB10), representing periods with fairly homogenous pollen content. A series of radiocarbon dates provides a chronology and allows the various zones to be correlated with cultural periods.

Pollen analysis in Yorkshire

Fig. 2 shows the distribution of sites in Yorkshire from which cores have been studied using pollen analysis. The number is impressive, totalling about 130, but there are additional sites where a partial analysis has been carried out, notably a large number of coring sites examined by the Humber Wetlands Project in the south-east of the county.

However, the distribution of sites is by no means even. Some areas, e.g. the North York Moors, Teesdale, have been intensively studied, whereas others have received relatively little attention, e.g. the Wolds, the Vale of Mowbray. Differences in coverage largely reflect the distribution of deposits suitable for pollen preservation, which in turn reflect the underlying geology. Thus, on the Pennines there are more sites on the Millstone Grit than on the Carboniferous Limestone, and on the North York Moors there are many sites on the Middle Jurassic sandstones and shales but very few on the calcareous rocks of the Upper Jurassic. The chalk of the Wolds is particularly poorly endowed with peats or lake sediments and the only sites from that area are over clayey sediments in the valleys. The lowland areas of the county once contained many wetland sites, e.g. the meres of Holderness (Flenley, 1984, 1987; Gilbertson, 1990), but the vast majority of them have been drained for agriculture over the centuries. Only occasional relic fens or carr woodlands survive with intact peat or lake deposits, e.g. Askham Bog near York (Hall *et al.*, 1979), Thorne and Hatfield Moors (Buckland & Dinnin, 1997, Smart *et al.*, 1986), or The Bog, Roos, in Holderness (Beckett, 1981). It should also be borne in mind that the temporal span of the sediment cores varies, with some sites holding a more or less complete record of the late- and post-glacial periods (*c.* 13,000 years) and others covering only a few hundred years. Pollen analysis has also been carried out on deposits from various archaeological sites in the county, often in order to address specific questions relating to a particular cultural period (e.g. Tinsley & Smith, 1974; Gilbertson, 1984).

The study of the vegetation history of Yorkshire goes back over seventy years now and researchers have included some of Britain's best known palynologists, e.g. D. D. Bartley, G. W. Dimbleby, C. D. Pigott, I. G. Simmons, J. H. Tallis and J. Turner. Much of the work has been carried out at the universities of Durham, Leeds, Manchester and Hull and the College of Ripon and York St John, where staff, postgraduate research students and undergraduates have all played a part. Work has also taken place under the auspices of archaeological surveys, e.g. the Vale of Pickering Research Trust, the Humber Wetlands Project. The bibliography to this paper is an attempt to bring all these contributions together in one inventory of palynological research in Yorkshire. The focus of interest and methods of study have both varied over the years. The research may be divided for convenience into three main phases, described below as the pioneer phase, the human interest phase and the problem-solving phase. However, the three phases overlap in time and many published research papers do not fall neatly into a single category.

THE PIONEER PHASE

Researchers in the first few decades were mostly concerned with the task of reconstructing the main sequence of events in the vegetation history of the county. Initially using Godwin's model as a means of zonation and approximate dating for their pollen diagrams, workers built up a general picture of the establishment of vegetation cover during and following the closing stages of the last glacial (the 'late-glacial period'). Sites containing deposits from this early period are mainly found in the lowlands, e.g. Holderness, the vales of York/Mowbray and Pickering. Early pollen diagrams included one from Malham Tarn (Pigott & Pigott, 1959, 1963) and one from Tadcaster (Bartley, 1962). Both recorded a late-glacial sequence of a cold phase with tundra-like vegetation in Godwin's zone I, followed by a warmer interstadial phase with establishment of open birch woodland in zone II, and a cold stadial phase with return to tundra conditions in zone III. This is in line with the three-fold pattern seen in other parts of north-west Europe during the late-glacial. At Tadcaster, Bartley also found indications of a warmer sub-phase within zone I, which he tentatively correlated with the Bølling oscillation recorded on the continent. During the cold stages of zones I and III, the vegetation cover was dominated by grasses and sedges, with occasional dwarf trees and shrubs (e.g. *Betula nana, Salix herbacea*). There are also pollen records for a wide range of herbaceous plants characteristic of arctic conditions, some of which are now extinct in Yorkshire (e.g. *Koenigia islandica*) and some of which are restricted to one or two sites only (e.g. *Saxifraga oppositifolia, Rubus chamaemorus*).

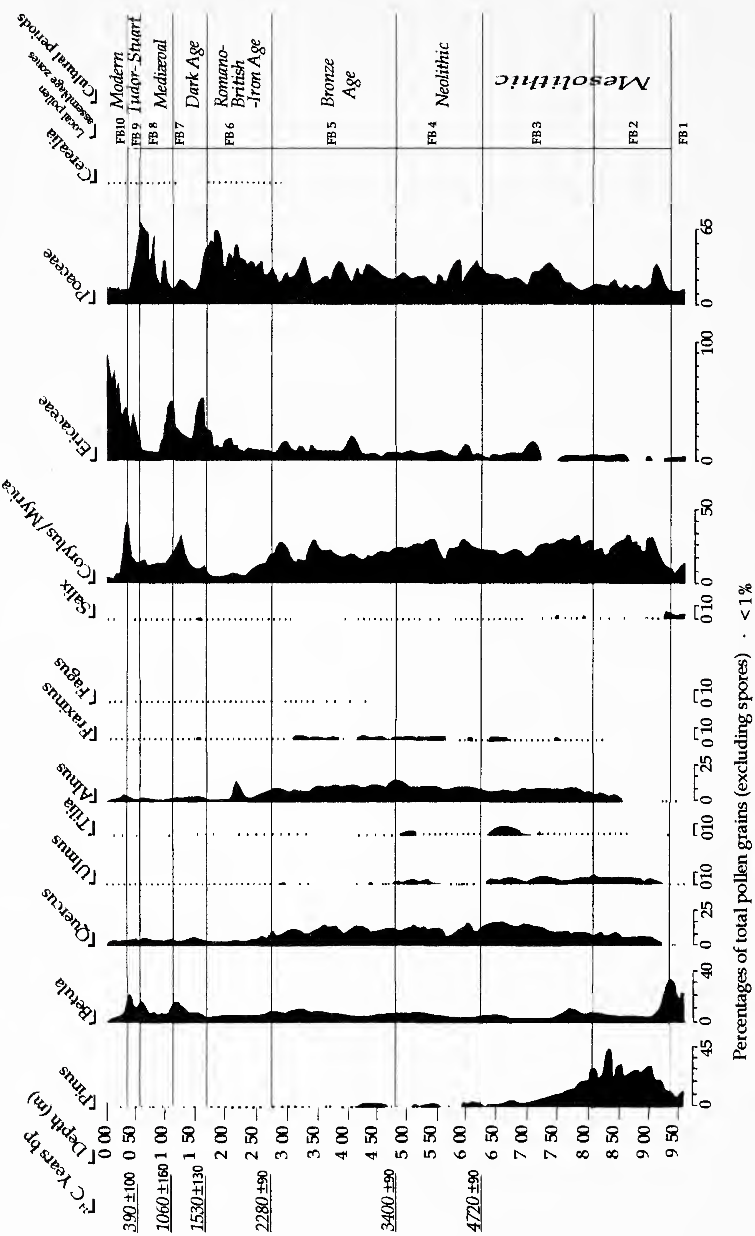

FIGURE 1
Pollen diagram from Fen Bogs, North York Moors.

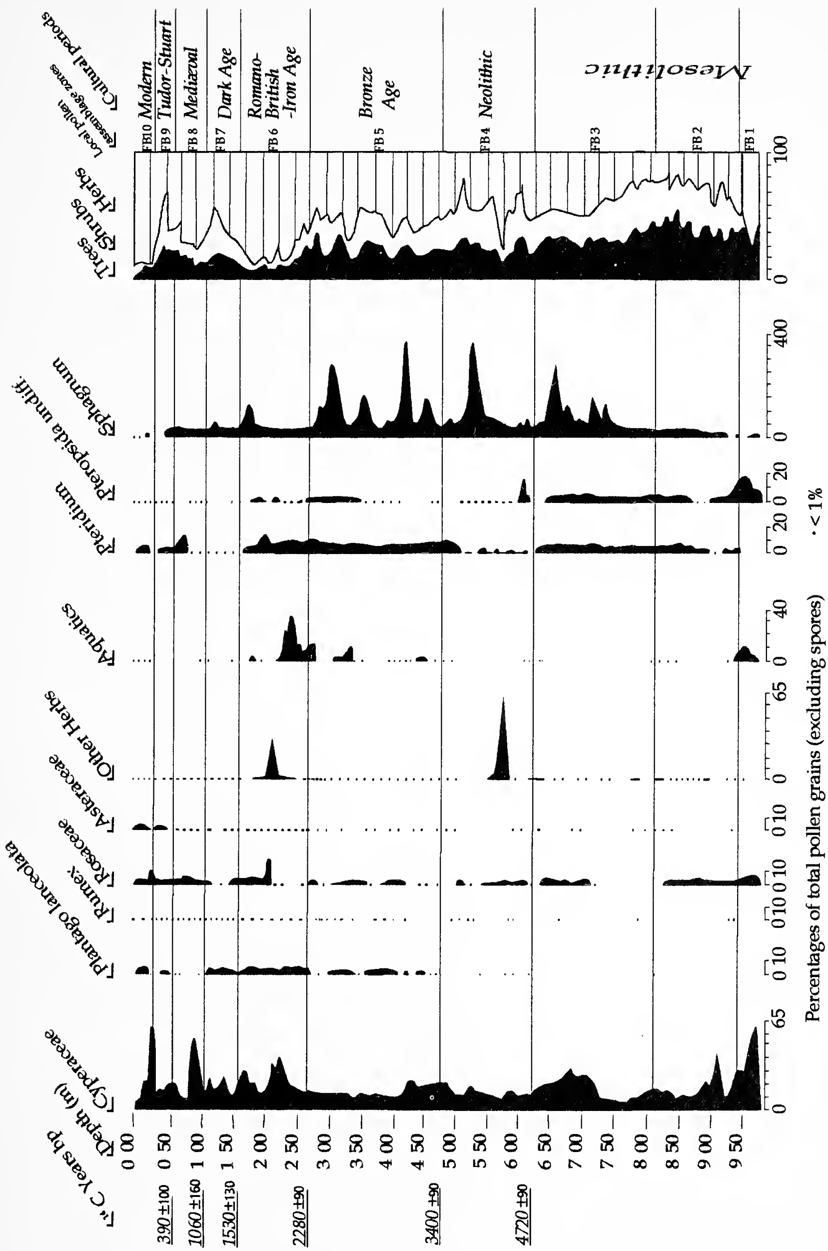

FIGURE 1
Pollen diagram from Fen Bogs, North York Moors.

Later work has corroborated this general picture and added further detail to the story. Hollows within glacial tills and former lakes impounded by moraines have provided fruitful sites for study, including Burton Salmon (Norris *et al.*, 1971); Cawood (Jones & Gaunt, 1976); Seamer Carrs, Stokesley (Jones, 1976a); Kildale (Jones, 1977a, 1977b; Keen *et al.*, 1984); West House Moss (Jones, 1977b), the Bog, Roos (Beckett, 1981); Skipsea Withow (Gilbertson *et al.*, 1987); Willow Garth (Bush & Ellis, 1987); Bingley Bog (Keen *et al.*, 1988); Dishforth (Giles, 1992), and Gransmoor (Walker *et al.*, 1993). It now appears that the climatic pattern reflected in the vegetation changes in Yorkshire was intermediate between that seen in continental Europe, where two distinct warm phases are evident, and that seen in western Britain (e.g. the Lake District), where one longer warm interstadial phase occurred. As most of the evidence comes from lowland sites, one can only speculate about the nature of the upland vegetation during the late-glacial. Conditions in zones I and III must have been extreme, with biting winds and low temperatures as major limiting factors for plant growth. It is likely that the Pennines, North York Moors and Wolds resembled tundra landscapes, with snow lying for much of the year and herbaceous vegetation only able to establish on soils still prone to solifluction and other mass movements (Blackham *et al.*, 1981). Tree and shrub growth would have been restricted to sheltered spots in the valleys. During the major interstadial of zone II, on the other hand, temperatures were almost as warm as today's, as indicated by fossil beetle remains found at some sites (e.g. Gransmoor, Walker *et al.*, 1993). Beetles have the advantage of mobility, enabling them to respond to changes in temperature faster than plants. By the time pioneer tree and shrub communities had become established (dominated by *Juniperus communis* and *Betula* spp.), temperatures may already have been decreasing again. Thus, for much of the late-glacial, vegetation was out of equilibrium with climate and it is now realised that the pollen record is a poor indicator of climate for this period.

There is no shortage of sediments dating from the post-glacial or Holocene period in Yorkshire and some sites record changes over the full span of approximately 10,000 years, e.g. Fen Bogs on the North York Moors (Atherden, 1976b, Fig. 1). Early workers, such as Erdtman (1927), Raistrick & Blackburn (1932), Conway (1954), Smith (1958), Dimbleby (1952, 1961, 1962a) and Simmons (1969a, 1969b), soon discovered that there was incontrovertible evidence for a former forest cover not only in the lowlands but also over the Yorkshire Pennines and the North York Moors. The main stages by which this forest cover developed could easily be linked to the general model proposed by Godwin (Table 1), with an initial birch forest with juniper understorey giving way to a phase of pine dominance (in the 'boreal') and then to a mixed deciduous forest during the 'atlantic'. The maximum extent of this forest cover was reached between 7000 and 3000 years ago, when average annual temperatures were about two degrees Celsius warmer than today's. One interesting piece of evidence for this 'climatic optimum' was the record of the exotic *Trapa natans*, the water chestnut, in Bronze Age deposits from Skipsea Bail and Low Meres (Flenley *et al.*, 1975). The picture from the early pollen diagrams for Yorkshire was of a fairly monotonous blanket of deciduous forest covering most of the landscape.

In order to find modern analogues for this Yorkshire 'wildwood', it is necessary to look to surviving remnants of more or less natural woodland on the continent, e.g. Bialowieza National Park in Poland. Here trees grow tall and straight, casting a shade which limits shrub or ground flora development to natural clearings, e.g. where a tree has fallen. The mid-Holocene forests of Yorkshire would have offered few habitats for herbaceous plants apart from those adapted to woodland conditions (most of which produce very little pollen and so are rarely recorded in the pollen diagrams). Herbivory was therefore based mainly on tree foliage rather than ground flora. The Yorkshire forests once supported large herbivores, such as wild cattle (*Bos* spp.), aurochs (*Bos primigenius*), wild boar (*Sus scrofa*) and bison (*Bison bonasus*) and their predators, e.g. the European lynx (*Lynx* sp.), brown bear (*Ursus arctos*) and wolf (*Canis lupus*) (Atherden, 1992).

More recent research has added greater detail to this general picture of the Yorkshire forests. Evidence from pollen diagrams and surviving fragments of forest above the present treeline has been supplemented over the years by many finds of buried timber beneath blanket peats, including those from published sites on the Pennines (Tallis, 1975) and North York Moors (Simmons and Innes, 1981). Even the limestone pavements of the Craven area formerly supported a forest cover, as shown by the research of Gosden (1968) and attested by surviving sites like Colt Park Wood National Nature Reserve. However, the many published pollen diagrams covering the mid-Holocene period serve to illustrate the variety of tree dominants, according to differences in soil and underlying geology. Whilst oak (*Quercus* spp.) was always important, in some areas it shared dominance with alder (*Alnus glutinosa*), as in the lowlands around the Humber estuary. In some areas of sandy soils, pine (*Pinus sylvestris*) retained a significant role well into the mid-Holocene, e.g. on glacial sands in the Vale of York and Holderness and on parts of the Pennines. On base-rich soils, elm (*Ulmus* spp.) and lime (*Tilia cordata*) assumed greater significance. Lime was particularly common in some parts of the Humberhead levels (J. Kirby, *pers. comm.*), where the woodland composition showed greater similarities with that of southern England.

The pollen diagrams from many upland sites suggest that the woodland cover was less dense on the higher ground, gradually giving way to scrub in which hazel was an important component. In a few areas, there is reason to believe that only a light canopy of woodland was established, under which herbaceous species continued to flourish. The intensive palynological research in Upper Teesdale (Turner *et al.*, 1973; Squires, 1971), carried out as a result of the flooding of part of the area by the Cow Green reservoir, has established beyond doubt that the famous 'Teesdale assemblage' of about seventy rare plant species represents a direct link with the late-glacial flora of the area (Squires, 1978; Hutchinson, 1966). Pollen records for many of the rarities have been found consistently throughout the entire post-glacial period. Another part of Yorkshire where it is likely that only a light woodland canopy was established is on the Wolds. Evidence from Willow Garth (Bush & Flenley, 1987) shows that herbaceous plants were important elements in the early post-glacial (up to 7980 BP) and again after 4300 BP. It is postulated that these plants of open habitats survived through the intervening gap in the sediment record in a similar way to those in Upper Teesdale. In both cases, the nature of the soil (based on sugar limestone in Upper Teesdale and on chalk on the Wolds) combined with the effects of altitude to limit the density of forest development through the mid-Holocene period.

Around 5000 years ago there was a dramatic decrease in the pollen records for elm (mostly *Ulmus glabra* in Yorkshire but probably including *U. procera* in some areas). This horizon is one of the most useful marker horizons for correlation of pollen diagrams from different parts of north-west Europe and is generally taken as the start of the Late Holocene period. Originally assumed by Godwin to be the result of a climatic change at the beginning of the 'sub-boreal', the elm decline has more recently been interpreted as the result of an outbreak of Dutch Elm Disease. It has also been linked by some writers to human activities, for instance through regular pollarding of the elm trees, which would have prevented them from flowering and producing pollen. The elm decline has been dated at numerous sites in Britain and dates all fall within a span of a few hundred years. The date of 4720±90 bp from Fen Bogs (Fig. 1) is fairly typical. The Late Holocene saw increasing human impact on the vegetation cover of Yorkshire. The advent of agriculture and later the development of metal-working were to have far-reaching effects on the scenery of Yorkshire, gradually changing the landscape from a predominantly natural one to one controlled and dominated by human activities. The majority of the woodland cover was replaced by moorlands and grasslands on the uplands and by enclosed farmland in the lowlands. The details of the story differ from area to area, according to the nature and extent of human impact. From the 1970s onwards, researchers began to take a keen interest in this process of human modification of the vegetation cover. This forms the second major phase in the study of the vegetation history of the county.

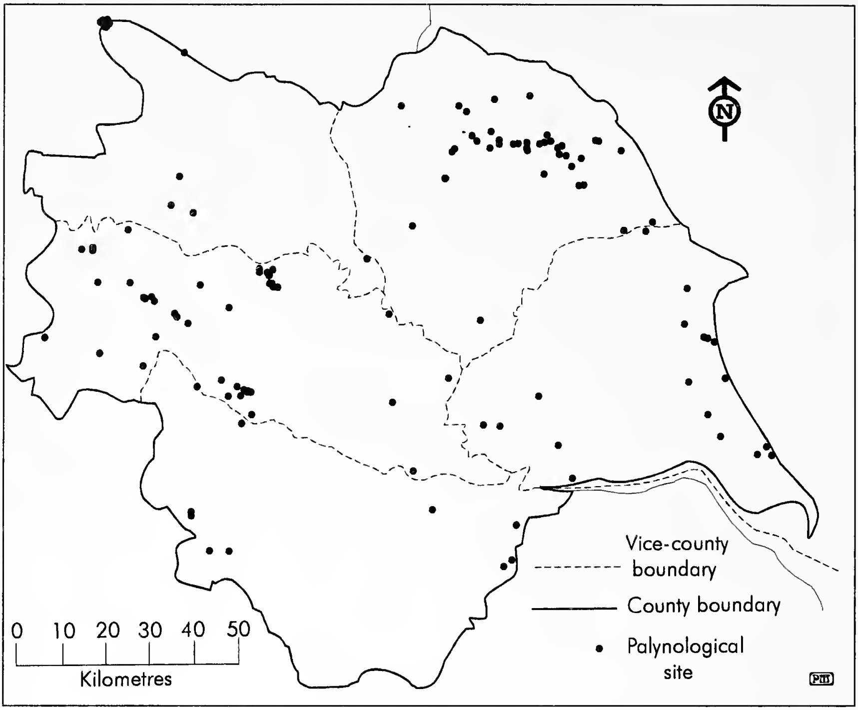

FIGURE 2
Map showing the distribution of palynological sites in Yorkshire.

THE HUMAN INTEREST PHASE

The presence of people in Yorkshire goes back at least 12,000 years and the pollen diagrams record increasing human impact on the vegetation during the post-glacial period. Particular attention has been devoted by palynologists to the prehistoric periods, especially the mesolithic, which covers 4000–5000 years. Humans were at the hunter-gatherer stage and their numbers are likely to have been small (perhaps only a few hundred in Yorkshire), but pollen analysis has revealed a significant impact on the vegetation cover in many areas. The earliest evidence comes from the Vale of Pickering, where the early mesolithic archaeological site of Star Carr (now dated to *c.* 9600 bp, Day & Mellars, 1994) was excavated in the 1950s (Clark, 1954; Walker & Godwin, 1954) and has been recently reassessed (Day, 1993, 1995, 1996; Mellars & Dark, 1998). An occupation site was constructed on the northern shore of a lake, 'Lake Flixton', which covered part of the eastern Vale of Pickering during the early post-glacial. Aspen poles were used to form a crude platform and the extensive reedswamps surrounding the site were burned. Bones recovered from the site show a preponderance of deer in the diet but a large range of other prey, including wild pig, elk, aurochs and beaver. Some of the deer antlers showed old wounds, suggesting that considerable hunting pressure was being exerted on the herds. The camp itself may have been occupied all year round or just for part of the year, as it is believed that these hunter-gatherer groups moved considerable distances in order to exploit a range of habitat types. Much of the landscape which these early mesolithic hunters knew is under the North Sea, as the post-glacial rise in sea level was only just beginning then. Another early mesolithic site has been excavated at Seamer Carr, a few miles further east in the Vale of Pickering and has also been the subject of intensive palaeoenvironmental research (Cloutman, 1988a, 1988b; Cloutman & Smith, 1988). Several other early Mesolithic flint sites have been discovered in the eastern Vale around the edge of the former Lake Flixton (P. Mellars, *pers. comm.*). Together these sites form an archaeological complex of international significance dating from the earliest period of the post-glacial. The pollen diagrams suggest that the impact on the vegetation was localised and probably temporary but it is clear that these early Yorkshiremen began the process of exploiting and manipulating their environment to suit their needs.

In the later mesolithic, there is further evidence of the impact of hunter-gatherer cultures from the upland areas of the North York Moors and Pennines. Fine-resolution pollen analysis, particularly at North Gill and Bonfield Gill Head, has revealed repeated phases of disturbance to the local woodland in association with charcoal and soot deposits (Innes & Simmons, 1988, 1999; Simmons *et al.*, 1989; Simmons & Innes, 1981-1996d). This suggests that the main agent of change was fire, which could have been used to drive game in a particular direction, to clear sight-lines or to remove dense undergrowth and stimulate fresh grass growth at favoured feeding spots. Certain plants which respond well to burning, such as hazel, may also have provided useful food in the form of nuts, and this phase corresponds with high values for *Corylus* pollen on the pollen diagrams. Jones (1976b, 1978) has suggested that mesolithic interference with the vegetation delayed the spread of deciduous trees on to the Cleveland Hills. The repeated use of fire over a long period of time would have prevented regeneration of deciduous trees in natural clearings and have exposed the soil to the leaching effects of the rainfall. Thus a process of soil acidification began and moorland vegetation types started to replace the woodland ground flora on the highest, most exposed areas. It is unlikely that the woodland itself was burned but scrub and undergrowth would have been fairly combustible. In those areas where pine survived in reasonable numbers, it might also have been burned and this would have aided its reproduction, as pine is partly fire-adapted. Indeed, people may well have started to use fire on a regular basis during the 'boreal' period, when pine was commoner and the climate was drier. The persistence of the technique into the deciduous forest phase may have been partly through inertia, and its efficacy as a means of controlling vegetation may have declined in the wetter 'atlantic' climate.

There is ample archaeological evidence for these mesolithic hunting activities in the form of tens of thousands of flint microliths scattered over the high moors (Elgee, 1930). They are found also on the Pennines, where similar effects on the vegetation have been encountered (Walker, 1956; Bannister, 1985; Tallis, 1964a, 1964b, 1975; Tallis & Switsur, 1983, 1990). On Soyland Moor, in the extreme south-west of Yorkshire, Williams (1985) made a detailed study of four pollen cores taken from an area of intensive mesolithic archaeological evidence. She presented compelling evidence that mesolithic people were clearing vegetation (by fire or by ring-barking trees) in order to provide better grazing land for wild or semi-domesticated herds. This clearance activity enabled the mesolithic people of the central Pennines to exploit both animal and vegetable resources (e.g. hazel nuts) over a period of several millennia, and the reduced tree cover led to acidification of soils and ultimately the spread of heather moorland. It is probable that these upland areas were targeted for hunting, particularly in the summer months, as the woodland was less dense than in the lowlands. However, it is almost certain that the later mesolithic people also used lowland areas, although here long-term effects on the vegetation cover are less easy to distinguish. As a result of this palynological research, our picture of the hunter-gatherer communities has been transformed from one of people having relatively little impact on their environment to one of people causing major, long-lasting modification to the vegetation of large areas of upland Yorkshire.

One of the interesting points to emerge from research in several parts of Europe including Great Britain is that the transition from hunting and gathering to agriculture – a major leap forward in cultural terms – was not apparently marked by major significant changes in the landscape or vegetation cover. Once hailed as 'the neolithic revolution', it seems rather to have been a gradual transition period during which the skills of agriculture were transferred from group to group and only slowly came to replace hunting and gathering as the main means of livelihood. Certainly in Yorkshire we do not see any marked change on the pollen diagrams with the advent of agriculture; early records for the pollen of cereals and agricultural weed species are few and far between. However, this may be partly a reflection of the distribution of pollen sites, as the areas most attractive to primitive agriculturalists were the chalk and limestone hills with light, well-drained soils, where peat and lake deposits are in short supply.

In most of the pollen diagrams, particularly those from the Yorkshire uplands, the neolithic and bronze age periods are marked by a series of small, temporary clearances, in which tree pollen decreases in favour of grasses, ruderal species and occasional cereals. These clearances probably represent cumulative records of shifting cultivation, as the fertility of the soil would have fallen rapidly within a few years and would have required long periods of fallow to restore. It is interesting to note that many valley peat bogs display a series of clay inwash stripes, the frequency of which increases with evidence for human impact, suggesting that clearance activities were initiating soil erosion (Simmons *et al.*, 1974; Jones, 1999). The pollen records contain weed species characteristic of both arable and pastoral farming, and it is likely that the two were closely integrated, with cattle and sheep feeding on the fields after harvest or during fallow periods, as well as browsing in the woodlands.

Some parts of Yorkshire provide evidence for larger-scale clearance of woodland in the bronze age. This is especially true of parts of the Pennines, where Tinsley (1975b, 1976) found evidence for extensive clearance of woodland on the Nidd-Laver interfluve during the early bronze age. This environmental impact is broadly contemporary with archaeological remains such as the Thornborough henges. Clearance activity is also recorded further south on Rombalds Moor in the bronze age (Bannister, 1985) and on the fertile limestone soils of the Craven lowlands (Bartley *et al.*, 1990). In Wensleydale, clearance at Thornton Mire is dated to 3600±89 bp, i.e. early bronze age (Honeyman, 1985). This evidence points to a significant change in the landscape of the most densely populated parts of the Pennines, as woodland gave way to agricultural or grazing land. One can only speculate on the impact of the construction of monuments such as the Thornborough henges or the Devil's Arrows (near Boroughbridge), but the pattern of monuments and their associated cursus suggests that whole areas may have formed ritual landscapes in the bronze age.

A similar intensive exploitation of the landscape was suggested for the later bronze age on the North York Moors by Spratt (1989), who postulated a division into landscape units utilising streams and lines of large round barrows as boundaries. As on the Pennines, the bronze age archaeology is very visible on the North York Moors, and it formed the subject of detailed archaeological work by Elgee (1930). Pollen diagrams from the North York Moors record less human impact in the bronze age than those from the Pennines, but the highest areas show the greatest decrease in woodland pollen (Jones *et al.*, 1979). Although these areas would have been the least suitable for arable agriculture, the slightly warmer, drier 'sub-boreal' climate made these uplands more hospitable for grazing purposes, and it is clear from the many archaeological remains that they were thoroughly exploited. The effects of grazing of domestic stock over many years would have prevented trees from regenerating and probably led to acidification of the soils and the spread of moorland vegetation, especially where the woodland cover was thinnest, i.e. on the highest ground. This was demonstrated in classic research by Dimbleby (1962b), who compared soils underneath bronze age barrows with those of the surrounding moorland. He found that the buried soils showed features typical of brown soils developed under deciduous woodland, whereas the moorland soils were podsolised. Later work by Abramson (1981) demonstrated that some pedological processes can continue despite the burial of the soils, but there is still a clear contrast in soil types between those under and those outside the bronze age monuments, showing that human impact can have significant effects on soils as well as vegetation.

In the iron age, in common with many other parts of Britain, Yorkshire saw a much more dramatic impact on the vegetation cover, with a sustained reduction of tree pollen and a major expansion of grasses and other herbaceous species. The effect is well illustrated on the pollen diagram from Fen Bogs (Fig. 1), where tree pollen is reduced to less than 15% in FB6, dated to 2280±90 bp. The clearance lasts from the early iron age to the end of the Roman period (dated to 1530±130 bp), with pollen types indicating both pastoral and arable agriculture. Similar dates for a major clearance have been obtained from other parts of Yorkshire, for instance, 2420±100 bp at Rishworth (Bartley, 1975) and about 2500 BP at sites in Holderness (Van de Noort & Ellis, 1995). In Wensleydale, Honeyman (1985) recorded a major clearance in the iron age, with signs of intensified agricultural activity in the Romano-British period, and Bannister (1985) recorded a similar iron age-Romano-British clearance on Rombalds Moor.

There are several possible reasons for this major impact on the vegetation. One is a shift of settlements to permanent sites in the lowlands, from which the uplands could have been exploited for grazing in a sustained way. Such a shift of settlement fits in with the archaeological evidence from sites peripheral to the North York Moors and the Pennines, and it may have been partly a response to a cooler, wetter climate during the first millennium BC. Another possibility is the use of iron implements, which would have been in more general use and plentiful supply than their bronze predecessors. The iron-shod plough, for instance, enabled some of the heavier lowland soils to be cultivated for the first time. The smelting of iron ore probably had a significant effect also, as the demand for charcoal led to systematic management of the woodlands by coppicing (Atherden, 1976a). This would have prevented many tree species from flowering, leading to a marked decrease in their pollen, as seen on the pollen diagrams. The advent of the Romans brought political stability and a more extensive market economy to Yorkshire. Agriculture appears to have flourished, based on the many villas and native farms, and the slightly warmer climate would have facilitated this. The combined effects of the iron age and Romano-British periods were thus several hundred years of intensified exploitation of many parts of Yorkshire. Rackham (1986) has claimed that most of the moorlands of Britain reached approximately their present boundaries by the end of the Roman period, and this claim certainly seems to hold true for Yorkshire.

The pollen diagrams record a regeneration of trees and shrubs at the end of the Roman period, corresponding with the 'dark ages' or Anglo-Scandinavian period. Again, the evidence comes mainly from sites in the uplands, so we are getting only a partial picture for Yorkshire. A third major phase of clearance of woodland and expansion in agriculture is recorded in medieval times at all sites which cover the period (e.g. Atherden, 1979, 1989). Archaeological and documentary evidence show that the three centuries following the Norman conquest were ones of expanding population and burgeoning agriculture. Colonisation of the uplands was led by the large monastic houses, e.g. Fountains and Bolton Abbey on the Pennines, Rievaulx and Whitby on the North York Moors. Houses in lowland areas often held land in the uplands, too, e.g. St. Mary's Abbey in York. Substantial communities of monks and lay brothers engaged in agriculture on a large scale, combining arable cultivation in the dales with the grazing of large flocks and herds on the uplands. They also had rights to exploit the woodlands for wood and timber resources. The effects on the pollen diagrams are seen in the great increase in grasses and decrease in trees and shrubs (FB8 on Fig. 1). The characteristic calcareous grasslands of the Pennines and southern North York Moors were probably established at this period. On the Wolds, the landscape also became a 'sheepscape'. On the more acidic soils, however, grassland was intermixed with heather moorland but the species composition was more varied than it is today. Acidification of soils in some areas was resulting in the formation of shallow blanket peats, which spread over much of the higher ground. On the North York Moors, Thomas

(1982) found that most of the blanket peats in the Fylingdales Moor area were less than 1000 years old.

In the lowlands, the more limited evidence also suggests intensive agricultural use, as seen at Askham Bog (Van de Noort & Ellis, 1999). Here, the succession to raised bog was halted by peat cutting in medieval times and the site reverted to fen woodland. Peat cutting also took place at Strensall and Skipwith Commons, where much of the surviving peat is of medieval or later date (Hayman, 1982; Winfield, 1983). Pits at Askham Bog and Skipwith Common were dug for hemp retting and *Humulus/Cannabis* type pollen is found on many Yorkshire pollen diagrams from about the fourteenth century on, e.g. from sites in Nidderdale (Tinsley, 1975a) and from the Vale of Pickering (Jagger, 1988). Where woodland survived in the medieval period, it was usually managed by coppicing or coppice-with-standards for firewood, fencing, utensils, constructional timber and many other uses. It is impossible to tell from the pollen diagrams whether the decrease in tree pollen was the result of such management or of the removal of trees for agriculture, but the documentary records complement the palynological ones for this period.

The last few hundred years are represented by relatively short accumulations of peat and pollen analysis is a less useful tool for this recent period. However, one feature which is very marked on pollen diagrams from the Pennines and North York Moors is the great rise in Ericaceae pollen towards the top, corresponding with the nineteenth and twentieth century rotational burning of the moorlands for grouse shooting. The almost complete dominance of Ericaceae pollen at the top of many diagrams suggests a loss of floristic diversity and the continued acidification of the soils. The modern coniferous afforestation also shows up on some diagrams at the very top. Although these changes in the landscape are just as dramatic as any which went before, there are alternative methods of study which give us more details than palynology.

THE PROBLEM SOLVING PHASE

Pollen analysis has been used alongside a range of other techniques to address particular questions which have emerged from earlier studies of vegetation history. One question which has fascinated palynologists in Yorkshire is how and when the process of peat formation began. Research on the North York Moors has shown great variability in the date of inception of peat growth, especially the blanket peats on the high watershed (Cundill, 1977; Simmons & Cundill, 1974a). Nearly always there is evidence for human impact at the time of peat initiation. In the Craven area, the peat often overlies limestone; as long ago as 1968, Gosden studied peat 'islands' over limestone pavement at Scar Close, Ingleborough. She was unable to decide whether they were remnants of a continuous peat layer which had developed over a former drift cover (subsequently eroded down the grykes) or whether the peat had developed directly over the limestone during a period of very high humidity. Later research revealed a variety of ways in which peat formation could occur over limestone (Smith & Taylor, 1989; Smith, 1991). These include peat developed through acidification of the surface organic layers of soils ('pedogenic peat'); peat formed over drift deposits in association with shake holes or dolines; and peat developed from former lakes or on acid substrates which spread laterally on to surrounding land ('blanket peat'), taking with it a 'floating' water table. In many cases there is evidence in the pollen diagrams of human impact in the inception and/or cessation of peat growth. There is abundant evidence for a former forest cover on the limestone areas of the Pennines, including charcoal layers at the base of some peat deposits. Removal of this tree cover would have altered the local water balance by increasing run-off, which may have led to waterlogging of previously well-drained soils. The clearance of woodland on the higher ground sometimes also led to erosion of mineral material into the valleys, capping existing peat bogs and preventing further peat growth, as at Gordale Beck or Martons Both (Smith, 1991). The factors controlling inception or cessation of peat growth are complex and variable and the exact sequence of events is unique at each site.

In the 1990s, attention has returned to the role of climate in vegetation history. Peat bogs in watershed situations, where the only source of moisture is rainfall ('ombrotrophic bogs') provide good records of changes in effective precipitation. Recent work by Chiverrell at May Moss and four other sites on the North York Moors used a range of techniques as 'proxy' precipitation records, including pollen analysis, plant macrofossils, testate amoebae and the degree of decomposition ('humification') of the peat (Chiverrell, 1998; Chiverrell and Atherden, 1999 and in press). He found good correlation between the different techniques, which reinforced his conclusion that changes in climate were the primary cause of the variations in the last 2500 years. Supplementary information was provided by a documentary database for the last 1500 years, compiled by Menuge (1997) and based on a wealth of source material, including chronicles, monastic chartularies, court rolls, forest records, personal diaries, school log books and newspaper cuttings.

Several major changes towards a wetter and/or cooler climate are recorded in the peat bogs, separated by periods of warmer/drier weather, when local water tables fell. The change to wetter, cooler conditions in the first millennium BC (the sub-boreal/sub-atlantic boundary) is confirmed as a significant shift in climate in iron age times, corresponding to the period when settlement was consolidated on the lower ground and a major clearance phase is seen on the pollen diagrams. By contrast, the period 200–400 AD corresponds to a warmer/drier climate, during which Romano-British agriculture flourished in the area, as attested also by archaeological and documentary records from other parts of the country. A second significant deterioration in climate is seen around 450 AD and is marked on the pollen diagrams by a regeneration of trees and shrubs. A similar date was found at Thorne and Hatfield Moors (Smith, 1985; van de Noort & Ellis, 1997) and by Tallis (1994) on the southern Pennines. At Harold's Bog on the western North York Moors, Blackford and Chambers (1999) identified a shift to wetter conditions later in the 'dark ages', in the mid-seventh century. In the ninth century there is evidence for another shift towards wetter conditions, lasting until the mid-tenth. The medieval period is well known as a period of warmer/drier climate in north-west Europe, corresponding to a major expansion of settlement and agriculture on the North York Moors, but Chiverrell's work reveals greater variability, with wetter phases in the eleventh and thirteenth to early fourteenth centuries. This is confirmed by the documentary records which show crop failures and famines associated with cold or wet weather in the eleventh century and a period of wet winters and dry summers in the thirteenth. At *c.*1400 AD there was a major change to wetter/colder conditions, which corresponds broadly with the beginning of the 'Little Ice Age', but once again the research shows a complex picture, with warmer/drier periods within it, especially from 1550 to 1600 and from 1750 to 1800. Another shift towards wet conditions took place around 1800 and lasted into the twentieth century.

This most recent phase of research on the North York Moors shows that it is possible to link the history of vegetation in Yorkshire with both climatic changes and human impact. Old ideas of simple causal factors, where changes in vegetation were explained by either climate or human impact, are now giving way to a more sophisticated concept of dynamic interaction between people and their environment. Vegetation history has moved from the phase when climate was thought to be the main controlling factor, through the phase when human impact was thought to be all important, to a realisation of the complex interaction between all factors. Further research work over the next few years will, no doubt, reveal similarly complex and fascinating stories for other parts of the county.

Conclusions

Although the history of Yorkshire's vegetation is in itself an absorbing and rewarding field of study for the naturalist, it also offers much of wider relevance at the dawn of a new millennium. Firstly, the links between past climate, soil and vegetation provide invaluable analogues for future interactions. For instance, by looking back to the post-glacial climatic optimum it is possible to see what the vegetation of Yorkshire was like in a climate warmer by one or two degrees Celsius than today's. Such studies may be of great predictive value over the next century, as global warming returns us to temperatures last experienced hundreds or even thousands of years ago. Pollen analysis also enables us to estimate the speed at which vegetation communities can adjust to changes in climate. This may be particularly important, as the predicted rise in temperature over the next hundred years is as fast as or faster than any change seen during the last ten thousand. We need to look back to the late-glacial period or the very beginning of the post-glacial for a comparable rate of change, and the evidence suggests that changes in vegetation lagged significantly behind changes in climate. This has serious implications for the ability of plant and associated animal communities to cope with the pace of future climatic change.

Secondly, there are clues in the research to another contemporary preoccupation, viz. biodiversity. The pollen diagrams give us more information on communities than individual species, as most pollen types are only identifiable to genus or family level, but the broad picture is clear. Biodiversity gradually decreased in the early post-glacial, as forest cover came to dominate most of the landscape of Yorkshire, reducing shade-intolerant species to a relatively small number of open habitats (e.g. Upper Teesdale, the Wolds, coastal sites). The impact of hunting and later of farming increased biodiversity again over the ensuing millennia, as seen in the increased number of taxa recorded on the pollen diagrams. Maximum biodiversity was probably reached in the eighteenth or early nineteenth century, since when it has shown a steady decline, as habitats have been lost through intensification of agriculture, felling of deciduous woodlands and rotational burning of heather moorlands. The study of vegetation history has revealed this accelerating loss of biodiversity throughout the twentieth century, which has severe implications for Yorkshire's flora and fauna in the future.

Finally, there are implications in the research for that other buzz word of the 1990s, 'sustainability'. In the lowlands, the economics and desirability of modern chemical farming are increasingly being questioned. In the uplands, the sustainability of hill sheep farming and the ethics of blood sports are causing equally searching questions to be asked. Just one of the possible outcomes could be colonisation of some of the present heather moorland areas with deciduous scrub or woodland. The implications of such a change for biodiversity and for amenity are the subject of current research on the North York Moors (D. Wharton-Street, *pers. comm.*). In all these contemporary issues, evidence from the past is being used in order to inform planning for the future. This is surely ample justification for the study of Yorkshire's vegetation history and, in my own case, has provided the motivation for a career spent peat boring and bog trotting in God's own county.

ACKNOWLEDGEMENTS

I am grateful to Paddie Morrison for assistance with the cartography for this paper and to the many people who have helped with fieldwork over the years. I acknowledge a huge debt to Ian Simmons and Judy Turner for first awakening my interest in vegetation history as an undergraduate. I should also like to pay tribute to Raymond Hayes and the late Don Spratt, who extended that interest to archaeology, and to Gordon Simpson, who turned me into a naturalist. Colleagues at the universities of Durham and Bradford and at the College of Ripon and York St John have been a great source of encouragement and support over the years. I am also grateful to my research students/assistants, especially Richard Chiverrell, Noël Menuge and Philip Abramson, whose work is quoted in this paper. Many undergraduates at the College of Ripon and York St John and the University of Bradford have produced dissertations, the findings of which have contributed to the research. They include Sarah Barnes, Richard Calverley, Martin Carey, Helen Harding, Graham Hayman, Andy Jagger, David Lewis, Jane Lincoln, Charlotte Matthews, Claire Pinder, Nicola Redvers-Higgins, Simon Smithson, Georgina Thomas and Len Winfield. Finally, my warm thanks go to my many friends in the Yorkshire Naturalists' Union and Yorkshire Wildlife Trust, whose support and friendship over the years has made it all worth while.

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BOOK REVIEW

A Fragile Eden: Portraits of the Endemic Flowering Plants of the Granitic Seychelles, written and illustrated by **Rosemary Wise.** Pp. xvi+216, including line drawings & 78 plates in full colour. Princeton University Press. 1998. £49.50 hardback.

Rosemary Wise, botanical artist in the Department of Plant Sciences at the University of Oxford, has the gift of portraying plants with both artistic skill and scientific accuracy. In 1995 she was awarded the Jill Smythies Medal of the Linnean Society for published botanical illustration. Her latest work displays these talents to the full: it is a spectacular evocation of the botanical treasures to be seen on some of the most beautiful of the tropical islands of the Indian Ocean. Besides the remarkable illustrations, the author complements each plate with a concise but effective text; in addition there is considerable introductory matter on the history of the islands, the collecting sites, the main habitats, etc. by the author and a chapter on the biogeography of the island by Malcom Coe.

It is to be hoped that in the future this will not prove to be a testimony to the glory which hath departed, for these islands, like many others in the region, are succumbing to tourist development and their fragile flora will need very special attention if it is to be protected. We can but thank those like Rosemary Wise for recording unique and endemic floras before it is too late.

MRD

THE HISTORY OF CARR WOODLAND AT BIRKS WOOD, NORTHERN LAKE DISTRICT

DAVID M. WILKINSON, TOM CLARE AND JOANNE CORKISH
Biology and Earth Sciences, Liverpool John Moores University, Byrom Street, Liverpool L3 3AF

ABSTRACT
A paleoecological study was carried out in an area of wet woodland in the northern Lake District. Alder woodland with a fern rich ground/epiphyte flora was present at the site for a minimum of 700 years (probably well over 1000 years). Prior to this more open water conditions were found. The Alder woodland appears to have started to grow at the site around 1800 BC, a late date for the Lake District. This woodland survived for a long time by the standards of carr vegetation which often undergoes succession to other vegetation types. Historical evidence suggests that the current wet Birch woodland is due to regrowth of woodland following a period of clearance. The status of carr woodland as 'ancient woodland' is discussed.

> 'The common alder . . . was far more abundant in the British Isles . . . than it is today; and this is not in the least surprising when we remember that the waterlogged soil of undrained marshes and ferns must have been very extensive' (Tansley 1939).

INTRODUCTION

Wet woodland communities, growing on wet mineral soils or carr woodlands growing on peat, would have been common in Britain prior to forest clearance. They appear to have covered large areas of the Wash, Severn estuary and Somerset Levels 5000 years ago. Smaller areas of such woodland would have occurred in river valleys and wetlands (Bennett, 1989; Brown, 1988). These communities have received much less attention than other types of native British woodland (e.g. Rackham, 1990), yet their status as natural vegetation types makes them important for nature conservation. There is also archaeological evidence suggesting that these habitats were a resource used by pre-agricultural humans as well as being a constraint on movement etc. (Wilkinson *et al.,* 1997; Smith, 1992).

The aim of this study was to investigate the history of a small area of wet woodland growing on peat in the northern Lake District. Wet woodlands now have a relatively restricted distribution in the Lake District. Ratcliffe (1997) described Alder woodland as extremely local in the area, found mainly on peaty soils associated with lowland fens or periodically flooded alluvium beside streams. Alder woodland in the Lake District, rather than lines of trees along stream sides, include woodlands in Martindale and near the Lune gorge (Halliday, 1997). The Martindale woods are of particular interest as they are found on hillsides rather than the valley bottom. Pearsall and Penninington (1973) suggested that more extensive hillside alder woodlands may have been found in the Lake District in the past. Willow carr is described as more common by Radcliffe (1997), being frequent around fens, lake edges and seasonally flooded woodland

THE SITE AND ITS HISTORICAL ECOLOGY

Birks Wood (Grid Ref. NY 297224) is an area of wet Birch woodland located at the edge of a former tarn, 3 km ESE of the centre of Keswick and 1.5 km SE of the well known Castlerigg stone circle (Fig. 1). It is not clear when the tarn disappeared but the absence of a related place-name suggests that it had been replaced by peat and other sediments more than one thousand years ago and that then, as now, the valley floor was an area of wetland prone to flooding. However such place name evidence should be treated with caution. As yet unpublished archaeological survey work in the area, by Tom Clare, shows that the stream flowing through the valley has been canalised and a new lower channel cut to reduce the water table.

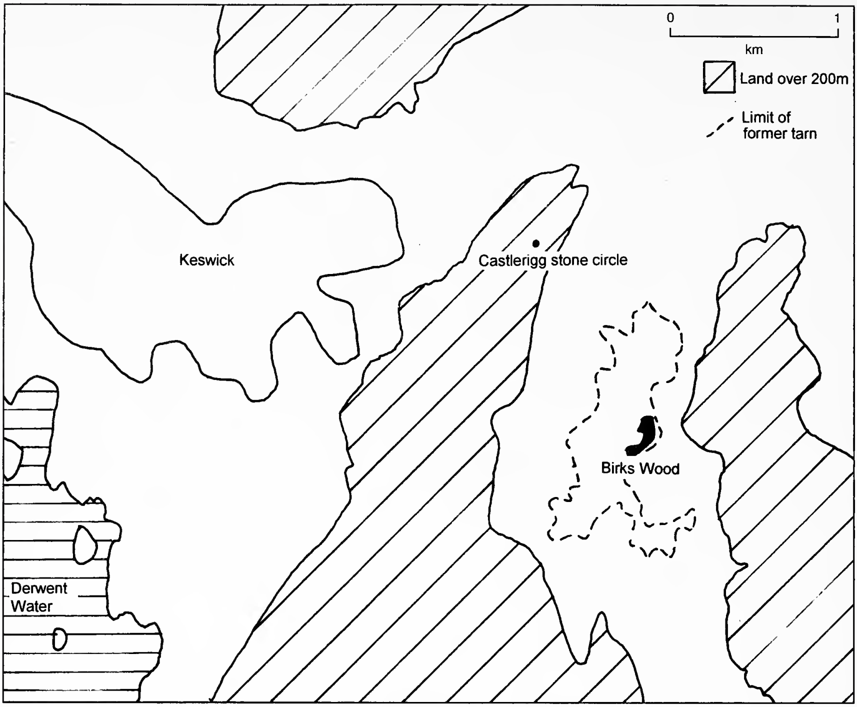

FIGURE 1
Birks Wood and the surrounding area.

The name *Birks* is Scandinavian for birch *Betula* (Gelling, 1984) and may therefore be taken as evidence for the existence of a similar wood 1000 years ago. However, within the Lake District words of Scandinavian origin, particularly those relating to topographical character, appear to have been used in local dialect long after the tenth century, so the name by itself cannot be taken as evidence for the antiquity of the wood. In this context it is of interest that the first edition Ordnance Survey of *c.*1850, shows only a few trees growing on what is recorded as an area of rough grassland. The birch carr may, therefore, be of relatively recent origin.

Paleoecological Methods

A 5 m long peat core was taken from the woodland using a 'Russian' peat corer. In the laboratory 1 cm^3 sub-samples were taken from the core at 20 cm intervals and prepared for pollen analysis using standard methods for peats (Moore *et al.*, 1991). The main types of sub-fossil pollen grains were identified at a magnification of ×400 and a count of approximately 300 grains was made per level. The pollen diagram was produced using the TILIA computer package (Grimm, 1991).

For macrofossil analysis sections of core 5 cm long were removed between 5 m and 3 m; these were washed through a 0.5 mm sieve and identifiable remains were counted under a low power microscope.

Two radiocarbon dates were obtained from a second parallel core taken next to that used for the paleoecological studies. These dates were determined at the Oxford University radiocarbon accelerator unit.

The pollen analysis was carried out by JC (under the supervision of DMW), the macrofossil analysis was by DMW, while TC studied the historical ecology of the area. The pollen analysis was carried out as a final year undergraduate project. As the analysis was done by a non-specialist, it should be treated with caution. However, since the key pollen grain for the purposes of this study was alder, which is easily identified, the results for this species can be considered very reliable.

Results

The results of the pollen analysis (Fig. 2) show that from 300 cm until 20 cm depth the site was occupied by Alder *Alnus* woodland with a ground or epiphyte flora rich in ferns. Prior to this the main tree species were Birch *Betula* and probably Hazel *Corylus*; however, this pollen is easy to confuse with Bog Myrtle *Myrica gale.* Very few Bog Moss *Sphagnum* spores were found until the top of the core.

To investigate the origin of the Alder woodland in more detail, macrofossil remains were extracted from peat between 300 and 500 cm (Table 1). These data suggest the infilling of open water: aquatic plants such as Pond weed *Potamogeton spp,* Bog Bean *Menyanthes trifoliata* and Yellow Water Lily *Nuphar lutea* vanish from the core by 350 cm. Of particular interest were the cases of two species of Caddis Fly larvae *Athripsodes aterrimus* and *Oecetis testacea;* these have been described in more detail by Wilkinson and Clapham (1996). *A. aterrimus* was widely distributed through the core between depths of 2 and 5 m, with 20 cases being recovered. This is a species of still water with aquatic and marginal vegetation. Only a single case of *O. testacae* was recovered from peats of 4.50-4.75 m depth. This caddis is of particular interest as the case is formed from plant material rather than the sand grains used by *A. aterrimus* and illustrates the good macro fossil preservation in the core.

Two radiocarbon dates were obtained: the first, from twigs from a depth of 30 cm, gave a date of 2910±45 (OXA 5084); the second was from twigs from a depth of 300 cm, gave a date of 3460±50 (OXA 5085). These dates appear to suggest that 270 cm of peat was formed in around 700 years. This appears unlikely as even tropical swamp forests with high production rates only produce around 2-3 mm of peat per year (Moore, 1987) and in a survey of rates of peat 'growth' in North America, Webb and Webb (1988) recorded a maximum rate of 0.5 m per thousand years. The most likely explanation is that the more

TABLE 1
Macrofossils from Birks Wood core.

	Depth cm							
	475–500	450–475	425–450	400–425	375–400	350–375	325–350	300–325
Plant Macrofossils								
Betula seeds		4	2	2	1	6		
Potamogeton fruits	2	10	21	14	33	23		
Nuphar seeds		2		3	2			
Menyanthes trifoliata seeds						8		
Carex fruits				1		3		
Wood fragments	+			+	+	+	+	+
S. alix leaf						1		
Animal macrofossils Trichoptera larval cases								
Athripsodes aterrimus	6	6			1	2		5
Oecetis testacea		1						

recent date is a product of contamination by older material, perhaps as a product of peat digging or past attempts to drain the site. The earlier date would suggest that the Alder woodland at the site originated around 1800 BC. This is a much later date for the rise in alder pollen than at most Lake District sites where the alder rise occurs from 7500 years ago (Pennington, 1997). Modern roots extending into older deposits can give dates which appear to be recent so the radio carbon dates from this site need to be treated with caution.

Discussion

The most interesting aspect of these results is the persistence of wet, fern-rich Alder woodland over 300 cm of core. Even if the upper radiocarbon date is correct, this woodland lasted for 700 years; as described above the time span is probably much longer. This conclusion, of the long-term persistence of alder woodland at the site is independent of the problems with the radiocarbon dates. This is because the 3 m of peats with the high alder values must have taken over one thousand years to form even assuming very high rates of peat formation.

Succession in wet temperate habitats tends to move from wetter to drier conditions, although individual sites may exhibit individual behaviour (Bunting & Warner, 1998; Walker, 1970). Based on the work of Walker (1970), many textbooks (e.g. Colinvaux, 1993) suggest that typical succession goes from open water through wet woodland to *Sphagnum* bog. Clearly at Birks Wood succession was halted at Alder woodland for probably in excess of 1000 years. Only at the top of the pollen diagram is there any suggestion of an increase in *Sphagnum* which may suggest the start of succession towards ombrotrophic bog. The current vegetation of wet Birch woodland may be due to human actions, perhaps the historically recent regrowth of tree cover after woodland clearance. Evidence for this is provided by the first edition Ordnance Survey, described above.

Since wet woodlands tend to be part of a successional process, they often change into other vegetation types (e.g. *Sphagnum* bog or dry woodland). This means that while wet woodlands were probably an important part of Britain's natural woodlands 5000 years ago they will often not fit modern definitions of ancient woodland as they may not have a long history at any one site. However, Birks Wood shows that in some cases Alder carrs can survive unchanged at a site for a long period of time without undergoing succession to other vegetation types.

The other conclusion of general interest arising from this study is the recent date for the expansion of alder compared with other Lake District sites. This result should be treated with caution due to the uncertainties over the radiocarbon dates. Assuming that the date of 3460 BP for the alder rise at Birks Wood is correct, this raises the question of why Alder pollen grains are not arriving at the site from other parts of the Lake District before this time. It is possible that this is due to the area being wooded, most pollen grains only travelling short distances (20-30 m) in wooded landscapes (Bradshaw, 1981). It is therefore possible that little pollen from the wider landscape is arriving at the site, with most of the pollen in the diagram being local *(sensu* Jacobsen & Bradshaw, 1981).

Acknowledgements

We thank Adrian Aspinall for help in the field, Alan Clapham for help with seed identifications and Steve Davis for help in pollen diagram production. A referee made many useful suggestions and Sykes Farm gave access to the site. The map in Fig. 1 is based upon Ordnance Survey material with the permission of The Controller of Her Majesty's Stationary office, Crown Copyright Licence No ED 244066.

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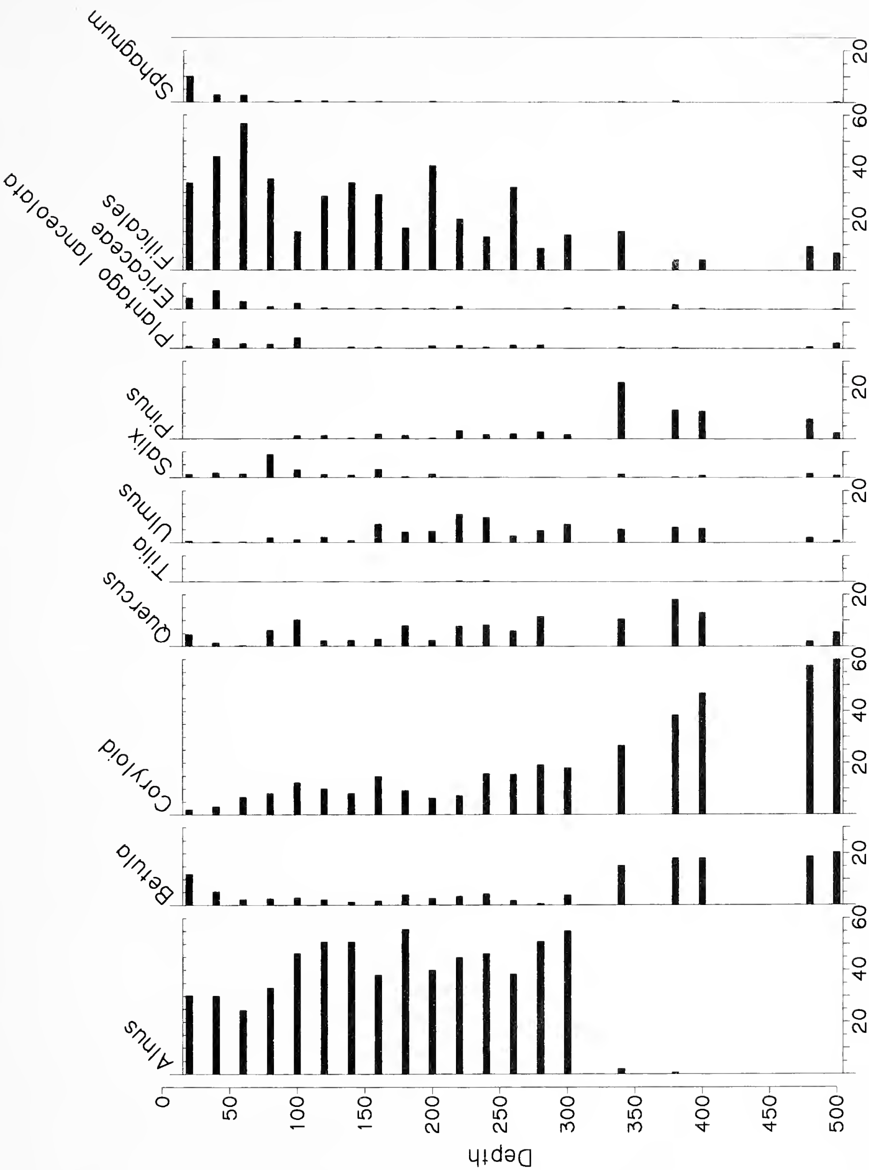

FIGURE 2
Percentage pollen diagram for principal taxa for the Birks Wood peat core.

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BOOK REVIEW

Seabird City: A Guide to the Breeding Seabirds of the Flamborough Headland by **Richard Vaughan.** Pp. 206, many photographs in colour and b/w. Smith Settle, Otley. 1998. £9.95 paperback.

This well-presented treatise consists of six main sections. Section I details the topography and the birdlife, both resident and migrant, of this impressive headland and includes instructions on how to get there. Section 2 deals with the seabirds in general and covers the world distribution of the Flamborough breeders and their social interactions. Section 3 outlines their seasonal presence on the cliffs, their moult periods and winter distribution. Section 4 is a month-by-month tour through the year illustrating the arrivals of the various species, their post-breeding dispersal and irregular presence during the winter months. Section 5 goes into great detail about the ancient eggers or 'climmers', who took many eggs from the cliffs up to the last climbs in 1954. This is a fascinating and well-researched section, which includes many old and evocative photographs and the book is thoroughly recommended for these chapters alone. Section 6 deals with the former breeding species, changes over the years and present breeding successes. I have given only brief details of the contents of each section, but there is a wealth of information contained within the book, which is certainly good value for money.

JRM

THE FLOWERING PLANTS OF SPURN

EVA CRACKLES

The following list of vascular plants for Spurn has been compiled from observations made by the author since 1946. Other authentic records for the same period have been included.

A particularly intensive examination of short turf and disturbed sand communities was made in 1954. At that time there were extensive areas of short turf and considerable stretches of intermittently disturbed sand, as, for example, along the site of the old railway. With the advent of myxomatosis in 1954 and the consequent absence or severe reduction of rabbit grazing, the vegetation of much of the peninsula moved towards a climax with *Hippophae rhamnoides* (Sea-buckthorn) predominating. The spread of Sea-buckthorn was accompanied by an equally remarkable spread of the alien *Claytonia perfoliata* (Springbeauty), which has, however, been present on the peninsula since at least the beginning of this century. Short turf areas have decreased drastically in extent and have at times been maintained by treading and not by grazing. Species characteristic of both short turf and open communities have decreased greatly in frequency; some may have become extinct or nearly so.

The tremendous increase in the number of visitors and therefore of foot pressure has resulted in the rapid spread of some species, e.g. *Bellis perennis* (Daisy) and *Plantago lanceolata* (Ribwort Plantain). The build up of *Spartina anglica* (Cord-grass) on the Kilnsea Clays has brought about interesting changes on the river side, particularly in the Kilnsea Warren area. A salt marsh is building up on the edge of the *Spartina* and changes in conditions on the sandy shore are accompanied by changes in the vegetation. In the early 1970s there was a dramatic loss of land on the seaward side of Kilnsea Warren due to erosion by the sea: a bomb crater with its marsh and aquatic flora completely disappeared. Land drainage operations, carried out north of Kilnsea Warren in 1973, resulted in the loss of another pond and adjacent marsh. The resulting extensive denuded area was covered in 1974 by an abundance of *Spergularia marina* (Lesser Sea-spurrey) which is thought to have developed from dormant seed, whilst a new drain contained *Ruppia maritima* (Beaked Tasselweed).

For a number of years botanists have found the 'canal' and its banks to be of particular interest. The 'canal' was cut a year after the severe flooding of 1st February 1953 and at first both the water in the 'canal' and the bank were completely devoid of vegetation. A fascinating process of colonisation followed, which included the arrival in quantity of two rare species, *Carex extensa* (Long-bracted Sedge) and *Juncus maritimus* (Sea Rush). By 1970 the 'canal' banks were less floristically rich than in the earlier stages of succession: some species were doomed to disappear while others diminished in frequency.

The large number of species of vascular plants recorded for Spurn is remarkable when one considers the small acreage involved (i.e. 280 acres above high water before the loss of land in the 1970s), and this reflects the variety of habitats. Two species. *Trifolium suffocatum* (Suffocated Clover) and *Parapholis incurva* (Curved Hard-grass), are at their absolute northern limit here.

Published lists for this period are to be found in Crackles, E. (1970) The flowering plants of Spurn, *Spurn Bird Observatory Report for 1970*, and (1975) The flowering plants of Spurn, *Naturalist* [**100**]: 59-65.

1975 TO 1985

Considerable changes occurred at Spurn over the decade 1975 to 1985. The storms and severe flooding early in 1978 and subsequent ravages of the sea led to further dramatic loss of land. Nevertheless, 45 species of vascular plant were added to the list. The vast majority of these additional species were new arrivals; not all have persisted.

Some additional species were introduced by flood-water. In 1978, a single plant of *Glaucium flavum* (Yellow Horned-poppy) occurred by the roadside, as did several plants of

Salsola kali (Prickly Saltwort), normally found only by river and on the sea-shore. Seeds of these plants had been brought in by river-water, which had broken through the sand-dunes just north of the chalk bank, and surged up the road. In the same year, two patches of *Silene uniflora* (Sea Campion) occurred at the edge of river-side dunes, just north of the chalk bank. The only previous vice-county records for Yellow Horned-poppy and the only coastal one for Sea Campion were made at the end of the 18th century.

The distribution of some species, e.g. *Leymus arenarius* (Lyme-grass) and *Diplotaxis tenuifolia* (Perennial Wall-rocket), was changed either by flooding or resultant human activity. Some maritime species have become more frequent since the flooding, e.g. *Eryngium maritimum* (Sea-holly) and *Catapodium marinum* (Sea Fern-grass). In a coastal belt to the north of Warren Cottage, where there was then much bare sand and gravel, *Juncus ambiguus* (Frog Rush) occurred together with *Parapholis strigosa* (Hard-grass) and there were tidal pools with *Ruppia maritima* (Beaked Tasselweed).

Some species were introduced with material imported to construct a new stretch of road after the 1978 flooding and again with clay used to build a protective bank in the warren in 1982. *Hypericum* x *desetangsii* was found on this bank in 1984, but did not reappear. Species recorded in the warden's garden in 1978 had been introduced with top-soil brought from Kilnsea to restore fertility to the garden which had been inundated with salt-water for two days during the winter flooding.

A salt-marsh continued to build-up on the river side. By 1978 there was a substantial salt-marsh with large areas dominated by *Puccinellia maritima* (Common Saltmarsh grass) and *Aster tripolium* (Sea Aster), which had replaced much of the *Spartina*. At the top of the salt-marsh a belt of *Suaeda maritima* (Annual Sea-blite) and *Salicornia europaea* (Common Glasswort) occurred by this time, but gradually other species advanced into this area.

New discoveries have been made as a result of critical study. *Erophila verna* var. *praecox* is found to be locally abundant; the presence of *E. verna* (Common Whitlow-grass) requires confirmation. Similarly the Polypody, present in the dunes since 1978, is *Polypodium interjectum* (Intermediate Polypody), a taxon recognised for the first time in the early 1970s.

A published list for this period appeared as "additional species" in Crackles, E. (1986) *The Flowering Plants of Spurn*, which is otherwise mainly a reprint of the 1975 *Naturalist* paper.

1986 to 1999

Succession proceeded on the river side and fairly recent photographs show zones dominated by *Atriplex portulacoides* (Sea-purslane) and *Cochlearia* sp. (Scurvygrass). More recently some erosion of the salt-marsh has been reported; also the deposition of a considerable amount of sand on the river shore.

Further storms and severe flooding have resulted in further loss of land and other changes. The area remaining to the east of the road north of the warren has become a very marshy area co-dominated by *Spergularia marina* (Lesser Sea-spurrey), *Suaeda maritima* (Annual Sea-blite) and *Puccinellia distans* (Reflexed Saltmarsh-grass). The area is a mosaic of microhabitats with *Salicornia europaea, Suaeda maritima* and *Juncus bufonius* (Toad Rush), with scattered *Aster tripolium* (Sea Aster). *Schoenoplectus tabernaemontani* (Grey Club-rush) has recently turned up in a pond in the area.

Twenty-three species of vascular plants have been added to the Spurn list since that published in 1986. One, *Orchis simia* (Monkey Orchid), was first recorded in 1974 when a fine flowering spike was found by Ann Fritchley. This was the first British occurrence north of the Thames and one of only four British localities known at that time. The plant was artificially pollinated by the author in 1975 and other plants subsequently using a stem of *Elytrigia atherica* (Sea Couch). Twenty-five plants occurred in 1981, including nine flowering ones; but 14 plants have flowered at some time. The area was inundated with salt water in the early part of 1982; no flowering spikes were produced in that year and no plants seen since. The record was omitted from earlier lists for conservation reasons.

Plants of *Cochlearia danica* (Danish Scurvygrass) were found at the narrow neck in 1998 and their occurrence is believed to be related to the spread of this species along salted roadside verges in the East Riding.

Short turf species which have recently occurred on the sheep-grazed chalk bank include *Vicia lathyroides* (Spring Vetch), *Cerastium diffusum* (Sea Mouse-ear) and *Myosotis ramosissima* (Early Forget-me-not), with *Aira praecox* (Early Hair-grass) being locally frequent. The rare *Parapholis incurva* (Curved Hard-grass) still occurs in the southern part of the chalk bank area. *Phleum arenarium* (Sand Cat's-tail) occurs in quantity in the vicinity of the car park just north of the lighthouse.

Ruppia cirrhosa (Spiral Tasselweed) occurs in the canal scrape constructed to attract waders which is an important additional habitat for this rare species. *Polypodium interjectum* (Intermediate Polypody) persists.

KEY TO LIST OF SPECIES

Nomenclature is according to Stace, C. (1992) *New Flora of the British Isles* (1st ed., Cambridge University Press). Some information concerning the status of species in the Spurn area and in Yorkshire is provided as follows:
* = species recorded during the period 1975-1985
** = species added since 1985
al = alien
esc. = garden escape
E.Y. = only record for E. Yorkshire
o = species of open communities, i.e. where bare sand is present and therefore requiring a sandy area which is disturbed but not too frequently.
R = rare in E. Yorkshire, i.e. under six records
R.Br.sp. = rare British species
Sc.Br.sp. = scarce British species
s.t. = species more or less restricted to short turf and therefore now scarce
Y = only record for Yorkshire

Species more or less restricted to particular localities in the Spurn Bird Observatory area are noted thus:
a = arable areas in warren and to the north of it
c = 'canal'
c.b. = chalk bank area
d = dunes between cottage and 'narrow neck'
g = warden's garden
l.b.c. = near old life boat cottages
l.h. = lighthouse area
n = other areas north of Kilnsea Warren
n.n. = 'narrow neck'
p.c. = point camp
r.s. = river shore.
s.m. = salt-marsh
s.s. = seashore
w = Kilnsea Warren

A record is dated if there is reason to think the species may not have persisted.

LIST OF SPECIES

FERNS & ALLIES

Dryopteris filix-mas (L.) Schott (Male Fern)* p.c.
Equisetum arvense L. (Common Horsetail)*
Phyllitis scolopendrium (L.) Newman (Hart's-tongue Fern)* w
Polypodium interjectum Shivas (Intermediate Polypody)* d

DICOTYLEDONS
Acer pseudoplatanus L. (Sycamore)*
Achillea millefolium L. (Yarrow)*
Aegopodium podagraria L. (Ground Elder)* w
Agrimonia eupatoria L. (Agrimony)* d
Alliaria petiolata (M. Bieb.) Cavara & Grande (Garlic Mustard)** c.b.
Amsinckia micrantha Suksd. (Common Fiddleneck)** al; p.c.
Anagallis arvensis L. (Scarlet Pimpernel)* o
Angelica sylvestris L. (Wild Angelica)*
Anthemis cotula L. (Stinking Chamomile)* a
Anthriscus caucalis M. Bieb. (Bur Parsley)*
A. sylvestris (L.) Hoffm. (Cow Parsley)*
Aphanes arvensis L. (Parsley Piert)* s.t.
Apium graveolens L. (Wild Celery)* n
A. nodiflorum (L.) Lag. (Fool's Water-cress)* n
Aquilegia vulgaris L. (Columbine)* esc.; w
Arctium minus sensu lato (Lesser Burdock)*
Arenaria serpyllifolia L. (Thyme-leaved Sandwort)* s.t.
A. serpyllifolia ssp. *leptoclados* (Rchb.) Nyman (Lesser Thyme-leaved Sandwort)
Armeria maritima (Miller) Willd. (Thrift)* c.b.
Armoracia rusticana P. Gaertn., B. Mey. & Scherb. (Horse-radish)
Artemisia vulgaris L. (Mugwort)* w
Aster tripolium L. (Sea Aster)* c; c.b.; s.m.; n
A. tripolium var. *discoideus* Rchb. (Rayless form of Sea Aster)*
Atriplex glabriuscula Edmondson (Babington's Orache)** r.s.
A. hastata L. (Spear-leaved Orache)* r.s.
A. laciniata L. (Frosted Orache)** R; r.s.
A. littoralis L. (Grass-leaved Orache)* c
A. patula L. (Common Orache)*
A. portulacoides (L.) Aellen (Sea-purslane)* c.b.; s.m.; n

Barbarea stricta Andrz. (Small-flowered Winter-cress)* d, 1979
B. vulgaris W. T. Aiton (Winter-cress)*
Bellis perennis L. (Daisy)*
Beta vulgaris ssp. *maritima* (L.) Arcang. (Sea Beet)* r.s.
Blackstonia perfoliata (L.) Huds. (Yellow-wort)* w; p.c.
Brassica nigra (L.) Koch (Black Mustard)
B. rapa L. ssp. *oleifera* (DC.) Metzger (Oil-seed Rape)** al

Cakile maritima Scop. (Sea Rocket)* o; s.s.; r.s.
Calystegia soldanella (L.) R. Br. (Sea Bindweed)* R: o; n.n.; l.h.
C. silvatica (Kit. ex Schrader) Griseb. (Large Bindweed)
Campanula rapunculoides L. (Creeping Bellflower)* al
Capsella bursa-pastoris (L.) Medik. (Shepherd's-purse)*
Cardamine flexuosa With. (Wavy Bitter-cress)** p.c.
C. hirsuta L. (Hairy Bitter-cress)*
Carduus nutans L. (Musk Thistle)*
Centaurea nigra L. (Common Knapweed)*
Centaurium erythraea Rafn (Common Centaury)* c; w
Centranthus ruber (L.) DC. (Red Valerian)** n
Cerastium diffusum Pers. (Sea Mouse-ear)* R; s.t.; o
C. fontanum Baumg (Common Mouse-ear)*
C. glomeratum Thuill. (Sticky Mouse-ear)* s.t.; o
C. semidecandrum L. (Little Mouse-ear)* s.t.; o

C. tomentosum L. (Snow-in-summer)* esc.; l.h.
Chamerion angustifolium (L.) Scop. (Rosebay Willow-herb)*
Chenopodium album L. (Fat-hen)* a
C. murale L. (Nettle-leaved Goosefoot)* g, 1978
Chrysanthemum segetum L. (Corn Marigold)** c.b., 1997
Cirsium arvense (L.) Scop. (Creeping Thistle)*
C. arvense var. *incanum* (Fisch.) Ledeb.* al; E.Y.; d
C. vulgare (Savi) Ten. (Spear Thistle)*
Claytonia perfoliata Donn ex Willd. (Springbeauty) al; R
Cochlearia anglica L. (English Scurvygrass)* s.m.
C. danica L. (Danish Scurvygrass)** n.n.
C. officinalis L. (Common Scurvygrass)* s.m.
Conium maculatum L. (Hemlock)*
Conopodium majus (Gouan) Loret (Pignut)
Convolvulus arvensis L. (Field Bindweed)*
Conyza canadensis (L.) Cronquist (Canadian Fleabane) al; w, 1948
Coronopus didymus (L) Sm. (Lesser Swine-cress)* R; n
C. squamatus (Forssk.) Asch. (Swine-cress)* n
Crataegus monogyna Jacq. (Hawthorn)*
Crepis capillaris (L.) Wallr. (Smooth Hawk's-beard)*
Cruciata laevipes Opiz. (Crosswort) n
Cynoglossum officinale L. (Hound's-tongue)** R; d, 1998

Daucus carota L. (Wild Carrot)*
Diplotaxis muralis (L.) DC. (Annual Wall-rocket)* al
D. tenuifolia (L.) DC. (Perennial Wall-rocket)* R: p.c.; d
Dipsacus fullonum L. (Teasel)*

Echium vulgare L. (Viper's-bugloss)** p.c.
Epilobium hirsutum L. (Great Willow-herb)*
E. parviflorum Schreb. (Hoary Willow-herb)*
Erigeron acer L. (Blue Fleabane)* w; d; c.b.
Erodium cicutarium (L.) L'Her. (Storksbill)* s.t.; o
Erophila verna (L.) DC. (Whitlow Grass)* s.t.
E. verna var. *praecox* (Steven) Diklic (Whitlowgrass)* E.Y.
Eryngium maritimum L. (Sea-holly)* R; o
Euphorbia exigua L. (Dwarf Spurge) a
E. helioscopia L. (Sun Spurge)* a
E. lathyris L. (Caper Spurge) al; n, 1947
E. peplus L. (Petty Spurge)* g
E. x *pseudovirgata* (Schur) Soo* al; R; ds, first recorded 1948

Fallopia convolvulus L. (Black Bindweed)* a
Filago vulgaris Lam. (Common Cudweed)
Filipendula ulmaria (L.) Maxim. (Meadow-sweet)*
Foeniculum vulgare Mill. (Fennel)*
Fumaria officinalis L. (Common Fumitory) a

Galium aparine L. (Cleavers)* a; d
G. mollugo L. (Hedge Bedstraw)* w
G. verum L. (Lady's Bedstraw)* s.t.
Geranium dissectum L. (Cut-leaved Crane's-bill)* a
G. molle L. (Dove's-foot Crane's-bill)* s.t.
G. pratense L. (Meadow Crane's-bill) w

G. robertianum L. (Herb Robert)** c.b.; d; p.c.; w
Glaucium flavum Crantz (Yellow Horned-poppy)* R
Glaux maritima L. (Sea-milkwort)* c.b.; c
Glechoma hederacea L. (Ground-ivy)*
Gnaphalium uliginosum L. (Marsh Cudweed)* a

Hedera helix L. (Ivy)* w
Helianthus annuus L. (Sunflower) al; d, 1954
Heracleum sphondylium L. (Hogweed)*
Hesperis matronalis L. (Dame's-violet)*
Hippophae rhamnoides L. (Sea-buckthorn)* R; Sc.Br.sp.
Honckenya peploides (L.) Ehrh. (Sea Sandwort)* r.s.
Hyoscyamus niger L. (Henbane)* p.c.; g, 1978
Hypericum maculatum Crantz x *H. perforatum* L. = *H.* x *desetangsii* Lamotte* w, 1984
Hypochoeris radicata L. (Cat's-ear)*

Impatiens glandulifera Royle (Indian Balsam)* al; r.s., 1978
Inula conyzae (Greiss.) Meikle (Ploughman's-spikenard)* p.c.

Lamium album L. (White Dead-nettle)** n
L. amplexicaule L. (Henbit Dead-nettle)* g, 1978
L. hybridum Vill. (Cut-leaved Dead-nettle)* g, 1978
L. purpureum L. (Red Dead-nettle)*
Lathyrus pratensis L. (Meadow Vetchling)*
Leontodon autumnalis L. (Autumn Hawkbit)*
L. saxatilis Lam. (Lesser Hawkbit)* s.t.
Lepidium draba L. (Hoary Cress)* al
Leucanthemum vulgare Lam. (Oxeye Daisy)*
Ligustrum vulgare L. (Wild Privet)*
Limonium vulgare Mill. (Common Sea-lavender)* c.b.
Linaria vulgaris Mill. (Common Toadflax)* c.b.
Linum catharticum L. (Fairy Flax)*
Lobularia maritima (L.) Desv. (Sweet Alison) al; E.Y.; l.b.c., 1964
Lonicera caprifolium L. (Perfoliate Honeysuckle)* esc.; R; p.c.
Lotus corniculatus L. (Common Bird's-foot-trefoil)*
L. glaber Mill. (Narrow-leaved Bird's-foot-trefoil)* c
Lycium barbarum L. (Duke of Argyll's Teaplant)* al; w
Lycopus arvensis L. (Small Bugloss) a

Malva svlvestris L. (Common Mallow)*
Matricaria discoidea DC. (Pineappleweed)*
M. recutita L. (Scented Mayweed)* a
Medicago lupulina L. (Black Medick)*
M. sativa L. ssp. *sativa* (Lucerne) al; c, 1963
Melilotus alba Medik. (White Melilot)* al; p.c.
M. altissimus Thuill. (Tall Melilot)* al; n
M. indicus (L.) All. (Small Melilot)* al; R; p.c., 1978
M. officinalis (L.) Pall. (Ribbed Melilot)* al; w
Myosotis arvensis (L.) Hill (Common Forget-me-not)*
M. ramosissima Rochel (Early Forget-me-not)* s.t.; c.b.
Myriophyllum spicatum L. (Spiked Water-milfoil)* c

Odontites vernus (Bellardi) Dumort. (Red Bartsia)* a

Oenanthe fistulosa L. (Tubular Water-dropwort)* n
Ononis repens L. (Common Restharrow)*
O. spinosa L . x *O. repens* L. = *O.* x *pseudohircina* Schur*

Papaver dubium L. (Long-headed Poppy)* w; d
P. rhoeas L. (Field Poppy)*
P. somniferum L. (Opium Poppy) al; R; n, 1961
Parietaria judaica L. (Pellitory-of-the-wall)* n
Pastinaca sativa L. (Wild Parsnip)*
Pentaglottis sempervirens (L.) Tausch ex L. H. Bailey (Alkanet) al
Persicaria amphibia (L.) Gray (Amphibious Bistort)* n
P. lapathifolia (L.) Gray (Pale Persicaria)* a
P. maculosa Gray (Redshank)* a
Petroselenum crispum (Mill.) Nyman ex A. W. Hill (Parsley) esc.
Picris echioides L. (Bristly Ox-tongue)*
Pilosella officinarum F. Schultz & Schultz-Bip. (Mouse-ear-hawkweed)* s.t.
Plantago coronopus L. (Buck's-horn Plantain)* s.t.
P. lanceolata L. (Ribwort Plantain)*
P. major L. (Greater Plantain)*
P. maritima L. (Sea Plantain)* c; c.b.; s.m.
P. media L. (Hoary Plantain)** w
Polygonum arenastrum Boreau (Equal-leaved Knotgrass)** l.b.c.
P. aviculare sensu lato (Knotgrass)
Potentilla anserina L. (Silverweed)*
P. reptans L. (Cinquefoil)*
Primula veris L. (Cowslip)* p.c.
Prunella vulgaris L. (Self-heal)*
Pulicaria dysenterica (L.) Bernh. (Fleabane)*

Ranunculus acris L. (Meadow Buttercup)*
R. baudotii Godr. (Brackish Water Crowfoot)* R; c; w
R. bulbosus L. (Bulbous Buttercup)*
R. ficaria L. (Celandine)** n
R. repens L. (Creeping Buttercup)*
R. sardous Crantz (Hairy Buttercup)* c; a
R. sceleratus L. (Celery-leaved Buttercup)*
Raphanus raphanistrum L. (Wild Radish)* w
Reseda lutea L. (Mignonette)* p.c.
R. luteola L. (Weld)*
Rhinanthus minor L. (Yellow-rattle)*
Ricinus communis L. (Castor-oil-plant)* al; R; s.s.
Rubus fruticosus sensu lato (Bramble)*
Rumex acetosa L. (Sorrel) *
R. acetosella L. (Sheep's Sorrel)
R. crispus L. (Curled Dock)*
R. obtusifolius L. (Broad-leaved Dock)

Sagina apetala Ard. (Annual Pearlwort)* p.c.
S. maritima Don (Sea Pearlwort)* R; c.b.; *Nat.* 1970: 131
Salicornia dolichostachya Moss (Long-spiked Glasswort)* Y; *Nat.* 1977: 34
S. europaea L. (Common Glasswort)* r.s.; c.b.; s.m.; n
S. fragilis P. W. Ball & Tutin (Yellow Glasswort)* s.m.; r.s.; c.b.; Y; *Nat.* 1977: 34
Salsola kali L. (Saltwort)* R; s.s.; r.s.

