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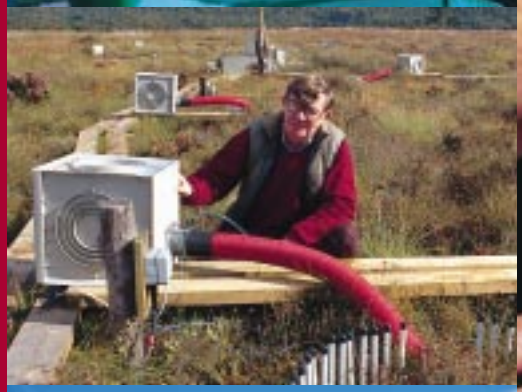

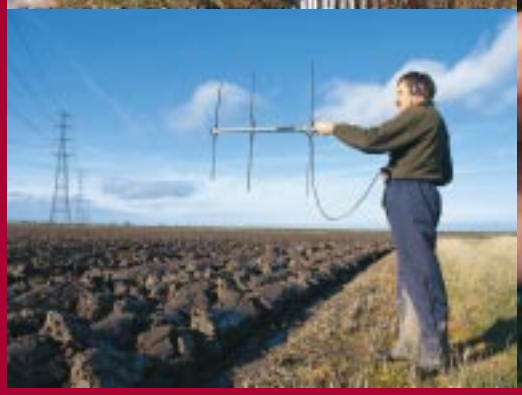

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A review of the invertebrate assemblage of acid mires

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Contents

1. Introduction

The author has been commissioned by English Nature to produce a review of the invertebrate assemblage associated with acid mires in England. The objectives of this review are defined in the Project Specification as follows:

- to list all of the species considered to be part of the acid mire invertebrate assemblage;
- to state the importance of habitat structure (eg bare ground, scrub etc) within such mire systems;
- to state any correlations between invertebrate community and the wetland types as described by Wheeler and Shaw (2002), and in the National Vegetation Classification (NVC) (Rodwell ed. 1991 & 1995).

This is one of a number of reviews of the invertebrate fauna of various habitats commissioned recently by English Nature. In particular, this report overlaps with that commissioned previously on the invertebrate fauna of seepages (Boyce 2002a).

1.1 Scope of report

This report treats only the extant invertebrate fauna of acid mires in England. There are a number of other specialist acid mire invertebrates that are only known in Britain from Scotland and Wales. Note that species that have become extinct in England have been excluded from consideration here. This means that a few species, such as the Rosy Marsh Moth *Coenophila subrosea* and the weevil *Bagous petro*, which formerly occurred in England, and have a strong association with acid mires are omitted.

1.1.1 Taxonomic coverage

The Project Specification stipulated that the report should cover the following groups:

- Spiders (Araneae)
- Dragonflies and Damselflies (Odonata)
- Water bugs (Heteroptera: various families)
- Caddis flies (Trichoptera)
- Craneflies (Diptera: Tipulidae)
- Long-headed flies (Diptera: Dolichopodidae)
- Soldierflies and their allies (Diptera: larger Brachyceran families)
- Hoverflies (Diptera: Syrphidae)
- Dung flies (Diptera: Scathophagidae)
- Other fly families (Diptera: Acalyptrata: Micropezidae, Uliidae, Sciomyzidae)
- Ground beetles (Coleoptera: Carabidae)
- Water beetles (Coleoptera: Dytiscidae and Hydrophilidae)
- Rove beetles (Coleoptera: Staphylinidae)
- Other terrestrial beetle families (Coleoptera: various families)

In addition, the author has included information on the following groups:

- Grasshoppers and crickets (Orthoptera)
- Butterflies and larger moths (Lepidoptera: various families)
- Aculeate Hymenoptera

The two following criteria have been critical in deciding which taxa should be included for consideration in this review:

- **Taxa for which there is adequate information on habitat preferences.** This is obviously the key criterion in judging whether a given species is a specialist inhabitant of acid mire habitats, and in particular in assigning the species to specific assemblages.
- **Taxa for which we have information on UK distribution and conservation status.** Because this review is intended to provide a qualitative assessment of the conservation importance of the various kinds of acid mire habitats, it is essential that we are able to evaluate the rarity and threat status of the communities with which we are dealing.

Though our knowledge of acid mire invertebrate assemblages has greatly improved in recent years, nonetheless, we should still regard the list of species in section 2, and the community assemblages in section 3 as being provisional pending the compilation of further information on their distribution and ecology in Britain. It is hoped that this will be regarded as a working document that should be amended and added to as we improve our knowledge of the invertebrate fauna of acid mires.

1.1.2 Coverage of mire types

One of the first decisions to be made in preparing this report was to arrive at a definition of acid mires. The continental definition of mires only includes those bogs where peat growth has raised the mire surface above the level of the ground water table, with the plants having to extract all of their nutrients from rainwater. Such mires are referred to as ombrogenous bogs, and in Britain comprise raised and blanket bogs. On the continent, all other types of bog vegetation are referred to as fens, in recognition that their water supply is derived from ground water (topogenous bogs), albeit often from very acid and nutrient poor sources.

British definitions of mires are much less exacting, generally being taken to refer not only to ombrogenous bogs, but also to a range of topogenous types, where the water is extremely acidic and nutrient-poor (Rose 1953). Rodwell (ed. 1991) has an even more catholic definition of mires, which includes a wide range of wetland types, some of which are extremely calcareous and/or relatively nutrient rich.

For the purposes of this report, we have adopted a traditional British interpretation of mires that includes all ombrogenous systems, plus a range of topogenous mire types, where the ground water feeding these is acidic (usually < pH5) and nutrient-poor. Generally these are mire systems dominated by Purple Moor-grass *Molinia caerulea*, cottongrasses *Eriophorum*

spp, Deer-sedge *Trichophorum cespitosum*, rushes *Juncus* spp, Ling *Calluna vulgaris*, Cross-leaved Heath *Erica tetralix* and bog-mosses *Sphagnum* spp.

In reaching this definition of acid mires, the main aim has been to encompass as much of the natural range of variation within those areas of England that support our main concentrations of such vegetation. The greatest extent of acid mire vegetation in England is found in the northern uplands, in areas such as the Pennines, Lake District and North York Moors. Elsewhere, there are also extensive upland mire communities on Dartmoor, Exmoor and Bodmin Moor in south-west England. In the lowlands, it is again in the west, with its siliceous, acid rocks and high rainfall that the greatest concentrations are to be found, with the most significant resource being in Devon and Cornwall in south-west England, and Lancashire and Cumbria in the north-west. Elsewhere, the most important concentration is on the Tertiary sands and gravels of Dorset, Hampshire and Surrey, where acidic valley mires form part of the mosaic of "lowland heath" vegetation.

In terms of the classification adopted by the National Vegetation Classification (NVC), this report encompasses the following range of plant communities:

A24 *Juncus bulbosus* community (where this occurs as small, peaty, bog pools within acid mires)
M1 *Sphagnum auriculatum* bog pool community
M2 *Sphagnum cuspidatum/recurvum* bog pool community
M3 *Eriophorum angustifolium* bog pool community
M4 *Carex rostrata-Sphagnum recurvum* mire
M5 *Carex rostrata-Sphagnum squarrosum* mire
M6 *Carex echinata-Sphagnum recurvum/auriculatum* mire
M15 *Scirpus cespitosus-Erica tetralix* wet heath
M16 *Erica tetralix-Sphagnum compactum* wet heath
M17 *Scirpus cespitosus-Eriophorum vaginatum* blanket mire
M18 *Erica tetralix-Sphagnum papillosum* raised and blanket mire
M19 *Calluna vulgaris-Eriophorum vaginatum* blanket mire
M20 *Eriophorum vaginatum* blanket and raised mire
M21 *Narthecium ossifragum-Sphagnum papillosum* valley mire
M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture
M25 *Molinia caerulea-Potentilla erecta* mire
M29 *Hypericum elodes-Potamogeton polygonifolius* soakway
M31 *Anthelia julacea-Sphagnum auriculatum* spring
M32 *Philonotis fontana-Saxifraga stellaris* spring
M35 *Ranunculus omiophyllus-Montia fontana* rill
S9 *Carex rostrata* swamp
W1 *Salix cinerea-Galium palustre* woodland (where present as small scrub patches within acid mires)
W2 *Salix cinerea-Betula pubescens-Phragmites australis* woodland (where present as small scrub patches within acid mires)
W4 *Betula pubescens-Molinia caerulea* woodland (where present as small scrub patches within acid mires)

Of the priority habitats listed in the EC Habitats Directive, the following fall within the scope of this report:

- Northern Atlantic wet heaths with *Erica tetralix*
- Temperate Atlantic wet heaths with *Erica ciliaris and E tetralix*
- Active raised bogs
- Degraded raised bogs still capable of natural regeneration
- Blanket bogs
- Transition mires and quaking bogs (more acidophilous types only)
- Depressions on peat substrates of the Rhynchosporion

Additionally, lowland raised bogs and blanket bogs are priority habitats with a costed action plan in the UK Biodiversity Action Plan (BAP), and the definition of the lowland heath priority habitat in the UK BAP includes areas of valley mire and wet heath that are often an element of the vegetation mosaic within such sites (UK Biodiversity Steering Group 1995).

Inevitably, there is a degree of arbitrariness in cutting out a section of vegetation from a continuum of wetland vegetation communities. Thus, though not obviously "mires", acidic *Molinia* grasslands (M25) and rush pastures (M23) are included in this report. Both are an integral part of the range of British acid mire vegetation, especially in the uplands, and frequently occur on acidic soils with a pH of less than five. However, more mesotrophic *Molinia* grassland types (M24 and M26), such as those typical of the Culm measures of north-west Devon and north Cornwall, are excluded. The omission of these mesotrophic marshy grasslands means that there is no place in this report for consideration of a well defined suite of species such as the Marsh Fritillary butterfly *Euphydryas aurinia*, and the Narrow-bordered Bee Hawk-moth *Hemaris tityus* that have their headquarters on such "rhos" pastures. Rush pasture (M23) vegetation has only been included where it is growing on acid peat soils. In this case, it usually occurs in valley bogs, where run-off or springwater results in somewhat more mesotrophic conditions. In such situations, it almost always occurs as part of a mosaic of vegetation that also includes more recognisable acid mire types. The very extensive stands of rush pasture associated with mineral soils are beyond the scope of this report and are not considered here.

Also excluded are more mesotrophic and/or calcicolous mire types dominated by moderately tall sedges *Carex* spp, horsetails *Equisetum* spp and Marsh Cinquefoil *Potentilla palustris* (M8, M9 and S27), though these mire types do sometimes occur locally in typical acid mire systems (eg as an early successional community on the fringes of open water, around relatively base-rich springs within acid mires, and in the lagg zone of lowland raised bogs). Geographically, these communities also have major English loci in the fens of East Anglia, outside of the main acid mire areas described above, and it was felt the their inclusion would make the analysis of invertebrate communities too unwieldy. Sedge mires and swamps of this type support an extremely rich invertebrate fauna in their own right, which warrant separate consideration.

Small bog pools on an acid, peat substrate (A24, M1, M2 and M3) are included within the scope of this report, as they form part of the "hummock-hollow" matrix in many mire systems, especially in raised and blanket mire types. Larger water bodies, and/or those on a mineral substrate are excluded. Acid flushes and seepages (M6, M29, M31, M32 and M35) are also included, as these form part of the acid mire habitat mosaic under consideration in this report, though these already form part of another English Nature review of the

invertebrate fauna of seepages (Boyce 2002a), and there is thus some overlap between these two reports.

Isolated bushes and patches of scrub on acid mires are another integral part of the mosaic of habitat features found on many acid mire systems in Britain. For example, in lowland valley mires, the central strip along the watercourse corridor frequently has scattered bushes or a thin band of more continuous scrub reflecting the concentration of nutrients in this part of the acid mire system (Rose 1953). Generally, the stands under consideration here are much too small and fragmented to be assigned to a NVC type, and often constitute single bushes. Most scrub patches would probably be referable to the W1, W2 and W4 communities. Such isolated bushes and scrub host a specialist invertebrate community, which is generally absent from larger blocks of wet woodland. Most commonly such bushes and scrub patches are dominated by birches *Betula* spp or willows *Salix* spp. As required by the Project Specification, this habitat feature is considered here, but larger blocks of wet woodland are a habitat in their own right, and are beyond the scope of this review.

1.2 Methodology

1.2.1 Defining acid mire associates

One of the requirements of this contract was to give an indication of the fidelity of the various invertebrates discussed to acid mire habitats. Given the relatively limited information on habitat preferences for many of the invertebrate taxa under consideration, this can currently be no more than a provisional guide, which should be modified in the light of further information. As stated in section 1.1.2, the definition of acid mire adopted for this report includes not only terrestrial habitats, but also small pools and flushes, where these occur as part of the matrix of acid mire habitats. A large number of the invertebrate species included in this review are known to be aquatic in at least some part of their life cycle. Good examples are found amongst the dragonflies and damselflies, water bugs, caddis flies, certain crane, dance and long-headed flies and water beetles.

Key acid mire invertebrate species are listed in section 2, and each is assigned a fidelity grade. Three fidelity grades from A to C have been created, and each key species has been assigned to one of these categories as follows:

Grade A – Acid mire obligates. Species that are exclusive inhabitants of acid mires, with almost all of their British records referring to these habitats.

Grade B – Acid mire specialists. Species that are primarily found in seepages and their margins, but which occasionally occur in other situations. Generally in excess of 75% of British records refer to these habitats.

Grade C – Acid mire preferentials. Species found in other wetland habitats, but which nonetheless have a strong association with acid mires. Generally in excess of 50% of British records refer to these habitats.