Sambucus nigra L. (Elder)*
Scabiosa columbaria L. (Small Scabious)**
Scrophularia auriculata L. (Water Figwort) 1962
Sedum acre L. (Biting Stonecrop)*
S. album L. (White Stonecrop)* esc.; w
S. anglicum Huds. (English Stonecrop)* R; p.c.
Senecio erucifolius L. (Hoary Ragwort)* c.; w
S. jacobaea L. (Ragwort)*
S. jacobaea var. *floxulosus* DC. (Rayless form of Common Ragwort)* w
S. squalidus L. (Oxford Ragwort)* al
S. sylvaticus L. (Heath Groundsel)* w
S. viscosus L. (Sticky Groundsel)* al
S. vulgaris L. (Groundsel)*
Seriphidium maritimum (L.) Polj. (Sea Wormwood)* c
Sherardia arvensis L. (Field Madder)* s.t.
Silaum silaus (L.) Schinz & Thell. (Pepper Saxifrage)* n
Silene dioica (L.) Clairv. (Red Campion)* r.s., 1971
S. latifolia Poir (White Campion)*
S. noctiflora L. (Night-flowering Catchfly) a
S. uniflora Roth (Sea Campion)* R; c.b.
S. vulgaris Garcke (Bladder Campion)* d
Sinapis alba L. (White Mustard)*
S. arvensis L. (Charlock)* a
Sisymbrium altissimum L. (Tall Rocket)* al; w
S. officinale (L.) Scop. (Hedge Mustard)* w
S. orientale L. (Eastern Rocket)* al; w; c.b.
Solanum dulcamara L. (Woody Nightshade)*
S. sarachoides Sendtn. (Green Nightshade)* al; E.Y.; p.c., 1979
Sonchus arvensis L. (Field Sow-thistle)* r.s.
S. asper (L.) Hill (Prickly Sow-thistle)* c
S. oleraceus L. (Smooth Sow-thistle)* a
Spergula arvensis L. (Corn Spurrey)* a
Spergularia marina (L.) Griseb. (Lesser Sea-spurrey)*n; c.b.; c
S. media (L.) C. Presl (Greater Sea-spurrey)* r.s.; s.m.
Stellaria media (L.) Vill. (Chickweed)*
S. pallida (Dumort.) Pire (Lesser Chickweed)** R; o
Suaeda maritima (L.) Dumort. (Annual Sea-blite)* c; c.b.; r.s.; s.m.; n
Symphytum asperum Lepech. x *S. officinale* L. = *S.* x *uplandicum* Nyman (Russian Comfrey)*
S. officinale sensu lato (Comfrey)*

Tamarix sp. (Tamarisk)* Introduced? p.c.
Taraxacum laevigatum sensu lato (Lesser Dandelion)* p.c.
T. officinale sensu lato (Dandelion)*
Thalictrium flavum L. (Common Meadow-rue)* d
Torilis japonica (Houtt.) DC. (Upright Hedge-parsley)* n
T. nodosa (L.) Gaertn. (Knotted Hedge-parsley) a, 1946
Tragopogon pratensis L. (Goat's-beard)* n
Trifolium arvense L. (Hare's-foot Clover)* o
T. campestre Schreb. (Hop Trefoil)*
T. dubium Sibth. (Lesser Trefoil)*
T. fragiferum L. (Strawberry Clover)* c; n; c.b.
T. micranthum Viv. (Slender Trefoil) R; o; *Nat.* 1946: 155

T. pratense L. (Red Clover)*
T. repens L. (White Clover)*
T. scabrum L. (Rough Clover)* R; s.t.
T. striatum L. (Knotted Clover)* R; s.t.
T. suffocatum L. (Suffocated Clover)* Y; s.t.; w; *Nat*. 1946: 155; p.c.; Sc.Br.sp.
Tripleurospermum maritimum (L.) Koch (Scentless Mayweed)*
Tussilago farfara L. (Coltsfoot)*

Ulex europaeus L. (Gorse)*
Urtica dioica L. (Stinging Nettle)*
U. urens L. (Small Nettle)* a

Valeriana officinalis L. (Common Valerian)* d
Valerianella locusta (L.) Laterr. (Common Cornsalad)* s.t.
Verbascum thapsus L. (Great Mullein)* p.c.
Veronica arvensis L. (Wall Speedwell)*
V. chamaedrys L. (Germander Speedwell)* a
V. persica Poir. (Common Field-speedwell)* a
V. spicata L. (Spiked Speedwell) casual, 1961
Vicia cracca L. (Tufted Vetch)*
V. hirsuta (L.) Gray (Hairy Tare)* d
V. lathyroides L. (Spring Vetch)* R; s.t.; o; c.b.
V. sativa L. ssp. *sativa* (Common Vetch) w
V. sativa L. ssp. *nigra* (L.) Ehrh.* d
V. sepium L. (Bush Vetch) n
V. tetrasperma (L.) Schreb. (Smooth Tare)* n; w
Vinca major L. (Greater Periwinkle)* l.h.
V. minor L. (Lesser Periwinkle)* esc.; w
Viola arvensis Murray (Field Pansy) a
V. canina L. ssp. *canina* (Heath Violet)* R; o; n.n.; d
V. tricolor L. ssp. *curtisii* (E. Forst.) Syme (Wild Pansy)*

MONOCOTYLEDONS
Agrostis capillaris L. (Common Bent)*
A. stolonifera L. (Creeping Bent)* n
Aira caryophyllea L. (Silver Hair-grass)* o
A. praecox L. (Early Hair-grass)* s.t.
Alisma plantago-aquatica L. (Water Plantain)* w
Allium vineale L. (Wild Onion)* c
Alopecurus geniculatus L. (Marsh Foxtail)* n
A. pratensis L. (Meadow Foxtail)
Ammophila arenaria (L.) Link (Marram)*
Anacamptis pyramidalis (L.) Rich. (Pyramidal Orchid)* w; d; p.c.
Anisantha sterilis (L.) Nevski (Barren Brome)
Anthoxanthum odoratum L. (Sweet Vernal-grass)*
Arrhenatherum elatius (L.) P. Beauv. ex J. & C. Presl (False Oat-grass)*
Asparagus officinalis L. (Asparagus) al.

Bolboschoenus maritimus (L.) Palla (Sea Club-rush)* c; r.s.
Brachypodium pinnatum (L.) P. Beauv. (Tor-grass)* w
Briza media L. (Quaking-grass)* w
Bromus hordeaceus L. (Soft-brome)*
B. hordeaceus ssp. *thominei* (Hardouin) Braun-Blanq. w

Carex arenaria L. (Sand Sedge)*
C. caryophyllea Latourr. (Spring Sedge)* s.t.
C. distans L. (Distant Sedge)* R; c; w
C. divisa Hudson (Divided Sedge)** R; d; Sc.Br.sp.
C. extensa Gooden. (Long-bracted Sedge)* R; c
C. flacca Schreb. (Glaucous Sedge)*
C. otrubae Podp. (False Fox-sedge)* c; w
Catapodium marinum (L.) C. E. Hubb. (Sea Fern-grass)* R; o; l.b.c.; c.b
C. rigidum (L.) C. E. Hubb. (Fern-grass)* o
Cynosurus cristatus L. (Crested Dog's-tail)*

Dactylis glomerata L. (Cock's-foot)*
Dactylorhiza fuchsii (Druce) Soo (Common Spotted-orchid) w, 1961
Deschampsia cespitosa (L.) P. Beauv. (Tufted Hair-grass)

Eleocharis palustris (L.) Roem. & Schult. (Common Spike-rush)* n
Elytrigia atherica (Link) Kerguelan ex Carreras Mart. (Sea Couch)* s.s.
E. atherica var. *setigerum* Dumort.* d.
E. atherica x *E. juncea* = *E.* x *obtusiuscula* (Lange) N. Hylander*
E. juncea (L.) Nevski (Sand Couch)* s.s.
E. repens ssp. *arenosa* (Spenner) A. Löve** c.b.; w.
E. repens ssp. *repens* (L.) P. Beauv. (Common Couch)*
E. repens x *E. atherica* = *E.* x *oliveri* (Druce) Kerguelan ex Carreras Mart.** d.; l.h.; n; w.

Festuca arenaria Osbeck (Rush-leaved Fescue)* R.Br.sp.
F. ovina L. (Sheep's-fescue)* s.t.
F. rubra ssp. *juncea* (Hackel) K. Richter** n

Holcus lanatus L. (Yorkshire-fog)*
Hordeum murinum L. (Wall Barley)* w
H. secalinum Schreb. (Meadow Barley)* n; c
Hyacinthoides non-scriptus (L.) Chouard ex Rothm. (Bluebell)* esc.

Iris foetidissima L. (Stinking Iris)* al; R; r.s., 1976
Iris sp. * esc.

Juncus ambiguus Guss. (Frog Rush)* R; n; *Nat.* 1986: 23
J. articulatus L. (Jointed Rush)
J. bufonius L. (Toad Rush)* n; w
J. conglomeratus L. (Compact Rush)
J. effusus L. (Soft Rush)
J. gerardii Loisel. (Mud Rush)* c
J. inflexus L. (Hard Rush)*
J. maritimus Lam. (Sea Rush)* R; c

Lemna minor L. (Common Duckweed)* w
Leymus arenarius (L.) Hochst. (Lyme-grass)* R; r.s.
Lolium perenne L. (Perennial Rye-grass)*
Luzula campestris (L.) DC. (Field Wood-rush)*

Narcissus pseudonarcissus L. (Daffodil)* esc.

Ophrys apifera Huds. (Bee Orchid) w, 1950 one plant; c; c.b. 1996
Orchis mascula (L.) L. (Early-purple Orchid) w

O. morio L. (Green-winged Orchid)* w
O. simia Lam. (Monkey Orchid)* d, 1974-1981
Ornithogalum umbellatum L. (Star-of-Bethlehem)* esc.; w

Parapholis incurva (L.) C. E. Hubb. (Curved Hard-grass)* Y; o; c.b.; *Nat.* 1970: 131
P. strigosa (Dumort.) C. E. Hubb. (Hard-grass)* c; s.m.
Phleum arenarium L. (Sand Cat's-tail)* E.Y.; o
Phragmites australis (Cav.) Trin. ex Steud. (Common Reed)*
Poa annua L. (Annual Meadow-grass)*
P. compressa L. (Flattened Meadow-grass)* w
P. humilis Ehrh. ex Hoffm. (Spreading Meadow-grass) *Nat.* 1946: 155
P. pratensis L. (Smooth Meadow-grass)*
P. trivialis L. (Rough Meadow-grass)
Potamogeton pectinatus L. (Fennel-leaved Pondweed)* c
Puccinellia distans (Jacq.) Parl. (Reflexed Saltmarsh-grass)* n
P. maritima (Huds.) Parl. (Common Saltmarsh-grass)* s.m.

Ruppia maritima L. (Beaked Tasselweed)* R; *Nat.* 1946: 155; dike, n; c
R. cirrhosa (Pentagna) Grande (Spiral Tasselweed)** canal scrape; R

Schoenoplectus tabernaemontani (C. Gmelin) Palla (Grey Club-rush)** n
Spartina anglica C. E. Hubb. (Common Cord-grass)* r.s.; sparse in 1946, then extensive on Humber mud flats, but now scarce; c

Triglochin maritimum L. (Sea Arrowgrass)* c; s.m.
Trisetum flavescens (L.) P. Beauv. (Yellow Oat-grass)* n

Vulpia bromoides (L.) Gray (Squirrel-tail Fescue)** n

Zostera angustifolia (Hornem.) Reichb. (Narrow-leaved Eelgrass)* Humber mud flats; Y; *Nat.* 1977: 88
Z. marina L. (Eelgrass) formerly washed up in bay; Y
Z. noltii Hornem. (Dwarf Eelgrass)* Humber mud flats; *Y.N.U. Ann. Rep.* 1974; Y

SUMMARY

372 taxa have been recorded since 1945, 301 of which were recorded prior to 1975, 45 additional records were noted between 1975 and 1985, and a further 26 since 1985. Over this period there has been some loss of habitat, notably arable land. All the characteristic coastal species are still present, as are almost all those of short turf and open sand communities. *Carex caryophyllea* appears to be extinct.

ACKNOWLEDGEMENTS

I am indebted to Mr Peter Cook for up-to-date information concerning the river shore and the area north of the warren, and major revisions of the list, and to Prof. Mark Seaward for reprocessing and integrating my published and unpublished lists.

BOOK REVIEW

Insects, Plants and Set-aside edited by **Adrian Colston** & **Franklyn Perring**. Pp. vi+55. Botanical Society of the British Isles Conference Report no. 23. London. 1995. £6.50.

The large scale impact which agricultural policies have on natural biodiversity is well understood, but this slim publication provides a detailed scrutiny of the impact of one such policy, "set-aside" (the practice of obliging farmers to cease cultivation of a proportion of their land in order to minimise over-production). By showing how such policies can be fine-tuned in the interests of positive environmental outcomes, this conference report makes a significant contribution to the debate. Sponsored jointly by the BSBI and the Royal Entomological Society, it contains papers on the current options for set-aside and the Countryside Stewardship Scheme; establishment of grasslands on set-aside land; arable weeds; genetic consequences of set-aside both for plants and insect populations; management of set-aside land for rearing game birds; and the impact of successional changes in plant and insect populations. Brief abstracts are also provided from a panel discussion on "the way ahead", involving the head of Countryside Stewardship at the Countryside Commission (Tim Allen) and representatives of the Ministry of Agriculture (Sarah Hendry) and the Department of the Environment (Sarah Webster). This booklet is eminently affordable by all those involved in farming and conservation, and provides much food for thought.

JE

CONTRIBUTORS

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Printed in Great Britain by Titus Wilson & Son, Kendal ISSN 0028-0771

January-March 2000 Number 1032
Volume 125

The Naturalist

A QUARTERLY JOURNAL OF NATURAL HISTORY FOR THE NORTH OF ENGLAND

Published by the Yorkshire Naturalists' Union

Editor **M. R. D. Seaward** MSc, PhD, DSc, FLS, The University, Bradford BD7 1DP

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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 Naturalist is issued free to individual members of the Yorkshire Naturalists' Union and to Affiliated Societies.

Institutions and Subscribers £20.00 Registered Charity No. 224018

Editor **M. R. D. Seaward** MSc, PhD, DSc, FLS
The University, Bradford BD7 1DP

Volume 125
2000

Published by the Yorkshire Naturalists' Union

Otters obtained during the 19th century from the River Don ox-bows at Wheatley Park, Doncaster.
[From the collection of Sir William B. Cooke of Wheatley Hall, photographed during the 1920s while on loan to Beechfield House Museum, Doncaster.]

HISTORICAL REVIEW OF THE OTTER *(LUTRA LUTRA* L.) IN HATFIELD CHASE, ISLE OF AXHOLME AND CATCHMENTS OF THE TORNE, TIDAL DON AND WENT

C. A. HOWES
Museum & Art Gallery, Doncaster DN1 2AE

"This spring (1627) the otters were more numerous than any man remembered them and they were making havoc among the salmon in the Trent. This was the day appointed for the meet at Temple Bellwood, when all Belton and Beltoft were to assemble and make a great riddence of the vermin."

The Manuscript in a Red Box [Hamilton, J.] (1903)

INTRODUCTION

This review forms the second in a series of studies designed to provide a background to current monitoring of the otter (*Lutra lutra* L.) in river catchments, drain network systems and still water bodies associated with the 'Humberhead Levels Natural Area'. The histories and development of these waters are reviewed with respect to their suitability as otter habitats.

The wealth of historical allusions gathered from a wide range of sources (see references) is presented in support of otter habitat conservation policies expressed in a range of Environment Agency 'River Catchment Management Plans', 'Water Level Management Plans' and 'Flood Defence Maintenance Programmes' and local 'Biodiversity Action Plans'. They will also assist statutory bodies and riparian land owners (Internal Drainage Boards, British Waterways, Local Authorities, Environment Agency etc.) in the re-establishment of viable otter populations within resuscitated river catchments in the lower Trent/Don regions.

DATA SOURCES

Records have been derived from a wide range of archival, published, verbal and material sources. These include parish records, hunt trophies, museum specimens, press reports of the Doncaster, Goole and Lincoln regions, natural history journals, notably *The Naturalist,* topographical and local historical works and interviews and correspondence with local naturalists, anglers, farmers, gamekeepers and other residents. The relative productivity of these sources is shown in figure 1.

THE STUDY AREA

The study area forms the central portion of the geographically distinctive flat lowland wetland region of the 'Humberhead Levels Natural Area' (Hirst 1997). It extends broadly from the Southern Magnesian Limestone ridge of South Yorkshire in the west to the tidal lower Trent in the east, and includes the catchments of the Torne in the south (SK/5790 to SE/8311), the tidal reaches of the Don from Doncaster to Goole (SE/5704 to SE/7422), the River Went to its confluence with the Don (SE/5216 to SE/6618), and the networks of drains and canalised water courses of the Hatfield Chase and Isle of Axholme. Although situated largely in South Yorkshire, the more easterly and northerly elements of the region fall within the new counties of North Lincolnshire and East Yorkshire respectively and part of the Went catchment borders or lies within North Yorkshire.

Historical reviews of otters in the lower Trent and the catchment of the River Idle in Nottinghamshire, which forms part one of this series, are dealt with in Howes (1998) and the Don upstream of Doncaster in Howes (1976).

THE HISTORIC LANDSCAPE

Prior to the 1620s the lowland and tidal reaches of the untamed rivers Went, Don, Torne

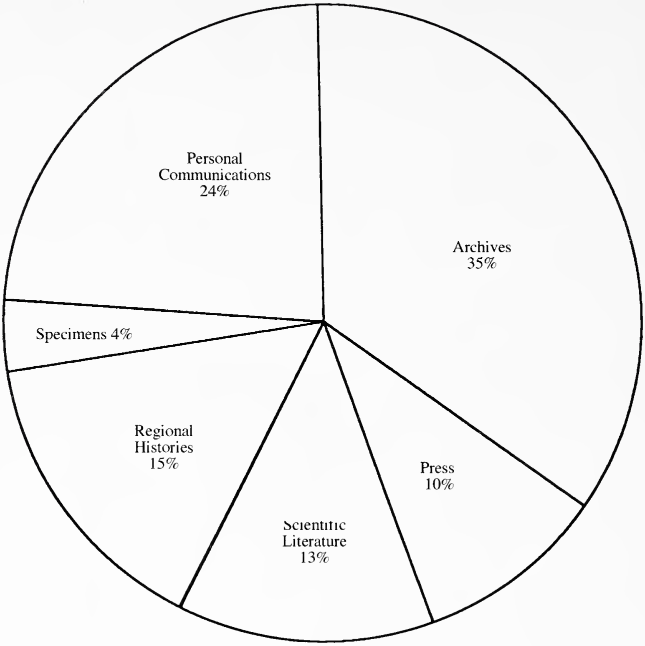

FIGURE 1
Productivity of data sources.

and Idle meandered amongst meres, marshes and peat moors before exchanging waters with the brackish, estuarine Ouse and Trent. This 'northern Everglades' formed the basis of a rural economy which included fish trapping, wildfowling, egg-collecting and reed-cutting. The Trent, Ouse and Don supported lucrative salmon fisheries and the twenty or so fisheries in the vicinity of the Tudworth and Thorne Meres yielded an estimated twenty thousand eels annually (Tomlinson 1882). During the 15th century, swaneries and fisheries at Crowle supplied cygnets, waterfowl, eels (*Anguilla anguilla* (L.)), pike (*Esox lucius* L.), roach (*Rutilus rutilus* (L.)), perch (*Perca fluviatilis* L.) and tench (*Tinca tinca* (L.)) to the kitchens of Selby Abbey (Haslop 1986). Otters could undoubtedly have thrived in this landscape, their perceived predation of commercial fish stocks giving rise to the attitudes expressed in the above quotation from the historical novel *The Manuscript in a Red Box* ([Hamilton] 1903) and up to the late 18th century bounty money was paid for otter heads.

In the 1620s and1630s, the extensive river and tidally fed meres and wetlands of the Hatfield Chase were largely marginalised or removed by the drainage schemes of Cornelius Vermuyden. These diverted the Idle into a new easterly. flowing channel at Idle Stop (SK/7296). The once meandering Torne, which joined the Idle near Tunnel Pits (SE/7304) and ultimately the old Don at Sandtoft (SE/7308), is now much diverted, straightened, considerably embanked and directed through a 'V' shaped water course. Now technically regarded as a 'highland drainer', the Torne is frequently above the level of the surrounding mechanically drained arable landscape, waters from which are lifted into it via a series of pumping stations.

The entire flow of the Don north from Stainforth (SE/6421) was diverted north through an artificial channel to join the Ouse at Turnbrigg (SE/6621) and later via the 'Dutch River' at Goole (SE/7422). The region of Hatfield Chase between Thorne Moors and Hatfield Moors, forming the old (pre-1620s) eastern course of the Don is now drained by a number of water courses including the Hatfield Waste Drain and the Boating Dyke. From the south, taking waters from the old course of the Idle in the Bull Hassocks area, are the South Engine Drain and the Folly Drain. All these waters, including the Torne, are placed into parallel channels known as the 'Three rivers' and finally pumped into the estuarine section of the lower Trent at Keadby (SE/8311).

Other major easterly flowing drains entering the Trent are the Warping Drain from the Park Drain Hotel (SK/7298) and Owston Ferry (SK/8199), the Paupers Drain (SE/7814 to SE/8515) and the Adlingfleet Drain (SE/8018) to SE/8521). A detailed history of the courses of the Old river Don, its 'meres' and its associated Hatfield Chase waters is given in Taylor (1987).

Allusions to the Natural Rivers

Went: An entry in the diary of the Rev. Abraham De la Pryme for 1697 described the water course as a 'narrow river not six yards over, but the crookedest and deepest that I ever saw in my life . . . Every turn of the river makes a great bogy on the other side, on which the water is thrown by the current and there is delicate fish therein . . .'. Of the abundance of eels, the otters preferred prey, he noted '. . . such quantities of eels that the like was never seen. Sometimes there will break out, or fall out of the hollow bank sides, when people are a fishing, such vast knots of eels, almost as bigg as a horse, that they break all their nets in pieces' Jackson (1870). Clearly a river of this configuration, and with such an abundance of eels, made the Went an ideal habitat for otters. Though currently relatively heavily engineered, the Went supports a good coarse fish stock, and is adjacent to a landscape of thickly hedged pastures and meadows, marshes, networks of drains, willow groves, and the washlands of the Went Ings. It therefore has a good potential for otter recolonisation.

Don: Adjacent to the tidal Don at Trumfleet water mills (SE/6011), De la Pryme recorded in 1697 that 'there are commonly, every May, such vast numbers of young eels comes over the wheels with the water and runs into the mill, that they are forced to give over working, and to send into town for the swine to devour them, for they are innumerable as the sand on the sea shore' (Jackson 1870).

Torne: 19th century and earlier maps show the Torne to have been a river meandering between reed beds and marshes. Descriptions by the 18th century otter hunters refer to 'sluggish and moderately deep' sections being the otters' strongholds; indeed, 'John Brooke of Awkley . . . could point out various places among the flags (*Iris pseudacorus*) of the old serpentine Torne where the otter had been killed'. The holts were known to be in hollows in the 'overhanging banks' and 'the deep recesses formed by the tortuous roots of the alder (*Alnus glutinosa*), and sometimes within a hollow in the body of the tree . . . the elevated dry patches which divide the currents are spots upon which he deposits his spraints and here he breakes up his prey and leaves the refuse' (Hatfield 1866).

Habitat Modifications and Additions

The navigation dividend: The tightly meandering nature of the lower Don between Doncaster and the port of Thorne was clearly attractive to otters, judging from the abundance of their records. The history of re-routing, and straightening the river and adding sections of canal for navigation purposes cut off a series of meanders and oxbow lakes, creating at least six significant isolated still waters which served to increase the habitat diversity of the catchment. The first section of the Dun Navigation between Holmstile (SE/5703) and Barnby Dun (SE/6010) opened in 1733 and was extended downstream to Fishlake Ferry (SE/6513) a little after 1740 (Firth 1998). The resultant series of isolated meanders and ox-bow lakes, particularly at Wheatley Park, Kirk Sandall and Barnby Dun, were evidently attractive to otters, giving rise to a number of breeding and hunting records.

Since the 1940s several sections of old river meanders have been landfilled and the pressure to continue this process still exists. Currently all but two which survive are now managed for angling.

The Stainforth and Keadby Canal (SE/6512 to SE/8311), with its associated soak drains which linked the Dun navigation with the Trent in 1802, in a sense recreated the pre-1620s eastern arm of the lower Don. The New Junction Canal (SE/6110 to SE/6518) which linked the Dun Navigation to the Aire Calder Navigation in 1905, potentially made a new passage for otters between the Don, Went and lower Aire catchments and provided a new series of aquatic habitats in the form of soak drains and 'borrow pits'. The Southfield Reservoir (SE/6518; 6519), a compensation lake for the Aire Calder Navigation, was constructed in two sections in 1890 and 1910 respectively. Covering some 47 ha it is the largest still water body in the study area and is well stocked with coarse fish. It was regularly frequented by otters in the 1930s and 1940s but in 1958 became a busy sailing and now wind surfing venue.

The railway dividend: The 'delves' and soak drains adjacent to the embanked railway networks created largely during the late 19th and early 20th centuries formed linking corridors between river catchments and wetland regions and gave rise to extensive linear runs of sallow carrs, reed beds and open waters often holding fish stocks. Radiating out from Doncaster across the flood plains of the Humberhead levels are the major rail routes to Selby, Goole, Scunthorpe and Gainsborough. Railway casualties have been a negative effect of this development and more recently the larger still waters created by the railways, such as Arksey Pond (SE/5706), Cementation Pond (SE/5606), Inkle Moor Pond (SE/6916), Thorne Delves (SE/6713; 6813) and Willow Garth Pond (SE/5707), are all managed for angling.

The mineral extraction dividend: Some sixteen permanent still water sites have resulted from mineral excavation for sand, gravel, clay, gypsum and warp (Armthorpe (SE/6504). Bank End (SE/9969), Belton (SE/7805), Birds Wood (SE/7300; 7301), Blaxton Common (SE/6810) Carr Side (SE/6902), Crowle (SE/7711), Ellerholme (SE/6903), Hatfield Fishing Ponds (SE/6711), Hatfield Moors (SE/6906; 6907), Hatfield Marina (SE/6610), Hayfield (SK/6399), Lindholme Lake (SE/7306), Moss (SE/5814), Tire'em Hall (SE/6805) and Tudworth (SE/6810). Although these have a potential as otter sites seven are managed for angling, three for boating and three have terrestrialised through a drop in the water table. Only those at Armthorpe, Birds Wood and Hatfield Moors are currently undisturbed. Although more quarries have been and are being excavated, a generally falling ground water table renders their water holding capacity problematical with landfill and low grade agriculture regarded as a more lucrative end-use.

Pre-19th Century Bounty Payments

Evidence of bounty payments made for otters can occasionally be located in the accounts of churchwardens and other parish officials in riparian parishes from the late 16th century to the first quarter of the 19th century (Howes 1978, 1984, 1998).

Attempts were made at the Doncaster Metropolitan Borough Archives Department, the Borthwick Institute for Historical Studies, and the County Records Offices at Nottingham and Lincoln to trace appropriate documents relating to riparian parishes situated within the following river catchment areas:

River Don – Arksey with Bentley; Barnby Dun; Doncaster; Fishlake, Stainforth.
River Trent (left bank) – Althorpe; East Lound; Owston Ferry; West Butterwick.
River Torne – Cantley; Loversall; Rossington; Tickhill; Wadworth; Wroot.
Pre-1620s course of river Don and Hatfield Levels drains – Adlingfleet; Crowle; Eastoft; Hatfield; Thorne; The Isle of Axholme – Belton; Epworth; Graizelound; Haxey.
River Ouse Goole; Hook; Swinefleet; Whitgift.
River Went – Cowick; Moss; Sykehouse.

Relevant archives from the appropriate date period were only traceable for eleven of these 32 targeted parishes (see Appendix 1). Of these, only eight parishes contained records of 'vermin' bounty payments, of which only three, Arksey with Bentley (34 records), Doncaster (2 records) and Owston Ferry (4 records) (9% of those investigated) produced records of otters. The resultant 40 otter records, ranging in date from 1619 to 1762, are itemised in Appendices 2, 3, and 4.

OTTER HUNTING

On 15th August 1862, the Doncaster journalist C. W. Hatfield (1866) interviewed Mr Hill Lee, schoolmaster and local historian of Auckley on the subject of his own forebears Robert Lee (1745 to 1814) and Mr Whitaker (1710 to 1794) of Auckley, two of the most celebrated otter hunters in the Doncaster region. Whitaker was described as being a remarkable character who wore immense waterproof boots and was armed with a spear and often with a long pole 'shod with an iron pike' with which he could 'vault with ease over rivers and drains after the manner of the Dutch'. He was a solitary hunter and his otter killing services were in demand on all the local landed estates, 'the more he protected the stew ponds, the more cordial were his receptions', and he regularly patrolled the banks of the Torne, Trent and Don in pursuit of the otter. Other followers of otter hunting on the Torne during the late 18th and early 19th centuries were John Bradbury, John Brooke, William Elvidge, Edward Law, Thomas Milner, George Mowbray and John Watson. They generally kept an otter hound and had their fixed days for 'hunting' (Hatfield 1866).

Private packs of otter hounds, such as those managed by Sir Charles Legard and by Colonel Dawson, visited the Don in the 1890s, notably at the invitation of Sir William Cooke of Wheatley Park. Whilst based at Bawtry for their annual week's sport, the Buckinghamshire Otter Hounds, formed in 1890, visited and made kills at Lindholme Lake up to the 1950s.

REVIEW OF OTTER RECORDS BY RIVER CATCHMENT, DRAIN NETWORK OR WATER BODY

Records from all sources are presented in chronological order for each water body, drain or river system commencing in the south of the study area.

River Torne and the Doncaster Carrs above Rossington Bridge: During the 18th century otters regularly visited the fish ponds of the estates at Loversall (SK/5798) and Alverley (SK/5499), situated on the fringes of the fens and marshes of the Doncaster, Balby and Rossington Carr complex (Hatfield 1866). In 1812, in snowy conditions, John Wright tracked an otter across the Doncaster Carrs (SE/5801) where it had killed a pike, and on to the lake known locally as the Old Eaa (SE/5900) where it had killed a second fish (Hatfield 1866). In January 1907 a 3′ 6″ 14 lb female was shot by Arthur Shirtcliffe at Styrrup Haugh, Tickhill (SK/5991). The specimen was preserved by the local taxidermist James Watson (*Doncaster Gazette* 4.1.1907). During the prolonged winter of 1946-7, tracks and the remains of fish kills which included roach and gudgeon (*Gobio gobio* (L.)) were seen on the Torne bank from Park Wood (SK/6199) and Rossington Bridge (SK/6299) (R. Rhodes, *pers. comm.* 1987). The last otter seen in this part of the catchment was an adult on the newly subsided and inundated carrland at Low Ellers (SE/5900) in 1963 (B. Baxter, *pers. comm.* 1969).

River Torne downstream of Rossington Bridge: In the early winter of 1810, John Wright, a Doncaster Corporation gamekeeper, shot an otter at Rossington Bridge; its body was later found downstream at Tunnel Pits (Hatfield 1866). Mr William Brook of Bawtry noted in 1863 that 'the river Torne, from Acomb Bridge (SE/6410) to Rossington Bridge (SK/6299), afforded much sport in the otter hunt' (Hatfield 1866). In 1976 anglers again reported seeing otters in the Wroot area (SE/7003) and the section known as the Three Rivers (SK/8110) (D. Mahoney, *pers. comm.* 1976).

Single spraints were located by the bridge at Hirst Wood (SE/7809) during the 1994 national otter survey (Strachan & Jefferies 1996) and in November 1994 by the author.

Drains associated with the Hatfield Levels and Keadby Canal: On 13th May 1906 an otter weighing 21 lb and measuring 4′ 6" was trapped and killed on the southern edge of Thorne Moors at Medge Hall Farm (SE/7412) and other otters had been seen in the area (*Doncaster Gazette* 18.5.1906). During the 1st week of January 1921 an adult female was shot near Hatfield (SE/61) and a week later an otter cub was found asleep in a farm stackyard about one or two miles distant and also dispatched (*Doncaster Chronicle* 7.1.1921). An adult otter was shot (*c.* 1923) by Joseph Richardson in the Boating Dyke on the Hatfield Levels; the mounted specimen is in Doncaster Museum (Howes 1987). In the 1930s, otters were known to occur in the Crowle Brick Ponds (SE/7711) and in 1963 there were sightings and fish kill remains (W. Bunting, *pers. comm.* 1976). On 5th June 1971, signs in the form of a slide through bank-side vegetation and the remains of characteristically chewed roach and bream (*Abramis brama*) were seen in the North Engine Drain, downstream of Dirtness Pumping station (SE/7710) (Howes 1987). In September 1982, otters, including young, were seen in the North Soak Drain of the Stainforth and Keadby Canal between Medge Hall (SE/7412) and Keadby Power Station (SE/8311), and on 2nd September an otter was sighted in an angling pond near the power station (A. Frankish, *pers. comm.* 1987). In October. 1997 an otter was killed on the A18 west of the Crowle/Hirst Priory Junction (SE/7810) (A. Dickson, *pers. comm.* 1998) and at 05.45 hrs on 12th March 1998 one was seen crossing the A18 near the same point (C. Taylor, *pers comm.* 1989).

Drains of the Isle of Axholme: Between 1730 and 1748 the churchwardens of Owston Ferry paid one shilling per head for four otters (see Appendix 4). In 1939 a 4′11″ specimen was shot in Temple Drain at Belwood (SE/7908) and preserved by a local taxidermist (M. Jackson, *pers. comm.* 1986; F. Robinson, *pers. comm.* 1986). In November 1972 one was seen in the Warping Drain at Owston Ferry (SK/7998) (B. Fetherstone, *pers. comm.* 1972).

Hatfield Moors and Lindholme Lake: Otters frequented Lindholme Lake and the drain on the east side of the moor during the 1930s (Marshall *et al* 1989). Up to the 1950s Lindholme Lake (SE/7306) was seasonally visited by the Buckinghamshire otter hounds. A visit in 1950 'caused local excitement', though no kill was made. (Hyde 1952); however, a mounted specimen and a mounted head, both dating from the 1950s, in the collection of Jack Lyon at Lindholme Hall were procured at the lake (Hyde 1952, D. Mahoney, *pers comm.* 1976; Marshall *et al.* 1989). In 1976 otters were still being observed here by local anglers (D. Mahoney, *pers. comm.* 1976). From the 1970s to the 1990s, otters were present in the Hatfield Waste Drain (SE/7207) on the northern boundary of Hatfield Moors; indeed, a holt was still in use during the late 1990s (B. Craggs, *pers. comm.* 1998).

Thorn Moors: Although Thomas Bunker (1898) knew of no otters on the moors, one was shot in the Thorne Waste Drain (SE/7213) in the 1890s (M. Snow, *pers. comm.* 1989). Contrasting with Bunker's (1898) comment, Corbett (1907) claimed that the otter still abounded in the neighbourhood of Thorne Moors (SE/71). The only records actually referring to the peat moor involve otters in the peat canals area (SE/7215) in the late 1930s, along Swinfleet Warping Drain (SE/7415) in 1947 and along Thorne Waste Drain in 1963 (Bunting 1976). Significantly, during the winter of 1972-37 following the peat industry's excavation of major drainage ditches through the peat and into the underlying clays along the southern edge of the 'canals area' (now Thorne Moors National Nature Reserve), the footprints of many species, including otter, could be seen in the fresh clay (Limbert 1979).

River Don: (Doncaster to Goole): The churchwardens' accounts for the township of Doncaster show that in 1619 one shilling was paid for two otter heads (see Appendix 3). In the 1700s, otters were known to frequent the River Cheswold (SE/5703) near St George's vicarage and in periods of flooding, otters enter the open sewers connected with the Don at Doncaster (SE/50) (Hatfield 1866). The churchwardens' accounts for the parish of Arksey with Bentley (SE/50) reveal that between 1720 and 1762 bounties of one shilling each were paid for some 34 otters with a maximum of five being declared in 1762, giving an average cull of 1.2 per year (see Appendix 2). Nonetheless, during the 1790s William Guest reported that he still 'frequently met with the otter in the River Don at Bentley' (Hatfield 1866).

In 1794 two were killed with one shot at their holt in the bank of a Don oxbow at Wheatley Park (SE/5805) and in the early 19th century, Richard Guest and John Tomlinson caught one in Cobshire [Cockshaw] dyke end in the catchment of the Eaubeck, near Reedholme House (SE/5810) (Hatfield 1866). In 1833 otters were present in Wheatley Ponds at Wheatley Park (SE/5805) (Hatfield 1866) and in December 1844, several otters were present in the old river Don at Kirk Sandall (SE/6008), their many footprints being distinctly visible in the sandy bank (*Doncaster Gazette* 20.12.1844). One caught a nesting duck at Sandall Grange (SE/6006) in 1850 (Hatfield 1866), and in September 1890 Sir Charles Legard's Otter Hounds found but did not kill an otter in the old course of the Don about a mile above Kirk Sandall Lock (SE/5906) (*Goole Weekly Times* 26.9.1890). In early February 1891 a 3′ 7″ 18 lb otter was shot by James Piper in one of the Dun Drainage drains at Kirk Sandall (SE/6007) (*Doncaster Gazette* 6.2.1891) and in late September 1892 Col. Dawson's otter hounds encountered an otter at Barnby Dun (SE/6109) (*Doncaster Gazette* 23.9 1899).

In June 1911 an otter was at Sandall Lock (*Doncaster Chronicle* 9.6.1911) and in 1921 one was killed on the railway lines in Wheatley Park (SE/5804) (Howes 1976). In November 1926, Mr E. C. Senior, Curator of Doncaster Museum, notified the *Doncaster Chronicle* that 'Two cases of very fine otters captured at Wheatley Ponds [SE 5805] may be seen at the museum' (Senior 1926). These were likely to be the specimens mentioned above, placed in the collection of Sir William-Cooke of Wheatley Hall and loaned and later donated to Doncaster Museum.

During the 3rd week of October 1933 two young were caught at Rawcliffe Bridge (SE/7021) (Bramley 1933, YNU Circular 385) and on 13th June 1938 a 'family party' of five were reported in the adjacent River Aire at Rawcliffe (SE/6823) (Gallwey 1939). By the 1950s otters were reputedly rare around Doncaster though they evidently still visited the ponds (River Don oxbows) at Wheatley Park up till the 1940s, George E. Hyde (1952) recalling that a pair living behind the old hall provided interest and entertainment to the quiet observer on numerous occasions.

In 1959, on the warpings by the Rawcliffe Road, Thorne Waterside (SE/6714), on opening a 'potato pie' (clamp) a large male otter, using this structure as a refuge, was disturbed and killed. Its pelt, preserved by a local butcher, survived until recently (D. F. Finch, *pers. comm.* 1989). In 1966 an adult was seen in the Stainforth-Keadby canal at Bramwith lock (SE/6111). During this period breeding had taken place, as from time to time cubs were killed by local youths with air guns (J. McGarry, *pers. comm.* 1971). In April 1971 many footprints were present in the tidal mud and around the washland ponds between the Don and its flood banks at Stainforth East Ings (SE/6613 and 6713) and on 6th two adults and up to three cubs were observed (J. McGarry, *pers. comm.* 1971, Lenton *et al.* 1980). Footprints were also identified around the 'dugout' lake at Thorpe Marsh (SE/5909) on 14th April (R. Rhodes, *pers. comm.* 1971).

River Went: An otter was present on the fenland lake of Shirley Pool (SE/5611) in 1847 (Hatfield 1866). On 15th December 1872 a cub was found dead on the banks of the Went (*Land and Water* 1873; Southwell 1877). An adult otter was unsuccessfully pursued by the hunt in the Carr Drain at Cowick Park (SE/6302) in June 1909 (*Goole Times and Weekly Herald* 18.6.1909) and on 9th December 1919 a 28 lb female otter was killed on the Hull Barnsley Railway line near a fishing pond at Balne Moor (SE/5819) (*Goole Times*

12.12.1919). Otters were again reported from Shirley Pool in 1938 (Yale-Allen 19.38) and during the 1930s and 1940s, otters occurred fairly commonly on Southfield Reservoir (SE/6519). Jim Hall, water bailiff for the Castleford Angling Association, noted that 'Otters were fairly common, sometimes three or four could be seen in a morning. The best time to see them was at first light, their favourite haunt being the grassy triangle at the southern end of the reservoirs serpentine bank. When disturbed they would swim across the canal and soak drain and run across the Went water meadows towards the aqueduct' (Wall 1986). One was found dead by Reg. Rhodes on the eastern bank of the reservoir in January 1960 (Hazelwood 1961); in the autumn of 1972 one was encountered on the Went near its confluence with the Don (Wall 1986) and on 14th September 1981 one was seen at Southfield Reservoir (Burden 1981).

National Surveys

Water courses in the study area have been included in four national surveys of otter status and distribution. The first (Stevens 1957) was undertaken during 1952 to 1954, largely through correspondence with River Board managers and Otter Hunt masters and effectively related to all water courses. Her report suggested that within the lower Trent region they were 'numerous' and in the Yorkshire Ouse region, they were *very numerous*.

In 1977-79 (Lenton *et al.* 1980), 1984-86 (Strachan *et al.* 1990) and again in 1991-94 (Strachan & Jefferies 1996) the Nature Conservancy Council monitored trends in otter distribution in England. This was achieved by the examination of pre-detrmined 600m sample sites along stretches of riparian habitats within the north-western and south-eastern quarters (50km squares) of alternate 100km squares of the national grid.

The 1977-79 survey visited 24 sample sites on the canalised and heavily maintained water courses of the river Torne and the associated drains up to the Ouse within the lower Trent region and 16 sites in the lower Don/Went area in October 1978; all proved negative (Lenton *et al.* 1980). For the 1984-86 survey, the combined 40 sites were examined in October 1985 and again all proved negative (Strachan *et al.* 1990).

The 1991-94 survey revealed a single sprains on the Torne and this, together with a probable otter sighting on the lower part of the Trent, suggested that transient animals were using this system (Strachan & Jefferies 1996).

Summary and Discussion

This study has accumulated some 123 records or allusions to otters from the study area with dates ranging from 1619 to 1998. Appendix 5 indicates the numbers of records gathered for the 18th and 19th centuries and each decade through the 20th century separately for each of the target catchments of the Torne (12), tidal Don (64), Went (13), and the drain networks of the Hatfield Levels (13), Isle of Axholme (6), Thorne Moors (6) and Hatfield Moors (9).

Indications of the suitability of river courses for otter habitats deduced from early cartographic sources and allusions to the abundance. of otter prey species in the natural river catchments prior to the river diversion and drainage schemes of the 1620s and 30s suggest that otters would have been numerous and widespread througout the Humberhead Levels prior to the early 17th century.

Upstream of Hatfield Chase, the riverine habitats of the Tome, Don and Went, the superabundance of eels, the otters' preferred lowland prey species, indicated a continuation of otter abundance up to the late 18th century and allusions to the popular though solitary pastime of otter hunting indicate the Torne to have been a prime otter river up to the 19th century.

By isolating a number of substantial meanders of the lower Don, the development of the Dun navigation seems to have actually created a number of otter habitats. A considerable number of other aquatic habitats have also been created incidentally to the development of linear canal and railway systems and also by the mineral extraction industry.

Changes in staus: Figure 2 compares numbers of records gathered for the 18th and 19th centuries and each decade through the 20th century. This indicates the very high rate of persecution during the 18th century through specialist otter control on private estates and a bounty payment system operated through township or parish authorities. The churchwardens' accounts from the parish of Arksey with Bentley revealed bounty payments for some 34 otters, with a maximum of five in one year, between 1720 and 1762 representing an average cull of 1.2 per year (see Appendix 2). If this was typical, an average annual culling pressure of some 12 per year may have been exerted within riverside parishes from Doncaster to Goole. Interestingly, through the 19th century, when one would have expected a rise in documentary evidence of otters via the increased

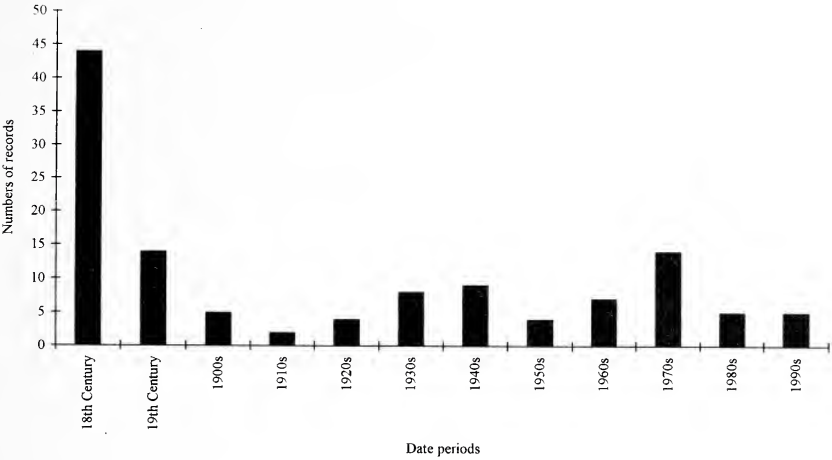

FIGURE 2
Records and allusions to otters since the 18th century.

availability of local newspapers, scientific journals and topographical histories, in fact otter records decline. This is probably related to the 19th century 'crash' in otter populations in South Yorkshire rivers due to persecution pressure (Howes 1976). Hugh Reid, the Doncaster taxidermist, remarked that 'every hand was uplifted against the otter, its desertion of its old haunts is entirely attributed to the . . . intense hatred of its habits of destruction of fish'. Referring to the Don at Doncaster around 1800, William Guest claimed that 'the otter has deserted its former haunts . . . becoming extinct by the vigilance of the expert gunner' and C. W. Hatfield noted that the otter's 'extermination on the banks of preserved ponds and pools has been nearly if not wholly accomplished' (Hatfield 1866). Figure 2 indicates that the decline continued through the early decades of the 20th century. Possibly due to a decline in game keeping and 'vermin' control during and after the First World War, numbers appear to increase up to the 1940s. However, a decline during the 1950s and 60s could reflect the population crash in lowland eastern England at this time, caused by the introduction of the cyclodiene organochlorine insecticides, aldrin, dieldrin and heptachlor (Strachan & Jefferies 1996). Since this family of pesticides, 'which became widely available by 1955, was used on cereal, brassica and root crops, the study area, which is largely managed for the benefit of the arable industry, would have been particularly heavily contaminated up to the period of their voluntary ban 1962 and total ban in 1975 (Strachan & Jefferies 1996). The peak of records during the 1970s can be accounted for by an increase in recorder effort in the form of an interview survey of anglers across the Hatfield Chase (D. Mahoney *pers. comm.* 1976) and the author canvassing for data for the Mammal Society otter survey at this time. Subsequent low numbers of records through the 1980s and 1990s is probably a reflection of a lower canvassing effort and therefore represents an under-estimation of occurrence. It does however confirm that some otters survived the organochlorine-poisoning 'crash' and the species still maintains a presence within the study area.

Productivity of river catchments: Figure 3 shows how the percentage frequencies of the 123 records are distributed between the river catchments and drain networks of the study area. Surprisingly this highlights the tidal lower Don catchment as being easily the most significant otter river, providing 52% of the records. Even excluding the 17th and 18th century bounty payments, the tidal Don accounts for 27% of the records, representing approximately twice the productivity of the Went catchment (13%), Hatfield Chase drain networks (13%) and Torne catchment (12%).

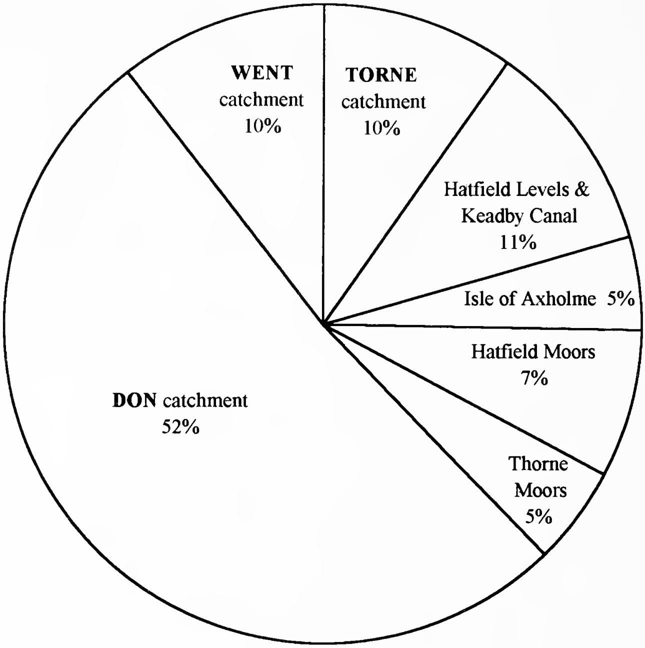

FIGURE 3
Relative productivity of otter records from drain and river catchments.

Possible problems with recreational use of still waters: This study has identified some 26 still waters which have been created by river straightening, canal and railway construction and the mineral extraction industry over the past 266 years. Although some of these have a history of otter usage, only five are currently free from the disturbance of water sports and angling interests. Since human disturbance is generally inimical to otter activity, this current level of recreational use of still water sites may be a significant impediment to successful re-colonisation. Further, since there is currently active lobbying by angling and fishery interests against the protected status of piscivorous birds within the study area, the almost universal utilisation of still waters, canals and the recently much improved rivers by angling interests, may raise objections should otter populations become established and increase. Meanwhile, in accordance with 'Local Biodiversity Action Plans', work proceed to install artificial otter holts at strategic sites on the Torne and lower Don catchments to enable vagrant animals which periodically pass through the region to form the basis of sustainable resident populations.

ACKNOWLEDGEMENTS

I would like to thank the many people who have assisted in this project, particularly Mrs E. Lyon for permission to examine the preserved specimens at Lindholme Hall, Mrs D. Mahoney for the results of her interviews with anglers in 1976 and my colleague Martin Limbert for references from 19th century newspapers. Valuable anecdotal records were supplied by Messrs B. Baxter, W. Bunting B. Craggs, B. Fetherstone, M. Hanson, M. Jackson, J. McGarry, R. Rhodes, M. Snow, C. Taylor and Ms. A. Dickson and A. Frankish.

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APPENDIX 1

Success rates in locating otter bounty records in Churchwardens' accounts in 32 targeted riparian parishes.

Parish	Appropriate date range	Vermin bounties	Otter bounties
Adlingfleet	*	–	–
Arksey with Bentley	*	*	*
Belton	*	*	–
Crowle	*	–	–
Doncaster	*	*	*
Fishlake	*	*	–
Haxey	*	–	–
Hook	*	*	–
Owston Ferry	*	*	*
Swinefleet	*	*	–
Wadworth	*	*	–
Total	11	8	3
% of 32 parishes	34%	25%	9%

APPENDIX 2

Detail of otter bounty payments in the Churchwardens' accounts of the township of Doncaster (Doncaster Archives Department no. P. 1/4/lA)

Year	Entry	Bounty payment £. s. d.
1619	Payed to John Harpen and John Roodes for two otters heads	– 1. –

APPENDIX 3

Details of otter bounty payments in the Churchwardens, and Overseers of the Poor accounts of the parish of Arksey with Bentley (Doncaster MBC Archives Department no. P. 6/B1-6)

Year	Entry	Bounty payment £. s. d.
1720	Pd. for 1 otter head	– 1. –
1723	Pd. for an otter	– 1. –
1725	Pd. to John Broughton for an otter	– 1. –
1725	Pd. to John Hill for an otter	– 1. –
1725	Pd. for 2 otters	– 2. –
1727	Pd. for 2 otters	– 2. –
1730	A Oter	– 1. –
1733	Pd. to Francis Best an otter	– 1. –
1734	Pd. to John Hill for an otter	– 1. –
1734	Pd. for an otter	– 1. –
1736	Pd. to John Robert for an otter	– 1. –
1737	Pd. June 3rd John Hill an otter	– 1. –
1737	Wm. Burley 2 otters	– 2. –
1737	An otter	– 1. –
1738	May 14th for an otter	– 1. –
1738	June 5th to Sanders, an otter	– 1. –
1739	Otter	– 1. –
1739	Otter	– 1. –
1739	Otter	– 1. –
1741	1 otter	– 1. –
1744	Pd. to William Serivit for 1 otter head	– 1. –
1744	Pd. for an otter	– 1. –
1747	Otter head	– 1. –
1756	Pd. John Seaton for 2 otters	– 2. –
1759	Pd. for an otter	– 1. –
1762	Pd. for five otters	– 5. –

APPENDIX 4

Details of otter bounty payments in the Churchwardens' accounts of the parish of Owston Ferry (Lincoln County Record Office no. PR/10/1)

Year	Entry	Bounty payment £. s. d.
1730	Paid for a Ottors head Christopher Wilkinson	– 1. –
1730	Paid for a Otter Francis Bouth	– 1. –
1748	Two Ottor heads 2/-. Register etc.	– 2. 6

APPENDIX 5

Records and allusions of otters per drain and river catchment

	pre-18th century	18th century	19th century	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	TOTALS
Torne catchment		2	3	1				1		1	2		2	**12**
Hatfield Levels & Keadby Canal				2		3	1			1	1	3	2	**13**
Isle of Axholme		4					1				1			**6**
Hatfield Moors							1	1	3		2	1	1	**9**
Thorne Moors			1	1			1	1		1	1			**6**
Don catchment	2	38	8		1	1	2	2	1	3	6			**64**
Went catchment			2	1	1		2	4		1	1	1		**13**
TOTALS	**2**	**44**	**14**	**5**	**2**	**4**	**8**	**9**	**4**	**7**	**14**	**5**	**5**	**123**

BOOK REVIEW

The History of British Mammals by **Derek Yalden**. Pp. 305, with 24 black and white drawings, 92 maps and figures and 22 tables. T. & A. D. Poyser. 1999. £25.95 hardback.

How often have attempts to get to grips with origins of the British fauna, flora or landscape history foundered in the academic exudate of such disciplines as archaeology, climatology, pleistocene geology and palaeo-ecology, each with their specialist vocabularies and time-scale terminologies? In his book Derek Yalden, with the wisdom of an old sage who has seemingly lived through it all, melts these disparate cultures into a coherent thematic strand and relates the origins and relationships of a changing mammalian fauna to the evolving landscapes, fluctuating climates and interactions with human-kind over the past fifteen thousand years.

His exhaustive quest to assemble and interpret the colourful histories of our multi-ethnic mammal fauna, culls and combines evidence from a huge literature, which incidentally includes significant references from *The Naturalist.* Every method and technique, from cave excavations and hunting records, to placename evidence and churchwardens' accounts, have been employed to demonstrate themes and case histories. Chapter headings and highlights are illustrated by Priscilla Barrett's elegant and technically rigorous pencil drawings.

Although a relatively slim volume, this is a truly mighty work, a life's work, written with the care and inspiration of a born teacher and the vigour of an enthusiast with an infectious curiosity about the biodiversity of the British Isles. This is a rare example of a textbook which is at once a life-saver for the baffled student. a rich source of new material for further studies and a most absorbing read – a detective story in nine chapters including many plots, a changing menagerie of characters from mammoth to muntjac and with some unexpected outcomes – you just can't put it down.

CAH

AQUATIC MACROPHYTES AND CONSERVATION IN THE DRAINS OF THE HULL VALLEY

R. GOULDER

Department of Biological Sciences, University of Hull, Hull HU6 7RX

ABSTRACT

Aquatic macrophytes were surveyed in thirty five 100 m lengths of drain in the summer of 1996. Fifty-one taxa were recorded; the mean species richness equalled 12.1. A conservation index was calculated for each site, and sites were grouped using TWINSPAN. The groups included one of six sites which tended to be larger drains with high conservation index, and one of six sites with zero conservation index which tended to be ochreous with high conductivity. The management regime of the Hull Valley drains, i.e. annual vegetation removal and sludging out at about ten year intervals, appeared to be compatible with the survival of a relatively rich aquatic flora.

INTRODUCTION

The flat lands of the Hull Valley in north-east England are drained by an extensive network of artificial channels, dug from the medieval period onwards and especially in the 18th and 19th centuries (Sheppard, 1958). Former wetlands have largely been replaced by intensive arable farming. It has been recognised that the drains, or dykes, are potential refuges for a previously widespread aquatic flora (Robinson, 1923; Crackles, 1968). The drains are frequently the sites of aquatic plant records in the East Yorkshire Floras (Robinson, 1902; Crackles, 1990). However, so far as the author is aware, there is a dearth of publications which consider in detail the vegetation and botanical conservation value of these drains, although Crackles (1952, 1974) emphasized the importance of the flora of the Leven Canal and its likely derivation from the vegetation of the post-glacial meres through which the navigation channel was cut in 1802. In contrast, there are many articles which describe the aquatic vegetation of Broadland drains, or dykes, and their management for conservation (George, 1977; Baker *et al.,* 1978; Driscoll, 1982, 1985, 1986, 1995; Burgess & Evans, 1990). Much of the extensive work on the vegetation of the Norfolk dykes is reviewed by George (1992). The present article aims to begin to redress this imbalance by providing information about the composition and conservation value of aquatic vegetation in some of the Hull Valley drains.

The study described is based on vegetation surveys of 35 sites made in the summer of 1996, with some revisits in 1997 and 1998. The drains surveyed included substantial watercourses, with widths up to *c.* 8 m, which are classified as main rivers (Anon., 1994) and are maintained by the Environment Agency, i.e. Beverley and Barmston Drain, Holderness Drain, Monk Dyke and Scurf Dyke; also included were lesser watercourses, maintained principally by the Beverley and North Holderness Internal Drainage Board or by riparian owners down to a width of 0.8 m. Most were trapezoidal in section, often deeply excavated. All held water during June to August 1996, when water depth ranged from a few centimetres to 1.2 m. There was mostly little or no summer flow, apart from in drains which apparently received water from the Wolds chalk; e.g. Scurf Dyke and Kirby Drain. The drains predominantly traversed arable land: 33 sites had arable on at least one side (21 on both sides), only six had pasture on one or both sides, and five had waste or copse on one or both sides. The survey sites, like the Hull Valley drains in general, are intensively managed (Plate 1). The customary procedure is an annual, post-harvest, cut and removal of aquatic vegetation, and mowing of bankside vegetation, using a hydraulically-operated Bradshaw-type bucket (Seagrave, 1988) worked from one bank. Roots, rhizomes and stream-bed materials are often removed along with foliage. The channels are sludged-out and re-profiled, in winter, approximately every 10 years using a hydraulic excavator. Sludging-out dates were obtained for 30 of the 35 sites surveyed in 1996. These had all been sludged-out at least once since 1983-1984.

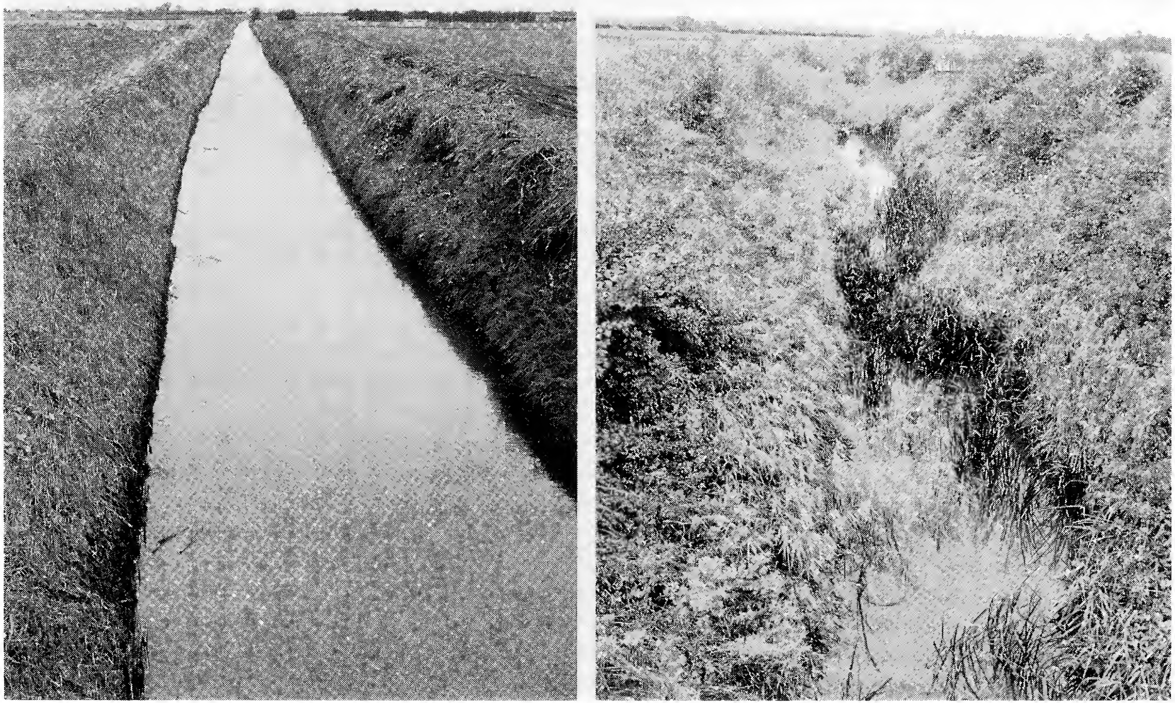

PLATE 1

Left: The Holderness Drain northwards from Linley Hill Road Bridge (Grid Ref. TA 081 457), a trapezoidal channel deeply excavated through arable land; September 1994, shortly after the steep banks had been mown and the aquatic vegetation, largely emergent shoots of *Sparganium erectum* and *Phragmites australis*, had been removed and piled at the top of the right hand bank. Right: the Holderness Drain westwards from the bridge on the Wawne-Meaux Road (TA 096 390); also September 1994 but before annual weed removal, emergent *S. erectum* and *P. australis* are conspicuous. Photographs by R. W. Holt.

TABLE 1
Sites surveyed in the Hull Valley in June-August 1996 with number of aquatic plant taxa in 100 m lengths of drain and conservation indices.

Site number	National Grid Reference (TA)	Name of watercourse	Number of taxa	Conservation index
1	074 475	Baswick Steer Drain	5	0
2	054 418	Beverley and Barmston Drain	15 (22)	4 (8)
3	085 483	Burshill Park Drain	4	0
4	081 457	"Carr Lane Drain"	4	0
5	114 453	Catchwater Drain	10	0
6	146 461	Catfoss Drain	15	0
7	077 443	Cross Drain	11	0
8	062 496	Decoy Drain	13 (14)	6 (6)
9	073 441	Eske Carrs Drain	3	0
10	079 511	Frodingham Church Drain	15 (15)	6 (6)
11	081 440	Hall Farm Drain	4	0
12	093 489	"Hallytreeholme Drain"	11	2
13	081 457	Holderness Drain (Linley Hill Road Bridge)	7	0
14	085 482	Holderness Drain (New Road Bridge)	17 (16)	4 (0)
15	074 422	Holderness Drain (Tickton Bridge)	13	0
16	074 425	Holderness Drain (Tickton Pumping Station)	17	3
17	095 495	Holt's Drain	15 (15)	5 (1)
18	053 493	Kirby Drain*	15 (18)	5 (5)
19	081 458	Leven North Carr Drain	8	0
20	104 416	Meaux and Routh East Drain	10	2
21	094 494	Mickley Dyke	23 (24)	8 (12)
22	107 437	Monk Dyke	12	2
23	132 499	Moor Main Drain	6	0
24	063 409	New Holland Drain	8	0
25	078 511	Old Course of the River Hull	16 (15)	6 (6)
26	094 495	Roam Drain	15	0
27	079 411	"Routh Carrs Drain"	5	0
28	103 415	Routh Roadside Drain	13	2
29	081 411	Routh and Meaux Drain	12	4
30	077 506	Scurf Dyke	19 (13)	9 (9)
31	059 482	Starberry Drain*	25 (22)	11 (2)
32	134 461	Stream Dyke	14	2
33	063 412	Turf Gutter and Eske River Side Drain	10	0
34	081 484	Ushaw's Drain	13	2
35	061 485	White Drain	19 (19)	8 (8)

Values in brackets are for summer 1997.
Names in inverted commas are neologisms.
*Indicates sites with high conservation index in summer 1996 which were sludged out in winter 1996-1997.

MATERIALS AND METHODS

A 100 m length of watercourse was surveyed at each of the 35 sites (Table 1). Each site was on a different drain except that four were at different locations along 6.3 km of the Holderness Drain. Sites were selected an the basis of access and permission to survey, there were no preconceptions about potential vegetatian composition.

In addition, on 7 August 1996, eight 100 m contiguous lengths of Monk Dyke were surveyed, working southward from Grid Reference TA 107 437.

The favoured survey strategy was to wade along the drain. Where this was unsafe, records of emergent and natant plants were made from one bank and submerged plants were sampled by grapnel hauls at frequent intervals. The checklist was that of aquatic plants which occur in England and Wales (Palmer & Newbold, 1983). Exceptions were that all *Juncus* species were included and a single category was added to record characeous algae. *Callitriche* species, and *Rorippa nasturtium – aquaticum/R microphylla* were not recorded separately. Also, *Potamogeton berchtoldii* and *P. pusillus* were not routinely separated although both were present. This was known from confirmation by N. T. H. Holmes or C. D. Preston, and from sections of the stipules (Preston, 1995). Some records of non-flowering batrachian *Ranunculus* were omitted because of difficulty with identification. Nomenclature follows that of Stace (1997).

An abundance score was given to each taxon using the simplified scale described by Holmes (1983). Percentage cover over the area 100 m x width of drain was estimated by eye or from frequency of occurrence in grapnel hauls. Abundance scores were: 1 = <0.1% cover, 2 = 0.1-5% cover and 3 = >5% cover.

A numerical index of botanical conservation value was calculated for each site. The approach is based on methods applied to woodland sites by Dony and Denholm (1985). Procedure was modified from that applied to pond vegetation by Linton and Goulder (1997). Native aquatic plant species which had potential conservation importance were each given a conservation score (Table 2) on the basis of their national and local vulnerability. Scores were assigned as follows: 1 = taxa recorded as infrequent in *Flora of the East Riding of Yorkshire* (Crackles, 1990); 2 = taxa recorded as uncommon (i.e. believed to occur in 12 or fewer localities) by Crackles (1990); 3 = taxa recorded as rare (i.e. believed to occur in three or fewer localities) by Crackles (1990); 4 = taxa which need special protection in at least the east of the former Yorkshire Water Authority area but which occur nationally in more than one hundred 10-km squares (Palmer & Newbold, 1983); 5 = taxa needing special protection in the former Yorkshire Water Authority area and which occur in 100 or fewer 10-km squares (Palmer & Newbold, 1983). If a species fell into two categories it was allocated the higher score. For each site, the sum of these scores equalled the conservation index.

Water samples were collected during June-August 1996 and pH and conductivity were measured, later on the sampling day, using appropriate meters.

Sites were grouped on the basis of their vegetation using two-way indicator species analysis (TWINSPAN). Default options were selected and the abundance scores for each taxon (1-3) were used as three pseudospecies (Kent & Coker, 1994). The method has been used to classify UK rivers (Holmes, 1983) and standing waters (Palmer, 1992) and was applied to Norfolk drains by Driscoll (1986), and Burgess and Evans (1990).

Results

Fifty-one taxa were recorded in June-August 1996 (Table 2). Forty-six of these featured on the Palmer and Newbold (1983) checklist, representing 25% of the 184 aquatic vascular plants which they cite as occurring in England and Wales.

The most common species was *Sparganium erectum*, recorded at 27 out of 35 sites (Table 2), with an abundance score of three at 21 sites. The whole width of the narrower drains was often occupied by the emergent shoots of this plant. The next most often recorded taxa were *Lemna minor* (25 sites), *Callitriche* agg. (24), *Phalaris arundinacea* (23) and *Agrostis stolonifera* (22). Of these, however, only *P. arundinacea* had an abundance score of three at most of the sites where it occurred.

In contrast, species found at only one site were *Baldellia ranunculoides, Butomus umbellatus, Ceratophyllum demersum, Iris pseudacorus, Juncus conglomeratus, Lemna trisulca, Myriophyllum verticillatum* and *Persicaria amphibia*. Found at two sites were *Potamogeton friesii, P. lucens, Schoenoplectus lacustris* and *Solanum dulcamara*, and at

TABLE 2
Aquatic macrophytes recorded in the Hull Valley Drains, June-August 1996.

Species	Number of records	Species	Number of records
Agrostis stolonifera	22	*Myriophyllum verticillatum* (5)	1
Alisma plantago-aquatica	13	*Persicaria amphibia*	1
Apium nodiflorum	9	*Phalaris arundinacea*	23
Baldellia ranunculoides (4)	1	*Phragmites australis*	18
Berula erecta	5	*Potamogeton berchtoldii/pusillus* (2)	11
Butomus umbellatus (4)	1	*Potamogeton crispus*	7
Callitriche agg.	24	*Potamogeton friesii* (5)	2
Ceratophyllum demersum (1)	1	*Potamogeton lucens*	2
Characeae*	5	*Potamogeton natans*	11
Elodea canadensis	12	*Potamogeton pectinatus*	9
Elodea nuttallii	3	*Ranunculus circinatus* (4)	5
Equisetum fluviatile	7	*Ranunculus sceleratus*	7
Glyceria fluitans	7	*Ranunculus trichophyllus* (4)	3
Glyceria maxima	13	*Rorippa nasturtium-aquaticum/ microphylla*	18
Groenlandia densa	12	*Sagittaria sagittifolia*	5
Hippuris vulgaris	4	*Samolus valerandi* (2)	3
Iris pseudacorus	1	*Schoenoplectus lacustris* (3)	2
*Juncus articulatus**	16	*Solanum dulcamara*	2
*Juncus conglomeratus**	1	*Sparganium emersum*	4
Juncus effusus	14	*Sparganium erectum*	27
*Juncus inflexus**	9	*Typha latifolia*	5
*Juncus subnodulosus**	3	*Veronica anagallis-aquatica*	4
Lemna minor	25	*Veronica beccabunga*	6
Lemna trisulca (1)	1	*Veronica catenata*	5
Mentha aquatica	13	*Zannichellia palustris*	8
Myosotis scorpioides	11		

Values are number of records from thirty-five 100 m lengths of drain.
Conservation scores allocated to plants on the basis of national and local vulnerability are given in brackets.
*Indicates taxa additional to the Palmer and Newbold (1983) checklist.

three sites *Elodea nuttallii, Juncus subnodulosus, Ranunculus trichophyllus* and *Samolus valerandi* (Table 2). Of these less often recorded species, only *B. umbellatus, E. nuttallii, P. lucens* and *Ranunculus trichophyllus* achieved an abundance score of three at any of the sites where they were found.

The mean number of taxa per site, in June-August 1996, was 12.1 (range 3-25) (Table 1). The mean was 11.1 (2-23) when species extra to the Palmer and Newbold (1983) checklist were omitted. Twelve sites had a conservation index of four or greater (Table 1), including four sites with an index of eight or greater (Mickley Dyke, Scurf Dyke, Starberry Drain and White Drain).

Relations of species richness (number of taxa) and conservation index with environmental variables were explored using Spearman's rank correlation coefficient (r_s). The environmental variables were water depth (range 3-120 cm), width (0.8-8 m), pH (3.8-7.3), conductivity (428-2500 $\mu S\ cm^{-1}$) and time since last sludging out (1-12 years). Both richness and conservation index were negatively correlated with conductivity ($r_s = -0.46$ and -0.47 respectively, $n = 35$, $P < 0.01$). There were no other significant correlations with environmental variables ($P > 0.05$). Richness was, however, strongly

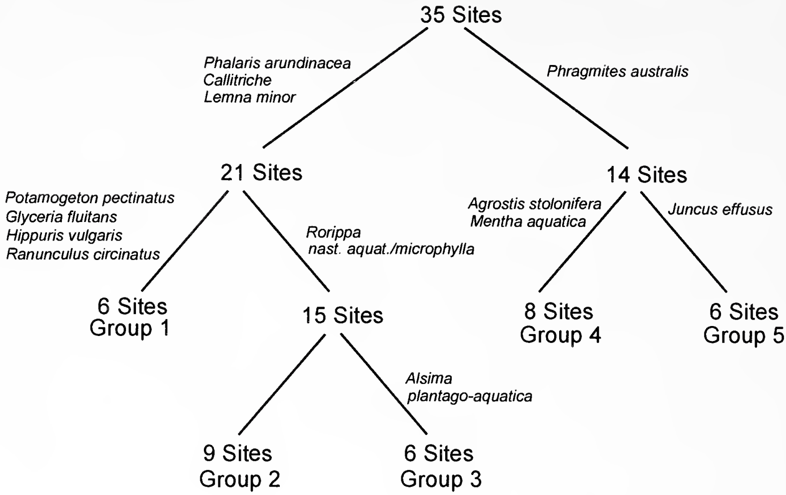

FIGURE 1
Dendrogram showing the separation of sites into five groups by TWINSPAN using records from summer 1996; the indicator species for each dichotomy are included.

correlated with conservation index ($r_s = 0.80$, n = 35, P <0.001).

TWINSPAN separated the sites into five major groups. The dendrogram (Fig. 1) gives the number of sites in each group and the indicator species for each dichotomy. The sites in each group are shown in Fig. 2. Sites with similar vegetation and taxa with similar environmental requirements are put close together; the body of the spreadsheet gives the abundance score for each taxon at each site (Kent & Coker, 1994).

Sites with a conservation index of four or greater are flagged with an asterisk in Fig. 2. The sites in the group of six at the extreme left (group 1) tended to have high conservation value. Five of the 12 sites with a conservation index of four or greater were in this group. This was significantly more than would be expected by chance (P <0.05, chi-square test). In contrast, the group of six sites at the extreme right (group 5) contained no sites with a conservation index greater than zero.

Ten of the 12 sites which had a conservation index of four or greater in summer 1996 were resurveyed during July-August 1997 (Table 1); also, Kirby Drain, where the vegetation was cut in early August 1997, was resurveyed in October 1997 after re-growth.

Two of the high conservation index sites had been sludged out during winter 1996-1997; i.e. Kirby Drain and Starberry Drain. The vegetation composition in Kirby Drain was scarcely changed: in 1997 the conservation index equalled five, the same as in the previous year, while the number of species had increased marginally from 15 to 18 (Table 1). There was, however, change of more consequence in Starberry Drain. The conservation index decreased from 11 to 2 (because of the loss of *Myriophyllum verticillatum* and *Ranunculus circinatus*) although the number of species fell only from 25 to 22.

At the other nine resurveyed high conservation index sites, which had been subject to autumn plant removal but not sludging out, the changes in conservation index and richness, between 1996 and 1997, were generally modest (Table 1). Thus the conservation index was constant at five sites, decreased at two sites and increased at two sites. The decrease from four to zero in the Holderness Drain at New Road Bridge was due to loss of *Potamogeton berchtoldii/pusillus* and *Samolus valerandi*; that from five to one in Holt's Drain to loss of

	Group 1						Group 2									Group 3						Group 4								Group 5					
	17*	25*	30*	2*	21*	26	1	6	23	5	10*	20	22	29*	33	8*	24	28	12	31*	32	7	14*	35*	15	16	18*	27	34	4	13	19	9	11	3
Elodea canadensis	2	3	3	3	3	-	-	-	-	-	1	2	-	-	1	-	-	-	2	2	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Sparganium emersum	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Butomus umbellatus	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hippuris vulgaris	3	-	3	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lemna trisulca	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Persicaria amphibia	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potamogeton lucens	-	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ranunculus circinatus	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sagittaria sagittifolia	1	2	3	-	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glyceria fluitans	-	2	1	1	3	1	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glyceria maxima	-	3	3	3	3	3	-	-	-	3	3	-	3	3	3	-	-	3	-	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Potamogeton crispus	-	2	2	3	3	-	-	-	-	-	3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potamogeton friesii	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ranunculus trichophyllus	-	-	-	-	3	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elodea nuttallii	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Myriophyllum verticillatum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ceratophyllum demersum	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ranunculus sceleratus	-	-	-	-	1	-	-	2	-	1	2	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Solanum dulcamara	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Veronica catenata	-	-	-	-	1	-	-	3	3	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Veronica anagallis-aquatica	-	-	-	-	-	-	-	2	-	2	2	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apium nodiflorum	-	-	-	-	2	1	-	2	-	1	1	-	-	-	1	-	-	-	-	1	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Callitriche agg.	-	1	2	3	1	2	-	3	3	2	3	2	2	3	3	3	2	3	3	2	2	1	2	-	-	1	1	-	-	-	-	1	-	-	-
Lemna minor	1	3	2	1	1	1	3	1	3	3	3	3	2	2	3	1	1	1	1	1	1	-	-	-	-	1	-	-	3	-	-	-	-	1	1
Phalaris arundinacea	3	3	2	3	3	3	1	2	-	3	3	3	3	3	2	3	3	-	1	3	2	1	-	-	3	-	2	-	-	-	-	1	-	-	-
Potamogeton berchtoldii/pusillus	-	3	-	-	-	-	-	-	-	-	-	2	2	-	-	3	-	2	1	3	3	-	2	2	-	-	2	-	-	-	-	-	-	-	-
Rorippa nast.-aqua./microphylla	-	1	-	-	1	-	3	2	2	-	-	3	2	3	2	2	2	2	1	1	-	-	2	-	1	-	-	3	1	-	-	-	-	-	-
Typha latifolia	-	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-
Veronica beccabunga	-	-	-	-	-	-	-	2	2	-	-	-	1	-	-	2	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-
Agrostis stolonifera	1	1	1	-	1	2	-	-	2	-	3	2	2	3	-	2	2	2	-	1	2	-	1	1	2	2	2	3	3	-	-	-	-	-	-
Characeae	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	1	-	3	-	-	-	-	-	-	-	-	-	-	-
Groenlandia densa	-	1	1	3	1	-	-	-	-	-	-	-	-	-	-	3	-	3	1	3	-	1	2	3	-	-	-	-	-	-	-	-	-	-	2
Potamogeton pectinatus	1	-	1	3	3	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	1	-	-	-
Alisma plantago-aquatica	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-	2	2	3	2	2	1	2	2	2	1	2	-	-	-	-	-	-	-	-	-
Sparganium erectum	3	2	1	1	-	2	-	3	-	3	-	3	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3	-	3	3	3	3	-	-	-
Zannichellia palustris	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	3	-	-	2	3	3	-	2	-	-	-	-	-	-	-	-	-	-	2
Myosotis scorpioides	-	-	-	2	2	1	-	3	-	-	1	-	-	-	-	-	-	-	-	2	-	-	2	1	1	1	2	-	-	-	-	-	-	-	-
Potamogeton natans	3	3	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	-	3	-	1	-	-	3	-	3	-	-	-	-
Equisetum fluviatile	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	-	-	1	2	-	-	-	-	2	-	1	2	-	-	-
Juncus articulatus	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	3	1	2	-	2	3	2	-	2	2	-	2	3	2	2	3	3	-
Juncus effusus	1	-	-	2	-	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	2	-	1	3	3	3	3	1	-
Phragmites australis	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	3	2	3	-	3	3	3	1	2	3	3	3	3	3	3	3	3
Juncus inflexus	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	3	-	-	1	2	1	3	2	-	-	-	-	-	-	-	-
Mentha aquatica	-	-	-	1	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	3	2	1	2	2	1	3	-	1	-	-	-	-
Juncus conglomeratus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Samolus valerandi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	2	-	-	-	-	-	-
Baldellia ranunculoides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Berula erecta	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	1	2	-	-	-	-	-	-	-	-	-
Juncus subnodulosus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	2	-	-	-	-	-	-	-	-
Iris pseudacorus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Schoenoplectus lacustris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-

FIGURE 2

TWINSPAN output showing the sites in each group and the composition of their vegetation. Values are abundance scores for each aquatic plant at each site (site numbers are across the top, see Table 1 for key).
*Indicates sites with conservation index of four or greater.

Ranunculus circinatus. The increase from four to eight in the Beverley and Barmston Drain reflected the appearance of *Ceratophyllum demersum, Lemna trisulca* and *P. berchtoldii/pusillus*; that from eight to 12 in Mickley Dyke was due to the appearance of *R. circinatus*. The number of taxa was constant at three sites, decreased at three sites and increased at three sites.

The two high conservation index sites which were sludged out in winter 1996-1997 were again surveyed in July 1998. In Kirby Drain the conservation index had increased to seven, from five in 1997, due to the recording of *Samolus valerandi*, while the number of taxa had increased from 18 to 23. In Starberry Drain the conservation index had increased from two to seven (*Potamogeton berchtoldii* was re-recorded and *P. friesii* was new) and richness had increased from 22 to 24 taxa. *Myriophyllum verticillatum* and *Ranunculus circinatus*, both present in 1996 before sludging out, had not reappeared.

The cumulative number of taxa along eight 100 m lengths of Monk Dyke, on 7 August 1996, increased from eight to 15 species (Fig. 3).

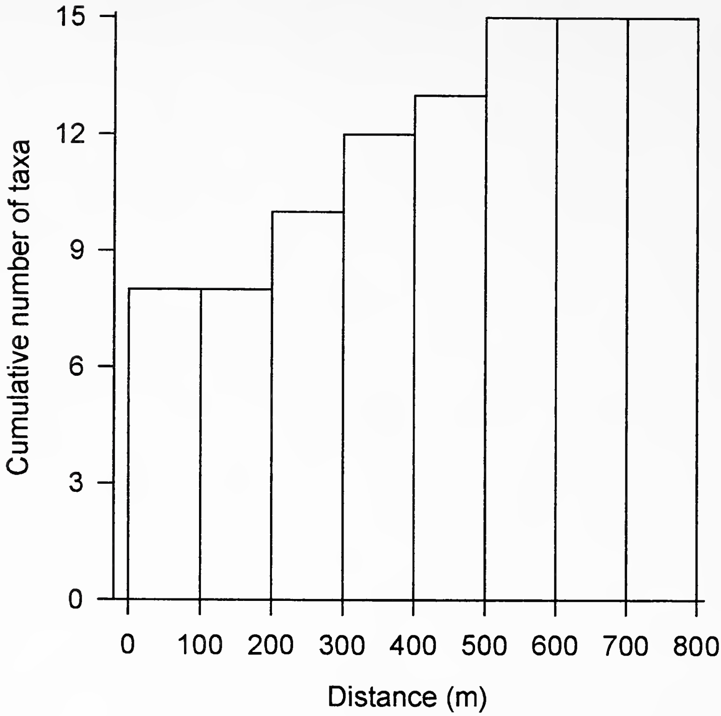

FIGURE 3
Cumulative number of aquatic plant taxa recorded along eight 100 m lengths of Monk Dyke on 7 August 1996.

Discussion

The Hull Valley drains are clearly of botanical significance. Comparison with other studies is not straightforward because a common checklist has not been used. However, the total of 51 aquatic taxa recorded in summer 1996 compared well with other records for Eastern England. Examples from Norfolk include: (1) 66 and 62 hydrophyte taxa, excluding bryophytes and *Chara,* from dykes at Oby and Thurne respectively, during 1972-1975 (Driscoll, 1982); (2) 33 hydrophyte species, including bryophytes, from 26 dyke sites at Horsey and 38 species from 33 sites at Somerton, in 1981 (Driscoll, 1983); (3) 47 aquatic vascular plants from 38 dykes at Holkham (Driscoll, 1986). However, the Hull Valley drains are, perhaps, less floristically rich than drains in some other parts of the UK: e.g. (1) the drainage channels of the Monmouthshire Levels where 108 aquatic angiosperms were recorded (Scotter *et al.,* 1977), and (2) the drainage ditches on the Nene Washes RSPB Reserve from where 65 species, on the Palmer and Newbold (1983) checklist, were found (Folkard *et al,* 1998).

The mean number of 12.1 taxa per site in the Hull Valley drains also compared favourably with the Norfolk dykes. For example: (1) means of hydrophyte species per dyke of 8 (range 1-15) at Horsey and 6 (1-20) at Somerton in 1981 (Driscoll, 1983); (2) a mean number of taxa per dyke, for eight dyke types in the Bure and Yare Valleys, ranging from 3-18.7 (George, 1992).

The substantial between-site variation in number of taxa and conservation index in the Hull Valley drains (Table 1) was not immediately explained by reference to obvious environmental variables such as water depth, width, land use or time since sludging out. The association of low species richness and conservation index with high conductivity was apparently due to the occurrence of ochreous sites which supported few species and tended to have high conductivity: e.g. Eske Carrs Drain with three taxa and conductivity 2500 $\mu S\ cm^{-1}$; Hall Farm Drain with 4 taxa and conductivity 2130 $\mu S\ cm^{-1}$. George (1992) described similar ochreous dykes in Norfolk, brought about by deep-drainage of calcium-deficient, acid-sulphate soils, which also had a depleted flora.

The TWINSPAN output (Fig. 2) emphasized the between-site differences. There were groups of drains with different aquatic plant communities. Furthermore, one vegetation type, represented by the six sites in group 1, indicator species *Potamogeton pectinatus*, *Glyceria fluitans*, *Hippuris vulgaris* and *Ranunculus circinatus*, contained a disproportionate number of sites with high conservation index. These sites were also species rich, each with 15-23 taxa. It was not obvious what were the favourable environmental features although the five high-conservation-index sites in this group tended to be on larger drains. Two of them, Beverley and Barmston Drain and Scurf Dyke, were main rivers; all were between 2 m and 8 m wide. In contrast, the six sites in group 5, best indicator species *Juncus effusus*, all had zero conservation index and were species poor, with 4-8 taxa. This was probably related to five of these sites being ochreous.

The relationship between management of Norfolk dykes and their aquatic flora was reviewed by George (1992). Sludging out, although initially causing an impoverished flora, leads to maximum botanical diversity after about four years, provided there are adequate plant propagules left and/or reinoculation from nearby watercourses is possible. This model was apparently applicable to the Hull Valley drains. Annual vegetation clearance and periodic sludging out, as well as being essential for good drainage, are probably important in sustaining floristic diversity. Without continuing maintenance aggressive species, like *Sparganium erectum,* would quickly become dominant and the drains would become choked. Thus, when nine sites with conservation index of four or greater in summer 1996 were resurveyed in summer 1997, following intervening weed removal, there was no consistent pattern of change in conservation index or species richness (Table 1). Also, the two high-conservatian-index sites which were sludged out in winter 1996-1997 had largely regained their 1996 conservation index and richness within two years, although an uncommon species, *Myriophyllum verticillatum,* had not reappeared in Starberry Drain. A potential problem is that too vigorous sludging out might remove all propagules of a sparcely distributed species; e.g. *Baldellia ranunculoides, Butomus umbellatus.* Recolonization from nearby watercourses might then be unlikely.

The management of adjacent agricultural land is also relevant to vegetation in drains. George (1992) highlighted both change from pasture to arable and increased use of nitrogenous fertilizer as being potentially linked to floristic deterioration. There is relatively little pasture in the Hull Valley, but there is the potential for further enrichment from fertilization.

The use of a conservation index, which equalled the sum of conservation scores rather arbitrarily allocated to taxa which were perceived as potentially threatened in East Yorkshire, was a tactic to allow recognition of sites of botanical conservation value. Advantages of this approach are that it is quick and that quantitative between-site comparisons are facilitated. Since, however, conservation index and number of taxa were strongly correlated, the latter is also potentially a quantitative, and easily determined, indicator of conservation value. Wilkinson (1998) likewise found that species richness of aquatic plants in ponds and lakes in Wales was to some extent an indicator of the likelihood that rare species would be present.

Further evaluation of the conservation index is appropriate:

(1) Implicit in its use is that it is the presence of vulnerable taxa that conveys conservation value to a site. If, however, the whole plant community is regarded as the conservation

resource then it is arguable that community types should be recognized and safeguarded if appropriate.

(2) Some of the taxa which were allocated conservation scores may not genuinely be threatened in East Yorkshire, rather they may be under-recorded, probably because they are relatively inconspicuous. For example, the fan-leaved water crowfoot, *Ranunculus circinatus,* considered to be in need of special protection in Yorkshire (Palmer & Newbold, 1983) was recorded from five out of 35 drain sites in summer 1996. Similarly, the fine-leaved *Potamogeton* species, *P. berchtoldii/pusillus,* both described as uncommon (i.e. believed to be present at 12 or fewer locations in East Yorkshire) by Crackles (1990) were, one or the other, recorded at 11 out of 35 drain sites.

(3) Following on from the previous point is that the very act of collecting data and applying the index undermined its validity. Taxa were allocated their conservation score on the basis of a prior understanding of how often they occur in East Yorkshire. More finds of a particular taxon might mean that, with hindsight, it deserved a lower score.

(4) Palmer and Newbold (1983), which was the source of information on the regional status of nationally vulnerable aquatic plants, used for allocation of conservation scores, has become out of date. The authoritative book by Preston and Croft (1997) was not published at the time of planning of this 1996 survey but could usefully be consulted in future work.

The choice of 100 m lengths of drain for survey was a compromise between effort needed and comprehensiveness of data. Holmes (1994) suggested that 500 m of river is the minimum length for adequate assessment of plant species richness. This suggestion was apparently supported by the data from Monk Dyke on 7 August 1996 (Fig. 3) where the maximum cumulative number of species was achieved only after six 100 m lengths had been surveyed. However, that survey was made after heavy overnight rain when turbid water, probably related to operation of a combined sewer overflow, hampered recording along the initial 250 m. In contrast, on 21 June 1996, under clear-water conditions, 12 taxa were recorded from the first 100 m compared to eight on 7 August. Thus more work is needed to establish the ideal length of drain to be surveyed for its vegetation.

This study showed that, amidst the intensive agriculture of the Hull Valley, a wealth of aquatic plants is to be found in the drains. Many are probably relicts of a formerly-widespread, pre-drainage, wetland flora. Aquatic plants, however, can be surprisingly mobile, perhaps as an adaptation to life in a habitat which is often transient, and have developed a wide range of dispersal strategies (Preston & Croft, 1998). Some of the Hull Valley aquatic plants are recent arrivals. Nuttall's waterweed, *Elodea nuttallii,* first recorded in Britain in 1966 (Preston & Croft, 1997), was found at three of the sites on Hull Valley drains in summer 1996. Since then, the introduced water fern, *Azolla filiculoides*, which was not recorded at any of the sites surveyed in summer 1996 or 1997, became widespread and abundant in the Beverley and Barmston Drain by October 1998.

Acknowledgements

I thank Caroline Essery and David Fullwood of the Environment Agency and John Frankish of the Beverley and North Holderness Internal Drainage Board for information about maintenance of drains. I am grateful to land holders who allowed access.

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BOOK REVIEW

Provisional Atlas of the Longhorn Beetles (Coleoptera, Cerambycidae) of Britain by **P. F. G. Twinn and P. T. Harding**. Pp. 96. Biological Records Centre, Monks Wood. 1999. £5.00 paperback.

This, the latest addition to the series of BRC atlases, covers the Cerambycidae (longhorn beetles). The very readable introduction covers such diverse subjects as life history, origins of the British fauna, accidentally introduced species and future Cerambycid recording. There then follows a check list of 'native' species and a nomenclatural cross-tabulation between standard references, both of which make for easier understanding of past works.

A map giving the overall coverage indicates the 10 km squares for which records have been received. Coverage of Yorkshire and to the south of it is extremely good but rather sparse to the west and north of the county. Two further maps indicate the intensity of recording (records received for each 10 km square) and the total number of species recorded in each 10 km square. These three maps are extremely useful, as they allow the reader to see instantly where our gaps in knowledge occur and, therefore, where recording activity would be best directed.

The main bulk of the book consists of the 60 distribution maps relating to those longhorn species considered to be native or naturalised. The 150 or so additional species which have been recorded in Britain (mainly as accidental introductions) are not covered, although an interesting discussion is directed towards the ten species which have appeared in British keys or checklists. Atlases of this type are not the place for illustrations, descriptions or keys to species, but references under each map indicating where these can be located are useful.

Rather than discuss the biology of each species in detail (a very brief account only is given), the authors have chosen to indicate references from which this can be obtained. I find this approach rather distracting and, unless these publications are available to the reader, acquiring them can be very expensive. Unfortunately individual recorders have not been acknowledged, the number of contributors apparently being too numerous to list. Most recorders appreciate seeing their name in print and, more importantly, being acknowledged in this way keeps the momentum of interest alive. The lists of museums from which data have been extracted and journals consulted are most useful however, and will prevent duplication of effort in the future.

This publication is a fine example of what can be achieved by dedicated authors and an array of contributors. It is a reflection of our knowledge of British Cerambicid distribution up to 1998 and as such deserves be on the bookshelf of everybody interested in this impressive group of beetles.

MLD

UNDERGROUND STREAMS IN THE MALHAM AREA, AN EIGHTEENTH CENTURY NOTE ON MALHAM TARN AND ITS ENVIRONS, AND A REMARKABLE EARLIER DISCOVERY

GEOFFREY FRYER

Institute of Environmental and Natural Sciences, Lancaster University, Lancaster LA1 4YQ

Introduction

Interest in the geology, physiography and natural history of Malham Tarn and its environs is of long standing. What seems to be the earliest truly scientific note, however, appears to have been overlooked, yet is of particular interest in showing that discoveries made in the latter part of the 19th century had in fact long been anticipated by knowledgeable inhabitants of the Malham area. This ancient knowledge is here set in the context of what is known about the course of the underground streams in the area. The situation is more complex, and our understanding less exact, than is often assumed.

Subterranean Drainage and the enigma of the Malham Tarn outflow

Although located amidst Carboniferous limestone, Malham Tarn, which lies at an altitude of about 375 m. (1,229 ft.), is rendered watertight by an underlying layer of impervious glacial clays, and in part by slaty Silurian rocks that make up the southern part of its bed. Its overflow runs southwards for some 500 m, then, after crossing the North Craven Fault, disappears at the Tarn Sinks (Fig. 1). It was for long assumed that the water that here left the surface continued underground to emerge at the foot of Malham Cove as the infant Aire. As long ago as 1786 Thomas Hurtley, who described Malham Tarn as "the fountain of the river AIR", and Malham Cove as "the highest piece of perpendicular limestone rock in the known world"(!) and not less than 288 feet high, said that at its foot there "issues a strong current of water intensely cold and clear as crystal, having traversed upwards of a mile from the TARN in its subterranean caverns".

In a more scientific work, John Phillips (1836), a pioneer investigator of Yorkshire geology, said that the stream that leaves Malham Tarn "sinks into the open-jointed limestone rock and bursts forth in a full and perpetual stream" at the foot of Malham Cove. Some years later he noted that the Aire "springs at once a full stream" from that source, being supplied by subterranean channels in the limestone, and that some water "no doubt comes by this means from Malham Water", i.e. Malham Tarn (Phillips 1853).

Davis and Lees (1880) stated categorically (p. 49) that "The River Aire, in its passage from Malham Tarn, sinks into a cleft in the limestone, and emerges at the foot of the precipitous Cove". On p. 329 they added "The stream from Malham Tarn runs half a mile southwards, and sinks through a large opening in the limestone, which is filled to the surface with rounded blocks of stone. Nothing more is seen of the water until the foot of Malham Cove is reached, though there is every appearance of the water having at one time passed along the surface and tumbled . . . over the face of the magnificent amphitheatre of limestone forming Malham Cove".

Even today, at times of exceptionally heavy rain, the capacity of the sinks to take all the water leaving the Tarn is exceeded and some of it flows down the dry valley towards the Cove. Clayton (1966) records how in 1962 some water even cascaded over the usually dry waterfall at Comb Scar, which lies along this route, and D. E. Cottton (*pers. comm.*) saw the same in 1967. Such overflow appears to have happened more frequently in the 18th century, when water sometimes reached the Cove itself. According to Hurtley (1786), after periods of very wet weather "when the Water-sink . . . is unable to receive the overflux of the Lake there falls a large and heavy torrent, making a more grand and magnificent Cascade than imagination can form an idea of". He also recorded that if a strong wind blew from the south or south-west at such times, little water reached the bottom of the Cove, but was blown into the air as a mist, and noted that this was seldom seen by the traveller in the summer months. According to a guidebook by W. Howson, published in 1850 and cited by Kendall and Wroot (1924) and others, this also happened at least twice in the first half of the 19 th century.

A variant of the belief that the overflow from Malham Tarn reaches the base of the Cove via the sink was suggested by Boyd-Dawkins in his book *Cave Hunting* (1874) cited by Tate (1879). He envisaged the Aire as originating in the bed of Malham Tarn, flowing thence through a fissure in the limestone directly to the foot of the Cove.

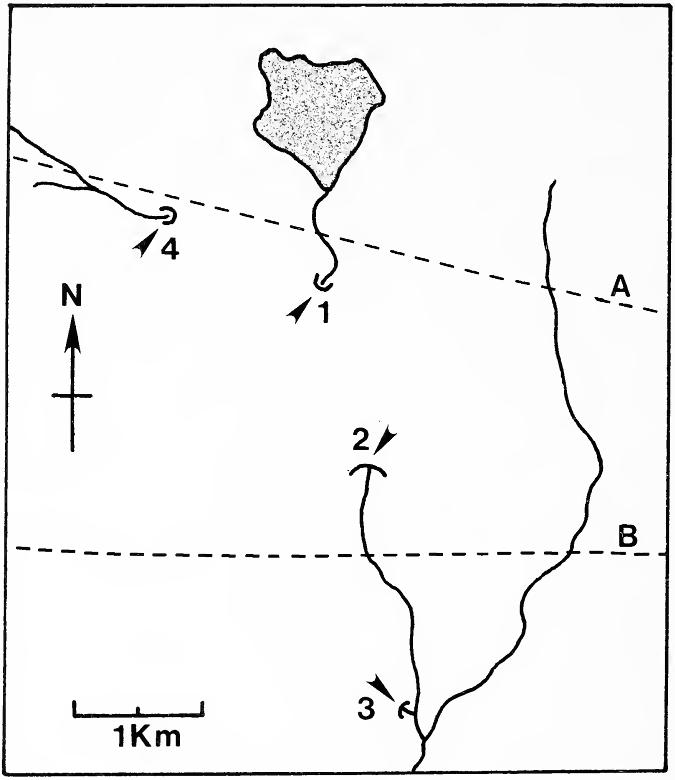

FIGURE 1
Malham Tarn and the Sinks and Springs near the Source of the River Aire.
1. The Tarn sinks; 2. Malham Cove Spring; 3. Aire Head springs; 4. Smelt mill sink.
A and B indicate the North and Mid-Craven faults respectively.

Notwithstanding the then generally accepted origin of the water issuing from beneath the Cove, the possibility had not gone unnoticed that it may, at least in part, be derived from the stream to the south-west of the Tarn, Smelt Mill Sike, that goes below ground in the area called Streets at the site of a former smelt mill - Smelt Mill Sink (NGR SD882660) (Fig.1). The first to suggest this possibility in print appears to have been Whitaker (1805) who, clearly reporting local knowledge, wrote of the water emerging at the Cove that "it is well known that a collection of springs rising in the Black Hills, Hensetts and Withers is swallowed up in a field called the Street, and, from the turbid colour of the water, very unlike that of the Tarn, there is little doubt that, after a subterraneous course of more than two miles, this is the stream that [there] emerges again". The distance involved is actually about 1.5 miles (*c.* 2.5 km). In the latter part of the 19th century it was evidently widely believed by those living in the area that, when the former smelt mill was working, the water emerging at the foot of the Cove was often discoloured. Tate (1879), however, said that Walter Morrison, the then owner of the land, understood that the pollution was not at the smelt mill but at lead mines on Pikedaw, more than 2 km further south. As the stream from this area joins the Aire below Malham village, local people would hardly confuse any such incidents with discoloration at the foot of the Cove, and subsequent events support their story. The smelt mill, of which a chimney remains, was erected at the beginning of the 19th century, replacing an earlier mill that had fallen into ruin. The date of such contamination could therefore have been early.

As to the fate of the water that disappears at the Tarn sinks, the apparently obvious route had in fact long been challenged. What appears to be the earliest, forgotten, report is referred to below, but first various opinions and investigations call for discussion. Although Hurtley (1786) was evidently unaware of such local beliefs, Whitaker (1805) said that "The inhabitants of Malham plead, with great anxiety, that the waters of the Tarn actually appear again in two most abundant and beautiful springs about a quarter of a mile below the village and nearly three miles from the place of immersion". Moreover, Walter Morrison informed Tate (1879) that "Tradition, but not a clear tradition, says that Lord Ribblesdale tried the experiment, by putting in chaff at the Malham Tarn watersinks and that it came out at Airehead". It is now clear that to attribute the first experiment of this kind to Lord Ribblesdale was not only "not a clear tradition" but wrong. The title of Baron Ribblesdale was not conferred until 1797 – on Thomas Lister (1752-1826), a previous owner of the Malham Tarn Estate – who could not have been the originator of this experiment for, as we shall see, the idea was familiar to inhabitants of Malham before he was born.

More positively, an engineer by the name of Leather told Tate that some years before 1879, while working for Walter Morrison, he had for some time held back the water in the Tarn, which is provided with sluice gates, before releasing an increased volume. Its fate "proved conclusively" that the water emerging at the Cove is not that which disappears at the Tarn sinks, which in fact "comes out on the right bank of the stream some distance below the village of Malham, at Airehead". Morrison himself had repeated the experiment with the same result, and some years later did so again to please Ruskin who was then on a visit. Whether simultaneous observations were made at the Cove during these experiments is not recorded.

Smith and Atkinson (1977), who studied the same problems a century later, wrongly credit Morrison as being the first to carry out such experiments. Tate (1879) makes it quite clear that it was Leather who did so. Morrison simply repeated them.

Tate (1879) also carried out a number of experiments, the first for which details were published. It is necessary to outline these in order to understand the complexities involved and the uncertainty that long prevailed. The situation is indeed less clear cut than is generally assumed to be the case today.

Tate held back the water in the Tarn to raise the level and then released it. One hour after it entered the Tarn sinks the level at Aire Head began to rise, and 25 minutes later had risen 4.25 inches in the 4 ft wide stream. At this time there was no change at Malham Cove. After a further unspecified lapse of time during which the stream at Aire Head had risen "nearly a foot" there was a rise of 2 inches at the Cove, where the stream was 31 ft 6 inches wide. After about 5 hours 30 minutes the Tarn sluices were virtually closed.

On the following day, 13 hours after closure, the sluices were again opened. One hour 7 minutes after the increased flow entered the sinks a perceptible rise in level was noted at Aire Head. About 2 hours 30 minutes later the 4 ft stream had risen 13 inches. A rise in level was also noted at the Cove. First detected 1 hour 45 minutes after the pulse entered the sinks, 5 minutes later it had risen 0.25 inch. Over the next 40 minutes it gradually rose by 2 inches, and after a further 1 hour 25 minutes reached an apparent maximum of 2.75 inches in the 31 ft 6 inches wide stream. After 4 hours the Tarn sluices were again closed.

On the following day there was heavy rain, the sluices were opened, and flow at a high level persisted both at Aire Head and the Cove. The sluices were then again closed and remained so on the following day. Levels fell at both Aire Head and the Cove. By early evening the water at the Cove was 0.75 inch below its normal level.

Tate believed that his investigations proved conclusively that both the Aire Head and Cove streams are supplied from Malham Tarn via the Tarn sinks. That water, as he believed, reached Aire Head more quickly than it reached the Cove, though the distance is greater - some 3.5 km (>2 miles) as opposed to about 1.5 km (<1 mile) – he explained by postulating a broad but shallow watercourse to the Cove and a narrow and deep fissure to Aire Head. In fact he recorded the transmission of a pulse, not the passage of a parcel of water. It may be noted that neither the chaff nor the bran that he put into the sinks reappeared during the period of observation. A noteworthy feature of the subterranean passage from the Tarn sinks to Aire Head is that this involves crossing the Mid-Craven Fault (Fig. 1).

He also believed that he had refuted the possibility that the water that disappears at the smelt mill sink emerges at Malham Cove. In particular, an analysis of hardness indicated that water at the smelt mill sink was harder than that at the Cove. He found it "impossible to believe that flowing undiluted through a mile and three quarters of limestone strata, [it] should during its voyage lose between two and three degrees of hardness, as must be the case if these two streams are continuous". He then immediately made a statement that negated this argument, but which throws light on a matter that seems subsequently to have been inadequately considered. "Besides, the volume of the Smelt Mills syke is not a twentieth of that of the Cove stream". If the volume of water going underground at the smelt mill is only about 5% of that which emerges at the Cove (to which it was later proved that it does indeed flow) it must be supplemented from elsewhere. This alone explains the "change" in hardness. Moreover, Tate himself showed that some water came from Malham Tarn, and this was less hard than that from the Smelt Mill Sike, which would explain the reduction in hardness. In fact, as was to be discovered much later, while some of the water from the Smelt Mill Sike goes to Malham Cove, some of it goes elsewhere (see below). Another complication is that Tate almost certainly thought that his experiments showed that water passes quickly through the underground system. This is not always the case. He seems not to have distinguished between the transmission of pulses and actual transit times. His experiments did indeed show that, on the occasions concerned, water from the Tarn sinks found its way to the Cove; they did not, however, prove that the Cove springs do not receive water from the Smelt Mill stream.

Thompson (1891) tried to trace the course of the Tarn outflow by adding the dye uranin at the Tarn sinks. After three hours there was no trace of it at either Aire Head or the Cove. Although in Tate's experiments there had been a rise in level at both places within less than three hours, these were caused by pulses and not by the transmission of parcels of water. In any portion of a conduit that is completely full of water the transmission of a pulse is instantaneous, as when one turns on a tap and water is instantly driven by a pulse entering the pipe at the water source. Partly filled conduits transmit pulses in the same way as they do in a surface stream. Especially where completely filled conduits are likely to be involved, pulses are no guide to transit times. Thompson did not wait long enough to see the emergence of his coloured streams. However, he made one observation that should be borne in mind. He noticed a second water sink not marked on Ordnance maps.

In 1899 the Yorkshire Geological Society systematically investigated the course of various underground streams in the Carboniferous Limestone area of the county, including those in the vicinity of Malham. From the results, published in the *Proceedings* of the Society in 1900 and 1904, those referring to the Malham area are conveniently summarised by Wilson (1912) and, in less detail, by Kendall and Wroot (1924). Smith and Atkinson (1977) also tabulate the results. The experiments again included the releasing of pulses of water from the Tarn. An increase in flow at Aire Head was always observed, but usually, though not invariably, an increase also occurred at the Cove. The amount of rainfall just before the experiment was conducted, and the consequent level of saturation below ground, may have been responsible for the differences.

More informative, but also not without ambiguity, was the addition of common salt, ammonium sulphate, and the dye fluorescin to the streams near the sink holes. On 22 June,13 cwt (*c.* 661 kg) of ammonium sulphate was added to the outlet stream of the Tarn, and a flush of water sent it downstream. Flow increased at the expected time at Aire Head, but no trace of the additive was detected until 4 July, some 12 days later. It continued to be detectable until 11 July. The additive also appeared at the Cove on the same day, even though there had been no increase in flow there when it was flushed downstream and caused such an increase in flow at Aire Head. A probable explanation of this apparent anomaly is given below.

On 22, 23, and 24 June, three tons (*c.* 3050 kg) of common salt was added to the stream at the smelt mill sink. Not until 4 July did it appear, and at the Cove only. On 24, 27, and 28 June, fluorescin was added to the stream at the smelt mill sink. On 4 July (ten days after the first addition) the spring at the foot of the Cove became intensely green and so continued for about a week.

The slow progress of these chemical indicators was initially surprising as enhanced flow is apparent at Aire Head within not much more than an hour after the release of a pulse of water. However, such a pulse pushes forward water that lies ahead of it and is transmitted instantaneously through any water-filled section of the watercourse. The appearance of all the chemical indicators on the same day was attributed to the vagaries of rainfall. Heavy rain just prior to the event apparently caused all the underground streams to flow briskly, which flushed out the water therein that evidently flows very slowly at other times.

Kendall and Wroot (1924), whose brief summary of the investigations understates the complexities and apparent anomalies involved, and who do not refer to Tate's experiments, rightly emphasise that "The investigation proved that the underground waters pursue their course in complete independence of the surface topography". They then say that "The Malham Cove spring . . . discharges the water sinking at the Smelt Mill Sike together with the surface water from the limestone area west of the Cove and the valley at its head". The last-mentioned additions go some way to explaining the deficit to which Tate alluded, though some of this water, at least at times, has an additional destination. They continue "Only under exceptional circumstances does it [the Cove spring] receive a portion of the Tarn water. Usually the overflow of the Tarn, disappearing at the Tarn Sinks, reappears at Aire Head Springs". In fact "exceptional circumstances" appear to prevail rather often. They did so in Tate's experiments and in most of the similar flushing experiments conducted by the Yorkshire Geological Society, as they did also in the experiment involving the labelling of the Tarn outflow with ammonium sulphate, and they were to do so in later investigations. Moreover, while the experiments with common salt and fluorescin conclusively demonstrated the connection between the Smelt Mill stream and the Cove, they did not preclude the possibility that the Tarn water made a contribution to that appearing at the Cove. The design of the experiment did not enable this possibility to be excluded. In fact there was such a connection at that very time. The experiment with ammonium sulphate was conducted simultaneously, and it clearly demonstrated such a link!

As an explanation of the separation of the underground watercourses and of the intermittent connections between them, Kendall and Wroot say that "A watershed of rock, possibly a ridge of the Silurian floor beneath the Carboniferous Limestone, or more probably an area of limestone in which the joints are not so open as usual, apparently separates the two underground flows. Under exceptional circumstances, however, the level of saturation on one side of the barrier may rise so high as to allow water to flow over into the adjoining drainage area, and therefore to affect the springs usually draining the one area only". This explanation appears plausible, though overflow from the stream derived from the Tarn into the channel that supplies the Cove spring appears to be not infrequent. An alternative explanation, suggested more than 50 years later, is mentioned below.

It will be recalled that ammonium sulphate appeared at the Cove 12 days after it was added at the Tarn sinks, though at the time it was flushed downstream there was no increase in flow at the Cove (though there was at Aire Head). This is explained if levels below ground were low when the marker was added, so there was then no overflow from the Aire Head channel to the Cove channel. Later, heavy rain would increase the levels within the channels to such an extent that water in the Aire Head channel was able to override the barrier and allow ammonium sulphate to cross to the Cove channel. It duly appeared at the Cove.

Smith and Atkinson (1977) also studied these subterranean systems. As well as measuring flow rates, and employing water pulses, they used fluorescent dyestuffs and dyed spores of the clubmoss *Lycopodium clavatum* as markers. *Lycopodium* spores have a diameter of about 25 microns, are slightly denser than water, and are therefore easily kept in suspension by even slight turbulence. They were recovered at the outlet springs in plankton nets and could easily be picked out from the debris collected by use of a microscope. The fluorescent dyes can be detected even at concentrations lower than can be picked up by a fluorimeter by hanging bags of activated charcoal in the streams that adsorb the dye, which can be washed out by chemical means and its fluorescence measured.

In April 1972, at a time of high discharge but with little rain during the course of the experiments, a pulse was released from the Tarn, 300 gm of the liquid dye rhodamine WT were added, and 4 kg of *Lycopodium* spores dyed with saffranine introduced at the sink. The same weight of spores, dyed with malachite green, was added at the smelt mill sink. The pulse arrived at Aire Head about one and a half hours after its release and flow reached a maximum about 45 minutes later. There was no rise at the Cove. Dye appeared in both springs at Aire Head, in a little over 18 hours and achieved a maximum concentration within 25.5 hours. The first spores from the sinks arrived within 13.5-24 hours. Exact times of arrival are difficult to determine. These times were much shorter than the 12 days recorded about 70 years earlier. No dye was detected in water samples at the Cove but the charcoal revealed a minute trace of it. That some water took the route to the Cove was also shown by the collection of 6 saffranine-stained *Lycopodium* spores. At Aire Head 209 were recovered.

Malachite green-stained spores from the smelt mill sink reached the Cove within 2 - 6.5 hours. Moreover, quite unexpectedly, such spores travelled also to the south spring at Aire Head, and in much greater numbers, the first arriving after between 6.5 and 10 hours of travel. No spores were recovered from the adjacent north spring.

In July 1973, experiments were carried out at a time of low flow, but there was some rain during the course of them. Water at the Tarn sinks was labelled with rhodamine WT, and at the Smelt Mill with pyranine. A pulse from the Tarn caused a rise in level to begin at Aire Head 1 hour 30 minutes later. A slight rise in level began at the Cove after about 4 hours 15 min, at which time flow at Aire Head reached its peak.

Unfortunately, presentation of the other results is confused. They are shown graphically, but it is stated in words that water travelled from the Tarn sinks to Aire Head in 43 hours and to the Cove in 20 hours. However, an unsuitable scale on the horizontal axis of the graphs shows transit times to Aire Head and the Cove as 33 hours and 8 hours respectively. The 33 hours is evidently an erroneous plotting of what should be 43 hours: dye-stained water is shown arriving at the Cove in about 8 hours because the scale has clearly been misread by 12 hours.

Dye from the smelt mill again travelled not only to the Cove but, as in 1972, to Aire Head. The time taken to reach each destination was the same – 22 hours – though the graphs, which show changes in concentration of the dye, are utterly confused. Considering that the earlier experiment demonstrated a connection between the smelt mill and only one of the Aire Head springs, it is surprising that nothing is said about whether only one spring or both received dye-stained water.

What remains unexplained is why neither the huge quantity of common salt nor the fluorescin added to the Smelt Mill Stream in 1889 was detected at Aire Head, to which the experiments of 1972 and 3 clearly demonstrated that some of its water flowed! Possible explanations are that connections are intermittent and depend on water levels, or it may even be that new channels were established in the intervening years.

Smith and Atkinson suggest that a major conduit leads from the Tarn sink to Aire Head, that a minor conduit branches from it to the Cove, and that somewhere along the minor route is at least one bottleneck. They suggest that the maximum flow that can pass the bottleneck is reached in wet conditions, and that if a pulse enters the system when discharge is already above what the bottleneck can transmit, there will be no effect at the Cove. However, when the discharge is low, there will be spare capacity at the bottleneck and the pulse will travel to the Cove. They suggest that a little water always passes to the bottleneck which would explain the consistent recovery of small amounts of tracers at the Cove.

They say it is difficult to detect what they describe as "a very small rise in water level" at Malham Cove, and calculate that in their experiments less than 0.5% and about 16% of the water from the Tarn emerged there. However, on one occasion Tate (1879) measured simultaneous rises of 2 inches at the Cove and "nearly a foot" at Aire Head, and on another 2.75 and 13 inches at these sites respectively. As the Cove stream is almost eight times as wide as that at Aire Head, simple comparison of cross sectional areas shows that the Cove may sometimes receive more Tarn water than does Aire Head! Such large discharges are not easily reconciled with the idea of a narrow conduit with at least one bottleneck on the route to the Cove envisaged by Smith and Atkinson.

In contrast to the suggestions of Tate (1879), who did not differentiate between pulses and the translocation of parcels of water, and Kendall (as in Kendall and Wroot 1924), Smith and Atkinson believe that pulses of water reach Aire Head before they arrive at Malham Cove because a greater proportion of the course to Aire Head is waterfilled.

To summarise a complex situation: while connections between the Tarn sinks and Aire Head, and between the Smelt Mill Sike and Malham Cove, are well established, they are not the invariable subterranean routes followed by the streams concerned as they are now often assumed to be. Conditions that give rise to considerable flow between the Tarn sinks and Malham Cove appear to be frequent, and a connection between the Smelt Mill Sike and the south spring at Aire Head has now been proven. Indeed the situation can with justification be described as an underground network in which (if the Aire Head springs be taken as just one source) every possible connection between different sinks and springs exists under certain circumstances.

Surprisingly, Fortey's (1993) popular but scholarly book, *The Hidden Landscape*, perpetuates the simplistic and long discredited belief that, after its subterranean journey, the Malham Tarn outflow stream emerges at Malham Cove. He even says "It is the same water, no doubt about it, because dyes thrown in above, well up below". It is particularly unfortunate that this erroneous information should appear in such a widely read, twice reprinted, and justly praised account of British geology.

John Fuller's Account of the Tarn Outflow Stream in 1741

The work of the Yorkshire Geological Society, long accepted as that which demonstrated that the Tarn outflow supplies the Aire Head springs, had in fact been anticipated much earlier. Even before the experiments of Tate (1879) and of Leather before him, there was a local tradition, current before 1805, that suggested even earlier investigations. An apparently forgotten account from considerably earlier than this gives more specific information and demonstrates conclusively that Morrison's suggestion that these investigations might have been carried out by Lord Ribblesdale were groundless.

As well as giving a brief description of what he calls *'Malholm' Tarn* (see below), John Fuller (1741) presents some startling information about its outflow stream and its course after it disappears below ground. First, however, he refers to Malham Cove "which measures 82 Yards perpendicular" and notes that above it "there still remains the Appearance of a Chanel for 2 or 300 Yards together, which, by its having no Mould or Earth to cover it, I judge to have been a Passage for that Water, which formerly used to tumble over the Precipice, but now has found a Passage under-ground and flows out at the Bottom of the Rock". It is to be noted that he does not specifically state that this water originated in Malham Tarn. Indeed his account provides evidence of a very different state of affairs.

Particularly enlightening are his remarks on the outflow of the Tarn and on the course it follows beneath the ground. These are quoted verbatim and in full. "The superfluous Water of this Lake is discharged by a gliding Stream, about Four Feet broad, and Two or Three Inches deep; which runs above-ground 2 or 300 Yards, and then dips under-ground at Two different Places about 10 Yards distant from one another. What becomes of these Streams after their dipping, (though the Relation appears somewhat fabulous, yet) as it is affirmed by all the Men of Credit in the Neighbourhood, I could not help believing it. About a Mile below *Malholm* village there are Two Springs that discharge themselves into the River *Air* about 10 Yards distant from one another, one somewhat greater than the other. The Neighbours assured me that if Wheat-chaff was put into either of the Rivulets at the place of their dipping, in about Eight Hours time it would come out at the greater or lesser Spring, and not out of both, into the River *Air*, which is from the Place of their first dipping about Two Miles and an half. By this it appears, that these Two Rivulets never communicate in their subterraneous Passage".

This remarkable statement shows that experiments had been undertaken, evidently by those living in the vicinity of Malham, probably more than 160 years before those of the Yorkshire Geological Society in 1899, and long before those carried out a little earlier by Tate and Leather. What is more, these had revealed that much of the outflow of Malham Tarn emerges at Aire Head, some 3.5 km from the point at which it disappears below ground. Moreover, these investigators had not only discovered this fact but had apparently ascertained that the Tarn outflow at that time went below ground as two streams, separated from each other by only a few metres, and that these maintained their integrity and emerged at Aire Head only a few metres apart.

Fuller's description of the Malham Tarn outflow stream refers to the situation as he saw it. About 260 years later the stream immediately above the sink is considerably more than 4 feet wide, but very shallow. Its descent below ground is somewhat different from what he described. At times of modest flow it runs briskly to the place at which it sinks, and there simply vanishes. There is no obvious chasm, the space into which it falls having evidently been filled by stones carried by the stream. At times of greater flow, the sink cannot take all the water, some of which continues for perhaps 150 metres before vanishing as at the first sink. Below this is the dry valley covered with terrestrial vegetation. The intermittent stream between the two sinks is clearly recognisable when dry. Its pebbles and small boulders then carry shrivelled mosses, including *Fontinalis*, which flourish during periods of flow. It may have been to the lower sink that Thompson (1891) referred as a second sink not marked on O.S. maps. A little earlier Tate (1879) referred, twice, to "all" the Tarn water sinks, so the situation is obviously subject to relatively rapid change.

As Fuller's informants were correct about the subterranean course of the Tarn outflow, one can hardly doubt that two streams which maintained their integrity throughout their lengths were at that time involved. The probability is that this is still the case. It is necessary only to envisage that the two sinks that he described have become confluent, or that one has become completely blocked. There are still two springs at Aire Head, nearer to Malham than Fuller's mile, and more widely separated than his 10 yards. Fuller evidently saw the sinks, but his description of the Aire Head springs may have been based on what he was told. Remarkable support for the belief that these springs are supplied by separate underground streams came, more than 230 years after Fuller reported the probability, when Smith and Atkinson (1977) discovered that one of them, and only one, is connected to the Smelt Mill Sike. This clearly indicates that, for at least part of their course, they are completely separate, and is a remarkable vindication of the refinement of the earliest recorded observations. This holds good even if the Smelt Mill Sike connection is of recent origin. At present the smaller spring may be reduced to a trickle in dry periods but then displays evidence of its more copious discharge at other times by moss-covered stones near its origin, just as does the stream bed below the main sink.

The key facts, however, are that Fuller recorded what had clearly been established by experiment sometime before 1741: that most of the water that disappeared at the Tarn sinks usually emerged, not beneath Malham Cove, but at the more distant Aire Head springs, and that the two springs were independently connected to their sources. Unless somewhere a written record is preserved, there is no means of knowing for how long before they came to Fuller's attention these discoveries had been made.

There remains the great discrepancy between the 12 days taken for water labelled in the experiments of 1899 to pass through the underground channels and the 8 hours which Fuller was told was the time taken for water-borne chaff to do so. It is now clear, however, that there can be great variations in transit times, that ultimately reflect variations in rainfall. This is indicated by the 43 hours in 1973 and about 18 hours in 1972, recorded by Smith and Atkinson (1977) which much more nearly approach the transit time reported by Fuller. Because of friction the surface water in a stream flows much faster than that near the bottom, which goes some way (under certain conditions perhaps a long way) to explain differences in transit times. However, unless flow below ground is very laminar, (it is usually in conduits and turbulent) or unless the experiments were carried out at a time of very low flows, one might have expected a trace of the additives used in 1899 to have been carried to near the surface by turbulence during their journey below ground, and to have completed it in a period more akin to that taken by the chaff. As it was, they were apparently flushed out by heavy rain after a period of modest flow. It should be noted that the fluorescin made the journey in the same stream as the common salt in two days less. Much probably depended on the rate of flow at the time the chaff was added and on the amount of water already present in the underground streams. For such experiments a time of brisk flow following heavy rain would naturally be chosen. This would be conducive to rapid through-put. If chaff was added after rain that followed a period of relatively dry weather there is no reason why, if Kendall's theory is correct, it should have crossed the barrier and entered the channel that goes to the Cove. Reconciliation with the ideas of Smith and Atkinson is debatable. Whatever the explanation, Fuller was correctly informed about the course of the stream, or, more precisely, of two parallel streams.

Early 18th Century Comments on Malham Tarn and its Flora and Fauna

Fuller's remarks on Malham Tarn are less dramatic than those relating to its outflow but include some interesting facts. He found it necessary to tell his readers, most of whom were probably resident in southern England, that "Tarn" is a Saxon word for a lake (it is in fact Old Norse) and expresses surprise that Camden, who must have passed nearby, made no mention of it. He overestimated its area, which he put at 3 to 400 acres. It is currently about 153 acres and was somewhat smaller in the 1740s as its level was artificially raised in 1791. A particularly perceptive observation was that "There are but Two visible Springs that supply it with Water, one lies East, the other North-west; and by what I could guess, there are only these Two Springs; for the Discharge seems to be no greater than what these Springs supply". By springs he means spring-fed streams, that correspond well with his account. The actual springs are shown on a map in Sinker (1960).

Fuller makes the surprising statement, "There are no Weeds in it", and notes that "In a fine still Day, you may see the white chalky Bottom, where it is 10 or 12 foot deep", which gives some credence to his comment. One's first impression is, however, that it seems improbable that, save for *Elodea canadensis*, a relatively recent invader, much of the present flora was then lacking. As well as *Elodea*, the Tarn currently supports an angiosperm flora of several species of *Potamogeton, Myriophlyllum spicatum, Callitriche stagnalis*, some *Littorella littoralis*, and beds of *Carex rostrata* in two bays. There is also an extensive sward of the charophyte *Chara delicatula* and much *C. aspersa* in one area, as well as clumps of the moss *Fontinalis antipyretica* on stones and around the inlet. An account of its vegetation as it was almost 200 years after Fuller's visit is given by Sledge (1936), and further information is provided by Holmes (1965).

It is not known at what season Fuller visited the Tarn. Holmes noted that, except after mild winters, all the previous season's growth of *P. lucens* and *Myriophyllum* has disappeared by April, that new growth starts from the rhizomes, and that flowering spikes do not usually break the surface until August, so the time of his visit may have given Fuller a wrong impression. As he lived in that period referred to as "the little ice age" it is almost certain that the winter prior to his visit was severe by present standards. Holmes also remarked that *P. lucens* had increased in the previous 60 years and that *P. berchtoldii* did so between 1950 and 1962, so conditions can change rapidly and may have been different in about 1740 from those in the 20th century. Considerable changes have taken place in the status of submerged macrophytes in Windermere during the 20th century (Wade *et al.* 1981), so one cannot simply dismiss Fuller's comment. The small increase in depth since his visit may have had some effect.

Of its fauna Fuller says only that "The *Tarn* abounds with only Two sorts of Fish, *Trout* and *Perch*: the *Trouts* very large and red; the *Perch* far exceed in Size and Goodness any I have ever seen, being commonly 20 Inches long, weighing Four or Five Pounds." He is very specific about the size of the Perch, with which species he was obviously familiar. While 4 or 5 lb is about the usual maximum weight for the Perch, larger individuals are known, the record being 4.75 kg (*c.*10.47 lb) (Miller and Loates 1997). A record length of 51 cm (just over 20 in) is cited. Girth, and therefore weight, increase disproportionately in very large individuals, so Fuller's estimate of length, "commonly 20 Inches" is not unduly far from that expected of a 5 lb Perch. For fishes, estimates of weight, often measured, are more likely to be accurate than those of length. That those reported by Fuller were considerably larger than the largest recorded in the Tarn more than 200 years later by Holmes (1965), some 2.75 lbs, is no reason to doubt their weight, which was indeed corroborated by Hurtley (1786) who reported that "Trout have been taken here [of] eleven pounds: Perch five or upwards". Whitaker (1805) also noted that Malham Tarn was "inestimable for its fishery of Trout and Perch, which grow to an unusual size". Fishes often grow particularly well in alkaline waters, and Perch of about 5 lb weight have been caught in the non-calcareous Ullswater in the English Lake District. Furthermore, as Holmes (and Hurtley before him) noted, the Perch population of Malham Tarn fluctuates greatly in numbers over periods of only a few years. An episode of heavy mortality, caused by disease or severe Spring weather, coinciding with a poor year class, can give rise to a situation where a lake for a time supports a relatively small population, individuals of which therefore enjoy easy living and grow well. Such a situation indeed arose in Malham Tarn in the late 1990s when its Perch population suffered heavy mortality. Many dead fishes were washed ashore. Likewise in 1976 some 98% of the adult Perch in Windermere succumbed to an infection of unknown identity.

Like Fuller, Hurtley (1786) said that only two fishes, Perch and Trout, "will live in this Alpine water". However he clearly meant fishes of interest to the angler or for the table, as he then promptly said that "there are immense quantities" of Loaches (=Stone Loach) and Miller's Thumb (=Bullhead) which, with gastropods (which he called Periwinkles !), comprised the principle food of both the Perch and Trout. Holmes (1965), however, found that fishes featured to only a minor extent in the diet of the Trout of the Tarn, though much more so in that of the Perch. Large Trout, however, tend to be more piscivorous than small, and such fishes were evidently much commoner in the 18th century than in Holmes' time. Hurtley gives a fanciful account of the supposed rivalry between the Perch and Trout and notes that "not many years ago" Perch greatly predominated in numbers, but that currently Trout "are vastly the stronger party". Fluctuations in numbers, noted by Holmes (1965), have clearly long been a feature of the Perch populations of Malham Tarn and, as shown by events towards the end of the 20th century, continue to be so.

Hurtley's reference to the Stone Loach and Bullhead is perhaps the first report of these fishes in Malham Tarn. There are more ancient references to Trout and Perch.

Although the species involved seem not to be mentioned, Holmes (1965), with justification, assumes that apparently unnamed fishes referred to in two 12th century grants of the fishery of Malham Tarn to the monks of Fountains Abbey were Trout and Perch. He found it difficult to see how these species could have colonised the Tarn, which is guarded by what he took to be impassable barriers, and concluded that they must have been introduced by man in the distant past. It is true that Malham Tarn is an isolated water body, but its fish fauna nevertheless includes Bullhead, Stone Loach, Minnow, and Three-spined Stickleback. While the last two could conceivably have been introduced inadvertently when the Tarn was stocked with Trout, as it has at times in recent centuries, it is difficult to believe that all four species were so introduced. The Bullhead is abundant in certain streams in the area. If these species colonised the Tarn naturally, the Perch may have done likewise, perhaps at a time when conditions for so doing were more propitious than at present. The Trout, which frequents streams in the locality, has colonised isolated water bodies elsewhere and, although also stocked, probably reached the Tarn unaided by man. Other fully aquatic animals whose colonisation of Malham Tarn is not easy to envisage have nevertheless accomplished this feat. Noteworthy among these are no fewer than 22 species of molluscs: 13 gastropods and 9 bivalves. Shells of six of these have been found in the Preboreal marls beneath the raised bog to the west of the Tarn which, some 10,000 years ago, was part of a larger Tarn (Holmes 1965). Access may have been easier, to them and to fishes, either at that time or subsequently, than it is at present.

The monks of Fountains Abbey were only the first of the recorded exploiters of the Perch. The accounts of the Cliffords of Skipton Castle in 1609 include payment for getting "pearch and troot from Mawater," an old name for Malham Tarn (Whitaker 1805). Commenting on this, Clarke and Roebuck (1881) note that the Perch, Bullhead, Stone Loach and Minnow achieve their highest altitude in Yorkshire in Malham Tarn, and the same may be true of the Three-spined Stickleback, as it is for several of its crustaceans and molluscs. Indeed some of the molluscs, which require calcareous waters, here achieve their highest altitude in Britain.

The Vicissitudes of an Early Discovery

More than two and a half centuries ago Fuller placed on record what had already been discovered about the subterranean route taken by the outflow of Malham Tarn. This knowledge, at that time familiar to "men of credit" in the Malham area, had evidently become no more than local hearsay before the end of the 19th century. Although by then also forgotten, Fuller's report preserved this information.

It is ironical that Fuller's account escaped inclusion in the comprehensive bibliography of works on the geology and physical geography of West Yorkshire given in Davis and Lees (1880), of which the earliest entry is a note by Martin Lister in 1674. The list is chronological and, had it been included, Fuller's paper would have been sixth in the sequence. There is particular irony in the fact that, like that of Fuller, all five earlier papers appeared in the *Philosophical Transactions of the Royal Society*, the earliest scientific journal, which must therefore have been searched. Martin Lister was the author, or in one instance co-author, of the first four. A yet further irony is that the sixth work listed is the book by Thomas Hurtley (1786) on the "natural curiosities" of the Malham area, whose author makes no mention of what Fuller had reported less than fifty years earlier, though it was certainly a "natural curiosity". Hurtley was the master of Malham school and might therefore have been expected to be familiar with local knowledge and tradition. Perhaps he made few enquiries among the local inhabitants to whom he referred as "chiefly Farmers" who "alike ignorant of the refinements and inquietudes of the gay world, live in ease and pastoral simplicity". Happily this gem of information was preserved in what was destined to become a treasure house of scientific history, from which it has now been retrieved.

The main subterranean course of the outflow of Malham Tarn was established long ago, though the facts were apparently never adequately recorded. The discovery could have been made long before Fuller heard of it. No information on this appears to have been preserved. Also unknown is the identity of the individual who recognised that an apparently obvious fact needed checking, who did so by means of a simple but ingenious experiment, and thereby not only revealed that what seemed self-evident was incorrect, but made a remarkable discovery.

I am grateful to Dr D.E.Cotton for a personal observation and for drawing my attention to the Smith and Atkinson paper.

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BOOK REVIEWS

Dragonflies: Behaviour and Ecology of Odonatata by **Philip S. Corbett**. Pp. xxxii + 829, including numerous line drawings, b/w photographs and tables, plus 16 pp of colour plates and frontispiece. Harley Books, Great Horkesley, Colchester. 1999. £62.50.

Dragonflies are primitive insects whose beautiful, often conspicuous, adults and unobtrusive, usually aquatic, larvae have attracted much attention. Just how much is made apparent by Philip Corbet's splendid book on the behaviour and ecology of the more than

5000 extant species.

Little is said about structure, information being readily available elsewhere. Of behaviour and ecology there is almost a surfeit. As a would-be conscientious reviewer I set out to read the entire book. I confess I did not. The more than 80 pages of fact-packed appendix tables, for example (and there are more in the text) are repositories for reference, not straightforward reading. Only a sample of what is covered can be mentioned. Habitat selection, a logical starting point, is apparently predominantly visual, but our own *Cordulegaster boltonii* is evidently a water diviner that can follow water-filled culverts lying beneath pavements, and some tropical species lay eggs in hollows *before* they fill with water. Such are the sort of items that strew the way as one proceeds. Oviposition, the culmination of habitat selection, sometimes involves tandem pairs, and here for example one learns the signifinance of the so-called sentinel position of the males of certain zygopterans, of which there are excellent photographs. Eggs, hatching and larval biology are dealt with (like almost everything else) in great detail. Respiration, foraging, detection of prey, diets, the transformation of energy, predators, parasites, defence mechanisms and population dynamics are all thoroughly treated. I was intrigued to learn that some larvae eject faecal pellets like a bullet from a gun, and that one species can project them 19 cm vertically and at least 60 cm horizontally! The account of larval biology is rounded off by 50 pages on growth, metamorphosis and emergence. Those accustomed to the long duration of larval life in temperate lands (some species possibly spend as long as 10 years as larvae) may be surprised to learn that some tropical species perhaps produce seven or eight generations a year.

Behaviour and ecology are, of course, vastly different in adults and larvae. Adults often have a long pre-reproductive period. Aspects of this and the subsequent reproductive phase that are treated include thermoregulation, flight, activity patterns, feeding, longevity, predators and migration. Of the last there are some striking examples. Reproductive behaviour is complex in dragonflies – and is dealt with in more than 130 pages. The book is rounded off by a survey of interactions between man and dragonflies and by consideration of their conservation. The bibliography of more than 4000 entries occupies 122 double-columned pages.

This is an enormous, well-synthesised and comprehensive compilation to which one can turn for information on specific topics – and almost certainly find it. Simply to read steadily through it is to risk being overwhelmed by detail, though it is well written and well illustrated.

It seems incumbent on reviewers to find a mistake, if only to prove they have read what they review, or to conjure up a quibble. To do either seems unfair in the case of such a fine book, but gregarines are protozoans, not, as stated on p. 134, metazoans (as the author knows for this is simply a slip), the small crustaceans often eaten by larvae are not truly planktonic, and a few cross references are wrong. E.g. there is no section 4.1.1 to which one is referred on p. 158. Figure 11.40, not by the author, is crude, not easy to follow, and could have been re-drawn with advantage. These quibbles are trivial – like a speck of soot on an immaculate table cloth. I will risk challenging one claim. Corbet says that in their aerial agility and general mastery of flight, dragonflies are without peers save perhaps for a few raptorial birds. I'd put my money on certain Diptera. Hover flies can not only hover but fly backwards, the speedy House fly can turn over in flight and land upside down on a ceiling, and although they assemble in enormous, close-packed, milling swarms, males of certain midges apparently never bump into each other, as male dragonflies not infrequently do when engaged in aggressive activities. One marvels at both groups.

This will surely become the standard work on dragonfly behaviour and ecology, not only for experts but for those like the reviewer, whose interest is not matched by profound knowledge of these remarkable insects, but to whom a copious source of information to which they can turn at need will be very welcome. The book is beautifully produced and the contents do justice to its appearance.

GF

Insects on Cherry Trees by **Simon R. Leather** and **Keith P. Bland.** Illustrations by **Miranda Gray.** Pp. 82, with 4 colour plates. Naturalists' Handbooks 27. Richmond Publishing, Slough. 1999. £15.00 hardback. £3.95 paperback.

This well-produced series already includes handbooks on insects associated with nettles. thistles, cabbages and docks. Cherry trees, of which there are just two native species, may seem a surprising addition, but there are several introductions of which *Prunus cerasus* has apparently been here since Roman times. Ten species are described, and 79 species of insects associated with five of these are tabulated. This is not, however, a complete list: 96 species known to feed on these trees in Britain are listed later. As many other insects visit cherry trees for other purposes, categorisation is not easy.

A chapter on island biogeography and species-area studies suddenly appears as Chapter 2. While this usefully compares trees with islands, one suspects that its inclusion reflects the interests of the authors as much as the needs of would-be readers, to many of whom it will probably be forbidding. A chapter on insect-plant interactions provides further background information.

There are keys to cherries, and to the major groups of insects with which readers were earlier presumed to be familiar. Keys to individual groups follow, to larvae as well as adults where appropriate, though not to beetles or immature bugs. Homopteran hemipterans, dealt with first, are oddly separated by all other groups from heteropterans, that come last. Only use will reveal the effectiveness of the keys. The hint, "use a microscope" in order to examine the aedeagus of a 4 mm homopteran seems superfluous. One would have to be very skilled to do so without one, and one wonders whether those who need to be instructed how to separate major groups of insect will know what an aedeagus is. They are not told. Keys to larvae irritate by using "larva" or "larvae" unnecessarily more than 80 times.

There is a chapter on methods, a list of useful addresses, and what to the beginner will be a daunting list of references. Four colour plates of plants and insects and a number of clear line drawings support the text.

Except perhaps for works on specific groups of organisms, it is extremely difficult to provide books that can "be enjoyed by inexperienced naturalists and by students at school and university" yet be useful to professional ecologists" which is the aim of this series. Just how well the authors have succeeded only time will tell.

GF

In Search of Ross's Gull by **Michael Densley**. Pp. xxii + 268, 80 colour plates and 8 figures. Peregrine Books, Leeds. 1999. £34.95 hardback.

The author sets the scene by outlining his early encounters with this enigmatic species: the writings of the 19th century naturalists; his awareness of a record at Bridlington, in his native Yorkshire in 1962 and a subsequent involvement with the fate of a bird shot near Tadcaster, Yorkshire, in the winter of 1846/47. It was this last exercise that kindled his obsession with Ross's Gull. The Tadcaster bird, originally housed in the City of Leeds Museum, was thought to have been destroyed when the Museum was bombed during the Second World War but, in 1976, he was told of a stuffed Ross's Gull in the Wakefield Museum. Subsequent and painstaking investigations proved that this was the Tadcaster bird which had, apparently, been on loan to Wakefield during the war and had thus survived.

The book is made up of eight major section: early research, frustrations and early sightings, history and some early heroes, migration and vagrancy, Alaska, a letter to Brezhnev (the author wrote a personal letter to the President of the Supreme Soviet to ask permission to visit the USSR in order to study Ross's Gull), Kolyma and the finale. Densley has succeeded in imparting his obvious passion for this bird and the very detailed anecdotal style is a joy to read. One can share the frustrations caused by Soviet red tape, the regular and uncertain delays, the discomfort of myriads of mosquitoes on the open tundra, the spartan accommodation and food, all of which were endured, often alone, in this vast and mysterious country.

This is not a scientific treatise in the accepted sense and does not pretend to be; instead, we have a very readable, well written and evocative account, in which no-one interested in birds, particularly gulls, or interested purely in adventure could fail to be fascinated. Some of the colour photographs are stunning and add greatly to the book's appeal; the fact that they are only numbered and not fully captioned, necessitating reference to a list of plates, is somewhat frustrating. The edition is limited to 500 copies and so anyone wanting to read this colourful and entertaining account of one man's quest, and I recommend that you do, should buy it now. The very occasional typographical and grammatical lapses can be forgiven.

JRM

Birds and Boys at Sedbergh. One hundred years of watching and recording birds at Sedbergh School, Cumbria by **Ingram Cleasby** . Pp. xii + 150, with several photographs and line drawings. Privately published (available from The OS Secretary, Sedbergh School, Sedbergh, LA10 5RY. 1999. £00.00 paperback.

Sedbergh School has a long tradition of involvement with natural history and has maintained an active Ornithological Society since 1888. The Society's Chairmen have included such eminent persons as E. M. (Max) Nicholson CB, the first Director of The Nature Conservancy Council, co-founder of the British Trust for Ornithology and instigator of the World Wildlife Fund and Freddie Spencer Chapman, later to become Col. F. S. Chapman DSO, an outstanding Himalayan climber, Arctic and African explorer and author of *The Jungle is Neutral.* There have been other more recent sons who have achieved fame or popularity.

Situated in the heart of the north-western corner of Watsonian Yorkshire (Vice-county 65), surrounded by the Howgill, Bough, Widdale and Middleton Fells and close to the impressive Cautley Crag, it is perhaps inevitable that a major part of the Society's interest and study should have centred on birds of prey, notably the Peregrine Falcon and the Common Buzzard. It was here, in the remoteness of the fells, that these two species had their former county stronghold until a more recent expansion in their ranges. The Common Raven too featured in their studies, persisting as it did in spite of much persecution, on the impressive crags of Cautley, Combe Scar and Black Force.

The studies of these and many other upland breeding species are outlined in some detail. There are chapters dealing with gains and losses among the breeding birds, waterfowl on Killingbeck Reservoir, Lily Mere and the upland tarns, surveys and censuses, bird ringing, expeditions to the Northumberland coast and to Ravenglass to study seabirds, recent developments and the future. Each section contains a wealth of information on the involvement of the masters and their charges during the survey work. Ecological studies are now an integral part of the teaching programme and the majority of boys, rather than an interested minority, are being introduced to wildlife through their field-work. The book ends with a list giving the known status of the 202 species of birds recorded in the area up to 1999.

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CAH

Deer and the New Woodlands? Managing Deer in Community Forests and the Urban Fringe. edited by **Melvyn Jones, Ian D. Rotherham and Andrew J. McCarthy**. Pp. 77 including numerous line drawings. maps and graphs. Wildtrack Publishing, PO Box 1142, Sheffield S1 1SZ, for *Journal of Practical Ecology and Conservation.* Special Publication No. 1 (expanded edition). 1999. £10.00 paperback (A5 format).

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Policy initiatives and opinion on rising deer populations are given from the perspective of local authorities, the South Yorkshire Forest Partnership, the Forestry Commission, and the British Deer Society. Wildtrack Publishing is to be congratulated for making available this timely review which provides an invaluable baseline for what is proving to be a dynamic and potentially contentious conservation situation.

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Printed in Great Britain by Titus Wilson & Son, Kendal ISSN 0028-0771

April-June 2000

Number 1033
Volume 125

The Naturalist

A QUARTERLY JOURNAL OF NATURAL HISTORY FOR THE NORTH OF ENGLAND

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.

Subscriptions should be sent to:

Mr Richard Comley, 1 Highfield Rise, Stannington, Sheffield S6 6BS

All other YNU matters should be addressed to:

Mr John A. Newbould, Stonecroft, 3 Brookmead Close, Sutton Poyntz, Weymouth, Dorset DT3 6RS

The Naturalist is issued free to individual members of the Yorkshire Naturalists' Union and to Affiliated Societies.

Institutions and Subscribers £20.00 Registered Charity No. 224018

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Otters obtained during the 19th century from the River Don ox-bows at Wheatley Park, Doncaster. [From the collection of Sir William B. Cooke of Wheatley Hall, photographed during the 1920s while on loan to Beechfield House Museum, Doncaster.]

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CAH

THE SPHECID WASPS, *CRABRO* AND *CROSSOCERUS* (HYMENOPTERA: SPHECIDAE) OF WATSONIAN YORKSHIRE

MICHAEL E. ARCHER
17 Elmfield Terrace, Malton Road, York YO31 1EH

This paper gives an account of the records and distribution of the wasp genera *Crabro* and *Crossocerus* in Watsonian Yorkshire until the end of 1999. This is the second in a series of four papers to give an account of the Sphecidae of Watsonian Yorkshire (Archer, 1996). The species of *Crabro* are large yellow and black wasps while the species of *Crossocerus* are small and usually black, although a few species have yellow markings. Species of both genera are often associated with open sandy habitats, dead wood and dead bramble stems in sunny situations. Adults are mainly active during the summer months when fine weather conditions prevail. Currently there are two species of *Crabro* and 18 species of *Crossocerus* present in Watsonian Yorkshire (Table 1). Keys to the species can be found in Richards (1980), Dollfuss (1991), Bitsch and Leclercq (1993) and Yeo and Corbet (1995).

Life cycles and habits
Crabro and *Crossocerus* wasps are summer insects. Adults are active mainly during June, July and August, sometimes during May and September and exceptionally during April and October (Table 6). Each species passes through one, or sometimes two, generations a year.

The species of *Crabro* are subterranean nesters in sandy soils exposed to the sun. They dig a main tunnel of 15-28 cm length with 3-7 cells at the ends of the main and branch

TABLE 1.
Records and distributional units of *Crabro* and *Croossocerus* from Watsonian Yorkshire to 1999.

Species	records	localities	1 km	10 km	VCs
C. cribrarius	132	50	50	31	4
C. peltarius	104	22	22	15	4
C. elongatulus	127	92	85	50	5
C. ovalis	91	31	31	21	4
C. palmipes	9	3	3	2	1
C. pusillus	182	73	70	45	5
C. tarsatus	130	56	56	42	5
C. wesmaeli	41	17	17	12	3
C. annulipes	69	46	45	34	5
C. capitosus	24	17	17	13	5
C. cetratus	59	21	21	21	5
C. leucostoma	6	3	3	3	1
C. megacephalus	131	81	79	48	4
C. nigritus	33	25	25	21	4
C. styrius	7	6	6	6	2
C. walkeri	7	6	6	6	3
C. podagricus	55	32	32	25	5
C. quadrimaculatus	162	52	50	32	4
C. binotatus	13	10	10	10	3
C. dimidiatus	85	64	61	44	5
Total	1467	284	160	100	5

tunnels. Each cell is stocked with 5-9 medium sized flies (e.g. Calliphoridae, Syrphidae). An egg is laid on the throat of the first fly brought into the cell. When the nest is completed it is sealed with sand grains.

The species of *Crossocerus* are either subterranean nesters in soil, or aerial nesters in hollow stems, e.g. bramble, or in dead wood where they often use old beetle burrows. Their cells are usually stocked with small flies except for *C. walkeri* which hunts mayflies and *C. annulipes* which hunts hemipteran bugs.

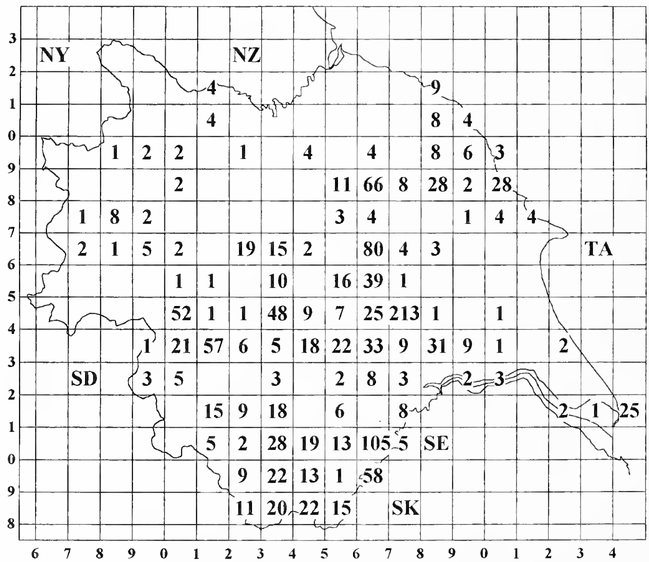
Further biological information can be found in Bohart and Menke (1976), Iwata (1976), Lomholdt (1976), Richards (1980), Bitsch and Leclercq (1993) and Gauld and Bolton (1996).

Historical Account

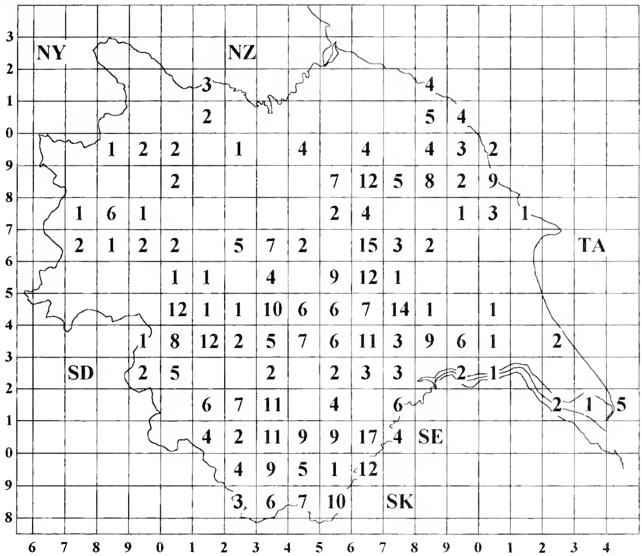
Work on *Crabro* and *Crossocerus* started with Smith (1852) who recorded five species: *Crabro cribrarius, C. peltarius* (as *patellatus*), *Crossocerus elongatulus* (as *elongatulus* and *obliquus*), *C. megacephalus* (as *leucostoma*) and *C. dimidiatus*. Smith (1858) added *Crossocerus wesmaeli* and *C. capitosus*.

Roebuck (1877, 1880) repeated the work of Smith recording *Crossocerus elongatulus* as *luteipalpis* and adding new locality records. Roebuck (1907) added *C. pusillus* (as *varius*). Thus at the beginning of the twentieth century eight species had been recorded.

Butterfield and Fordham (1931) added six species: *Crossocerus nigritus* (as *pubescens*), *C. cetratus, C. podagricus, C. tarsatus* (as *palmipes*), *C. ovalis* (as *anxius*) and *C. quadrimaculatus*. Butterfield and Fordham also included *Crabro scutellatus* (Scheven) based on a published record and an unpublished record. Specimens representing this species from Yorkshire have not been found and since currently this species is not recorded north of Norfolk, records of it are rejected. The records of *C. scutellatus* are probably



MAP 1.
Number of records for each 10 km square of *Crabro* and *Crossocerus* from Watsonian Yorkshire.



MAP 2.
Number of species for each 10 km square of *Crabro* and *Crossocerus* from Watsonian Yorkshire.

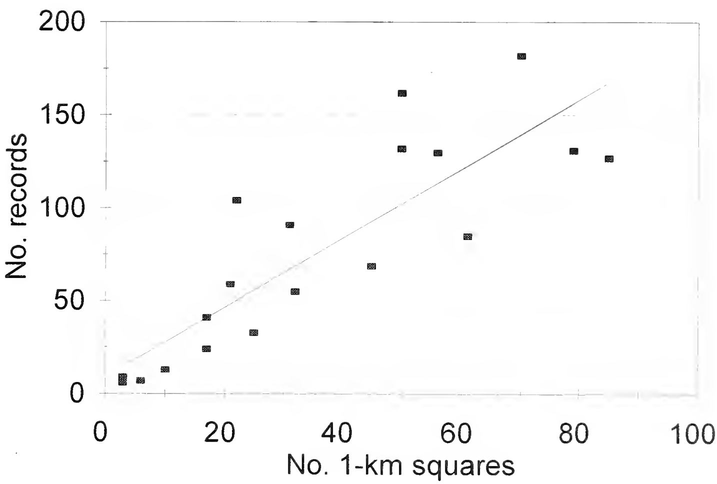


FIGURE 1.
Abundance *v.* range of species of *Crabro* and *Crossocerus* from Watsonian Yorkshire.

TABLE 2.
Localities from Watsonian Yorkshire to 1999 with eight or more species of *Crabro* and *Crossocerus*.

	No. species	No. records
Strensall Common	15	80
Allerthorpe Common	14	165
Duncombe Park	12	64
Holmehouse Wood, Keighley	11	42
Shipley Glen	10	42
Blaxton Common	10	30
Crow Wood	10	28
Keswick Fitts	10	28
Skipwith Common	9	26
South Cliff Common	8	28
Rossington Bridge	8	25

misidentifications of *C. peltarius*. Recently a specimen of *C. peltarius* was found at Brayton Barff, near Selby, lacking yellow colouration on the thorax and the first gastral tergum which could readily be mistaken for *C. scutellatus*. A dead specimen of *C. scutellatus* entered Yorkshire during 1992 from Poland (Archer, 1997).

Walsh & Rimmington (1956) added *Crossocerus walkeri* and *C. binotatus*. More recently the following species have been added: *C. leucostoma* (Archer, 1986; with records from 1982), *C. palmipes* (Archer, 1986; with records from 1977) and *C. styrius* (Archer, 1987; with records from 1927). Records for *C. annulipes* do not seem to have been previously published for Yorkshire although records are known from 1925.

The Record Data Base

The 20 species of *Crabro* and *Crossocerus* are represented by 1467 records from 284 localities in 160 1 km squares or 100 10 km squares in Watsonian Yorkshire (Table 1). A record is based upon a specimen where the data varies in one of the following: name, sex, locality and day-date of capture or observation. The author has seen the specimens of 958 (65.3%) of the records.

Watsonian Yorkshire may be considered to include, at least in part, 195 10 km squares: Map 1 shows the number of records, and Map 2 the number of species, found in each 10 km square. Records are known from 51% of the 10 km squares. Records are scarce from the following natural areas (Archer, 1998a): Yorkshire Wolds, Holderness, northern parts of the Pennine Dale Fringe and the Vales of York and Mowbray, and Humber Estuary except for square TA41. The following four natural areas with only a small part in Watsonian Yorkshire also seem to have been little visited: North Pennines, Tees Lowlands, Forest of Bowland and Southern Pennines.

Using the number of records per species as a measure of abundance and the number of 1 km squares in which each species occurs as a measure of range, a plot of abundance versus range can be made (Fig. 1). The correlation coefficient of 0.86 indicates a statistically highly significant relationship ($P<0.001$), indicating that as the range of a species increases so does its abundance. The regression equation can be expressed as: Abundance = 1.87 x Range + 9.07.

The eleven localities with eight or more species of *Crabro* and *Crossocerus* are given in Table 2. Most of the localities are sandy except for two, Duncombe Park and Holmehouse Wood, near Keighley, which are clay sites. Keswick Fitts is a silty and sandy site on well vegetated banks of the River Wharfe.

TABLE 3.
Time source of records of *Crabro* and *Crossocerus* from Watsonian Yorkshire to 1999.

	No. records
pre-1900	9
1900s	20
1910s	31
1920s	140
1930s	101
1940s	63
1950s	19
1960s	40
1970s	155
1980s	472
1990s	398

TABLE 4.
Names and years of activity of collectors with 20 or more records of *Crabro* and *Crossocerus* from Watsonian Yorkshire to 1999.

	No. records	Years of activity
Archer, M. E.	640	1967-1999
Fordham, W. J.	125	1898-1937
Burn, J. T.	96	1965-1991
Wood, J.	87	1924-1965
Coldwell, J. D.	58	1985-1997
Hincks, W. D.	43	1942-1958
Shaw, R.	33	1989-1993
Britten, H.	25	1934-1937
Butterfield, R	22	1907-1993

TABLE 5.
Sources of records of *Crabro* and *Crossocerus* from Watsonian Yorkshire to 1999.

	No records
Doncaster Museum	23
Keighley Museum	73
Leeds Museum	14
Manchester University Museum	92
Oxford University Museum	1
Rotherham Museum	24
Scarborough Museum	27
Sheffield Museum	54
York Museum	6
Private collections	962
Sighted records	3
Literature records	187

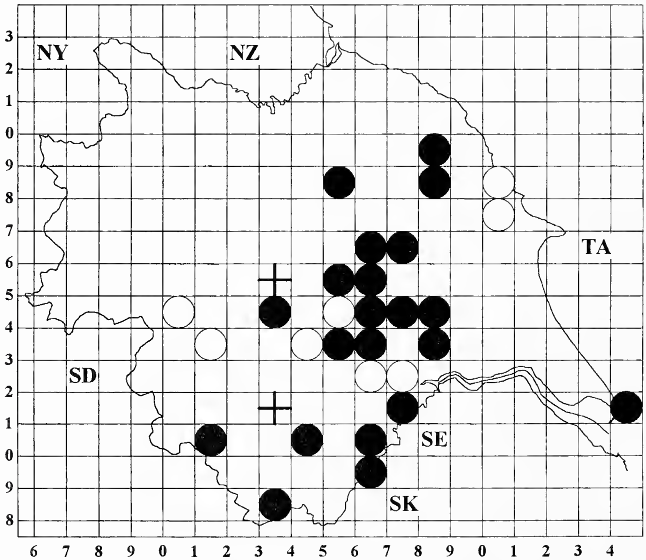
Table 3 shows the number of records from the 19th century and each decade of the 20th century. Few records are known from the 19th century and the 1900s or the 1910s (4.1% of records). Most records are from the 1970s, 1980s and 1990s (69.9%), although there is a second minor peak of records during the 1920s and 1930s (16.4%). The dates of 19 records are unknown.

Table 4 shows the nine most important collectors of records. W. J. Fordham, at Allerthorpe Common, H. Britten, at North York Moors, and R. Butterfield and J. Wood, mainly at and near Keighley, were the dominant collectors during the early part of the 20th century. W. D. Hincks, mainly at Spurn Point, and J. Wood were the major collectors during the middle of the 20th century. During more recent times, J. T. Burn, mainly around Doncaster, J. D. Coldwell, mainly around Barnsley, R. Shaw, in and around Sheffield, and M. E. Archer, in many parts of Yorkshire, have been the main collectors.

Table 5 shows the sources of records with 12.7% from published and unpublished literature, 21.5% from museum collections, and 65.8% from private collections and sighted records. Keighley, Manchester University and Sheffield Museums have been particularly important sources of records. The curators of nine museums and 66 people with private collections have provided records for which the author is grateful.

Species Accounts

Information for each species is given as follows: biological name; Yorkshire status (Archer, 1993); map number if given, or if no map the 10 km squares are given (B = records before 1970, A = records 1970-1999); seasonal appearance of adults in Yorkshire (Table 6); relative abundance of females and males in Yorkshire (Table 7); nesting habit; national status (Archer, 1998b). Localities are given for the Yorkshire rare species. Maps produced from DMAP by Dr A. Morton.



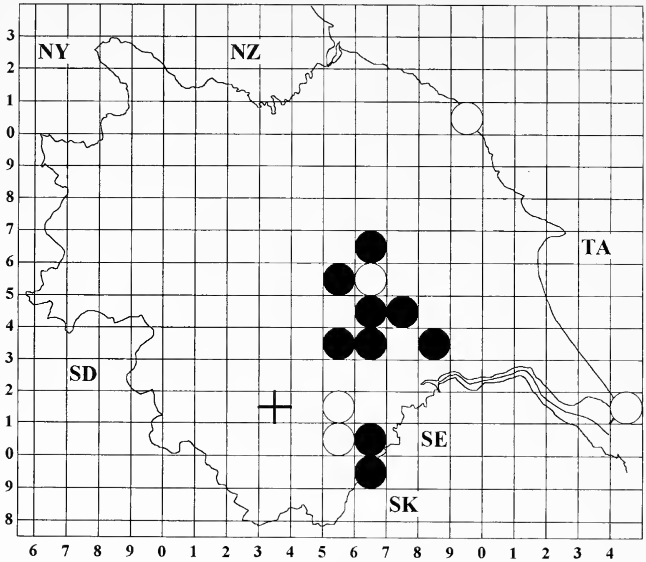
MAP 3.
Crabro cribrarius (Linnaeus, 1758)
(+ pre-1900, ○ before 1970, ● 1970 onwards).

TABLE 6.
Seasonal appearance of adults of *Crabro* and *Crossocerus* in Watsonian Yorkshire to 1999.

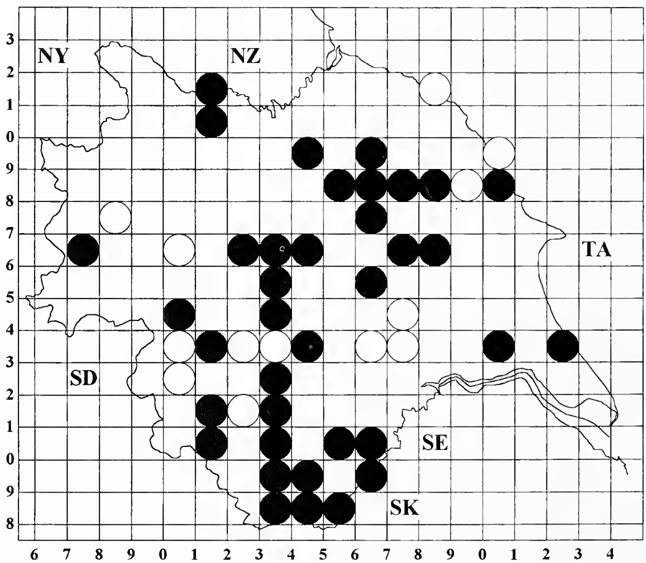
	April	May	June	July	Aug.	Sep.	Oct.
C. cribrarius			18	65	36		
C. peltarius			41	50	8	1	
C. elongatulus		3	28	66	17	3	
C. ovalis		8	28	35	11	4	
C. palmipes.				5	3	1	
C. pusillus			15	71	70	20	
C. tarsatus		5	59	31	30	11	
C. wesmaeli		3	9	14	9	4	
C. annulipes			4	33	21	9	
C. capitosus		1	7	10	5		
C. cetratus		4	20	19	10	5	
C. leucostoma		4	2				
C. megacephalus	1	9	48	30	22	2	
C. nigritus		2	14	8	6	2	
C. styrius		1	1	3	1		1
C. walkeri			1	6			
C. podagricus		1	13	30	10	1	
C. quadrimaculatus			15	67	67	8	
C. binotatus			1	6		1	
C. dimidiatus			16	39	11	4	

TABLE 7.
Number of records of sexes of *Crabro* and *Crossocerus* from Watsonain Yorkshire to 1999.