It should be noted that the acid mire fidelity grade assigned to each species refers to its fidelity to the whole range of acid mire habitats, more detailed sub-division of this assembly into communities associated with various acid mire habitat features follows in section 3. Obviously many more species are found in acid mire habitats than those listed in section 2,

but these more generalist wetland species are not considered in this report. The description of full invertebrate communities for acid mires has still barely begun, and is well beyond the scope of this review. To provide the initial list of possible key species, as wide a range of entomological literature has been sampled as possible given the time constraints on the project. Particular emphasis has been placed on examination of the National Reviews to invertebrate groups produced by the Nature Conservancy Council (NCC) and Joint Nature Conservation Committee (JNCC) and to the national recording schemes for various invertebrate taxa. The recent reviews of wetland ground and rove beetles (Lott 2003a) and seepage invertebrates (Boyce 2002a) have also been referred to. In addition, the views of various invertebrate ecologists have been sought, and the contractor has used his own experience of acid mire invertebrate assemblages to undertake this initial sorting process. Note that in deciding on the degree of fidelity to English acid mires of the various species, their habitat associations throughout Britain have been used as the basis for classification. This provided a much larger pool of data to work with, especially the very large number of records generated by the Welsh Peatland Invertebrate Survey (WPIS) (Holmes and others 1991a-f 1992 & 1995a-f).

The entry for each key species listed in section 2 indicates the degree of fidelity of the species in question to acid mire habitats. Notes on the habitat, ecology and conservation status of the species are also included here.

1.2.2 Defining acid mire communities

For many years entomologists have recognised the difficulty of fitting invertebrate assemblages comfortably into existing (largely botanical) habitat classifications. Many have advocated ignoring these classifications completely and beginning to develop invertebrate community classifications instead. Whilst this might be ideal, there are major problems in adopting this approach. The first is the sheer number of species that invertebrate ecologists have to deal with. It is absolutely necessary in adopting such an approach to focus on a particular element of the invertebrate fauna, preferably a group with a number of specialist species that are known to be highly characteristic of the habitat or habitats that are being studied. Examples of studies of this type in British acid mires and wetlands are the ground beetles (Holmes and others 1993a & b, Lott and others 2002, Lott 2003a), rove beetles (Lott and others 2002, Lott 2003a) and water beetles (Foster & Eyre 1991). Most of these studies have used multivariate computer programmes such as TWINSPAN and DECORANA as a means of categorising invertebrate assemblages and identifying the environmental factors that are most important in creating these assemblages. In most of these studies, the end groups into which the samples have been categorised are difficult to interpret, though the key environmental factors that have created these end groups are of interest.

The second problem in using classifications based solely on invertebrate assemblages is that much of the legislation and policy relating to nature conservation in Britain is based on botanical classifications. For example, designation of Sites of Special Scientific Interest (SSSI) and candidate Special Areas of Conservation (cSAC) are designated using an evaluation based largely on botanical criteria. Similarly, though Biodiversity Action Plans (BAPs) do include a few rare or threatened acid mire invertebrates, their main effect on invertebrate communities will be felt through implementation of those various Habitat Action Plans (HAPs) in national, regional and local BAPs that are pertinent to acid mires.

In this review, an attempt to overcome these problems has been devised by a simple invertebrate community classification based on seven key habitat features identified as being of key importance for acid mire invertebrates in the course of preparation of the annotated list of key species in section 2. These seven features are:

- *Sphagnum* lawns
- Grass, rush and sedge tussocks and litter
- Ericaceous dwarf shrubs
- Stagnant water
- Running water
- Scattered trees and scrub
- Bare peat

A fuller description of each of these habitat features can be found in section 3.1 below.

In section 3.2 the invertebrate communities of these habitat features in relation to the major hydrotopographical classification of British acid mire systems are discussed. This section also attempts to relate the invertebrate fauna to the various NVC botanical communities of Rodwell (1991 & 1995) that are listed in section 1.1.2. The main hydrotopographical mire types pertinent to this report are as follows:

Ombrogenous mires

Lowland Raised Bogs
Blanket Bogs

Topogenous mires

Waterfringe Bogs
Sump Bogs (Basin Mires)

Soligenous mires (valley bogs)

Spring-fed Bogs and Soakways
Run-off Bogs

In this way, it is hoped that it is possible to both describe meaningful (albeit broad-brush) invertebrate communities, and the conservation management issues they experience, whilst at the same time working within the classificatory framework that provides the basis for much of our nature conservation designation and protection. For this second phase of the analysis, the review concentrates on those invertebrate data sources where there is good quality habitat information. The large surveys carried out by Coulson & Butterfield (1985) and Lott, Procter & Foster (2002) in England have been valuable, though the latter was primarily looking at fen habitats. Extensive reference has also been made to the massive database accumulated by the WPIS, as this is much the largest single source of information on the invertebrate fauna of acid mires in Britain. The lowland raised mire at Thorne and Hatfield Moors in south Yorkshire has also been the subject of a detailed invertebrate survey (Heaver & Eversham 1991)

2. Invertebrates associated with acid mires

The emboldened capital letter before the species name indicates the acid mire fidelity score allocated to that species and the emboldened letters/numbers after the species authority indicate any national and international status attaching to it. The table at Appendix 2 lists all of the acid mire associates included in this section, with brief notes on national status (where applicable), fidelity to acid mires, and the key habitat features and hydrotopographical mire types in which they occur. An explanation of the various national statuses used in this report can also be found at the end of Appendix 2. Further information on the sites mentioned in the species accounts below can be found in the Site Gazetteer (Appendix 1).

2.1 Arachnida

The main reference used in compiling the species accounts below has been the new two-volume UK spider distribution atlas (Harvey and others 2002a and b). Other main sources used are Bratton, ed. (1991), Locket & Millidge (1951), Locket, Millidge & Merrett (1974), Merrett, (1990) and Roberts, MJ (1985 1987 & 1995) and the DEFRA/BugLife UKBAP 'Managing Priority Habitats for invertebrates' volume on spiders (Colenutt 2003). Where other sources have been used, these are mentioned in the individual accounts for each of the species.

2.1.1 Linyphiidae

C *Theonoe minutissima* (O-P Cambridge). A very tiny Theridiid spider most often found in northern England, and also relatively widespread in Scotland and Wales. In southern England, *T. minutissima* is very scarce, with most records being from Cornwall, Devon, Somerset, Dorset, Hampshire and Surrey. It is usually found in *Sphagnum* in acid bogs, though it also occurs on drier heaths.

B *Walckenaeria alticeps* (Denis). This money spider was confused with *W. antica* (Wider) until recently. It has a very scattered distribution across England and Scotland, with most British records being from Wales. It appears to favour overgrown acid mires with rank Purple Moor-grass, Bog-myrtle, and it is also frequently found under trees such as birch, where they occurs on mire systems. Away from acid mires, it is also occasionally found in fen habitats in southern England and East Anglia.

B *Walckenaeria nodosa* O-P Cambridge. This is a markedly northern money spider in its British distribution, with most records being from northern England, and also from Scotland and Wales. Elsewhere in England, *W. nodosa* shows a very scattered distribution, with main clusters of records being from the Pennines, the lowland mires of Cheshire and Shropshire, West Cornwall, and from valley mires on the main blocks of lowland heath in Dorset, Hampshire and Surrey. Commonly found on bogs and wet heaths, but also known from other wetland habitats, such as wet woodland and fens.

C *Walckenaeria kochi* (O P-Cambridge). A money spider found in a range of wetland situations, including saltmarshes. Nonetheless, most British records of this species are from acid mires, with population centres in Yorkshire, on the Cheshire mosses and meres and in west Wales. Elsewhere, there are scattered records from Scotland, northern England and north Wales. It is very scarce in southern England. *W. kochi* is generally found in tussocks and litter.

B *Walckenaeria clavicornis* (Emerton). This is an Arctic-Alpine money spider, which is known from a few sites in the Pennines, and also from a single lowland raised mire in south Lancashire. Most of its British sites are in Scotland, and it is also known to occur very locally in the Brecon Beacons and Snowdonia in Wales. The spider is found in *Sphagnum* mires and other montane habitats and is absent from southern England.

A *Hypselistes jacksoni* (O-P Cambridge). A money spider that shows a very strong affinity for acid mire habitats, with almost all British records being from lowland bogs and wet heaths. It has its British stronghold in Wales, with main English populations being in the Pennines, North York Moors, on the south-west peninsula, and on the lowland valley mires of Dorset, Hampshire and Surrey. It also has a wide, but very scattered distribution in Scotland. There are a couple of isolated colonies in relict mire habitats in Norfolk.

C *Pelecopsis mengei* (Simon). Most of the British records of this money spider come from northern Britain, with English records deriving from upland areas in the Pennines and the North York Moors. It is quite widespread in the uplands of Scotland and Wales. In southern England, this is a very scarce spider, with a handful of "relict" colonies, which reach their southern limit on Exmoor. *P. mengei* appears to favour quite heathy bogs, often where there is a scatter of birch or Scot's Pine scrub. It is also found in other wetland habitats and in damp, shaded woodlands.

C *Silometopus elegans* (O-P Cambridge). As with a number of the other money spiders included in this review, *S. elegans* is essentially a northern species, which in England is quite common in upland areas along the Pennines and on the North York Moors, and it is also of wide occurrence in the mountains of Wales and Scotland. In southern England, it is very scarce, being mostly found on high ground on Exmoor and Dartmoor, with a handful of sites on the lowland valley bogs of Dorset, Hampshire and Surrey. More atypically, there are strong populations in the East Anglian fens and in the Thames valley. This money spider occurs in a wide range of wetland habitats, and in the uplands especially, it may also occur in dry, stony areas.

B *Satilatlas britteni* (Jackson) **Nb.** This is a species with two main habitats, *Sphagnum* bogs and saltmarshes, with most British records relating to the former. Most of its British sites are in Wales, and there are also scattered colonies in Scotland. In England it is a very rare spider, which is recorded from a handful of sites in northern England, and from Cheshire, Dorset and Hampshire. There is a single old record from Dartmoor, Devon.

B *Notioscopus sarcinatus* (O-P Cambridge) **Nb.** This money spider has a very scattered distribution over much of Britain. In England, the main concentrations of records are from the valley mires of Hampshire and Surrey, from the west Midlands and North York Moors. It also has a few sites in East Anglia, where it occurs in both fens and remnant acid mires. Frequently, this spider is found in wet *Sphagnum* and *Polytrichum* mosses growing under scrub within acid mire systems.

A *Glyphesis cottonae* (La Touche) **Na.** A very rare money spider, which is now restricted in Britain to two areas in England; the mires of Cheshire and Shropshire, and the valley bogs of Dorset, Hampshire and Surrey. There is also an old record from Cumbria. This is a specialist inhabitant of acid mires, which is generally found in wet *Sphagnum* moss.

C *Glyphesis servulus* (Simon) **Na?** Another very rare species, which is found at a handful of sites in Wales and southern England. This species is found in wet litter across a range of wetland habitats. Where it occurs in acid mires, it is often associated with tall, tussocky Purple Moor-grass with abundant litter. Formerly this species was assigned RDBK status, but the work of the WPIS has shown it to occur in a number of sites in south Wales, and it should probably be downgraded to Na status.

B *Erigone capra* Simon **Nb.** Most of the known populations of *E. capra* are on upland blanket bogs, where it often occurs in *Sphagnum* and litter around the fringes of bog pools. This is primarily a species of the Scottish uplands, though towards the north of its range it is also found at lower altitudes. In England, it is only known from a few sites in the Pennines and Lake District, and in Wales it is known from just one site in the Brecon Beacons.

A *Erigone welchi* Jackson **Na.** There are only two known sites for this rare money spider in England, these being in Derbyshire and the New Forest, Hampshire. Elsewhere in Britain, it appears to have its stronghold in the mountains of north Wales, and it is also known from a handful of sites in Scotland. The usual habitat of *E. welchi* is saturated *Sphagnum*, with webs being spun in the moss cushions just above the water surface.

A *Erigone psychrophila* Thorell **Na.** As with *E. capra*, this species is a specialist inhabitant of upland blanket mires, where it is most often found in saturated *Sphagnum* moss at the margins of bog pools. There is only one English colony of *E. psychrophila*, on the Cheviot in Northumberland. All its remaining British stations are in the Scottish Highlands.

A *Latithorax faustus* (O-P Cambridge). Another upland money spider, which is generally an inhabitant of blanket bogs. As with the three *Erigone* spp discussed above, *L. faustus* seems to be particularly associated with *Sphagnum* and wet litter occurring on the fringes of bog pools in acid mires. In England, it is quite widespread in the Pennines and Lake District, and also occurs widely in Wales and Scotland, descending to sea level in the north of the latter country.

A *Semljicola caliginosus* (Falconer) **Nb/RDB5.** Most of this money spiders' British colonies are in northern England, where it inhabits *Sphagnum* and wet litter on blanket mires in the Pennines and Lake District. There are otherwise just a handful of Scottish colonies of this endemic species.

C *Drepanotylus uncatus* (O-P Cambridge). An upland money spider, which is quite widespread in northern England, Scotland and Wales. In southern England, it is very scarce, with most records being from Exmoor, Dartmoor and Bodmin Moor. There are also a few records from the lowland heaths of Dorset, Hampshire and Surrey, and from East Anglia. *D. uncatus* occurs in a range of wetland habitats, but the majority of its British sites are acid mires.

B *Leptothrix hardyi* (Blackwall). *L. hardyi* has a very similar distribution to the last species, though it is much more localised. Most British records are from the uplands of northern England, and from Scotland and Wales, with southern English outposts on Exmoor, Dartmoor, and on the lowland heaths of Dorset, Hampshire and Surrey. It is unusual amongst upland spiders in favouring sparsely vegetated areas such as those that have been burnt recently.

A *Hilaira nubigena* Hull **Na.** This is a very scarce upland spider, with a concentration of records in the Pennines in northern England. Elsewhere in Britain, it is only known from a scattering of sites in Scotland. *H. nubigena* is generally found at altitudes in excess of 400 metres, in association with *Sphagnum* and rushes in acid flushes and on blanket mires.