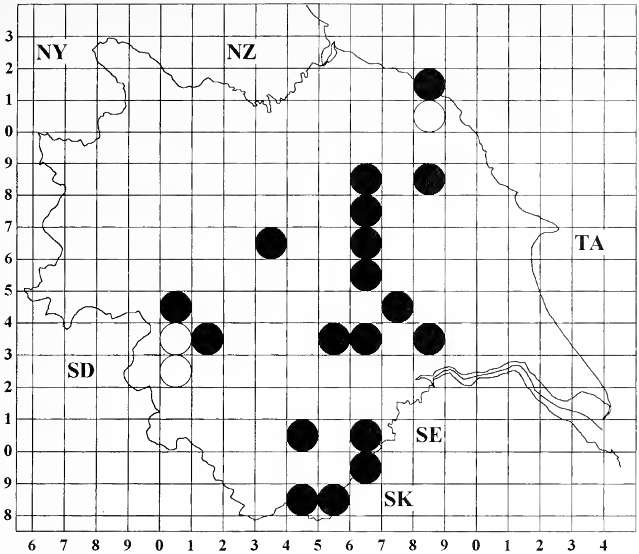
	Females	Males	Unknown
C. cribrarius	47	49	36
C. peltarius	39	40	25
C. elongatulus	46	46	35
C. ovalis	68	10	13
C. palmipes	5	0	4
C. pusillus	104	41	37
C. tarsatus	73	39	18
C. wesmaeli	20	10	11
C. annulipes	40	12	17
C. capitosus	7	7	10
C. cetratus	30	18	11
C. leucostoma	3	2	1
C. megacephalus	53	26	52
C. nigritus	12	9	12
C. styrius	6	1	0
C. walkeri	2	4	1
C. podagricus	24	21	10
C. quadrimaculatus	84	53	25
C. binotatus	7	1	5
C. dimidiatus	34	32	19



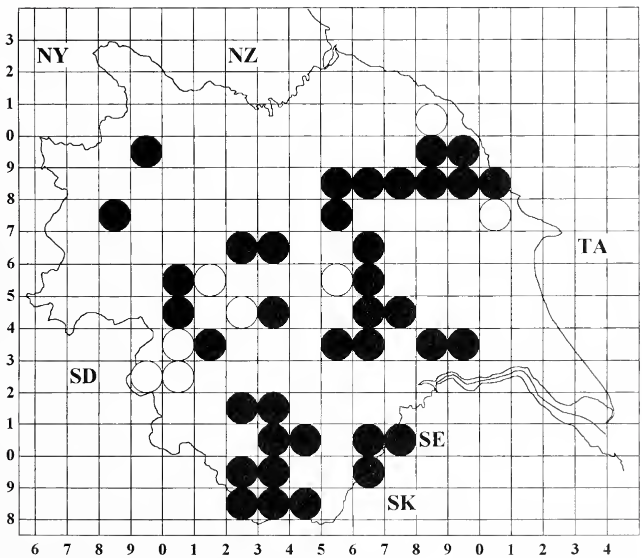
MAP 4.
Crabro peltarius (Schreber, 1784)
(+ pre-1900, ○ before 1970, ● 1970 onwards).



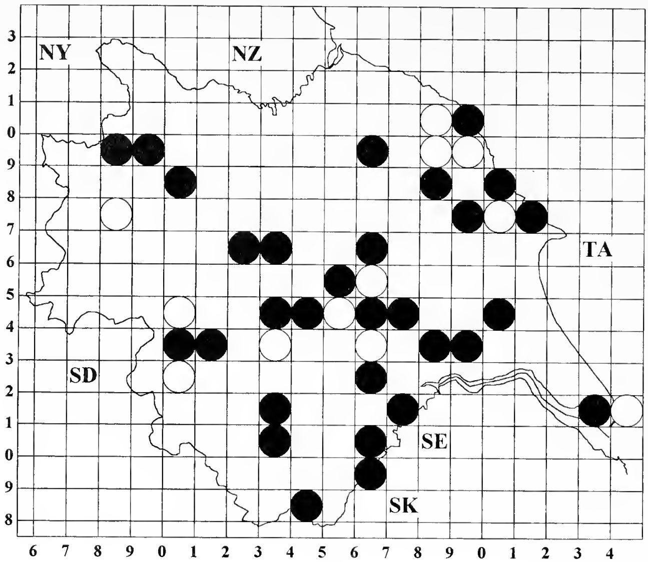
Map 5.
Crossocerus elongatulus (Vander Linden, 1829)
(○ before 1970, ● 1970 onwards).



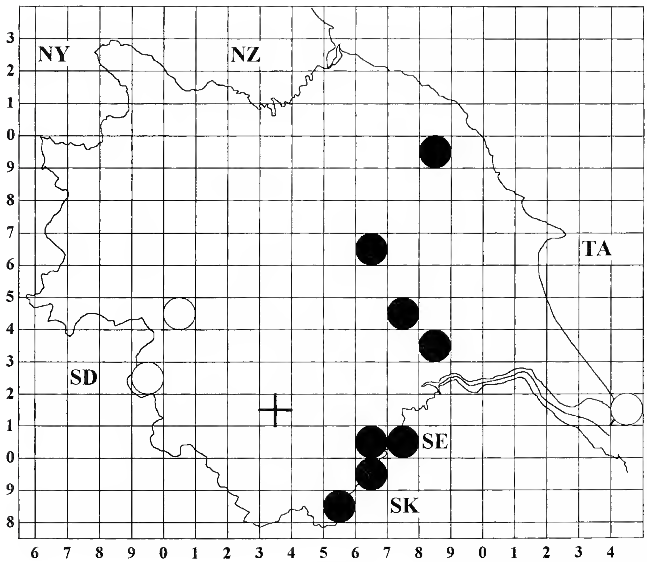
MAP 6.
Crossocerus ovalis Lepeletier & Brullé, 1835
(○ before 1970, ● 1970 onwards).



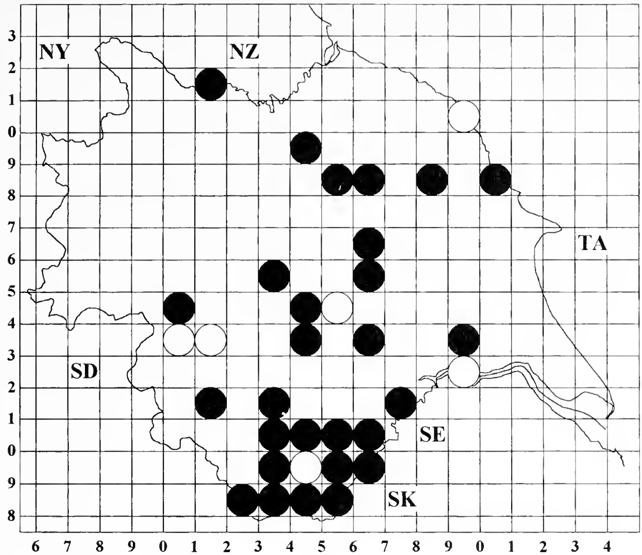
MAP 7.
Crossocerus pusillus Lepeletier & Brullé, 1835
(○ before 1970, ● 1970 onwards).



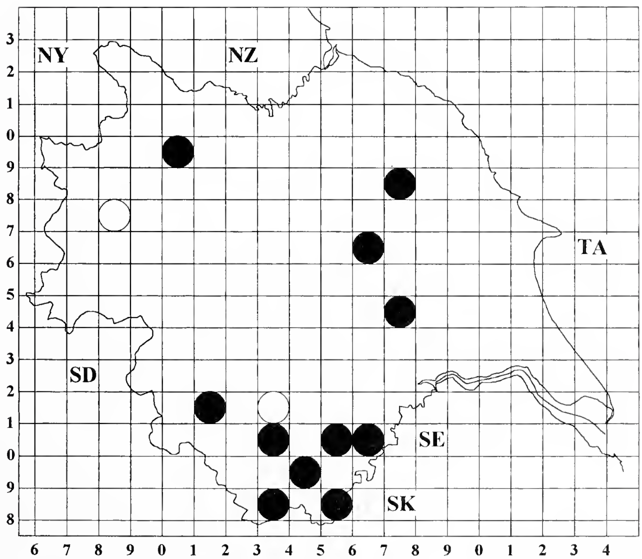
MAP 8.
Crossocerus tarsatus (Shuckard, 1837)
(○ before 1970, ● 1970 onwards).



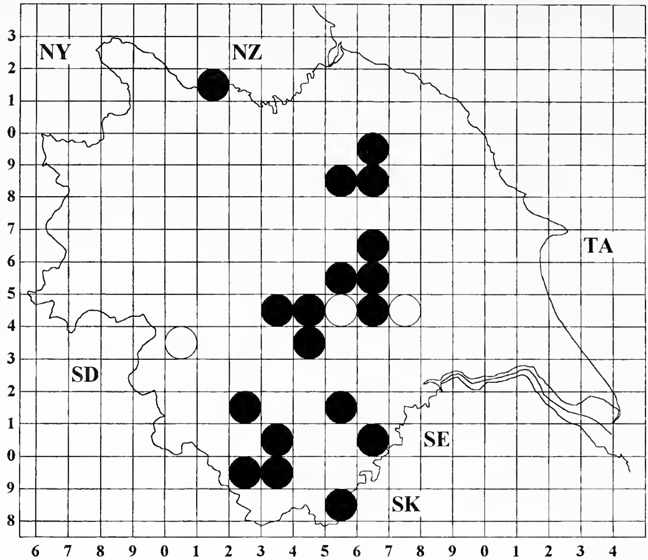
MAP 9.
Crossocerus wesmaeli (Vander Linden, 1829)
(+ pre-1900, ○ before 1970, ● 1970 onwards).



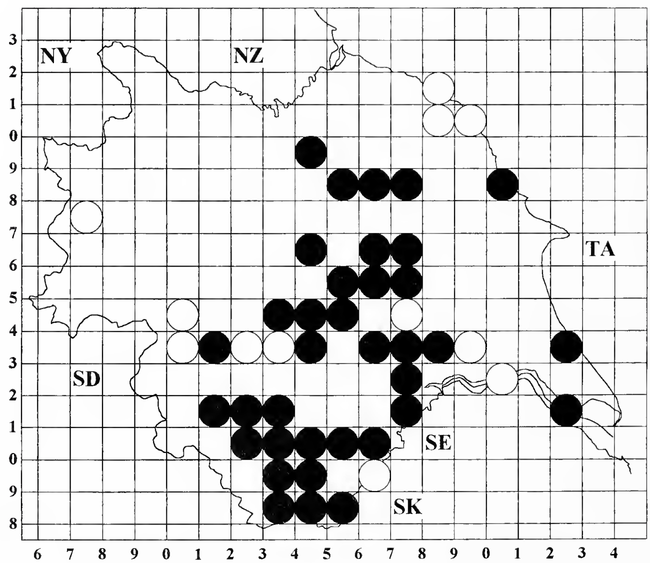
MAP 10.
Crossocerus annulipes (Lepeletier & Brullé, 1829)
(○ before 1970, and ● 1970 onwards).



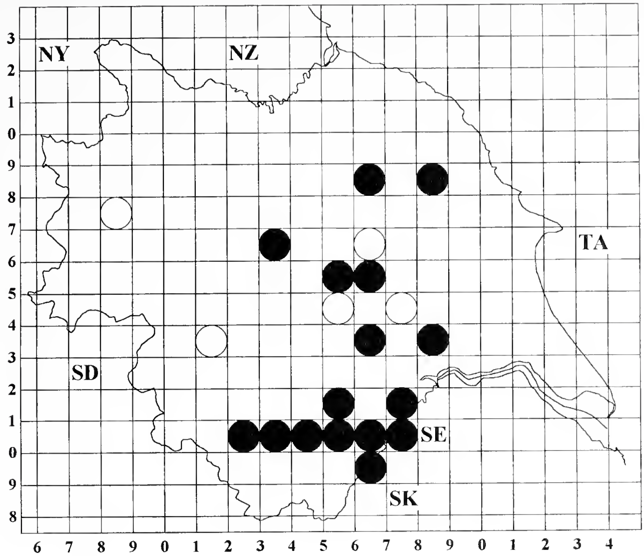
MAP 11.
Crossocerus capitosus (Shuckard, 1837)
(○ before 1970, ● 1970 onwards).



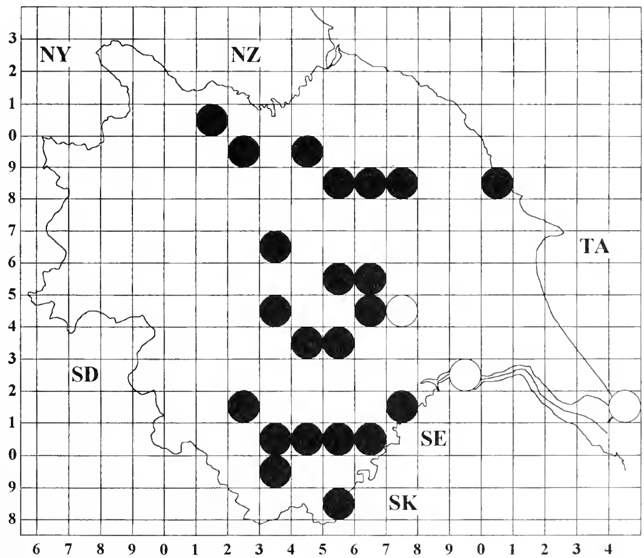
MAP 12.
Crossocerus cetratus (Shuckard, 1837)
(○ before 1970, ● 1970 onwards).



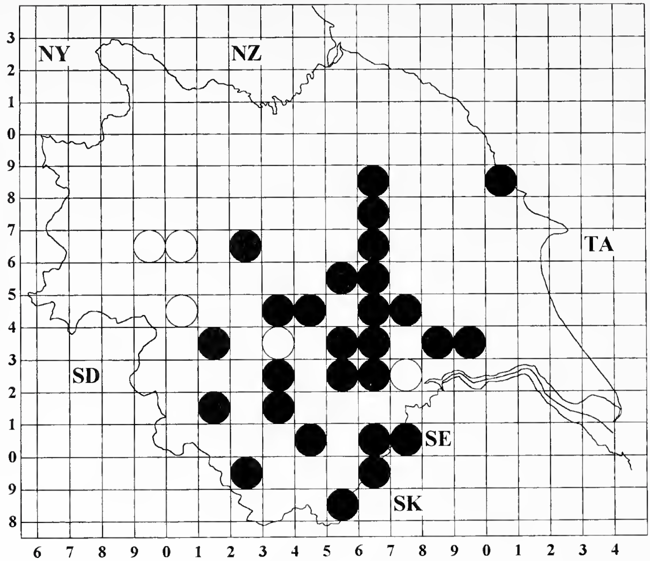
MAP 13.
Crossocerus megacephalus (Rossius, 1790)
(○ before 1970, ● 1970 onwards).



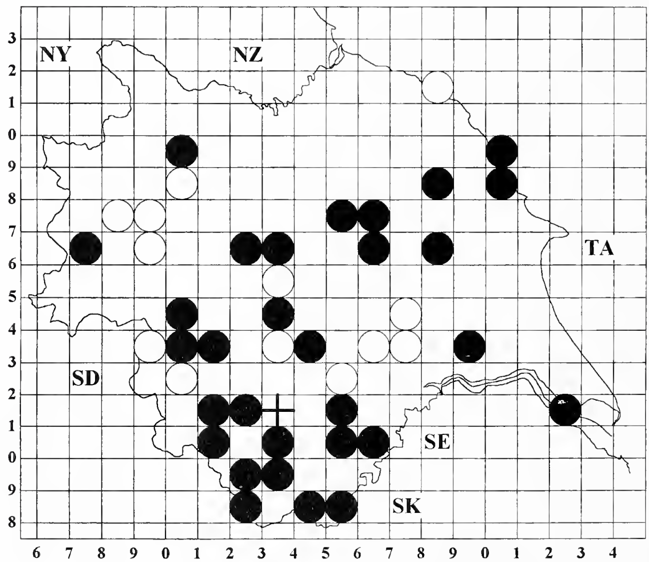
MAP 14.
Crossocerus nigritus (Lepeletier & Brullé, 1835)
(○ before 1970, ● 1970 onwards).



MAP 15.
Crossocerus podagricus (Vander Linden, 1829)
(○ before 1970, ● 1970 onwards).



MAP 16.
Crossocerus quadrimaculatus (Fabricius, 1793)
(○ before 1970, ● 1970 onwards).



MAP 17.
Crossocerus dimidiatus (Fabricius, 1781) (+ pre-1900, ○ before 1970, ● 1970 onwards).

Crabro cribrarius (Linnaeus, 1758)
Common; Map 3; June-August; more-or-less equal; subterranean; nationally universal.
Crabro peltarius (Schreber, 1784)
Frequent; Map 4; June-September; more-or-less equal; subterranean; nationally universal.
Crossocerus elongatulus (Vander Linden, 1829)
Common; Map 5; May-September; more-or-less equal; subterranean; nationally widespread.
Crossocerus ovalis Lepeletier & Brullé, 1835
Frequent; Map 6; May-September; females much more frequent; subterranean; nationally universal.
Crossocerus palmipes (Linnaeus, 1767)
Rare; SE60 (A, Blaxton Common), SK69 (A, Crow Wood, Rossington Bridge); July-September; females more frequent but sample small; subterranean; nationally scarce.
Crossocerus pusillus Lepeletier & Brullé, 1835
Common; Map 7; June-September; females more frequent; subterranean; nationally universal.
Crossocerus tarsatus (Shuckard, 1837)
Common; Map 8; May-September; females more frequent; subterranean; nationally universal.
Crossocerus wesmaeli (Vander Linden, 1829)
Occasional; Map 9; May-September; females more frequent; subterranean; nationally universal.
Crossocerus annulipes (Lepeletier & Brullé, 1829)
Common; Map 10; June-September; females more frequent; aerial; nationally universal.
Crossocerus capitosus (Shuckard, 1837)
Occasional; Map 11; May-August; more-or-less equal; aerial; nationally universal.
Crossocerus cetratus (Shuckard, 1837)
Frequent; Map 12; May-September; females more frequent; aerial; nationally widespread.
Crossocerus leucostoma (Linnaeus, 1758)
Rare; SE66 (A, Strensall Common), SE68 (A, Duncombe Park), SE69 (A, Harland Beck); May-June; more-or-less equal, but sample small; aerial; nationally rare.
Crossocerus megacephalus (Rossius, 1790)
Common; Map 13; April-September; females more frequent; aerial; nationally universal.
Crossocerus nigritus (Lepeletier & Brullé, 1835)
Frequent; Map 14; May-September; females more frequent; aerial; nationally widespread.
Crossocerus styrius (Kohl, 1892)
Rare; SD86 (B, Malham Tarn), SE04 (B, Holmehouse Wood, near Keighley), SE13 (B, Shipley Glen), SE60 (B, Armthorpe), SE14 (B, East Morton), SK39 (A, Woolley Wood); May-October; females more frequent, but sample small; aerial; nationally widespread.
Crossocerus walkeri (Shuckard, 1837)
Rare; NZ80 (B, Goathland), SE04 (B, Holmehouse Wood, near Keighley), SE10 (A, Little Don Valley), SE13 (A, Shipley Glen), SE34 (A, Keswick Fitts), SE68 (A, Duncombe Park); June-July; males more frequent, but sample small; aerial; nationally scarce.
Crossocerus podagricus (Vander Linden, 1829)
Frequent; Map 15; May-September; more-or-less equal; aerial; nationally universal.
Crossocerus quadrimaculatus (Fabricius, 1793)
Common; Map 16; June-September; females more frequent; subterranean; nationally widespread.
Crossocerus binotatus Lepeletier & Brullé, 1835
Rare; SE21 (B, Bretton Park), SE30 (A, Hugset Wood), SE40 (A, Wombwell Ings),SE44 (A, Stutton), SE50 (A, High Melton), SE66 (A, Strensall Common), SE68 (A, Duncombe Park), SE99 (B, Helwath Beck), SK39 (A, Wharmcliffe Wood), SK49 (A, Bramley); June-September; females more frequent, but sample small: aerial; nationally rare.
Crossocerus dimidiatus (Fabricius, 1781)
Common; Map 17; June-September; more-or-less equal; aerial; nationally universal.

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FOOD AVAILABILITY AND FORAGING BY MOORLAND BUMBLEBEES *BOMBUS* SPP.

RAY HEWSON

Department of Zoology, University of Aberdeen, Tillydrone Avenue, Aberdeen AB24 2TZ

INTRODUCTION

Moorland is an unfavourable habitat for bumblebees. Food plants are few and their flowering periods largely discrete. Foraging is restricted by cold windy weather, rain, and frost in spring and autumn. Four species of *Bombus* occur regularly on northern heather moorland: *B. monticola*, *B. lucorum* (together with or replaced by *B. magnus*) and *B. jonellus* (Hewson & Walsh 1981, Hewson 1990). *B. monticola* and *B. jonellus* have a northern and western distribution, *B. lucorum* is widespread (International Bee Research Association/Biological Records Centre 1980). Carder bees *B. muscorum* and *B. pascuorum* occur rarely but may be more numerous on wet north-west heathland (Hewson 1979).

This paper considers the availability and use of food plants of bumblebees on a study area in north-east Scotland, and changes in the numbers and proportion of *B. monticola* between 1986 and 1988 and 1996-98. These are compared with Yalden's (1982, 1983, 1984) studies on bumblebees in the Peak District of England.

THE STUDY AREA

The study area comprises the upper part of a heather *Calluna vulgaris* dominated hill, Baudy Meg, 488m a.s.l. in Glen Tanar, Aberdeenshire, a *Calluna – Erica cinerea* heath (Rodwell 1991). A track circling the hill between 270 m and 430 m provided a 6 km transect for assessing vegetation cover and flowering performance and for counting bumblebees. The track was divided by natural features (track junctions, presence of trees) into four approximately equal sections. Annual daily mean temperature was 5.9°C (Meteorological Office 1952) and the area was classified as exposed, average annual wind speed 4.4–6.2 ms^{-1} in Birse and Robertson (1970). Management for red grouse *Lagopus l. lagopus*, the area's primary function, entailed burning patches of old heather to provide fresh new growth as food for grouse. Little burning had been done between 1977 and 1997 so that the heather was largely old and occasionally degenerate, providing fewer and shorter flower shoots than earlier growth phases (Gimingham 1960). Grazing on heather by red deer *Cervus elaphus* and roe deer *Capreolus capreolus* was negligible and there were no sheep. Temperature and rainfall records were available at Glen Tanar 180m a.s.l. and 3 km from Baudy Meg.

There were only four main food plants for bumblebees on the study area, *Vaccinium myrtillus* and *V. vitis-idaea*, *Erica cinerea* and *Calluna vulgaris*.

METHODS

There were 18 visits to the study area between 1 May and 2 October 1996, 24 visits between 5 May and 8 October 1997, and 20 visits between 1 June and 26 September 1998. Some of these were restricted to the lower, West section. Wind direction and strength, cloud cover, rain and temperature, (cool or warm, checked later against Glen Tanar weather records) were recorded on each visit, together with the time spent on each section of the transect. There were fewer, less systematic, counts in 1986 and 1988.

The relative abundance of the main food plants of bumblebees was assessed by noting their presence or absence at intervals of 40 paces along the transect. The cover of flowering *Calluna* and *Erica cinerea* was assessed by eye to the nearest tenth on 1 m^{-2} plots at 20-30 randomly chosen sites along each section of the transect on each visit. *Vaccinium vitis-idaea* and *V. myrtillus* were less uniform in cover and flowering shoots were counted in irregular patches 0.5 m-2 m long and about 1 m^{-2} in area.

Bumblebees were counted on food plants within 1 m of the transect. White-tailed bumblebees were principally, but perhaps not exclusively, *Bombus magnus*, identified by the yellow band on the thorax extending below the root of the wing (Afford 1975). The same methods were used between 1986 and 1995, but counts were sporadic.

On moorland 25 km from Baudy Meg 70% of white-tailed bees were B. magnus (Hancox 1992) and a few white-tailed bumblebees collected on the study area were all *B. magnus*. As foraging white-tailed bees could not always be identified to species they were lumped as *B. magnus/lucorum*. The other bumblebee normally found on Baudy Meg, *B. monticola*, presented no difficulties in identification. There were a few *B. jonellus* and even fewer *B. muscorum* and *B. pascuorum*.

RESULTS

Food availability

There were marked differences in abundance of the various food plants (Fig. 1): *Calluna* was clearly dominant on all four sections; *E. cinerea* was more abundant on the lower and less exposed West section than on the other three sections combined (X^2 = 45.18, 1 d.f., P<0.001); the steep North section had little *E. cinerea* but a fair amount of *Vaccinium* spp., East and South had little *Vaccinium* or *Erica*; *E. cinerea* and *Vaccinium* spp. were more abundant along the sides of the track on the transect than in the study area moorland generally.

Recording presence or absence of food plants exaggerates the importance of *Vaccinium* spp. which were thinly distributed among the other moorland vegetation at densities of no

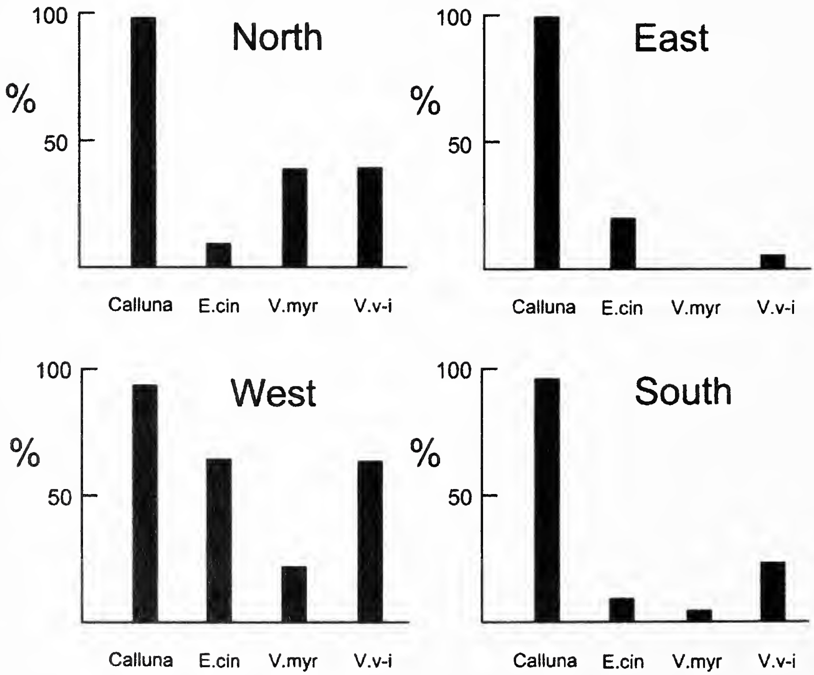

FIGURE 1
Vegetation on baudy Meg; percentage of samples on each section of transect.

more than 4.5 flowering plants per m^2 for *V. vitis idaea* and 2.0 for *V. myrtillus.*

Flowering periods

The early food plants of bumblebees on Baudy Meg, *V. vitis-idaea* and *V. myrtillus*, began flowering in early May, reached peak flowering later that month, and ceased flowering by the end of June (Fig. 2). Limited sampling in 1998 showed a later peak, in mid-June, but with flowering over by the end of June. *V. vitis-idaea* had a second brief, sparse, flowering in September, with flowers less than a fifth as abundant as in spring. These flowers did not produce fruit, and were rarely visited by bees.

E. cinerea started to flower as *Vaccinium* ceased, around the third week in June in 1996, 1997 and 1998, reached a peak lasting 2-3 weeks from late July, and continued flowering until early October (Fig 2). In 1998 flowering was about a third less abundant than in the earlier two years.

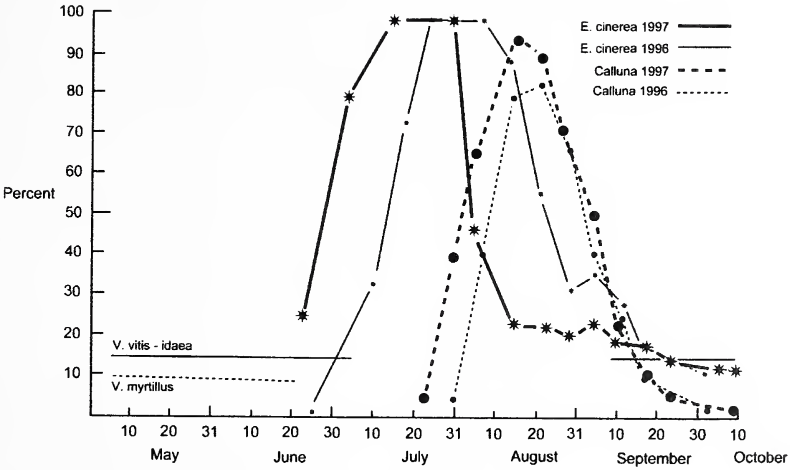

FIGURE 2
Sequence of flowering of food plants, percentage of 1 m^2 samples covered by flowers. For *Vaccinium* spp. duration of flowering.

There was an overlap, and hence no food shortage, between the decline in flowering of *E. cinerea* and the rise in *Calluna*, which began in late July 1996 and 1997 but about 10 days later in 1998. Flowering of *Calluna* finished about the same time as *E. cinerea* in early October.

Numbers of bumblebees and seasonal peaks

In 1996-98 there were more bumblebees on the lower (West) section than on the other three combined (Table 1) and because this section was visited more often data from it have been used to compare annual peaks and totals (Table 2).

No bumblebees were seen foraging before 26 June 1996 (two visits in May), 4 July 1997 (eight visits in May and June), or 11 June 1998 (two visits in early June) although both *V. vitis-idaea* and *V. myrtillus* had reached peak flowering in May and June. In 1999 the first foraging bumblebees were seen on 30 May.

TABLE 1.

Counts of bumblebees on the same day on the four sections of the study area

	Number of counts	lower(west) section	remainder	binomial test z	P
1996	12	138	65	5.05	<0.001
1997	3	64	32	3.60	= 0.0016
1998	8	222	131	4.79	<0.001

TABLE 2.

Summer and autumn peaks in *B. magnus/lucorum* (means and S.E.) in the lower (west)section;

	July counts	July X	August counts	August X	September counts	September X
1996	4	18.5 ± 8.1	5	12.0 ± 3.4	2	11.5 ± 6.5
1997	3	16.3 ± 9.8	5	6.0 ± 0.3	5	55.0 ± 9.3
1998	4	17.3 ± 8.9	3	5.7 ± 1.7	5	45.8 ± 13.7

Of 132 *B. magnus/lucorum* on 10 July 1995 all of 44 on the north section were torpid or dead on or beneath *E. cinerea*, as were many of the remaining 88 *B. magnus/lucorum* on the whole transect. The minimum temperature on 9 July was 1°C (possibly 0°C at the top of the north section) compared with an minimum of 5.9°C (range 3.5°C to 9.0°C) during the previous eight days. At this date *E. cinerea* would not have reached peak flowering although a substantial proportion would have done, so ample food would have been available. Few *B. magnus/lucorum* were found later in the year and there was no September peak. In other years peak numbers occurred in July and September 1997 and 1998, and in July 1996. There were always fewer bumblebees in August. The July peaks were associated with foraging on *E. cinerea*, the September ones occurred when both *Calluna* and *E. cinerea* were flowering though past their peak.

In 1986 and 1988 *B. monticola* was relatively abundant (Table 3), and more numerous than *B. magnus/lucorum* in 1986 (binomial test z = 3.56, P<0.001), though the sample is small. A change in relative abundance of the two species may already have started between 1986 and 1988 (X^2 = 86.29, 1 d.f., P<0.001). By 1996-98 the ratio of *B. monticola* : *B. magnus/lucorum* had changed from 97 : 173 to 43 : 853 and *B. monticola* had become uncommon.

TABLE 3.

Changes in numbers and relative abundance within years of *B. monticola* and *B. magnus/lucorum*. The apparent increase in *B. magnus/lucorum* between 1986 and 1988 and 1996-1998 is due to an increase in counts in the later period (see Methods).

	B. monticola on *E. cinerea*	*B. monticola* on *Calluna*	*B. magnus/lucorum* on *E. cinerea*	*B. magnus/lucorum* on *Calluna*
1986	68	12	18	22
1988	17	0	45	88
1996	17	0	68	77
1997	5	1	94	207
1998	19	1	91	316

Foraging

Numbers of bees seen foraging at any one time may be affected not just by feeding preferences and weather but also by the annual cycle of the bumblebees concerned particularly the time of emergence of over-wintered queens and the duration of the foraging season. *B. lucorum*, and probably *B. magnus,* appear relatively early, feeding on *Salix* but preferring *Erica* spp. *B. monticola* has a similar annual cycle (Alford 1975). Prys-Jones and Corbet (1991) describe *B. monticola* as inhabiting moorland with *Vaccinium* spp.

Foraging on *Vaccinium*, although important to white-tailed bees and *B. monticola* in the Peak District (Yalden 1982, 1983) and to *B. magnus/lucorum* and *B. monticola* on high ground in north-east Scotland (Hewson 1986), was minimal in both spring and autumn on Baudy Meg with never more than seven bumblebees foraging on *V. vitis-idaea*. The scarcity of flowers on *Vaccinium* spp. would make foraging unprofitable.

Foraging by *B. magnus/lucorum* began on *E. cinerea* in mid-June to early July and on *Calluna* in August and continued on both plants until late September. Although *Calluna* reached a peak of flowering around mid-August numbers of *B. magnus/lucorum* did not peak until September.

More *B. monticola* fed upon *E. cinerea* than *Calluna* in 1986 plus 1988 (Table 3, binomial test ($z = 6.86$, $P<0.001$) and again in 1996-98 ($z = 5.79$, $P<0.001$). On the other hand *B. magnus/lucorum* foraged more upon *Calluna* in the earlier period ($z = 3.50$, $P = 0.0023$) and again in 1996-98 ($z = 4.11$, $P<0.001$).

On moorland in north-east Scotland (Figs. 3 & 4) *B. monticola* again foraged more upon *Erica* spp., *Arctostaphylos uva-ursi*, and *V. vitis-idaea*, *B. magnus/lucorum* on *Calluna*. *B. monticola* out-numbered *B. magnus/lucorum* (Hewson 1986), confirming that *B. monticola* is a moorland as well as a montane bumblebee.

Comparison with moorland bumblebees in the Peak District

Yalden (1982, 1983, and 1984) studied bumblebees, particularly *B. monticola,* on four *Calluna*-dominated sites in the Peak District *c.* 400 km south of Baudy Meg. There were large areas of *V. myrtillus* and at most sites *V. vitis-idaea, E. cinerea* and/or *E. tetralix*. Foraging on a further 15 food plants at the moorland fringe, and absent from Baudy Meg, was also examined. Baudy Meg was surrounded by *Calluna – E. cinerea* heath (Rodwell 1991). Bumblebees were classified as *B. monticola* or white-tailed bees, probably *B.*

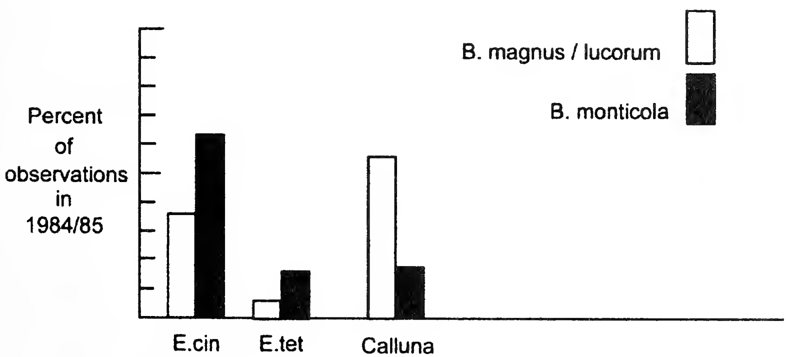

FIGURE 3.

Food plants of *B. magnus/lucorum* and *B. monticola* on Baudy Meg in 1984-85.
A small area of *E. tetralix* was omitted from later work (from data in Hewson 1986).

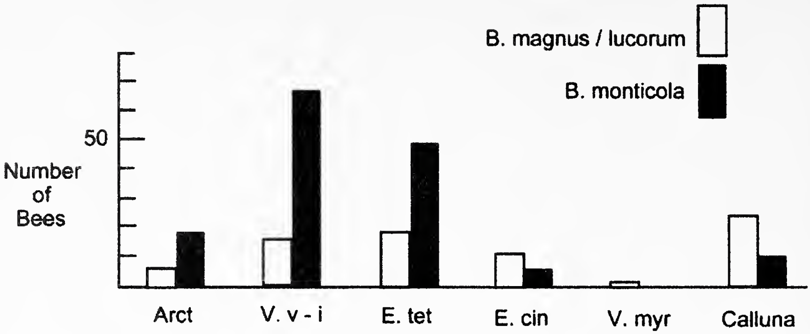

FIGURE 4.
Food plants of *B. magnus/lucorum* and *B. monticola* at Corgarff in 1984-85 (from data in Hewson 1986).

lucorum. They were counted during 15 minute periods on preferred food plants (Yalden 1983).

Counting bees along the 1.6 km lower section of Baudy Meg took about 30 minutes, with food plants evenly distributed. For comparison of the two areas the numbers of bumblebees in the Peak District have been doubled. Numbers of white-tailed bees peaked there in May and August. At the early peak *B. magnus/lucorum* was more abundant on Baudy Meg than white-tailed bees in the Peak District in 1998 and similar in 1997; at the later peak it was much more abundant.

In the Peak District white-tailed bees were more numerous in May and August, foraging on *Salix* and *V. myrtillus* in spring, *Erica* spp. and *Vaccinium* in summer. *B. magnus/lucorum* on Baudy Meg peaked two months later in the spring on *E. cinerea* and a month later in autumn on *E. cinerea* and *Calluna*.

White-tailed bees outnumbered *B. monticola* in the Peak District except in July and early August, when *B. monticola* foraged largely on *Lotus corniculatus* and *Trifolium repens* which were not available at Baudy Meg in July and on *E. cinerea* and *Calluna* in August. Accordingly Yalden (1983) considered *B. monticola* a bumblebee of the moorland fringe. It would therefore tend to be affected adversely by modern farming methods which affect the food plants which flourish at the moorland fringe (Edwards 1998).

On the other hand *B. monticola* on Baudy Meg had no access to some of the main food plants in the Peak District, where *E. cinerea* was uncommon.

DISCUSSION

A big decline occurred in *B. monticola* between 1986-88 and 1996-98. Possible causes include global warming, with montane species retreating northwards or to higher altitudes, cyclical fluctuations, disease and changes in food supply due to heather-burning (muirburn) or its absence. Some southern bumblebees have increased in north-east Scotland and the Highlands: *B. lapidarius* (Macdonald 1998) and B. terrestris (A. Lamb, *pers. comm.*), but there were no data for *B. monticola.* Disease specific to *B. monticola* seems unlikely; a long-term cyclical fluctuation even more so. The absence of muirburn on the study area led to the shading out by *Calluna* of *Vaccinium* spp. and *Erica* spp. and as these are important foods of *B. monticola* in north-east Scotland (Hewson 1986) this appears the likeliest cause of the decline.

B. magnus/lucorum had a shorter foraging period on Baudy Meg, July to late September, than in north-west Scotland or when compared with white-tailed bees in the Peak District. In north-west Scotland foraging started with *Salix* in April, went on to *Iris pseudacorus* in June and to *E. tetralix* and *Calluna* in September (Hewson 1979). In the Peak District white-tailed bees, probably *B. lucorum*, foraged from May to September, starting with *Salix* and finishing with *Calluna*. Peak numbers occurred in May and August compared with peaks in north-east Scotland in July on *E. cinerea* (uncommon in the Peak District) and somewhat later than the peak flowering of *Calluna* in August. Absence of *Salix*, the presence of alternative food plants, and a substantial second flowering of *Vaccinium* in the Peak District appear to be the factors determining the longer duration of foraging in the Peak District. Yalden (1984) gives the September food of *B. monticola* as 73.5% *V. myrtillus* and 18.4% *Calluna.*

At Corgarff 25 km from Baudy Meg and at a similar altitude (400–550m) *B. monticola* peaked in June and early July on *Arctostaphylos uva-ursil* and *V. vitis-idaea* and in September on *E. tetralix* and *V. vitis-idaea* confirming that *B. monticola* is a montane species compared with *B. magnus/lucorum*, particularly above 550 m (Hewson 1986).

On Baudy Meg in September, when flowering was sparse on both *E. cinerea* and *Calluna*, *B. magnus/lucorum* and more particularly the few *B. monticola* were more often found on *E. cinerea* than on *Calluna*. A possible explanation lay in their distribution. *E. cinerea* formed a narrow but fairly continuous fringe along the transect while what flowers remained on *Calluna* were in clumps as much as 20m apart or more and required a greater foraging effort.

Good management for red grouse entails the regular and systematic burning of small patches of heather to provide young shoots as food (Miller 1980, Picozzi 1968). In the early years after burning *E. cinerea*, *V. myrtillus* or *A. uva-ursi* may be temporarily dominant (Gimingham 1960) and would provide a varied and abundant food supply for bumblebees particularly *B. monticola*; also the flower shoots of *Calluna* are longer in its pioneer and early building stages than later in its development. It may well be that active management of heather moorland for grouse provides a better habitat for bumblebees and future work might profitably examine this possibility.

ACKNOWLEDGEMENTS

For assistance with fieldwork I thank R. Hartland-Mahon, B. Hewson, J. Stevens and A. Stolte, and for helpful comments on an earlier draft M. Edwards and Dr M. Macdonald.

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BOOK REVIEWS

Atlas of the Land and Freshwater Molluscs of Britain and Ireland by **Michael Kerney.** Pp. 261, Harley Books, Colchester, Essex. 1999. £20 hardback.

This long awaited publication replaces the provisional atlas published by the Conchological Society and the Natural Environment Research Council in 1976. The new atlas includes 9 species currently known only from the fossil record. A further 11 species are included which have been recorded over the last 24 years as now living in the British Isles. Like all publications of this type, however, they are (and should be by their very nature) always out of date; for example the *Journal of Conchology* recently reported the occurrence of the freshwater bivalve *Corbicula fluminea* (Muller) new to Britain. The new atlas also includes illustrations of all the species, and valuable ecological information, including notes on European distribution. The individual distribution maps for some species show how fast a new introduction can spread. In 1976 the slug, *Boeffgerilla pallens* Simroth, 1912, was only known from 5 locations in the British Isles; the new atlas records it from almost every county in England and Wales, as well as the lowlands of Scotland and Ireland, and it is still spreading rapidly. This publication should prove a valuable tool for all conchologists, but should be even more valuable to all working in the field of Biodiversity.

AN

Insect Lives. Stories of Mystery and Romance from a Hidden World, by **Erich Hoyt** and **Ted Schultz.** Pp. 347 including numerous line drawings. Mainstream Publishing Co., Edinburgh. £15.99 hardback.

Naturalists should not be deterred by the sub-title of this book, which is presumably intended to attract readers with only a peripheral awareness of insects. In fact it contains much that should interest them. It consists of some 75 articles ranging from one-page trivia – even a couple of cartoons and a poem on a louse by Robert Burns – to serious and interesting contributions to entomology. Coverage is wide: from the Old Testament, Aristotle, Darwin and Fabre to modern investigators. Each entry is prefaced by a short introduction by the compilers. Apart from some classical items such as Smeathman's account of termites in which, in 1781, he described not only the queen but a king – a fact subsequently doubted for almost a century – there are some first rate modern contributions. These deal with mites in moths' ears (a fascinating story), the life cycle of bot flies, the behaviour of a mud dauber, social behaviour in burying beetles, an aphid mimic of a lacewing larva, an account of dancing bees that takes the story beyond what was revealed by Karl von Frisch, and a variety of other topics. One cannot but wonder how some of the remarkable behaviour one reads about evolved. Some of the accounts are indeed stories of mystery as the sub-title claims! Numerous black and white illustrations, some of historic interest, enliven the text. Not everyone will enjoy every entry in this eclectic compilation but the mix as a whole is enjoyable and instructive. The sort of book one could give as a present.

GF

A FURTHER NOTE ON THE DISCOVERY OF ROESEL'S BUSH-CRICKET *METRIOPTERA ROESELII* (HAGENB.) IN YORKSHIRE

MARTIN LIMBERT
Museum & Art Gallery, Chequer Road, Doncaster DN1 2AE

In a review of the genus *Metrioptera* in Yorkshire (Limbert 1998), it was noted that the earliest evidence of Roesel's Bush-cricket involved a pair of specimens in the Thomas Stainforth collection in the Hull & East Riding Museum. The associated data note their capture, presumably by Stainforth himself, on the Humber shore in the Easington/Skeffling area on 15th September 1934. The record was referred to in a general way by Burr (1936), but Brown (1949) and Hincks (1950) both inferred that nothing else was in print about the insect in Yorkshire until its rediscovery in 1947.

It is therefore surprising to find a short paper, written by Burr (1935) and alluded to in *The Naturalist* (Anon 1935), recording Roesel's Bush-cricket and allied insects collected in Yorkshire by Thomas Stainforth. As the information relating to the bush-cricket adds to that outlined above, it is republished here to unite it with the recent review of the genus. Stainforth, although retaining a pair of specimens, forwarded two additional males to Burr. Regrettably, there is no evidence that these latter two now survive (Limbert 1998). The males, like the pair, were taken on 15th September 1934, on the Humber shore "between Easington and Skeffling". Quoting Stainforth, Burr provides the following detail about the species:

> It occurs on a damp, grassy bank of the embankment that serves to prevent flooding by the river Humber at high tides, and on the landward side of it, which faces north, and slopes in this direction towards a brackish ditch.

Burr's interesting paper lists 12 species from Stainforth. These include Lesser Marsh Grasshopper *Chorthippus albomarginatus* (De Geer) along the Humber at Easington (September 1934), a male Egyptian Grasshopper *Anacridium aegyptium* (L.) from Hull docks (undated), and Ring-legged Earwig *Euborellia annulipes* (Lucas), also from the docks (July 1932).

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BOOK REVIEWS

A Question of Balance: Game animals and their role in the British countryside edited by **Stephen Tapper**. Pp. 288, with over 70 full colour photographs and 23 figures. The Game Conservancy Trust, Fordingbridge, Hampshire. £25.00 soft-backed, including post & packing, available from The Game Conservancy Trust Sales Centre, tel. 01425 651003.

Up to the first half of the 20th century, many of the notable vertebrate records in the British natural history literature emanated from country land-owning, game-keeping, hunting and angling sources; indeed, several notable Yorkshire mammal studies resulted entirely from co-operation with the gamekeeping fraternity. Sadly, since the Second World War a pronounced cultural separation between the predominantly urban naturalists and the predominantly rural field sport interests has severed this mutually beneficial relationship. Since 1969 the Game Conservancy Trust has undertaken an impressive programme of game-bag data analysis together with field research projects on habitats, land management and on both game and predatory species in Britain's rapidly changing agricultural, afforested, moorland and aquatic landscapes. Stephen Tapper and his co-workers have established towering reputations in this field and this well written, superbly illustrated and lavishly produced volume makes the main findings of their research available to a wider audience. It includes useful lists of references and through the medium of very revealing graphics, provides a serious contribution to understanding the changing status of key game and predatory bird, mammal and fish species in today's dynamic and industrialised countryside. This is an invaluable exchange of data not to be missed.

CAH

The Natural History of Ecclesall Woods Part 1 edited by **Ian D. Rotherham and Melvyn Jones.** Pp. 53 including numerous line drawings and maps. Wildtrack Publishing, PO Box 1142 Sheffield S1 1SZ. for Peak District Journal of Natural History and Archaeology. Special Publication No. 1 July 1997. £5 paperback (A4 format).

Sheffield's woodlands are the envy of British cities and the most important within Sheffield's 'green mantle' are the complex of ancient and bosky compartments forming the celebrated Ecclesall Woods. For over a century the woods have attracted the attentions of naturalists and in 1990, reflecting the breadth and depth of this research, a special issue of the *Sorby Record* (no. 27) was dedicated to a series of these natural history studies.

This attractive and engrossing publication is based on five dissertations which developed out of the seminal Sorby review and which trace the site's history and management from Medieval deer park, 16th century coppice woodland through to present day high forest and public amenity 'greenspace'. Of particular interest and forming the basis for the anthology is Melvin Jones' and Peter Walker's fascinating and painstakingly researched account of the woods' sophisticated management and resource usage history. Set against the changes in woodland ecology and the air quality effects of close proximity to heavy industry and urban development, are excellent contributions on bryophytes by Tom Blockeel, sphagna by Paul Ardron, fungi by Tony Lyon, lichens by Oliver Gilbert and birds by Paul Medford and Ian Rotherham.

This is a worthy product from Wildtrack Publishing, a welcome addition to the growing corpus of multi-disciplinary works on South Yorkshire woodlands and should be on the shelves of all local naturalists.

CAH

ENTOMOLOGICAL REPORTS FOR 1996-1999, COLEOPTERA: STAPHYLINIDAE (ALEOCHARINAE)

M. L. DENTON

This is the first report to document the Aleocharinae of Yorkshire since that which appeared in *The Naturalist*, **121:** 49-52. The report was the first to place emphasis on the species' national status and, similarly, in the report which follows all species quoted in the Joint Nature Conservation Committee publication *A review of the scarce and threatened Coleoptera of Great Britain, Part 2,* have been categorized. The definition of status categories attributed to these species are as follows:

1) NOTABLE A i.e. 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.
2) NOTABLE B i.e. thought to occur in between 31 and 100 10 km squares of the National Grid or, for less well recorded groups between eight and twenty vice- counties.
3) NOTABLE i.e. estimated to occur within the range of 16 to 100 km squares of the National Grid. Subdivision of this category into Notable A and Notable B has not been attempted.
4) INDETERMINATE i.e. considered to be Endangered, Vulnerable or Rare, but there is not enough information to say which of these categories is appropriate.
5) INSUFFICIENTLY KNOWN i.e. taxa with very few known localities, but which belong to a poorly recorded or taxonomically difficult group.

For reasons described in the first Aleocharinae report (*The Naturalist*, **111:** 91-96), the sex of the specimen(s) on which identification was based has been indicated; it can be assumed that all specimens were male, unless otherwise stated.

I would like to take this opportunity to thank the small number of dedicated collectors and identifiers for their continued support in documenting the Aleocharinae of Yorkshire. The following initials appear in the list that follows: RBA = R.B. Angus, LA = L. Auckland; RGB = R.G. Booth; MLD = M.L. Denton; WRD = W.R. Dolling; MH = M. Hammond; JBJ = J.B. Jobe; CJ = C. Johnson; DAL = D.A. Lott; RJM = R.J. Marsh; JAO = J.A. Owen; EJS = E.J. Smith and RCW = R.C. Welch.

New county record. *New vice-county record.

Deinopsis erosa (Stephens). (61) Hollym Carrs (TA32), not sexed, 21/11/97, in marsh; WRD det. MLD. (*63) Worsborough Country Park (SE30), not sexed, 30/4/96, in *Salix* litter; EJS (teste MLD). (64) Askham Bog (SE54), not sexed, 10/4/99; DAL. The only previous records are from Hornsea (TA24) in 1903, Hagg Wood (SE54) in 1963 and Wheldrake Ings (SE74) in 1989.

Cvpha discoidea (Erichson). (61) Hornsea Mere (TA14), both sexes, 26/10/96, in ground litter; RJM. The only previous record was from Hornsea (presumably the Mere) on an unrecorded early 20th century date. A widely distributed but local species that is confined to England (mainly southern) and afforded Notable B status.

C. laeviuscula (Mannerheim). (*65) River Cover, Middleham (SE18), 8/10/95, in *Hypholoma fasciculare*; JBJ det. MLD.

C. pulicarius (Erichson). (*64) Fountains Abbey (SE26), 3/9/95; RJM det. CJ. The only previous records are from Mulgrave Wood (NZ81) in 1934, Dunnington Common (SE65) in 1971, Morton Wood (SE10) in 1985 and Aughton Ings (SE73) in 1988. A widespread but locally distributed species that is afforded Notable status.

Oligota apicata Erichson. (63) Morton Wood (SE10), 19/6/85, under bark; MLD det. CJ. (*64) Askham Bog (SE54), sex unknown, 23/6/96; RGB and JAO. The belated record from 1985 is in addition to those published in *The Naturalist*, **111:** 92. The only previous records are from Whitby (NZ81) in 1935, Anstone Stones Wood (SK58) in 1935 & 1985 and Scarborough (TA08) on an unrecorded date. A widespread but local species in England and south-east Scotland that is afforded Notable status. The species may be a predator of *Cis* (Cisidae) larvae and mites.

O. picipes (Stephens). (61) Staxton (TA07), 5/6/96; LA det. MLD. (62) Rawcliffe Meadows (SE55), 14/5/97, vegetable matter around a pond; MLD. The only previous records are from Saltergate (SE89) in 1937, Spurn (TA41) in 1948, Gawthorpe (SE22) in 1948 and Stoney Royd (SE30) in 1987.

O. pusillima (Gravenhorst). (63) Eggborough Power Station (SE52), 24/11/94; RJM. The only previous records are from Dalton (SE11) in 1948, Spurn (TA41) in the late 1940s/early 1950s and 1990, Thirsk (SE58) in 1986 and Whitley (SE51) in 1989.

Myllaena gracilis (Matthews). (64) Askharn Bog (SE54), female, 10/4/99; DAL. The only previous records are from Hagg Wood (SE54) in 1963, Thornton Ellers (SE74) in 1989 and Fisherman's Channel (TA21) in 1991.

M. kraatzi Sharp. (*61) Danthorpe (TA23), female, 18/6/96, flood refuse at the side of a beck; WRD (teste MLD) The only previous records are from Saltburn (NZ62) in 1894, Grinkle Wood (NZ71) on 1907, Aysgarth (SE08) in 1931, Lealholm (NZ70) in 1987 and Scarborough (TA08) on an unrecorded date. The species is widespread but local in Great Britain (but not recorded from the Midlands) and is afforded Notable status.

Gyrophaena joyioides Wuesthoff. (*63) Rivelin (SK29), 14/8/93, in fungi; EJS (teste MLD). (64) Upper Dunsforth Carrs (SE46), 22/5/99, in *Boletus* sp.; MLD. Breary Marsh (SE24), 16/10/99, in *Polyporus* sp.; MLD. The only previous records are from Hetchell Wood (SE34) in 1989 and Ringhay Wood (SE43) in 1993. Mainly restricted to southern England, the species is afforded Notable status.

G. strictula Erichson. (*63) Hallfield Dore (SK28), 1/4/95; EJS (teste MLD). Booth Wood, Wortley (SK39), 9/4/95; EJS. Damflask (SK29) 15/4/95; EJS. Wharncliffe Wood (SK39), 4/4/98; EJS. The only previous record was from Scarborough (TA08) as long ago as 1868. A widespread but local species which is afforded Notable B status.

Placusa depressa Maklin. (*62) Rawcliffe Meadows (SE55), 7/6/97, under bark in the Copse; MLD. The only previous records are from Stocksmoor (SE21) in 1971 and Warncliffe Wood (SK29) in 1987. A widely distributed species that is predominantly northern in distribution and which is afforded Notable status.

Phytosus balticus Kraatz. (61) Spurn (TA41), not sexed, 23/7/63, under tidal refuse on shore; RCW. The only previous records are from Scarborough (TA08) on an unrecorded date, Eston (NZ51) in 1909, Saltburn (NZ62) in 1909 and Spurn (TA41) in the late 1940s/early 1950s.

Gnypeta ripicola (Kiessenwetter). (*62) Duncombe Park (SE68), female, 26/6/93, ground litter on river bank; RJM (teste CJ). (63) Damflask (SK29), female, 15/4/95; EJS (teste MLD). The only previous record was from Margery Wood (SE20) in 1989. The species is afforded Notable B status but is perhaps more widely distributed than currently thought as it was not recognised as British until 1980.

Schistoglossa aubei (Brisout). The only Yorkshire record of this species which is given the national status of 'Insufficiently Known' concerns four males collected at Bubwith (SE73) in February 1919 by J. H. Day. Doubt was cast on this record when it was found that Fordham (*The Naturalist*, **45:** 199-202) had stated that these are "apparently referable to this species". These specimens have now been located in the Carlisle Museum, and have been re-identified as *Atheta melanocera* (Thomson) (JAO *pers. comm.*). The species is therefore removed from the Yorkshire List.

S. curtipennis (Sharp). Since the realisation that *S. benich* Lohse is a British species and, as females are inseparable from *S. curtipennis*, the record of a female from Langsett (SE20) on 16/3/89 (*The Naturalist*, **115:** 98) should be deleted. The only records concerning dissected males relate to specimens from Deer Hill (SEO1) on 13/3/83, Yateholme (SE10) on 25/1/85, Hades (SE10) on 3/2/85, Rushy Moor (SE51) on 22/3/86 and Blackmoorfoot (SEO1) on 16/4/98.

S. gemina (Erichson). (64) Bishop Monkton Ings (SE36), 14/6/97, in marsh litter; MLD. The only previous records are from Askham Bog (SE54) in 1971, Rushy Moor (SE51) in 1985, Rossington Bridge (SE60) in 1987, Aughton Ings (SE63) in 1987 and North Duffield Ings (SE73) in 1987. A wetland species which is afforded Notable status.

Amischa forcipata Mulsant & Rey. (63) Rocker Rocks (SK29), 9/11/97; EJS (teste MLD). The only previous records are from Derwent Ings (SE73) in 1987, Sprotbrough (SE50) in 1988 and Blacktoft Sands (SE82) in 1988. A widely distributed but local species.

Dinaraea linearis (Gravenhorst). (*62) Rawcliffe Meadows (SE55), 22/2/96, in flood refuse; MH det. MLD. The only previous records are from Shirley Pool (SE51) in 1911 and Melton Wood (SE50) in 1982.

Liogluta nitidula (Kraatz). The records given as the first for VC63 (*The Naturalist* **111:** 94) were given in error. A problem with nomenclature arose and records of this species were ascribed to *L. nitidiuscula* (Gravenhorst) on the YNU database. *L. nitidula* is fairly widespread in the county with most records stemming from the north-east and south-west.

 # *Trichiusa immigrata* Lohse. (61) Brook Farm, Elstronwick (TA23), not sexed, 27/5/96, in compost bin; WRD det. MLD. (63) Blackmoorfoot (SEO1), female, 10/5/99 and both sexes, 23/6/99, 4/7/99 & 16/8/99, in old hay/dung; MLD. This immigrant species was first recorded as British during 1992 when specimens were located in Kent (*The Coleopterist* **2** (1): 18) and it had spread north to Leicestershire by the end of 1994 (*The Coleopterist* **4** (1): 14). The Yorkshire occurrences show a further northward extension to the species' range of about 65 miles.

Atheta fallaciosa (Sharp). (62) May Moss (SE89), 5/5/96; LA (teste MLD). The only previous records are from Danby High Moor (NZ70) in 1987, Skipwith Common (SE63) in 1989 and Thorne Moor (SE71) in 1990.

A. hygrobia (Thomson). (61) Hornsea Mere (TA41), 29/11/86, in reed litter; RJM (teste MLD). The only other records are from Bubwith (SE73) on an unrecorded date, Ashberry Pastures (SE58) in 1972, Rudding Park (SE35) in 1973, Blackmoorfoot (SE01) in 1989 and Owston Wood (SE51) in 1990.

A. terminalis (Gravenhorst). (61) Wheldrake Ings (SE74), 25/10/96, in the *Glyceria* beds along the old course of the River Derwent; MLD. The only previous records are from Bubwith (SE73) in 1919 and 1933 and Wheldrake Ings (SE74) in 1995. The species was described as new to science from the 1919 captures (*Entomologist's Monthly Magazine*, **56:** 131-133). The species' national status is given as Insufficiently Known and, with the exception of the above, has recently only been recorded from two vice-counties (South Hampshire and Worcestershire).

A. vilis (Erichson). (64) Staveley Lagoon (SE36), both sexes, 27/5/95; RJM. Askham Bog (SE54), sex unknown, 23/6/96; RGB and JAO. The only previous records are from Sprotbrough (SE50) in 1987 and Askham Bog (SE54) in 1994.

A. monticola (Thomson). (*61) Brook Farm, Elstronwick (TA23), 21/8/96, in rotting Giant Puffball *Lycoperdon giganteum*; WRD det. MLD.

A. divisa (Marke). (*64) Queen Mary's Dub (SE37), female, 4/9/68; CJ. The only previous record was from Bubwith (SE73) in 1919.

A. nigritula (Gravenhorst). (63) Rivelin (SK28), 16/8/98, in decaying fungus; EJS (teste MLD). The only previous records are from Wharncliffe Wood (SK39) in 1992 and Skipwith Common (SE63) in 1993. A Notable species which is found in southern England with scattered records north to South East Scotland.

A. benickiella Brundin. (64) Askham Bog (SE54), sex unknown, 27/10/97; RGB. The only previous record was from Studley (SE27) on an unrecorded date. The species is afforded Notable status.

A. cadaverina (Brisout). (*62) Deep Dale (SE99), female, 20/6/99 and male, 12/7/99; LA det. MLD. All previous records (11) are from VC63, the first being in 1984.

 # *A. taxiceroides* Munster. (62) Woodhouse Plantation (SE98), 20/8/95; LA (teste MLD). (63) New House Wood (SE20), 8/8/98, in *Piptoporus betulinus*; MLD (teste CJ). Toftwood, Rivelin (SK38), female, 8/9/98, in decaying fungus; EJS (teste MLD). Molly Carr Wood (SE11), 25/10/99, in decaying fungus; MLD.

A. subsinuata (Erichson). (63) Blackmoorfoot (SEO1), female, 16/8/99, in carrion; MLD. The only previous records are from North Stainley (SE27) in 1967, Birkstall (SE22) in 1969, near Pickering (SE89) in 1969, Boyston (TA16) in 1972 and Almondbury (SE11) in 1985.

A. aquatilis (Thomson). (*64) Breary Marsh (SE24), 21/11/98, in ground litter; RJM (teste MLD). A Notable species which is widespread but local in England and parts of Wales.

A. incognita (Sharp). (62) May Moss (SE89), 20/7/96; LA det. MLD. The only previous records are from Rivelin (SK28) in 1993 and Ellers Springs (SE88) in 1995.

A. basicornis (Mulsant & Rey). (*64) Askham Bog (SE54), sex unknown, 23/6/96; RGB and JAO. The only previous record was from Thorne Moor (SE71) in 1985. A wetland species that is widespread but local in England which is afforded Notable status.

A. nidicola (Johansen). (*63) Ewden Pond (SK29), female, 31/3/97; EJS (teste MLD). The only previous records are from the Dalby Forest (10 km square ?) in 1966, Askham Bog (SE54) in 1967 and Blackbrook Wood (SK28) in 1992.

A. oblita (Erichson). (62) May Moss (SE89), 10/8/96; LA det. MLD. The only previous records are from Saltburn (NZ62) in 1897 and Potter Brompton (SE97) in 1986.

 # Phlotopora coreficalis of British authors. (63) Booth Wood, Wortley (SK39) 16/2/97; EJS (teste CJ).

Calodera nigrita Mannerheim. (62) Rawcliffe Meadows (SE55), 5/3/97, in flood refuse; MLD (teste CJ). The only previous records are from Thorganby (SE64) in 1971, Bishopwood (SE53) in 1983, Thorne Moor (SE71) in 1985 and Scarborough (TA08) on an unrecorded date. A species of wetlands and marshes that is widespread but local in England which is afforded Notable status.

C. uliginosa Erichson. The species was described as new for Yorkshire from specimens collected at West Bretton (SE21) on 25/3/48 (*The Naturalist* **74:** 151). The specimens (both sexes) are in the Manchester University Museum collection and have been re-identified as *C. riparia* Erichson (CJ *pers. comm.*). As there are no other county records this deletion removes the species from the Yorkshire List. *C. riparia* has been encountered in Yorkshire on seven previous occasions and this record becomes the first for VC63 and the fourth for the county. The species is restricted to wetland habitats and is afforded Notable status.

Meotica exilis (Erichson). (*64) Askham Bog (SE54), sex unknown, 23/6/96; RGB and JAO. The only previous record was from Thorne Moor (SE71) in 1971.

Deubelia picina (Aube). (*63) Botany Bay, Wintersett (SE31), both sexes, 19/3/99 and 28/3/99, in marsh litter; MLD. The only previous records are from Collingham (SE34) in 1917, Duncombe Park (SE68) in 1987 and Wheldrake Ings (SE64) in 1991.

Oxypoda amaena Fairmaire & Laboulbene. (63) Rocker Rocks (SK29), 9/11/97; EJS (teste MLD). (*64) Askham Bog (SE54), sex unknown, 27/10/97; RGB. The only previous records are from Spurn (TA41) in 1950, Hade Edge (SE10) in 1985 and Langsett (SE10) in 1986. A widespread but local species which is afforded Notable B status.

O. brachyptera (Stephens). (*63) Botany Bay, Wintersett (SE31), female, 19/3/99, in marsh litter; MLD. (*64) Bishop Monkton Ings (SE36), 14/6/97, in marsh litter; MLD and 5/9/98, in sedge litter; RJM.

O. exoleta Erichson. (*62) Rawcliffe Meadows (SE55), 2/7/97, pitfall trap set by a pond; MLD det. CJ. The only previous records are from Lockwood (SE11) in 1948, Spurn (TA41) in 1950 & 1951, Sunk Island (TA21) in 1986 and Aughton Ings (SE73) in 1988. The species is associated with rabbit *Oryctolagus cuniculus* burrows and is afforded Notable status.

O. induta Mulsant & Rey. (*63) Whiteley Wood (SK38), female, 22/10/98, in decaying fungus; EJS (teste MLD). The only previous records are from Whitby (NZ81) and Skeldon (NZ80), both in 1936.

Crataraea suturalis (Mannerheim). (*61) Staxton (TA07), female, 15/6/96; LA det. MLD. The only previous records are from Elland gravel pit (SE12) in 1946, Swinden Plantation (SE10) in 1988, Studley Royal (SE26) in 1989, Bolton Abbey (SE05) in 1992 and Beckhole (NZ80) on an unrecorded date.

Aleochara bipustulata (Linnaeus). The realisation that more than one species was masquerading under this name *(The Coleopterist*, **6** (1): 1-45) has made all records on the YNU database suspect. The records of this species given in *The Naturalist*, **121:** 52 are still pertinent however, and along with the additions below, indicate that the species is widely distributed in the county. (61) Beacon Ponds (TA41), both sexes, 21/7/63; RCW. Spurn (TA41), both sexes, 21/7/63 and 23/7/63; RCW. Brook Farm, Elstronwick (TA23), not sexed, 24/5/96, in sheep dung; WRD det. MLD. (62) Hayburn Wyke (TAO9), 20/7/92; MLD. Rawcliffe Meadows (SE55), in flood refuse, 27/3/97; (MLD). (63) Thorne Moor (SE71), 11/6/90; MLD. Sprotbrough (SE50), 14/7/97, in dung; RJM det. MLD. (64) Ringhay Wood (SE43), 17/9/90; RBA det. MLD.

A. cuniculorum Kraatz. (61) Spurn (TA41), sex unknown, 23 and 24/7/63, in carrion-baited pitfall trap in rabbit *Oryctolagus cuniculus* burrow; RCW. The only previous records are from Skipwith Common (SE63) in 1919, Kearby (SE34) in 1937, Askwith (SE14) in 1937, Spurn (TA41) in the late 1940s/early 1950s and Blackmoorfoot (SE01) in 1987.

A. diversa Sahlberg. (63) Drop Clough (SEO1), 4/2/87; MLD. (*62) May Moss (SE89), 2/9/96; LA det. MLD. The only previous records are from Willowgarth (SE52) in 1992 and 1993. The record from Drop Clough pre-dates those given in *The Naturalist*, **121:** 52 to become the first authenticated record for Yorkshire. A very local species that is afforded Notable status.

A. spadicea (Erichson). (*63) Wharncliffe Wood (SK2998), female, 1/11/89; EJS det. MLD. Although collecting details remain unknown, the species' true habitat is the subterranean nests of the Mole *Talpa europaea.*

 # A. verna Say. A revision of the subgenus *Coprochara* by RCW (*The Coleopterist*, **6** (1); 1-45) has indicated that this species is far more widespread than the JNCC publication *A review of the scarce and threatened Coleoptera of Great Britain, Part 2*, suggests. Examination of specimens originally identified as *A. bipustulata* (Linnaeus) has revealed the following records: (61) Bubwith Ings (SE73), female, 21/9/87; EJS det. RCW and 13/10/92; MLD. Towthorpe (SE86), 26/5/90; MLD det. RCW. Wressle (SE73), female, 6/5/94, in vegetable refuse; RJM det. RCW. (62) Danby Low Moor (NZ71), 17/8/87; MLD det. RCW. May Moss (SE89), 10/8/96; LA det. MLD. (63) Blackmoorfoot (SEO1), 20/1/98, in flood refuse; MLD. (64) Studley (SE26), both sexes, 2/9/95, in old fungi and a dead fawn; MLD and RJM det. RCW. Prior to this revision the species had only been recorded from the Hebrides (Outer and Inner) and afforded the national status of Insufficiently Known; this will obviously need revising.

NOTES ON YORKSHIRE MOLLUSCA – NUMBER 12: THE OCCURRENCE OF THE SLUGS *LEHMANNIA VALENTIANA* (FERUSSAC, 1821) AND *LIMAX (LIMACUS) MACULATUS* (KALENICZENKO, 1851) IN YORKSHIRE

ADRIAN NORRIS
Natural Sciences and Ethnography, Leeds Museum Resource Centre, Moorfield Road, Yeadon, Leeds LS19 7BN

Colin Howes of Doncaster Museum forwarded a note to me, published in the *Doncaster Evening Star* on 18 November 1999, about the discovery by a school boy, Andrew Jackson, of the continental slug *Lehmannia valentiana* (Ferussac, 1821) near his home in Tickhill near Doncaster, VC63. The slug was found in a garden at the edge of the town bordering arable land on 14 November, grid reference SK/588937. This is the first record of this slug having being found in an open situation in Yorkshire. A search of the Yorkshire records for any indication that this slug may have been recorded as a greenhouse alien also proved negative. This record, therefore, constitutes the *first Yorkshire record* for this species. Pupils of Queen Elizabeth's High School, Gainsborough, who have been recording slug distributions and contributing to the national mapping scheme, have recorded this species from other new locations, in Lincolnshire and Nottinghamshire, over the last two and half years. The slug was identified by Chris du Feu, of Beckingham, Nottinghamshire, one of the teachers at the school.

On 16 December in the company of Dr David G. Robinson, Malacologist from the U.S. Department of Agriculture, Animal and Plant Health Inspectorate, I located a colony of *Lehmannia valentiana,* on waste ground bordering Burley Road, close to the centre of Leeds, grid reference SE/298339. This is the first record for VC64, and only the second record for Yorkshire.

Lehmannia valentiana has been recorded from Britain for many years as a greenhouse alien, but in recent years it has been found living in the wild in various locations. The first of these records was in 1981, when it was recorded from a garden, and on waste ground, at Portmarnock, Co. Dublin, Eire. Since that date it has been found in numerous locations, including Merseyside and the East Midlands (Kerney, 1999).

On 2 January 2000, I located a specimen of the slug *Limax (Limacus) maculatus* (Kaleniczenko, 1851) on the wall of a garden of Allerton Grange Rise, Leeds VC64 grid reference SE/305379. This is only the second record of this slug having been found in Yorkshire. The first Yorkshire record was reported in Norris (1992), from the village of Arncliffe, Littondale, found by the author on 4 April 1992, grid reference SD/933718.

At 8.55 am on 14 April 2000, Bill Ely found a single immature specimen of *L. maculatus* crawling on the pavement of Whybarne Terrace, Rotherham SK/430925. This is the third Yorkshire record and the first for VC63.

These new records would suggest that these species are about to spread across the county.

REFERENCES

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Norris, A., 1992, Notes on Yorkshire Mollusca – Number 9: *Limax (Limacus) maculatus* (Kaleniczenko, 1851) a slug new to Yorkshire. *Naturalist* **117:**131-132.

EUTNAYACRA GLAUCATORIUS (FAB.) (HYMENOPTERA, ICHNEUMONIDAE) IN YORKSHIRE

W. A. ELY

Rotherham Biological Records Centre, Recreation Offices, Grove Road, Rotherham S60 2ER

Fordham (1929) reported this insect (under its earlier name of *Amblyteles glaucatorius*) as new to Yorkshire from a male specimen collected by him at Allerthorpe on 17 August, 1925, and identified by Claude Morley. I located this specimen in the Natural History Museum, London, where it had been re-determined by J. F. Perkins as *Ctenichneumon castigator* (Fab.), an insect with almost a dozen Yorkshire records. There had been no further reports of *Eutnayacra glaucatorius* from the county and it was, therefore, deleted from the Yorkshire list.

I can now report that this ichneumon is reinstated to the list, as a male was included in a batch of specimens passed to me for identification by Mr A. Brackenbury. It was collected at Flora Street, Sheffield on 28 August, 1985.

May I take this opportunity to express my gratitude to Austen Brackenbury as well as to Derek Whiteley, Joyce Payne and the many other naturalists who pass specimens on to me and thereby contribute significantly to our knowledge of the parasitic Hymenoptera of Yorkshire.

REFERENCE

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Y.N.U. BRYOLOGICAL SECTION: ANNUAL REPORT 1998-1999

J.M. BLACKBURN
6 Bylands Grove, Fairfield, Stockton on Tees TS19 7BG
and
T. L. BLOCKEEL
9 Ashfurlong Close, Dore, Sheffield S17 3NN

EXCURSIONS

Sectional meetings have been held as follows:

Spring 1998: – Darnbrook (VC64), 2 May
Autumn 1998: – Millington Wood (VC61), 17 October

For a report of these two meetings, see Blockeel (1999).

Spring 1999: Goathland (VC62), 1 May

The small party met in Goathland and followed a footpath into the woods north of the village. In the morning we worked upstream, examining the rocks and banks of West Beck. Though the area was all acidic in nature, the woods are rich in species with a good mix of habitats.

The rocks in the beck had *Brachythecium plumosum* and *B. rivulare, Fontinalis antipyretica, Hyocomium armoricum, Racomitrium aciculare, Rhynchostegium riparioides, Chiloscyphus polyanthos, Conocephalum conicum, Marsupella emarginata* var. *emarginata* and *Scapania undulata.* The steep banks and crags above the beck were quite rewarding with the three commoner species of *Rhytidiadelphus* present, the woodland form of *Ctenidium molluscum, Cirriphyllum piliferum* and both *Heterocladium heteropterum* var. *heteropterum* and *H. heteropterum* var. *flaccidum*, the latter being only the second record in the vice-county. There were good patches of the attractive *Hookeria lucens,* and both *Isothecium myosuroides* and *I. alopecuroides (=I. myurum).* One rock had a large patch of *Dicranum fuscescens. Barbilophozia floerkei* was frequent, and three species of *Calypogeia* were seen, *C. arguta, C. fissa* and *C. muelleriana.* Two very welcome finds were a small amount of *Bazzania trilobata* in only its fourth currently known site in VC62 and the similarly rare *Riccardia palmata* on a wet crag, along with *Lophozia incisa* and *Tetrodontium brownianum.* The wetter areas on the slopes contained three of the commoner *Sphagnum* species, *S. denticulatum (= S. auriculatum), S. palustre* and *S. fallax* ssp. *fallax (= S. recurvum* var. *mucronatum).* Epiphytes included *Metzgeria furcata,* and there were several large patches of *Nowellia curvifolia* on old logs.

The cliffs around the waterfall were examined after lunch and produced the find of the day. This was *Fissidens taxifolius* var. *pallidicaulis* growing in a wet rock crevice, a new vice-county record. *Jungermannia pumila* was also found here. The beck area down to Beck hole was unrewarding, but an ash tree at Beck hole produced *Orthotrichum affine, O. pulchellum* and *O. stramineum.*

The remainder of the afternoon was spent at Thomason Foss. Here some limestone influence was evident in the bryophyte cover, with *Palustriella commutata* var. *commutata* (= *Cratoneuron commutatum* var. *commutatum*), *Eucladium verticillatum, Mnium stellare, Blindia acuta* and *Amphidium mougeotii*, the two latter species being very scarce in N.E. Yorkshire. *Tetrodontium brownianum* was found again on the wet cliff, and also *Fissidens osmundoides*. A notable find on the rock near the Foss was the tiny liverwort *Hygrobiella laxifolia*, not seen in VC62 for over 30 years, though it is easily overlooked. The rocks in the stream has *Hygrohypnum ochraceum*. This ended a very successful day, bringing the total number of bryophytes seen to 101.

Autumn Meeting: Skipton Woods (VC 64), 16 October

The autumn meeting of the Bryological Section was arranged for Skipton Castle Woods in order to make a contribution to the survey being organised by local naturalists Tom Bailey and Douglas T. Richardson. We entered the woods from the Castle and recorded along the beck as far as the ring road. The ground in the woods is neutral to base-rich, and this was reflected in the flora. These were in good condition, the autumnal form of *Pellia endiviifolia* being particularly fine and plentiful. Species noted on and near the banks of the Eller Beck included *Fissidens pusillus, Plagiomnium rostratum* and *Rhynchostegiella teneriffae (= R. teesdalei). Homalia trichomanoides* was on the base of a sycamore trunk, and *Eucladium verticillatum* and *Leiocolea turbinata* occurred in a seepage area on one bank with some rock exposure. The woodland flora included *Cirriphyllum piliferum* and *Plagiochila asplenioides.* The epiphytes on tree bark were not especially diverse, but included small amounts of *Dicranum tauricum, Zygodon viridissimus* var. *viridissimus* and *Frullania dilatata.* Less predictable was *Sanionia uncinata (= Drepanocladus uncinatus)* growing on an elder.

A concrete culvert where the beck emerged from under the ring road had plentiful *Orthotrichum cupulatum* var. *riparium* on its sides. Further diversity was provided by a stretch of limestone wall forming the upper perimeter of the woods. *Zygodon viridissimus* var. *viridissimus* was here again, with *Bryoerythrophyllum recurvirostrum, Syntrichia intermedia* (= *Tortula intermedia*) and the liverwort *Porella platyphylla.*

The final area visited was Sougha Gill, which proved to be quite rich. *Rhynchstegiella teneriffae* was plentiful in the stream bed and *Fissidens crassipes* was also present. *Nowellia curvifolia* was on at least two old logs. Other species recorded on the steep banks of the gill were *Mnium stellare, Hookeria lucens* and *Isothecium alopecuroides* (= *I. myurum*).

73 species were recorded in total.

RECORDS

The list below includes all new vice-county records and other records of note. Recorders' initials: JMB = J. M. Blackburn; TLB = T. L. Blockeel; PJC = P. J. Cook; DTH = D. T. Holyoak; KR = K. Raistrick; AWR = A. W. Ritson; IRW = I. R. Wallace.

Trichocolea tomentella: (62) 44/88 Seive Dale Fen SSSI, Dalby Forest, JMB, Nov 1998; (62) 44/89 Marshy wood by Grain Beck, Allerston High Moor, JMB, July 1999.

Cladopodiella francisci: (62) 44/89 Marsh by Eller Beck, Fylingdales, JMB, July 1999.

Hygrobiella laxifolia: (62) 45/80 Thomason Foss, Beck Hole, TLB, May 1999.

Leiocolea gillmanii: (65*) 34/89 Base-rich flushed turfy ledge, Cotterdale, TLB 4 July 1998. Second English record.

Moerckia hibernica: (62) 45/52 Dune slack, Coatham, Redcar, JMB & DTH, May 1998. This is the first sighting here since 1898.

Sphagnum subsecundum sens. str.: (63*) 43/19 Edge of slightly enriched stony flush, 350m alt., Abbey Brook, near Berristers Tor, TLB 27/034, 16 Feb 1998.

Sphagnum girgensohnii: (63) 43/19 Wet shale bank by waterfall, Abbey Brook, near Berristers Tor, TLB 27/267, 13 Dec 1998.

Polytrichum alpinum: (62) 44/99 Bankside, White Wood, Langdale End, JMB, July 1999.

Dicranella subulata: (65*) 34/69 Vertical soil banks at base of escarpment, Carlin Gill, western Howgills, KR, 4 July 1999.

Dicranum montanum: (64) 44/35 On rotten logs, Nidd Gorge, Knaresborough, TLB & IRW, 28 Oct 1999.

Dicranodontium denudatum: (64) 44/35 On rotten log, Nidd Gorge, Knaresborough, TLB & IRW, 28 Oct 1999.

Fissidens exilis: (61) 54/32 Exposed wet clay, Hollym Carrs, PJC, 3 Feb 1998.