A *Hilaira pervicax* Hull **Nb.** This money spider shows a very similar British distribution to *H. nubigena*, but is somewhat less localised than that species, being found more widely in Scotland, and also in north Wales, in addition to sites in the northern Pennines. It also appears to exclusively occupy acid mires with *Sphagnum* and rushes, and is an upland species, though in northern Scotland it occurs close to sea level.

A *Carorita limnaea* (Crosby & Bishop) **RDB1.** This is the most threatened British money spider to be found in association with acid mire habitats in Britain. It is only known from two sites, Wybunbury Moss in Cheshire and Whixall Moss in Shropshire. At both sites, it occurs in very wet *Sphagnum*-dominated acid mire, with Cross-leaved Heath, cottongrasses and Cranberry *Vaccinium oxycoccos*.

B *Aphileta misera* (O-P Cambridge). A widespread money spider, which is chiefly known from a range of acid mire habitats in northern England and Wales, with scattered sites in Scotland. In southern England, it is much more localised, chiefly occurring on Exmoor, Dartmoor and Bodmin Moor in the south-west and in the valley bogs of Dorset, Hampshire and Surrey. It is also known from a number of fenland sites in East Anglia.

A *Meioneta mossica* Schikora. This is a recently recognised species of money spider, formerly confused with the common *M. saxatilis* (Blackwall). It seems to be exclusively found in open *Sphagnum* lawns, with the adult building a small web amongst the upper layers of the moss cushion. Currently this spider is only known from a handful of sites in Scotland and Wales, with a record from Dartmoor being the only currently known English site.

A *Maro lepidus* Casemir **RDB3.** A very rare money spider, with English records from two sites in Yorkshire, and a further two in Westmorland. It is otherwise only known from a handful of sites in north and mid Wales. All known sites are acid mires, generally with abundant *Sphagnum*, though it has also been found amongst rushes and in dense Purple Moor-grass.

A *Centromerus levitarsis* (Simon) **RDB2.** There are relatively recent records of this very rare money spider from a lowland raised bog and an acid mire in Cumbria, and from a blanket mire on Dartmoor, Devon. Otherwise, there are old records from the Delamere Forest, Cheshire and from a handful of sites in Scotland, where it has been found on blanket mire in the vicinity of bog pools. In all cases, the species has been found amongst *Sphagnum* moss.

B *Bathyphantes setiger* F O P-Cambridge. This money spider has a scattered distribution throughout England, Scotland and Wales, with the greatest concentration of records being from the latter country. It occurs in a variety of acid mire types, and also in other wetland habitats.

C *Taranucnus setosus* (O P-Cambridge). A spider of southern England and Wales, which becomes increasingly rare in northern England, and is a great rarity in Scotland. It occurs in a variety of wetland habitats, with a significant proportion of records coming from acid mires.

This species appears to favour areas with deep litter and good vegetation structure, such as is provided by well-grown ericoid dwarf shrubs.

2.1.2 Araneidae

C *Hypsosinga sanguinea* (CL Koch) **Nb.** This orb-weaving spider is found amongst mature heather on damp heathland in southern England, with its stronghold being on the lowland heaths of Surrey, Dorset and Hampshire. It is also known from single sites in Devon, Worcestershire and Staffordshire, and occurs in other habitats, particularly rank calcareous grassland.

C *Singa hamata* (Clerck) **Nb.** In England this orb-weaver is known from only a handful of sites as far north as Cumbria and Yorkshire. There are a few sites for it in the New Forest, Hampshire, and it is also known from a single site in mid-Wales. A number of its sites are on lowland raised bogs, though it also occurs in other habitats, such as damp, rank grassland.

2.1.3 Lycosidae

C *Trochosa spinipalpis* (F O P-Cambridge). A wolf spider that is found in a wide range of wetland habitats throughout England, Scotland and Wales. *Sphagnum* bogs and wet heaths constitute one of the main habitats of this species.

B *Pirata tenuitarsis* Simon. This wolf spider is found in the southern half of England and throughout Wales, and it frequently replaces *P. piraticus* in acid mires within this range. It has been much confused with the latter species, which is very similar to it. It is usually found amongst *Sphagnum*, often close to bog pools, though there are also a number of records of it in fenland sites in East Anglia.

C *Pirata uliginosus* (Thorell). This species has two main habitats in Britain, rank calcareous grassland, and rank, species-poor *Molinia* grassland. It is widespread throughout the British Isles. It is one of a very few invertebrate species of acid mires that appear to tolerate frequent burning of its habitat.

B *Pirata piscatorius* (Clerck). This is predominantly a species of southern England and Wales, where it occurs in a range of wetland sites. It especially favours very wet areas of *Sphagnum* bog, with the females building a vertical silken tube amongst the moss that leads down beneath the water level, allowing the spider to escape when disturbed. In England, it has major populations on the lowland heaths of Dorset, Hampshire and Surrey, on the Cheshire/Shropshire mires, and in the East Anglian fens.

2.1.4 Pisauridae

A Raft Spider *Dolomedes fimbriatus* (Clerck). This imposing spider is only really common in the lowland bogs of Dorset, Hampshire and Surrey. Elsewhere in England, there are scattered sites for it in Devon, Somerset, Norfolk, Shropshire and Cumbria. In Scotland and Wales, it is also highly localised.

2.1.5 Dictynidae

B *Lathys nielseni* (Schenkel) **Na.** This is a species of damp heathland, and is often found in damp litter amongst *Molinia* tussocks. It is only known from a handful of sites in Surrey, Sussex and Hampshire.

2.1.6 Liocranidae

C *Scotina palliardii* (L Koch) **Na.** Another species of damp heathland, which has a very local distribution on the lowland heaths of Dorset, Hampshire and Surrey. It is also sometimes found on chalk grassland. This spider is found in areas with mature heather and litter.

2.1.7 Clubionidae

A *Clubiona norvegica* Strand **Nb.** Essentially *C. norvegica* is a species of blanket mires, where it is usually found amongst *Sphagnum*. It is known from a few sites in northern England, and also from scattered locations in Scotland. Its British headquarters is in Wales, where it is known from a number of sites throughout the country.

2.1.8 Gnaphosidae

A *Gnaphosa nigerrima* L Koch **RDBI?** This is a recently discovered spider, which may previously have been confused with the common *G. lugubris*. It is currently only known to occur at Wybunbury Moss, Cheshire where it has been recorded in pitfall traps set up in *Sphagnum* lawns. No status has currently been assigned to this species, and until further studies of it are undertaken, it would probably be best regarded as of RDBI status.

B *Gnaphosa leporina* (L Koch). This is another spider amongst a suite of species that are particularly characteristic of damp heathland. It has a wide, but very scattered distribution throughout England, Scotland and Wales. In England, the main areas where this spider occurs are the heaths of Dorset, Hampshire and Surrey and the North York Moors.

2.1.9 Zoridae

C *Zora armillata* Simon **RDB3.** This spider only occurs in two small areas of southern England: on the lowland heaths of Dorset, where it is found in moss and litter on areas of wet heath and acid bog, and in the fens of Cambridgeshire and Huntingdonshire, where it is found amongst reed and sedge litter.

2.1.10 Philodromidae

A *Thanatus formicinus* (Clerck) **RDB2.** There have been no records of this exceptionally rare crab spider in Britain since 1930, when it was recorded at two sites in Sussex. Otherwise, it has only ever been recorded from the New Forest, Hampshire, where it has not now been seen since 1894. This is a species of rank mire vegetation, where there are mature heather plants or tall tussocks of Purple Moor-grass.

2.1.11 Salticidae

C *Sitticus caricis* (Westring) **Nb.** A rare jumping spider, which is found in both bog and fen habitats. It is predominantly a species of southern England, where the majority of records are from the lowland mires of Dorset, Hampshire and Surrey, and the fens of East Anglia. There are also some isolated populations on the fens and bogs of Anglesey.

B *Sitticus floricola* (CL Koch) **RDB3.** Another of the specialities of the meres and mosses of the Cheshire/Shropshire Plain. *S. floricola* is found at a number of sites here, and occurs in both fen and acid mire habitats. Adults are often found in a retreat in the flowerheads of cottongrasses, though other tall vegetation is also used. In winter, they retreat deep into *Sphagnum* hummocks. It is otherwise only known from a couple of sites in south-west Scotland.

B *Evarcha arcuata* (Clerck) **Nb.** This jumping spider is almost entirely restricted to the lowland heaths of Dorset, Hampshire and Surrey, where it is quite widespread in damp heaths and bogs amongst tall heather and *Molinia*.

2.2 Odonata

Though there are few British species, the Odonata are nonetheless a very important group to consider when looking at the invertebrate fauna of acid mires, with a number of stenotopic acid mire species, some of which are extremely scarce and threatened in Britain. The main sources used in compiling the following list have been Colyer & Hammond (1983) and Brooks (1997).

2.2.1 Coenagrionidae

A Small Red Damselfly *Ceriagrion tenellum* (de Villers). A scarce damselfly of shallow, acid pools and slow-flowing runnels. It has a markedly southern distribution in Britain, with its largest populations being on the southern heaths of Dorset, Hampshire and Surrey, where it is quite widespread in acid pools and runnels in the valley mires. It also occurs at scattered sites in south-west England and west Wales. Elsewhere it is very rare, with just a few old records from East Anglia, where it may now be extinct.

B Southern Damselfly *Coenagrion mercuriale* (Charpentier) **RDB3/ECII/BAP.** This is one of the most important insects occurring on acid mires in Britain. It is a threatened species throughout its European range, and in Britain is chiefly found on valley mires in the New Forest, Hampshire and south Wales. In England, further populations occur on acid mires in Dorset and Devon. There are also colonies on calcareous wetlands in Hampshire, Oxfordshire and Anglesey, north Wales. On its acid mire sites, the Southern Damselfly is found on small flushes and runnels, though generally those that are spring-fed and have at least some some nutrient enrichment. Because of its inclusion in Annex II of the EC Habitats Directive, the Southern Damselfly is subject to a number of ongoing studies, including very detailed investigation of its autecology (Purse 2002) and a review of its status at all its British sites (Boyce 2002b).

2.2.2 Aeshnidae

C Common Hawker *Aeshna juncea* (Linnaeus). Though it is found in a range of waterbodies, this dragonfly is especially characteristic of bog pools with acid waters, where it replaces its close relative the Southern Hawker *Aeshna cyanea*. It has a wide British distribution in the north and west, but in southern England and East Anglia, it is much more restricted to districts with acid pools, such as the lowland heaths of Hampshire, Dorset and Surrey.

2.2.3 Libellulidae

A Keeled Skimmer *Orthetrum coerulescens* (Fabricius). *O. coerulescens* has a markedly southern distribution in Britain, with its main populations being on the lowland heaths of Hampshire, Dorset and Surrey, in south-west England and in west Wales. Elsewhere, there are scattered colonies in northern England and Scotland, most of these being up the west coast. The Keeled Skimmer occurs in shallow, slow-flowing flushes, where there is a deep, peaty substrate in which the larva is able to bury itself.

B Black Darter *Sympetrum danae* (Sulzer). This is a common dragonfly of acid mire habitats, the nymphs usually being found in small bog pools, and in *Sphagnum* fen around the fringes of larger still waterbodies. A map of the distribution of this species is a map of the distribution of acid mire habitats in England, and it has even found its way to very isolated acid mire sites, such as those in East Anglia. It is also found throughout Wales and Scotland, wherever suitable habitats occur.

A White-faced Darter *Leucorrhinia dubia* (Vander Linden). The White-faced Darter is a very scarce species in England, which is found in a few "centres", on the heaths of Surrey, on the Cheshire mosses and meres, and on the lowland raised bogs of Cumbria. It is a little more widespread in western and central Scotland, though still having a very localised distribution. It is a stenotopic inhabitant of shallow bog pools with an abundance of *Sphagnum*.

2.3 Orthoptera

The main sources used in the preparation of the accounts for this order have been Marshall & Haes (1988) and Haes & Harding (1997).

2.3.1 Acrididae

A Large Marsh Grasshopper *Stethophyma grossum* (Linnaeus) **RDB2/BAP.** The Large Marsh Grasshopper is now restricted to very wet, acid bogs (often referable to the M21 NVC community) in the New Forest and on the lowland heaths of Dorset. Formerly, it also occurred in the Somerset Levels, but loss and degradation of acid mire habitats has resulted in its extinction there. It is not known to occur in Scotland or Wales, but there are scattered colonies on bogs in the southern half of Ireland. Adults can be seen from July onwards, and are most easily recorded during hot, sunny weather, when their very distinctive clicking song can be heard.

2.3.2 Tettigoniidae

A Bog Bush-cricket *Metrioptera brachyptera* (Linnaeus) **Nb.** A handsome bush-cricket, easily distinguished from other species by the pale band on the hind edge of the pronotum

and the green colour of the ventral surface of the abdomen. As its name suggests, this is a bog specialist, which is only found on areas of reasonably dry acid mire, especially wet heath in the British lowlands. Its main distribution centre is on the lowland heaths of Dorset, Hampshire, Surrey and Sussex. It is also common on the East Devon Pebble beds, and on the heaths of the Bovey Basin in south Devon. Elsewhere in southern England, it occurs at scattered sites in Cornwall and Somerset, and there are also some colonies in East Anglia, where suitable habitat occurs. Further north, there are very scattered colonies in the West Midlands (including a large colony on Cannock Chase), into Yorkshire, Lancashire and Cumbria. The Bog Bush-cricket also occurs at a few sites in Wales, but is not known from Scotland.

2.4 Heteroptera

Only the aquatic Heteroptera have been covered by this review. The main sources of information used in compiling the following list have been the excellent new distribution atlas of Huxley (2003) and the earlier work of Macan (1965).

2.4.1 Hebridae

B *Hebrus ruficeps* (Thomson). This tiny bug occurs throughout the British Isles, where it is generally found in acid mires by sieving *Sphagnum* moss. It is common over the whole range of acid mire vegetation in England.

2.4.2 Gerridae

B *Gerris costae* (Herrich-Schaffer). Though found in southern Europe, in Britain this is an exclusively northern species, confined to the Pennines and Lake District in northern England and to Scotland. It is found in small, peaty pools on blanket mire.

C *Gerris lateralis* Schummel. Another predominantly northern species, though with a few scattered sites in southern England. It is also found in Wales and in Scotland. It appears to favour acidic swamps, especially those with Bottle Sedge *Carex rostrata*, though it is also found in more mesotrophic wetlands.

2.4.3 Notonectidae

C *Notonecta obliqua* Thunberg. This is one of the more uncommon backswimmers. Nonetheless, it still has a wide distribution throughout England, Scotland and Wales. *N. obliqua* is primarily an inhabitant of peaty pools with little aquatic vegetation, though it can also be found in larger waterbodies, and also in waters of higher base status.

2.4.4 Corixidae

B *Glaenocorisa propinqua* (Fieber). Primarily a species of northern England and Scotland, though there are "relict" populations of this water boatman in Surrey and Somerset. Like *N. obliqua*, this is a species that favours sparsely vegetated peaty pools. It can also be found in larger acid water bodies.

B *Hespercorixa castanea* (Thomson). *H castanea* is a very characteristic water boatman of base-deficient standing water in western Britain. It is quite widespread in northern England, Scotland and Wales, and it is also found on the lowland heaths of Dorset, Hampshire and

Surrey and in south-west England. Unlike the preceding two species, *H. castanea* favours shallow acid pools with abundant *Sphagnum*, sedges and cottongrasses. It is also found in similar microhabitats around the margins of larger waterbodies, provided that these are acidic.

C *Arctocorisa carinata* (Sahlberg C). This is exclusively an upland species, which is rarely found at altitudes of less than 300 metres. It is confined to the Lake District and the Pennines in England. Otherwise, its British distribution is limited to the Scottish mountains. It is an inhabitant of quite large, unvegetated, peaty pools.

C *Callicorixa wollastoni* (Douglas & Scott). *C. wollastoni* shares the same habitat preferences as *A. carinata*, and its British distribution is very similar, encompassing Scotland and upland districts of northern England, where it is generally found at altitudes in excess of 400 metres. With *Glaenocorisa propinqua*, these three species constitute a distinctive water boatman community of bare, peaty pools on blanket mires.

C *Sigara scotti* (Douglas & Scott). *S. scotti* is predominantly a northern species, with most records being from Scotland, northern England and Wales. However, it is also found at scattered southern sites, especially on the lowland heaths of Surrey, where it replaces *Hespercorixa castanea* in more sparsely vegetated peaty pools.

C *Sigara semistriata* (Fieber). As with most of the acid mire corixids, *S. semistriata* favours sparsely vegetated pools. It is primarily found in northern England and Scotland, in base-deficient peaty pools, though it does also occur at scattered sites in southern England on fen peats.

2.5 Lepidoptera

The following sources have been used in compiling the species accounts in this sub-section: Asher and others (2001), Beaumont ed. (2002), Collins (1997), Goater & Norriss (2001), McCormick (2001), Porter (1997), Riley (1991), Skinner (1984), Smith (1997), Sutton & Beaumont eds. (1989) and Waring, Townsend & Lewington (2003). The Northern Footman *Eilema sericea* (Gregson), which is a very rare (RDB2) inhabitant of a handful of acid mires in northern England, the West Midlands and Wales was formerly considered to be a good species. However, it is now thought to be no more than a form of the Scarce Footman *Eilema complana* (Linnaeus) (Waring, Townsend & Lewington 2003), and for this reason has been excluded from consideration in the key species accounts below.

2.5.1 Satyridae

A Large Heath *Coenonympha tullia* (Muller). The Large Heath is the only British butterfly that shows a strong affinity for acid mire habitats. It is a northern species that has its British headquarters in Scotland, with additional colonies in northern England and north and mid Wales. In England, it reaches its southern limit on the lowland raised mires of Crowle, Thorne and Hatfield Moors, on the Yorkshire-Lincolnshire border. This species shows a very strong relationship with ombrogenous mires, being found on both lowland raised bogs and upland blanket bogs. In the former habitat, its main English stronghold is on the lowland mosses of Cumbria and Lancashire, whilst in the latter habitat, it is primarily found on the Border Mires of Northumberland. Interestingly, the butterfly appears to be absent from the Pennines, though there are populations on the North York Moors. The larvae are usually

found feeding on Hare's-tail Cottongrass *Eriophorum vaginatum*, though Common Cottongrass *E angustifolium* and Jointed Rush *Juncus articulatus* have also been reported as larval foodplants.

2.5.2 Geometridae

C Small Grass Emerald *Chlorissa viridata* (Linnaeus) **Na**. This beautiful geometrid moth is easily recognised by a combination of its small size, deep green colour and the straight pale line on the hindwing. The larva is also distinctive, being pale green, with an incomplete pinkish dorsal stripe and a cleft head. It feeds on a range of plants, chiefly Ling, Cross-leaved Heath, gorse *Ulex* spp., and Creeping Willow *Salix repens*. It also feeds on small willow and birch saplings, where these are growing in open situations. The moth is readily disturbed from heathland vegetation in June and early July and is also attracted to mercury vapour light. The larva can be beaten or swept from its foodplants in July and August. In England, the Small Grass Emerald is most often encountered on the extensive wet heaths of the New Forest, S. Hants. Its other main stronghold is on wet heathland in Dorset, with recent records from many of the larger heathland blocks such as Winfrith and Tadnoll Heaths, Studland, Morden Bog and Wareham Forest. In South Devon strong colonies still occur on heaths on the East Devon Pebblebeds, and it is also present on Chudleigh Knighton Heath and Bovey Heathfield in vc3. Elsewhere, this is a very rare moth, with post-1980 records from Cornwall, Somerset, Sussex, Surrey, West Lancashire and Cumbria. It was formerly of wider occurrence, with old records from Worcestershire, Gloucestershire, Wiltshire, Shropshire and Westmorland.

C Purple-bordered Gold *Idaea muricata* (Hufnagel) **Nb.** The Purple-bordered Gold is readily recognised by its pink and yellow colouration. Its foodplant, Marsh Cinquefoil is found in both very wet acid bogs and more calcicolous wetland habitats, especially transition mires, which are beyond the scope of the current report. Its strongholds are in the New Forest, Hampshire, the east Dorset heaths, the meres and mosses of Cheshire and Lancashire, and the mosses of Lancashire and Cumbria. It is also known from Crowle, Thorne and Hatfield Moors on the Lincolnshire/Yorkshire border. Outside of England, it is known from a single site in west Wales, but is unknown from Scotland.

C Ruddy Highflyer *Hydriomena ruberata* (Freyer). Most often the larvae of the Ruddy Highflyer are found feeding on the foliage of willows, with Eared Willow *Salix aurita* appearing to be especially favoured. Stunted willow bushes growing in open bogs and wet heaths appear to be particularly favoured, though the moth also breeds in carr and other wetland habitats. This is a northern and western species, which occurs from south-west England, through Wales into northern England and Scotland.

B Slender-striped Rufous *Coenocalpe lapidata* (Hubner) **Na.** A distinctive moth that has light brown forewings crossed with numerous darker lines, with the ground colour in the male being markedly darker than the female. The females fly in dry weather in the afternoon in September and early October, and both sexes also come to mercury-vapour light. The Slender-striped Rufous is usually found in association with rush-dominated flushes, but in the wild, the larval pabulum is still unknown, though buttercups *Ranunculus* spp have been suggested. This is a montane species, known from a wide scattering of sites in Scotland, with a single old record from Westmorland, and a more recent, unconfirmed record from Durham. The remote habitat and late flight period of the moth makes it likely that the species still

occurs in the north Pennines and Lake District, and should be re-found given systematic searching.

C Argent and Sable *Rheumaptera hastata* (Linnaeus) **Nb.** The striking black and white pattern on both fore- and hindwings of this day-flying moth makes it an extremely distinctive species when it is on the wing in May and June. It occurs in two main habitats; coppiced woodland and acid mires and wet heaths, with the larvae usually being found between the spun-together leaves of birch seedlings and saplings in the latter habitat. In its acid mire habitats, this species generally occurs as the form *nigrescens* Prout, formerly regarded as a full sub-species. The larvae of this form are also found on Bog-myrtle. The cessation of coppicing across southern England has resulted in a marked decline of the typical form, and to its inclusion on the UK BAP as a priority species. The Argent and Sable now has a wide, but highly localised distribution across central southern England and the Midlands, including the Welsh Borders and eastern Wales. The form *nigrescens* has shown a much less marked decline, and there are still strong colonies in northern England and western Scotland.

B Manchester Treble-bar *Carsia sororiata* (Hubner) **Nb.** This moth is easily recognised by a combination of its grey ground colour, the shape of the dark black-brown lines that cross the forewings, and especially by the extensive reddish flush that suffuses the outer, apical area of the forewings. British populations are referable to the sub-species *anglica* Prout. It flies from July through to September, when it can be disturbed during the day from vegetation, or trapped at mercury-vapour light. The larvae of the Manchester Treble-bar feed on various species of *Vaccinium*, especially Bilberry *V. myrtillus*, Cranberry and Cowberry *V. vitis-idaea*. It is an inhabitant of wet moorland and bogs in both lowland and upland situations. It is of widespread occurrence in Scotland, and is also relatively frequent in north-eastern England, in Northumberland and Durham. In the north-west, it is found at a scattering of sites on the remaining "mosses" of Cumbria and Lancashire. Further south, there are isolated populations in Shropshire and Staffordshire.

C Bordered Grey *Selidosema brunnearia* (Villers) **Na.** British populations of this moth are referable to the sub-species *scandinaviaria* Staudinger. The Bordered Grey is unusual in occurring in a number of different habitats, including bogs, dry heaths, calcareous grassland and sandhills. In acid mire habitats, it is primarily an inhabitant of the mosses of Westmorland, with an isolated population in Shropshire. It may also occur in acid mires in Hampshire, Dorset and Surrey, though here it is primarily a denizen of lowland dry heaths. It is also known from a handful of sites in southern and western Scotland. The larva feed on heathers where it occurs in acid mire and heathland habitats. Adults are readily disturbed during the day, and also come to mercury-vapour light in small numbers during July and August.

C Ringed Carpet Moth *Cleora cinctaria* Denis & Schiffermuller **Na**. A geometrid moth that is readily recognised by the "ring" marking on the upper side of the forewing. The larva is green, with a dark dorsal stripe, and with paler lines on either side of this. It feeds up on birch, Bilberry, Bog-myrtle and heathers. Its habitat is very similar to the preceding species, being lightly wooded damp heathland. The British headquarters of the Ringed Carpet is in the New Forest, but it is also found on a scatter of lowland heaths across southern England, and there are a few sites in Scotland and Wales. There is also an unconfirmed record of the moth from the East Devon Pebble bed heaths.

C Grey Scalloped Bar *Dyscia fagaria* Thunberg. A very distinctive moth, with pale grey upper wings crossed by curved dark lines enclosing a striking discal spot. It is of wide, but local occurrence in northern England, the West Midlands, Scotland and north Wales. In southern England, its main stronghold is on the heaths of Dorset, Hampshire and Surrey, with only a handful of widely scattered colonies elsewhere. The larvae feed on various heather species, with the moth being found in both wet heaths and acid bogs, but also on dry heathland. Adults can be found from late May till July, and are usually recorded resting on heather plants at night.

2.5.3 Noctuidae

B Light Knot Grass *Acronicta menyanthidis* (Esper). The Light Knot-grass is a handsome moth in which the forewings have a pale grey mottled ground colour, overlain with a number of more distinctive blackish markings. The adult flies from late May through to mid July, and comes to mercury-vapour light. The very distinctive black, hairy larvae have a bright red lateral line and white edged lateral spiracles. They are found on a range of plants growing in bogs and wet heaths, especially ericaceous dwarf shrubs, Bog-myrtle and Bogbean. This is a northern moth, which has a wide, but localised distribution through Scotland, northern England (as far south as Shropshire) and Wales. The nominate form is replaced through much of the Scottish Highlands by sub-species *scotica* Tutt.

B Northern Arches *Apamea zeta* (Treitschke). The Northern Arches has been found in both peaty and dry moorland habitats, but it is though likely that the larvae usually feed on the roots and stem bases of Purple Moor-grass, though their largely subterranean habits makes them very elusive, and they have yet to be found in the wild in Britain. It is mainly found in upland areas of Scotland, but has recently been recorded from a site in Northumberland. On the Scottish and English mainland, it is represented by the sub-species *assimilis* Doubleday, whilst on the Shetland Islands, it is replaced by the Exile [sub-species *marmorata* (Zetterstedt)], which was formerly regarded as a separate species. The adults fly from June to August, and come to both sugar and mercury-vapour light.

B Haworth's Minor *Celaena haworthii* (Curtis). The combination of the reddish-brown ground colour and white marked reniform stigma and longitudinal lines on the forewing make this an unmistakeable noctuid. It is a northern species, which is widely distributed in Scotland, northern England and the northern half of Wales. To the south of this, it is very localised, with the main breeding populations being on Exmoor, in the New Forest, and in the Norfolk Broads, where it occurs in fenland habitats. The larvae are thought to primarily feed on Common Cottongrass, though in areas where this is absent, rushes may be used instead. The adult male flies during the day in August and September, when it can be quite readily recorded and both sexes also come freely to light.