Fissidens taxifolius var. ***pallidicaulis:*** (62*) 45/80 Mallyan Spout, Goathland, TLB, May 1999.

Gymnostomum calcareum: (64) 44/35 On magnesian limestone outcrop, Nidd Gorge, Knaresborough, TLB & IRW, 28 Oct 1999.

Aloina brevirostris: (62) 45/52 Dune slack, mixed with steel works waste, Coatham, Redcar, JMB & DTH, May 1998.

Torlula subulata var. ***angustata:*** (62*) 45/50 Sandstone ledge, Hasty Bank, Stokesley, JMB, Nov 1998. First record since 19th century.

Microbryum floerkeanum: (62) 44/67 Calcareous soil in stubble field near Skewsby, JMB, Sept 1998.

Schistidium maritimum: (62*) 54/09 Maritime rocks, Hayburn Wyke, AWR, Nov 1999. First record since 19th century.

Ephemerum serratum var. ***minutissimum:*** (62*) 44/77 Stubble field at Butterwick, JMB, Sept 1998.

Pohlia drummondii: (65*) 34/89 Wet soil on stone on stream bank, Cotterdale, TLB 4 July 1998.

Bartramia pomiformis: (62) 45/50 Trackside bank, Seave Green, Bilsdale, JMB, May 1999; (62) 44/69 Rocks by Hodge Beck, Bransdale, JMB, May 1999.

Orthotrichum rivulare: (65) 44/08 On Salix by R. Ure, Wensley, TLB 28/129, 24 July 1999

Orthotrichum sprucei: (64) 44/35 On tree root by river, Nidd Gorge, Knaresborough, TLB & IRW, 28 Oct 1999; (65) 44/08 On tree bole by R. Ure, Wensley, TLB 28/128, 24 July 1999

Orthotrichum tenellum: (64*) 44/27 On *Salix* on river bank, 50 m alt, south bank of R. Ure at West Tanfield, TLB 28/137, 24 July 1999.

Ulota phyllantha: (64) 44/27, on *Salix* on river bank, 50 m alt, south bank of R. Ure at West Tanfield, TLB 28/138, 24 July 1999.

Cryphaea heteromalla: (65*) 44/09 Lower part of beech bole, Leyburn Shawl, TLB 24 July 1999.

Palustriella commutata var. ***falcata:*** (63) 43/19 In slightly base-rich stony flush, Abbey Brook, near Berristers Tor, TLB 27/033, 16 Feb 1998.

Reference

Blockeel T. L. 1999. Y.N.U. Bryological Excursions 1998. *Bulletin Yorkshire Naturalists' Union* **31:** 27-28.

BOOK REVIEWS

The Liverwort Flora of the British Isles by **Jean A. Paton**. Pp. 626, 314 b/w figures. Harley Books, Colchester. 1999. £52.50 hardback.

From time to time a book is published which is instantly recognisable as a classic in its field. Jean Paton's long-awaited *Liverwort Flora* is just such a book. Its authoritativeness is proclaimed by its physical bulk and weight alone (over 2.5 kg)! Mrs Paton's knowledge of the British liverworts, acquired during a half century's dedicated and constant study, is unrivalled. She has an intimate field knowledge of the British flora, having studied in their natural habitats all but five of the 296 species described.

There are 21 pages of introductory matter which deal with the collection and examination of specimens, an overview of their habitats, distribution and conservation, and a full explanation of the text and figures. The structure and life-cycle of liverworts are not described in detail; readers are referred to existing textbooks and manuals for this information.

The bulk of the book deals with the descriptions and illustrations of the species and higher taxonomic units. It is important to stress that these are completely original: Mrs Paton has gone back to the plants themselves and has taken nothing as assumed. This is one of the great strengths of the book but, as the descriptions are based almost exclusively on British and Irish material, it does mean that the wider European and worldwide picture is generally not taken into account. For most readers, however, the primary use of the book will be to identify their collections. To this end, there are separate dichotomous keys to the orders and genera, and within the genera to species. The descriptions are both detailed and clear. Because of their technical content beginners may find the keys and descriptions somewhat daunting, but there is a full glossary and explanation of the terms used. Most importantly, the illustrations (line drawings) are outstanding, and are surely the most comprehensive and detailed ever produced of European species. The majority of the figures are full-page, and include all the salient diagnostic features, including oil bodies, gemmae, perianths, androecia, and in some cases stem sections. They are aesthetically pleasing too, no mean achievement for plants which are morphologically varied and complex. A particularly important feature of both the descriptions and the figures is the attention given to atypical and poorly developed forms; it is just these forms which cause the greatest difficulties of identification.

The descriptions are accompanied by a detailed account of the ecology of the species, and a summary of their distribution both within and outside the British Isles. This is followed by a more general discussion of each species, including taxonomic matters, field characters, morphological forms, and comparisons with similar taxa. These notes are invaluable. Only a few infraspecific taxa are accepted, and most bryologists will be relieved to find that *Lophocolea cuspidata* is united with *L. bidentata*, and all those tiresome varieties of *Lophozia ventricosa* have disappeared!

This book will be most useful to bryologists with some previous familiarity with the liverworts, but no serious bryologist at whatever level can afford to be without it. I hope it will encourage more naturalists to begin the study of these beautiful and fascinating plants. In the British Isles we have about 70% of the European flora, and many species with rare and disjunct distributions. Mrs Paton's achievement is all the more remarkable because she has not enjoyed the benefits of being attached to an academic or botanical institution. During the past 40 years she has elucidated many of the taxonomic problems associated with these plants, and this book represents the culmination of those studies. It is hardly possible to praise it too highly. Those who baulk at the price can be assured that is worth every penny and they should order their copy without further delay.

TLB

YORKSHIRE NATURALISTS' UNION EXCURSIONS IN 1994

Compiled by
A. HENDERSON

ELLER'S SPRING, DALBY FOREST (VC62), 21 May (J.M. Blackburn)

Twenty members assembled in the car park at Low Dalby, before proceeding into the newly created Forest Nature Reserve south of the village, accompanied by Mr John Mackenzie, the North York Moors Forest District Manager. The weather soon deteriorated and the day was largely cold and wet. Specific areas within the reserve were targeted and, despite the moderate attendance, they all received some attention. In addition English Nature and local landowners had given permission for access to two SSSIs, at Sand Dale and Nabgate. One group walked as far as High Paper Mill Farm. The remainder spread through the reserve, particularly round the large lake. After lunch two groups drove up Sand Dale to visit the disused limestone quarry adjacent to the Nabgate SSSI. Fresh bat droppings were seen at boxes and numerous deer slots, with roe deer disturbed at roost. Grey squirrels were frequent and evidence of badgers was reported. Two toads were found under stones and there were tadpoles in the large and small lakes. The Sand Dale SSSI received most attention. The site was in three distinct sections. The section west of Thornton Beck was a large alder carr. East of the beck was a very wet marsh and east of the track a hilly meadow with calcareous springs. All three sections produced surprising finds and the records will be forwarded to English Nature, along with our thanks. The tea and meeting in the village hall at Low Dalby were attended by representatives of 14 affiliated societies. The President, Mr L. Magee, presided at the meeting. Mr Mackenzie was warmly thanked, in particular for waiving all charges for the day.

ORNITHOLOGY (M. L. Denton)

The flock of 25 Crossbill that flew over the pre-meeting gathering may well have bred in the area as it is known that they do so. Siskin, another species known to breed in the pine woods, was seen in numbers throughout the day. Both species have benefited from the planting of conifer plantations. Proof of breeding was obtained for both Grey Wagtail and Dipper, as adults were seen flying along the beck carrying food for their ever-hungry young. The presence of both Marsh and Willow Tit was confirmed upon hearing their distinctive calls; the latter has suffered a national decline, for reasons unclear and probably very complex. A wide range of warblers was present, including Willow Warbler, Chiffchaff, Garden Warbler, Blackcap and Whitethroat. Despite a small Heron colony on a nearby nature reserve none were seen. During the course of the day 67 species were encountered.

COLEOPTERA (M. L. Denton)

A summary of beetles encountered during the day follows. Around the large lake on the Forest Nature Reserve: Carabidae, 10 species, Hydrophilidae 1, Staphylinidae 29, Pselaphidae 1; along the beck in the Forest Nature Reserve: Carabidae 4, Rhizophagidae 1, Elateridae 1, Chrysomelidae 1; around the pond at the bottom of Heck Dale: Carabidae 2, Staphylinidae 1, Cantharidae 1, Coccinellidae 1; in the wood above Heck Dale: Curculionidae 1, Scolytidae 1; in the pond at the entrance of the Bat hibernaculum: Gyrinidae 1, Nitidulidae 3, Cryptophagidae 3, Coccinellidae 2, Lathridiidae 3, Chrysomelidae 4, Apionidae 1, Curculionidae 5; around the small lake on the Forest Nature Reserve: Carabidae 2, Staphylinidae 1, Elateridae 1, Coccinellidae 1, Chrysomelidae 1, Curculionidae 1.

PLANT GALLS (L. Lloyd-Evans)

Eighteen galls were recorded: 1 bacterial, 8 fungal, 4 gall-mites (all eriophyd), 1 aphid, 1 sawfly, 1 gall-midge and 2 gall-wasps. As expected so early in the season nearly half were caused by fungal rusts and smuts. From the forester's point of view the most significant species was the aphid, *Adelges abietis,* which forms "pineapple" galls at the base of spruce shoots causing distortion and damage, particularly to nursery stock. A later generation migrates to its secondary host, the larch, where it does not cause galls but becomes covered with masses of white wool, making spray control difficult.

BOTANY (D. R. Grant)

Thorntondale is situated on the Jurassic Limestone which is overlaid with clay, giving rise to soils that can rapidly lose calcium by leaching, causing acidic conditions in surface soils. At the start of Heckdale an open area had a stand of *Calamagrostis epigejos.* An old limestone quarry yielded *Aquilegia vulgaris.* The edges of the forest rides were covered with *Rubus dasyphyllus,* and *Hieracium vulgatum* occurred on one banking.

The richest areas were where springs emerged from the hillsides on the SSSI. The eastern side had grassy acidic mounds; the plants here were; *Calluna vulgaris, Carex nigra, Antennaria dioica* and *Drosera rotundifolia,* whilst only a metre away alkaline-loving plants such as *Selaginella selaginoides, Valeriana dioica* and several sedges occurred, as also *Listera ovata* and *Pedicularis sylvatica.* The western portion was similar but with a larger area of alkaline soil. There were many sedges; particularly interesting was *Carex dioica, whose* male and female spikes occur on different plants, which was growing with *Pinguicula vulgaris, Anagallis tenella, Schoenus nigricans,* and *Eleocharis quinqueflora.* In the very wet areas *Pedicularis palustris* was growing with the stonewort, *Chara rudis* (see Grant & Henderson (1994) *Bulletin* **22:**16-17, Stewart (1998) *Bulletin* **29:** 35). The small pond had a nice stand of *Hippuris vulgaris.*

On the track leading to High Paper Mill Farm, *Rosa caesia* and *Rubus lindleianus* grew. The large fishing pond near the farm had, at its inlet, a large stand of the sedges *Carex acutiformis* and C. *rostrata* Also here were *Iris pseudacorus* and *Lythrum salicaria.*

Ellers Wood is a very wet alder-carr wood with undergrowth composed of much *Carex acutiformis* and *C. remota.* Unusual species in the wood were *Thalictrum flavam* and *Paris quadrifolia.*

Some members visited the Ellerburn Banks Y.W.T. nature reserve and reported a good show of *Ophrys insectifera.* Other members went to see *Actaea spicata* and *Monotropa hypopitys* at their *locus classicus.*

The area covered by the meeting is extremely productive and deserves revisiting later in the year. Due to the very cold winds experienced during April and May, many species were not in flower, particularly sedges and orchids.

BRYOLOGY (J. M. Blackburn)

The meeting started well by producing *Orthotrichum stramineum* on *Salix* by the car park. The morning was spent among the alders in the Ellers Wood SSSI, where the bulk of the records were epiphytic. *Dicranum tauricum* was frequent here with *Tetraphis pellucida* and *Orthotrichum pulchellum. Dicranum montanum,* growing in low scurvy patches, proved to be a new vice-county record. Among the liverworts seen were *Lepidozia replans, Plagiochila britannica* and a small quantity of *Ptilidium pulcherrimum. Radula complanata* was growing by the stream. Much of the felled areas inspected was regenerating and the presence of considerable coarse grass reduced the bryophyte interest, particularly west of the alder carr and also at the bottom of Sand Dale.

The large disused limestone quarry near Nabgate produced little, though *Barbula revoluta* was good to see and the fringes had some large patches of *Rhytidiadelphus triquetrus.* The limestone area to the left of the track just before the quarry entrance proved especially rewarding, with a new record for the vice-county, *Ditrichum flexicaule* (sensu stricto). *Trichostomum crispulum* (the form with slender leaf apex), *Encalypta streptocarpa* and *E vulgaris* were present and a patch of the attractive *Rhodobryum roseum.* The boggy field which was part of the Sand Dale SSSI was interesting, with the recently recognised

Drepanocladus cossoni (formerly *D. revolvens* var. *intermedius*), *Philonotis calcarea*, *Leucobryum glaucum* and *Plagiomnium elatum* with its characteristic large mid-leaf cells. The best find here was *Breutelia chrysocoma* which is rare in the north-east. The area around the small pond at the bottom of Heck Dale produced 25 species, including three species of *Orthotrichum* on elders and *Pleuridium subulatum* on a calcareous mound. This was a very successful day for bryophytes with a total of 75 mosses and 13 liverworts recorded.

MYCOLOGY (J. and K. G. Payne)
The day was spent searching for rusts and smuts. A total of twelve rust fungi was found, but nowhere without close searching. *Puccinia maculosa* on *Mycelis muralis* was in the quarry where *Milesina kriegeriana* also occurred on a moribund frond of *Dryopteris dilatata*. The long winter had killed off last year's foliage on many plants, so that overwintering spores were difficult to find. *Puccinia sessilis* was on *Allium ursinum* in the wood by the Visitor Centre. Gordon Simpson reported that *Crepis paludosa* was well rusted with what is likely to be *Puccinia major*. Smuts seen were *Entyloma ficariae* in mosaics on the leaves of *Ranunculus ficaria*, and *Ustilago violacea*, the anther smut of *Lychnis dioica*, which lends a sooty appearance.

The most interesting specimen proved to be a cast and decaying sheep's horn which had a fine crop of *Onygena equina*, Dr L. Lloyd-Evans later affirming the identification by microscopic examination.

SCOUT DIKE AND ROYD MOOR RESERVOIRS (VC63) June 4
BOTANY (D. R. GRANT)
This unland reservoir is situated on the western edge of the Coal Measures series of rocks which are represented by sandstones and shales. The reservoir had *Litorella uniflora* and *Callitriche hamulata*. A small pond nearby had *Ranunculus omiophyllus* and *Nitella flexilis*. The surrounding rough area had *Hieracium vagum* and *Genista anglica* together with *Carex binervis* and C. *viridula* subsp. *oedocarpa*. The footpath side had *Rubus warrenii*, *R vestitus* and *R. infestus*. In the small wooded area were *Salix pentandra* and *Equisetum sylvaticum*. Near Royd Moor reservoir *Rosa mollis*, *R. caesia*, *Dryopteris affinis* subsp. *borreri* and *Ulex gallii* were observed. The reservoir had *Carex acuta* and *Persicaria amphibia*.

FRESHWATER BIOLOGY (L. Magee)
Both reservoirs were at a high level at the time of the visit. There was a marked difference in the marginal and aquatic vegetation of the two reservoirs. Royd Moor (built 1934) was more exposed, at a higher altitude and constructed on peaty moorland. Scout Dike (built 1928) had a much more extensive marginal and aquatic flora with large and continuous stands of *Littorella uniflora*, *Polygonum amphibium* and *Callitriche hamulata*. These stands had vast numbers of Common Frog and Toad tadpoles which were probably too dense for the stocked predatory Rainbow Trout to enter.

No newts were seen in either reservoir but Great Crested and Smooth Newts were found in the tree-lined excavation close to Royd Moor reservoir. The mollusc *Lymnaea peregra* was present in both reservoirs. An interesting find was the stonewort *Nitella flexilis* in man-made scrapes close to Royd Moor reservoir (there are a few recent stonewort records from this upland area). The only fish fry found in the margins were a few dead Three-spined Sticklebacks. Unfortunately it was not possible to take water samples and pH values for comparison during the visit, but a further survey is planned for later in the season.

BARDEN AND BARDEN MOOR (VC64) 2 July (Leslie Magee)
After a difficult journey for many, through heavy mist on the route, 34 members assembled in the field next to the river at Barden Bridge. However, the weather quickly improved and

one party explored the old woodlands and the riverside. The small party who went up to Upper Barden reservoir found visibility down to a few yards and the air distinctly chilly. The party soon descended to Lower Barden and explored the reservoir perimeter, the interesting ashlar goits,which provide a striking macro-habitat, and the surrounding moors and springs. At the Boyle room at Bolton Priory for tea and reports there were 24 members representing 16 societies. Votes of thanks were proposed to the Trustees of the Chatsworth Settlements for permission to visit the estate and for the free parking arrangements', to the Vicar of Bolton Church for the use of the room and facilities, and to the President Mr L. Magee for organising the excursion.

MAMMALS AND AMPHIBIA (A. Norris)
Rabbits were frequent on the moorland and at the edges of the woodland. Moles, Hedgehogs and Weasels were also seen. Common Frogs and Toads were frequent, both in the damp goits and the woodlands. Palmate Newt tadpoles *Triturus helveticus* were found in some of the springs.

ORNITHOLOGY (L. Magee)
The noisy Black-headed Gull colony could be heard through the mist at Upper Barden but the party left long before it could be observed. The most exciting report of the day was that of fwo family parties of Stonechats and a Merlin seen at close quarters (Dr Lloyd-Evans). Yellow, Grey and Pied Wagtails were seen during the day; all three species breed in the area. A pair of Great-crested Grebe were on Lower Barden (seen with a juvenile later in the month); Snipe, Curlew and Sandpiper were active during the day.

CONCHOLOGY (A. Norris)
Most of the time was spent in the rich old woodland bordering the river Wharfe downstream of Barden Tower. 25 species of mollusca were found; 23 in the woodland or close to the ruins of Barden Tower and a further two in the streams close to the reservoirs on Barden moor. A number of old woodland indicators occurred, including *Leiostyla (Leiostyla) anglica* and *Perforatella (Zenobiella) subrufescens,* both found further downriver in Bolton Abbey Woods. The walls of Barden Tower produced *Clausilia (Clausilia) dubia* and *Helicigona lapicida.* The latter was also found climbing up an elder tree close to one of the outer walls; the first time I have noted this in Yorkshire, although it is commonly found on trees in some other areas.

LEPIDOPTERA (R. J. Hunt)
Very few species were reported during the day. They included two Silver Ground Carpet Moths *Xanthorhoe montanata,* one Small Heath Butterfly *Coenonympha pamphilus,* one Meadow *Brown Maniola justina* and the numerous Small Coppers *Lycaena phlaeas* seen on Barden Moors.

COLEOPTERA (R. J. Hunt)
The two coleopterists who attended the meeting made their way from the car park at Barden Bridge to Barden Low Reservoir *via* the public highway, sweeping the vegetation on the verges. The weevils *Phyllobius calcaratus, P. pomaceus* and *P. viridicolis* were seen. On arrival at the entrance gate to Barden Broad Park we followed the track to Barden Lower Reservoir where several dried-out rabbit carcasses were inspected. They contained very few beetles but the list included *Thanatophilus rugosus* and *Catops chrysomeloides.* Sweeping the vegetation produced good numbers of the chrysomelid, *Crepidodera transversa* from nettles, and the small ground beetle *Pterostichus diligens* was found by sieving sphagnum moss. After lunch at the reservoir the party returned to the river at Barden, finding on the descent numerous Copper butterflies which may breed on the large patches of Sheep Sorrel growing in extensive areas where the ling had been burnt off.

The area around the car park and river side at Barden Bridge produced the small ground beetle *Agonum albipes*, found in damp situations. Turning over the stones in the pools we found the water beetle *Platambus maculatus*. The riverside vegetation produced the Soldier Beetles *Cantharis lateralis* and C. *nigra* as well as the Raspberry Beetle *Byfurus tomentosus*.

OTHER ARTHROPODS (D. T. Richardson)
Recording was confined to the moors bordering the Upper and Lower Barden Reservoirs. Two woodlice, the ubiquitous *Oniscus asellus* and *Porcellio scaber*, were seen. Of the five species of centipede only *Lithobius melanops is* of importance as the first record for the 10 km square. Two of the four species of millipede, the generally accepted, sub-cortical *Cylindroialus punctatus* and *Proteroinlus fuscus* were quite common among the roots of the heather. Only one Harvestman *Megabunus diadema*, common in the square, was seen. Two species of ants were recorded, *Formica lemani* and *Myrmica ruginodis*. Full lists of species recorded are on file.

BOTANY (D. R. Grant)
Most of the day was spent examining the areas adjacent to the two reservoirs on Barden Moor. The area is over-grazed, millstone-grit moorland with much Bracken cover; the most interesting sites were springs which feed the reservoir, the ashlar goits and the feeder streams. A small silt-pond near the lower reservoir had large colony of *Potamogeton polygonifolius* growing with *Ranunculus aquatilis* and the Stonewort *Nitella flexilis*. In the dry joints of the stone-lined goits the ferns *Asplenium trichomanes* and *A. adantium-nigrum* were frequent, the latter being very local in Wharfedale.

Around the springs there was marshy ground which supported *Myosotis stolonifera, M. laxa, Montia fontana* and *Epilobium brunnescens*. On the dryer hillsides there were small quantities of *Carex pilulifera, Aira praecox and Melampyrum pratense*. In an area of calcareous shale there were diminutive plants of *Linum catharticum* and *Fragaria vesca*. Unusual ferns were represented by *Dryopteris affinis* subsps. *borreri* and *Opeopteris limbosperma*. The Shoreweed *Littorella uniflora* and *Hydrocotyle vulgaris* were well established. on the exposed bed of the reservoir. Near to the overflow stream were *Carex panicea, C. viridula ssp. oedocarpa* and C. *pulicaris* together with *Juncus acutiflorus, Eriophorum angustifolium* and *E. vaginatum*.

Lists of plants recorded by other botanists included *Allium paradoxum, Thalictrum minus, Actaea spicata* and *Equisetum telmuteia*.

LICHENOLOGY (A. Henderson)
Most of the morning was occupied along the western bank of the Wharfe, heading about a half-mile south of Barden Bridge. Though the corticolous lichens here are less diverse and developed than the richer well researched old woodland flora of Strid Wood further south, they nonetheless have considerable variety and interest. Barden Tower and its surrounds were also visited before lunch and had lichen montages typical of such ancient buildings and ruins. After lunch the walk across moorland to Barden Reservoir was intriguing, most of the terricolous lichens of heath, low stonework and pathways being subject to intense grazing and trampling pressures. *Peltigera praetextata* in some places had its thalline surface entirely masked by densely packed isidiate lobules. Similar dense lobulation/ branching was observed in adpressed cushions of *Collema tenax* var. *ceranoides, Collema crispum, Coelocaulon aculeatum* and *Cladonia* spp. Most exciting to find fruiting plenteously were colonial thalli of *Agonimia tristicula*, our tiniest squamulose lichen, with an unexpected abundance of blackbrown, striate, barrel-shaped perithecia at the peak of development. The sloping stone packing of the reservoir edge had a limited lichen flora in the upper water level zone, including the yellow-brown aquatic *Hymenelia lacustris*, above a lower brackish wrack-like belt of withered moss and algal detritus. The lichens of the moorland reservoir area were not amply assessed in the time available and merit a return visit.

FRESHWATER BIOLOGY (G. Fryer, L. Magee, D. T. Richardson)
An interesting situation prevails in three ponds adjacent to the lower reservoir. Notwithstanding the presence of *Sphagnum* near the margin, the faunas of the two ponds fed by streams on the west side indicate that they are alkaline or only weakly acid, while the pond at the upper end of the reservoir receives acid water. The latter is impoverished; the former have rich invertebrate faunas. In one of them the amphipod *Gammarus pulex* was plentiful and the large chydorid anomopod *Eurycercus lamellatus* was abundant. Both shun acidic waters, and the latter (like species of *Simacephalus,* of which one was present) is predominantly a lowland species in Yorkshire. Large cyclopoid copepods with similar preferences were also present. Other invertebrates were diverse and often numerous. A detailed comparison of these ponds would be very informative.

The pond at the foot of Near Long Gill, Lower garden, had adults of *Sigara dorsalis* and large numbers of nymphs of the Summer Mayfly *Siphlonurus lacustris*. There are very few Yorkshire records for this species but recent discoveries by the Freshwater Biology Section indicate that it may be under-recorded. (Adults were captured from the adjacent Lower Barden Reservoir at the end of July but they appear to have originated from the pond since no hatch was observed.) Stoneflies recorded were *Nemourella picteti, Protonemoura meyeri,* and the hemipterans *Sigara venusta* and S. *dorsalis* were found in the pond at the foot of Far Long Gill (44/034565).

MARFIELD QUARRY (VC65) 16 July (D. Millward)
Our thanks must go to Keith Good who kindly stepped in at short notice to lead the meeting as the Divisional Secretary was unable to attend. Fortuitously Keith knew the site well and was therefore able to answer questions. The excursion was well attended and members were blessed with a lovely summer day. The meeting was held in the canteen at the Redland offices adjacent to the site where the company generously provided tea and biscuits. We are very grateful to Redland (now Lafarge Redland Aggregates Ltd) for their hospitality and allowing access to what is proving to be an excellent wildlife site.

ORNITHOLOGY
36 species were recorded.

CONCHOLOGY (A. Norris)
The area of Marfield Quarry and Fen produced 23 species of mollusca in spite of the hot dry conditions. Within the confines of the Nature Reserve of Marfield Quarry 18 species were located, none of which are of special note. The most interesting fact which came to light was the sparsity of freshwater molluscs. Only 3 species were found in spite of the area having a large quantity of water habitats. The total list for the reserve area should increase in number with subsequent examination in wetter conditions. The most interesting find of the day was a single specimen of *Theodoxus fluviatilis* in the River Ure.

CRUSTACEA (G. Fryer)
In general the quarry pools had sparse faunas but, after sorting, the diversity turned out to be quite good with the promise of future improvement.

Gammarus pulex was found in a streamlet in the fen and Crayfish *Austropotamobius pallipes* occur in the river.

There were many Brown Hydra, probably *Hydra oligactis*, in the far pond, where the minute and beautiful snail *Armiger crista* also occurred.

LEPIDOPTERA (J. Payne)
The old gravel pits had a large number of Meadow Browns flying throughout the day, with a smaller number of Ringlets among them in some areas; these were well marked with numerous clear rings. Small Skippers were flying vigorously at the sheltered area near the tunnel end. Other butterflies were in very low numbers. Mall Tortoiseshell and Red

Admiral were noted but both specimens were worn and dingy. Two male Common Blues were reported and Small Copper was seen. Green-veined and Large White were present. The commonest moth was Shaded Broadbar flying in the long grass in less disturbed areas. A single Cinnabar was noted. As this member of the Tiger family feeds on Ragwort, of which there were acres in flower, it is likely that a good colony will develop. Silver Y was also seen hovering over flowers. The only two 'micros' named were Straw Belle *Udea lutealis* and Green Oak Tortrix T. *viridana.*

The fields near the river yielded Meadow Brown, Small Tortoiseshell and Green-veined White as well as Silver Y and a Green Carpet caught by Mr Good.

COLEOPTERA (R.J. Hunt)

Eleven species were recorded: Carabidae 4, Dytiscidae 2, Silphidae 1, Cantharidae 1, Coccellinidae 1, Chrysomelidae 1 and Cuculionidae 1.

ORTHOPTERA (J. Lucas and B. Lucas

Two species of Grasshopper, *Omocestus viridulus* and *Chorthrippus brunneus,* were seen during the day.

TRICHOPTERA (M. Andrews)

Four common Caddis Flies were collected by Mr Payne: *Limnephilus lunatus, Mystacides longicornis, M. azurea* (probably bred at the gravel pits) and *Silo pallipes* (more likely to have bred in the river).

PLANS GALLS (L. Lloyd-Evans)

Plant galls were rather scanty: 6 gall-mites, *(Aceria macrorhyncha* and *A. pseudoplatani* on *Acer pseudoplatanus, Eriophyes goniothorax* on *Crataegus,* and, in Marfield Fen, *Aceria brevitarsus, Eriophyes inangulis* and *E. laevis* on *Alnus glutinosus),* 3 gall-midges *(Dasineura fraxinea* and *D. fraxini* on *Fraxinus* and *Japiella veronicae* on *Veronica chamaedrys,* 2 saw-flies *(Pontania proxima* on *Salix alba* and *P. viminalis* on *S. purpurea)* and 1 fungus were recorded. Most colourful were the gold spots of the fungus *Taphrina populina* on poplars and the pink flushed spheres of the sawfly *Pontania viminalis* on Purple Osier *Salix purpurea.*

BOTANY (D.R.Grant)

Marfield Fen is situated between the gravel pits and the River Ure. This marshy area has a stand of *Carex acutiformis* growing with colonies of *Juncus subnodulosus* and *C. disticha.* In small open areas *Schoenus nigricans, Pinguicula vulgaris* and *C. lepidocarpa* occur. In a very muddy area there is a fair amount of *Glyceria plicata,* with several colonies of *Dactylorchis fuchsii.* Near the river there is a large bed of *Eupatorium cannabinum.* To the west side of the area where there are a few trees and it is much drier there are a few plants of *Lithospermum officinale.*

The gravel pits have a good selection of aquatic plants: several clumps of *Schoenoplectus lacustris* together with *Potamogeton crispus, P. pectinatus, Myriophyllum spicatum* and *Hippuris vulgaris* occur in the largest pit, with sedges represented by *C. paniculata, C. rostrata, C. otrubae* and *C. spicata* which grows on the dry banking. On the banking were also many colonies of *Primula veris* growing with *Dipsacus fullonum, Rubus dasyphyllus, R. eboracensis* and *R. caesius.* Other pits had *Polygonum amphibium, Zannichellia palustris* and *Salix purpurea.* The stoneworts *Chara hispida* and *Nitella flexilis* were also found in two different pits, reflecting the different pH values of their waters.

LICHENOLOGY (A. Henderson)

Between the quarry entrance and the lakes damper patches of ground held colonies of *Collema crispum, C. limosum* and *C. tenax* v. *ceranoides* amongst very well developed

Nostoc commune, by far the most obvious of the lower plants to be seen there. *Peltigera didactyla* occurred infrequently in drier areas.

The remainder of the morning was spent exploring Marfield Fen and the river-bank, where trees had a few of the commoner *Parmelia* species, *Ramalina farinacea, Hypocenomyce scalaris* and a limited *Xanthorion.* Old fence posts and struts here were well covered with a mainly crustose community, dominated by the dark thalli of *Micarea denigrata, Placynthiella icmalea,* dull green *Lecanora conizaeoides,* white-grey *Trapelia flexuosa, Porpidia tuberculosa* and *Lecanora polytropa,* with occasional foliose intrusions of *Parmelia sulcata, Hypogymnia physodes* and the massed golden lobules of *Xanthoria candelaria.*

In the afternoon stones and terrain around the lakes produced merely expected species, most of the *Cladonia* seen being extremely incipient, but the day's total was extended to 53 species by some additions from the stone, grassy scrub and trees on the embankment of Marfield Plantation. If the quarry communities are left comparatively undisturbed, they have the potential of interesting diversification.

FRESHWATER BIOLOGY (L. Magee)

The partially landscaped quarries lying close to the River Ure have an ample supply of good quality water; they are obviously developing rapidly, but their potential has been far from reached. There is a good stock of large fish of unidentified species in the lagoons; it was stated that various cyprinid species had been introduced by local people. In the adjacent River Ure there were large numbers of stoneloach, bullheads and minnows, with brown trout taking mayflies from the surface of the deeper water. A very lively population of crayfish with red claws, at first thought to the American Signal Crayfish, was found under moss-covered stones near the bank. The National Rivers Authority, who are concerned at the decline in the native populations, were notified and the site was visited soon afterwards. The population was confirmed as the native Crayfish *Austropotamobius pallipes.* The native Crayfish is a protected species which is under threat from predation and disease carried by the introduced alien Signal Crayfish *Pasifactus leniusculus.* Small frogs and toads were found sheltering under debris in a few places near the water's edge.

Pupae of the caddis fly *Goera pilosa* were abundant on the stones in the river; the non-casemaking larvae of *Rhyacophila dorsalis* was the only other caddis larva found in quantity in the river at this location. The Small Dark Olive Mayfly *Baetis scambus* was seen in flight and on the surface of the river. Nymphs of the Lake and the Pond Olive *Cloen simile* and *C. dipterum* were found where running water entered the lagoons but did not appear to be in any numbers. They tend to be among the first colonisers of still water. Mr and Mrs Lucas reported the Common Blue Damselfly *Enallagma cyathigerum* flying all over the area (at least 400 estimated). Only three adults of *Ischnura elegans* were seen but several larvae were identified.

KILNSEA BEACON LAGOONS NATURE RESERVE (VC61) 13 August (P. J. Cook)

The Beacon Lagoons Nature Reserve is on an SSSI extending over more than 70 acres on land part-owned/part-leased by the Spurn Holderness Countryside Society. It is managed in association with the Spurn Heritage Coast Project. There are saline lagoons with important populations of both Beaked and Spiral Tasselweeds, and there is an important Little Tern breeding colony. This field meeting was timed so as not to disturb ground-nesting birds, and members were invited to collect data for assessing the biodiversity of the site. The sky was overcast with cloud for most of the day, but broke for a while around noon, and there was a cooling breeze off the Humber.

The turnout was good with representatives from most sections of the Union. In the absence of a Secretary for VC61, the South Holderness Countryside Society provided the services of one of their Executive Committee, Peter Cook, to lead the field event while other members of the committee and volunteers prepared food and tea in Patrington Church Hall.

The day started well but to the extreme embarrassment of the hosts, and the disappointment of guests who had travelled a considerable distance, the party leader found himself barred from the main part of the reserve because someone had earlier seen an item of charismatic macrofauna (a Bluethroat). As a consequence, the party broke up. Some entomologists eventually found rewards entangled in spiders' webs in the gentlemen's toilet and another party took a long hike along the flood defences towards the Humber bank, eventually finding the riches of Kilnsea Canal. This party experienced hearing Roesel's Bush-cricket *(Metrioptera roeselii)* at its extreme northern station and saw local rarities such as Sea Rush *(Juncus maritimus)*, Long-bracted Sedge *(Carex extensa)* and Narrow-leaved Bird's-foot-trefoil *(Lotus glaber)*.

About 30 people eventually gathered for refreshments and Mr L. Magee chaired the meeting. We were joined by Professor M.R.D. Seaward and Mr A. Henderson who had experienced a rewarding day on Spurn. Thanks were given to the hosts and the acting VC secretary. Importantly, the day had been enjoyed by all, was rounded off well with good hospitality, and the YNU had gained itself a secretary for VC61!

BOTANY (D.R.Grant)

Members visited Beacon Ponds south of Easington where the sandy shore had its usual maritime species including *Cakile maritima, Honkenya peploides* and *Leymus arenarius.* Nearer the ponds on saline mud were *Atriplex prostrata* and *A. littoralis.* The ponds were filled with masses of *Ruppia maritima* together with small amounts of *R. cirrhosa.* The grassy lane near here had *Carduus nutans, Daucus carota* and *Rubus ulmifolius.*

The Humber bank has much saline marsh with typical species such as *Aster tripolium, Spartina anglica, Puccinella maritima* and *Parapholis strigosa.* There are small colonies of *Seriphidium maritimum, Triglochin maritimum* and *Glaux maritima.* On the drier sandy parts of the raised banking the clovers *Trifolium frageriferum* and *T. scabrum* were found. *Picris echioides* also grew on the side of the road and other grassy tracks.

The 'canal' area had much *Juncus gerardi* growing with *Carex extensa* and *C. distans.* In the water were *Potamogeton pectinatus* and a species of *Chara.*

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

Although the lichen flora of the Kilnsea area was not particularly rich or exciting, the field meeting provided an opportunity to gather data for the national mapping scheme, as well as for the British Lichen Society's churchyard survey, from a hitherto poorly worked area. Mature dunes to the west of Kilnsea supported a poor terricolous lichen flora of only four *Cladonia* species, but concrete coastal defences provided a more profitable habitat for 26 saxicolous taxa; a few additional species were found on bark, lignum, old tractor tyres and painted ironwork.

Kilnsea church and its small graveyard, containing a few monuments, furnished records of 30 saxicolous species.

A visit was then made to Spurn Point in order to assess the status of the lichen flora, more particularly that at the extremity which appears to be highly poleophilic due to increasing human activity there. The more interesting 'natural' flora was to be found on *Sambucus* and *Salix*, but rather dry, compacted mossy terricolous habitats, which supported a few collemataceous, *Cladonia* and *Peltigera* species, received most of our attention; buildings, many of them derelict, and coastal defences also provided niches for at least 28 species. (For a more detailed account of the lichen flora of Spurn Point, see Seaward & Henderson [1994] *The Naturalist* **119:** 151-154).

FRESHWATER BIOLOGY (L. Magee)

There was little scope for freshwater biology due to the lack of sites (the Canal was not visited). However, the ditches on Beacon Lane held brackish water with a pH value of 8.24. There was a very dense and active population of the Brackish-water Shrimp *Gammarus duebeni.* This species has become adapted to freshwater habitats in the UK, in particular on the west coastal areas. It is also common in Ireland. Its distribution does not appear to be well worked out in eastern England. Specimens lived on only for a short time in an aquarium where *Gammarus pulex* survived successfully. The drainage ditches were searched for invertebrates and a look out was kept for the larvae of the very rare caddis fly *Ylodes reuteri* of RD2 status without success. Much of the likely habitat has been 'improved'. The ten-spined stickleback *Pungitius pungitius* was found in some ditches.

BOOK REVIEWS

Understanding Lichens by **George Baron.** Pp. iv + 92. Richmond Publishing, Slough. 1999. £9.95 paperback.

A delightful evocation of and a most useful introductory guide to these fascinating symbiotic organisms, interest in which has increased over the past few decades due to their value as environmental indicators, more particularly of air pollution and of ecological continuity. The author packs a wealth of information on them and guidance to their study in chapters headed: (1) what is a lichen?; (2) the lichen thallus; (3) growth forms of lichens; (4) reproduction and dispersal of lichens; (5) lichen physiology; (6) lichens and their environment; (7) the amateur study of lichens; (8) the uses of lichens; (9) the classification of lichens; (10) the literature of lichenology. Chapters 7 and 10 will be particularly useful to those making a study of lichens for the first time. The text is complemented by photographs (including 4 pages in colour) and line drawings. Strongly recommended to amateur naturalists and to school, college and university students who consider undertaking field projects involving lichens.

MRDS

The Correspondence of Charles Darwin. Volume 11. 1863 edited by **Frederick Burkhardt, Duncan H. Porter, Sheila Ann Dean, Jonathan R. Topham and Sarah Wilmot.** Pp.xlii + 1038, with 11 pp. of b/w photographic plates. Cambridge University Press. 1999. £55.00 hardback.

A further volume in this remarkable series, justifiably described by one reviewer as a "glittering masterpiece of scholarship". The latest work reveals Darwin's personal concern for public opinion to his theory, having hitherto dealt only with the scientific community. Important letters relating to George Bentham's discussion of Darwin's theories in his presidential address to the Linnean Society of London are included, as well as many which show his passion for botany, more particularly his increased interest in plant research directed towards collecting more experimental proof of natural selection to satisfy his critics. Such work included experiments on dimorphic plants and on cross and hybrid sterility, but the construction of a hothouse at Down House at this time allowed him the opportunity to experiment with tropical plants, especially orchids. As ever, a very high standard of editing and publishing has been maintained, the letters supported by meticulous textual apparatus, together with appendices, a biographical register, bibliography, index to correspondents and a most detailed index.

MRDS

Flora of Great Britain and Ireland. Volume 5. Butomaceae – Orchidaceae by **Peter Sell and Gina Nurrell.** Pp.xxix + 410, including line drawings. Cambridge University Press. 1996. £60.00 hardback.

With Clapham, Tutin and Moore's *Flora of the British Isles* (2nd ed. 1987) and Stace's *New Flora of the British Isles* (2nd ed. 1997), both excellent works also produced by Cambridge University Press, is there room for yet another such authoritative work? After detailed inspection of this new title, quite clearly there is, but at this price its readership will be much more limited than for the previous titles. This is unfortunate, since the scholarly input of the senior author's life-time work in the Cambridge Herbarium is clearly evident, particularly in the treatment of critical genera.

Keys to families, genera, species, etc. are provided for all taxa together with detailed taxonomic accounts (occasionally supported by a line drawing of critical diagnostic features, eg. utricles of *Carex*, transverse sections of innovation leaves of *Festuca rubra* agg. and *F. ovina* agg., labella of *Dactylorhiza*), which will allow for greater precision in the identification of plants, although some subspecies and varietal problems will inevitably remain problematic. Although Stace (q.v.) packs an enormous amount of material into a flora designed to be used in the field, the encyclopaedic level of detail encompassed in the work under review, was clearly impossible for the former work to retain its function as a portable guide.

Forthcoming volumes are eagerly awaited. Dedicated plant taxonomists and libraries, colleges and universities are strongly advised to purchase this authoritative work.

MRDS

The European Garden Flora. Volume V. Dicotyledons (Part III). Limnanthaceae to Oleaceae. Edited by **J. Cullen *et al.*** Pp. xxii + 646, including 55 figures. Sponsored by The Royal Botanic Garden, Edinburgh, The Royal Horticultural Society and The Stanley Smith Horticultural Trust, Cambridge. Cambridge University Press. 1997. £100.00 hardback.

This 'manual for the identification of plants cultivated in Europe, both out-of-doors and under glass' maintains the high standards set by previous volumes (see *Naturalist* **111:** 144, 1986; **115:** 20, 1990; **120:** 141, 1995) in providing a scholastically but accessible work for both professional and amateur. In all, 90 families are covered, including such important genera as *Acer, Begonia, Cyclamen, Euphorbia, Fuchsia, Geranium, Ilex, Primula* and *Rhododendron.* Keys to families, genera and species, together with line drawings of leaves, fruits, etc. for critical taxa, are provided, and references to useful illustrations and taxonomic accounts are cited for each plant diagnosis. For many genera, some guidance on cultivation is given.

It is unfortunate that at this price such a rich source of botanical and horticultural information will not be available to most individuals, but libraries, horticultural societies and gardening clubs are strongly recommended to purchase all volumes of what will be the definitive work on the subject for many years to come.

MRDS

The Myxomycetes of Britain and Ireland. An Identification Handbook by **Bruce Ing.** Pp. iv + 374, including 357 line drawings. Richmond Publishing, Slough. 1999. £35.00 hardback.

These fascinating organisms, slime moulds (syn. molds), shuffled back and forth between the plant and animal kingdoms and now shown to be Protozoa, though still treated as 'honorary fungi', are at long last given the treatment they deserve. British and Irish natural historians will be greatly appreciative of Bruce Ing's enthusiasm for these little studied, but frequently encountered, micro-organisms; based on the author's lifetime of observation, this handbook with fill a noticeable gap in the literature, the last identification guide being G. Lister's *Monograph of the Mycetozoa,* the third and last edition of which appeared three-quarters of a century ago!

After introductory chapters (21 pages) dealing with phylogeny, life cycle, ecology, distribution, collection, culture, examination and preservation, keys are provided to order and families, followed by detailed diagnoses to taxa complemented by keys to specific level where necessary. Each diagnosis includes information on sporocarp, spores, habitat and distribution, as well as references where possible to published illustrations. The latter may well be necessary since the line drawings accompanying each taxonomic entry are of variable quality (a pity no colour illustrations were included) – the only downside to a book which is strongly recommended to the field biologist, who is all too apt to avoid those groups of organisms lacking suitable identification guides. Undoubtedly, with such an aid, and at such a reasonable price, a stronger interest in slime moulds is confidently forecasted.

MRDS

The English Parson-Naturalist. A Companionship between Science and Religion by **Patrick Armstrong.** Pp. x + 198, plus 16 pages of b/w photographic plates. Gracewing, Leominster. 2000. £12.99 paperback.

For three-and-a-half centuries, clerics have been significantly involved in the development of natural sciences in England. Patrick Armstrong provides us with a fascinating insight into their role in this development, not only through the works of luminaries such as John Ray and Gilbert White, but also many other famous, and not-so-famous, clerical naturalists who devoted much of their lives to interpreting and understanding the natural world through botanical, entomological, ornithological, geological, etc. achievements. The part they played in bringing new scientific discoveries (often as a result of their travels overseas) to public notice, in the foundation of the conservation movement, and in the origins of the National Trust and the RSPB are all portrayed in this informative and delightful book. Strongly recommended for library purchase and to professional and amateur naturalists alike.

MRDS

Alien Plants of Yorkshire by **G. T. D. Wilmore.** Pp viii + 304, 14 line drawings, map of Yorkshire vice-counties. Yorkshire Naturalists' Union, 2000. £15 + £2 p.& p. paperback (£12 + £2 to members of YNU, available from the Treasurer).

Geoffrey Wilmore's new Flora is unique, being the first to deal only with the alien plants of any British county. It is the YNU's Millennium publication, and the first Yorkshire and British Flora of the century. After a brief Preface and Introduction, the main part of the book deals with the records for aliens accumulated by successive YNU Recorders. Extra species have been gleaned from relevant literature but not from herbaria. For each species the method of its introduction is given and the country or region of origin. Localities, Recorders and dates are then given within each of the vice-counties. Appendices list: (1) aliens for which detailed information is not available, (2) species which are not listed in the current standard British botanical reference books, (3) species native in Britain which are known to be introductions in Yorkshire. These are followed by a list of Recorders and Referees and a Bibliography. There are one or two minor quibbles. The Contents page does not give page numbers; one might argue about the commonness or otherwise of some of the species; PPA has been credited with a record of which she has no recollection, but, although the contributions made by some individual members are acknowledged, no reference is made to the industrious Bradford Botany Group as a whole. The book is full of interesting information for anyone interested in the flora of Yorkshire and will no doubt also be seized upon by "twitchers" from other parts of the country.

PPA

Printed in Great Britain by Titus Wilson & Son, Kendal   ISSN 0028-0771

July-September 2000

Number 1034
Volume 125

The Naturalist

A QUARTERLY JOURNAL OF NATURAL HISTORY FOR THE NORTH OF ENGLAND

Published by the Yorkshire Naturalists' Union

Editor **M. R. D. Seaward** MSc, PhD, DSc, FLS, The University, Bradford BD7 1DP

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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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Institutions and Subscribers £20.00 Registered Charity No. 224018

STOCK DOVES BREEDING IN CROPTON FOREST, NORTH YORKSHIRE

DAVID C. JARDINE
49 Bellfield Road, North Kessock, Inverness IV1 3XX

ABSTRACT
A study of Stock Doves breeding in nest boxes in Cropton Forest found higher productivity than that reported in other studies of this species. Mean clutch sizes were similar to those in other studies, but hatching success and nestling survival were higher in this study. Productivity of nests where the adults were handled was significantly lower than those nests where they were not handled, although clutch sizes were similar. Desertion rates were significantly lower when adults were handled after the eggs hatched.

INTRODUCTION

The Stock Dove *Columba oenas* has recently been listed on the Orange data list of birds in Britain because of conservation concern over the recent decline in its population (Gibbons *et al.*, 1996). There are few published studies of this unassuming bird (Campbell, 1950; Delmée, 1954; O'Connor & Mead, 1981); this paper documents the findings of a short study in North Yorkshire during 1996 and compares results with previous published information.

STUDY AREA AND METHODS

The study was conducted in Cropton Forest, North Yorkshire (54° 20′ N, 0° 47′ W) where a proportion of the population was nesting in boxes which had been situated within and close to the forest edge for the use of owls. Cropton Forest extends to around 4500 ha of mainly coniferous forest which was established between 1930 and 1965. It comprises mainly Scots Pine, Sitka Spruce and Japanese or hybrid larches in roughly equal area with smaller areas of native broadleaves and other conifers. There has been extensive felling and replanting and it now has a reasonably balanced age class structure. The forest lies between 70 and 290 m above sea level. To the north and west there is an extensive area of heather moorland, while to the east is a smaller area of moorland and further conifer forest; to the south there is an area of mixed farming with cereal crops and areas of permanent pasture for cattle. Significantly there are also around 400 ha of pasture which is spread throughout the forest in fields of 5 to 70 ha in extent.

The size of the total population of Stock Doves within the forest was not known. A sample of 25 boxes was visited at roughly two-weekly intervals between the middle of April and early October. A further visit was made to 15 of the boxes in early November to check for late clutches and the success of late autumn broods. The boxes were all plastic barrels (50 litre) attached to trees or poles at heights between 3 and 4.5 m. On each visit the contents of the box was recorded and measurements (wing length – maximum chord to nearest millimetre and weight to nearest gramme) of any young present were taken. All the young and some of the adults were ringed.

RESULTS

Clutch size

A total of 80 clutches was found comprising 1 clutch of 3 eggs (1%), six clutches of one egg (8%) and the remaining clutches (91%) of two eggs. The mean clutch size was 1.94 eggs (Table 1). There was no significant variation in clutch size during the breeding season ($r_S = -0.670$, NS) (Table 2)

Hatching success and desertion rates

In two clutches, the outcome was not ascertained and these have been excluded from the

TABLE 1
Comparison of clutch sizes of Stock Doves in Cropton Forest in 1996 and a similar study in Belgium (Delmée, 1954).

No. of eggs	Number of clutches Cropton Forest		Belgium	
1	6	(8%)	6	(4%)
2	73	(91%)	126	(81%)
3	1	(1%)	14	(9%)
4	–		5	(3%)
5	–		2	(1%)
6	–		3	(2%)
Mean clutch	1.94		2.23	
SE	0.033		0.064	
N	80		156	
Pairs	24		46	

analyses. Table 2 shows the variation in hatching and fledging success through the breeding season: clutches where one of the adults had been handled were excluded from this analysis as there are indications that such disturbance was affecting breeding success (see below). Clutches early in the breeding season were successful, but there was a decline in productivity in May and then a rise to a peak in mid-summer, allowed by a decline in autumn. None of these differences, however, was statistically significant (Mann-Whitney tests, U >2.5, NS).

TABLE 2
Breeding performance of Stock Doves in Cropton Forest in 1996 by month of laying.

Month Eggs laid	No. of clutches	Mean(SE) clutch size	Mean(SE) brood size	Mean(SE) fledged size
Mar	7	1.86 (0.14)	1.86 (0.14)	1.71 (0.18)
Apr	10	1.80 (0.13)	1.50 (0.27)	1.50 (0.27)
May	5	1.80 (0.20)	1.00 (0.45)	1.00 (0.45)
June	16	1.94 (0.06)	1.56 (0.20)	1.31 (0.24)
July	5	2.00 (0.00)	2.00 (0.00)	2.00 (0.00)
Aug	12	1.92 (0.08)	1.17 (0.27)	1.17 (0.27)
Sept	2	2.00 (0.00)	1.00 (1.00)	1.00 (1.00)
Total	57	1.89 (0.04)	1.47 (0.11)	1.39 (0.11)

For the 78 clutches where the outcome was determined, 24 (30.8%) failed to hatch through desertion or predation of the adults. Nestling survival was very good with 94.1% of those hatching surviving to fledging. No losses of youngsters were attributed to predation. In only one nest were both youngsters known to have died through desertion or predation of the adults. All other broods reared at least one young with the cause of death of the sibling remaining unknown.

The nesting outcome was known for 21 of the occasions on which adults were captured. The productivity of the 21 nesting attempts where adults were handled is compared with the productivity of the 57 nests where the adults were not handled (Table 3).

TABLE 3
Breeding productivity of Stock Doves in Cropton Forest – comparison between nests where adults were handled with those where they were not.

Category	n	Mean(SE) clutch size	Mean(SE) brood size	Mean (SE) fledged brood
handled	21	2.00 (0.00)	0.81 (0.21)	0.81 (0.21)
not handled	57	1.89 (0.04)	1.47 (0.11)	1.39 (0.11)

Productivity was significantly lower in those nests where adults were handled (hatching, $z = 2.75$, $p < 0.01$; fledging, $z = 2.39$, $p < 0.05$) Desertions as a result of handling one of the adults were significantly lower after the eggs had hatched ($X2 = 4.66$, $p < 0.05$) (Table 4).

TABLE 4
Outcome of Stock Dove nests following handling of breeding adult in Cropton Forest in 1996.

Nest contents	eggs	chicks
Outcome:		
desertion	9 (64%)	1 (14%)
no desertion	5 (36%)	6 (86%)

Numbers of clutches and site productivity
There was wide variation in the number of clutches laid per box (Table 5) and greater variation in the number of young reared per box (Figure 1). At both sites where only one clutch was recorded, one of the adults was found predated in the nest box. A Tawny Owl *Strix aluco* took over one of these boxes for nesting and this species was probably also the predator at the other box 300 m away.

TABLE 5
Comparison of number Stock Dove clutches per nest box/site in Cropton Forest in 1996 and a study in Belgium (Delmée, 1954).

No. of clutches	Cropton Forest		Belgium	
1	2	(8%)	–	
2	4	(17%)	3	(7%)
3	8	(33%)	9	(21%)
4	3	(13%)	23	(55%)
5	6	(25%)	7	(17%)
6	1	(4%)	–	
Mean no. of clutches	3.42		3.8	
n	24		42	

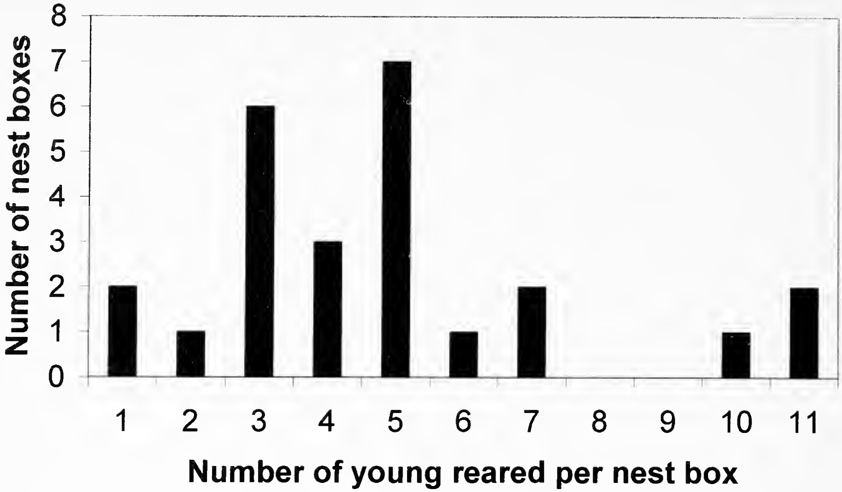

FIGURE 1
Number of young Stock Doves reared per nest box in Cropton Forest, North Yorkshire in 1996.

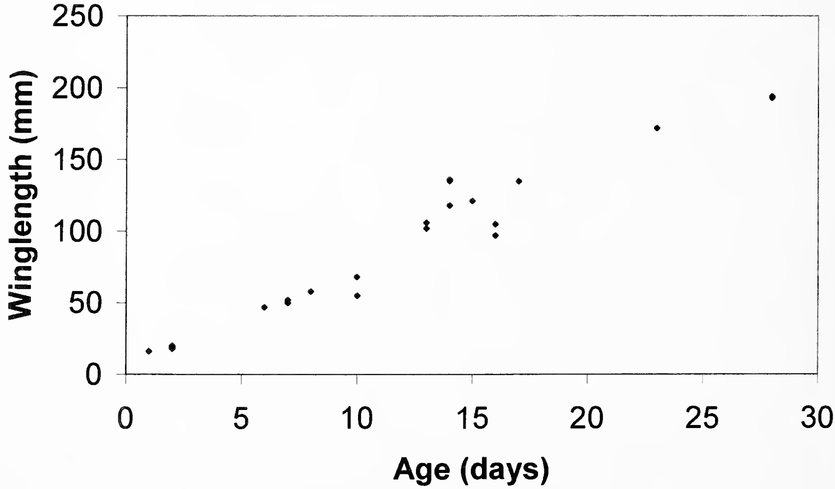

FIGURE 2
Growth of nestling Stock Doves in Cropton Forest, North Yorkshire in 1996: wing length (mm) versus age (days).

Nestling growth rates

Six nestlings were found on what was believed to be the day of hatching or the following day. These had wing lengths between 16 and 20 mm. Figure 2 shows the growth in wing length of these youngsters. Young birds were found using the nest boxes with wing lengths up to 195 mm (*c.* 28 days) although most youngsters appeared to fledge with wing lengths around 160-180 mm (*c.* 22-25 days).

Site fidelity

Of the 20 adult birds ringed, four were subsequently recaptured; three were in the box in which they were originally caught, the fourth was in the adjacent box at a distance of 100m. Time between capture and recapture varied between 12 and 50 days.

Discussion

O'Connor and Mead (1981) report that few nest records had been received from coniferous woodland. The provision of nest boxes undoubtedly assists Stock Doves in the colonisation of conifer forests where nesting holes can be scarce. Where nesting sites are, or have been made available, Stock Doves are a regular component of the avifauna of lowland conifer forests in Britain (*pers obs.*) and in Eastern Europe the species is more strongly associated with conifer woodland than deciduous (Fuller, 1995). It is possible that the low returns of nest records from conifer woodland reported by O'Connor and Mead (1981) may be a consequence of observer bias.

The mean clutch size found in this study was similar to that found by Campbell (1950) and in Belgium by Delmée (1954). It is possible that the one clutch of three eggs may have been the result of two females using the same nest as all other clutches were of one or two eggs. Using clutch size to identify nest sharing, the occurrence of this was less frequent in the present study than found by Campbell (1950) and in Belgium (Delmée, 1954) (Table 1) and was probably a consequence of the provision of adequate nest sites through the nest box scheme.

Hatching success for nests where the adults were not handled (77.7%) was higher than in other studies reported in the literature. But if all nests found in this study, including those where the adults were handled are analysed, the hatching success (67.6%) is remarkably similar to that found by Campbell (1950) (66.4%) but higher than that reported by Delmée (1954) (53.6%). Overall fledging success (excluding nests where adults were handled) in this study was higher (73.5%) than recorded in Oxfordshire (40.1%) and in Belgium (37.8%) (Campbell, 1950; Delmée, 1954). The fledging success of all nests at Cropton (including those where the adults were handled) was also higher (63.6%) than in other studies. The presence of gamekeepers in Cropton forest who actively controlled predators, and also the type of nest box, may have been influencing factors, but as no comparable information was available for the circumstances or levels of disturbance in Oxfordshire and Belgium the true reasons for the difference remain unknown.

In total, 31.2% of the nests in this study failed to produce young (30% at the egg stage and 1.2% at the nestling stage) and in a further 2.5% of nests the outcome was unknown. O'Connor and Mead (1981) in an analysis of nest records report 11.6% successful nests, 30.3% failed nests and 58.2% of nests with unknown outcome. In their analysis of nests known to have failed, the ratio of failures at the egg stage: nestling stage was 1.61:1; while in this study nestling survival was much better leading to a ratio of 24:1.

The difference in the breeding productivity of the nests where adults were handled and the nests where adults were not handled suggests that studies with this species have to be conducted carefully and results interpreted with caution. If adults are to be handled, then it is clear that the risks of desertion are high, particularly if the nest is still at the egg stage. It is recommended that future workers only handle the adults of this species at the nest once the young have hatched.

The higher hatching rate and nestling survival probably led to the greater number of young reared per box in Yorkshire (3.96) than recorded in the Belgian study (3.06) or another in Germany (3.25) (Delmée, 1954; Mockel & Kunz, 1981). This is particularly marked in comparison with the Belgian study which had a larger average clutch size (Table 1) and the average number of clutches per box/nest site (Table 5).

The lack of any significant seasonal variation in breeding success in this study is different from that reported in Oxfordshire by Campbell (1950) where a mid-summer peak was found. It is clifffficult to explain this difference without fuller information on the Oxfordshire study. Possible explanations include variations in the weather, food supply, predation rates, or the proportion of young birds breeding early in the year. The weather during late spring 1996 was cold and damp, and was probably responsible for the dip in productivity in the birds in this study between April and June (Glue, 1997).

These results suggest that the Cropton population, breeding in boxes in a conifer forest, was faring well in comparison with those in other studies and that the provision of suitable breeding sites in this habitat has the potential to act as a population source rather than a sink. The ringing studies have not yet provided data to test this hypothesis.

The small sample of adults recaptured while nesting suggests a high degree of site fidelity in this species.

ACKNOWLEDGEMENTS

I am indebted to Pawl Willet for putting up the boxes for his owl project and for allowing me to study the Stock Doves in them. Members of the East Yorks. Ringing Group provided valuable assistance in the field. Earlier drafts of this paper was improved by comments from Janet A. Jardine, Hugh Insley, Graham Scott and an anonymous referee.

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SEASONAL DIFFERENCES IN THE UTILISATION OF AGRICULTURAL HABITATS BY SMALL RODENTS

L. WEBB AND K. A. VELANDER*
School of Life Sciences, Napier University, 10 Colinton Road, Edinburgh EH10 5DT

ABSTRACT
The population and community structure of small rodents on arable and set-aside habitats was studied in winter and summer in order to determine seasonal patterns of habitat use. An area of 0.3 ha on each study site was live trapped during each sample session and the Fisher-Ford method applied to estimate population densities. Overall, species richness increased from two in the winter trapping sessions to four in the summer. Wood mice *Apodemus sylvaticus L.* were found on all study sites whereas bank voles *Clethrionomys glareolus* Schr. and field voles *Microtus agrestis L.* were mainly restricted to the established set-aside. This study lends itself to the conservation management of small mammal species within agricultural ecosystems. Maintaining areas of long grass along field margins or as part of longer rotation setaside may benefit the survival of vole species.

INTRODUCTION
Small rodents contribute to the biodiversity of agricultural ecosystems. They assist natural regeneration within farm woodlands and hedgerows by bringing seed stock into these areas, either to make food caches or by defecation of seeds consumed elsewhere (Golley *et al.*, 1975; Hayward & Phillipson, 1979) and by sustaining populations of avian (Gorman & Reynolds, 1993) and mammalian (King, 1985) predators. However, when population densities are high, small mammals can pose an economic risk to farmers by depleting crops (e.g. Flowerdew, 1994). Therefore, in order to conserve and manage small rodent species, it is important to determine their distribution and abundance in various agricultural habitats.

The ecology and behaviour of small rodents has previously been studied in a variety of ecosystems including woodland (e.g. Kikkawa, 1964; Fitzgibbon, 1997), maritime sand-dunes (Gorman & Akbar, 1993) and farmland (e.g. Montgomery & Dowie, 1993; Kotzageorgis & Mason, 1997). The general consensus in the literature is that many factors influence the spatial distribution of small rodents, including season (Flowerdew, 1985), social behaviour and reproduction (Montgomery, 1989) and habitat. Modern farming practices ensure that agricultural habitats are dynamic with frequent temporal fluctuations in levels of food and cover; as the latter is required for protection from predation and inclement weather, small rodents move between temporary patches of suitable habitat. Food choice, along with food supply and degree of cover, may influence distribution since wood mice are typical seedeaters (Hansson, 1985), while voles are more dependent on herbaceous species (Fitzgibbon, 1997).

Due to different habitat requirements, rodent species exploit agricultural habitats in various ways. Populations of wood mice *Apodemus sylvaticus* L. are found in both fields and field margins (Montgomery & Dowie, 1993), whereas bank voles *Clethrionomys glareolus* Schr. and field voles *Microtus agrestis* L. tend to remain in field boundaries (Tew, 1994). Set-aside has been studied as a specific use of agricultural land and it has been suggested that it is a sub-optimal habitat for wood mice (Rogers & Gorman, 1995). Tattersal *et al.* (1997) found that one year old setaside did not harbour large numbers of rodents of any species. More established setaside may support populations of field vole since this species favours grassy habitats (Southern, 1965; Gurnell, 1985) and avoids cultivated fields (Hansson, 1977).

The aim of this study was to compare the community and population structure of small

* Corresponding author
E-mail address: k.velander@napier.ac.uk

rodents on various agricultural treatments, including set-aside and arable fields at different successional stages. Comparisons were made between summer and winter because these seasons represent two extremes in the population cycles of rodents. In winter, food is often scarce and energy requirements are high because of harsh weather conditions. Food is likely to be more abundant in summer and, at this time of year, reproduction is of primary importance to small mammals. Determining the patterns of habitat use by small rodents over seasons is useful when proposing management strategies to sustain farmland biodiversity.

Methods

Study Area

The study was carried out at Boghall Farm, Scottish Agricultural College, Midlothian, Scotland. An area of established set-aside and arable fields at various successional stages were sampled in both late winter/early spring (February-March 1999) and summer (June-August 1999).

Site 1 was a field sown with winter barley *Hordeum vulgare* the previous autumn. The area was sampled in February, late June and mid-July (two weeks prior to harvest). The study area encompassed a hedgerow which bordered the field; a list of hedgerow vegetation species can be found in Table 1.

Site 2 represented the area which underwent the greatest changes in land use throughout the period of study. It was sampled over three consecutive weeks in February, once when the less than one-year old set-aside was in stubble, once after the field was spread with manure and once after ploughing. The same field was sampled a further four times between June and August by which time there was an established crop of spring barley. Site 2 was adjacent to Site 1.

Site 3 was an area of set-aside established more than two years prior to the study. At Phase 1 Vegetation Survey level, the area can be classified as improved grassland with small patches of scrub (Nature Conservancy Council, 1990) – see Table 1. This site was bordered by a spring barley field (Site 2) and a broad-leaved woodland and was sampled at the beginning of March and on four further occasions between June and August.

Population Sampling

A 50 x 60m trapping grid was set up with pairs of Longworth traps spaced at approximately 10 m intervals. Bedding and dried rodent food were provided in each trap and replenished as necessary. In accordance with regulations to prevent shrew deaths, dog food was provided in traps without shrewholes. Trapping was preceded by a 72-hour pre-baiting period, after which traps were set and checked daily for four days, as recommended by Gurnell and Flowerdew (1990). Captured individuals were identified to species level, weighed, sexed, and examined for reproductive condition.

The fur of individuals was clipped to enable their identification on future recaptures. The age of an individual – adult or juvenile – was determined by both pelage condition and body mass. Generally, individuals greater than 17 g (Rogers & Gorman, 1995) in summer, and 15 g (Fitzgibbon, 1997) in winter, were classed as adult.

Estimation of Population Size

The Fisher-Ford method was chosen to estimate absolute population size, since it is a comparatively robust method, particularly when used with small samples (Southwood, 1978). Fisher-Ford provides an estimate for each sample day excluding the first. Therefore, in this study where there were four trapping days per session, population estimates were derived for the last three days. These estimates were representative of the 0.3 ha grid area and were multiplied up to give density per hectare. The mean density for each sample week was taken in order to compare sites. For the full methodology of the Fisher-Ford method, see Southwood (1978).

TABLE 1
Plant species list for the hedgerows and set-aside

	Species	*Hedgerow*	*Set-aside (Site 3)*
Grasses	*Agropyron repens*		X
	Agrostis canina	X	X
	Cynosurus cristatus		X
	Dactylis glomerata	X	
	Deschampsia flexuosa	X	
	Festuca ovina	X	X
	Holcus lanatus		X
	Milium effusum	X	
	Phleum pratense		X
	Poa trivialis		X
Other	*Achillea millefolium*		X
	Cirsium palustre		X
	Cratuegus monogyna	X	
	Epilobium angustifolium	X	
	Galium aparine	X	
	Heracleum sphondylium	X	
	Leontodon sp.		X
	Luzala campestris		X
	Medicago lupulina		X
	Myosotis sylvatica		X
	Plantago lanceolata		X
	Plantago major		X
	Prunella vulgaris		X
	Ranunculus acris	X	
	Rosa canina	X	
	Rubus fruticosus	X	
	Rumex acetosa	X	
	Rumex obtusifolius		X
	Silene dioica		X
	Stellaria media		X
	Taraxacum sp.		X
	Trifolium repens		X
	Urtica dioica	X	
	Veronica persica		X
	Vicia sativa		X

RESULTS

COMMUNITY STRUCTURE

Four species of rodent – wood mouse *Apodemus sylvaticus,* bank vole *Clethrionomys glareolus,* field vole *Microtus agrestis* and house mouse *Mus musculus* – were trapped in the summer, whereas only wood mice and bank voles were trapped over the winter months.

Wood mice were found on all three sites during both seasons (Fig. 1). On Site 1, the winter barley field, wood mouse density was lowest at 5 ha^{-1} during February and highest at 76 ha^{-1}, a few weeks prior to harvest. During the February sampling sessions the density on Site 2 remained quite stable, ranging from 53 to 63 ha^{-1}. The lowest density on Site 2, 16 ha^{-1}, was recorded in June. Wood mice were trapped on Site 3 in the March sampling period and in three of the four summer periods.

Bank vole captures were negligible on Site 1 during both the summer and winter (Fig. 1). This was also the case for Site 2 in all but one of the sampling sessions, 11th August, when density was 42 ha^{-1}. Bank voles were trapped on site 3 in all sampling sessions with the highest density of 75 ha^{-1} recorded in June.

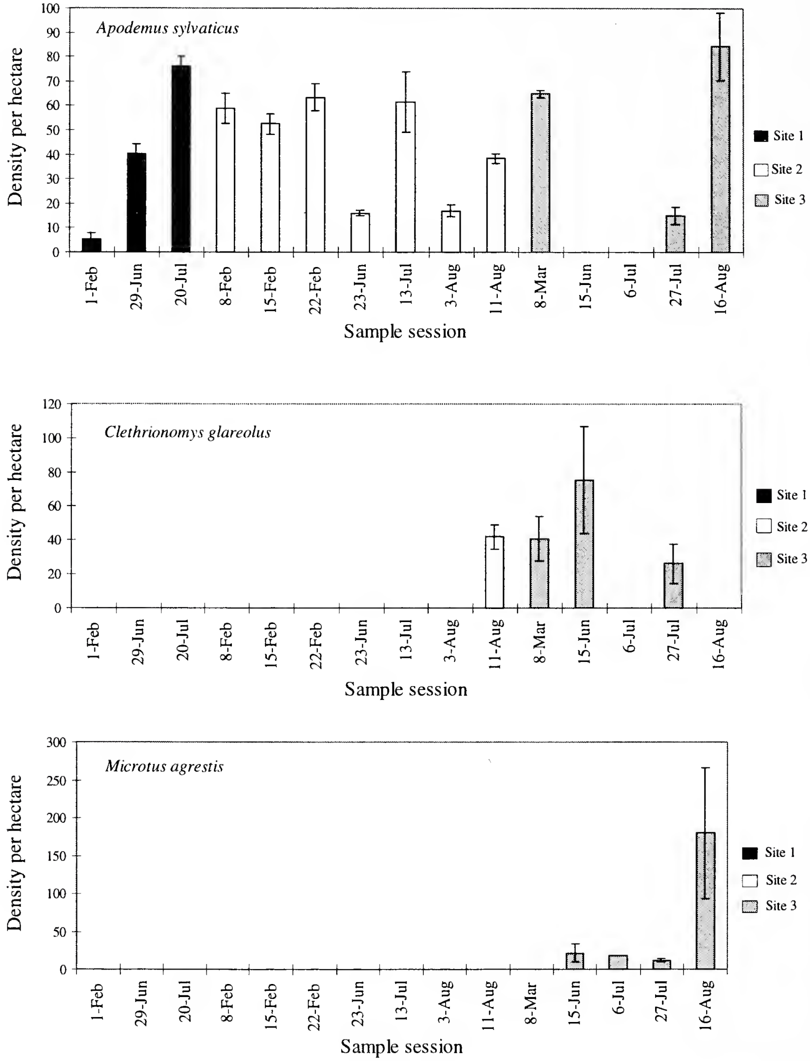

FIGURE 1

Population estimates (± SE) of *Apodemus sylvaticus, Clethrionomys glareolus* and *Microtus agrestis.* An asterisk (*) indicates the presence of a species in numbers too low to calculate population densities.

During the summer, field voles were only caught in any significant number on Site 3, with densities ranging from 12 ha^{-1} to 180 ha^{-1} (Fig. 1). In Fig. 1 an asterisk signifies the presence of a species, but in numbers too low to apply the Fisher-Ford method. House mice were trapped on Sites 1 and 2 in the summer, but the number of captures proved insufficient to estimate population size.

Population Structure

Site data was collated in order that population structure for the winter and summer populations of both bank voles and wood mice could be compared. Graphs of the percentage composition of each age-sex category for each population are shown for wood mice (Fig. 2), and for bank voles (Fig. 3). Wood mice captures in both winter and summer were composed mainly of adult males. Adult females made up a similar proportion of captures in both seasons. Fewer juveniles of both sexes were captured in summer than in winter. For bank voles, female adults formed the greatest numbers of captures in both seasons. Only adult field voles were trapped during the summer period, an individual being classed as an adult if it showed signs of reproductive activity, e.g. lactation in females and enlarged testes in males.

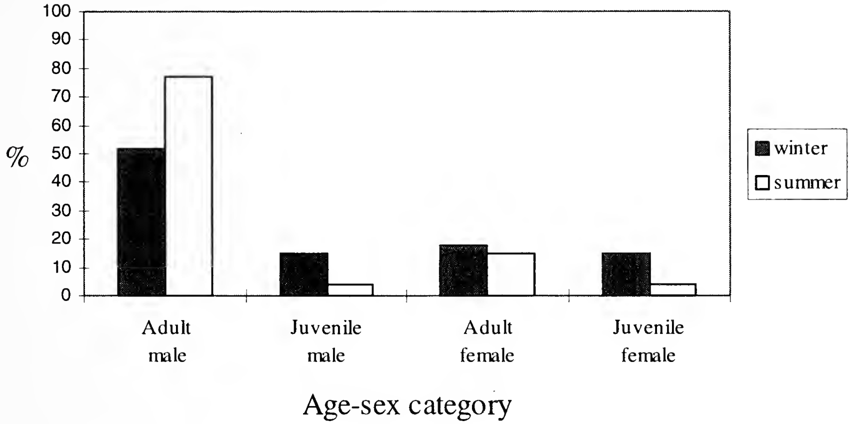

FIGURE 2
Percentage of each age-sex category in seasonal populations of *Apodemus sylvaticus.*

Sex Ratios

A Chi^2 test with Yates' Correction was applied to investigate significant departures from sex ratio unity for each species in each four-day trapping session. In wood mice, 43% of sample sessions displayed a significant male bias (χ^2 >3.84, P = 0.05, d.f. 1). This male bias was observed mostly on Site 2 during the summer. For bank voles, only one out of 12 sites analysed for a departure from sex ratio unity showed a significant female bias (χ^2 = 6.125, P = 0.05, d.f. 1). This female bias was observed on Site 3 in the sample session beginning 16 August. One third of the sites analysed for field vole sex ratios displayed a significant female bias (χ^2 >3.84, P = 0.05, d.f. 1), these occurred on Site 3 in the sessions beginning 6 July and 27 July.

Body Mass

A Kruskal-Wallis test was used to investigate whether there were significant differences in the body mass of each species in all sample sessions. Trapping sessions which yielded very

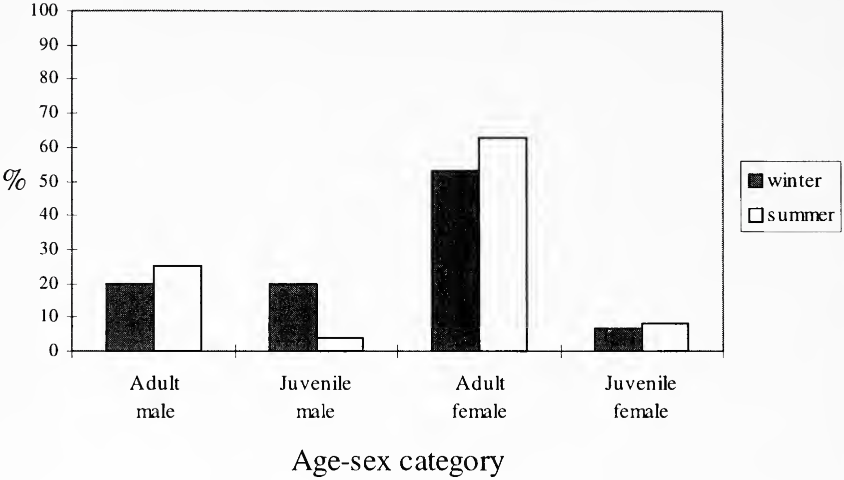

FIGURE 3
Percentage of each age-sex category in seasonal populations of *Clethrionomys glareolus.*

small samples were omitted from the test. A significant difference in body mass between sites was found for wood mice (Kruskal-Wallis, $p = 0.000$, d.f. 11). There was no significant difference between winter sites or between summer sites, therefore the difference was seasonal, with body mass significantly lower in winter than in summer. A significant difference in body mass (Kruskal-Wallis, $p = 0.002$, d.f. 6) was found for bank voles, and again this was attributed to season, with the average body mass in one of the winter sample sessions being significantly lower than those in summer. There was no difference in the average body mass of field voles captured on Site 3 during the summer (Kruskal-Wallis, $p = 0.293$, d.f. 3, NS). Mean body mass and 95% Confidence Intervals were graphed for each species at each site in winter and summer (Fig. 4).

Discussion

Population Structure

Male juvenile bank voles and juvenile wood mice of both sexes were captured in far lower numbers in summer compared to winter. The literature has provided several explanations for this observation. Watts (1969) suggests that a low number of juveniles in the summer is due to poor survival. This may be exacerbated by infanticide by adult males (Wilson *et al.,* 1993), particularly when aggressive during the breeding season. However, Tanton (1969) does not attribute low summer captures to poor survival and suggests that it occurs because juveniles will not forage far from the nest site until competition with adults forces them to move further. Similarly, Kikkawa (1964) suggests that adults compete with juveniles for the actual traps and are therefore found to be more abundant during trapping studies. In this study the lack of juveniles in the summer was attributed to size as most of the traps had shrew holes enabling smaller juveniles to escape. Juveniles captured during the winter trapping period would have been 'overwintered', born towards the end of the previous breeding season and hence larger. Those trapped in the summer months were only recently weaned juveniles, therefore their body weight would be far lower than the overwintered juveniles. It is possible for newly weaned juveniles to escape through shrewholes, whereas this may prove far more difficult for larger overwintered animals. The relatively low captures of juvenile wood mice in summer could therefore be attributed to such escapes. It

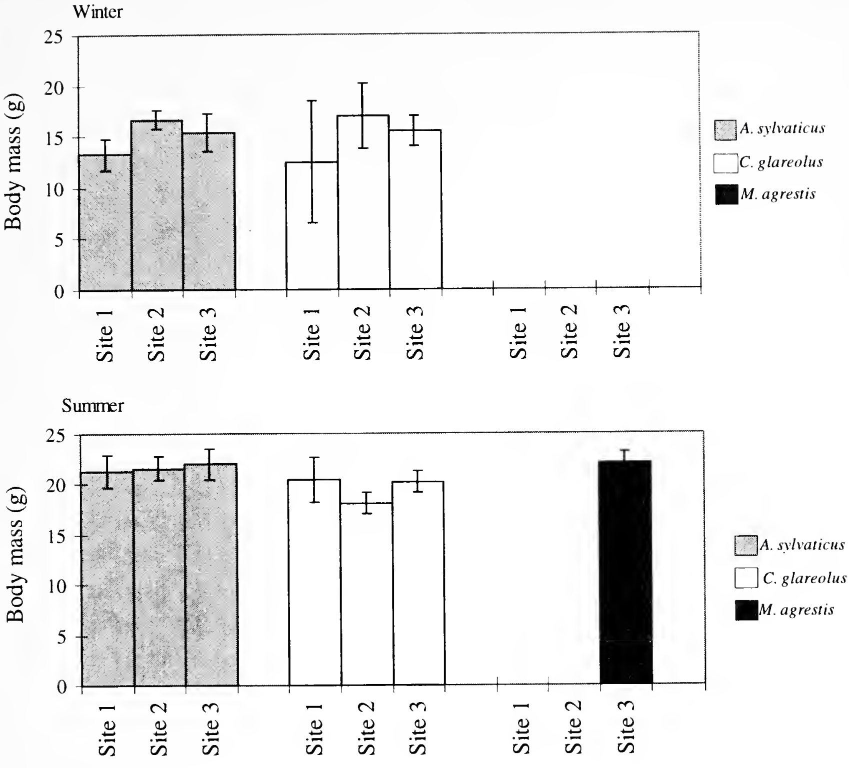

FIGURE 4
Mean body mass (± 95%) of *Apodemus sylvaticus, Clethrionomys glareolus* and *Microtus agrestis* populations on the three sites in winter and summer. *Microtus agrestis* were only trapped in significant numbers on Site 3 in the summer.

is important to recognise that the use of shrew holes is likely to lead to inaccurate estimates of the age structure of populations (Little & Gurnell, 1989).

The high degree of male bias in the wood mice populations is a common phenomenon (e.g. Tanton, 1965; Kotzageorgis & Mason, 1997) which can probably be attributed to social behaviour. Wood mice do not have a rigid social structure during the winter, but when the breeding season starts, females tend to become territorial. Males respond to this by increasing their home range size (Wolton & Flowerdew, 1985), and are therefore more likely to be trapped, resulting in a sex ratio bias (Flowerdew, 1976). Since male bias was significant mainly in the summer sampling periods, this was presumably attributable to breeding behaviour.

Male bank voles tend to be more abundant than females during the summer, while females are the more abundant sex during autumn and winter (Tanton, 1969). Since bank voles display a similar social structure to wood mice in the breeding season (Gipps, 1985), the observation by Tanton (1969) that males are more abundant in summer could also reflect their larger home range size and hence increased likelihood of being trapped. This was not supported by this study as females were most frequently caught in both seasons.

The preponderance of female bank voles could be attributed to their local activity, i.e. although their range is smaller relative to males during breeding season, they may be more active in areas around traps. For example, female wood mice are active in the middle of the day during the breeding season (Montgomery & Gurnell, 1985), presumably because of increased energy requirements. The same is probably true for breeding female bank voles, and in this study it appears that females have become more trap-prone as a result of their foraging behaviour.

The observation that the average body mass of wood mouse and bank vole populations differed significantly between winter and summer reflects findings by Tanton (1969). Body mass did not differ significantly between sites within a season suggesting that body mass was not a function of the type of agricultural land upon which a population existed.

The Fisher-Ford model was used to allow comparisons between population densities on different sample sessions. Overall, the absolute population estimates, appeared to be high. For example, the density per hectare estimate for field voles in the sample session 16 August is perhaps an overestimate which can be attributed to a rapid increase of captures over the four day sample period – the Fisher-Ford model does not compensate for this. One of the many assumptions of Mark Release Recapture models is that the marking and handling of animals does not affect their chance of recapture. However, Montgomery (1985) stated that the handling and marking of wood mice can delay their recapture by one day which would ultimately lead to an overestimate of population size. Population overestimation can also occur if transient individuals caught in the peripheral traps of the study grid are counted as part of the actual population. In order to compensate for this, a 'boundary strip adjustment' can be applied whereby the grid is increased in size in order to minimise an overestimate (Brent, 1962). Conversely, however, an underestimate could occur if the peripheral captures *are* actual grid inhabitants and therefore the adjustment was not applied to trapping data.

Seasonal Patterns in Habitat Utilisation

Rodent species richness increased from winter to summer on all of the agricultural habitats sampled. Two species, field vole and house mice, were only trapped in summer while wood mice and bank voles were trapped in both seasons. The presence of house mice in small numbers in arable fields during summer months supports findings by Green (1979).

Wood mice were the only rodent species to be found on all agricultural land types, thus suggesting that they adapt easily to a variety of habitats. Wood mice density on Site 1 was lowest in the February sampling session, possibly because the winter barley was only a few centimetres high and offered little cover. The peak population density of wood mice on Site 1 occurred only a few weeks prior to harvest and was almost double the density found there only three weeks previously. As wood mice numbers tend to remain stable during early summer (Montgomery, 1989), it is probable that this increase was due to an influx of wood mice prepared to exploit a plentiful food supply in a crop ready for harvest.

Bank voles were found only in small numbers on arable fields and highest densities were found on the area of established set-aside. However, on one sample occasion during August, a density of 42 ha^{-1} was observed on the spring barley field (Site 2). This would support the finding that bank voles sometimes move into arable fields during the breeding season (Fitzgibbon, 1997). In summer, field voles were only trapped on Site 3 – the established set-aside – which reflects the observation that they prefer grassy habitats (Gurnell, 1985). It would therefore be beneficial to both vole species to include areas of set-aside approximately two years old on farmland, particularly in areas along field margins. Set-aside will only provide suitable vole habitat if it does not give way to scrub (Morris, 1993). On Site 3, patches of scrub were present in the form of hawthorn *Cratuegus monogyna,* this area should therefore be managed accordingly to maintain suitable vole habitat.

The absence of field voles in the winter trapping sessions could be explained by their reluctance to enter Longworth traps (Redpath *et al.,* 1995). The fact that field voles were caught frequently in some of the summer sampling sessions could be attributable to a change in behaviour during the breeding season. For example, the animals may range further in their search for potential mates, or to meet increased energy demands associated with mating and sustaining young.

Disturbance occurs in agricultural habitats through activities such as spraying and harvesting, the latter being especially disruptive by altering the physical structure of the habitat. Although wood mouse population size can decrease by 80% after harvest, few animals are killed outright by the combine harvester and the decrease is more likely to be caused by increased predation due to rapidly decreased cover, or migration to more suitable habitat (Tew & Macdonald, 1993). Site 1, the winter barley field, was harvested in the week beginning 11th August. In that same week, Site 2 (the adjacent spring barley field) was sampled in order to determine the degree of inter-field movement from the harvested field. However, only 14% of wood mouse captures in the spring barley field had previously been trapped in the field undergoing harvesting, which might imply that they sought refuge elsewhere, for example in woodland or field boundaries.

The sampling session (Site 2-23rd June) which commenced one day after the field was sprayed with fungicide indicated a low density of wood mice, which was not unexpected since the disturbance encountered during spraying may have caused the mice to move temporarily to other areas. On the other hand, a series of disturbances on Site 2 in February did not appear to affect population size, which remained stable whilst the field was in stubble and after manure spreading and ploughing. It was thought that this might have been attributable to a large number of transients in the trapping grid, but this observation was not supported by trapping data which showed that many individuals were recaptures. Also, the relatively high population densities of wood mice over the three weeks in February on Site 2 disagrees with previous observations that arable fields support few of this species in winter (Fitzgibbon, 1997). The presence of wood mice in traps, even on a newly disturbed area, could have occurred because of food scarcity leading the animals to adopt a more 'adventurous' foraging strategy. Indeed, Tanton (1969) proposed that a high population density or a food shortage at low density may cause the animals to enter the traps: the latter effect may have caused the relatively high capture rate on the disturbed habitat of Site 2.

In conclusion, agricultural land-use shapes the majority of the British countryside and can result in habitat loss for many of our native species. Therefore, wildlife conservation needs to be integrated with farming, and this study has highlighted some management practices which could be implemented on farmland without compromising crop yield. Maintaining areas of long grass along field margins, or in fields as part of a long set-aside rotation, and preserving hedgerows which may provide a refuge when harvesting occurs, can all help to conserve small rodent species and their predators in agricultural ecosystems.

Acknowledgements

The Scottish Agricultural College kindly allowed us to carry out this study at Boghall Farm. We thank Sandra Grant, Harry Ellsmore and Robert Knapp for their assistance in collecting winter trapping data.

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HELORIDAE (HYMENOPTERA, PROCTOTRUPOIDEA) IN YORKSHIRE

W. A. ELY

Rotherham Biological Records Centre, Norfolk House, Walker Place, Rotherham S65 1AS

Helorids are small black insects, recognised at once by their characteristic wing venation (Fig. 1), which are parasitoids of larval lacewings. In common with other parasitic Hymenoptera, the apparent thorax has the anterior part of the abdomen attached to it and the petiole which connects this 'thorax' to the 'abdomen' is also part of the abdomen. The three British species can be identied from the following key:

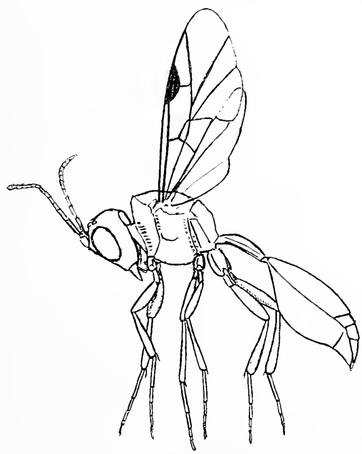

FIGURE 1
Helorus ruficornis Foerster, 1856

1a Head and 'thorax' strongly honeycombed with crater-like depressions and strong wrinkles — *Helorus nigripes*

1b Head and 'thorax' generally smooth or with fine punctures — 2

2a Petiole short and compact (about twice as long as wide), pterostigma more slender (about 3.5 times as long as wide), hind part scutellum wrinkled — *Helorus anomalipes*

2b Petiole more slender (at least 2.5 times as long as wide), pterostigma shorter (about 2.5 times as long as wide), scutellum smooth and shining — *Helorus ruficornis*

Helorids are not commonly recorded in Yorkshire. During the late 1940s Douglas Hincks recorded two species and collected one of them again in the 1950s. The third British species was first collected in the late 1970s and all three were recorded during the 1980s, when there were 21 records from three vice-counties. I have seen and

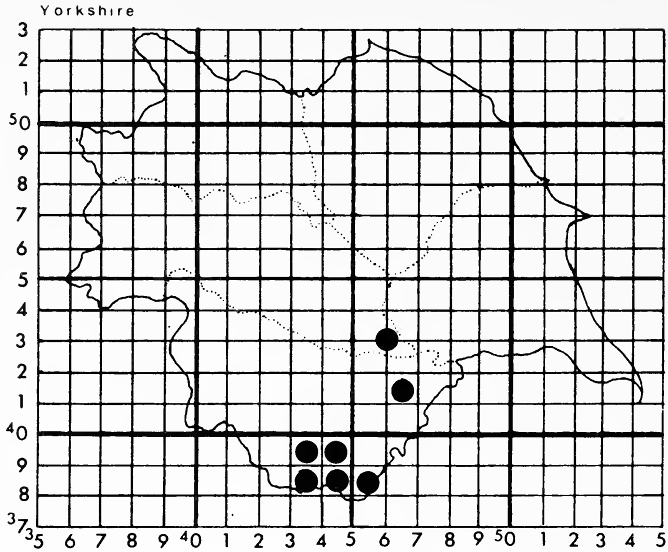

FIGURE 2
Recorded distribution of *Helorus anomalipes* (Panzer, 1798) in Yorkshire

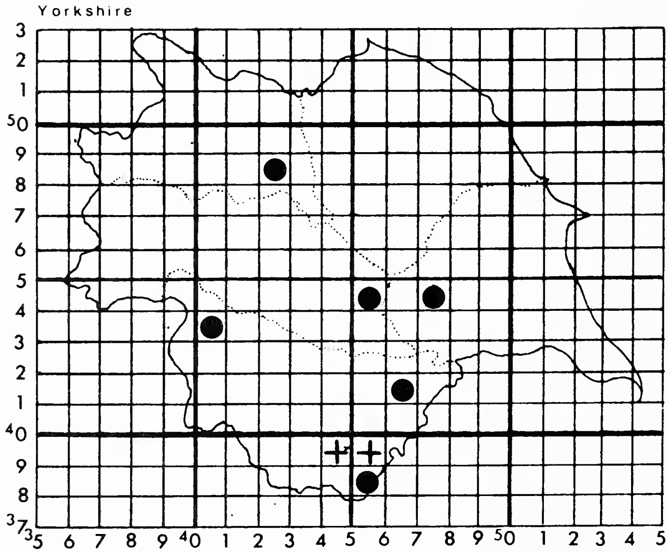

FIGURE 3
Recorded distribution of *Helorus nigripes* Foerster, 1856 (+) and *Helorus ruficornis* Foerster, 1856 (●) in Yorkshire

confirmed the identification of all specimens recorded here.

The records of each species are as follows:

Helorus anomalipes (Panzer, 1798)
Fourteen records from seven 10km squares in two vice-counties between 1948 and 1989 (Fig. 2), recorded between 8 July and 16 August.

VC 63

12 July 1982	Don Canal, Tinsley (SK4092)	WAE
14 August 1982	Brancliffe Limeworks (SK5481)	WAE
28 July 1983	Kirk Smeaton (SE61)	JTB
26 July 1984	Fitzwilliam Canal (SK4394)	WAE
30 July 1984	Masbrough (SK4192)	WAE
8 July 1985	Crookesmoor (SK3388)	DW
10 August 1985	Tinsley Sewage Works (SK4091)	WAE
16 August 1986	Norwood Locks (SK4782)	WAE
7 August 1987	Don Canal, Holmes (SK4092)	WAE
12 August 1987	Don Canal, Holmes (SK4092)	WAE
16 August 1987	Don Canal, Holmes (SK4092)	WAE
26 July 1988	Dinnington Colliery site (SK5286)	WAE
29 July 1989	Catcliffe Flash (SK4287)	WAE

VC 64

6 August 1948	Brayton (SE52-63)	WDH (Hincks 1953)

Helorus nigripes Foerster, 1856
This is a rare insect in Britain with fewer than ten specimens known (Cooter & Ferguson 1993). We have two records from two 10 km squares in one vice-county between 1978 and 1983 (Fig. 3), recorded from July and early September.

VC 63

8 September 1978	Maltby (SK5192)	MC, DWT
July 1983	Broom Valley (SK4392)	WAE

Helorus ruficornis Foerster, 1856
Nine records from seven 10 km squares in four vice-counties between 1947 and 1989 (Fig. 3), recorded between 11 June and 21 August.

VC 61

5 August 1989	Allerthorpe Common (SE7547)	WAE

VC63

emerged July 1947	St Ives (SE03)	WDH (Hincks 1953)
14 August 1980	Treeton Dyke (SK4386)	WAE
20 July 1983	Rushy Moor (SE61)	PS
14 July 1984	Langold Holt (SK5685)	WAE
21 August 1985	Holmes Carr Great Wood (SE61)	PS

VC64

11 June 1954	Askham Bog (SE54)	WDH (Hincks 1957)

VC65

18 July 1982	Bedale Hall (SE2688)	WAE
18 July 1982	Langthorn Wood (SK2589)	WAE

On the basis of very few records there is a suggestion that *H. anomalipes* and *H. nigripes* are more restricted to the south of the county while *H. ruficornis* is more widespread. Although the flight periods recorded here are very similar there is an indication that *H. ruficornis* flies earlier while *H. nigripes* flies later. I hope that further specimens may be collected in order throw more light on these very tentative conclusions, and I would be grateful for any records and specimens which members care to pass to me for identification or confirmation.

ACKNOWLEDGEMENTS

I am grateful to all those collectors who passed specimens to me or deposited them in a museum collection: J. T. Burns, M. Crittenden, W. D. Hincks, P. Skidmore, D. W. Twigg and D. Whiteley. I also wish to express my gratitude to Colin Johnson, Martin Limbert, Dr Peter Skidmore and Derek Whiteley for providing access to the entomology collections at Manchester Museum, Doncaster Museum & Art Gallery and Sheffield City Museum.

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BOOK REVIEW

Geologische und Entomoökologie der rezenten Seidenbiene *Colletes*. Volume 1 by **Detlef Mader.** Pp. xliii + 807. Logbook, Köln. 1999. DM 98.00 (about £31.50) hardback.

The solitary bees of the genus *Colletes* usually nest underground, lining their burrows and cells with a cellophane-like material which is also used to separate the cells. This glistening lining resembles silk, so these insects are popularly known as silk bees. This large book is the first of two comprehensive volumes on the silk bees, particularly *C. daviesanus.* The world literature has been scanned to produce it, surely a labour of love.

The nesting site characteristics of the *Colletes* species of the palaearctic, nearctic and neotropical are considered in great detail. The types of substrates chosen, whether nesting is on vertical or horizontal surfaces, whether nests are in aggregations or solitary, and the persistence of particular nesting sites are among the topics considered. The importance of the cellophane-like linings is also examined. Descriptions of the geological strata and man-made structures (e.g. buildings) used for nesting sites by *C. daviesanus,* mainly in Germany but also in the rest of Europe, are supported by numerous colour photographs.

The pollen and nectar sources of palaearctic, nearctic, neotropical and Ethiopian species are recorded in great detail, with summary tables of the *Colletes* species associated with each plant family and genus. Further chapters deal with the cleptoparasites and predators of the silk bees and other aculeate species that nest in the same substrates as *C. daviesanus.*

The references cover 63 pages and the index, based on species (including 246 *Colletes* spp.), runs to 132 pages, so that coverage of the world literature should be virtually complete. The book also contains 88 colour plates, 306 photographs, 45 maps, 39 b/w illustrations, and 51 geological profiles of *C. daviesanus* nesting sites.

This is a book for the specialist interested in silk bees and for the natural historian interested in studying a rare example of pure natural history summarising the raw data of a taxonomic group of organisms. In this modern scientific age dominated by theory driven observations and experimentation this is an exceptional book.

MEA

JAMES BOLTON'S 18TH CENTURY PAINTINGS OF LEPIDOPTERA

GEOFFREY FRYER
Elleray Cottage, Windermere, Cumbria LA23 1AW

INTRODUCTION

James Bolton (1735? - 1799) of Halifax, justly famous as a botanist, and especially as a mycologist, who recorded and made splendid illustrations of fungi, lichens, mosses, ferns and flowering plants, was an all-round naturalist whose interests also extended to animals. An excellent account of his life, activities, and the works that he bequeathed to posterity is given by Edmondson (1995). Best known of his animal portraits are those of birds and their nests and eggs illustrated in his *Harmonia Ruralis; or, An Essay towards a Natural History of British Songbirds,* a two-volume work published in 1794 and 1796. Several of the plates in this work include insects or, occasionally, spiders. Although I had been aware of this for some years, a deeper interest was kindled when, in collaboration with Jill Lucas, I began to collect information on the changes that have taken place in the butterfly fauna of the Huddersfield area since recording began. As the area defined includes parts of the Halifax district it occurred to me that Bolton's illustrations conceivably provided the earliest records for the area, and this led to an attempt to trace all his illustrations of butterflies. Although information on the provenance of the species illustrated unfortunately proves to be ambiguous, his paintings of Lepidoptera (essentially butterflies) are nevertheless of considerable intrinsic interest.

EARLY CONTRIBUTIONS TO ENTOMOLOGY BY JAMES OR THOMAS BOLTON

Bolton would certainly be familiar with, if not a contributor to, the collection of butterflies and moths ("papilios and phaloenas"), birds, plants "and other curiosities" that had been assembled at least as early as 1763 by his brother Thomas (1722?-1778). This collection was seen at that time by William Withering who recorded the fact in his diaries which were published almost 60 years later. Following Thomas' death this collection was sold, prior to which event James prepared a now lost catalogue of its contents. Fortunately a schoolmaster friend, John Ingham, evidently copied details from this which show that, as well as fossils and shells, Thomas' collection included 400 butterflies, 40 hawkmoths, many hundreds of other moths, and many beetles (Edmondson, 1995).

While it was Thomas who was particularly devoted to entomology, James was knowledgeable about the habits and life histories of the insects that he began to illustrate towards the end of his life. Long before this, either he or his brother sent to Moses Harris a specimen of a moth, the Grey Scalloped Bar, *Dyscia fagaria,* that was illustrated in the recipient's famous *Aurelian* (1766). This, as Harris noted, "was caught near Hallifax in Yorkshire, by Mr Bolton, who informs me that he took it in the evening, on the moor; and is the first of the kind I have ever seen". It is unfortunate that Harris refers to the sender only as "Mr Bolton" so we are left uncertain as to which brother is concerned. On balance it was probably Thomas, but this is unproven.

A second moth was sent to Harris who listed and illustrated it in *The Aurelian* under the name of Shaded Broad-barr (modern spelling "bar") and who records that "the same gentleman . . . informs me he took it in the months of May and June," an item of information of considerable relevance. Although it is not specifically stated from where Bolton collected this species the entry follows immediately after that for the Grey Scalloped Bar, and the inference is that it was from the same area. There has been doubt as to the identity of this moth. There are three possible contenders, the Shaded Broad-bar, *Scotopteryx chenopodiata,* (which is easily ruled out), the Lead Belle, S. *mucronata,* and the July Belle, *S. luridata,* of which the last two were long treated as one species under the name S. *mucronata.* The illustration given by Harris perhaps most resembles the Lead Belle. Moreover this species flies from mid-May to mid-June, while the July Belle flies from mid June to early August and the Shaded Broad-bar in July and August (Skinner, 1984). In Northumberland and Durham, where S. *luridata is* common and widespread, it does not appear on the wing until *late* June and is present throughout July, as its English name suggests (Dunn & Parrack, 1986), so Bolton's reference to his moth as having been taken as early as May appears to confirm its identity as S. *mucronata* It is unlikely that flight periods differed significantly from those that prevailed until the very recent period of global warming, and comments on the seasonal cycles of butterflies by James Bolton (see below) confirm this. According to Sutton and Beaumont (1989) all the dated records suggest that of the two species formerly conflated as S. *mucronata,* the July Belle predominates in Yorkshire, and all confirmed records at that time were of this species, as they still are (H. E. Beaumont, *pers. comm.).* They also note that it predominates in Derbyshire and Durham. Because Bolton is so precise in his dates it therefore appears that he encountered, almost certainly in Yorkshire, what in northern England is now the rarer of the two sibling species – the Lead Belle, but absolute proof may never be forthcoming.

A permanent reminder of the Boltons' connection with entomology is the scientific name of the Golden-ringed dragonfly *Cordulegaster boltonii.* This anisopteran was described, under the name *Libellula boltonii,* by Donovan (1807) from a single individual that "was discovered in Yorkshire some years ago by Mr Bolton, and communicated to Mr Drury [Dru Drury], in whose cabinet it has remained unnoticed till the present time". Its specific name was bestowed "in compliment to Mr Bolton, the gentleman to whom we are indebted for its discovery." Again the finder is referred to simply as "Mr Bolton", but there can be little doubt that this refers to Thomas and not to James, and it is pleasing that, although overshadowed by his more famous brother, Thomas should be commemorated in this way. The holotype of C. *boltonii* must have been sent to Drury and have resided in his collection for well over 20 years before Donovan described it. Drury amassed a large collection of insects, many provided by his numerous correspondents. This was sold in 1805, not long after his death. Donovan's comment suggests that he had access to the dragonfly that he described as *Libellula* (now *Cordulegaster) boltonii* before this event took place.

Lepidoptera Illustrated in James Bolton's *Harmonia Ruralis*

The largest number of Lepidoptera, eight butterflies and one moth, produced as contributions to a specific project, appear in the *Harmonia Ruralis,* all in the second volume. In an introduction to this volume Bolton writes: "Flies, being food of the birds, may undoubtedly, on that account be introduced with propriety". Another reason for adding them was that "they also serve to occupy such spaces in the plates, as, if left without any kind of object would give an appearance of poverty and emptiness to them". Few illustrations that may have originated as space-fillers, as was probably the case for the Lepidoptera, can be of greater interest two centuries and more after they were produced.

Various other insects and a few spiders are included. Some of these are given scientific names, and brief comments on their habits and habitats are sometimes appended. A few are readily recognisable, but precise identification is often difficult or impossible, though scrutiny by specialists in the different groups may be enlightening. Bolton engraved the plates himself, as Dr John Edmondson pointed out to me. This meant that any writing on them had to be done in "mirror", a skill he had to master. The birds and insects on the printed pages were coloured by hand though occasional small insects were left as uncoloured outlines.

In the sequence in which they appear, the Lepidoptera illustrated are Orange Tip, *Anthocaris cardamines,* Black-veined White, *Aporia crataegi,* Small Tortoiseshell, *Aglais urticae,* Peacock, *Inachis io,* Brimstone, *Gonepteryx rhamni*, Tiger moth, = Garden Tiger, *Arctia caja,* Red Admiral, *Vanessa atalanta,* Small White, *Pieris rapae,* and Clouded Yellow, *Colias croceus.* Although each receives a brief comment, unfortunately no information regarding their provenance is provided. Ironically such information is given for the only zygopteran dragonfly included – *Pyrrhosoma nymphula,* under the name *Libellula Minus* (Bolton used capitals for specific names). It was known at that time as *L.*

minius. Of this species, two individuals of which are portrayed, he gives information on its flight period and haunts and says "it is frequent amongst the bushes besides the River Calder, near Halifax". This shows that, as expected, some (probably most) of the insects illustrated were obtained locally. His brother's collection having been sold, if material was required from which illustrations could be made, the obvious source would be insects that could be procured locally.

Of the comments made on individual butterflies, those that accompany a pleasingly drawn male Orange Tip provide an example. He writes "The Butterfly is called Wood-Lady, the Caterpillar feeds on Wild Rape, Ladysmock &c.; changes to a chrysalis in July, and flies the May following: haunts rivulets and moist meadows", all of which is splendidly concise and informative. Although it is not said from where the insect was obtained it seems highly probable that it was of local provenance. It was regarded as "not uncommon" when Hobkirk (1859) compiled the first published list for the Huddersfield area.

The well illustrated Black-veined White raises particularly intriguing questions that merit discussion. Formerly widely distributed in southern England and Wales, this species extended northwards, certainly to Lincolnshire and Nottinghamshire, and into Yorkshire, but a record for Hawick (S. Scotland) before 1845 is probably erroneous. It is now extinct in Britain. Although Porritt (1883) makes no mention of it as a Yorkshire insect there are at least three references to it as such. Morris (1853 and subsequent editions) said "It has been taken, I am told, at Bishop's Wood, Cawood", but does not identify his informant. While the locality is precise, and the record of this distinctive species is probably valid, it lacks supporting evidence.

Clearly valid, but tantalisingly imprecise in certain respects, is a record hidden in the discussion following a paper delivered to the South London Entomological and Natural History Society by Weir (1888), of which a summary was fortunately published. Here it is recorded that "Mr Carrington" said that "His first experience of *A. crataegi* was in Yorkshire, in a rough place close to Stockton Forest, where it was very plentiful, and the same abundance was noticeable of *M[elanargia] galathea*" – the Marbled White. "Mr Carrington" was John T. Carrington, a competent entomologist who, for example, presented a learned paper at the next meeting of the same society. Stockton Forest is clearly an erroneous rendering of Stockton on the Forest, which lies between York and Stamford Bridge. Carrington was misquoted. This is confirmed by the reference to the Marbled White, whose restricted Yorkshire range formerly extended to that area (Porritt, 1883), and now almost does so again. This species has never been recorded from that part of Yorkshire which lies south of Stockton on Tees, the only other possible Stockton. Carrington did not say in which year he saw the Black-veined White in Yorkshire. What he did say was that in 1878 or 1879 there was a very severe winter and that in the following summer both it and the Marbled White had "utterly disappeared" from the area concerned. While this may imply that he first saw it near Stockton on the Forest in 1878, what is reported does not exclude the possibility that he did so earlier than this, or that he saw it there more than once. This record, and that of Morris, are accepted by Emmet and Heath (1989).

Thanks to Colin Howes and Martin Limbert a third record has been unearthed. Again there is an unfortunate typographic error. In a note published in response to an enquiry in the previous year by A. H. Waters about the then current status of the Black-veined White, Rockett (1892) reported its capture in the neighbourhood of "Sewerby, Hull" in 1885, but Sewerby Hall is clearly intended. There is only one Sewerby in Yorkshire, or indeed in England. This is near Bridlington, and here Sewerby Hall is located. Rockett records how two unidentified larvae were found feeding on "a species of thorn" and reared by a friend. From the ensuing pupae adults of the Black-veined White emerged. An immediate search in the same place yielded six pupae, all of which produced adults within a day or two. Three of these were in the possession of C. E. Rockett in 1892. Rockett noted that "many of the young trees and thorns about there were newly planted varieties from the Continent" and suggested that eggs or young larvae may have been brought with them. Thus, although the identity of the insects is not in doubt, there is some uncertainty as to whether they were of native origin.

In view of the vague history of the Black-veined White in Yorkshire it is particularly unfortunate that Bolton gives no indication of the provenance of the individual that he illustrated. It still bred in most counties south of Yorkshire in the early 19th century and evidently did so in Yorkshire considerably later than this, so the possibility that it occurred in the vicinity of Halifax in the 18th century cannot easily be dismissed. Bolton refers to its larvae as feeding on Hawthorn, *Crataegus monogyna,* which information could have been obtained from other sources, and says it pupates in May, and appears on the wing in June and early July, which again may have been derived from some other source, but could indicate personal familiarity. There is nothing to indicate that he considered it to be a rarity, as which he regarded the Clouded Yellow, or a species of restricted distribution. One feels that had he not known it locally he would have mentioned its range, but we are left with no more than intriguing and probably unresolvable possibilities.

The Small Tortoiseshell, called simply "the Tortoise-shell Butterfly", Peacock and Red Admiral were doubtless all familiar to Bolton around his home and, while this is not stated, it is highly probable that the illustrations were prepared from locally obtained individuals. There would be no need to go further afield. The Red Admiral was referred to by Bolton as "the admirable butterfly". The Brimstone has, during the past century and a half, been of intermittent occurrence in the vicinity of Halifax and Huddersfield where its larval food requirements – Purging Buckthorn, *Rhamnus cathartica,* and Alder Buckthorn, *Frangula alnus,* – are scarcely available. The larval food plants were known to Bolton and he was evidently familiar with the adult in nature as he says that it "is easily taken", but he makes no reference to the provenance of the insect illustrated.

The Small White, called the "small garden White," was doubtless common around Halifax in Bolton's time as it was during the 19th and 20th centuries. He illustrates both sexes. The curious thing about the illustration of the male is that he has applied a dark grey, almost black, wash with the result that the illustration does not resemble any described form of this species. Whether this was some kind of unrectified mistake (are all copies so coloured?) or an unlikely change in colour of the pigment with time is unknown.

The Clouded Yellow, which he calls the "dark clouded yellow," was said to be "very rare in most parts of this kingdom", which suggests that he had knowledge of its distribution. He would not know that it was an intermittent migrant. At that time the possibility that butterflies might arrive in Britain from the Continent seems not to have been considered: even well into the next century such suggestions tended to be ridiculed.

Among the points noted about the Garden Tiger moth, which he called the "large Tyger Moth", is that it "is commonly found among new hay" an observation that suggests habits observed locally.

Other Illustrations of Butterflies by James Bolton

In 1910 Charles Crossland gave a lecture on James Bolton to the Halifax Scientific Society which in the same year appeared in printed form in the *Halifax Guardian* and, with slight alterations, as a sixpenny booklet issued by the author. In it he refers to having seen sixteen flower paintings in water colour done on vellum by Bolton, then in the possession of W.Horne of Leyburn. All were signed and bore dates from 1786 to 1795. Crossland recorded that "a Camberwell Beauty butterfly is added to one, and the Greater Tortoise Shell to another". The whereabouts of these paintings is now unknown. The Camberwell Beauty, *Nymphalis antiopa,* has been recorded sporadically as an immigrant in the Halifax – Huddersfield area over a long period and the individual referred to may have been one such. Its intermittent occurrence is of scant significance – such individuals never breed here. The Large Tortoiseshell, *Nymphalis polychloros,* now perhaps extinct in Britain save as a rare migrant, was formerly to be found in the Halifax – Huddersfield area. Indeed four individuals were encountered in the Sowerby Bridge, Halifax, Cromwell Bottom region of

PLATE 1
James Bolton's painting of a Small Copper butterfly and a posy of flowers. Water-colour on vellum. *c.* 1792. By courtesy of the Trustees of the National Museums and Galleries on Merseyside.

the Calder Valley in 1989, 1991 and 1992 (Cain 1990, 1992; Cain & Baggaley, 1994.) If the individual painted by Bolton was locally procured it would be the earliest to be recorded in the area.

Thanks to John Edmondson I learned that in a set of paintings entitled "Twelve Posies gathered in the Fields", now housed at the National Museums and Galleries on Merseyside, plate 12 includes a Small Copper, *Lycaena phlaeas,* a species additional to those listed above, which brings to eleven the number of species of British butterflies known to have been painted by Bolton. The twelve watercolours, of which two bear the date 1792, are on vellum and are bound into an album. As Edmondson (1995) says, they appear to have been painted as a series, so that which includes the Small Copper, a fine illustration, (reproduced here for the first time as Plate 1) was probably painted in about 1792, slightly earlier than the butterflies that appear in the *Harmonia Ruralis.* The butterfly was not part of the original composition but was painted separately and attached later, perhaps for balance or to add to the decorative effect, or even to hide a defect in the vellum. There is nothing to indicate the provenance of this insect, or of the flowers, but as the Small Copper was probably common in the area in which Bolton lived, though it went through periods of scarcity in later years, it seems reasonable to assume that its portrait is of a locally obtained individual, but proof is unfortunately lacking. The flowers are Wood Cranesbill, *Geranium sylvaticum,* which is uncommon in the area frequented by Bolton but plentiful a little further north, Cross-leaved Heath, *Erica tetralix,* and Daisy, (which Bolton calls the Lesser Daisy) *Bellis perennis.* The composition is further enhanced by a small spider suspended by a thread from the Cranesbill.

Nelson (1981) records that in the Chester Beatty Library, Dublin, there is a bound volume of thirty-eight watercolours of which thirty seven are certainly by Bolton, fifteen of them being signed and dated between 1782 and 1791. One is of a rose accompanied by a Peacock butterfly and another is of an Opium Poppy, *Papaver somniferum,* cultivar that includes a butterfly described by Nelson as "possibly a Red Admiral". This well-painted butterfly, resting with closed wings on the stem of the poppy, is not a Red Admiral. Although not identified, it is certainly not a European species. Bolton is known to have copied paintings of flowers done by the great flower painter Georg Ehret (1708-1770), and Nelson (1981) gives an illustration of one such that bears the inscription "Ehret del" in Bolton's handwriting. Ehret, like some of his predecessors and contemporaries, sometimes added butterflies to his paintings of flowers, and Bolton probably adopted this fashion to enhance and balance his painting. As this was of an exotic plant he presumably thought it appropriate to incorporate an exotic butterfly, perhaps copied from an illustration seen elsewhere. While interesting, this butterfly is of no relevance in the present context. The Chester Beatty Peacock was apparently painted before the butterflies of the *Harmonia Ruralis,* but as another example appears in that work it does not extend the list of species painted by Bolton.

Acknowledgements

Harry Beaumont and Philip Winter kindly gave me the benefit of their expertise on the taxonomy of the moths sent to Moses Harris by one of the Bolton brothers; Colin Howes and Martin Limbert led me to a forgotten record of the Black-veined White, and Dr. Geoffrey Boxshall enabled me to see otherwise inaccessible literature. I am particularly indebted to Dr. John Edmondson who not only encouraged me to pursue this matter but generously provided helpful information from his great store of knowledge of James Bolton, and gave access to Museum material in his care. Permission to reproduce the plate was kindly granted by the trustees of the National Museums and Galleries on Merseyside. To all these I express grateful thanks.

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OCCURRENCE OF TWO ADVENTIVE SPECIES OF CTENUCHIDAE (LEPIDOPTERA) IN YORKSHIRE

H. E. BEAUMONT

37 Melton Green, West Melton, Rotherham S6H 6AA

Moths of the large family Ctenuchidae have a largely tropical distribution. Many are mimics of Hymenoptera or, like their close relatives in the family Arctidae, are brightly coloured, suggesting that they are distasteful to predators. The life histories of many species remain unknown but the two that are the subject of this note are associated with bananas (*Musa saepientum* Linnaeus) which are undoubtedly the source of their introduction into the county.

Euchromia lethe (Fabricius, 1775)

While attending the Yorkshire Naturalists' Union Entomological Section meeting at Cliffe Castle Museum, Keighley on 2 October 1998, advantage was taken of an invitation to view the collections there. Among undetermined material of several orders was a striking moth, evidently belonging to the family Ctenuchidae. The specimen, together with its cocoon, had been brought to the museum by a Mrs Hattersley of Avondale Road, Shipley (VC63) on an unspecified date, the label pinned beneath the cocoon, which was attached to a fragment of banana skin, reading "This moth emerged from the light brown cocoon on the left which was affixed to a banana skin. JULY 1948". Presumably the banana had been purchased locally. Arrangements were made to take the specimen and its associated cocoon on loan. The moth was readily determined as *Euchromia lethe* (Fabr.). This species, an inhabitant of West Africa and the Congo basin, is quite frequently discovered in Britain among imports of bananas of West African origin. There does not, however, appear to be any previous record of this moth having occurred in Yorkshire, the present specimen having apparently languished unrecognised for fifty years.

Antichloris viridis Druce, 1884

At a meeting of the Yorkshire Naturalists' Union Entomological Section held at Wilberfoss on 15 April 2000, Mr D. Giggal of Barnsley exhibited a Ctenuchid moth labelled as *Antichloris viridis*, one of two found by his son-in-law Mr D. Gore during a period of employment in 1998 at a fruit packing company at South Elmsall, near Pontefract, West Yorkshire (VC63). The genus *Antichloris* is restricted to the neotropical region from where some 27 species have been described. Being aware that a further two species of this genus were listed in the recent British checklist (Bradley, 1998), a loan of the specimen for study was requested. Mr Giggal not only readily agreed, but also kindly donated the specimen to the author.

Reference to Field (1975) confirmed the identity of the moth as *A. viridis*, one of the more destructive pests of banana in Central America and northern South America, with a distribution ranging from Ecuador, Colombia and Venezuela northwards to southern Mexico. After feeding on the under surface of banana leaves, the larvae construct weak and very thin whitish-yellow cocoons behind the leaf sheaths or on the stalks or between the fruit, the latter two situations accounting for their being transported widely with exported bananas. It is recorded from widely scattered localities in Britain (Heath, 1979). These two moths from South Elmsall are the first to be recorded in Yorkshire.

The two other species of *Antichloris* listed from Britain by Bradley (1998) are *A. caca* Hübner, 1818 and *A. eriphia* (Fabricius, 1777); both these species are also associated with, and potentially liable to be imported with, bananas. I have been unable to locate any information about either so far as their occurrence in Britain is concerned, Heath (1979) commenting of *A. caca*: "Although listed in Kloet & Hincks (1972) no other reference to the occurrence of this species in Britain has been traced". *A viridis* is undoubtedly the species of *Antichloris* most frequently imported into Britain, but the possibility of other members of the genus occurring here should be borne in mind.

ACKNOWLEDGEMENTS

My thanks are due to Margaret Hartley, Keeper of Natural Sciences at Cliffe Castle Museum, Keighley for arranging a loan of the moth from the collections under her care and to Mr D. Giggal for his donation of the moth exhibited at Wilberfoss. Both the above have kindly allowed me to publish the records of their respective moths.

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THE SCARCE VAPOURER MOTH *ORGYIA RECENS* HUBNER (LEP: LYMANTRIIDAE) IN AND ADJACENT TO THE HUMBERHEAD LEVELS NATURAL AREA

C. A. HOWES
Doncaster Museum and Art Gallery, Doncaster DN1 2AE

INTRODUCTION

Of approximately sixty species belonging to the genus *Orgyia* distributed mainly in the Holarctic, only two, *O. antique* (Lin.) the common vapourer moth and *O. recens* Hubner the scarce vapourer moth occur in Britain. Like others of their genus, the females are flightless having only vestigial wings, the males are usually day-flying and indulge in characteristic, swooping flights (de Worms, 1979).

The scarce vapourer moth, formerly occurred very locally across central, southern and into south-western England and parts of South Wales. In recent decades its distribution has contracted considerably, with populations now restricted to north-west Norfolk (VC 28), South Lincolnshire (VC 53), North Lincolnshire (VC 54) and with a notable concentration in south-west Yorkshire (VC 63) (Skinner, 1984; Key, 1986a; Shirt,1987). This study has located evidence of its occurrence in adjacent vice-counties of south-east Yorkshire (VC 61), north-east Yorkshire (VC 62), mid-west Yorkshire (VC 64) and Nottinghamshire (VC 56) with most occurring in the context of bog, sandy heath and wet woodland habitats of the Humberhead Levels, Vale of York, Sherwood Sandstone and Lincolnshire Coversands 'Natural Areas'

CONSERVATION STATUS

In 1987 the scarce vapourer was one of twenty British and one of only three Yorkshire moth species classified as Red Data Book (RDB) category 2 'Vulnerable'. This category included species declining throughout their range in Britain and whose position was in imminent threat of declining to the Category 1 'Endangered' status if the causal factors of decline continued to operate (Shirt, 1987; Sutton & Beaumont, 1989). A subsequent review adjusted its RDB status to Category to 3 'Rare' (Waring, 1995). This included species known to exist in only fifteen or fewer 10 km squares in Britain, with small populations regarded as 'at risk' but not 'Endangered' or 'Vulnerable'.

Judged to have suffered a 25% to 49% decline in its numbers or distributional range over the previous 95 years, and occurring in only 16 to 100 10 km squares in Great Britain, it qualified for inclusion in the 'Long List of Globally Threatened or Declining Species' (UK Biodiversity Steering Group, 1995).

AIMS

As part of Doncaster Museum's Biodiversity Action Plan research, an attempt has been made to assemble a complete catalogue of sites and records within and adjacent to the Humberhead Levels Natural Area. Data has been gathered from a wide range of sources with a view to forming a better understanding of the scarce vapourer's natural distribution, habitat requirements and status changes. The project also seeks to identify possible causes of decline in the Yorkshire/Humber region and to develop effective habitat and population management strategies to facilitate the moth's sustainable future.

BIOLOGY

Life history

The batch of 400 to 800 white cylindrical eggs with a slight depression at the apex are typically laid on the cocoon from which the female has emerged. The highly ornate larvae reaching about 40mm in length are generally blackish grey in colour with interrupted reddish subdorsal and spiracular longitudinal bands. Long 'pencils' of forward pointing blackish spatulate hairs are situated on either side of the prothorax, four thick tussocks of deep brown hairs project dorsally from abdominal segments 1-4 and a long 'pencil' of hairs is directed backwards from segment 8 (de Worms, 1979). Larvae appear to have two feeding strategies and two cycles of development. Some feed and develop rapidly and form the basis of a small second generation. Some of the first generation and all of the early instar second generation over-winter as larvae and continue feeding in spring, pupating in late May (de Worms, 1979). The deep brown pupae, covered with greyish hairs are encased in a tough silken cocoon usually spun in the foliage of the food plant (de Worms, 1979).

The adults are partly bivoltine with the first generation emerging in from June to July and the scarcer second generation from August to October (de Worms, 1979). As mentioned above, the grey, short-winged, flightless females lay their eggs on the cocoon attached to the food plant. The male has dark chocolate brown forewings with a white sub-apical mark and a white spot at the tornus which are sometimes linked by a broken white line. The much commoner *O. antique* has ochreous red forewings which lack the white sub apical mark.

Food plants

The larvae most frequently feed on the foliage of hawthorn *(Crataegus* spp.), oak *(Quercus* spp.) and sallow *(Salix* spp.), though a range of other broadleaf trees and shrubs are recorded (de Worms, 1979). This study has produced evidence of them on birch *(Betula* spp.), heather (*Calluna vulgaris*), rose (*Rosa* spp.*)*, meadowsweet (*Filipendula ulmaria*) (Hyde, 1980), alder buckthorn (*Frangula alnus*) (Ian Mcdonald, *pers. comm.* 1999) and sorrel (*Rumex* sp.) (Peter Skidmore, *pers. comm.* 1995). It is probable that the herbaceous taxa *Filipendula* and *Rumex* represented incidents where larvae had fallen from adjacent woody trees or shrubs. It may also indicate where in late season, the leaves of the woody food-plant have become too rich in protective toxins such as tannin, forcing the feeding larvae to move elsewhere (P. Waring *pers. comm.* 1999). Since this polyphagous species feeds on a range of the most abundant and ubiquitous vegetation, the availability of food

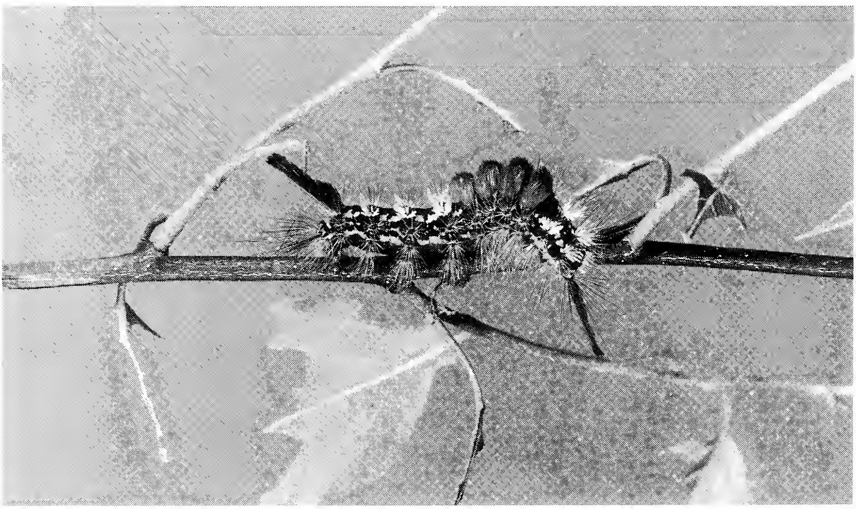

FIGURE 1

Scarce vapourer larva almost certainly reared from stock collected in the Hatfield Woodhouse area, Doncaster during the 1930s. Photograph reproduced from a glass plate negative made by George Edward Hyde.

plants is not likely to account for the moths limited distribution and vulnerable status in Britain.

CURRENT REVIEW

The catalogue of sites located by this study (see Appendix 1) is arranged in alphabetical order within counties and records for each site are entered chronologically. Although lepidopterists have in the past used generalised locality terms, such as Doncaster, York, Selby and South Yorkshire, interviews and correspondence with collectors and the examination of collectors notebooks and lepidoptera collections (see Appendices 1 & 2) has identified some twenty six specific sites in Yorkshire, six in North Lincolnshire and three in Nottinghamshire.

Of the sites identified in Watsonian Yorkshire (see Appendix 1), only nine have produced records since 1980, representing a 67% decline. All the post 1980 sites are located within the Humberhead Levels Natural Area, effectively the region of the post-glacial Lake Humber. Of these, the following two populations have recently been destroyed; the hedgerow at the Green Tree Inn at Hatfield Woodhouse inadvertently by landscaping; and the western fringes of Hatfield Moors SSSI by peat, sand and gravel extraction (Skidmore, 1981;Waring, 1996).

Of six sites located in North Lincolnshire (Crowle Moor (SE/7514); Epworth Turbary (SE/7504); Holme Plantation (SE/9105); Manton and Twigmoor (SE/9305); Messingham Sand Quarry (SE/9003) and Scotton Common (SK/8798)), only four are known to have supported populations after 1980. Of the three Nottinghamshire sites (Edwinstowe (SK/66); Newark (SK/85) and Thorney (SK/8573)), none apparently survived after the 1940s.

Ironically, the counting of sites to produce an indication of frequency can result in numerical anomalies. For instance, Thorne Waste (one site), massively de-vegetated by the practices of the horticultural peat industry since the 1970s, is split into separately named islands of vegetation viz Crowle, Goole, Thorne and Inkle Moors (4 sites). This complement of post 1980s sites therefore actually contributes to an over-optimistic impression of frequency. Current survivals merely represent isolated fragments of the former status which are therefore vulnerable to the vagaries of accidental destruction or random developments. Of the fourteen 10 km squares for which there are records within Watsonian Yorkshire, only eight remained occupied after 1980 (representing a 43% decline), and of the twenty three 1 km squares for which there are records, only eleven remained occupies after 1980 (representing a 52% decline).

Geographical distribution (substrate)

Most sites are associated with the Holocene drift substrates of the Humberhead Levels, effectively the silts, clays, sands and peats of the bed of the post glacial Lake Humber, with others on the north Lincolnshire coversands, the Sherwood sands and gravels and the lower Trent valley silts of north Nottinghamshire.

Geographical distribution (altitude)

Omitting Arthur Doncaster's 19th century Sheffield record (Porritt, 1883) and an unverified larvae from Fewston reservoir in 1934 (Margaret Hartley, *in litt.* 1995) all the specific sites in this study are lowland, ranging from one to 65 m OD. This latter height, which refers to the summit of Brayton Barff, may be an exaggeration since Jackson's collecting site is more likely to have been wet woodland at its base (*c.* 20m OD). Figure 2 shows that 21 (60%) sites are situated below 10 m OD, with 13 (38%) below 5 m, indeed the most frequent spot height was two metres with six localities. The lowest sites are generally associated with Holocene river flood plains of the Hatfield Chase and the Isle of Axholme. This predilection for lowland sites which are or were historically subject to prolonged seasonal flooding perhaps explains the phenomenon of all its life stages (including pupation and over-wintering larvae) remaining in the foliage or canopy of the woody food plants.

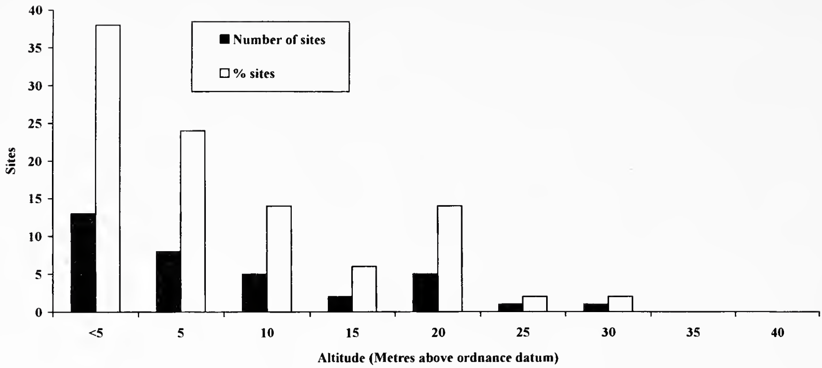

FIGURE 2
Altitude range of Scarce Vapourer Moth sites in and adjacent to the Humberhead Levels Natural Area.

Poulation Monitoring and Protection

The identification of sites forms the first stage in the necessary process of periodically monitoring residual populations. Actions can then commence with a view to assuring the sustainable future for the Humberhead Levels populations. Further, sites which prove positive may be protected by either conservation management agreements with the landowners, backed where appropriate by Local Authorities applying non-statutory second tier conservation designations or English Nature applying statutory SSSI designations. Occupied hedgerows automatically qualify as 'important' under paragraph 6. (1) (a) of the Hedgerow regulations (1997) of the Environment Act (1995), therefore if an application is made for hedgerow removal a Local Authority is empowered to serve a 'Hedgerow Retention Notice'.

Possible Causes of Decline and Restricted Distribution

Biology and the problem with hedge-laying

Of the 14 British moth species where the females are flightless, the scarce vapourer is the only one which oviposits, overwinters as a larva and pupates amongst the foliage of its food plant. As seen above, this is likely to be an adaptation for survival in shrubby food plants in habitats subjected to prolonged inundation. By contrast its commoner relative *O. antiqua* does not overwinter as a larva and generally pupates in crevices in bark, fences and other structures, therefore avoiding the effects of aggressive hedgerow management.

Although the lack of mobility in the adult female severely limits the vapourer's ability to colonise new sites or to avoid the consequences of habitat destruction, many of the vestigialwinged members of the Geometridae remain widespread and abundant in Britain. It may be significant that all thirteen British species pupate on or under the ground and therefore avoid the trauma of hedgerow management. The emergent, females, equipped with proportionally very long and agile legs, are able to climb back into the chosen shrub, tree or hedgerow and select suitable oviposition sites on or near to suitable food substrate. With the scarce vapourer however, the strategy is for their short-legged females to be already in place on the larval food plant when they emerge from their pupal cocoons. There is therefore no need for long legs and normally no handicap in being sedentary and ovipositing on their strategically placed empty pupal cases. Although undoubtedly an adaptive advantage in pre-drainage and pre-enclosure times, this arboreal behavioural strategy becomes a serious liability if the pupal cases and overwintering larvae are destroyed or become detached and dispersed by hedgerow management.

In lowland Britain's post enclosure landscape, the scarce vapourer's shrubby food plants, particularly hawthorn and oak would typically have been managed as hedgerow elements. This may have expose a weakness in the feeding/breeding strategy since routine hedgerow management is likely to prune out much of the foliage supporting the cocoons, eggs and particularly the over-wintering larvae. This may explain why the species was already 'scarce' in the days of Stainton (1857) and Morris (1859). However, during the era of manual hedge laying, it is likely that at least some of the larvae-bearing foliage would have been plaited or laid back into the thick stock-proof hedge structure, enabling some level of survival. By contrast, the violent mulching action of modern reciprocal-blade mechanical hedge flailing is likely to be profoundly more destructive.

It would seem likely that current mechanical hedge management practices have accelerated the species scarcity. It may therefore be significant that a hedgerow in Finningley where a colony still survives, is managed manually as part of the national hedge-laying championships.

Mechanical hedge trimming and flailing had its experimental origins in the 19th century (Blandford, 1976) though the current equipment used ubiquitously by the farming industry and Highway Authorities only dates back to the tractor-mounted hedge cutting machinery demonstrated at the Royal Show in 1948. By 1971 some 38,000 sets of equipment were being used in Britain (Pollard *et al.*, 1974). Interestingly the timing of the scarce vapourer's decline would seem to coincide with this historical development, with only 34% of Yorkshire populations surviving beyond 1980. Perhaps the scarce vapourer has become the 'corncrake' of the hedgerow fauna, its specialist biology rendering it peculiarly vulnerable to mechanisation.

Wetland habitat reduction – land drainage and groundwater abstraction

A cursory examination of the prevailing habitats at known sites confirms an association with lowland heath, wet woodland, fen and bogland habitats, thus the decline is likely to be generally associated with the national decrease and fragmentation of these habitat categories. The current data enables a greater refinement of interpretation. Although confined to a region of relatively warm summer temperatures (16.7°C July mean) and low annual rainfall (1941-1970 mean = 579mm) with no pronounced seasonal variation, the species exhibits a marked preference for sites with a high water table. Further, the curious concentration of historical and surviving sites along the courses of the Holocene river flood plains, indicates an association with and possibly a reliance on seasonal inundation. Underlying causes of decline are therefore likely to be associated with the history of river diversion and flood management (notably of tidal Don and the once tidal Idle, Torne and Went) commencing in the 1630s and continuing through the 19th and into the late 20th centuries. Since prolonged inundation would have been the prevailing situation during the Bronze age when the fens and lowland raised mires of the Humberhead levels were forming and would have remained the case up till the above mentioned drainage schemes, this would serve to explain the past and current residual distribution of this evidently highly specialist member of the Humberhead Levels wetland fauna.

Commencing in the 1930s and substantially increasing after the 1960s, the exploitation of the Sherwood sandstone aquifer to the east of Doncaster has coincided with the desiccation of wetland sites in the historic Hatfield Chase region (Howes, 1994). At Blaxton Common, the extensive bodies of open water of the 1960s disappeared in the mid 1970s and by 1991 the water table had dropped to about 10 metres below ground level. At the carr woodland adjacent to the Finningley scarce vapourer hedge, the water table in 1991 was some 4.9 metres below ground level. At Tyrham Hall sand quarries on the south western corner of Hatfield Moors and adjacent to one of George Hyde's 1930s scarce vapourer sites (see Appendix 1), the water table in 1991 was some 7.5 metres below ground level. Table 1 lists the locations and dates of commissioning of those major abstraction boreholes situated near to known scarce vapourer sites. The groundwater levels for 1980 and 1991 are given for each borehole together with the last recorded date of wild scarce vapourer.

TABLE 1

Water Abstraction Boreholes and Groundwater Draw-Down effect at some *O. recens* sites.

Borehole Location	Dates Commissioned	Groundwater level Metres OD) 1980	1991	*O. recens* site.	Last Record
Boston Park	1969-83	+1.00	–8.28	Hatfield Moors (west)	1974
Finningley	1961	–4.35	–6.00	Finningley	1989
" "	"	"	"	Blaxton Common	1971
Hatfield Woodhouse	1965-9	–4.80	–4.76	Green Tree	1983
Thornham	1939 + 1980	–1.05	–6.18	Auckley	1960s

This once predominantly wetland region is now subject to serious soil moisture deficits to the extent that sand storms and peat-dust 'brown-outs' are frequent and there is a seasonal requirement for agricultural spray irrigation.

Arable development

The trend to arablisation from the 1960s onwards in lowland eastern England and significantly within the Humberhead Levels Natural Area, has led to widespread hedgerow removal. Additional damage to hedgerow faunas will inevitably have been caused by agricultural spray drift and stubble burning (now discontinued).

Urbanisation

Post war urban development has been responsible for the destruction of some sites. The entomologicaly celebrated Wheatley Wood, Doncaster was developed as the site of the Intake housing estates in the 1950s, Green House Park, Doncaster is now a tiny municipal green-space in the heavily urbanised Wheatley Hills district, and sites in the expanding dormitory villages of Blaxton and Branton were built over during the 1960s and 1970s (see Appendix 1).

Population and Habitat Management

Legislation and Official policy

The few remaining occupied sites should be protected from destruction or inappropriate treatment by habitat management agreements backed up where appropriate by either statutory or none-statutory designation as mentioned above. The sites also require inclusion in such strategic conservation documents as Environment Agency river catchment management plans, groundwater management strategies and associated Biodiversity Action Plans.

Population supplementation

The rearing and release of rarities into the wild is a highly controversial issue amongst lepidopterists, the practice threatening confusion in geographical distribution, gene pool and habitat preference monitoring. However, since this practice already takes place, usually in secrecy and in isolation, it is important to monitor these events and if possible manage them into agreed species conservation strategies. To the credit of my correspondents, information on the following release and supplementation events has been freely supplied for this review.

The Nature Conservancy Council was informed that in 1960 a colony was successfully introduced onto Strensall Common (SE/6561) (R. Key, *pers. comm.* 2000). During the

1970s and 80s larvae raised from stock collected from the 'Green Tree Inn' hedge, Hatfield Woodhouse (SE/6809), were annually released back into the donor site by the Doncaster lepidopterist Albert Wright (P. Skidmore, *pers. comm.* 1995). At Blaxton Common, some 200 larvae bred from stock collected from the hedgerow along Wroot Road (SE/6800) in 1971 were returned to the donor site by T. Hartman (T. Duro & J. Culpin, *pers. comm.* 1999). Over 500 larvae reared from stock collected from the hedge by the A614 opposite Crow Wood, Finningley (SK/6797) were returned in 1989 (Viles, 1989; B. L. Statham, *in litt.* 1999). Stock collected by the late S. M. Jackson from the Bishops Wood, Selby (SE/5533) population is maintained as a captive culture by members of the Entomological Livestock Group (formed in 1978) and used periodically to supplement wild populations or in attempts to establish new colonies. This stock was used post 1990 to supplement the Crowle Moor (SE/7514) population where, although the new colonies were successful, particularly on hawthorn, the best were inadvertently felled during conservation management work (M. White, *in litt.* 1999). In 1998, 200 larvae reared from Bishops Wood stock were released onto Birch on the western side of Blaxton Common (SE/684015) but re-examination in 1999 found no sign of survival (S. R. Sowden, *in litt.* 1999). A 'sleaved' colony reared from Bishops Wood stock currently exists on a birch tree in a garden in Auckley (SE/6501) (S. R. Sowden, *in litt.* 1999). In 1998 2000+ larvae raised by the Entomological Livestock Group were released back at the Bishops Wood site to supplement the wild population (S. R. Sowden, *in litt.* 1999). In 1993, using Bishops Wood stock, attempts were made to establish populations at Deep Carrs Quarry (SK/5582), where its continued presence was confirmed in 1994 and Worksop (SK/5880) (M. White, *in litt.* 1999).

'Rescue Entomology'

In the light of the scarce vapourer's evidently vulnerable reproductive strategy and the inability of isolated populations to expand or migrate, in accordance with guidelines set out in Sutton and Beaumont (1989) an effective conservation strategy could link targeted habitat management in suitable wetland sites with an agreed programme of captive rearing and release.

Since unique genetic attributes of surviving populations may have become refined to suit the requirements of the moths in these specific locations, there is an argument to keep these colonies pure'. However, with an inevitably small gene-pool, the problems of 'in-breeding' may justify the consideration of periodic introductions of stock from other sites.

In the event of occupied sites being threatened by hedgerow management, tree felling or vegetation removal, larvae and pupal cocoons should be 'harvested' in advance of such work and transferred to suitable adjacent shrubby food-plants. Stock could also be captive-reared and released back to the site when the vegetation has recovered sufficiently. There is also a justification for the release of captive-reared stock in the context of habitat restoration programmes i.e. in the aftermath of peat and mineral workings as at Hatfield Moors.

DEDICATION AND ACKNOWLEDGEMENTS

In 1995 Doncaster Museum was privileged to acquire the lepidoptera collection and associated notebooks and manuscripts of the late Samuel Maurice Jackson (1914-1995), YNU Lepidoptera recorder from 1963 to 1993 (Tannett, 1995). The wealth of unpublished data on the scarce vapourer moth discovered amongst Maurice Jackson's specimens and miscellaneous documentation led directly to the compilation of this review. It is fitting therefore to dedicate this work to this extraordinary Yorkshire naturalist.

Since photographs of *O. recens* are virtually unknown in the British literature, it is opportune to publish here for the first time the historic photograph of a mature larva (see Figure 1) reproduced from a glass plate negative made by the pioneer entomological photographer George Edward Hyde (1902-1986) of Doncaster. The specimen was almost certainly reared from stock collected in the Hatfield Woodhouse area during the 1930s.

I would like to thank Dr Roger Key (English Nature), Dr Paul Waring (Joint Nature Conservation Committee), Messrs Harry Beaumont and Philip Winter (YNU Lepidoptera recorders) and Dr Peter Tannett (YNU Entomological Section) for encouragement and comments on successive drafts of this study. For records and anecdotes, thanks are due to Ms Margaret Hartley (Cliffe Castle Museum, Keighley); Joyce Payne (YNU Lepidoptera Study Group); Dr Shiela Wright (Wollaton Hall Museum, Nottingham); Dr Peter Skidmore (Entomological Consultancy, Swansea); Messrs M. Denton (Yorkshire Museum); R. Comley (Rotherham Museum); J. Culpin, T. Duro, B. L. Statham and I. Viles (Derbyshire and Nottinghamshire Entomological Society); B. C. Eversham (Cambridgeshire Wildlife Trust); R. I. Heppenstall (Yorkshire Wildlife Trust); I. Mcdonald (Doncaster Naturalists' Society); A. Norris (Leeds City Museum), S. Ogilvie (Yorkshire Museum); C. Ralston (English Nature), S. R Sowden (Entomological Livestock Group); S. Thompson (Scunthorpe Museum); G. Trinder (Lincolnshire Wildlife Trust); M. White (Entomologist, Worksop) and C. Yates (Huddersfield Museum).

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APPENDIX 1

YORKSHIRE SITES AND RECORDS

Askern (SE/51) VC 63
1988. (Jackson, 1981, annotated by SMT.) [Probably refers to nearby Owston Wood see below].

Askham Bog (SE/S748) VC 64
Pre. 1883. William Prest and G. T. Porritt. (Porritt, 1883). See York.

Auckley (SE/6501) VC 63
ca. 1960. Larvae in Hawthorn hedge along Auckley Common Lane (R.I. Heppenstall, *pers. comm.* 22.12.1995 & 8.1.1996).
1998. 13.9.1998 200 2nd and 3rd instar larvae from Bishop Wood stock released onto Birch tree in garden of 12 The Paddocks, Auckley (SE/652009) (S. R. Sowden, *in litt.* 20.10.1999).
1999. 20.10.1999 100+ larvae from the above stock still present in a 'sleeve' on the Birch tree in garden of 12 The Paddocks, Auckley (S. R. Sowden, *in litt.* 20.10.1999).

Bishops Wood (SE/5533) VC 64
Pre. 1877. (Porritt, 1877). John W. Taylor, etc. (Porritt, 1883).
1986. Pair mating 6.7.1986 JM. (Lockwood, 1986).
? 1988. Female taken from Owston Wood by Maurice Jackson attracted male and fertile brood raised. Specimens released back into Bishops wood to supplement the wild population (Jackson, 1986).
1988. 1m. reared (Jackson, 1986).
1991. 1 larva on 13.9.1991 SMJ (Lockwood & Ramsden, 1991; Jackson, 1991).
1992. Larvae 14.5.1992 (Jackson, 1993). 5.6.1992 reared m. 14.6.1992 reared f. 26.10.1992 reared m. from ova from female reared from Bishops Wood larva (Jackson notebook No.4a, Jackson 1993).
1998. 2000+ larvae of Bishop Wood stock raised by the Entomological Livestock Group, released back on site to supplement the wild population (S. R. Sowden, *in litt.* 20.10.1999).
For examples of where Bishops Wood stock has been used to supplement populations at other sites see entries for Auckley, Blaxton Common, Crowle Moor, Deep Carr Quarry and Worksop.

Blaxton Common (SE/6801) VC 63
1960. (Skinner, 1984; Key, 1986b).
1963. lm. reared -.6.1963 from larva beaten from the hedgerow along Wroot Road (SE/6800 (R.I. Heppenstall, *pers. comm.* 8.1.1996).
1971. 4 larvae collected 19.6.1971, 2 by J. Culpin, and 2 by T. Hartman from young short growth from the Hawthorne hedgerow on the Wroot-Finningley road. Adults were raised from which a second generation was bred. Larvae from J. Culpin were passed to Mr E. C. Pelham-Clinton and from T. Hartman to Mr Densel Ffennell. Some 200 larvae were returned to the donor site by T. Hartman and sample adults were placed in various private collections including those of T. Duro (T. Duro & J. Culpin *pers. comm.* 13.12.1999).
1998. 13.9.1998 200 2nd and 3rd instar larvae from Bishops Wood stock released onto Birch tree on Blaxton Common (SE/684015). (S. R. Sowden, *in litt.* 20.10.1999).
1999. 8.9.1999 release site re-examined but no signs of specimens (S. R. Sowden, *in litt.* 20.10.1999).

Blaxton Village (SE/6700) VC 63
1970s. Site known during 1970s was built over by 1989 (B. L. Statham *in. litt,* 27.8.1999).

Branton (SE/6401) VC 63
1967. 3 larvae (P. Skidmore, *pers. comm.* 1.12.1995).
1967. Larvae on Hawthorn hedge off Whiphill Lane. Area cleared for housing development in 1967 (S. R. Sowden, *in. litt.* 1.8.1998).
1973. 1 larva (P. Skidmore, *pers. comm.* 1.12.1995).

Brayton Barff (SE/5830) VC 64
1935. May - June several larvae (Jackson notebook No. 1).
26.6.1935 reared f. 28.6.1935 reared (deformed) m. 30.6.1935 reared m. (Jackson notebook No.1).
1954. Formerly present, last seen in 1954 S. M. Jackson (YNU Card Index).
1956. -.5.1956. Larvae on Sallow and Hawthorn (YNU *Lepid. Bull.,* 1956; Jackson, 1991).

Deep Carrs Quarry (SK/556825) VC 63
1993. 118 larvae released 28.8.1993 and c. 1000 larvae released 18.9.1993. Stock raised from Bishops Wood material obtained via S. M. Jackson (M. White, *in litt.* 1999).

Doncaster (SE/60) VC 63
1850s. (Stainton, 1857; Morris, 1859) (possibly refers to Wheatley Wood (SE/6004) Doncaster Museum Card Index).
1934. single larvae was taken which developed into a male. *'The insect had not been met with earlier by the writer'* (Hyde, 1936).
1935. -.6.1935. 'A *number of larvae . . . were collected near Doncaster and several moths were reared including a few of the curious and almost wingless females'* (Hyde, 1936).
1936. 6m & 1f reared -.7.1936 (G. E. Hyde Colln.).
1937. *'Several larvae taken'* (Hyde, 1938).
1938 & 1948 (YNU Ann. Rep for 1966).
1930s & 1940s. *'Local east of Doncaster and less common than formerly'* G. E. Hyde Doncaster Museum Card Index).
Larvae from the Doncaster district exhibited by Mr W. E. Minnion on 22.9.1948 at a meeting of the South London Entomological and Natural History Society *(Entomologist, 1949).*
1949. 12m reared -.6.1949 (L. G. F.Waddington Colln.).
1959. 2m reared 14.7.1959 (G. E. Hyde Colln.).
'. . . *a locality within three miles of the centre of Doncaster'* [possibly Wheatley Wood] (Hyde, 1980)

Finningley area (SK/69) VC 63
1962 G. E. Hyde (Doncaster Museum Card Index).
1965. 7.6.1965 *'Quite plentiful on hawthorn hedge on the roadside. Location shown to us by Mr [Albert] Wright of Doncaster. J. B. & CRH'* (Jerry Briggs Catalogue notes, Keighley Museum).
-.6.1965 reared from larvae from Finningley (C. R. Haxby Colln.).
1966. specimens reared from Finningley stock (J. Briggs Colln).
1989. -.5.1989. By the A614 opposite Crow Wood (SK/6797) B. L. Statharn beat 2 larvae from the roadside hedge and 7 larvae from small hawthorn bushes on the wide grassey verge (B. L. Statham, *in litt.* 27.8.1999).
10.5.1989. Same site produced one larva which was left in situ (B. L. Statham, *in litt.* 27.8.1999).
Over 500 larvae were reared by Mr Statham and returned to the area in 1989 (Viles, 1989).

Fewston (SE/1954) VC 64
1934. '. . . *a larva picked up on Fewston Reservoir bank in August by Miss Jackson'* (Bradford Naturalists' Society records).

Goole Moors (Thorpe Moors) (SE/71) VC 63
Pre. 1966. (YNU Circular 1966 no. 631).
1966. Recorded on YNU Excursion to Goole Moors 12.6.1966 (Crossley 1966). A male and a female reared from larvae collected on this occasion are in the H. E. Beaumont Collection (H. E. Beaumont, *in litt.* 3.12.1995).

Greenhouse Park, Doncaster (SE/5904) VC 63
[adjacent to the site of Wheatley Wood]
1907. Early Sept. 1907. Male caught on wing by Mr E. B. Tomkinson (Hewett, 1907).

Hatfield Moors (SE/60;70) VC 63
1930s. up to 30 larvae found on Sallow, Heather and Hawthorn '*in the vicinity of Hatfield Moors*' (SE/6906 & 6805). More larvae were subsequently found on Birch, Rose and Meadowsweet. (Hyde, 1980).
1935. 1m& 1f reared -.7.1935 (G. E. Hyde Colln).
1936. 1m reared -.6. 1 936 (G. E. Hyde Colln.).
1956. 1m reared 21.7.1956 by Eric W. Smith of Doncaster (R. I. Heppenstall Colln.).
1959. 1f reared 8.6., 2f reared 9.6 .and 1m reared 6.7.1959 (E. W. Smith Colln.).
1960. lm reared -.6., lm reared 6.6., lm reared 18.6.,1m reared 23.6.1960 (E. W. Smith Colln.).
1965. 1m reared -.7.1965 (E. W. Smith Colln.).
1969. Larvae June 1969 by Dr A. M. R. Heron (Jackson, 1970).
1974. G. E. Hyde (Doncaster Museum Card Index).
1981. Referring to land being cleared and worked for sand and gravel extraction along the western side of Hatfield Moors, Skidmore (1981) *notes 'It is known that at least one or two colonies have been lost owing to clearance'* (Key, 1986b; Waring, 1996).
1992. Larvae on Sorrel *(Rumex* sp.) under ancient oak on Richard Lyons' land near Lindholme Hall (SE/7005) (P. Skidmore, *pers. comm.* 1.12.1995).
Larvae on oak foliage in wood on north-eastern edge of the moor (SE/7207) (P. Skidmore, *pers. comm.* 1.12.1995).

Hatfield Woodhouse ('Green Tree Inn' hedge) (SE/6809) VC 63
1930s. First located by Mrs Kath. Hyde, probably during the 1930s (see Doncaster & South Yorkshire). Became a well known local site.
1970s-1980s. During the 1970s and 80s Albert Wright collected larvae from the 'Green Tree Inn' hedge, and raised broods with which he annually supplemented this wild population (P. Skidmore *pers. comm.* 1.12.1995).
1981. Larvae noted by G. Hyde and Dr A. M. R. Heron (YNU Card index; Jackson, 1981).
1983. 'Collected few [larvae] the year before last (i.e. 1983)' G. E. Hyde, *pers. comm.* 1985 (Doncaster Museum Card Index).
1980s. 'Green Tree Inn' (Key, 1986b).
1995. August 1995, hedgerow removed and site landscaped with ornamental gardens as part of Pub refurbishment (Waring, 1996).

Inkle Moor (Thorpe Moors) (SE/7016) VC 63
1985. R. S. Key (Doncaster Museum Card Index).
Morton's Bog (3-4 miles SW of Selby) (SE/52) VC 64
1954. Larvae. Formerly present, last seen in 1954 S. M. Jackson (YNU Card Index).

Owston Wood (SE/5710) VC 63
1983. 7.7.1983 1 female reared (R. I. Heppenstall, *pers. comm.* 22.12.1995 & 8.1.1996; Key, 1986b).
1988. September 1988 S. M. Jackson (see Bishops Wood) (Doncaster Museum Card Index, Jackson, 1981, annotated by SMJ. 1986).

1991. Larvae (Jackson, 1991).

Potteric Carr (SE/5900) VC 63
1974. 23.7.1974. 1f reared from 2 larvae (R. I. Heppenstall, *pers. comm.* 22.12.1995 & 8.1.1996; Jackson, 1981; Key, 1986b).

Rossington (SK/69) VC 63
Pre. 1883. William Warren (Porritt, 1883).

Selby area (SE/52; 53; 63) VC 64
Pre. 1883. John W. Taylor etc. (Porritt, 1883).
1937. 2m -.8.1937 (Thornton Colln.).
1939. '. . . a note by Mr W. Buckley incorporates the capture by S. M. Jackson of *O. gonostigma* = *recens* from near Selby'. (Dearing, 1940).
1954. 2m reared -.7.1954 (S. M. Jackson Colln.) [= Selby Golf Links see Jackson notebook No. 3].

Selby Golf Links Wood (SE/5629) VC 64
1954. Single larvae collected on 25.7.1954 (m), 28.7.1954, 31.7.1954 1 larva (m) (Jackson notebook No. 3).

Sheffield (? SK/38) VC63
Pre. 1883. Arthur Doncaster (Porritt, 1883).

Skipwith Common (SE/63) VC 61
1947. Autumn 1947 (Jackson, 1991).
1948. 29.5. & 1.8.1948 (J. Ramsden Colln.).
1949. 9-11.7.1949 2m reared by E. Ramsden (Thornton Colln.).
1956. -.5.1956. Larvae on Sallow and Hawthorn (*YNU Lepid. Bull.* 1956).
1957. 15.6. 1957 (E. Richards Colln.).
1960. 28.5.1960. Larvae common E. Richards & C. I. Rutherford (YNU Ann. Rep. for 1960). *'I believe the larvae have been found on hawthorn on the edge of the common (E. Richards)'* (Jackson, 1990)
1940-1960. (Hyde, 1980; Key, 1987).

South Yorkshire VC 63
1942. 4m reared -.7.1942 (G. E. Hyde Colln.).
1943. 1m reared -.6.1943 (G. E. Hyde Colln.).
1945. 1m reared -.6.1945 (G. E. Hyde Colln.).
1948. 1m reared -.7.1948 (G. E. Hyde Colln.).
1950. 1m reared -.6.1950 (G. E. Hyde Colln.).
1958. 2m reared -.7.1958 (G. E. Hyde Colln.).
1969. 6m reared -.7.1969 (G. E. Hyde Colln.).
1970. 1m reared 21.6.1970 & 1m reared -.11.1970 (G. E. Hyde Colln.).
(see Hatfield Moors, Hatfield Woodhouse and Thorne Moors).

Strensall Common (SE/6561)VC 62
1960. Population successfully introduced (Key, 1987; and *pers. comm.* 2000).

Thorne [Moors] (SE/71)VC 63
1939. 2 larvae collected 4.6.1939, male emerged 20.7.1939, female emerged 25.7.1939 (Jackson notebook No.1).
1952. 1 reared (Jackson ,1991).
1954. Three reared (Jackson, 1991).

1960. Larvae collected by A. Steel (YNU Ann. Reps. for 1960 & 1966).
1969. Larvae in '6 canals' area [now NNR] (SE/71-15-) 2.7.1969 (P. Skidmore, *pers. comm.* 1.12.1995).
1970. Larvae (A. Wright) (Doncaster Museum Card Index).
1976. (SE/75 1 6) Thorne Moors Ento. Survey (A. Steel & R. Crossley) (Doncaster Museum Card Index).
1978. (Skidmore *et al.,* 1985).
1980. 'Repeatedly at this site. Recently declined. Extinct ?' (Key, 1986).
1995. Larvae found (SE/7215) (B. C. Eversham, *pers. comm.* 15.12.1995).

Wheatley Wood (SE/6004) VC 63
1850s. (Stainton 1857, Morris 1859) (possibly refers to Wheatley Wood) (Doncaster Museum Card Index).
Pre. 1907. (YNU Transactions 1907). '. . . *a locality within three miles of the centre of Doncaster'* [possibly Wheatley Wood (SE/6004)] (Hyde, 1980). Site cleared for the intake housing estates during 1950s.

Wheldrake Ings (SE/700434) VC 61
1996. 2 males in flight 31.8.1996 (C. Ralston, *pers. comm.* 22.2.2000; Hammond, 1996).
1997. 1 male in flight 12.8.1997 (C. Ralston, *pers. comm.* 22.2.2000.)

York (SE/S4) VC 64
1960. 17m reared October 1960 (L.G.F.Waddington Colln.) (The locality 'York' used on Mr Waddington's data labels but could possibly refer to Askham Bog, York where it was known in the 19th century).

LINCOLNSHIRE SITES AND RECORDS

Crowle Moor NNR (SE/7S914S) VC 63
1978. Larvae photographed -.6. 1978 (R. Key) (Duddington & Johnson, 1983).
1990. Larvae reared -.7.1990 (J. H. Duddington Colln).
Post 1990. Captive-reared stock released post 1990. Although colonies were thriving, particularly on hawthorn, the best were inadvertently felled (M. White, *in litt.* 25.11.1999).

Epworth Turbary (SE/7S8036) VC 54
1980s. larva (G. Trinder, *pers. comm.* 24.11.1999).
1984. 23.6.1984. Larva photographed on *Frangula alnus* on Doncaster Naturalists' Society visit (I. Mcdonald, *pers. comm.* 1999).

Holme Plantation (SE/910053) VC 54
1969. -.7.1969 (Duddington & Johnson, 1983).
1971. reared -.6.197 1 (J. H. Duddington Colln.).
1971. reared 8.7.1971 (J. H. Duddington Colln.).
1972. -.7.1972 (Duddington & Johnson, 1983).

Manton Warren & Twigmoor Woods (SE/9305) VC 54
1960. Joe. H. Duddington (Key,1986a).

Messingham Sand Quarry NR (SE/908032) VC 54
1976. Larvae -.6.1976 (Duddington & Johnson, 1983).
1985 Joe. H. Duddington (Key, 1986a).

South-Lincolnshire (no locality given) **VC 54**
1984. P. Wilson (Key, 1986a; Shirt, 1987).

Lincoln (no locality given) **(SK/94) VC 54**
1912. 2m 1.7.1912 H. C. Haywood (Thornton Colln.).
1912. 1f 2.7.1912 H. C. Haywood (Thornton Colln.).
1921. 3m (College of Ripon & York St John Colln.).

Lincolnshire (no locality given) **VC 54**
1935. 1m (J. Armitage Colln.).
1947. 1m. S. G. Smith (J. Armitage Colln.).

Scotton Common NR (SK/870985) VC S4
1961. Males flying 17.7.1961 (Duddington & Johnson, 1983).
1990. Reared -.8.1990 (2nd brood) (J. H. Duddington Colln.).

NOTTINGHAMSHIRE SITES

Edwinstowe (SK/66) VC 56
Pre. 1916. '*Six larvae swept on the common from which two males and a female were bred*' J. R. Hardy (Carr, 1916). Not recorded since Carr (Cooper & Wright 1993; Wright, 1997).

Newark (SK/85) VC 56
1932. 7m and 2f -.7.1932 H. C. Haywood (Thornton Colln.).

Thorney (SK/8573) VC 56
1949. Larva collected by O. M. White. Reared on *Betula pendula,* male emerged 5.7.1949 (S. Wright, *pers. comm.*; Wollaton Hall Mus. Colln.).

Worksop (SK/587809) VC 56
1993. 108 larvae (reared from Bishops Wood stock via S. M. Jackson) released 29.8.1993. 'Many hundreds of larvae' (from the same stock) released *c.* 29.9.1993 (M. White, *in litt.* 1999).

APPENDIX 2

COLLECTIONS CONSULTED

* = *Orgyia recens* present with Yorkshire/Humberhead Levels specimens represented.
\+ = *Orgyia recens* present with non local or unprovenanced specimens.

Collection	**Location**
J. H. Allis Collection	+ Yorkshire Museum.
John Armitage Collection	* Leeds City Museum
Robert Benson-Jowitt Collection	+ Leeds City Museum
Jerry Briggs Collection	* Cliffe Castle Museum, Keighley
Harry E. Beaumont Collection	* Collectors home in West Melton
College of Ripon & York St. John, York	+* Leeds City Museum
Joe. H. Duddington Collection	* Scunthrope Museum
Cecil R. Haxby Collection	* Cliffe Castle Museum, Keighley.
R. Ian Heppenstall Collection	* Collectors home in Rossington.
George Edward Hyde Collection	* Doncaster Museum.
Samuel Maurice Jackson Collection	* Doncaster Museum.
Quentin Collection	+ Yorkshire Museum.
J. Ramsden Collection	* Cliffe Castle Museum, Keighley.
E. Richards Collection	* Cliffe Castle Museum, Keighley.
Eric W. Smith Collection	* Doncaster Museum.
Joseph Norman Thornton Collection	+* Leeds City Museum.
L. G. F. Waddington Collection	* Doncaster Museum.
O. M. White	+ Wollaton Hall Museum, Nottingham.
Young Collection	Rotherham Museum.

ENTOMOLOGICAL REPORT: DIPTERA (TIPULOIDEA AND EMPIDOIDEA)

ROY CROSSLEY

INTRODUCTION

A major event of 1999 was the eagerly awaited publication of *Insects of the Barnsley Area* by John Coldwell (Sorby Record Special Series No.12, Sorby Natural History Society). The list of Tipulidae (Craneflies) includes 138 species, many of which are the result of recent assiduous collecting by its author, and it comes as no surprise to learn that a further 17 species have been found by him since the manuscript went to print! Empidoidea comprise 209 species, with 2 additions since publication. These diptera constitute only a small proportion of the total insect species listed for a region of southern Yorkshire which embraces a wide range of fine habitats, including some post-industrial sites of quite unexpected interest (the majority now sadly built-over).