C Small Rufous *Coenobia rufa* (Haworth). The Small Rufous is a small and rather obscure noctuid moth, with straw to reddish-brown-coloured forewings marked with a few darker dots. The larvae of this species feed on rushes, with Sharp-flowered Rush *Juncus acutiflorus* being especially favoured, though Soft Rush *Juncus effusus* is also frequently used. The Small Rufous occurs in a range of wetland habitats, wherever its foodplants grow, but is very local. It is most frequent on the lowland heaths of Dorset, Hampshire, Surrey and Sussex, but occurs in widely scattered colonies throughout England. It is also quite frequent on the coastal lowlands of Wales, and occurs at a handful of sites in southern and western Scotland.

This species has a well-marked dusk flight in July and August, when adults can be collected readily.

B Shoulder-striped Clover *Heliothis maritima* (Graslin) **RDB3.** An attractive yellow-brown moth with darker cross-bands. Easily distinguished from its congeners by the dark "shoulder stripe" at the base of the forewings. This is a very scarce species, confined to the lowland heaths of Dorset, Hampshire and Surrey, where the adults fly strongly on warm days in June and July. The larvae feed on the flowerheads of Cross-leaved Heath, Ling and Bog Asphodel *Narthecium ossifragum*, where these are growing in wet heath and valley bog. There are also a number of quite recent records from the Lizard, Cornwall, though its status in this area requires confirmation. In England, the species is represented by the endemic sub-species *warneckei* Boursin.

C Silver Hook *Deltote uncula* (Clerck). A very striking and unmistakeable moth, with the forewings marked with a variety of cream, white and brown markings, including the large, white hook-shaped reniform stigma. This moth is found in a variety of wetland habitats, but is especially frequent in areas of acid bog and wet heath. The larvae feed on a variety of wetland grasses and sedges. This species shows a curiously disjunct distribution in Britain, with strongholds being on the lowland heaths of Dorset, Hampshire and Surrey, in the East Anglian fens, on the wet heaths and pastures of west Wales, on the lowland coastal bogs of north-west England and southern Scotland, and in the western Scottish Highlands. It flies from late May till early July, with adults being quite readily disturbed from tall vegetation. It also comes to mercury-vapour light in small numbers.

B Marsh Oblique-barred *Hypenodes humidalis* Doubleday **Nb.** A tiny, pale brown noctuid moth, with darker cross-bars, that is easily overlooked as a micro-moth. Its stronghold is on the lowland heaths of Dorset, Hampshire, Surrey and Sussex. Elsewhere, it is extremely localised, though it has a wide distribution that encompasses much of England, Scotland and Wales. It is occasionally found in other wetland habitats, but shows a strong preference for acid mires, where the caterpillars probably feed on various bog plants, though the larva is currently unknown in the wild. The adults can be found most easily by netting in the evening, at which time there is a strong dusk flight. They also come readily to mercury-vapour light and to sugar.

2.6 Trichoptera

The main references used in compiling the list of caddis flies associated with acid mires have been the two major reviews of Wallace (1991 & 2003). The Trichoptera are relatively poor in acid mire species, with most British caddis being found in running water habitats, or larger waterbodies such as ponds and lakes.

2.6.1 Phryganeidae

B *Agrypnia obsoleta* (Hagen). An upland caddis fly that is quite common on the moors of Scotland, northern England and north Wales. It is most frequently found in small, acidic pools on blanket bogs.

A *Hagenella clathrata* (Kolenati). **RDB1.** *H clathrata* is the rarest caddis fly found in acid mire habitats in Britain. It is only known from three English sites, in Surrey, Staffordshire and Cheshire, where it occurs in a valley bog, a large basin mire and a lowland raised bog

respectively. In all cases, the microhabitat occupied by larvae is shallow seasonal pools between Purple Moor-grass and Hare's-tail Cottongrass tussocks, where there is a very slight flow of water.

B *Oligotricha striata* (Linnaeus). A common species in northern England, Scotland and Wales, where it is primarily an inhabitant of small, *Sphagnum* pools on blanket mires. However, it does also occur in a few valley mires in southern England.

2.6.2 Limnephilidae

A *Limnephilus coenosus* Curtis. A specialist caddis fly of ombrogenous mires, which is primarily known from blanket mires in Scotland, northern England and Wales. However, in the lowlands of north-western England, it also occurs on lowland raised bogs. Larvae of this species are found in shallow peaty pools with sparse vegetation that dry up over the summer months.

B *Limnephilus elegans* Curtis. Unlike the preceding species, this caddis fly appears to be predominantly a lowland species, which is found in more permanently saturated bog pools with abundant growth of *Sphagnum*, sedges and cottongrasses. It is very widely distributed throughout Britain, wherever there is suitable habitat.

A *Rhadicoleptus alpestris* (Kolenati). A local caddis fly, primarily found on blanket mires in northern England, Wales and southern Scotland. It is also found on some lowland bogs as far south as Staffordshire. Its ecology is similar to *Hagenella clathrata*, with larvae being found in tiny seasonal pools between tussocks of Hare's-tail cottongrass and other tall monocotyledons.

2.7 Diptera

The main general reference used in compiling the Diptera lists below has been Falk (1991b). For tipulids Stubbs (1992 & 2003) and for the long-headed flies Crossley (in press), Assis-Fonseca (1978), Rampazzi (2002), Pollet and others (1987) and Pollet (1991) have been referred to. The only Larger Brachyceran group with acid mire associates is the horseflies, with the list compiled by reference to the works of Drake (1991) and Stubbs and Drake (2001). Information on the distribution and ecology of hoverflies has been taken from Ball and Morris (2000), Stubbs and Falk (2002) and Morris (1998). Lastly, information on the dung flies has been gleaned from Falk and Pont (1996). Craneflies, horseflies and long-head flies are particularly important fly families to consider when assessing the invertebrate fauna of acid mire habitats, with a high proportion of scarce and stenotopic species being found in England.

2.7.1 Tipulidae

B *Erioconopa diuturna* (Walker). This is a northern species, chiefly found in the uplands on blanket bog, and it is listed by Stubbs (2003) as a species showing a strong association with this habitat. It has a wide but localised distribution in upland districts of Britain. The ecology of this species is very poorly understood.

A *Erioptera nielseni* de Meijere **N.** A widespread, but very local cranefly, which is most common in Wales and the New Forest, Hampshire, though having scattered colonies

elsewhere in western Britain as far north as Scotland. It shows an association with somewhat mesotrophic poor fens, often where there are rushes. The larvae are thought to develop in wet peat or moss.

B *Euphylidorea meigenii* (Verrall). This cranefly is a northern species of wide but local distribution, with most records being from blanket bogs. It is listed by Stubbs (2003) as a species associated with this habitat type. The larvae are found in bog pools.

B *Idioptera pulchella* (Meigen). Another northern tipulid of blanket bogs, which is listed by Stubbs (2003) as a species associated with this habitat type. The larvae are thought to be associated with *Sphagnum* moss.

A *Limonia aperta* (Wahlgren) **RDB1.** *L. aperta* is a very rare cranefly, with only two known sites in Yorkshire, plus three other widely dispersed sites in Scotland. The two English localities are a lowland raised bog and blanket bog. The larval ecology of this species is unknown, but it is very likely that it inhabits wet peat or moss.

B *Limonia dilutior* (Edwards). This cranefly has a local, but widespread distribution through much of England, Scotland and Wales. It shows a strong affinity for blanket bogs, and is listed by Stubbs (2003) as a species associated with this habitat. It is also found in valley mires on lowland heaths in southern England. The larvae of this species are thought to develop in damp peat.

B *Limonia distendens* (Lundstrom) **N.** This is a northern species, with the vast majority of records coming from Scotland and north Wales. However, there are also lowland records from the New Forest, Hampshire and from Surrey. This species is found around seepages in areas of acid mire, usually in upland districts.

A *Molophilus ater* (Meigen). *M. ater* is a local northern species in Britain, which shows a high fidelity to acid mire sites in Scotland, northern England and Wales. Many records of *M. ater* are from blanket mires, and Stubbs (2003) lists it as a species associated with this habitat. The larvae probably require areas of bare, wet peat.

C *Molophilus occultus* de Meijere. A common cranefly over much of Britain. *M. occultus* shows a marked preference for acid mire habitats, though it is also not infrequently found in other wetland habitats. The larvae probably require areas of bare, wet peat.

B *Ormosia pseudosimilis* (Lundstrom). This cranefly has a local, but widespread distribution through much of England, Scotland and Wales. It shows a strong affinity for peatland habitats, particularly blanket bogs, though it is also found in valley mires on the lowland heaths of southern England. The larvae of this species are thought to develop in damp peat.

C *Phalacrocera replicata* (Linnaeus) **N.** *P replicata* has a scattered distribution in England, Scotland and Wales, with most records being from northern England. It is found around shallow pools in both acid mires and fens, with the larvae developing in *Sphagnum* in the former habitat, though other mosses may be used in fenland situations. This appears to be a species of lowland habitats.

A *Phylidorea abdominalis* Staeger **N.** There are very scattered records of this cranefly from lowland bogs across England, Wales and Scotland. There appears to be an association with areas of bare, wet peat, in which the larvae are thought to develop. The favoured habitat of this species is in valley bogs and poor fens.

A *Phylidorea fasciata* (Linnaeus) **RDB1.** The stronghold of this rarity appears to be in the meres and mosses of Cheshire, though there are also records from Yorkshire and Westmorland. In Cheshire, *P. fasciata* has been found at the edge of a mere. The larval ecology is unknown, but it is thought likely that it develops in wet peat.

A *Phylidorea heterogyna* (Bergroth) **RDB1.** Another great rarity, *P. heterogyna* seems to be strongly associated with ombrogenous mires, with its only two English stations, in Shropshire and Cumbria, both being on lowland raised bogs, whilst its Scottish site is a blanket bog in the Flow Country. Larval biology is unknown, but it is likely that the larvae develop in damp peat.

C *Phylidorea pulchella* (Meigen) **N.** *P. pulchella* is most abundant in Scotland and northern England, with scattered colonies in southern England as far south as Dorset, Wiltshire, Hampshire and Berkshire. It occurs in lowland *Sphagnum* bogs where there are patches of bare peat, though it is also known to occur in wet woodland.

B *Phylidorea squalens* (Zetterstedt). This is another northern, upland tipulid, having a widespread northern distribution on blanket mires. It is listed by Stubbs (2003) as a species associated with this habitat type. The larvae are found in bog pools.

A *Prionocera pubescens* Loew **RDB2.** A rare cranefly that is a stenotopic inhabitant of lowland bogs. In England it has been found at a handful of widely scattered sites in Hampshire, Surrey, Cheshire, Yorkshire, and there are also single sites in Wales and Scotland. The larval ecology is poorly known, but there appears to be an association with *Sphagnum* lawns.

C *Prionocera turcica* (Fabricius). A much commoner and more eurytopic species than the above that is found in a range of wetland habitats, including fenland. Nonetheless, most British records are from acid mires, where the larvae are thought to be semi-aquatic. Generally, this is a lowland insect, found wherever its habitat occurs.

A *Tipula melanoceros* Schummel. The larvae of *T. melanoceros* are found in shallow, peaty pools in various kinds of acid mires in both upland and lowland situations. Despite its wide distribution in Britain, it appears to be a stenotopic inhabitant of acid mires. It is common on blanket mires in northern England and Wales, but is also widespread in the valley bogs of Dorset, Hampshire and the New Forest, and is frequently found elsewhere in the lowlands wherever its habitat occurs. It is however, surprisingly scarce in Scotland.

C *Tipula gimmerthali* Lackshewitz **RDB3.** This cranefly has its main centre of distribution in the Scottish Highlands. It is also known from a single site in northern England, at Moor House NNR, Cumbria. At the latter site, the larval habitat is thought to be base-rich upland seepages (Falk 1991; Stubbs 1992), but Stubbs (2003) also lists it as a blanket mire associate.

A *Tipula grisescens* Zetterstedt **RDB3.** *T. grisescens* is primarily an upland cranefly, with its main British distribution centres being on blanket mires in Scotland. There are a handful

of colonies on the Pennines in northern England and it has also been found in Cheshire and Shropshire. In Wales there are records from the Brecon Beacons.

B *Tipula holoptera* Edwards **N.** A very scarce cranefly, with a restricted, lowland distribution in southern England and Wales, the latter country being its British headquarters. In England, there are few records, most of these being from the New Forest and Dorset. Surprisingly, it is unknown in south-west England. The larvae are thought to inhabit acid flushes amongst Sharp-flowered Rush.

C *Tipula limbata* Zetterstedt **RDB3.** A northern cranefly, most often encountered in boggy woodlands in Scotland. There are also records from the Pennines in northern England, where the species has been found in acid flushes on moorland.

A *Tipula subnodicornis* Zetterstedt. A widespread species in the north and west of Britain, where it is an inhabitant of acid flushes in the uplands. It is common through much of Scotland, northern England and Wales, and there is an outlying "upland" population on Exmoor. In lowland England, there are a few colonies on the heaths of Hampshire and Surrey, and a very isolated colony is known from an acid mire in Norfolk.

C *Tipula yerburyi* Edwards **N.** This cranefly shows a preference for scrub on lowland wet heaths and acid mires. It has a restricted southern distribution in Britain, with most records being from the south-west peninsula and from Wales. It is a markedly western species, with records petering out towards the east.

C *Tricyphona immaculata* (Meigen). This is predominantly an upland tipulid, most commonly encountered on blanket bogs, and it is listed by Stubbs (2003) as a species that is associated with this habitat. However, it is also found on lowland peatlands, and has a wide but local distribution through much of Britain. Its ecology is poorly understood.

B *Tricyphona schummeli* Edwards. This is a northern species chiefly found in the uplands on blanket bog, and it is listed by Stubbs (2003) as a species showing a strong association with this habitat. It has a wide but localised distribution in upland districts of Britain. The ecology of this species is very poorly understood.