Coldwell's recent studies in the Barnsley area, combined with the long-term recording work which has been undertaken in Rotherham by W. A. Ely, and the work done by Dr. Peter Skidmore whilst at Doncaster, have resulted in the southern part of vice-county 63 becoming one of the most comprehensively recorded regions of Britain for Tipuloidea and Empidoidea over the past thirty years.

Further studies by myself at Forge Valley Woods NNR have resulted in the species totals now reaching 97 Tipuloidea and 206 Empidoidea. No comparative regional figures are readily available for the tipulids, but Forge Valley is currently the most species-rich single site for empidoids known in Yorkshire, and as far as can be ascertained, it ranks second only to Wicken Fen in Britain. Work at Forge Valley during the 1999 season was concentrated on the dry calcareous scrub and wooded hillside at the extreme south end of the National Nature Reserve which produced a number of new species, of which the most interesting were the hybotid fly *Oropezella sphenoptera*, present in some quantity, and the rare dead-wood crane-fly *Limonia uniseriata*, of which only a single specimen was found. I am obliged to the staff of English Nature, York, for permission to continue my long-term studies at this very productive site.

Records from High Batts Nature Reserve near Ripon feature prominently in this Report, the consequence of a survey I undertook which extended throughout the 1999 field season; I am obliged to the Reserve Management Committee for granting access and permission to collect. The resultant species list includes 56 tipulids, of which three are Red Data Book and five are Nationally Notable, and 128 Empidoidea species of which three are Red Data Book and four are Nationally Notable. Most are detailed in the following list, and of particular note is *Tipula laetabilis*, here reported for the first time south of the Scottish Highlands. This relatively small river-side Reserve at the northern end of the Southern Magnesian Limestone Natural Area, contains a variety of superbly managed habitats which support, in general, a high quality diptera fauna; further studies by entomologists with different specialisms would undoubtedly reveal many other treasures.

I am obliged to my colleagues Mr J. H. Cole and Mr A. E. Stubbs for assistance with the identification of problem specimens, and to Mr J. D. Coldwell and Mr W. A. Ely for many records, the more significant of which are incorporated into this Report. Records are those of the writer except where indicated otherwise. New County records are indicated by †, and Vice-County records by *.

The 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 following list, and nomenclature, follow Chandler (1998).

TIPULIDAE

Nephrotoma crocata (L.) RDB3. (64) High Batts Nature Reserve, 1♂ 13/5/99. This distinctive black and yellow species is very scarce in Yorkshire, with only three other records in the past thirty years, and a marked decline nationally, the reasons for which are unknown.

N. lunulicornis (Schumm.) Nb. (64) High Batts Nature Reserve, 1♂ 7/5/99; 1 ♂ 19/5/99. There are only four previous Yorkshire records for this species (three in the 1920s and one in 1953). Since 1960 it has been recorded nationally from fewer than ten widely scattered sites, associated with sandy river banks with trees or scrub, or in adjacent woodland (Falk, 1991).

† *Tipula* (s.g. *Lunatipula*) *laetabilis* Zett. (= *dilatata* Schumm.) RDB2. (64) High Batts Nature Reserve, 12/7/99. This is a recent (1975) addition to the British List (Chandler & Stubbs, 1977), hitherto known only from four riverside sites in the Scottish Highlands. At High Batts a male was taken in woodland, and a female on the same day near a pond; these constitute the first English records.

T. (s.g. *Pterelachisus*) *pabulina* Mg. (64) High Batts Nature Reserve, 7/5/99-19/5/99. There are two Yorkshire records prior to 1941 for this species, and then Sedbergh, 1973 and Marske, 1981. Nationally this is a very local woodland species preferring a rich and often calcareous soil; the females sit on tree trunks and the males flutter systematically up such trunks (Stubbs, 1991). This behaviour was watched frequently at High Batts.

† *T.* (s.g. *P.*) *pseudovariipennis* Czizek Nb. (64) High Batts Nature Reserve, 2♀♀, 29/4/99. (*leg.* & *det.* R.C., one specimen *teste* A. E. Stubbs). Nationally this is a local, mainly southern species, mostly recorded from broad-leaved woods on chalk, although there are a few records from localities with sandy soils (Falk, 1991).

CYLINDROTOMIDAE

* *Diogma glabrata* (Mg.) Nb. (63) King's Wood, Roche Abbey, 1986 *leg.* S. J. Hayhow, *det.*W.A.E.; marsh between Grange Wood and Maltby Dyke, 21/7/86 W.A.E. There are few Yorkshire records for this species, which appears to be widely but very locally distributed across the county.

PEDICIIDAE

* *Dicranota* (s.g. *Rhaphidolabis*) *exclusa* (Walker) (63) Midhope Reservoir, 8/9/99. 1♂ swept from shady moorland streamside vegetation, J.D.C. The only previous Yorkshire record is from Malham Tarn in 1956.

* *Ula mollissima* Hal. (61) Barmby Moor, 27/4/99 (*det.* J. H. Cole); (*62) Forge Valley Woods NNR, 26/7/99. This species has been recorded since 1974 from about ten widely distributed sites across Yorkshire, but these now reported are the first for the east of the county.

LIMONIIDAE

* *Crypteria limnophiloides* Bergroth (63) Little Don Valley 1/9/99 & 4/9/99; Midhope Reservoir 8/9/99 (all J.D.C.). There are numerous records from the north-east of the county but none hitherto from VC63.

* *Molophilus corniger* de Meij. Nb. (63) Old Spring Wood, Thorpe Salvin 31/8/86 W.A.E.

* *M. crassipygus* de Meij. (= *ochrescens* Edw.) (63) Gunthwaite Dam, 20/7/99 J.D.C. There are about ten widely scattered Yorkshire records for this species, but hitherto all of them have been in the northern half of the county.

* *M. niger* Goetg. Nb. (64) High Batts Nature Reserve, 19/4/99. Known in Yorkshire from near the River Derwent at Malton and Norton, and from Clough Wood, Gunthwaite, all in 1997.

* *Rhypholophus bifurcatus* Goetg. (6l) Newbald Becksies, 5/10/99; Hagg Wood, Dunnington, 12/10/99.(*62) Forge Valley Woods NNR, 19/9/97.

* *Paradelphomyia* (s.g. *Oxyrhiza*) *dale*i (Edw.) (63) Gunthwaite Dam, 18/7/99 J.D.C. Apparently scarce in Yorkshire,with only five previous widely scattered records, all of which date from 1980 onwards.

* *P.* (s.g. *O.*) *nielseni* (Kuntze) Nb. (62) Castlebeck Wood, 7/9/86 W.A.E. There are only three previous Yorkshire records for this species, from 1984 onwards, all of which are in VC63.

Pseudolimnophila sepium (Verr.) (64) High Batts Nature Reserve, 1/6/99. Local in Yorkshire with few records, all of which, except for one in Wharfedale in 1946, are in the north-east and far south of the county.

* *Atypophthalmus inustus* (Mg.) Nb. (61) Acklam, 15/7/99. 1 ♂ swept near dead timber at the edge of a chalk-spring-fed fen. There is only one other Yorkshire record, Rushy Moor Wood, 1982.

Dicranomyia (s.g. *Dicranomyia s.s*) *omissinervis* de Meij. RDB2 (63) common at Rockley Marsh, 4/7/99; fairly common at Elsecar Reservoir, 11/7/99, both J.D.C. The only previous Yorkshire record for this nationally Vulnerable species is Wentworth Park (VC63), 1982.

D. (s.g. *D.s.s.*) *ornata* (Mg.) Nb. (62) Forge Valley Woods NNR, 11/5/99 (1 ♂); (64) High Batts Nature Reserve, 29/4/99 & 10/5/99 (several of both sexes). This delicate crane-fly with patterned wings is associated with butterbur (*Petasites hybridus*) and the larvae probably develop in the stems of the plant. It is scarce in Yorkshire, the first county record after 1935 being Duncombe Park in 1983, and Bretton in 1998.

* *D.* (s.g. *Glochina*) *sericata* (Mg.) (62) Forge Valley Woods NNR, 17/5/99. On dry calcareous scrub. The only other reported Yorkshire locality for this species is a disused chalk quarry at Bishop Wilton (VC61), in 1996.

† *D.* (s.g. *Idiopyga*) *nigristigma* Nielsen (63) Little Don Valley, 1999: 28/7 1♂, 4/8 1♀, 4/9/♀♀ frequent, J.D.C. All from shady valley-side flushes.

* *D.* (s.g. *Numantia*) *fusca* (Mg.) (61) Acklam, 19/6/99 & 15/7/99.

Rhipida (s.g. *Rhipidia s.s.*) *uniseriata* Shiner RDB3 (62) Forge Valley Woods NNR, 1♂ 2/7/99. The only other Yorkshire record is for Caydale (VC62) on the occasion of the Y.N.U. meeting in 1984. This species is associated with dead wood, from which adults have been reared (Falk, 1991).

HYBOTIDAE

Oropezella sphenoptera (Lw.) (62) Forge Valley Woods NNR. Frequent on a dry calcareous hillside with scrub and broad-leaved woodland on various dates between 28/5/99 and 11/8/99. This is an uncommon species of southern Britain; elsewhere in Yorkshire it is known only from sites on the magnesian limestone in the Doncaster/Rotherham area, and at Duncombe Park (VC62).

* *Euthyneura inermis* (Beck.) Nb (64) High Batts Nature Reserve, 1/6/99. A recent (1987) addition to the British List, this species is known from ancient woodland sites in the North York Moors National Park (Hawnby, Forge Valley and Duncombe Park).

* *Oedalea ringdahli* Chvála RDB3. (64) High Batts Nature Reserve, 19/5/99 & 1/6/99, several examples of both sexes. The only previous Yorkshire record for this recent (1991) addition to the British List is 1♀ Forge Valley Woods NNR in 1995.

* *Platypalpus bilobatus* Weber (64) High Batts Nature Reserve. Another recent (1990) addition to the British List on the basis of a single male from an Essex chalk quarry in 1981. The species was next reported at Forge Valley Woods NNR where several specimens were found in the general vicinity of calcareous springs and moss cushions within the broad-leaved woodland in 1995. At High Batts, where the species appears to be well established, both sexes occured in some numbers between 7/5/99 and 1/6/99; specimens were found by sweeping arboreal vegetation along the sides of rides and paths.

† *P. difficilis* Frey Nb. (63) Anston Stones Wood 19/5/83, W.A.E. Although widely distributed nationally, this is a very localised species with only about ten known records since 1960, and with no clear habitat preferences (Falk & Crossley, in prep.).

* *P. praecinctus* (Coll.) Nb. (62) Forge Valley Woods NNR 26/7/99. First reported in the county from Blacktoft Sands RSPB Reserve in 1989, this species is known from several sites in v.c.61, and Nosterfield Gravel Pit (VC65) a short distance from High Batts. No habitat preferences have been detected and specimens are taken by general sweeping of arboreal vegetation.

† *P. pseudociliaris* (Strobl) Nb. (62) Forge Valley Woods NNR, 1 ♂, 28/5/99. Known from at least seven post-1960 sites across England and Scotland (Falk & Crossley, in prep.), the Forge Valley specimen was swept from dry calcareous scrub slopes, probably from hawthorn blossom (*Crataegus monogyna*).

* *P. stigma* (Coll.) Nb. (62) Forge Valley Woods NNR, 1♀, 17/5/99. Predominantly southern England in distribution, in Yorkshire this species is known from two sites on the chalk Wolds, and three on the magnesian limestone in VC63. The Forge Valley specimen was taken by sweeping on a dry calcareous scrub slope, probably in the vicinity of hawthorn.

Tachydromia woodi (Coll.) RDBI. (64) High Batts Nature Reserve, 9/6/99. Nationally this minute black fly with banded wings is only known from sites in the Monnow Valley (Herefordshire), and a single specimen by the River Wharfe at Otley (VC64) in 1985. The single specimen at High Batts was found running on the trunk of a birch. It is probably genuinely rare, with unknown biology, but the exact national status is unsure.

EMPIDIDAE

* *Wiedemannia* (s.g. *Chamaedipsia*) *lota* Walker Nb (63), Brookhouse Dyke, Brookhouse 1♂, 12/11/89, W.A.E. (*leg.* & *det.*W.A.E., *teste* R.C.). The only previous Yorkshire records for this species have been from Austwick, Malham Tarm and Gordale Beck (all in VC64).

* *Hilara bistriata* Zett. (63) Sandbeck Park (upper lake) 2/5/85, W.A.E.

H. griseifrons Coll. (64) High Batts Nature Reserve, 25/6/99. This species was previously known from four Yorkshire localities, three in the Doncaster/Rotherham area, and Fountains Abbey. The common habitat factor appears to be magnesian limestone, but this may be coincidental.

* *H. merula* Coll. RDB3 (64) High Batts Nature Reserve, 12/7/99 (*leg.* & *det.* R.C., *teste* J. H. Cole). Previous Yorkshire records, dating from 1987 onwards, have been from sites in the Lower Derwent Valley NNR, usually in the vicinity of field dykes.

† *H. scrobiculata* Lw. RDBK (61) Barmby Moor, 25/5/98, 1♀ (*det.* J. H. Cole). Nationally there are only five post-1960 records for this species. These are widely scattered from Sutherland to Somerset (Falk & Crossley, in prep.).

† *H. setosa* Coll. RDB3 (62) Duncombe Park, 1♂ & 1♀, 28/9/94. Forge Valley Woods NNR, 1♂, 25/8/95. Apart from a single record from County Durham in 1981, all previous records for this species nationally have been from northern Scotland (Falk & Crossley, in prep.).

* *Rhamphomyia* (s.g. *Pararhamphomyia*) *micropyga* Coll. Nb. (63) Old Warren Vale 5/5/90, W.A.E.; Hawks Wood, Thorpe Salvin 29/5/99. W.A.E. Although considered to be scarce nationally, there are recent records for this species from more than twelve localities across Yorkshire.

DOLICHOPODIDAE

† *Orthoceratium lacustre* (Scop.) (61) Kilnsea, 3/9/99. Examples of both sexes present in a damp sandy depression at the landward edge of the sea-shore near the visitor centre.

† *Thrypticus nigricauda* Wood Nb. (64) High Batts Nature Reserve, 25/6/99 & 12/7/99. Examples of both sexes were swept from marginal vegetation surrounding small ponds. There are only nine recorded sites in England and one in Wales for this tiny metallic green fly (Falk & Crossley, in prep.). Larvae of the genus mine the stems of monocotyledons.

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Printed in Great Britain by Titus Wilson & Son, Kendal ISSN 0028-0771

October-December 2000

Number 1035
Volume 125

The Naturalist

A QUARTERLY JOURNAL OF NATURAL HISTORY FOR THE NORTH OF ENGLAND

Published by the Yorkshire Naturalists' Union

Editor **M. R. D. Seaward** MSc, PhD, DSc, FLS, The University, Bradford BD7 1DP

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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.

Registered Office (for all enquiries, correspondence and payments):

Mr John A. Newbould, Stonecroft, 3 Brookmead Close, Sutton Poyntz, Weymouth, Dorset DT3 6RS (tel: 01305-837384; email: newbould@aol.com)

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Institutions and Subscribers £24.00 Registered Charity No. 224018

PLANT TRANSLOCATIONS AND "THE HAW" NEAR SKIPTON

DAVID J. HAMBLER AND JEAN M. DIXON
Department of Environmental Science, University of Bradford, Bradford, BD7 1DP

INTRODUCTION

Translocation has been defined in the broadest possible terms by Bullock *et al. (1997)* as "A general term for the transfer by human agency of any organism from one place to another". Translocation of plants, which according to another definition may include a single seed, spore or gamete, is a topic inviting controversy as the addition of a plant species (especially an alien) to any plant assemblage regarded as wild or the removal of an entire plant (perhaps even in the form of a seed) from the wild may be perceived as "damage". A degree of confusion is added to any discussion by a definition of "The wild" which "can include agricultural land, gardens, ponds and open glasshouses".

Controversy is sometimes focused on species categorised as rare or scarce, as a series of contributions to *BSBI News* illustrate:- "Plant translocations – for" (Walls, 1993) and "Plant translocations – against" (Wilson, 1993) exemplify a polarisation of views.

As Binggeli (1994) pointed out "In order to maintain a diverse natural flora some degree of plant translocation may be desirable", adding "It should involve only species unable to disperse between islands of semi-natural vegetation". The Haw, near Skipton (with its now destroyed summit at NG SE 015529) constitutes such an "island" – a calcareous hill surrounded by a lowland landscape in which the Carboniferous limestone and shale bedrocks are largely bunched beneath glacial deposits; valleys to the north and south are themselves bounded by acid moorlands. Descriptions of the drastically quarried hill, its past and its botany were given by Hambler (1995, 1996). The hill itself has been partially clothed with a glacial ablation deposit, indicating that it was submerged beneath a static ice sheet from which it did not emerge until the end of the Devensian glaciation (D. P. M. Comber *pers. comm.)*, when it must have become available for plant colonisation. [N.B. The Haw is not south of the glaciation limit as was erroneously implied by Hambler (1995)]. In one place only is there an exposure of bedrock which is ancient and not anthropogenic (D. E. Cotton, *pers. comm.).* Here at "Lookabout" there is an east-west ridge of weathered limestone and a north-facing scree bearing a somewhat abbreviated, but typical, flora characteristic of such habitats in the Craven uplands to the north. Quarrying has destroyed much of the hill but has provided calcareous nutrient-poor habitats with potential for attainment of species-richness.

That some species unusual in the district have been able to reach these habitats in recent years is evidenced by the arrival of *Echium vulgare* and *Inula conyzae,* which one might conclude from local botanical literature were not present one hundred years ago. It is, naturally, impossible to determine whether human agency was responsible for their arrival or for the loss of other species such as *Anthyllis vulneraria* (Rotheray, 1900), and this must be true of almost every native species found within the *c.* 200 ha (vertical projection) occupied by The Haw.

Reclamation of quarry spoil dumps on the northern side of the hill prior to the mid-20th century was always undertaken with the planting (i.e. translocation, with the spoil as a "recipient site") of trees alien to the region – Beech *(Fagus sylvatica),* Larch *(Larix decidua)* and Scots Pine *(Pinus sylvestris)* characterise woodland planted in the 19th century, shown by tree symbols on Figure 1. Sycamore *(Acer pseudoplatanus),* including purple leaved cultivars, and Norway Spruce *(Picea abies)* are present in later plantings on north-facing spoil slopes (labelled in Fig. 1) a little further eastwards. Only towards the end of the 20th century were native trees, shrubs, and non-woody species chosen for the ecological rehabilitation of the easternmost extremity of the spoil by Tilcon Ltd., the company which had recently taken over the still active Skipton Rock Quarry. Accounts of the materials planted and effects of rabbits *(Oryctolagus cuniculus)* on the vegetation have been published (Dixon & Hambler, 1993; Hambler *et al.,* 1995). All of this reclamation work has involved plant translocation to produce vegetation describable as semi-natural; even the most recent reclamation, with the use of native species, has involved commercial materials – some with a continental or other "foreign" ancestry: a few alien trees are present even here, including Grey Alder *(Alnus incana),* mixed with the native Common Alder *(A. glutinosa),* and, inevitably, Sycamore. An ideal commonly espoused in more recent years, that only material derived from local wild sites should be used in reclamation, was unattainable.

Here we present observations on the progress of small populations of three species, derived from seeds or young plants translocated to the area of spoil shaded on Figure 1. This area carries, at the present time, an open grassland and scrub community still evolving after its initiation on a bare north-facing spoil slope in 1984. The justification for the inward translocation of each of these species *Anthyllis vulneraria, Primula farinosa,* and *Sesleria albicans (S. caerulea)* is presented in the Discussion. Material of the last mentioned species had been planted on a steep barren spoil slope nearby at an earlier date, and observations on the outcome of this translocation are also mentioned.

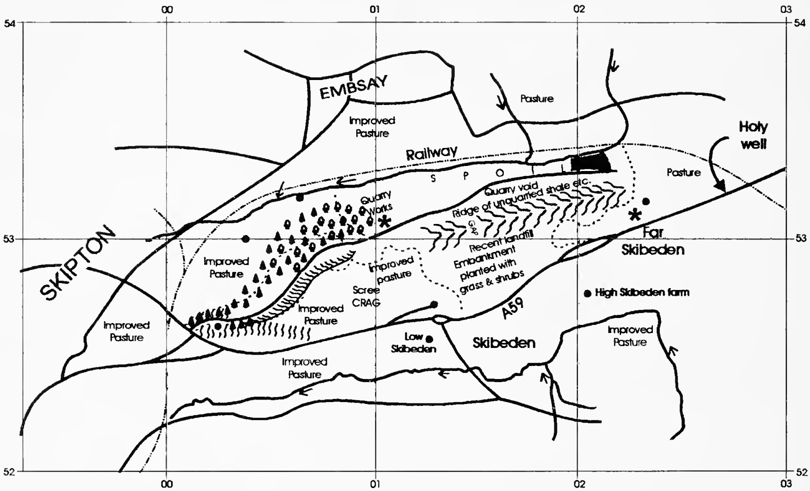

FIGURE 1

Sketch map of The Haw (the area between watercourses to the north and to the south). Only the area between the railway and the A59 road is considered here. Symbols represent woodland comprising alien trees planted in the 19th century. Sites of habitation in the 20th century are shown by solid discs; recent and current quarry office sites are shown by asterisks: the westernmost habitation and the easternmost office are now demolished, but alien garden plants remain in their vicinity. The experimental work was carried out at the eastern end of the spoil slope south of the railway (shaded area).

Initiation of experimental populations and observations

Commercial *Anthyllis vulneraria* (Kidney Vetch), probably of foreign origin, was a component of the original reclamation seed mixture sown on a north-facing spoil slope (varying between 0 and 30 degrees) at the eastern end of the hill. It failed to appear in the developing open grassy vegetation (where *Festuca rubra* became the dominant grass). Various experiments were subsequently carried out to test the performance of this species on the spoil, in relation to the activities of wild rabbits which were suspected of causing the initial failure. Each experiment involved seeding a small area of spoil, and providing complete, partial or no protection from rabbits. The conclusion drawn from these experiments, involving a few grammes of seed, was that the local rabbit population (in the period 1984 to 2000) would not allow any plant of this species to flower, and that complete destruction of any unprotected plant was likely. By 1999 a thriving population of *A. vulneraria*, derived from the experimental sowings, was expanding over the entire reclamation site from which rabbits had been excluded since 1996.

Primula farinosa (Bird's-eye Primrose) was transferred to the spoil in November 1995 as 41 small single rosettes derived from seed collected in July of that year. A small amount of peat in which the plants were cultivated was unavoidably transferred around the roots. The plants were distributed among three patches cleared in the sparse grassland. The experiment to observe the performance of the species in an unusual and man-made habitat was carried out within a rabbit exclosure, as this alien (translocated to the UK) mammal had already proved to inhibit the flowering of every other species on the spoil, including that of Cowslip *(Primula veris);* even species normally avoided by rabbits (e.g Ragwort *(Senecio jacobaea)* were not entirely immune. Observations on this small population to 1999 are summarised in Figure 2. In July 2000 the scape of almost every inflorescence was found to be severed; although the rosettes were undamaged, the floral parts had been shredded. It has not yet been possible to identify the animal responsible for this damage.

Sesleria albicans (Blue Moor-grass) seeds which had been sown near the summit of a steep unstable spoil bank to the west of the reclamation site in 1985 gave rise to thirty plants; these, despite some grazing by rabbits, flowered for the first time in 1987. In a later trial two thousand seeds, sown in 1993 on a small level area of the reclamation site, gave rise to plants which were so severely grazed as to be unrecognisable until 1999 – three years after rabbits had been excluded from the sown area – when intact leaves were observed; the grass never flowered here and could not be found in 2000.

Blue Moor-grass was sown in 1994 both inside and outside a rabbit exclosure on the reclaimed spoil. It persisted vegetatively but had not flowered in either situation by 1999 despite the complete exclusion of rabbits from the site from 1996 onwards. In the year 2000, the grass flowered both inside and outside the exclosure for the first time. The erection (in 1996) of a rabbit-proof fence around the whole site precludes firm conclusions regarding the vulnerability of *S. albicans* to rabbits in this particular location, but the earlier trial on a steep slope, and the later experiment, both indicate that the grass has not been precluded by abiotic factors from colonising The Haw, and that it is now established there.

Discussion

Anthyllis vulneraria is described as a C-S-R strategist – a competitive stress-tolerant ruderal – by Grime (1979). It is tolerant of dry, nutrient-poor calcareous habitats such as those produced as a result of quarrying and the limestone ballast of railway tracks, and occasional disturbance of the habitat is beneficial. Recorded by Rotheray (1900) as present on "Hawbank Rock, 1889, now gone" and noticed again in the vicinity in the 1940s by J. N. Frankland *(in litt.),* it has not been recorded subsequently on the hill. The sporadic appearance of this species suggests natural inflow of propagules resulting in recolonisation events, each producing a small population vulnerable to extinction – perhaps through an increase in the rabbit population, or removal of the land surface through quarrying. Repeated accidental translocation of this ruderal species to The Haw along the railways seems possible, as Rotheray (1900) describes *A. vulneraria* from railway banks on those lines linking the northern foot of The Haw, at Embsay, with calcareous areas to the north and west.

It is interesting to consider a further possibility for the origin of *A. vulneraria* wild on The Haw. Elsewhere in Yorkshire, notably on the Permian limestone, an associated species is *Brachypodium pinnatum* (Tor-grass) (Lavin & Wilmore, 1994). This grass was found in 1945 by J. N. Frankland: ". . . quite a lot of it . . . nearly at the top of Hawbank on the grassy slope above the Skipton-Bolton Abbey road. This was recorded in the Archives of The Craven Naturalists' Society at the time". We know of no later record, and the locality

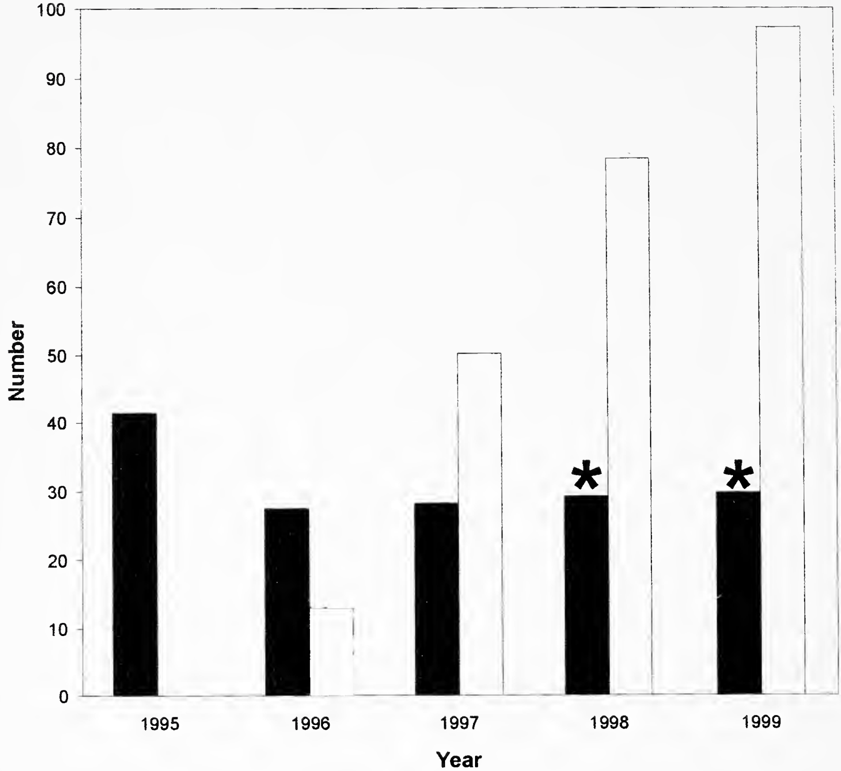

FIGURE 2
Performance of *Primula farinosa* planted on the spoil in November, 1995.
Solid columns show the number of plants surviving (initially 41 single rosettes);
clear columns show the total number of inflorescences produced in the year.
Asterisks indicate presence of rosettes or clones derived from seeding.

was presumably lost to quarrying and to landfill and embankment (Fig. 1). It is possible that *B. pinnatum* was, as Frankland suggested in a letter (see above), a floristic outlier from the Permian limestone as it ". . . does not grow anywhere on the mountain limestone . . .". It cannot be known whether either species had occupied the hill since prehistoric times (i.e. whether they are "native" there in one of the senses quoted by Bullock *et al., 1997),* or whether they might have been translocated accidentally on one or more occasions from the Permian limestone region by the road link which is now the A59. The two species, possibly once associated on The Haw, may have been lost through the destruction, by quarrying and landfill, of much of the southern aspect of the hillside subsequent to Frankland's observations.

Wilson (1993) suggested in contra-indication to translocation that ". . . a plant or plant community is far more than simply an adornment to the British heritage theme park, but is a living document that is intimately associated with the history and geomorphology of its site". There is, however, little possibility that this "document" may be interpreted accurately when, as is illustrated here, the possible explanations for the presence or absence of a species are so varied. The local re-enstatement of *A. vulneraria,* if this has been achieved, adds little to the "noise" with which present studies of "natural" distributions must contend. The use of seed or plants which are not of UK origin may indeed, as I. Akeroyd (quoted by Bullock *et al.,* 1997) suggests, lead to "confusion as to the natural distribution of the plants in Britain [and] to confusion of complex and ancient patterns in the landscape and creation of a facsimile of countryside". However, the presence of *A. vulneraria* on the hill may never have been any more "natural" than that of many other species: translocations to the hill are known to have modified distributions of some species in the UK as long ago as the 15th century (see Hambler, 1995). Natural distributions, insofar as they exist in the UK, may well be in process of irreversible change through global warming. It is possible that the race of *A. vulneraria* brought to The Haw might be better adapted to a changed climate than native material translocated there accidentally in the future, and that any "crossing between native and introduced plants leading to erosion of native genetic variation" (as suggested by the above author) may enhance, rather than diminish, the survival prospects of the species in the vicinity.

Primula farinosa is a species typically occurring in calcareous flushes and mires in the Craven district, although it is recorded from "dry as well as moist meadows" by Baines (1840). It has been a visual amenity on railway banks in the Dales (Wemyss-Cooke, 1996), and has been noted recently associated with seepage areas in a railway cutting through limestone (Susan Sutcliffe, *pers. comm.)* near Otterburn – a location corresponding to a 1899 notebook record by Lister Rotteray (see Acknowledgements). Populations in damp railway cuttings must occupy only a small area, and any one may well have originated as seed carried from limestone uplands through railway activity. Unlike the C-S-R strategist *A. vulneraria,* this hydrophile species with its minute seeds, and lack of ruderal attributes, is unlikely to find niches for germination along the greater part of those railway lines linking the Embsay to Bolton Abbey line, which runs along the northern foot of The Haw, with its main area of distribution in the Dales (Fig. 3). It is even less likely to be transported by road from its habitats on the Permian limestone to reach a moist site on The Haw. It could possibly, therefore, be a relict from peri-glacial times which survived on the calcareous "island" until the 19th century.

The area on The Haw occupied in the 19th century by *P. farinosa* remains in doubt: "Hawbank, Skipton" is given by Rotheray (1900), and "Haw bank, Skipton Rock" by Lees (1888). Neither author gives a date nor an indication of the authority for the record. "Haw Bank" was no doubt an old name for the intact steep western end of The Haw, whilst the addition of "Rock" implied an active commercial quarry. "Haw Bank Rock *(Limestone Quarry)"* appears on a mid-19th century OS map, and is located in NG square SE 0052, and in an 1889 edition "Hawbank Rock" is shown extending for a greater distance eastwards (along the southern rim of the quarry); "Skipton Rock Quarry" which appears on later maps, still further eastwards (away from Skipton), is also as a commercial designation, rather than a locality. Perusal of archival material has shed no further light on the 19th century plant records: two notebooks of field observations by Lister Rotheray made between 1898 and 1906 contain no mention of Hawbank, but do contain references to *Primula farinosa* in railway cuttings.

Comments from elderly local botanists have suggested that this species was not seen anywhere in the vicinity, even in the early part of the 20th century. North-facing slopes are favoured by Bird's-eye Primrose, and the topographical reconstruction of the hill presented by Hambler (1995) suggests where seepage might have occurred on the north facing hillside near its western end. It is possible that "poaching" (trampling the soil into a wet hummocky condition) by deer at seepage sites, and along the beck running westwards at the northern foot of the hill could have been advantageous to *P. farinosa* even in pre-history, and into Norman times when much of the hill was a deer park. Such areas have been modified by quarrying, and probably by more intensive grazing by sheep and cattle in the 20th century than in earlier times. Although heavy grazing may be inimical to the species' survival, the converse, neglect, leads to the development of coarse grassland,

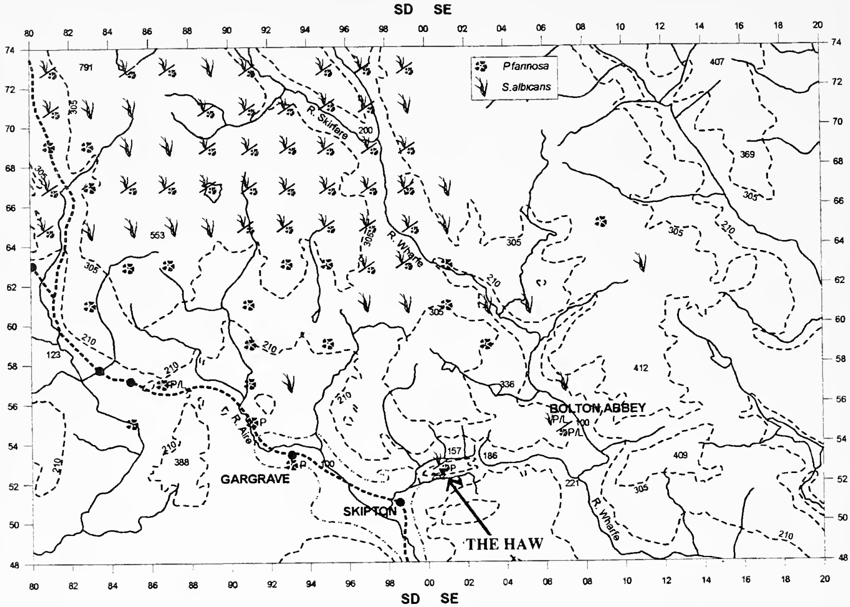

FIGURE 3
The Haw as an "island" isolated from watercourses originating in the limestone uplands and thus from the major area occupied by *Primula farinosa* and *Sesleria albicans.*
Records of each species within 2km x 2km grid squares are indicated by symbols.
P = pre-1900 records south of the limestone uplands;
L = such records made in the last two decades of the 20th century.

unlikely to accommodate *P. farinosa:* symbols on OS maps published between 1850 and 1900 suggest such neglect of much of The Haw.

The *P. farinosa* plants grown on spoil in the experiment described here may well constitute a re-introduction, to the hill (if not to a precise location), of a species which had survived from peri-glacial times cut off by forest, and later by lowland farms, from the limestone uplands.Water-borne seeds have evidently produced populations on limestone debris over grit-stone bedrock (e.g. near Bolton Abbey on the River Wharfe) south of the limestone uplands. Yet this mode of colonisation, or recolonisation, has not been available for The Haw as the nearby watercourses all have their origins in acid moorlands to the north and to the south as Figure 3 illustrates.

In view of the observation that seeds have been produced and have germinated on the spoil, it seems possible that the species could persist and increase for some years, aided perhaps by some focused management. There seems good reason for continuing the experiment for testing both the tolerances of the species, and the ability of a population with a small number of progenitors to increase from year to year despite a variable degree of damage attributable to rodents. Meanwhile any additional location for a nationally scarce species – a conservation "flagship" – is of obvious value.

Sesleria albicans may never have existed on The Haw as its only likely station prior to quarrying would have been the crag and scree shown on Figure 1. However, as a species of poor calcareous soils and sometime associate of *P. farinosa,* and as an attractive early flowering grass, it could add to the visual amenity and surface stability of spoil slopes. Justification for testing this species as a potentially valuable colonist of limestone quarry spoil at a site a few km. south of its major area of distribution, and for allowing the small experimental population to expand (should it be able), need not be laboured. Like *P. farinosa* this species of the limestone Craven uplands has colonised lowland sites to which it has been carried by water; such sites exist along the River Wharfe. Neither species can be so transported to The Haw as none of the nearby watercourses originate in these uplands (see Fig. 3). As a slow-growing species intolerant of disturbance, *S. albicans* is unlikely to find the limestone ballast of railway tracks appropriate for its spread, and its heavy "seeds" (caryopses) are unlikely to be moved by the air turbulence caused by passing trains.

It might be argued that the translocations of the last two species are in some way undesirable or illegitimate, and if regarded as surrogates for "rare vascular plants" two of the BSBI Guidelines, quoted by Bullock *et al.* (1997) would have been infringed: (1) "The donor population should be within 1km of the recipient site", (2) "Reintroduction should only be carried out where the species . . . has recently become extinct in the proposed recipient area". Nearby donor populations do not exist, and the date of extinction of *P. farinosa is* not known. Even the precise location and extent of its 19th century population is unknown.

Where no damage is likely to an existing population it is in the interests of its conservation to establish new populations. As Walls (1993) points out "The knee-jerk reaction that translocation obscures the natural distribution is surely untenable". His opinion differed from that of a previous writer (Payne, 1992) who deplored "intentional interference with natural plant distributions", and he claimed that "watching the decline of a species to extinction is not the 'fascinating study'" that Payne had seemed to suggest. The decline of *P. farinosa* has been mourned in popular literature (*cf.* Wemyss-Cooke, 1996), and its loss from The Haw is symptomatic of such decline. The production of new populations by whatever means, where "the translocation does not threaten other rare plants" (BSBI guidelines (quoted by Bullock *et al.*, 1997) must be an appropriate conservation measure.

"Translocation" *sensu* Bullock *et al. is* involved in every aspect of land reclamation, and Wilson (1993) has suggested that "The deliberate planting of uncommon species or the seeding of a species-rich "wildflower meadow" does little more than to create a rather unusual municipal flower bed". However it should perhaps be noted that on such grounds The Haw, might, in its entirety, be regarded as a "flower bed". Regrettably, it is an undoubted microcosm of the entire UK: "more than 40 percent of the taxa covered in Stace's *New Flora of the British Isles (1997)* are non-native" (Wilmore, 2000), whilst Wilmore's *Alien Plants of Yorkshire (loc. cit.)* adds another 133 taxa to the list – this from a single county! Numerous plant taxa which are not regarded as native to the north of England, or to the UK, have been found on The Haw. Furthermore it cannot be determined which of the species now regarded as native to the UK have been present in the vicinity "since prehistoric times . . . [or] . . . since at least the last glaciation, *c.* 14,000 BP . . . or [even] since the Neolithic, *c.* 6,000 BP", these are alternative definitions of "native" quoted by Bullock *et al.* (1997). The Haw, like much of the UK is in a state of floristic chaos, and unpredictable floristic alterations must be expected in consequence of ongoing climate change. Deliberate additions of plant taxa to the present disparate assemblage of species in "The wild" *(sensu* Bullock *et al.,* 1997) on The Haw will neither increase nor diminish this chaos in any significant respect. "The wild" is defined as "Any conditions in which organisms *can* [our italics] disperse to other sites or can breed with individuals from other populations". Paradoxically, *Anthyllis vulneraria,* planted on the quarry spoil, was unable to flower, and thus unable to disperse, until it was separated from wild rabbits by a fence.

As a site offering "some form of long-term protection", as advocated in the Guidelines referred to above, the quarry precincts are entirely appropriate as a recipient for any rare, scarce or declining native, calcicolous (in the broadest sense) plant species, and for phytometric experiments *(de facto* translocations) to test whether "the site [contains] suitable habitat". Any contra-indications to such translocations are trifling in view of a possibility of increasing the metapopulation of such a species, and the opportunity to increase knowledge of its tolerances.

SUMMARY

Translocations of plant species to The Haw, near Skipton, involving land reclamation and phytometric experimentation, have been described together with comment linking such work to some precepts in a review concerning translocation and to some published views on the subject.

ACKNOWLEDGEMENTS

We thank Tarmac Northern Ltd, for continuing the encouragement of our research on their quarry site in continuation of that offered by Tilcon Ltd. We thank Stewart Davidson for help with our figures, and Phyl Abbott for allowing the use of plant records made for a Flora of Mid-West Yorkshire (in preparation). Access to the notebooks of Lister Rotheray was courtesy of the staff of the Leeds Museum Resource Centre.

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NEW AND INTERESTING ORIBATID MITES (*ACARI: ORIBATIDA*) FROM TALACRE DUNES, NORTH-EAST WALES

FRANCIS D. MONSON
c/o Entomology Section, Liverpool Museum, William Brown Street, Liverpool L3 8EN

ABSTRACT
One hundred and nineteen species of oribatid mites *(Acari: Oribatida)* from Talacre Dunes, north-east Wales, are listed. Two new species *Lanceoppia (Baioppia) talacrensis* and *Quadroppia lesleyae* are described, and an *Oribatella* species, *Synchthonius elegans, Quadroppia hammerae* and *Punctoribates sellnicki* are recorded for the first time in the British Isles. The status of *Quadroppia pseudocircumita galaica* is now raised to species level.

INTRODUCTION
Talacre Dunes are the only remnants of the previously extensive coastal dune system in North Wales to the east of Anglesey. It is a link between the dune systems of Anglesey and North Wales and those of the Wirral coast in Cheshire and the Sefton Coast in South Lancashire. The sites are subject to high recreational pressure and have suffered considerable disturbance during the 20th century. Other sites such as Newborough Warren on Anglesey and Morfa Harlech to the south on the Welsh mainland, have received considerably more attention from entomologists and arachnologists. BHP Petroleum Ltd. now use part of the Talacre Sand Dunes as a site for a natural gas treatment facility importing this national resource inshore from the Irish Sea. BHP Petroleum Ltd. has entered into an agreed Management Policy with the Countryside Council for Wales with respect to 67 ha of land owned by BHP Petroleum Ltd. at Talacre, Clwyd (SJ119848). 45 ha of this land are contained within the 470 ha of Talacre Dunes. Consequently, a Minimum Management Plan has been produced to ensure that there is continuity and stability of management, to conserve and enhance the nature conservation interests of the site.

Typical habitats sampled in this study were open dune, dune grassland, dune slack areas, freshwater marsh and mixed scrub. The identifications here listed were made by the author from numerous sievings and pitfall trappings collected by Liverpool Museum, Entomological Section in the summer and autumn of 1995. Included are additional records from two collecting trips made by the author to the site in March, 1996 and 1999. All sievings were processed through Tullgren funnels.

There are 136 genera and 309 species recorded for the British Isles (Monson, 1998). This survey adds one genus and six species. There are now 132 species recorded for Clwyd of which 97 are recorded for the first time. The oribatid details following are but a small element of the invertebrate records amassed for the site up to 1997 by Liverpool Museum (Entomological Section). Included from other invertebrate Orders are two Red Data Book (RDB) species, 1 probable RDB species and 24 nationally scarce species. With the exception of the six oribatid species recorded here as new to the British Isles, most of the remainder are well known members of the British fauna. There are no known published records of oribatid mites for this site.

SPECIES NEW TO THE BRITISH ISLES
Lanceoppia (Baioppia) talacrensis sp. nov. (Figs. 1 & 2)

This represents the first British records of the genus *Lanceoppia* Hammer, 1962 and the subgenus *Baioppia* Luxton, 1985. This increases the number of *oppiid* genera in the British Isles to 16. A single female with two eggs and 375 µm long, pale straw in colour, was collected.

Description: rostrum narrow; rostral setae pectinate reaching about half their length beyond the rostral tip; the prominent transcostula in mid-prodorsum and narrower than the costulae which, together, form an elongate hexagon; the costulae bend medially about two thirds of their length posteriorly of the transcostula and finish at the medial edges of the bothridia; the costular setae are set a short distance posterior of the transcostula ridge, simple, fine and inserted two lengths apart. Intercostular setae are simple and very short; sensilli club shaped, smooth, directed medially. Nine pairs of notogastral setae, t_2 present; genital setae number 6 pairs; aggenital setae 1 pair; anal setae 2 pairs; adanal setae 3 pairs; setae ad_3 preanal; ad_1 postanal; pori *iad* in the inverse apoanal position; tibiae I and II each with a long medial pectinate seta; fine granulations evident locally anteriorly and anteriolaterally of the bothridia.

Etymology: The specific epithet refers to the type locality of the species.

Type: The holotype of *Lanceoppia (Baioppia) talacrensis* is deposited (in alcohol) at Liverpool Museum.

Distinguishing features:

L. (B) talacrensis may be distinguished from *L. (B) moritzi* using the following table:

	L. (B.) talacrensis	*L. (B.) moritzi*
1)	375 µm long;	280 µm long;
2)	setae t_2 present;	setae t_2 absent
3)	the transcostula and costulae trace the form of a ‘hexagon’.	the transcostula and costulae trace the form of a ‘trapezium’.

Remarks: The genus *Lanceoppia,* with *L. hexapili* as the type species, was described from Chile (Hammer, 1962). Luxton (1985) established the genus *Baioppia* to accommodate the distinctive features of *Lanceoppia moritzi* Hammer, 1968 although the status of this taxon was subsequently reduced to that of sub-genus (Subías & Balogh, 1989). Neither *Lanceoppia* nor *Baioppia* have hitherto been recorded from the Northern Hemisphere and Hammer and Wallwork (1979) characterise the former as being of Gondwanaland origin (both west and east). However, Hammer (1969) recorded the genus in collections made at quarantine stations in the U.S.A. Specimens were found associated with plants from Canada, Chile and Japan. It is possible, therefore, that the taxon described above was not originally native to the British Isles but was passively transported there by Man. There is every likelihood that its original locality was New Zealand since sub-genus *Baioppia* has, so far, been found nowhere else.

Quadroppia lesleyae sp. nov. (Fig.3 & 4).

Fifteen genera of Oppidae Grandjean, 1951 occur in the British Isles of which the genus *Quadroppia* Jacot, 1939 is represented by four species, *Q. quadricarinata* (Michael, 1885), *Q. maritalis* (Lions, 1982), *Q. bellula* Luxton, 1987, *Q. pseudocircumita* Mínguez, Ruiz & Subías, 1985 and *Q. pseudocircumita galaica* Mínguez, Ruiz & Subías, 1985 (Monson, 1998).

Two specimens (200 µm long), sex unknown, were collected.

Description: rostrum blunt and rounded; rostral setae fine, and curved medially; rostral sculpturing comprising a chitinous oval divided by a bar, in the form of a ‘bootprint’, the smaller rectangular to oval and situated adjacent to the transcostula, area proportions two thirds to one third; costulae strong; transcostula weak, medially; transcostular setae smooth, short, fine and inserted on the costula/transcostular junctions. Interlamellar setae also fine and smooth, inserted near the medial edges of the costulae on a pair of faint elongated oval zones. Sensilli clavate with smooth capituli. Notogaster somewhat arched with 9 pairs of smooth setae. Epimera 1 + 2 bordered medially in the form of an inverted ‘T’; epimera 3 + 4 well separated medially with the underlying sinuous feature between, appearing as though branched under epimera 3 + 4 laterally; the surface of epimera 3 + 4 with polygonal sculpturing; all ventral setae small and smooth; genital setae numbering 5 pairs, aggenital setae 1 pair; anal setae 2 pairs; adanal setae 3 pairs. Tarsus 2 with two solenidia.

The species has also been extracted from moss at Slapton Wood, Devon and Chedworth Wood, Gloucester (both by the author) and from yew litter at Roudsea National Nature Reserve, Cumbria (Luxton Data Base).

Etymology: The specific epithet honours the author’s wife, Lesley.

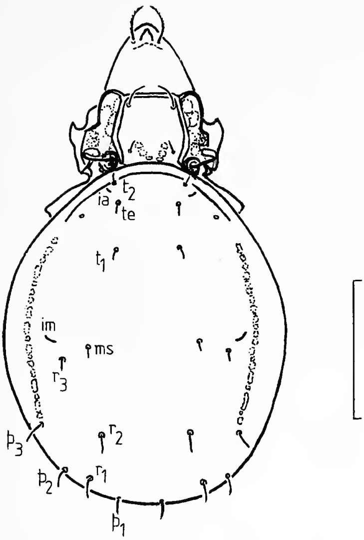

FIGURE 1
Lanceoppia (Baioppia) talacrensis sp. nov.
dorsal surface (scale bar = 100 μm)

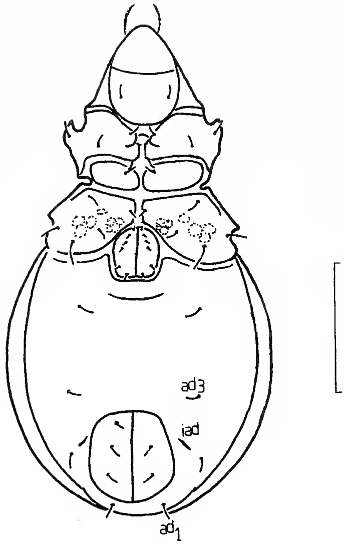

FIGURE 2
Lanceoppia (Baioppia) talacrensis sp. nov.
ventral surface (scale bar = 100 μm)

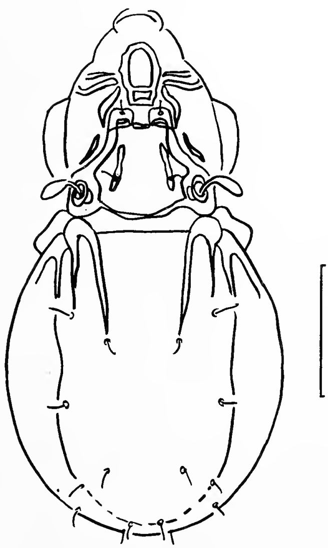

FIGURE 3
Quadroppia lesleyae sp. nov.
dorsal surface (scale bar = 50 μm)

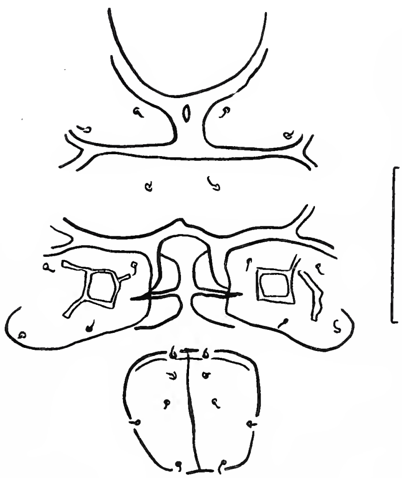

FIGURE 4
Quadroppia lesleyae sp. nov.
ventral surface (scale bar = 25 μm)

The holotype of *Quadroppia lesleyae* from Talacre Dunes (in alcohol) is deposited at Liverpool Museum and 10 paratypes (from Chedworth Wood) are deposited (in alcohol) at the Natural History Museum, London.

Oribatella species (Figs. 5 & 6)

There are three British genera in the Oribatellidae Jacot, 1925 of which *Oribatella* Banks, 1895 is represented by four species *O. berlesei* (Michael, 1898), *O. calcarata* (C. L. Koch, 1835), *O. superbula* Berlese, 1904 and *O. quadricornuta* (Michael, 1880). Four specimens of this genus (490 µm long), sex unknown were collected. They do not resemble the known British species and research is in progress to establish their specific identity.

Synchthonius elegans Forsslund, 1956 (Fig. 7)

Nine genera of Brachychthoniidae occur in the British Isles with *Synchthonius* van der Hammen, 1952 represented by a single species, *S. crenulatus* Forsslund, 1956 (Luxton, 1996). A second species of *Synchthonius, S. elegans is* newly recorded here.

The two species of *Synchthonius* may be distinguished on the basis of the length of their notochaetae. Length of notochaetae on the second segment of the hysterosoma not greater than the length of the sclerite in *S. crenulatus*; length of those on the second sclerite are twice as great as the length of the sclerite in *S. elegans* (Ghilarov & Krivolutsky, 1975).

Twelve specimens (220 µm long), sex unknown, were collected.

Previously recorded for Iceland, Europe, Western Siberia, Altai, Kirghizia and the Far East (Ghilarov & Krivolutsky, 1975).

Quadroppia hammerae Mínguez, Ruiz & Subías, 1985 (Fig. 8)

The features distiguishing *Q. hammerae* are that the transcostula is discontinuous medially with the notochaetae very short, with *lp* displaced medially and not in line with the *h* series (Mínguez, Ruiz & Subías, 1985).

Four specimens (165 µm long), sex unknown, were collected.

Previously recorded from Spain, the Canary Islands and New Zealand (Mínguez *et al.*, 1985).

Punctoribates sellnicki Willmann 1928 (Fig. 9)

Three genera of Mycobatidae occur in the British Isles with *Punctoribates* Berlese, 1908 represented by two species, *P. punctum* (C. L. Koch, 1839) and *P. quadrivertex* (Halbert, 1920) (Luxton, 1996).

The features distinguishing *P. sellnicki* are the narrow lamellae, with long and narrow cuspids with the bothridia thickly flask shaped and blunted (Ghilarov and Krivolutsky, 1975).

One specimen (320 µm long), sex unknown, was collected. Previously recorded from Europe and Central Asia (Ghilarov & Krivolutsky, 1975).

Annotated species list

Species new to the British Isles are identified with an asterisk and new regional records are also noted. The species are listed alphabetically for ease of reference. The distribution and previous habitat data of each species recorded are extracted, with permission, from the unpublished Luxton *Data Base of British Oribatida*. Each species name is followed by a capital letter coding, defining the local habitat(s) where found at Talacre Dunes.

Site codes: A1 = mixed moss/litter from the freshwater marsh;
A2 = moss only, from the freshwater marsh;
B = mixed moss/litter from grassland and scrub;
C = mixed moss/litter from the vicinity of a natural dune slack;
D = mixed moss/litter from the vicinity of a disturbed dune slack (area strewn with building rubble from a demolished habitation);
F1 = mixed moss/litter from the dune slopes;

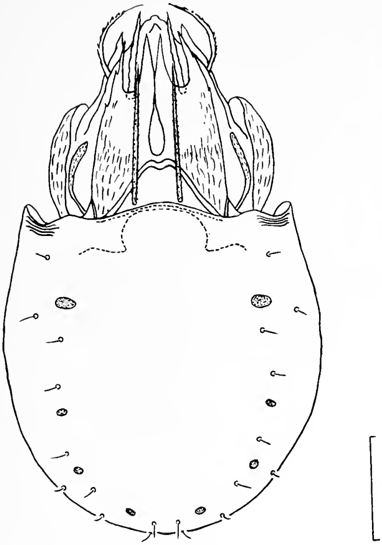

FIGURE 5
Oribatella, unknown species,
dorsal surface (scale bar = 100 μm)

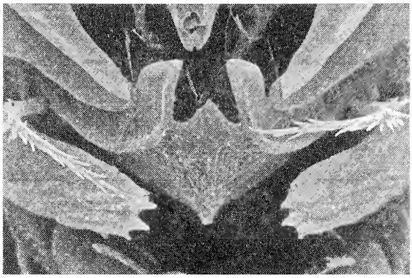

FIGURE 6
Oribatella, unknown species
ventral SEM of rostrum

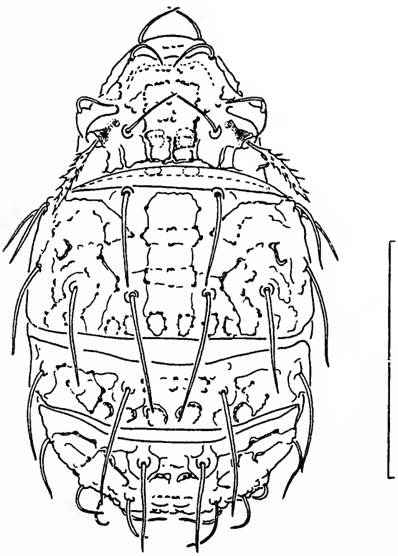

FIGURE 7
Synchthonius elegans, dorsal surface
(scale bar = 100 μm) (from Moritz, 1976)

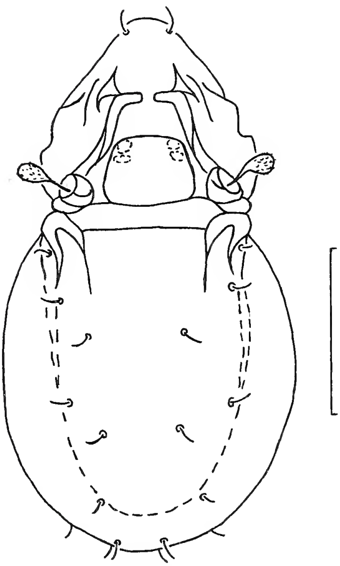

FIGURE 8
Quadroppia hammerae, dorsal surface
(scale bar = 50 μm)
(from Mínguez, Ruiz & Subías, 1985)

F2 = moss only, from the dune slopes;
G = mixed moss/litter from the vicinity of the slack seasonally inundated from the sea;
H = pitfall trap (habitat not recorded);
J = litter from the beach strand line.

Achipteria nitens (Nicolet, 1855) (Al, B)
Family: Achipteriidae. Found in Buckinghamshire, Cornwall, Essex, Tyne and Wear, Isles of Scilly (England); Isle of Man; Jersey (Channel Islands) and Clwyd (Wales) (but not Scotland or Ireland) in moss on the ground, *Sphagnum* bog, leaf litter and lichen.

Acrogalumna longipluma (Berlese, 1904) (B, F1)
Family: Galumnidae. First record for Wales. Found in Cornwall, Cumbria, Lancashire, Tyne and Wear (England); Jersey (Channel Islands) and Co. Mayo (Ireland) (but not Scotland or the Isle of Man) in leaf litter, under bark and in an ant's nest.

Adoristes ovatus (C. L. Koch, 1839) (A1, B, G)
Family: Liacaridae. First record for Wales. Widespread in the British Isles in moss, leaf litter in deciduous woodland, pine needles in pine woods and forests, fern debris, *Calluna* heathland and grassland.

Adoristes poppei (Oudemans, 1906) (A1, B)
Family: Liacaridae. Found in Devon (England); Isle of Man; Dyfed (Wales); Tayside and the Orkney Isles (Scotland) and Co. Wexford (Ireland) (but not the Channel Islands) in moss, mixed litter in deciduous and pine woodland, under gorse, on *Calluna* heathland and in tidal debris.

Atropacarus striculus (C. L. Koch, 1835) (D)
Family: Phthiracaridae. First record for Wales. Generally distributed in England; the Forth area of Scotland; Co. Kildare and Co. Clare (Ireland) (but not the Channel Islands or the Isle of Man) in leaf litter in pine and deciduous woodland, *Sphagnum* bog, under stones and in a mole's nest.

Banksinoma lanceolata (Michael, 1885) (G)
Family: Thyrisomidae. Widespread in moss, pine needles, fern debris, grassland, *Calluna* heathland, lichen and saltmarsh.

Berniniella serratirostris (Golosova, 1970) (F)
Family: Oppiidae. First record for Wales. Found previously only in Co. Wexford (Ireland) in wet grazed pasture.

Berniniella sigma (Strenzke, 1951) (G)
Family: Oppiidae. First record for Wales. Found in Bedfordshire and Devon (England) and the Isle of Man (but not Scotland, Ireland or the Channel Islands) in moss and mixed beech and oak woodland.

Caleremaeus monilipes (Michael, 1882) (G)
Family: Caleremaeidae. First record for Wales. Found in West Yorkshire and Staffordshire (England) and Co. Wicklow (Ireland) (but not Scotland, the Channel Islands or the Isle of Man) in decayed tree trunks.

Camisia horrida (Hermann, 1804) (F2)
Family: Camisiidae. Generally distributed in moss, leaf litter, bogland and lichen.

Camisia segnis (Hermann, 1804) (G)
Family: Camisiidae. Generally distributed in moss, gorse debris, leaf litter, *Calluna* heathland, sand dunes, lichens, acid peat bogland and beaten from spruce trees.

Camisia spinifer (C. L. Koch, 1835) (F1)
Family: Camisiidae. Widespread in moss, bogland, pine woodlands, *Calluna* heathland, sand dunes, lichens and house dust.

Carabodes labyrinthicus (Michael, 1879) (A1, G)
Family: Carabodidae. Widely distributed in moss, lichen, pine needles, beechwood litter, dead wood and an old bird's nest.

Carabodes marginatus (Michael, 1884) (A2, G)
Family: Carabodidae. Widespread in moss, leaf litter, *Calluna* heathland and lichens (including maritime).

Carabodes willmanni Bernini, 1975 (A1, B, C, G)
Family: Carabodidae. Found in Derbyshire, Northumberland (England); Isle of Man; Snowdonia (Wales); Strathclyde and Ailsa Craig, the Orkney Islands (Scotland) and Co. Mayo (Ireland) (but not the Channel Islands) in moss, lichens (including maritime), leaf litter and acid peatbog.

Cepheus latus C. L. Koch., 1835 (B)
Family: Cepheidae. First record for Wales. Otherwise found only in Co. Mayo (Ireland) in decayed tree stumps, moss in beechwood and *Sphagnum* bogs.

Ceratoppia bipilis (Hermann, 1804) (B, D, H)
Family: Ceratoppiidae. Very widespread in moss, pinewoods, *Calluna* heath and moorland, mixed deciduous woodland litter, coal shale tips, *Sphagnum* bog, grassland, maritime lichens and a bird's nest.

Ceratozetes gracilis (Michael, 1884) (A1, B, D)
Family: Ceratozetidae. Widespread in moss on the ground and on trees, dead wood, *Sphagnum* bog, old meadow, arable land, upland and *Calluna* moorland, mixed deciduous woodland and in debris in sea birds' nests.

Ceratozetes parvulus Sellnick, 1922 (G)
Family: Ceratozetidae. First record for Wales. Otherwise found only in Cumbria and Cheshire (England) in a mixed deciduous woodland and a *Sphagnum* bog respectively.

Chamobates borealis (Trägårdh, 1902) (G)
Family: Chamobatidae. First record for Wales. Otherwise widely distributed in moss, oak, beech, scots pine and sitka spruce woodlands, *Calluna* heathland, grassland, upland moor, litter, lichen, decaying herbage in grassland, heath-like dune vegetation and pasture.

Chamobates cuspidatus (Michael, 1884) (G)
Family: Chamobatidae. Widely distributed in moss, lichen, pine needles, fern debris, dead leaves, *Calluna* moorland and grassland.

Chamobates subglobulus (Oudemans, 1900) (B, D)
Family: Chamobatidae. Widely distributed in moss, on trees, under stones, on sea banks, deciduous litter, in a mouse's nest and beaten from pine.

Damaeobelba minutissima (Sellnick, 1920) (B, G)
Family: Damaeidae. First record for Wales. Otherwise found only in Bedfordshire and

Devon (England) in mixed deciduous woodland.

Damaeus riparius Nicolet, 1855 (G)
Family: Damaeidae. First record for Wales. Found in Cheshire, West Yorkshire, Devon (England); the Highland and Forth areas (Scotland) (but not Ireland, the Channel Islands or the Isle of Man) in moss, pine needles and grass.

Damaeus (Adamaeus) onustus (C. L. Koch, 1841) (G, H)
Family: Damaeidae. First record for Wales. Otherwise widespread in moss, under bark, in dead leaves and woodland litter, dead wood, under stones, in pine needles, *Calluna* heathland, *Sphagnum* bog, upland moorland and a bird's nest.

Damaeus (Paradamaeus) clavipes (Hermann, 1804) (B, D, H)
Family: Damaeidae. First record for Wales. Otherwise widespread in moss, bog, pine needles, heather, fern debris, dead wood, grass, ungrazed tussocky pasture, upland moor, grassed stabilised dunes and under gorse.

Dissorhina ornata (Oudemans, 1900) (A1)
Family: Oppiidae. First record for Wales. Otherwise widespread in moss, dead leaves, decaying wood, gorse needles, bog, *Calluna* heathland, pine woodland, mixed deciduous woodland, under bark, pastureland, grassed stabilised sand dunes, and salt marsh.

Dometorina plantivaga (Berlese, 1895) (G)
Family: Scheloribatidae. First record for Wales. Found also in Tyne and Wear and Hampshire (England); Jersey (Channel Islands); Co. Mayo (Ireland) (but not Scotland or the Isle of Man) in lichen and a cereal field.

Eniochthonius minutissimus (Berlese, 1904) (G)
Family: Eniochthoniidae. First record for Wales. Found also in Essex, Oxfordshire, Bedfordshire, Cheshire (England); Forth area (Scotland); Jersey (Channel Islands) (but not Ireland or the Isle of Man) in moss on the ground, ungrazed tussocky pasture, mixed woodland and litter.

Eupelops acromios (Hermann, 1804) (F1)
Family: Phenopelopidae. Widespread on oak and whitethorn trees, amongst fir needles, in moss, under stones on sea banks, oak woodland, upland moor, dead gorse, rotten wood, on furze bushes and pine trees.

Eupelops hirtus (Berlese, 1916) (B, D, G)
Family: Phenopelopidae. Found also in Northumberland, Tyne and Wear, Cumbria, Isles of Scilly (England); Clwyd (Wales) (but not in Scotland, Ireland, the Channel Islands or the Isle of Man) in bracken, litter and an ant's nest.

Eupelops plicatus (C. L. Koch, 1835) (A1, B, D, G, H)
Family: Phenopelopidae. Widespread in moss, on sea banks, pine needles, upland moor, leaf litter, sea washed turf, saltmarsh, acid peat bog and debris in sea bird's nest.

Euzetes nitens (Johnston, 1853) (A1, D, H)
Family: Euzetidae. Very widespread in moss, lichens, fungi, dead wood, pine needles, dead leaves, gorse debris, grass, on pine trees, in meadow land, decaying herbage in grassland, *Calluna* heathland, *Sphagnum* bog, mixed woodland, under stones on the sea shore and tidal debris.

Fosseremus laciniatus (Berlese, 1905) (F)
Family: Damaeolidae. First record for Wales. Otherwise found only in Oxfordshire and

North Yorkshire (England) in *Molinia* fen and upland moorland.

Hermannia gibba (C. L. Koch, 1839) (A1, B, G)
Family: Hermanniidae. Widespread in moss, pine needles, a nest of *Formica rufa*, leaf litter, sitka spruce woodland, mixed deciduous woodland, *Calluna* heathland, *Sphagnum* bog, upland moorland, and in house dust.

Hermanniella granulata (Nicolet, 1855) (F, G)
Family: Hermanniellidae. First record for Wales. Otherwise found in Cambridgeshire, Kent, Cumbria (England); Co. Wicklow and Co. Dublin (Ireland) (but not Scotland, the Channel Islands or the Isle of Man) in moss, in *Castanea* and *Fagus* woodlands, mixed deciduous woodland and decaying wood.

Humerobates rostrolamellatus Grandjean, 1936 (B)
Family: Ceratozetidae. Widespread in moss, on bark, *in Molinia* fen, *Calluna* heathland, sitka spruce woodland, on sand dunes, tidal debris, and salt marsh.

Hydrozetes lacustris (Michael, 1882) (A1, G)
Family: Hydrozetidae. Widely distributed in ponds and on freshwater weeds, in *Sphagnum* bogs, lichens, upland moorland, pasture, brackish pools and amongst stones at a water's edge.

Hygroribates marinus (Banks, 1896) (J)
Family: Ameronothridae. Widely distributed coastally under stones, in barnacles, on lichens and in tidal debris on sand.

Hypochthonius rufulus C. L. Koch, 1835 (G)
Family: Hypochthoniidae. First record for Wales. Otherwise widespread in moss, *Sphagnum* bog, mixed deciduous woodland, upland moorland, acid peat bog and under embedded stones.

Joelia fiorii Coggi, 1898 (A)
Family: Oribatellidae. First record for Wales. Otherwise found only in Devon and Cumbria (England) in mixed deciduous woodland.

**Lanceoppia (Baioppia) talacrensis* sp. nov. (F2)
Family: Oppiidae. First record for the British Isles.

Latilamellobates incisellus (Kramer, 1897) (A1, B, D, H)
Family: Ceratozetidae. Generally distributed (but not Scotland) in upland moorland, *Calluna* heathland, leaf litter, grassland, moss on a wall, saltmarsh, supralittoral lichens, heathlike dune vegetation, sand dunes, in tidal debris and on a coal shale tip.

Lauroppia maritima (Willmann, 1929) (A1, D, G)
Family: Oppiidae. First record for Wales. Otherwise found only in Bedfordshire, Cambridgeshire and Devon (England) in sitka spruce woodland and in moss on rotten bark.

Lauroppia neerlandica (Oudemans, 1900) (F1)
Family: Oppiidae. First record for Wales. Otherwise found in Bedfordshire, Cumbria, Devon, Norfolk, North Yorkshire, Oxfordshire, Isles of Scilly (England); the Isle of Man; the Western Isles (Scotland) (but not Ireland or the Channel Islands) in moss, forest litter, *Molinia* fen, upland moorland and sand dunes.

Lauroppia translamellata (Willmann, 1923) (G)
Family: Oppiidae. First record for Wales. Otherwise found only in North Yorkshire and

Devon (England) in upland moorland.

Licneremaeus licnophorus (Michael, 1882) (A1, Fl)

Family: Licneremaeidae. First record for Wales. Otherwise found only in Staffordshire and Devon (England) in moss on the ground and in decayed wood.

Liebstadia similis (Michael, 1888) (A1, B, G)

Family: Oribatulidae. First record for Wales. Otherwise widespread in the British Isles in moss, dead leaves, bracken debris, *Molinia* fen, lichen on bare ground, mature grassland, upland moor, decaying herbage, in grassland, grassed stabilised dunes, heathlike dune vegetation, saltmarsh and tidal debris.

Limnozetes ciliatus (Schrank, 1803) (A2)

Family: Limnozetidae. First record for Wales. Otherwise found in Cheshire, Cumbria, Derbyshire, Essex, Northumberland (England); Forth area (Scotland) and Co. Mayo (Ireland) (but not the Channel Islands or the Isle of Man) in *Sphagnum* bog and similar wet areas.

Liochthonius brevis (Michael, 1888) (C, G)

Family: Brachychthoniidae. First record for Wales. Otherwise found in Bedfordshire, Devon, Hampshire, North Yorkshire, Tyne and Wear (England); Isle of Man; Forth and Strathclyde areas (Scotland); Co. Mayo, Co. Meath (Ireland) (but not the Channel Islands) in dry *Sphagnum,* rotten wood, heathland planted with sitka spruce, mixed woodland, upland moorland, grassed heathlike dune vegetation, house dust and in a cellar.

Liochthonius lapponicus (Trägårdh, 1910) (G)

Family: Brachychthoniidae. First record for Wales. Otherwise found in Tayside, Stromness and Orkney (Scotland) and Co. Wexford (Ireland) (but not England, the Channel Islands or the Isle of Man) in pasture and under gorse.

Liochthonius muscorum Forsslund, 1964 (B)

Family: Brachychthoniidae. First record for Wales. Found previously only in Co. Wexford (Ireland) in pasture.

Liochthonius sellnicki (Thor, 1930) (B)

Family: Brachychthoniidae. First record for Wales. Otherwise found in Lancashire, Yorkshire (England); Western Isles, Orkney (Scotland); Co. Kildare, Co. Wexford and nr. Dublin (Ireland) (but not the Channel Islands or the Isle of Man) in upland moorland, deciduous woodland, grassland, a coal shale tip, heathlike dune vegetation, pasture and a cutaway raised bog.

Machuella bilineata Weigmann, 1976 (B)

Family: Oppiidae. First record for Wales. Found previously only in Cumbria and Devon (England) in humus under yew trees, humus and soil and moss on the ground.

Malaconothrus monodactylus (Michael, 1888) (A2)

Family: Malaconothridae. First record for Wales. Otherwise found in Staffordshire, Cheshire, Hertfordshire, North Yorkshire and Lancashire (England); the Isle of Man; the Forth and Highland areas (Scotland); Co. Mayo and Co. Wexford (Ireland) (but not the Channel Islands) in *Sphagnum* bog, surface soil, permanent grassland, upland moorland, forest soil and litter.

Malaconothrus processus van der Hammen, 1952 (A1, B, G)

Family: Malaconothridae. First record for Wales. Otherwise found in Oxfordshire, Cambridgeshire (England) and Co. Wexford (Ireland) (but not Scotland, the Channel Islands or the Isle of Man) in *Molinia* fen and tussocks, wet soil and *Iris pseudacorus* bog.

Medioppia obsoleta (Paoli, 1908) (B)
Family: Oppiidae. Widely distributed in moss, pine needles, bog, mixed woodland, turf, bracken litter, machair-type vegetation, *Calluna* and upland moorland, old grassland and associated vegetation.

Medioppia subpectinata (Oudemans, 1900) (G)
Family: Oppiidae. First record for Wales. Otherwise found in Oxfordshire, Northamptonshire, Cumbria, North Yorkshire, Cambridgeshire (England); Jersey (Channel Islands); Western Isles (Scotland) (but not Ireland or the Isle of Man) in *Molinia* fen, mature grassland, verge under an oak tree, upland moorland, moss, and leaf litter.

Metabelba papillipes (Nicolet, 1855) (B, D, G, H)
Family: Damaeidae. First record for Wales. Otherwise widely distributed in the British Isles in moss, grass, *Molinia* fen, damp soil near pond, bracken litter, deciduous wood litter and pine needles.

Microppia minus (Paoli, 1908) (F2)
Family: Oppiidae. First record for Wales. Otherwise found in Bedfordshire, Northamptonshire, North Yorkshire, Dorset (England); Co. Kildare and nr. Dublin (Ireland) (but not Scotland, the Channel Islands or the Isle of Man) in mixed woodlands, mature grassland, upland moorland, *Calluna* heathland, old grassland and associated vegetation.

Minunthozetes semirufus (C. L. Koch, 1841) (B, G)
Family: Mycobatidae. Widely distributed in moss, *Sphagnum* bog, *Molinia* fen, mixed woodland, old grassland, upland moorland, fungus, decaying herbage in grassland, wet grazed pasture and saltmarsh.

Moritzoppia keilbachi (Moritz, 1969) (A)
Family: Oppiidae. First record for Wales. Found previously only in the Isle of man, in moss and soil.

Multioppia excisa Moritz, 1971 (B)
Family: Oppiidae. First record for Wales. Otherwise found in Devon (England); Co. Mayo (Ireland) (but not Scotland, the Channel Islands or the Isle of Man) on grassed stabilised sand dunes, heathlike dune vegetation, pasture and in a *Salix* ditch.

Multioppia neglecta C. Pérez-Iñigo, 1969 (F2)
Family: Oppiidae. First record for Wales. Found previously only in the Isle of Man and Jersey (Channel Islands) in moss, pine and leaf litter.

Multioppia pulchra Littlewood and Wallwork, 1972 (F2)
Family: Oppiidae. First Record for Wales. Otherwise found only in the Western Isles (Scotland) in soil.

Nanhermannia coronata Berlese, 1913 (B, G)
Family: Nanhermanniidae. Generally distributed in wet moss, *Sphagnum* bog, litter, upland moorland, grassland and lichen (including maritime).

Nanhermannia elegantula Berlese, 1913 (F1, G)
Family: Nanhermanniidae. Previously found in Bedfordshire, Oxfordshire, Kent, Dorset,

Cumbria (England;) Jersey (Channel Islands); Gwynedd (Wales) and Co. Kildare (Ireland) (but not Scotland or the Isle of Man) in *Molinia* fen, *Castanea* and *Fagus* woodland, *Calluna* heathland, pinewood litter and old grassland.

Nanhermannia sellnicki Forsslund, 1958 (A1, F1)
Family: Nanhermanniidae. First record for Wales. Previously found in Devon and the Calf of Man (Isle of Man) only in mixed deciduous woodland and wet areas.

Nothrus anauniensis Canestrini & Fanzago, 1876 (B)
Family: Nothridae. First record for Wales. Otherwise found in Cambridgeshire, Cornwall, Buckinghamshire, Hertfordshire (England only) in mixed deciduous woodland, *Sphagnum* bog, and *Calluna* heathland.

Nothrus palustris C. L. Koch, 1839 (B, D, G)
Family: Nothridae. Generally distributed in moss, mixed deciduous woodland, *Sphagnum* bog, upland moorland, turf from machair-type vegetation, under bark, on a rabbit and in a mole's nest.

Nothrus silvestris Nicolet, 1855 (G)
Family: Nothridae. Generally distributed in moss on rocks and on the ground, under trees, dead leaves, under heather, *Sphagnum* bog, *Calluna* heathland, mixed woodland, acid peat bog and on a rabbit.

Odontocepheus elongatus (Michael, 1879) (G)
Family: Carabodidae. First record for Wales. Otherwise generally distributed in dead and decaying wood, *Sphagnum* bog, pine wood litter, *Calluna* heathland, mixed deciduous woodland and bracken litter.

Ophidiotrichus tecta (Michael, 1884) (G)
Family: Oribatellidae. First record for Wales. Otherwise found in Surrey, Bedfordshire, Devon (England); Jersey (Channel Islands) and the Forth area and Orkney Islands (Scotland) (but not Ireland or the Isle of Man) in moss, mixed woodland, *Calluna* moor and heathland.

Oppia nitens (C. L. Koch, 1836) (F2)
Family: Oppiidae. First record for Wales. Otherwise found in Staffordshire, Surrey, Tyne and Wear, Cheshire, Merseyside, Yorkshire, Lancashire, Cumbria, Hertfordshire (England) and Strathclyde (Scotland) (but not Ireland, the Channel Islands or the Isle of Man) in cellars, decaying wood and moss, hay refuse, garden debris, pine needles, a manure heap, house dust and in a coal tit's nest.

Oppiella nova (Oudemans, 1902) (A1, B, D, G)
Family: Oppiidae. First record for Wales. Otherwise generally distributed in moss on the ground, wet *Sphagnum, Molinia* fen, heathland, grassland and associated vegetation and a grassed coal shale tip.

Oribatella quadricornuta (Michael, 1880) (B, D)
Family: Oribatellidae. First record for Wales. Otherwise generally distributed in decaying and dead wood, moss on the ground, mature grassland, upland moorland, maritime lichens and acid peat bog.

**Oribatella* species (B, H)
Family: Oribatellidae. First record for the British Isles.

Oribatula tibialis (Nicolet, 1855) (D, G)
Family: Oribatulidae. Generally distributed in moss and dead leaves, *Molinia* fen, pine woodland, lichen and soil, mixed deciduous woodland, *Calluna* heathland, supralittoral lichens and in an old bird's nest.

Oribatula venusta (Berlese, 1908) (G)
Family: Oribatulidae. First record for Wales. Otherwise found at Holy Island, Northumberland (England) and Co. Mayo, Co. Dublin (Ireland) (but not Scotland, the Channel Islands or the Isle of Man) in tidal debris, moss on sandhills, under stones, on the seashore at highwater mark and on lichen.

Pantelozetes paolii (Oudemans, 1913) (B, D, G)
Family: Thyrisomidae. First record for Wales. Otherwise found in Cumbria, Devon, North Yorkshire, Oxford (England); Strathclyde (Scotland) and Co. Kildare and nr. Dublin (Ireland) (but not the Channel Islands or the Isle of Man) in a *Molinia* fen, upland moorland, grassland and associated vegetation and a winter wheatfield.

Parachipteria punctata (Nicolet, 1855) (B, D, G)
Family: Achipteriidae. First record for Wales. Otherwise generally distributed in moss, on trees and other vegetation, in dead wood, pine needles, on rotting fungus, ungrazed tussocky pasture, mixed deciduous woodland, *Calluna* heathland, bracken debris and maritime lichens.

Passalozetes perforatus (Berlese, 1910) (G)
Family: Passalozetidae. First record for Wales. Otherwise found only in Ireland in a salt marsh.

Peloptulus phaeonotus (C. L. Koch, 1844) (F2)
Family: Phenopelopidae. First record for Wales. Otherwise found in Cornwall, Cumbria, Cambridgeshire, Northumberland, Oxfordshire, Berkshire, Isles of Scilly (England); Forth area and the Western Isles (Scotland) and Co. Mayo and Co. Wexford (Ireland) (but not the Channel Islands or the Isle of Man) in wet and dry moss, upland moorland, in grass, grassed stabilised dunes, heathlike dune vegetation, and pasture.

Phauloppia lucorum (C. L. Koch, 1841) (A)
Family: Oribatulidae. Widely distributed in *Sphagnum* moss, lichens and bryophytes, on barley on the ground, moss on walls, soil, and rocks, maritime lichens and tidal debris.

Phthiracarus anonymus Grandjean, 1933 (G)
Family: Phthiracaridae. Widely distributed in moss growing on the ground and on decayed wood, in bogs, in pine needles, *Phragmites* litter, marshland and garden debris.

Phthiracarus globulus (C. L. Koch, 1841) (G)
Family: Phthiracaridae. Found in Cumbria, Devon, Warwickshire, Bedfordshire, Hampshire, Surrey, Oxford and Cambridgeshire (England) and Gwent (Wales) (but not Scotland, the Channel Islands or the Isle of Man) in mosses and liverworts on rocks, mixed deciduous woodland and fen land.

Phthiracarus membranifer Parry, 1979 (A2)
Family: Phthiracaridae. Found in Devon (England); Gwent (Wales) and the Highlands (Scotland) (not the Channel Islands or the Isle of Man) in moss and leaf litter in deciduous and sitka spruce woodlands.