2.7.2 Dolichopodidae

B *Campsicnemus alpinus* Haliday. A very small dolichopodid fly, with a wide distribution throughout Britain. It is found in both lowland and upland habitats from southern England to the extreme north of Scotland. Though it has a wide distribution, it shows a marked preference for acid mires and wet heaths, though it may also be found on drier heathland. The ecology of this species is not known.

A *Campsicnemus compeditus* Loew. A small species, with greyish-white face, and the front tarsi adorned with a long filamentous process on the basal segment. *C. compeditus* is a much more local species than the preceding, with most records deriving from moorland and montane habitats in northern Scotland (McGowan 1998). However, it is also found at scattered sites in England as far south as the Dorset heathlands. This species appears to be a specialist inhabitant of acid mires, which is most often found in areas with well-developed *Sphagnum* lawns.

A *Chrysotus obscuripes* Zetterstedt. This is a very local species, which is thought to be a specialist inhabitant of acid mire habitats. *C. obscuripes* has a wide distribution in Britain, being found from northern Scotland, southwards through England and Wales to the lowland heaths of Dorset and Hampshire. It appears to be associated with a high cover of *Sphagnum* mosses. It was formerly categorised as Nationally Scarce in Britain, but it has since been found to be more widespread, and has been downgraded.

B *Dolichopus atratus* Meigen. A large species, which is one of the most characteristic long-headed flies of acid mires in Britain. The combination of darkened legs, black postocular bristles, heavily bristled hind metatarsus and extensive dark wing cloud is diagnostic. *D. atratus* is found on acid mires throughout Britain. Adults can be found on bare peat or by sweeping in June and July.

C *Dolichopus atripes* Meigen. A large, metallic species, characterised by its all black legs, pale postocular bristles and yellow-brown face. *D. atripes* is primarily found on acid mires and wet heaths in Britain, though it also occurs in other wetlands and on drier heathland. It has a wide distribution throughout Wales, Scotland and England in both lowland and upland habitats. Adults can be found on bare peat or by sweeping between June and August.

C *Dolichopus lepidus* Staeger. Like the preceding two species, this is one of the large *Dolichopus* species with predominantly blackened femora, though in this case, the front and middle tibiae are yellow. It is quite an uncommon species, with a predominantly lowland distribution at scattered sites throughout England. It also occurs in Wales and southern Scotland. Adults can be found on wet peat or by sweeping between May and July. On the continent it is thought to be an acid mire specialist, though in Britain, it also occurs in other wetland habitats.

C *Dolichopus lineatocornis* Zetterstedt **LR.** This is a large *Dolichopus*, with predominantly yellow femora, and a swollen base to the male hind tibiae. There are a handful of records of this fly, with these all being from the New Forest, Hampshire and East Anglia. In the former area, it occurs in acid bogs, whilst in the latter region, it is a fenland insect. Little is known of its ecology, but there may be an association with damp peat at water margins. Adults have been recorded in June and July.

B *Dolichopus vitripennis* Meigen. This long-headed fly is very similar to *D. atripes*, but it has a silvery-white face, and the front and middle tibiae are yellow. Along with *D. atratus*, it is one of the most characteristic and widespread dolichopodids of British acid mires and wet heaths, though it can sometimes also be found in other wetland habitats. Adults can be found on wet peat or by sweeping in June and July.

C *Hercostomus aerosus* (Fallen). A medium-sized dolichopodid, with yellow femorae, black postocular bristles and a white face. It is a very common species throughout Britain, and though it shows a marked preference for acid mire and wet heath habitats, it is also found in a range of other wetlands. Adults have a long activity period, and can be found between May and October.

A *Hercostomus angustifrons* (Staeger) **N.** This is a medium-sized species, with black femorae and post-ocular bristles, some yellow on the legs, and with the scutellum hairy above. It is a widespread, but very scarce dolichopodid on acid peatlands throughout England. It is also known from Wales. The habitat of this species seems to be bare peaty

hollows on wet heathland and raised bogs. Adults have been recorded between June and September.

A *Hydrophorus albiceps* Frey. This dolichopodid genus is unusual in having unmetallic, grey or black adults. *H. albiceps* is further distinguished by its relatively large size, the pair of dark spots on each wing, and the group of spines on the underside of the front femora near its apex. This is a northern species, which has its centre of distribution in Scotland, though it is also found locally in England as far south as the West Midlands. It favours very wet areas, such as saturated peat around bog pools, and like other members of this genus, it may be found running across the water surface during the adult flight period, between June and September.

C *Hydrophorus nebulosus* Fallen. A very distinctive long-headed fly, most easily identified by the numerous dark spots on the wings. It is more widespread than the previous species, being found locally throughout England, Scotland and Wales. Like *H. albiceps*, it favours very wet areas, where the adults can be seen planing across the surface of bog pools, though this species is also found in other wetland habitats. The adult can be found throughout much of the summer.

C *Nematoproctus distendens* (Meigen) **LR.** A medium-sized dolichopodid, of a clear metallic green colouration, distinguished from related species by the small third antennal segment, dorsal arista and sinuous discal wing vein. *N. distendens* is known from a number of boggy sites in the New Forest, but it has also been recorded from other types of wetland habitat, with adults flying during June and July. It was first recorded from the New Forest in 1962, and this area remains its stronghold. Otherwise, it has been recorded from single sites in Dorset, Berkshire, Gloucestershire and Yorkshire. The ecology of this species is very poorly known.

C *Rhaphium longicorne* Fallen. A large dolichopodid that is characterised by its extremely long third antennal segment and apical arista. *R. longicorne* is widely, but locally distributed in Britain, with scattered colonies throughout England, Scotland and Wales. The ecology of this species is poorly known, but it appears to have a preference for acid mires, though it is also found in other wetland habitats. Adults can be found between May and July.

B *Tachytrechus consobrinus* (Haliday) **N.** A medium-large species with extensively yellow femora and a glistening white face in the male. This fly is a specialist inhabitant of lowland acid mires, with records coming from Devon, Somerset, Dorset, the Isle of Wight, Hampshire and Warwickshire in southern England. It is also known from Wales and Scotland. The ecology of this species is poorly known, though adults have been found on bare peat around acid seepages in the Blackdown Hills. Adults have an extended flight season, from May through to August.

2.7.3 Tabanidae

A *Atylotus fulvus* (Meigen) **N.** The national status of this horsefly belies its extreme scarcity in Britain, where it is only recorded with any frequency in the New Forest. Elsewhere, there are a few records from Bodmin Moor, Cornwall and Dartmoor in the south-west, and it is also known from a few places in south Wales. There are old records from East Anglia, but it appears to have become extinct in this region. *A. fulvus* is almost invariably found in acid

mires, quite often near to flushes in valley mires and the larvae are thought to inhabit wet peat in such areas where they are predators on other invertebrates.

A *Atylotus plebeius* (Fallen) **RDB1.** This is one of the rarest invertebrate species associated with acid mire habitats in Britain. It is only known from a handful of sites on the Cheshire Plain, where it is primarily found in association with mosses and meres in the glacial kettle holes of the Delamere Forest, Cheshire, and also from the lowland raised bog at Fenn's, Whixall and Bettisfield Mosses, Shropshire. Adults have been found in association with *Sphagnum* bog pools, which is presumably where the larvae are found. In Europe, this species shows a very northern distribution, and the British colonies may represent a "relict" population.

A *Chrysops sepulcralis* (Fabricius) **RDB1.** This is another rare horsefly that is a stenotopic inhabitant of acid mires. Its British stronghold is on the heaths of east Dorset, though it has recently been discovered in the New Forest, Hampshire, and also from southern Scotland. Like the preceding species, *C. sepulcralis* is often seen in association with *Sphagnum* bog pools. Like other members of the genus, it is probable that the larva of this species will be found in wet peat at the edge of water.

B *Hybomitra lurida* (Fallen) **RDB3.** Another speciality of the meres and mosses of Cheshire and Shropshire, *H. lurida* is otherwise known in Britain only from the Scottish Highlands. Larvae probably occur in damp peat at the edge of bog pools, though their ecology is not currently understood.

A *Hybomitra montana* (Meigen). This is the most widespread of the horseflies associated with acid mires in Britain. It has a wide distribution in the north and west, though it is a lowland species, which is largely absent from blanket mires. It occurs throughout southern England, wherever there are areas of suitable habitat and is common on the lowland heaths of Dorset, Hampshire and the Thames Basin. It even occurs on the few isolated acid mire sites still existing in East Anglia.

B *Tabanus sudeticus* Zeller. A widespread horsefly in northern and western England, *T. sudeticus* occurs from the southern heaths of Hampshire, through south-west England, Wales and northern England to Scotland. The larvae inhabit boggy peat, usually on lowland mires.

2.7.4 Syrphidae

C *Anasimyia lunulata* (Meigen) **N.** *A. lunulata* is an extremely scarce species, with the majority of records coming from west Wales. Elsewhere, there are very scattered sites in western Britain for this species from south-west England as far north as southern Scotland. The larvae are aquatic and inhabit acid pools and swamps.

C *Chrysogaster virescens* Loew. This is another syrphid with aquatic larvae, which are primarily associated with acid pools and runnels, though they are also to be found in other wetland habitats. *C. virescens* has a wide distribution in Britain, ranging throughout England, Scotland and Wales, and occurring wherever there is suitable habitat.

A Bog Hoverfly *Eristalis cryptarum* (Fabricius) **BAP/RDB2.** This drone-fly was formerly known in Cornwall, Devon, Dorset and Hampshire. It is now only known to occur at a

handful of sites on Dartmoor, having entirely disappeared from the rest of its historic range, including its former stronghold in the New Forest. The larvae are thought to inhabit acid flushes, where cattle and pony grazing pressure maintains open, poached conditions.

C *Melanogaster aerosa* (Loew) **N.** Though widely distributed throughout England, Scotland and Wales, *M aerosa* is very localised, and shows an association with acid mire habitats, though it can be found in a range of wetland types. The larvae of this species are aquatic, being found in muddy pools and flushes. This is generally a lowland species.

B *Microdon myrmicae* Schonrogge and others. **N.** A myrmecophilous hoverfly whose bizarre, slug-like larvae devour the immature stages of their host ants. Formerly, this species was known as *M. mutabilis*, but this taxon has recently been split into two very similar species, *M mutabilis* (Linnaeus) and *M. myrmicae*. These two are very difficult to separate as adults, with the larvae being easier to distinguish. It is thought that the larvae of *M. mutabilis* are exclusively found in the nests of Formicine ants, especially *Formica lemani*, whilst *M. myrmicae* larvae occur exclusively in the nests of Myrmicines, especially *Myrmica scabrinodis*. On acid mires, the latter ant is very common, whilst *Formica fusca* and *F. lemani* are not generally found, being dry country species. It is therefore almost certain that specimens from acid mires will prove to belong to the *M. myrmicae* segregate. The *Microdon mutabilis* aggregate has a very localised distribution in southern and western Britain, with the southern heaths of Dorset, Hampshire and Surrey, Dartmoor, Exmoor, west Wales and the southern Lake District being its major strongholds.

C *Orthonevra geniculata* Meigen. This hoverfly has a wide, but very localised distribution throughout Britain. It is primarily a species of acid bogs, with strongholds in the valley mires of the New Forest and Surrey, and large colonies also occurring in the Scottish Highlands. However, it frequently occurs in other wetland habitats, with strong populations also found throughout the East Anglian fen country. The larvae are thought to be semi-aquatic in saturated peat at the edge of pools and streams. The adult has an extended flight period from the second half of April, through to the end of June.

B *Pelecocera tricincta* Meigen **RDB3.** A lowland heathland species that is known from the valley mires and wet heaths of Devon, Dorset, Hampshire, Surrey and Sussex. The larvae of this species are unknown, but the adults show a strong association with wet heath and mire, where they visit flowers of Tormentil *Potentilla erecta* and Cross-leaved Heath. Adults can be found from June through to the beginning of October.

2.7.5 Scathophagidae

B *Gonatherus planiceps* (Fallen) **RDB3.** This is a montane species, with most records coming from over 1000 metres in the Scottish Highlands. In England, it is only known from the Moor House NNR. Its ecology is largely unknown, but it is thought to be associated with acidic flushes.

C *Cordilura aemula* Collin **RDB3**. A rare dungfly, *C. aemula* is known from scattered sites in Surrey, East Anglia and at Moor House NNR, where it is associated with *Carex* swamps. Its inclusion in this list should be regarded as provisional pending further information on habitat preferences.

C *Cordilura atrata* Zetterstedt **N.** This is primarily a Scottish insect, and in England it is only currently known from the Moor House NNR. Like most of the members of this genus, it is associated with *Carex* swamps, with the larvae feeding on sedge plants. Its inclusion in this list should be regarded as provisional pending further information on habitat preferences.

A *Cordilura hyalipennis* (Ringdahl) **RDB1.** This rarity has not been seen since 1965, when it was recorded from Ellerside Moss Westmorland. It has only otherwise been recorded from a single site, at Holker Moss, near Lancaster. Larvae are thought to feed on sedges in acidic swamps, but its inclusion in this list should be regarded as provisional pending further information on habitat preferences.

C *Cordilura rufimana* Meigen **N.** A northern species, found primarily in Scotland, but also occurring in northern England as far south as Cheshire, and in north Wales. The larvae feed on sedges in *Carex* swamps. Its inclusion in this list should be regarded as provisional pending further information on habitat preferences.

2.8 Coleoptera

General works consulted during the preparation of the list below were the atlases of ground beetles (Luff 1998), click beetles (Mendel & Clarke 1996), and soldier beetles and their allies (Alexander 2003) produced by the Biological Recording Scheme, the two-volume national review of rare and threatened Coleoptera produced by the JNCC (Hyman & Parsons 1992 & 1994) and the Coleoptera volumes produced in the DEFRA/BugLife UKBAP 'Managing Priority Habitats for invertebrates' series (Hammond 2003, Morris 2003, Telfer 2003 & Wright 2003). For ground beetles and rove beetles, the work of Lott (2003a) has proved invaluable, and for the former family, the author has also consulted the excellent work of Anderson, McFerran & Cameron, which contains much useful ecological information, though it only deals with the Irish Carabid fauna. For water beetles, Balfour-Browne (1940, 1950, 1958 & 1962) contains much useful information, as does Foster (in press). The distributional and ecological notes in Friday (1988) have also been referred to. Status categories of water beetles (Gyrinidae, Dytiscidae and Hydrophilidae) are included in parentheses, as the review of water beetles is still currently unpublished (Foster, in press), and they must therefore be considered to be provisional. Lastly, for the weevils (Apionidae and Curculionidae), the works of Morris (1990 and 2002) have also been referred to.

2.8.1 Carabidae

B *Carabus nitens* Linnaeus **Nb.** A large, metallic green and pink ground beetle that is found quite widely on the moors of northern England, being especially frequent along the Pennines, and on the North York Moors. There is also a well-established population on the lowland heaths of Dorset and Hampshire. Elsewhere, it occurs at scattered sites in Scotland and on the Isle of Man, but is unknown in Wales. It is primarily an inhabitant of wet heaths and bogs, though it is occasionally found in other wetland and heathland habitats such as dune slacks. In Ireland it appears to be confined to wet heathland and blanket mire on deep peats.

B *Elaphrus lapponicus* Gyllenhal **Na.** A very rare, northern ground beetle, for which there is only an old English record from the Lake District. All other records of *E. lapponicus* come from the Scottish Highlands. Its ecology is very poorly known, but it generally seems to occur at the boggy margins of montane flushes.

C *Elaphrus uliginosus* Fabricius **Nb.** This is also a species of acidic flushes, though it occurs in other wetland habitats. It is primarily a south-western species in Britain, with the majority of sites being in south-west England and Wales, though there are also colonies on the lowland heaths of Hampshire, and a few scattered records from western Scotland.

B *Trechus rivularis* (Gyllenhal) **RDB3.** *T. rivularis* is primarily an inhabitant of upland blanket bogs in Britain, occurring in such situations in Northumberland, north Wales and Scotland. However, there are also a handful of "relict" populations in lowland fens in Yorkshire and East Anglia.

A *Bembidion humerale* Sturm **RDB1/BAP.** This small ground beetle is currently only known from the Humberhead Levels, comprising Thorne, Hatfield and Crowle Moors in south Yorkshire and north Lincolnshire, where it has been quite recently discovered (Crossley & Norris 1975). This is an area of lowland raised bog that has been extensively worked for peat. *B. humerale* seems to favour areas of recently cut-over bog, where there are large expanses of bare peat. Sub-fossil remains of this species have been found in peat deposits of Neolithic age on the Somerset Levels (Duff 1993), indicating that it may have had a somewhat wider British distribution after the last Ice Age. This is a priority species in the UK BAP, and a Species Statement has been prepared for it recommending that monitoring of the beetle be undertaken (UK Biodiversity Group 1999b). It has also been the subject of English Nature-funded research that aims to elucidate its ecology, distribution and conservation requirements (Eversham 1996).

A Edmond's Ground Beetle *Tachys edmondsi* Moore **RDB1/BAP/RDB5.** *T. edmondsi* is a tiny ground beetle that is only known from a few valley mires in the New Forest, Hampshire. It occurs in hummocks of *Sphagnum* growing on damp ground around the periphery of valley mires. Sites occupied tend to be sheltered by trees and scrub, but are nonetheless exposed to full sun for much of the day, suggesting that it is extremely warmth demanding. There is a full Action Plan for this species in the UK BAP (UK Biodiversity Steering Group 1995). This species has been the subject of English Nature-funded research that aims to meet the targets set out for this species in the UK BAP (Pinchen & Williams 1997, 1998, 1999 & 2000 and Pinchen 2002 & 2003). Though it is listed as an endemic species, Hammond (2000) believes that this species is synonymous with other taxa described from France, Spain and North Africa.

A *Elaphropus walkerianus* (Sharp) **RDB1.** Another very rare inhabitant of *Sphagnum*-dominated mires in southern England. This tiny ground beetle has its stronghold in the New Forest, Hampshire and there is also a single site for it in a Surrey valley bog. This species is invariably found amongst wet *Sphagnum*, and in the New Forest it seems to occur in wetter areas than the preceding. There are sub-fossil records of *E. walkerianus* from the Somerset Levels (Duff 1993), suggesting that it was once a more widespread species in Britain.

B *Pterostichus aterrimus* (Herbst) **RDB1/BAP.** *P. aterrimus* has always been a great rarity in Britain, with the last known site being a valley mire in the New Forest, where the species has now become extinct. There are very old records of this species from the East Anglian fens, though it has long since become extinct there. It has recently been found to occur at a number of sites in Ireland, where it generally occurs in eutrophic and mesotrophic fens (Anderson 2000). There are sub-fossil records of *P. aterrimus* from the Somerset Levels (Duff 1993), suggesting that it was once a more widespread species in Britain. There is a full Action Plan for this species in the UK BAP (UK Biodiversity Group 1999a).

C *Pterostichus diligens* (Sturm). Though it is found in a wide range of wetland habitats throughout Britain, *P. diligens* shows a marked preference for acid mire habitats and clearly warrants inclusion in this report. Within mire systems, it occurs commonly in a wide range of habitats, but it is particularly abundant amongst wet litter of *Molinia*, *Juncus* etc. It is listed by Lott (2003a) as a species of wet heath and mire habitats.

B *Pterostichus rhaeticus* Heer. The distribution of this ground beetle in Britain is still poorly known, as it has only been separated from the closely similar *P. nigrita* (Paykull) recently. However, data collected thus far indicate that this species has a strong affinity for acid mire habitats throughout upland areas of northern and western Britain.

A *Agonum ericeti* (Panzer) **Nb.** This handsome, metallic pink ground beetle has a scattered distribution throughout northern and western Britain, where it shows a strong preference for ombrogenous mires in both lowland and upland situations. Most of its English sites are either on the upland blanket mires of the Pennines, Lake District and North York Moors, or the lowland raised bogs of Cumbria. However, it also occurs as a "relict" in some valley mires in the New Forest, and there are sub-fossil records from the Somerset Levels (Duff 1993), indicating that it may once have had a much wider distribution in the English lowlands. *A. ericeti* also occurs on raised and blanket mires across much of Wales and Scotland. It seems to favour mires with both *Sphagnum* hummocks and areas of warm, bare peat for it to hunt on in the day. Such conditions are best met in undamaged lowland raised bogs with well-developed hummock-hollow microtopography, and on watershed blanket mires with peat haggs.

C *Agonum gracile* Sturm. A widespread ground beetle, found in a range of wetland habitats throughout Britain, but that nonetheless occurs most frequently in acid mires. This is an extremely hygrophilous beetle, which is usually found in very wet mires amongst *Sphagnum* moss.

B *Agonum sexpunctatum* (Linnaeus) **Na.** This is a brightly coloured, diurnal ground beetle, with a scattered distribution in lowland England as far north as Yorkshire, though there are also a number of old records from Cumbria. Its headquarters are on the lowland heaths of Surrey and the New Forest, Hampshire. *A. sexpunctatum* is a lowland species, which favours wet heath, where it can be found running over bare peaty ground.

C *Acupalpus flavicollis* (Sturm) **Na.** A ground beetle with a very scattered distribution in southern England. It has strong populations in the valley bogs of the New Forest, and also occurs in Surrey in this habitat. Elsewhere, most of its sites are in riparian situations, where there is a sandy substrate. It is not known to occur in Wales, Scotland or Ireland.

B *Cymindis vaporariorum* (Linnaeus) **Nb.** *C. vaporariorum* has an exclusively northern distribution in Britain, and in England is restricted to northern upland areas such as the North York Moors and the Border Mires of Cumbria and Northumberland. It has a wide but scattered distribution in Scotland, and there is additionally a single record from Wales. Sub-fossil records from the Somerset Levels indicate that it would once have had a much wider British range (Duff 1993). This is primarily a species of *Sphagnum* bogs, though it is also sometimes found in drier upland habitats.

2.8.2 Gyrinidae

B *Gyrinus minutus* Fabricius **[LRnsB].** This is the only English whirligig beetle showing a strong affinity for acid mire habitats. It is a north-western species that is relatively widespread in Scotland, northern England and Wales, but is very rare in southern England, where it is currently only known from Dorset. *G. minutus* is usually found in peaty pools with sparse emergent vegetation.

2.8.3 Dytiscidae

B *Hydroporus gyllenhalii* Schiodte. This small reddish-brown water beetle is primarily an inhabitant of shallow, peaty pools in acid mires, where it is often found amongst *Sphagnum*, though it is also sometimes met with in other wetlands. *H. gyllenhalii* has a very wide distribution throughout the British Isles, wherever suitable habitat exists.

B *Hydroporus longicornis* Sharp **[LRnsB]**. Unlike the other acid water Hydropori, *H. longicornis* is generally a species of running water, occurring in small flushes and trickles amongst *Sphagnum* and litter. This is primarily an upland species of acid mires in northern and western Britain, but it does also occur in scattered sites in southern England, where scattered "relict" populations occur, often in shaded situations.

C *Hydroporus melanarius* Sturm. Another *Hydroporus* of bog pools, often found in sparsely vegetated peaty pools that dry up over the summer months. It is distributed throughout Britain, with most records being from northern England, Scotland and Wales. There are also records from East Anglia, where it occurs in peaty fenland habitats.

B *Hydroporus morio* Aube. A northern, upland species, usually found in bog pools. It is widespread in Scotland and northern England, and also occurs in north Wales. There are a few records from southern England, but it is very scarce. This dytiscid may replace *H. gyllenhalii* in bogs at high altitudes in northern Britain.

A *Hydroporus necopinatus* Fery **[EN] BAP.** Until recently, this species was known as *H. cantabricus* Sharp. This is an "Atlantic" element in the British fauna, which has a very restricted range along the western seaboard of Europe. In Britain, it is confined to lowland heaths in Dorset, where it occurs in shallow sparsely vegetated, peaty pools and vehicle ruts that dry up over the summer months. Because of its rarity in Britain, and its limited world range, this species has been included as a priority species in the UK BAP (UK Biodiversity Group 1999a)

B *Hydroporus obscurus* Sturm. A small and distinctive orange-brown *Hydroporus* that is most often met with in acid mires, where it is usually found amongst dense *Sphagnum* in bog pools and basin mires. However, it does also occur more locally in East Anglia in other fenland habitats. *H. obscurus* has a wide distribution through much of England, Scotland and Wales, though it is especially frequent in the uplands of the north and west.

C *Hydroporus tristis* (Paykull). Another member of the suite of *Hydroporus* species that are collectively characteristic of bog pools in acid mires. As with most of the other species of the genus, *H. tristis* is most frequent in the upland landscapes of northern and western Britain, but it is also found in southern and eastern England more locally, where it may occur in other wetland habitat types.

B *Agabus affinis* (Paykull). This is a widespread specialist of acid mires, being found throughout Scotland, Wales and England, wherever suitable habitat occurs. It is most often found in shallow pools in bogs, where it occurs amongst *Sphagnum* moss.

C *Agabus arcticus* (Paykull). As its name suggests, *A. arcticus* is a northern, upland species, which is not found in Britain south of north Wales. In Scotland, it is quite widespread, and in England it is entirely restricted to upland areas in the northern half of the country. It inhabits *Sphagnum* bog pools, and other water bodies in upland districts.

B *Agabus congener* (Thunberg). Like the above species, this is a northern dytiscid in Britain, and the two may be found together in *Sphagnum* moss in pools in acid mire systems. Its main British populations are in Scotland, northern England and north Wales. However, this water beetle does not appear to be so strictly confined to the uplands as the last, and there are even a handful of records from southern England, though whether these represent established colonies is uncertain.

B *Agabus montanus* (Stephens). For many years this species has been known to British coleopterists as *A. melanocornis* Zimmermann. It is the commonest *Agabus* of acid mire habitats, being found throughout Scotland, Wales and England. It is usually found in shallow bog pools with dense *Sphagnum*.

A *Ilybius aenescens* Thomson CG **[LRnsB].** Although *I. aenescens* has a wide distribution throughout Britain, it is nonetheless an extremely local insect, found at widely scattered sites. Both larvae and adults of this beetle are found amongst *Sphagnum* in bog pools.

A *Rhantus suturellus* (Harris). Formerly known as *R. bistriatus* (Bergstraesser). Another acid water specialist, which is found most frequently in Britain in *Sphagnum* pools. *R. bistriatus* has a wide distribution in Britain, being especially frequent in Scotland, northern England and Wales, with scattered colonies elsewhere in England where there is suitable habitat.

B *Acilius canaliculatus* (Nicolai) **[LRnsB].** This species is usually found in peaty pools in acid mire systems, quite often being found in old, flooded peat cuttings. It is primarily a northern insect, which is most often found in Scotland and northern England. However, there are also records of "relict" populations in Sussex and Kent, where it occurs in shaded habitats.

2.8.4 Hydrophilidae

C *Helophorus flavipes* Fabricius. A very common water beetle found in shallow, acid water in a range of habitats, though with sufficient records coming from acid mire systems to justify inclusion in this review. *H. flavipes* is found throughout the British Isles.

C *Helophorus tuberculatus* Gyllenhal **[LRnt].** This enigmatic water beetle is found in scattered sites in England and Scotland. It has primarily been found on wet moorland and mires, though there are records for a range of other habitats. This beetle appears to be associated with recently burnt areas.

B *Paracymus scutellaris* (Rosenhauer) **[LRnsB].** A small, black water beetle with a slight metallic reflection. It is a northern and western species, which is found in small flushes and seepages that are usually moderately base-rich, though still falling within the remit of this report. *P. scutellaris* occurs primarily in Scotland, Wales and south-west England, though there are also a few colonies elsewhere in southern England.