Phthiracarus nitens (Nicolet, 1855) (A2)
Family: Phthiracaridae. First record for Wales. Otherwise found in Cornwall, Devon,

Oxfordshire, Isles of Scilly, Hertfordshire (England), and Jersey (Channel Islands) (but not Scotland, Ireland or the Isle of Man) in moss and leaf litter.

Platynothrus peltifer (C. L. Koch, 1839) (A1, B, D, F1, G)
Family: Camisiidae. Very generally distributed in moss on the ground, *Sphagnum* bog, pine needles, heather and bracken debris, an ant's nest, mixed woodland, upland moorland, grassland, *Calluna* heathland, turf from machair-type vegetation, wet grazed pasture, acid peat bog, saltmarsh and maritime lichens.

Protoribates badensis Sellnick, 1928 (F2)
Family: Haplozetidae. First record for Wales. Found previously only in the Isle of Man in lichen on sand.

Punctoribates punctum (C. L. Koch, 1839) (B, G)
Family: Mycobatidae. Very generally distributed in moss, leaf litter in mixed woodlands, pastureland, upland moorland, *Sphagnum* bog, tidal debris, cereal fields, saltmarsh, sand dunes and a *Formica rufa* nest.

Punctoribates quadrivertex (Halbert, 1920) (G)
Family: Mycobatidae. Found previously in Northumberland (England); Glamorgan, Dyfed (Wales); Co. Mayo and nr. Dublin (Ireland) (but not Scotland, the Channel Islands or the Isle of Man) in maritime lichens and saltmarsh.

**Punctoribates sellnicki* Willmann, 1928 (G)
Family: Mycobatidae. First record for the British Isles.

Quadroppia galaica (Mínguez, Ruiz & Subías, 1985) (A1, F1)
Family: Oppiidae. First record for Wales. Found previously only in Devon (England) in moss on the ground in a deciduous woodland.

It is now appropriate to raise the status of sub-species *'galaica'* to that of species level. This conclusion has evolved after comparing numerous specimens of *Q. pseudocircumita galaica* with *Q. pseudocircumita* from a number of sites in England and Wales. The diffences are summarised below:

W. pseudocircumita galaica	*Q. pseudocircumita*
1) internal borders between epimera 3 + 4 is 'mushroom' shaped (see Fig. 10);	internal borders between epimera 3 + 4 are parallel and completely separate (see Fig. 11);
2) tarsus II with 2 solenidia;	tarsus II with 1 solenidion;
3) the rostral sculpturing completely enclosed, of uniform thickness and more or less oval in shape.	rostral sculpturing in the form of a 'hairpin' with the convex edge most strongly apparent.

**Quadroppia hammerae* Mínguez, Ruiz & Subías, 1985 (A2)
Family: Oppiidae. First record for the British Isles.

**Quadroppia lesleyae* sp. nov. (A2)
Family: Oppiidae. First record for the British Isles.

Quadroppia maritalis (Lions, 1982) (F2)
Family: Oppiidae. Generally distributed in moss, *Sphagnum* bog, mixed woodland litter, grassland, upland moorland, bracken, gorse litter, saltmarsh and grassed, stabilised sand dunes.

Quadroppia pseudocircumita Mínguez, Ruiz & Subías, 1985 (A1, F1)
Family: Oppiidae. First record for Wales. Found previously only in Devon (England) in moss on the ground in a deciduous woodland.

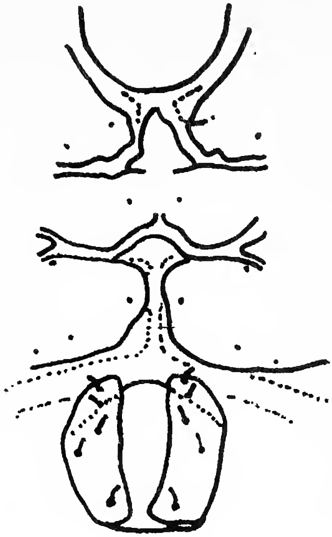

FIGURE 10
Q. pseudocircumita galaica,
part ventral view
(from Mínguez, Ruiz & Subías, 1985)

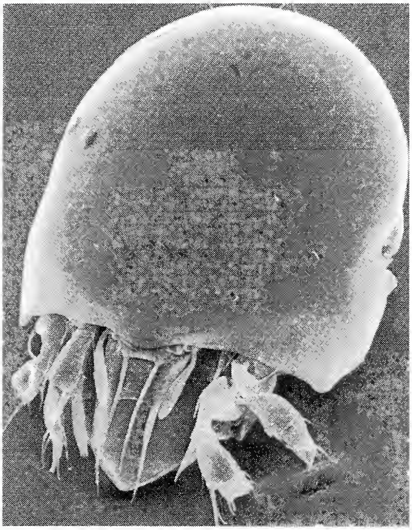

FIGURE 9
Punctoribates sellnicki
dorsal SEM

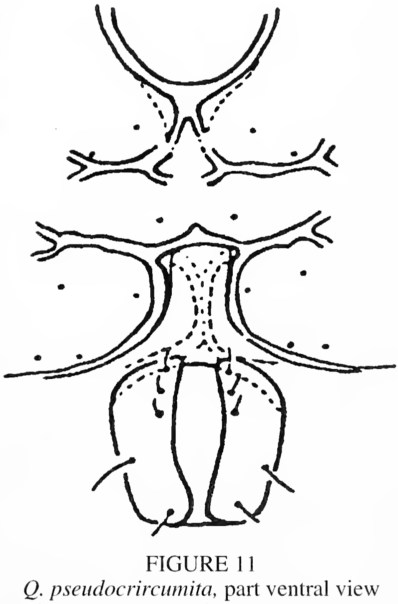

FIGURE 11
Q. pseudocrircumita, part ventral view
(from Mínguez, Ruiz & Subías, 1985)

Quadroppia quadricarinata (Michael, 1885) (B, F1)
Family: Oppiidae. Very generally distributed in moss, *Sphagnum* and rushes, mixed woodland litter, grassland, upland moorland and grassed stabilised dunes.

Ramusella insculpta (Paoli, 1908) (F1, G)
Family: Oppiidae. First record for Wales. Found previously only in Hampshire (England) in *Calluna* heathland.

Rhysotritia duplicata (Grandjean, 1953) (B, G)
Family: Euphthiracaridae. First record for Wales. Otherwise generally distributed in moss on the ground, dead wood, *Sphagnum* bog, in grazed tussocky pasture, mixed woodland and upland moorland.

Scheloribates laevigatus (C. L. Koch, 1835) (A1, A2, B)
Family: Scheloribatidae. Generally distributed in old wood, bracken debris, moss on the ground, grassland including tussocky pasture, bare ground, cereal field, upland moorland, damp debris of warehouse floors, and the nests of *Formica rufa* and a wren's nest.

Scutovertex sculptus Michael, 1879 (F1, F2, G, H)
Family: Scutoverticidae. Generally distributed, particularly in dry habitats, including moss on the ground, *Calluna* heathland, moss on walls, grassland, turf from machair-type vegetation, saltmarsh, abandoned sea bird nests, supralittoral lichen, sand dunes and tidal debris and on a field vole.

Sellnickochthonius hungaricus (J. Balogh, 1943) (B)
Family: Brachychthoniidae. First record for Wales. Previously found in Oxford (England) and Co. Wexford and Co. Offaly (Ireland) (but not Scotland, the Channel Islands or the Isle of Man) in litter, heathlike dune vegetation, pasture and cutaway bog.

Sellnickochthonius immaculatus (Forsslund, 1942) (C)
Family: Brachychthoniidae. First record for Wales. Previously found in Oxford (England); Tayside (Scotland); Co. Wexford (Ireland) (but not the Channel Islands or the Isle of Man) in grassed, stabilised sand dunes, heathlike dune vegetation, pasture, wet, grazed pasture, bog, bracken bed and grassland on sandy soil.

Steganacarus magnus (Nicolet, 1855) (G)
Family: Phthiracaridae. Very widely distributed on moss, in wood, moss under pine wood and in pine needles, among heather, bracken debris and fern debris, deciduous woodland, *Calluna* heathland, upland moorland, *Sphagnum* bog, heathland soil, alder fen and in a *Formica rufa* nest.

Suctobelba trigona (Michael, 1888) (B, G)
Family: Suctobelbidae. First record for Wales. Otherwise found in Essex, Tyne and Wear, Bedfordshire, Cumbria, North Yorkshire (England only) in moss, soil, *Sphagnum* moss, mixed woodland and upland moorland.

Suctobelbella acutidens (Forsslund, 1941) (A, F1, G)
Family: Suctobelbidae. First record for Wales. Otherwise found in Northamptonshire (England); Co. Kildare and Co. Wexford (Ireland) (but not Scotland, the Channel Islands or the Isle of Man) in mature grassland, pasture and under gorse, heathlike dune vegetation and grassed stabilised dunes.

Suctobelbella lobata (Strenzke, 1950) (A1, F1, G)
Family: Suctobelbidae. First record for Wales. Found previously only in Bedfordshire (England) in oak woodland.

Suctobelbella nasalis (Forsslund, 1941) (B)
Family: Suctobelbidae. First record for Wales. Otherwise found in the Isle of Man; Jersey (Channel Islands) and nr. Dublin (Ireland) (but not England or Scotland) in moss on the ground, deciduous wood litter and grassland.

Suctobelbella similis (Forsslund, 1941) (F1)
Family: Suctobelbidae. First record for Wales. Otherwise found in Bedfordshire, North Yorkshire (England) and the Western Isles (Scotland) (but not Ireland, the Channel Islands or the Isle of Man) in mixed woodland and upland moorland.

Suctobelbella subcornigera (Forsslund, 1941) (D, G)
Family: Suctobelbidae. First record for Wales. Otherwise widespread in moss, mixed woodland, heathland bracken litter, heathlike dune vegetation and lichen.

Suctobelbella subtrigona (Oudemans, 1900) (G)
Family: Suctobelbidae. First record for Wales. Otherwise found only in Bedfordshire, Oxfordshire, Cumbria, North Yorkshire, Nottinghamshire (England) in mixed woodland, *Molinia* fen and upland moorland.

**Synchthonius elegans* Forsslund, 1956 (B)
Family: Brachychthoniidae. First record for the British Isles.

Tectocepheus sarekensis Trägårdh, 1910 (A1, B, G)
Family: Tectocepheidae. First record for Wales. Otherwise found in Nottinghamshire (England) and Co. Kildare and Co. Wexford (Ireland) (but not Scotland, the Channel Islands or the Isle of Man) in mixed woodland, grassed stabilised dunes and pasture.

Tectocepheus velatus (Michael, 1880) (A1, A2, B, G)
Family: Tectocepheidae. Very widely distributed in moss, bracken debris, *Molinia* fen, *Calluna* heathland, mixed woodland, grassland, reclaimed and mature grassland, cereal fields, lichen, sand dunes and the nest of a coal tit.

Trichoribates novus (Sellnick, 1928) (C, D, F1, F2)
Family: Ceratozetidae. First record for Wales. Otherwise found in Cumbria (England) and the Isle of Man (but not Scotland, Ireland or the Channel Islands) in upland moorland and bogland.

Trimalaconothrus glaber (Michael, 1888) (A1)
Family: Malaconothridae. First record for Wales. Otherwise found in Essex, the Midland Counties, Hampshire, Durham, Cheshire, Northumberland, Cumbria (England); Forth area of Scotland and Co. Mayo (Ireland) (but not the Channel Islands or the Isle of Man) in forest litter and *Sphagnum* bog.

Zygoribatula knighti Luxton, 1987 (G)
Family: Oribatulidae. Found in the Isle of Man and Dyfed (Wales) (but not England, Scotland or the Channel Islands) in mixed deciduous litter and moss on sand dunes.

ACKNOWLEDGEMENTS
I am most grateful to Dr Malcolm Luxton of the National Museum of Wales for his help in confirming identifications of *S. elegans* and *Q. hammerae;* access to his Data Base of known published records of oribatids in the British Isles was invaluable. Thanks also to Dr Valerie Behan-Pelletier (Agriculture Canada, Ottawa) for her advice and assistance in confirming the identity of *Punctoribates sellnicki.* My own specimens were extracted using the Tullgren funnel facility at Liverpool Museum with thanks to Dr Stephen Judd, Curator

of Entomology, for his help and encouragement and to Mr M. Bigmore, Assistant Curator, for his previous work at the site collecting the bulk of the material on which this paper is based. The S.E.M. photograph of *P. sellnicki* was taken by Peter Young at The Liverpool School of Tropical Medicine (Microscopy Laboratory) whilst that of the *Oribatella* species was kindly arranged by Dr George Sharples at John Moores University, Liverpool.

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BOOK REVIEW

Animal Quest: a naturalist on four continents by **M. J. Delany.** Pp. 192 (with line drawings by Virginia Clucas & b/w plates), plus 8pp of full colour plates. Capponnellan Press. 2000. £9.95, plus £2.00 postage & packing, available from the author, Fern Lodge, Fern Hill, Bingley, West Yorkshire BD16 4AQ.

Michael Delany, formerly Professor of Environmental Science at the University of Bradford, is no stranger to Yorkshire naturalists. His particular speciality, small mammal ecology, has taken him to many parts of the world, making several countries his home for substantial periods of his life. As well as his detailed studies throughout the British Isles, he has worked in America, Africa and the Middle East. It was in Africa that he discovered a mouse new to science, the specialist at The Natural History Museum naming it *Delanymys brooksi* by – Delany's swamp-mouse has gained him international recognition and a place in history.

Many will have enjoyed the hour-long interview with him on local radio recently. Further pleasure will be derived from his biography which makes fascinating reading and provides an insight into the way a scientist is drawn into and develops his study. There is not much about his time at Bradford, other than his work on Pennine mice, but the rest will keep a naturalist absorbed.

MRDS

A MODERN TREE RING ANALYSIS FROM TARN MOSS, MALHAM TARN, YORKSHIRE

ALLAN PENTECOST AND DAN PEPPIATT
Division of Life Sciences, King's College London, Franklin Wilkins Building, 150 Stamford Street, London SE1 8WA

INTRODUCTION

During a recent survey of Tarn Moss, the large raised peat bog to the west of Malham Tarn, the age of the 50 or so Scots pine trees (*Pinus sylvestris*) scattered along the eastern margin of the tarn was questioned. It was decided to fell one of the trees to estimate the time of planting and this provided an opportunity to conduct a tree ring analysis to assist our understanding of recent environmental change on Tarn Moss. The site is favourable for tree ring studies since a meteorological station is situated *c.* 500 m NE at the same altitude.

METHODS

Tree ring measurement

A mature Scots pine (*Pinus sylvestris)* from Tarn Moss was chosen to represent an example from the original planting/seeding. It stood 50 m west of the shore of Malham Tarn (grid ref. 34/889668, altitude 380 m.). The tree was felled on 6.8.1998 and two slices taken at 30 cm and 35 cm above ground level, one for analysis and one for archiving. To improve ring clarity, one section, left to dry for two months, was rubbed with fine sandpaper followed by a wax polish. Two axes, originating at the growth centre, were chosen for measurement. The choice was dependent upon the clarity of rings and the ring width, both of which varied in the section. We chose axes at 207° and 72° from magnetic North where the rings were displayed clearly and were well separated. Using a metal ruler and magnifying glass, measurements were taken from the end of a growth ring (at the edge of late-wood growth) to the end of the late-wood growth of the consecutive ring, with an accuracy of ± 0.1 mm achievable between most rings. The raw data were converted into ring width indices (Creber, 1977; Schweingrüber, 1996), which utilise a fitted polynomial curve from which a standardized ring width index is obtained. The analysis was performed using an Excel spreadsheet. The standardised ring width index (SWI) was obtained as:

SWI = Actual ring width/fitted curve ring width

These SWIs have a mean of unity and their variance is independent of mean tree growth and the position of the chosen axes on the tree slice (Creber, 1977; Fritts, 1976). It is a necessary procedure as it eliminates differences in tree growth unrelated to climate, e.g. younger trees grow more rapidly than older trees and produce thicker rings. As suggested by Creber, the two sets of SWIs were compared, using a paired z-test (Sokal & Rohlf, 1995); their difference was found to be insignificant ($z = 0.76$, $p>0.1$). The two sets of SWIs from the chosen axes could then be averaged to give a mean width index for every annual ring. The averaged indices were compared statistically with a range of data taken from the meteorological station records at Malham Tarn.

Meteorological data

Data on monthly mean values of air temperature, precipitation, hours of sunlight and number of frost days were obtained for the period 1949 to 1997. Since *P. sylvestris* grows mainly between May and September, meteorological measurements were grouped into seasonal sets, December-February ('low-growth'), March-May, June-August and September-November ('main growth'). Product-moment correlations were then obtained between the averaged ring index and meteorological factors.

Results

Relevant climatic data from the Tarn meteorological station are summarised in Table 1. This is the highest continuously operating station in England which accounts for the low mean temperature and high rainfall. Measurements for total sunshine are discontinuous due to vandalism of the instrument. Frost day measurements were not recorded after 1979. During the period 1949-1997, the highest mean annual temperature (8.1 °C) was recorded for 1997, and the lowest (5.34°C) in 1955. The latter was also the driest year (1125 mm) with the wettest 1954 (1945 mm).

TABLE 1
Summary of meteorological data for Malham Tarn

	Annual max. temp* °C	Annual min. temp* °C	Mean temp.** °C	Annual rainfall mm	Annual sunshine hours	Annual frost days
period(s)	1950-1997	1950-1997	1950-1997	1949-1997	1957-1971 1987 1995-1997	1950-1979
mean	9.81	3.82	6.81	1471	1170	144
range	7.2-11.2	2.8-5.2	5.3-8.1	1125-1945	1125-1457	86-188

* Obtained by averaging the mean monthly air temperature records for each year. The yearly figures were then averaged for 'mean'. For 'range' the yearly averages were used.

** The yearly maximum and minimum figures were added and then divided by two to yield a single average for each year. These individual averages were then meaned over the entire period of observation to give the figure indicated. 'Range' is the range of the yearly averages.

The tree leaned slightly to the SE, was 7.4 m in height and had a girth of 100 cm at 30 cm above the ground. Its diameter at 30 cm ranged from 28.5 to 35.1 cm, the direction of greatest diameter being ENE. It was 81 years old according to the ring count and therefore planted/seeded in 1917 or shortly afterwards. For such an age the tree had a small stature. Although not used in the statistical analyses, the averaged *raw* growth ring widths are shown in Figure 1 along with the ring width indices. The data show three irregular peaks corresponding to 1939-1948, 1955-1965 and 1970-1980.

The mean annual ring width for the tree was 2.03 mm. A significant positive correlation was found between the mean winter temperature and the width of the consecutive SWI

TABLE 2
Some correlations between meteorological variables and standardised ring width indices

Variable	Period covered	Consecutive (CO) or current (CU) ring	Correlation coefficient	Significance
Mean winter temp.	Dec. - Feb.	CO	0.395	**
Mean winter temp.	Dec. - Feb.	CU	0.186	n.s.
Mean spring temp.	March - May	CU	0.270	n.s.
Mean summer temp.	June - Aug.	CU	0.127	n.s.
Mean autumn temp.	Sept. - Nov.	CU	0.228	n.s.
Rainfall	May - Sept.	CO	–0.355	*
Rainfall	Oct. - April	CO	0.086	n.s.
Sunshine	May - Sept.	CO	0.397	*
Sunshine	Oct - March	CO	0.048	n.s.

(Table 2), but no other significant correlations with temperature were found using either the current or consecutive width indices. A significant negative correlation was found between the May-September rainfall and the consecutive SWI, with a significant positive correlation between May-September sunshine and the consecutive SWI.

Discussion

The average life span of *P. sylvestris* is about 130 years and the mean height ranges from 15-30 m, reaching 36 m under optimal conditions (Carlisle & Brown, 1968 ; Milner 1992; Press, 1996). The height of our sample fell well below these figures, indicating that considering its age, conditions at the site were far from ideal. Although the tree grew within 10 m of two other pine trees of similar stature, the site was otherwise open and exposed to prevailing westerly winds.

Grace and Norton (1990) noted that winter air temperature can be at least as important as summer temperature for Scots pine growth in Scotland, while Hughes *et al.* (1984) have shown a strong correlation between winter temperature and ring width. In more continental areas, the availability of water in winter can be reduced by ground and trunk freezing (Grace & Norton, 1990; Fritts, 1976) which can lead to winter browning through needle desiccation (Wardle, 1971), though browning has not been reported from Malham. However, a positive relationship between winter temperature and the consecutive growth ring is understandable. The lag between increased ring thickness and favourable conditions may result from the development of healthier needle primordia which will ensure better growth in the future season (James *et al.*, 1994). However, for *P. sylvestris*, the needles have a lifespan of about four years which would partly smooth out this effect. Previous work has shown that a positive correlation is usually found between the current summer temperature and the current growth ring (Schweingrüber *et al.,* 1979; Hughes *et al.*, 1984) and the lack of correlation in our study was unexpected. The optimum air temperature for the growth of *P. sylvestris* is known to be closer to 20°C and it is possible that the actual temperature range and distribution rather than the temperatures themselves affect this correlation, which may explain our results.

It has been widely documented that lack of water can severely limit tree growth, especially during winter (James *et al.,* 1994): for example, Guiterez (1989) and Keller *et al.* (1997) found a reduction in radial growth by a factor of at least two when temperature in southern France increased by 2-3°C, linked to water availability. Such effects are usually less evident in Britain, though several droughts are recorded at Malham; for example, the mean SWI fell by nearly 30% between the drought year of 1976 and 1977, ending a long sequence of broad growth rings (Fig.1). The driest year, 1955, also corresponds to the lowest SWI. In view of this, a negative relationship between precipitation and ring growth seems odd. However, raised peat bogs such as Tarn Moss have unusual hydrological characteristics, with impeded drainage and a locally high water table. Over the past 25 years, attempts to slow drainage, reduce erosion and encourage *Sphagnum* growth have been made on Tarn Moss by blocking the drainage channels with wooden dams. Pine trees grow best on light, freely draining soils (Carlisle & Brown, 1968), so periods of high rainfall leading to rapid waterlogging could be detrimental, perhaps resulting in an overall negative correlation between ring growth and precipitation.

It is known that *P. sylvestris* is high light demanding and a significant positive correlation was found between the consecutive ring widths and the total hours of sunshine recorded during the main growing season (Table 2). Although there are no detailed studies available, there are data correlating air temperatures with consecutive ring growth (Camarrero *et al.,* 1998) and one might expect air temperature to reflect to some extent the pattern of solar radiation. It is also thought that temperature of the tree tissue is important to growth (Grace, 1988) and this is determined primarily by windspeed and evaporation (James *et al.,* 1994). Late frosts with air temperatures of –5°C can damage the cambium during bud opening, leading to reduced growth, and are known to be one of the most influential climatic variables for tree growth and distribution

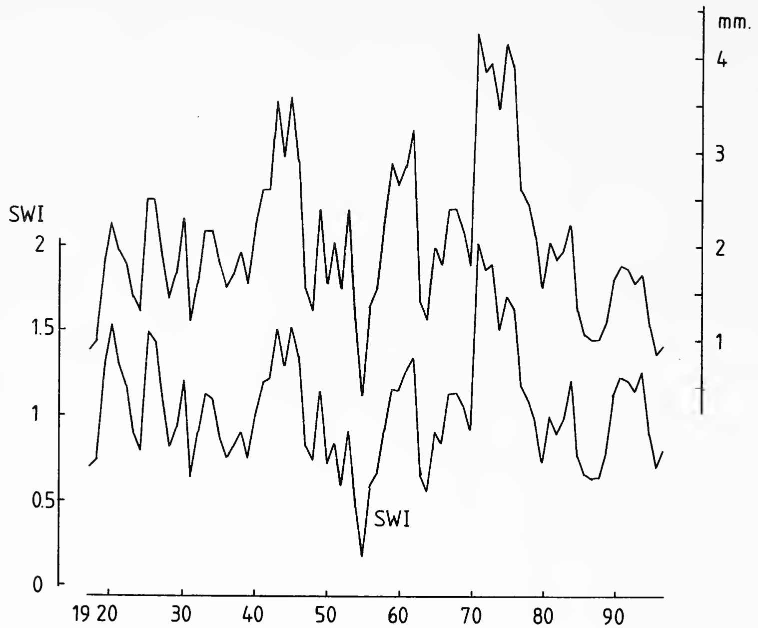

FIGURE 1
Figure 1. Graph showing the mean (N = 2) tree ring widths (above) and the standardised ring width indices (SWI, below) for *P. sylvestris* at Malham Tarn.

(Krasowski *et al.,* 1993). However, there was no significant correlation between days of winter/spring frost and current tree ring width. Late May frost, which has been shown to impact on *P. sylvestris* in some studies (Schweingrüber, 1996), was not significant for this tree.

Conclusions

A tree-ring analysis of a single Scots Pine (*Pinus sylvestris*) sampled from Tarn Moss, North Yorkshire within 500m of a weather station, was undertaken. The tree was stunted for its age and consecutive ring widths were positively correlated with winter air temperature and May-September sunshine. Ring widths were also negatively correlated with May-September rainfall. The results were explained by winter temperature affecting leaf primordia, rainfall causing local waterlogging of the site and the light-demanding requirements of the species. Tree growth was suboptimal due to low mean air temperature (7°C) and high wind exposure.

Acknowledgements

We are indebted to the staff of Malham Tarn Field Centre for provision of field equipment, accommodation and the meteorological data. Thanks also to the National Trust, particularly to Alastair Cluness and his team for permission to fell one of the trees and providing the equipment to do so.

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BOOK REVIEW

Ancient Woodlands: their archaeology and ecology – a coincidence of interest edited by **Pauline Beswick and Ian D. Rotherham,** assisted by Julian Parsons. Pp. 113, with 28 b/w drawings & maps. Landscape Archaeology and Ecology Volume 1, Proceedings of 1993 Landscape Conservation Forum, Sheffield. 1999. £6.00, including postage and packing, available from Wildtrack Publishing, P.O. Box 1142 , Sheffield S1 1SZ .

This slim volume, based on a national conference held in 1993, contains 13 contributions of varying length, focussing mainly on research into woodlands of the Sheffield area. Whilst some of the papers are merely summaries, others are substantial chapters (e.g. Jones on South Yorkshire's ancient woodland, which gives a full and fascinating insight into the historical documentation for woodland management). Some papers are of purely local interest, but one or two have broader application (Rotherham & Rose on Red Data Book species; Green on the importance of old trees and their management). The final contribution, by Baines, purports to be an overview of the conference, but it bears little relationship to the other papers and wanders well away from the theme of the conference.

Unfortunately, the volume has not been well edited. Many contributions overlap in their content; for example, the first three papers all summarize the history of woodland colonization, many papers repeat material on woodland management techniques, and there are two very similar papers on Eccleshall Woods. Furthermore, much of the material has been recently published elsewhere (eg. Jones' chapter is very similar to his chapter in Atherden & Butlin, eds, 1998, *Woodland in the Landscape: Past and Future Perspectives*). No attempt has been made to achieve a consistent style, and the contribution by Baines in particular sits uncomfortably with the rest, both in its content and its chatty style. The volume will be of most interest to people with a specific involvement in the conservation or management of woodlands in the Sheffield area.

MAA

YORKSHIRE NATURALISTS' UNION EXCURSIONS IN 1995

COMPILED BY
A. HENDERSON

HOLLYM CARRS AREA NEAR WITHERNSEA (VC61) 20 May (J. M. Blackburn)

INTRODUCTION (P. J. Cook)

A bright, sunny day and the first opportunity to visit a newly developing 27 acre nature reserve attracted about forty people from near and far. Such a good turnout in a wide range of disciplines helped the South Holderness Countryside Society to develop a baseline biodiversity inventory for this mixed meadow, wetland and developing decidous woodland reserve.

Refreshments were served by host Society volunteers in Hollym Village Hall. Mr Les Magee chaired the meeting and, following the reports, Mr Albert Henderson proposed a vote of thanks to the hosts. It was good to have the company of Dr Eva Crackles, Dr Eric Chicken, and so many friends from the recently restored Hull Natural History Society at this meeting.

MAMMALS AND AMPHIBIANS (R. J. Hunt)

Several Hares, a Hedgehog (dead) and the tracks of Roe Deer were seen and the nest of a small rodent was examined for fleas (see Siphonaptera, below). Common Frog and Smooth Newt were reported.

CONCHOLOGY (L. Lloyd-Evans)

Eleven species of mollusc were recorded, four from ponds, two from marshland and the rest from dry land. Most were common and widespread but *Lymnaea auriculata is* a more local and demanding species, hitherto unrecorded from TA32.

LEPIDOPTERA (J. Payne)

Owing to the cool, mainly overcast conditions little was flying. In the brief sunny periods several male Orange Tip butterflies made short flights. Green-veined White and Large White were present in small numbers. A single Small Copper was reported.

No larger moths were seen but it was pleasing to see three full fed Drinker larvae and one smaller one. Generally larvae were very scarce, the only other seen being a green geometrid on apple. The *Typha* heads which had not disintegrated had larvae and pupae of the micro *Limnaecia phragmitella.*

There were plenty of nettles, Field and Spear Thistles to supply food for members of the Nymphalidae and the grass feeders should not lack sustenance. However, desirable Leguminosae such as Bird's foot Trefoil, Kidney Vetch or Melilot seemed to be absent, so Dingy Skipper and Common Blue are not likely to breed unless these plants are introduced. One or two Holly bushes and some Ivy would increase the chance of Holly Blue settling in the reserve.

COLEOPTERA (W. R. Dolling & R. J. Hunt)

In the Smess Pond area: (Carabidae) *Leistus rufescens, Nebria brevicollis, Pterostichus strenuus, Agonum albipes, A. marginatum* and *Demetrias atricapillus;* (Dytiscidae) *Agabus nebulosus;* (Leiodidae) *Sciodrepoides watsoni;* (Biphyllidae) *Byphyllus lunatus* were noted.

In the Brick Pond area: (Carabidae) *Notiophilus biguttatus, Alaphrus riparius, Bembidion varium, B. obtusum* and *B. aeneum,* (Haliplidae) *Haliplus iommaculatus* and *H. ruficollis;* (Hydrophilidae) *Hydrobius fuscipes, Anacaena limbata* and *Enochrus testaceus;* and (Staphylinidae) *Stenus biguttatus* and *Lathrobium fulvipenne* were seen.

In the Meadow: (Carabidae) *Demetrias atricapilus;* (Staphylinidae) *Stenus similis* and

Tachyporus hypnorum; (Kateretidae) *Brachypterus glaber* on nettles; (Nitidulidae) the Rape Fly *Meligethes aeneus;* (Elateridae) *Agriotes lineatus;* (Coccinellidae) *Subcoccinella vigintiquattuorpunctata;* (Chrysomelidae) *Chalcoides fulvicornis* on sallows on the north edge and *Psylliodes affinis* on *Solanum dulcamara;* and (Apionidae) *Apion violaceum* were recorded.

In the Smess area: (Carabidae) *Bembidion genei* subsp. *illigeri* on the shores of Smess and the Extension Ponds, and *Dromius melanocephalus;* (Staphylinidae) *Stenus cicindeloides, Tachyporus solutus* and *T. obtusus;* (Keteretidae) *Brachypterus glaber* on nettles; (Cerambycidae) *Grammoptera ruficornis* at *Malus* flowers; (Chrysomelidae) *Chaetocnema concinna and Psylliodes affinis on Solanum dulcamara;* and (Apionidae) *Apion carduorum* were observed.

In the Marsh by the Brick Pond: (Carabidae) *Agonum fuliginosum* occurred.

ACULEATE HYMENOPTERA (R. Eades)
Insect activity was poor due to cold wind. No social wasps, no solitary wasps and no solitary bees were noted. Bumble bees recorded were six female Red Tailed Bumble-bee *Bombus lapidarius* along the northern boundary hedge and one female *Psithyrus bohemicus* near the gateway.

HEMIPTERA & DIPTERA (W. R. Dolling)
8 species were recorded: (Lygaeidae) *Chliacis typhae* on *Typha* in the Brick Pond; (Tingidae) *Tingis ampliata* on Creeping Thistle in the Smess area; (Cicadellidae) *Euselis plebejus* in the Meadow and *Mocydia crocea* in the Meadow and Smess areas; and (Delphacidae) *Javesella discolor* by sweeping grasses in the Smess area, *J. pellucida* similarly in the Smess area and the Meadow, and *Stenocranus major* on *Phalaris* by the Brick Pond and *S. minutus* on *Dactylis* in the Meadow. L. Lloyd-Evans recorded the waterboatman *Notonecta marmorea* in the new pond; this is a species probably now extending its range, often coastal, and able to tolerate high salinity. Some flies remain to be worked up but the following Syrphidae (Hoverflies) were identified: *Melanostoma mellinum, Platycheirus clypoeatus, P. immarginatus* and *P. manicatus.*

SIPHONAPTERA
Mr R. S. George identified the fleas from the rodent nest mentioned above as *Ctenophthalmas nobilis vulgaris, Amalaraeus penicilliger mustelae* and *Megabothus turbidus,* enabling the nest to be identified as that of a species of vole.

PLANT GALLS (D. P. Savage)
Only four species were seen within the confines of the reserve. The most interesting were the galls of the Tephritid fly *Urophora stylata* in the heads of *Cirsium vulgare.* On Hawthorn *Crataegus monogyna* the gall mite *Eriophyes goniothorax* was identified. On Blackthorn *Prunus spinosa* galls of two species of mite were found. These were *E. similis ssp. prunusspinosae* and *E. padi* ssp. *prunianus* var. *homophyllus.* Further galls identified on oak and elm in Hollym village are outside the scope of this survey. These were Oak Marble *Andricus kollari,* Currant Gall *Neutoterus quercusbaccarum* and the aphid gall *Eriosoma ulmi.*

OTHER ARTHROPODS (P. J. Cook)
Under wood the Woodlice *Porcellio scaber* and *Oniscus asellus* were found.

BOTANY (P. J. Cook and E. Chicken)
The vascular flora of the meadow and its bordering ditches and oldest pond has been surveyed by Dr Eva Crackles on several occasions since 1986 and the flora of the whole reserve has been under constant surveillance since 1991. The Management Plan for the site stipulates that there are to be no introductions to the site, with the exceptions of trees and

shrubs on the area designated to become a deciduous woodland. Such permitted introductions are to be of local provenance. This meeting was an opportunity for Eva to see the whole reserve for the first time and her company and comments were much appreciated.

Dr Eric Chicken kindly undertook the task of generating a list of species. It was rather early in the season to effect positive identification of several species but the locations of those new to the list were noted for critical study later in the year. These included *Veronica hederifolia ssp lucorum, Rumex crispus x R obtusifolius, Callitriche* agg., *Rorippa palustris* and a Water Crowfoot from the new ponds. Of particular note to visitors from the West and North Ridings, unfamiliar with the Holderness arable flora, was the preponderance of Black Twitch *Alopecurus myosuroides.*

MYCOLOGY (C. S. V. Yeates)

One of the most useful aspects of vice-county meetings of the Union is that one collects in areas which one would not normally ever consider visiting. The rare and unusual may sometimes turn up, but equally productive can be the extension of the known range of more familiar species.

On this occasion some useful records were made. Of great interest were the quantities of the fruiting stage of the ergot fungus *Claviceps purpurea* in one part of the reserve. Naturalists who were familiar with the site commented that there had been large quantities of sclerotia on *Phalaris* the previous summer. Several other species were recorded on this grass, including the discomycete *Lachnum (Dasyscyphus) controversum.* Another *Lachnum* in the area was *L. palearum* on dead *Elytrigia repens,* which also held the tar-spot ascomycete *Lophodermium gramineum.* Seven species of micro-fungi were collected on dead *Brassica* stems on the reserve although all were widespread species.

Near the reserve on *Heracleum* was the parasitic ascomycete *Taphridium umbelliferarum.* This is very much a VC meeting specialist. Nearby on *Phragmites* was the hyphomycete *Periconia britannica,* new to the county.

Puccinia oxalidis was observed in Hollym village on *Oxalis latifolia,* a first vice-county record. This rust was first noted in Yorkshire in the Scarborough and Middlesbrough areas in 1987. Its initial spread north in Britain appears to have been restricted to sites near the coast. It is however now widespread in the Huddersfield area and is still spreading. Another rust noted in gardens, this time in Withernsea, was the bluebell rust *Uromyces muscari.* This forms the most easterly Yorkshire record and was on the non-native *Hyacinthoides hispanicus.* It is probably most often recorded on this host in VC61, rather than on the native species. On the native bluebell it is very widespread in Yorkshire but seldom occurs in any quantity in any one site, whereas on the introduced species in gardens attack is often very severe. In all 42 species were recorded.

LICHENOLOGY (A. Henderson)

The derelict arable land of the area is still almost wholly free of lichen colonisation, so that the main source of lichenological interest during the day in all parts of the reserve was mature hedgerow, particularly those stretches of field boundary to the north and south of 'Smess' and south of the Old and New Ponds, with older *Fraxinus* especially bearing a nitrophilous *Xanthorion* community, as expected on land with a history of agricultural fertilisation. Interesting in this connection was the occurrence on *Fraxinus* by the ponds of numerous *Physcia* thalli with very broad, short lobes and extremely few marginal cilia, which proved difficult to determine to species level. As collected specimens were still puzzling under the microscope later, material was despatched to Professor Moberg of Uppsala, author of the 1977 monograph on the genus, *Physcia,* who determined the specimens as P. *tenella,* and commented: 'I am quite aware of the problem with the material you sent, evidently from a polluted area and not fully developed, and the fertilisation probably makes it grow without the typical long lobes'. Despite this morphological variation, the lichen appeared healthy and prolific. *Xanthoria parietina* and

X *polycarpa,* growing with the *Physcia,* were frequently attacked by the lichenicolous fungus, *Lichenoconium xanthoriae. Xanthoria candelaria* seemed free from invasion.

Apart from *Cladonia coniocraea, Evernia prunastri* was the only fruticose lichen recorded. *Lecanora expallens* vied in many parts with *L. conizaeoides* as a background crust on bark, both species often heavily algal-covered. Often almost immersed in alga, too, was occasional *Micarea prasina,* at times adjacent on Elder to the microfungus *Trimmatostoma betulinum.* Much of the fencing on the reserve is recent, and only a few patches of *M. denigrata* were noted among the near-ubiquitous *Lecanora conizaeoides* on older struts and posts. Such aging lignum should be left as long as possible to assist further lichen colonisation. Similarly, some of the more thickly branching hedgerow trees might usefully be opened up.

FRESHWATER BIOLOGY (L. Magee)

The 27 acre site has two acres of wetland which can be increased by improvements and clearing of the ditches as the newly planted trees mature and the reserve develops. The soil type is, to quote the vernacular, "olderness", "a chalky till, seasonally waterlogged, fine loamy soil, with narrow strips of clayey alluvial soils". No water analysis was done but the pH was high at 8.6. The aquatic or marginal plants were colonisers, in contrast to the current (and deplorable) practice of introducing showy, rare or alien plants. A scrape made two years ago had a marginal flora of Watermint *Mentha aquatica,* Soft Rush *Juncus effusus,* Hard Rush *J. inflexus,* Reed Grass *Phalaris arundinacea* and Fool's Water-cress *Apium nodiflorum.* Aquatic plants included Curled Pondweed *Potamogeton crispus,* Bulrush *Typha latifolia* and Rigid Hornwort *Ceratophyllum demersum.* It was pleasing to find a well-established Stonewort, the identity of which is to be determined. The oldest pond on the site of former claypits was mature and had a dense marginal flora including the Water Crowfoot *Ranunculus aquatilis* and the Pondweed *Potamogeton natans.* A well established Water Starwort, considered to be *Callitriche truncata,* awaits confirmation.

The pond had a large population of the Mayfly known as the Pond Olive *Cleon dipterum.* These were in all stages of development from winged female imago to small nymphs. Juveniles of a species of *Notonecta* (Waterboatmen) were common in all the ponds as were larvae and adults of the Chironomid, *C. plumosus.* A single larva of the Damsel Fly *Lestes sponsa* was identified from the oldest pond and an adult damsel fly, *Coenagrion puella* was seen. A beetle larva of about 8 mm length was common in all the ponds. The remains of an old ditch were choked with decaying vegetation and the dominant invertebrate was the Water Hog Louse *Asellus aquaticus.* The reserve has considerable potential in an area where freshwater sites are sparse. The Freshwater Biology Section intend to monitor progress with visits later in the season.

FALLING FOSS, NEAR WHITBY (VC62) 3 June (J. M. Blackburn)

Twenty seven members assembled in the Falling Foss car park before dispersing into the Forest Nature Reserve, at the invitation of Forest Enterprises. The weather was fine and improved during the morning. The afternoon became dull and at 1500h, heavy rain brought the meeting more or less to a close. One group headed southwards up May Beck as far as the second car park where the stream was crossed, and returned by Old May Beck Farm to the foss. Others went north as far as the conifer stand in the NE corner of the reserve. The area around and below the foss itself received much attention, as did Parsley Beck and its surrounds upstream as far as the waterfall at the reserve boundary. Several members visited a lake near Leas Head Farm outside the reserve. A curious feature of the reserve is an outcrop of rock which was hollowed out to form a small room some 200 years ago. The rock is inscribed "The Hermitage". Several members took advantage of it when the rain started.

The tea and indoor meeting were held at Stainsacre Hall. The meeting was chaired by the immediate past President, Mr Leslie Magee. Sixteen members were present, representing ten affiliated societies. Apologies were received from Professor Seaward and Mr A. Norris.

Following the reports Mr A. Henderson commented that, with less pollution now, it is probable that the area will respond to the present management policy. He then proposed a vote of thanks to Forest Enterprises, to Mr Alan Kitson the warden of Stainsacre Hall, and finally to the Divisional Secretary.

COLEOPTERA (R. J. Hunt)

The party of four coleopterists headed from the car park down to the stream and Falling Foss itself. Leaf litter that had accumulated behind walls in the woodland was sieved, producing quite a number of Staphylinidae. Sieving bankside flood litter by the stream produced the water beetle *Platambus maculatus* and several ground beetle species in the genus *Bembidion.* The carabids *Nebria gyllenhali* and *Agonum albipes* were numerous along the stream sides. Sweeping the vegetation in the area around Midge Hall produced the large weevil *Liophloas tessulatus* from *Heracleum.* David Savage had found a fine specimen of the chrysomelid *Chrysolina polita,* and Robert Angus took what appeared to be a member of the Cleridae. After lunch we headed for the northern end of the woodland and met a party of botanists who handed me a good specimen of the carrion beetle *Oiecoptoma thoracicum.* The heavy downpour swiftly brought collecting to a close and we made our way back to the car park in a state of saturation.

PLANT GALLS (D. P. Savage)

Plant galls were evident around the car park, and in all thirty galls were seen in the confines of the wood. The area most closely examined was the edge of the woodland between Midge Hall and Leas Head Farm.

On the mature oaks in this area two galls were found, both of which are under-recorded in the county. *Andricus legitimus* induces stunted acorns each of which contains a single wasp larva. Some of the stunted acorns examined contained several larvae, these belonging to the wasp *Synergus clandestinus,* an inquiline inhabiting the gall of the *Andricus.* The second gall on *Quercus* was *Andricus quercuscorticis* which induces galls on the callous material which forms in places where the tree has suffered damage.

The oak bud galls caused by *Andricus lignicola* which are persistent when present were not seen at this site. Although this species – which was first recorded in Yorkshire during the late 1970s – is now widespread, it is absent from sites recently examined in the eastern part of the county.

Other galls of note were two induced by gall midges on a lime. Both cause distinctive leaf edge rolls on the host. *Dasineura thomasiana* produces galls which are glabrous and contain red larvae. *Dasineura tiliamvolvens* produces distinctly hirsute galls which contain orange larvae. There are few records for both these species in Yorkshire.

BOTANY (D. J. Grant)

The area visited is situated on the Ravenscar group of rocks, which date from the Jurassic. These rocks consist of sandstones and shales. The whole area is also covered with boulder clay, resulting in an acid soil.

Members left the car park and headed upstream. Open areas in the woodland held several colonies of *Rubus scissus* and a few plants of *R. vestitus.* Ferns were abundant, the most interesting species being *Dryopteris affinis.* Damp clayey areas had *Carex pendula* and C. *laevigata.* Wood-rushes were also frequent, represented by *Luzula sylvatica, L. pilosa* and *L. multiflora.*

At the May Beck car park a dry bank produced *Aira praecox.* The beck was then crossed and members walked past Old May Beck Farm towards the Falling Foss waterfall. In the wooded portion *Trientalis europaea* was discovered, and nearby a large stand of *Claytonia sibirica* was in full flower. Near the waterfall the horsetails *Equisetum telmateia* and *E. sylvaticum* were found, together with a small quantity of *Crepis paludosa.* Typical woodland species seen in this area were *Sanicula europaea, Galium odoratum, Melica uniflora* together with *Polystichum setiferum* and *Orchis mascula.* Interesting trees seen were *Carpinus betulus, Ulmus glabra* and *Prunus avium.* A rare bramble *Rubus pallidus* was here too, this species being more or less confined in the county to these woodlands in the NE. Other brambles seen during the excursion were the common *R. dasyphyllus* and *R. nemoralis.* Aquatic plants were scarce, only *Typha latifolia* and *Scrophularia auriculata* being reported.

Members who worked along Parsley Beck reported a colony of *Gymnosporangium dryopteris* near the dam. There are small pockets of alkaline soil in various places, these being indicated by calcicoles such as *Primula vulgaris, Viola reichenbachiana* and *Carex sylvatica.*

Note (*Alder woodland at Parsley Beck*) (J. A. Newbould)
In the afternoon, having made for the pond to the south of Leas Head Farm at NGR NZ880032, Mr Magee, Mr Henderson and myself, were surprised to find pollarded alder *Alnus glutinosa.* Equally interesting was the ground flora, which often with alder is a fen type with sedges or, due to nutrient enrichment from the water course, is dominated by plants such as stinging nettle *Urtica dioica* and other tall sprawling plants. Here the ground flora was creeping soft-grass *Holcus mollis* with bluebell *Hyacinthoides non-scripta* and greater stitch-wort *Stellaria holostea.* This ground flora is more usually associated with the oak-bracken-bramble type of woodland (N.V.C. type W10) of drier ground in the south of the county. Of particular interest was the positioning of the alder. In the small dell the trees were not all adjacent to the streamside but had the appearance of an orchard. Later we met a local farmer who, in describing the wildlife of the area, told us that these trees had been cropped to make clogs for miners working in the local iron ore extraction mines in years gone by.

BRYOLOGY (J. M. Blackburn)
The area of the reserve away from the streams was typical upland acidic woodland and the species found reflected this: *Atrichum undulatum, Dicranella heteromalla, Dicranum majus, D. scoparium, Hypnum jutlandicum, Isopterygium elegans, Mnium hornum* and *Lepidozia reptans.* At the southern end, at May Beck car park, a base-rich flush had *Cratoneuron commutatum* var. *commutatum.* These areas were inspected on an exploratory visit prior to the meeting.

The morning was spent in the area of May Beck below Falling Foss upstream from its confluence with Parsley Beck. This area is both steep and wet, with boulders and old logs scattered among the trees. The stream area itself produced *Brachythecium plumosum, B. rivulare, Dichodontium pellucidum, Heterocladium heteropterum, Hookeria lucens, Hygrohypnum luridum, Hylocomium armoricum, Racomitrium aciculare, Rhynchostegium riparioides* and *Jungermannia sphaerocarpa.* A rotting log here had the attractive liverwort *Nowellia curvifolia.* One base-rich boulder had the calcicoles *Ctenidium molluscum, Eucladium verticillatum* and *Neckera complanata,* and also *Zygodon viridissimus* var. *stirtonii.* A large patch of *Cirriphyllum piliferum* was on the bankside. The crag at the top of the banking had the liverworts *Jungermannia riparia, Leiocolea turbinata and Marsupella emarginata.* The commoner *Calypogeia* species were also represented. The find of the day, however, was a patch of *Herzogiella seligeri* in fruit on a rotting log high up on the bank near the foss itself. This moss grows mainly in SE England but has a few scattered localities in NE Yorkshire.

Most of the afternoon was spent in the older woodland in and about Parsley Beck. The trees were less rich than anticipated, but nevertheless produced *Ulota crispa, U. norvegica, Orthotrichum affine, O. pulchellum, Zygodon conoideus* and *Metzgeria fruticulosa* the last three confined to an elder tree. *Chiloscyphus polyanthos* was found in fruit by the stream and, on wet rocks, *Tetrodontium brownianum* – always good to find. A quick visit in the rain downstream in Little Beck added little, though the *Tetrodontium* was seen again. There was a lot of *Nardia compressa* on the stream banks and *Drepanocladus uncinatus* was growing on a branch by the stream.

This was an excellent area for bryophytes, with moisture and shade giving high humidity. A total of 79 mosses and 26 liverworts was recorded.

MYCOLOGY (C. S. V. Yeates)
An excellent day's collecting was marred somewhat by the heavens opening in mid-afternoon and by the writer's damaging an eye on a broken stem of *Deschampsia cespitosa* (an occupational hazard of rooting around in marshes!).

Heracleum sphondylium proved to be a productive substrate, with no fewer than ten species of micro-fungi being found on it. These included the hyphomycetes *Ramularia heraclei* (first Yorkshire record) and *Trichellula aquatica* (first vice-county record) the latter normally being found as an aquatic species in stream foam. Also on *Heracleum* was the parasitic ascomycete *Taphridium umbelliferarum.*

Other interesting records included the discomycete *Lachnum elegantisporum* on a dead grass stem, the loculoascomycetes *Mycosphaerella aspidii* on head stems of *Dryopteris filix-mas* (first county record), *Leptosphaeria caricola* on dead leaves of *Carex pendula* (first vice county record) and the pyrenomycete *Ceriporia palustris* also on dead leaves of C. *pendula* – another first Yorkshire record – as was the hyphomycete *Dactylaria junci* on dead stems of *Juncus effusus.* The coelomycete *Coniothyrium equiseti* on dead stems of *Equisetum telmateia* was new to VC62.

Larger fungi were not much in evidence, the highlight being the delightful *Marasmius hudsonii* found by Helen Thornton on dead *Ilex* leaves (although calling this tiny agaric with its unmistakable long-spined fruit-bodies a larger fungus is something of a misnomer).

In all 78 species were collected. Voucher material of many of the above finds will be lodged in the herbarium at Leeds City Museum.

LICHENOLOGY (A. Henderson)
Trees and stone in the area of Foss woodland examined during the morning's inclement weather had a reasonably diverse but not at all unexpected lichen flora (*c.* 60 species), some twenty or so species forming the bulk of the corticolous communities seen, with *Graphis scripta, Chaenotheca ferruginea, Pertusaria amara* and *Amandinea punctata* forming expansive crusts below *Evernia prunastri* and the less frequent *Ramalina farinacea* (usually on *Fraxinus).* Closer and more probing study than the weather encouraged might well be productive of some less expected species.

In the afternoon an excurse outside the reserve boundary over by Lea Head Farm revealed an unusual coppiced alder community a short distance north of the pond. Alders here, which at one time provided the wood for the clogs of a local immigrant ex-Lancashire body of miners, had only a limited flora of *Cladonia macilenta, C. polydactyla, Hypogymnia physodes* and *H. tubulosa,* but a mature *Fraxinus* had on a low horizontal branch the sole thallus seen during the day of *Cetraria chlorophylla* (10 x 12.5 cm) among plenteous *Cliostomum griffithii* and *Parmelia* species.

FRESHWATER BIOLOGY (L. Magee)
Although there was heavy rain during the afternoon the becks were low and it was possible to survey the Parsley Beck, the May Beck and the old dam on Parsley Beck. The two streams which feed the dam had pH values of 5.7 and 7.8 respectively. The pH value ofthe Dam varied from 6.2 to 7.2. The stream with the higher mineral content has a good population of the Summer Mayfly *Siphlonurus lacustris.* In 1994 both larvae and adults were found in the dam in small numbers. This species has a very local distribution in moorland habitats in Yorkshire. Other invertebrates included the Pond Olive Mayfly *Cloeon dipterum* and the Water bugs *Callecorixa preusta* and *Notonecta glauca.* Species of the Pond Skaters *Gerris* and Beetles *Gyrinus* were active in the dam and in small pools in the feeder streams. Four adults of the Great Water Beetle *Dytiscus marginatus* were also seen.

May Beck had a sparse population of invertebrates which included several *Leuctra* species. There were a few nymphs of the Blue-winged Olive Mayfly *Ephemerella ignita.* The Golden Ringed Dragonfly *Cordulegaster boltonii* has been reported from the May area but no larvae were located in the two tributary streams. Caddis fly larvae were scarce but the non-casemaking species *Rhyacophila dorsalis* was present and some unidentified net-making species.

Palmate Newt *Triticus helveticus,* Common Toad and Common Frog were seen in and around the small feeder streams. Large numbers of Toad tadpoles were present in Parsley Beck downhill of the outfall.

The only fish seen was the Bullhead *Cotos gobio* under stones in May Beck.

The dam had a large stand of the attenuated form of *Juncus bulbosus* and a small patch of the Watermilfoil *Myriophyllum alterniflorum.* Unfortunately much of the dam was inaccessible due to its depth and the amount of soft silt. Close to the Dam was a small Alder plantation, pollarded at ground level probably 20 to 30 years earlier. Alders, formerly an important cash crop, were often planted in marshy ground.

BURGHWALLIS WOOD, SHIRLEY POOL AND RUSHY MOOR (VC63) July 1 (T. Higginbottom)

On a cool, misty morning thirty members, their friends and members of the Doncaster Naturalists' Society met by the Scout hut in Burghwallis Wood. The site had never been visited by the Union. An unusual feature of the wood is that it is given different names on different scale maps of the Ordnance Survey. On the 1:25,000 sheet SE41/51 it is referred to as Burghwallis Wood, while on the 1:50.000 sheet 111 it is called Squirrel Wood, the name which is locally used.

A year-long study by the Doncaster Naturalists' Society has shown that this wood has a relatively poor woodland flora, and this is reflected in its limited entomological interest. Regular weekend camps held by scout groups must have a disturbing impact on birds and mammals which might otherwise be attracted to the wood. The reports on this day show a slightly different picture, insofar as although the *variety* of flora and fauna was considered impoverished, nevertheless many interesting records were made. The information provided has enabled the Doncaster Naturalists' Society to make some recommendations about the future management of the wood. The reports of visits to the more renowned site of Shirley Pool and Rushy Moor give some cause for concern, although many of the plant rarities are still there. I believe that English Nature are involved in plans to conserve these unique habitats.

BOTANY (D. R. Grant)

Burghwallis Wood is situated on the eastern edge of the Magnesian Limestone; it is used as a scout camp. There are large areas of mown grass, the remainder of the ground being covered with coarse vegetation. Calcicolous shrubs are represented by *Cornus sanguinea* and *Euonymus europaeus.* There are colonies of *Primula vulgaris* and *Carex sylvatica.* The central area has a layer of acid clay or sand covering the limestone, and this has large stands of *Rubus dasyphyllus.* The *grass Melica uniflora* and the bramble *R. rufescens,* both indicators of ancient woodland, were present in one area. Burghwallis church hall had *Phyllitis scolopendrium* growing on its boundary wall.

Common Lane, leading from the wood to Owston Bar, has wide verges with *Ligustrum vulgare* and climbing plants such as *Clematis vitalba* and *Bryonia dioica.* Other plants of note were *Ballota nigra* and *Stachys palustris,* and one area had a large colony of the garden plant *Solidago canadensis.*

After lunch members visited Shirley Pool, where it was pleasing to find that the plant rarities are still to be found. *Ranunculus lingua, Cladium mariscus* and *Calamagrostis epigejos* were all in full flower. Also here at the northern end of the pool were *Rumex hydrolapathum, Juncus subnodulosus* and *Carex riparia.* Other marsh plants noted were *Sparganium erectum, Lycopus europaeus, Scutellaris galericulata* and *Myosotis laxa.* In the rough field edges bordering the pool *Rubus procerus, R. echinatus* (a southern English species) and *R. warrenii* were in flower. *Alopecurus myosuroides* was a cornfield weed in this area.

The quality of the water in Shirley Pool is poor, and no aquatic plants were found. Other members who visited the Rushy Moor area reported large stands of *Thalictrum flavum, Juncus subnodulosus,* and *Cladium mariscus,* with the hybrid woundwort *Stachys anagallis-aquatica,* was reported from a ditch near the A19 towards Owston.

MYCOLOGY (C. S. V. Yeates)

Considerably more gound was covered on this meeting than is usual for the notoriously tardigrade mycologists. Fungi with no or few previous Yorkshire records included the following:

At Squirrel Wood the imperfect stage of the discomycete *Drepanopeziza sphaeroides* was on a large *Salix babylonica* tree, this is the first vice-county record. At Shirley Pool the parasitic *Taphrina sadebackii* was found on leaves of *Alnus glutinosa.*

This is much less frequently recorded than the more conspicuous, clearly gall-forming *T. tosquinetii* on the same host. Also by the pool *Deightoniella arundinacea* was found to be very frequent on stunted trampled *Phragmites* by a path; this was new to Yorkshire. Nearby the rust *Puccinia phragmitis* was found in its aecial stage on *Rumex lapathifolium.*

The botanically rich Rushy Moor area provided many of the best finds of the day. These included the loculoascomycete *Ophiobolus erythrosporus* on dead stems of *Stachys* x *ambigua* (a new substrate for this species in the county). Also in this area were the discomycetes *Lachum acutipilum* and *Tapesia kneiffi* on dead *Phragmites;* the loculoascomycetes *Diapleella clivensis* and *Leptosphaeria agnita,* the former on dead stems of *Centaurea nigra,* the latter a *Eupatorium* specialist and the first vice-county record; the coelomycete *Phomopsis durandiana* on dead stems of *Rumex lapathifolium* was a first county record. The best rust of the day was also here – *Uromyces junci is* very local in Yorkshire and appears to be virtually limited to *Juncus subnodulosus,* on which it was here found to be abundant. The infrequently recorded rust *Puccinia conii* on *Conium maculatum* was found on disturbed land near Askern, and in a dyke by the main road the parasitic ascomycete *Burenia inundata* was found on *Apium nodiflorum.* A satisfactory total of 73 species was recorded. Voucher material of many of the above finds will be lodged in the herbarium at Leeds City Museum.

LICHENOLOGY (M. R. D. Seaward)

The lichen flora of Squirrel Wood provided much of interest to the lichenologist, due in no small measure to the specialist knowledge of epiphytic microspecies afforded by Mr P. M. Earland-Bennett of Essex who accompanied the Yorkshire contingent. In all, 35 species were recorded, 30 of which were epiphytes on *Corylus, Crataegus, Fraxinus, Prunus spinosa* and *Sambucus,* the latter's soft bark providing a favourable substratum for *Bacidia arnoldiana, B. caligans* and *Physcia aipolia* Other notable finds were *Dimerella pineti, Lecanora saligna, Placynthiella dasaea, Porina leptalea, Ramalina farinacea* and *Fellhanera ochracea,* a recently described species new to the British flora.

A visit was also made to Burghwallis church, restoration of which has virtually removed its entire lichen flora from the walls. However, the gravestones provided more suitable substrata, supporting 16 acidophilous and 25 calcareous species, the more interesting of which were *Acarospora rufescens* and *Verrucaria dolosa.*

A visit to Owston church was more rewarding: of the 52 species recorded on church walls and memorials, those of special mention are *Caloplaca isidiigera, Lecanora conferta, Lepraria lobificans* and *Porpidia soredizodes;* these and several other species have been overlooked/under-recorded in Yorkshire, as proved from recent surveys of many of the county's churchyards by Mr D. H. Smith and others. Of particular interest were *Phaeophyscia orbicularis* and *Physcia caesia:* although common species, they are only occasionally found in fruit as was the case here.

A mid-afternoon walk towards Shirley Pool revealed an occasional flora in the field hedgerows typical of an agriculturally eutrophicated habitat, best developed on *Fraxinus*, with *Evernia prunastri* and *Ramalina farinacea* amongst *Xanthoria*, *Physcia* and *Parmelia* species on a background of *Amandinea punctata* and *Lecanora dispersa* agg.

INGLEBOROUGH ESTATE, CLAPHAM (VC64) 15 and 16 July (L. Magee)
The two-day meeting was blessed with fine weather and was well attended. Thirty members representing 17 societies turned out on Saturday and 14 members of 14 societies came on Sunday. The facilities at Ingleborough Hall were very convenient and enabled some of our members to take a well-earned break after some strenuous exploring. Although the venue was familiar to many of the visitors, there were some noticeable changes in the vegetation and fauna compared to ten years ago. Several species new to the estate were recorded (including one new Yorkshire record and a new vice-county record). Some reports are comprehensive but it is not possible to publish complete lists. Further information may be requested from the secretary of the Freshwater Biological Section. A vote of thanks was given to Dr Farrar and the Bradford Education Committee for permission to visit the Estate and for the use of the facilities and to the Freshwater Biological Section who organised the Excursion.

MAMMALS AND LOWER VERTEBRATES (J. Lambert)
Roe Deer, Grey Squirrel, Brown Hare, Rabbit, Woodmouse, Shrew were seen. There were several molehills in the woodland and on the pastures.

ORNITHOLOGY (J. Lambert)
Although dense woods are not the best places to locate birds on a very hot summer's day the party recorded 26 species in and around the Estate. A Mallard with seven ducklings was feeding on the lake as were Coot and Moorhen. Two predators, Tawny Owl and Kestrel were disturbed in the woodland. All three species of wagtails were active near the beck; the Yellow Wagtails were still feeding young. Although House Sparrows were busy in the village, the commonest species seen were Wren, Swallow and Jackdaw. Blue Tits were numerous in the Woods and a family party of Long-Tailed Tits was active. Surprisingly no one reported seeing Dippers during the weekend.

ENTOMOLOGY (R. J. Hunt)
Two entomologists attended the meeting on the Saturday and initially headed towards the lake, sieving grass cuttings on the way. This produced a few very small Staphylinidae. Sweeping fared little better, yielding a few *Anaspis* species, small weevils and the slightly larger weevil *Phylobius oblongus* from vegetation at the lakeside. By sweeping pathside vegetation after joining the main pathway, a *Coccinella septempunctata* and the small Click Beetle *Agriotes pallidus* were obtained. The Carabidae *Pterostichus madidus* and *Abox parallelepipedus* were found frequently by turning over stones on the bank side.

In the open area approaching Ingleborough Cavern, beyond the Estate boundary, *Carabus violaceus*, *C. problematicus* and again *P. madidus* were found under logs and stones. Sieved sheep dung produced several *Aphodius rufipes* and two *Bembidion tibiale* were found on the beckside shingle.

The snail-eating beetle *Silpha atrata* was under a rotten log near to the cave entrance. In the same area, a small puddle in a wet flush contained the Water Beetle *Agabus bipustulatus* and species of Staphylinidae. *Quedium auriconus* was located in a luxuriant growth of wet moss hanging in a waterfall.

LEPIDOPTERA (J. Newbould & G. Fryer)
The following Butterflies were seen during the two days: Small Heath, Common Blue, Red Admiral, Green-veined White, and the large Yellow Underwing.

OTHER ARTHROPODS (D. T. Richardson)
Three species of woodlice were found under stones and very few centipedes. An exciting find was the Black Millipede *Cylindroialus caeruleocinctus* in sparse woodland on the slopes above the Beck. This is a new record for VC64; previous records for Yorkshire are: VC61 4 sites, VC62 4 sites, and VC63 2 sites (Prior to 1970, J. Allison).

BOTANY (D. R. Grant, July 15)
The botanical party walked through the village to the Low Pond which was found to have a monoculture of *Glyceria maxima* There were no sedges or aquatic plants to be seen. East of the Hall, *Carex sylvatica* and *Circaea lutetiana* were members of a typical limestone woodland flora. After much searching only poor specimens of *Rubus caesius* and *R. dasyphyllus* were located.

Members then visited the lake where plants of interest were *Poa nemoralis* and *Mycelis muralist* There are many naturalised plants of garden origin in the grounds of the estate.

After lunch members went by car to Newby Moor and worked the area from Clapham railway station to the cross roads on the B6480. There are large stands of *Iris pseudacorus* growing in the marshy ground by the stream sides. Also associated is *Juncus acutiflorus.* It is in the open areas with short turf that more unusual plants occur: several sedges, the rarest of them *Carex hostiana,* which grows with *Blysmus compressus* and *Pedicularis sylvatica*

Then members moved further west onto Sniddles Moss to see the pond where *Baldellia ranunculoides* and *Apium inundatum* occur.

The pond also has *Myriophyllum spicatum* and *Ranunculus trichophyllus.* In the boggy part of the moss *Narthecium ossifragum, Drosera rotundifolia* and *Menyanthes trifoliata* were found. A duck shooting pond to the west of the moss had *Potamogeton natans, P. berchtoldii* and *Carex rostrata.*

Members returned on the old Ingleton railway line where *Hypericum humifusum* was growing on the dry south facing banking and *Sagina nodosa* on the damp ballast.

(P. Abbott, 16 July)
The floor of the woodland immediately north of Ingleborough Hall was covered with Irish Ivy, *Hedera helix* ssp. *hibernica,* but the canopy was too dense to allow anything else of botanical interest to flourish.

The limestone scars along the south-eastern shore of the lake were an alpine delight. It was amazing how many remnants or offspring of Reginald Farrer's introductions were surviving, naturalised, in the vertical fissures. Someone coined the phrase "Farrerrl (= feral) plants"! Perhaps the most attractive at the time was an encrusted saxifrage, tentatively identified as *S. callosa,* but *Ramonda myconi,* a Pyrenean plant in the family Gesneriaceae, had obviously flowered earlier. The native Spurge Laurel, *Daphne laureola* was also there. The sandy island at the northern end of the lake held *Veronica anagallis-aquatica, V. scutellata, Sagina nodosa, Epilobium brunnescens* and several other more common marginal plants. There were no submerged aquatics visible from the shore.

In the woodland above the lake was an enormous stand of Beech Fern, *Phegopteris connectilis,* and a few leaves of May Lily, *Maianthemum bifolium.* On the bank of the stream were *Senecio fluviatilis* and *Blysmus compressus.* The open pasture higher up had Mountain Everlasting, *Antennaria dioica* and *Alchemilla glabra, A. filicaulis* ssp. *filicaulis* and *A. glaucescens.*

Thwaite scars and the limestone pavement above produced: *Draba incana, Polygonatum odoratum, Convallaria majolis, Gentianella campestris* and the Rigid Buckler Fern, *Dryopteris submontana.*

Note Plants, presumed to have been introduced by Farrer, seen during the YNU meeting in the Ingleborough Estate, 16 July 1995, are:

*Erinus alpinus**	*Primula ?auricula**
*Ramonda myconi**	*Alchemilla conjuncta*

*Arenaria balearica**
*Moltkia suffruticosa**
*Geranium ?cinereum**
Berberis vulgaris
Lonerica sp.
Polygonatum x hybridum
*Iberis sempervirens**
*Saxifraga ?callosa**
*Silene alprestris**
Petasites japonicus
Aruncus dioicus
Narcissus sp.
Gunnera manicata
Rhododendron spp.
Maianthemum bifolium
Pleioblastus pygmaeus
Sasa palmata

Plants marked with an asterisk were in fissures in the scar overlooking the lake. The *Geranium* and the *Primula* were not flowering; The *Saxifraga* was in flower, but only a rosette was within reach.

The route taken was along the south-eastern shore of the lake and along the eastern side of the stream from SD747695 to SD752704.

MYCOLOGY (C. S. V. Yeates)
Relatively few fungi were encountered during the course of the Saturday. The most noteworthy included the pyrenomycete *Physalospora alpestris* on dead leaves of *Carex viridula* ssp. *oedocarpa* in the Long Scar area, where also found was the tiny targe-like ascomycete *Microthyrium ciliatum* var. *hederae;* the latter is a first vice-county record of what is surely an under-recorded taxon. On dead grass stems in the woodlands proper were two infrequently recorded discomycetes, *Micropeziza poae* (the second Yorkshire and first vice-county record), and *Pezizella eburnea.* The coelomycete *Pestalotiopsis monochaetioides* was found on fallen leaves of *Chamaecyparis lawsoniana* (or a closely related species). This was new to the county. On the Sunday Mr M. W. Sykes reported the cone-dwelling agaric *Baeospora myosura.* In all 42 species were recorded.

FRESHWATER BIOLOGY (G. Fryer, L. Magee and D. T. Richardson)
Clapham Lake presents a rather monotonous, bare shoreline, devoid of marginal vegetation. Submerged vegetation – a few tufts of *Myriophyllum, Elodea* and patches of charophyte – is also scanty and too far offshore to be easily accessible, limiting the number of habitats available for crustaceans. The bottom is mostly gritty or stony, but accumulations of dead leaves occur at the south end and large areas of the bottom are covered by fine detritus derived from leaves, which provides a congenial substratum for a variety of benthic species. The water is only weakly alkaline. In spite of its restricted range of habitats, the body of the lake yielded a respectable number of species, nine of them additional to those published in *The Freshwater Crustacea of Yorkshire* (1993): *Ilyocryptus sordidus, Alona affinis, Cyclocypris laevis, Cypria ophthalmica, Ilyocypris bradyi, Cypridopsis ridua, Acanthocyclops viridis, A. bicuspidatus* and *Gammarus pulex.*

The open water supports large populations of *Bosmina longirostris* and *Ceriodaphnia pulchella* (both being plentiful on each visit). In a Yorkshire context the fauna has a distinctly lowland facies, most of the species found being common. The tiny ostracod *I. bradyi,* of which several individuals were found, is known from only 13 other sites in Yorkshire, and the remarkable anomopod *I. sordidus,* a specialised mud- and detritus-frequenter which has lost the ability to swim, is not particularly common in the county. A 5-tentacled brown hydra, the triclad *Polycelis nigra,* several microturbellarians, some of them numerous, a minute species of the bivalve *Sphaerium,* the snail *Potamopyrgus antipodarum* and various mites and insect larvae were also noticed. Caddis fly records from the Lake are sparse (Miss M. Andrews) but empty cases of *Agapoetes fuscipes* and larvae of Limnephidae were noted.

The River Limpet *Ancyllus fluviatilis* was the only common mollusc in the Beck.

Potamopyrgus jenkinsi and *P. antipodarum* were found in the lake.

The stoneworts *Nitella flexilis* var. *flexilis* and *Chara vulgaris* var. *vulgaris (det.* A.

Henderson), were obtained from deep water in the lake by dragging. *Elodea canadensis* was well established near to the outfall.

The pH values ofthe water, determined by Mr Richardson, varied from 8.68 at the cave to 7.8 downstream of the lake outlet. The only species of fish found to be numerous in the beck was adults and fry of the Bullhead *Cotus gobio.* A single juvenile Brown Trout was seen in the Beck near to the village.

Mr Richardson's discovery of the sponge *Ephydatia mulluri is* the first Yorkshire record.

Stonefly populations in the Yorkshire Dales have suffered from the toxic modern sheep dips in recent years. We were pleased to find small larval populations of two of the larger taxa *Dinocras cephalotes* and *Perla* sp.

One Mayfly imago was seen on the wing, The Blue-winged Olive, *Ephemerella ignita* and the following larvae were identified: *Baetis buceratus, B. rhodani, Ecdyonurus torrentis, E. venosus, Rhythrogena semicolorata,* all of them typical of non-acid, stony-bottomed upland streams.

FOXGLOVE COVERT (VC65) 12 August

COLEOPTERA (R. J. Hunt)

Due to security constraints the area now known as Foxglove Covert was not entered for many years and has developed into a patchwork of willow carr, some gorse scrub and general dense vegetation. A scrape and some ponds have been created and these, despite the very dry summer, were still blessed with a running water supply from the hillside.

The coleopterists initially investigated the two small ponds near the field centre and several species of water beetle were found including *Platambus maculatus, Ilybius fuliginosus* and *Hyroporus palustris.* On the mud and in the pondside vegetation several species of ground beetle were obtained including the very common *Agonum albipes.* Attention was then paid to the scrape area and its connecting channels, and again several species of water beetle were found. Amongst these were *Colymbetes fuscus* and *Agabus sturmi* and a female *Dytiscus semisulcatus.* The whirligig *Gyrinus substriatus* could be seen in large numbers on most of the open water areas. A pile of damp vegetation which had been dredged from one of the ponds yielded a large number of rove beetles, the most interesting being *Philonthus addendus* and *P. Iongicornis.*

Owing to the very dry weather conditions the ground flora was very desiccated and little attempt was made to collect using a sweep net. One interesting specimen was, however, swept from pondside vegetation: this was the unusually coloured ladybird *Aphidecta obliterata.*

On returning to the car park a final piece of aggregate was turned over. This revealed four specimens of the beautifully marked rove beetle *Platydracus stercorarius.* The head, thorax and abdomen are matt black with the antennae, legs and elytra red; the segments of the hind body are patterned by a silver pubescence.

Foxglove Covert could well turn out to be a very interesting area from an entomological viewpoint, and would repay another visit in the near future. For preference this would be in less extreme weather conditions in late spring or early summer.

BOTANY (D. R. Grant)

The area visited is situated on the Millstone Grit series of rocks, which are overlain with boulder clay. This gives rise to acid soils, although small pockets of alkalinity occur, marked by plants like *Primula vulgaris* and *Briza media.* Much *Salix* scrub has been cleared from the area, and several ponds and a scrape have been excavated.

The most noteworthy plant on the reserve is *Silaum silaus,* a plant typical of old basic meadow-land. Drier areas have *Calluna* and *Ulex europaeus,* together with species such as *Hypericum humifusum, Carex pilulifera, Danthonia decumbens* and *Nardus stricta.* Sedges are well represented as the area has several marshy areas and clayey runners with species such as *Carex flacca, C. pallescens, C. viridula* in the grassy areas and *C. rostrata* by the side of the large scrape.

In open bushy areas the roses *Rosa caesia* and *R. mollis* were found. Brambles were represented by *Rubus dasyphyllus* and *R. lindebergli.* This last species was still in full flower in spite of the hot dry weather which prevailed during July and early August.

The ponds held a number of aquatic plants including a water crowfoot and *Myriophyllum spicatum.* Pondweeds were represented by *Potamogeton natans* and *P. crispus.* Several plants had been introduced, including *Ranunculus lingua, Lythrum salicaria* and *Lagarosiphon major.* The beds of the ponds had good growths of the stoneworts *Chara vulgaris* var. *longibracteata* and C. *virgata,* the latter also being seen straggling sinuously in the flow of the outlet stream below the small footbridge.

MYCOLOGY (C. S. V. Yeates)

A satisfying total of 85 fungal species was accumulated on the day, chiefly by the writer and Alan Legg. Given the time of year and dry weather conditions there were, of course, mostly 'micro' species. The importance of these fungi from the standpoint of eco-systems and biodiversity should not be underestimated. There were some excellent finds.

Among the pyrenomycetes *Diaporthe ilicis* on *Ilex* twigs was a first Yorkshire record. This should, however, be treated with caution as in the past a broad species-concept was often applied to this genus, and in addition *Diaporthe* often has *Phomopsis* anamorphs and *Phomopsis crustosa is* very common in Yorkshire on dead holly twigs and leaves. AWL collected and incubated some rabbit dung and recorded – amongst other species – *Sordaria macrospora,* also (and less ambiguously) new to the county.

The attractive discomycete *Lachnum (Dasyscyphus) bicolor* var. *rubi* which was found on dead *Rubus idaeus* stems appears to have a distinctly north-western distribution in Yorkshire, its most southerly known site being at Bolton Abbey. AWL found both the anamorphic and teleomorphic stages of *Dermea ariae* on *Sorbus aucuparia.* This is a new VC65 record of a species which is distinctly uncommon in Yorkshire, the comments in *A Fungus Flora of Yorkshire* (1985) being somewhat misleading. The bright yellow predominantly summer-fruiting *Hyaloscypha flaveola* – often a feature of the Union's excursions in recent years – again put in an appearance on dead *Pteridium* fronds. More exciting was the finding of *Velutarina rufo-olivacea* separately by AWL (on *Crataegus)* and by the writer (on *Ulex).* There are only a few old records of this in Yorkshire – all from VC62. The resupinate basidiomycete *Botryobasidium aureum* appears to be a third Yorkshire and first VC record, although it is possible that earlier records are hiding in the complicated synonymy one often encounters in this group. The parasitic hyphomycete *Ramularia ajugae* on *Ajuga* was new to the vice-county, and AWL's scrutiny of dead attached *Crataegus* twigs again paid dividends with his discovery of *Taeniolina scripta,* another new fungus for Yorkshire.

LICHENOLOGY (A. Henderson)

Lichens in this mainly wooded area were nowhere profuse but nonetheless *Salix* gave records of 12 species including well-formed sheets of *Toninia aromatica,* while *Fraxinus* bark had numerous patches of strongly fruiting *Micarea prasina* competing with foliose *Parmeliopsis ambigua* among a developing *Parmelietum* population. The pale waxen fruits of *Dimerella diluta* and dark coating of *Porina carpinea* were frequent in deeply shaded niches and treebases where there also occurred the white-tipped pycnidia of *Micarea botryoides. Hypogymnia physodes* was seen on *Ilex* and more expectedly *Buellia punctata* on *Crataegus.* Stones in pathways bore *Thelidium minutulum, Rhizocarpon obscuratum* and *Catillaria chalybeia,* along with the commoner *Verrucaria* and *Porpidia* species and *Sarcogyne regularis.* The man-made substrates encountered during the day were almost entirely devoid of lichen cover, with the exception of the lignum of some older fencing which had plentiful expanses of *Trapeliopsis granulosa, Micarea denigrata* and *Placynthiella icmalea.*

FRESHWATER BIOLOGY (L. Magee)
Observations were made entirely within the boundaries of the Covert including the Risedale Beck. The pools, streams and marshy places were affected by prolonged drought and there was a minimum flow in the feeder streams. No samples were taken for water analysis but the pH values of most of the ponds and streams were recorded.

In the feeder stream (pH 6.7) from the moorland spring in the training area juvenile frogs and the Three-Spined-Stickleback *Gasterosteus aculeatus* were present in small numbers. The few insects found in the stream included: Pond Skater *Gerris gibbifer;* caddie larvae *Goera pilosa, Agapetes fuscipes* and the non-casemaking *Rhyacophila dorsalis.* A single adult female of the dragonfly *Aeshna grandis* was seen in the area. The only mollusc found was a single specimen of *Potamopyrgus jenkinse.*

In two large ponds (pH 7.4) with a water temperature 15 Celsius, as has become common practice, a number of aquatic and marginal plants had been introduced. They included: Greater Spearwort *Ranunculus lingua,* Narrow-leafed Water Plantain *Alisma lanceolatum* and the alien Curly Pondweed *Lagorosiphon major.* Dragonflies and damselflies had colonised, where adults were seen on the wing and larvae were identified. They included: *Aeshna grandis, Sympetrum danae* and *Coenagrion puella.* Large numbers of the Pond Olive Mayfly *Cloen dipterum* were found but no adults were seen.

The stoneworts *Chara vulgaris* var. *longibracteata* and *C. virgata* were pleasing discoveries in the ponds and the connecting stream. They sheltered large numbers of the Freshwater Shrimp *Crangonyx pseudogracilis* which has become established in Britain during the past 50 years. Also found in the connecting stream, which was virtually a marsh, were an adult female Great Diving Beetle *Dytiscus marginalis* and several larvae. The leech *Erpobdella octoulata* and the Water Bug *Callicorixa praeusta* were also identified.

In the South Stream small brown trout *Salmo trutta* and Bullheads *Cotos gobio* were present. Three species of caddis fly larvae were seen: *Goera pilosa, Anabolia nervosa* and *Hydropsyche* species. A few river limpets *Ancylus fluviatilis* were noted. The sighting of one Water Vole, a species virtually exterminated by Mink, was welcome. The ponds and wet places are an attractive part of the willow carr. The streams will benefit from maintaining an open corridor to attract those species of *Odonata* which prefer open streams as habitat.

Surveys in late spring will no doubt add considerably to the list of species.

BOOK REVIEW

George Perkins Marsh: Prophet of Conservation by David Lowenthal, with a Foreword by **William Crondon**. Pp.xxvi + 572. University of Washington Press, Seattle. 2000. US$ 40.00.

George Perkins Marsh (1801-1882) was a writer, linguist, lawyer, politician and diplomat. His book *Man and Nature, or Physical Geography as Modified by Human Action*, first published in 1867, represented the dawn of a modern approach to the understanding of the world. Marsh wrote "Man is everywhere a disturbing agent. Wherever he plants his foot, the harmonies of nature are turned to discords". In many parts of the world the landscape was the result of a dialogue between humans and their environment, a dialogue that had not always been a balanced one. *Man and Nature* thus represents an important early milestone in the development of the modern conservation approach.

David Lowenthal, American-bred, but latterly Professor of Geography at University College, London wrote *George Perkins Marsh: Versatile Vermonter* in 1958. This present biography, which "wholly supersedes" this earlier volume, considers the development of Marsh's personality against the backdrop of the landscapes that had influenced him. We see him as a young man amidst the forests, farmlands, small towns and rivers of New England in the 1820s, and as a US envoy in the lively cities of the Mediterranean in the 1850s. Here too are the people who contributed to the fabric of a fascinating life: the small-town lawyer in Burlington, Vermont, the shifty American businessman in the Levant, the self-important congressman. This superbly written biography provides a brilliant insight into the life and background of one who was influential in the development of today's environmental movement.

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CONTRIBUTORS

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Printed in Great Britain by Titus Wilson & Son, Kendal ISSN 0028-0771