C *Anacaena lutescens* (Stephens). *A. lutescens* occurs in a wide range of acid water habitats throughout Britain. It is sufficiently widespread in small, still and flowing water bodies within acid mire systems to justify inclusion within this report, though it also occurs in a range of other wetland habitats.

A *Laccobius atratus* (Rottenburg) **[LRnsB].** This is another water beetle of acid flushes and seepages, where it is usually found amongst *Sphagnum*. It is widely distributed in western Britain, as far north as southern Scotland, and it also occurs on the lowland heaths of southern England, wherever its habitat occurs.

A *Helochares punctatus* Sharp [**LRnsB].** Another of the characteristic water beetles of acid bog pools, where it is frequently found amongst *Sphagnum*. This is a lowland species, which is most common in southern England and Wales, though it does also occur in southern Scotland.

A *Enochrus affinis* (Thunberg) **[LRnsB].** Another obligate acid mire inhabitant, *E. affinis* is found in *Sphagnum* in bog pools. It occurs on the lowland heaths of southern England, and through much of Wales, northern England and Scotland. In Britain it is primarily a lowland species.

B *Enochrus fuscipennis* (Thomson CG). This water beetle has only been separated from *E. quadripunctatus* (Herbst) quite recently, and it is still too early to definitively state its British distribution and ecology. However, it does appear to be an acid water species, with many of its British records deriving from acid mire systems.

2.8.5 Staphylinidae

C *Olophrum fuscum* (Gravenhorst). This rove beetle occurs in wet litter in a range of wetland habitats, but it is found in acid mires with sufficient frequency to justify inclusion in this list. *O. fuscum* has a wide distribution in Britain, though it appears to be most frequent in the north and west. It is usually found in moss and litter, and is also frequently collected in pitfall traps.

C *Eusphalerum minutum* (Fabricius). This species is a local inhabitant of wetlands throughout Britain, where it is usually found on flowers of a wide range of wetland plants. Its degree of association with acid mires is unclear, but it has been listed by Lott (2003a) as a species of "mires", and has provisionally been included in this list.

C *Hadrognathus longipalpus* (Mulsant & Rey). **Nb?** *H. longipalpus* was only discovered in this country in 1987 (Lott 1989), and has not yet been assigned a national status. Though Lott's initial record was from scrubby grassland in a quarry in Cumbria, there have since been a number of records from Wales, most of which are from acid mire habitats (Holmes and others 1990, Whitehead 1991).

C *Bibloplectus ambiguus* (Reichenbach). The habitat affinities of the tiny beetles of this genus of pselaphine rove beetles are still far from clear. However, current evidence suggests that this species does show a preference for acid mire habitats. There are scattered records of this species throughout England and Wales, though it appears to be scarce in Scotland. It occurs in a wide range of wetland habitats, where it is found in moss and litter.

B *Bibloplectus tenebrosus* (Reitter) **RDBK.** This rarity is known from scattered sites in England and Wales, with recent English records from Woodwalton Fen and Holme Fen, Huntingdonshire and Hickling Broad, Norfolk and Askham Bog, Yorkshire (DA Lott pers. comm.). At Woodwalton Fen, the beetle has been found in sedge litter, and at Askham Bog it has been found in grass tussocks. However, at Holme Fen, a thriving population has been found in *Sphagnum squarrosum* and *Sphagnum fimbriatum* in the small oligotrophic nucleus that survives at this fenland reserve (Welch 1983). The two recent Welsh records are both from acid mire habitats.

C *Bibloplectus spinosus* Raffray **N.** Both Hammond (2003) and Lott (2003a) suggest a relationship between this species and acid mire habitats. However, the majority of Welsh records are from other wetland habitats, especially very wet swamp communities, though it has also been recorded from acid mires in the latter country. It has provisionally been included in this study, pending further ecological studies. This is predominantly a species of lowland situations, which is found through much of England and Wales, but is absent from Scotland. It is often found in thick cushions of wet moss, including various *Sphagnum* spp.

C *Pselaphaulax dresdensis* (Herbst) **N.** This small beetle is a lowland species, with a very scattered distribution in England, Wales and southern Scotland. Its status as a species of acid mires is doubtful, with many records coming from more calcicolous and/or mesotrophic swamp and mire communities, where it is often found amongst "brown mosses" such as *Calliergon* spp. This is certainly the case in Wales, where it is almost exclusively found in such situations. However, Lott (2003a) lists it as being associated with "bogs", whilst Hammond (2003) includes it as a specialist inhabitant of lowland raised bogs, though in both cases, the definition of bog habitat is a much broader one than that adopted for this report, and its status as an acid mire associate must be regarded as provisional pending further investigation.

B *Pselaphus heisei* Herbst. This is quite a common pselaphine rove beetle, which is found in a variety of wetland habitats, though showing a particular affinity for acid mires. At many sites, it is found in thick, wet litter in Purple Moor-grass bogs, though it can also be found in *Sphagnum* mosses. *P. heisei* has a wide distribution throughout England, Scotland and Wales, wherever there are areas of suitable habitat.

B *Tachyporus transversalis* Gravenhorst. Though not accorded any national status, this is a very local rove beetle, with a scatter of records from wetland habitats across lowland Britain. It appears to show a strong preference for acid mire habitats, and is listed by Lott (2003a) as a species of "bogs". It has been found amongst wet moss and litter on wet heathland. In Wales, it shows a strong association with wet heaths and ombrogenous mires.

A *Gymnusa brevicollis* (Paykull). This aleocharine rove beetle is a stenotopic inhabitant of saturated *Sphagnum* moss in extremely wet acid mires, often occurring at the edge of bog pools. It is widely, but locally distributed throughout much of Britain.

B *Gymnusa variegata* Kiesenwetter **N.** A much scarcer species than the above, *G. variegata* occurs from the Midlands northwards in England, and is widespread, but very local in Scotland and Wales. It occupies broadly similar habitats to *G. brevicollis*, but is also sometimes found in other wetland types, such as fens.

A *Myllaena kraatzi* Sharp **N.** This is a stenotopic inhabitant of acid mires, with beetles generally being taken by shaking out *Sphagnum* moss and litter. It is comparatively frequent in the valley mires of southern England, but has a very scattered distribution elsewhere, though it occurs widely in northern England, Wales and Scotland.

B *Oxypoda procerula* Mannerheim. Predominantly a northern and western species, *O. procerula* shows a strong affinity for acid mire habitats in both lowland and upland situations. It is most often taken by shaking out *Sphagnum* moss and litter. It is closely similar to *O. elongatula*, from which it has only been separated quite recently. The latter seems to replace it in more mesotrophic and/or calcicolous habitats in the lowlands.

C *Ilyobates nigricollis* (Paykull) **RDBK.** This is a very scarce rove beetle in Britain, with English records being confined to two sites in Somerset and Yorkshire. Its stronghold appears to be in Wales, where there are a number of recent records, most of which come from specimens collected in pitfall traps set on acid mire habitats. It appears to particularly favour wet heath habitats, though it is also found in other habitats, such as damp woodlands.

C *Schistoglossa aubei* (Brisout). **RDBK.** Though there are both recent and old English records from the East Anglian fens, there is a recent record from a lowland raised mire in south Scotland, and there are also old English records from Newton Reigny Bog, Cumbria. In fenland sites, specimens have been collected from tussocks, and on mires, by sieving *Sphagnum* moss (Sinclair & Owen 1998). *S. aubei* is listed by Hammond (2003) as a species associated with both blanket and lowland raised bogs.

C *Schistoglossa curtipennis* (Sharp). A small and obscure rove beetle of wetland habitats, which appears to show a preference for acid mire habitats, though the very limited knowledge of its ecology makes this statement provisional pending more detailed investigation of its ecology. Lott (2003a) lists this as a species of "mire" habitats, associated with vegetation tussocks.

B *Philhygra arctica* (Thomson CG). *P. arctica* is a strictly upland species, which is restricted in Britain to north Wales, northern England and Scotland. Both Lott (2003a) and continental authors note an association with *Sphagnum* bogs. Hammond (2003) lists *P. arctica* as a species of blanket mires, though noting that it also occurs on upland heaths.

B *Atheta strandiella* Brundin **N.** This is primarily a northern and western species in Britain, with most records from Scotland, Wales and northern England. Its ecology is very poorly known, so its inclusion as an acid mire associate must be regarded as provisional pending further studies. However, Owen (1989a) notes that it is frequently associated with *Sphagnum* on the continent, where it is often found in carrion and dung. Interestingly, he also notes the occurrence of the species in fen litter in Norfolk.

C *Stenus lustrator* Erichson. As with most of the *Stenus* included on this list, *S. lustrator* occurs in a range of wetland habitats. However, a relatively high proportion of its British

sites are acid mires, and it is provisionally included in this list, pending further investigations of its ecology. It occurs sparsely through much of England, Scotland and Wales.

C *Stenus fuscipes* Gravenhorst. Local, but widely distributed in Britain. The ecology of this species is poorly known, and its degree of affinity to mire habitats is questionable. However, Lott (2003a) lists it as a "mire" species that is found in litter, and a high percentage of its Welsh records emanate from acid mire habitats.

C *Stenus melanarius* (Marsham). A widespread, but very local species in Britain. It is found in a range of wetland habitats, including fens, but it is thought to be especially associated with acid mires. Lott (2003a) lists it as a "fen and bog" species and Hammond (2003) notes it as an associate on "lowland raised bogs" (by which he means any lowland acid mire habitat). It is readily found on mire sites by sieving *Sphagnum* moss.

C *Stenus subdepressus* Mulsant & Rey **RDBI.** This species has only been recorded from damp places on heathland in Dorset, Hampshire, Surrey and Berkshire. There have been no records of this beetle since 1961, when it was recorded from Esher Common in Surrey, and it is feared that it may have become extinct in Britain.

C *Stenus opticus* Gravenhorst **Na.** *S. opticus* is a rove beetle of permanently saturated wetlands. In East Anglia, it is known from fenland sites, but in other parts of England, and particularly in Wales, it is primarily an insect of very wet acid mires, where it is most often found by pitfalling in *Sphagnum*-dominated habitats.

A *Stenus kiesenwetteri* Rosenhauer **RDB2.** A stenotopic inhabitant of lowland bogs on southern heathland, the stronghold of *Stenus kiesenwetteri* is in the valley mires of the New Forest, where it can be collected quite readily by sieving *Molinia* litter in areas of very wet bog. Elsewhere, there are also records of this species from Devon, Dorset, Sussex, Surrey and Berkshire.

B *Stenus oscillator* Rye **Nb.** This is primarily an insect of wet flushes in upland regions of northern and western Britain, though there are records from other wetland habitats in southern and eastern England. It is most often found by sweeping rushes or by sieving *Sphagnum* growing around acid flushes.

B *Stenus brevipennis* Thomson CG. This is predominantly an upland species of northern and western Britain, which shows a strong affinity for mire habitats, being especially associated with blanket mires. It occurs quite widely, but very locally in south-west England, Wales, northern England and Scotland. Hammond (2003) includes it in his list of blanket mire associates, though he notes that it is also found on upland heaths.

C *Stenus niveus* Fauvel **Nb.** Though it is found in a wide range of wetlands, *S. niveus* occurs with sufficient frequency in acid mire habitats to be included in this report. It has a very wide, but localised distribution in Britain, which encompasses most of England, Scotland and Wales. It has been collected in pitfall traps and by hand-searching tussocks and moss. Hammond (2003) lists this as a species that is characteristic of "lowland raised bogs" (by which he means the whole range of lowland acid mire habitats).

C *Euaesthetus laeviusculus* Mannerheim. All three species of this genus occur quite frequently in acid mires, but are also found very frequently in other wetland types. This

species seems to have the strongest affinity to acid mires, though Welsh studies suggest it is at least as frequent in other fen and marsh habitats. It appears to be widely distributed across Britain, but is generally the scarcest species in the genus. It is listed by Lott (2003a) as a species associated with "mires".

B *Paederus caligatus* Erichson **RDB3.** This handsome rove beetle has its headquarters in the New Forest, where it seems to especially favour well-grazed acid mires with some poaching. It is primarily an insect of valley bogs associated with the lowland heaths of southern England, with other records being from Dorset, Surrey and the fringes of Dartmoor, Devon. It is also known from the Somerset peat moors, where it occurs in fen habitats (Duff 1993), and there is a single record from Wales.

B *Lathrobium terminatum* Gravenhorst. *L. terminatum* has a wide distribution in Britain, and in England is found throughout the country. It is found in a range of wetland habitats, but is a characteristic component of the fauna of *Sphagnum*-dominated bogs, in which habitat it is one of the most frequently encountered beetles.

C *Lathrobium zetterstedti* Rye **Nb.** This is exclusively an upland species, which is known from high ground in Wales, northern England and Scotland. The habitat requirements of this beetle are very poorly understood, but there may be an association with blanket mires. Lott (2003a) describes its habitat as "wet moorland."

C *Lathrobium rufipenne* Gyllenhal **RDB2.** This very rare rove beetle occurs in a handful of sites in the Cheshire meres and mosses, and in the Norfolk Broads. In the latter area, it occurs in wet sedge litter in fens, but in the former, it is found in very wet *Sphagnum* bogs, where it is most often found by treading down the vegetation into the water, causing the beetles to float to the surface (Lott 2003b).

B *Ochthephilum fracticorne* (Paykull). Like its relative *Lathrobium terminatum*, this beetle is a characteristic component of the fauna of *Sphagnum* bogs, where it is frequently to be found by shaking out moss cushions. It is similarly widespread, being found across the range of acid mire types in both upland and lowland situations throughout Britain. It is also found in other wetland habitats, but is most frequent in acid mires.

C *Erichsonius cinerascens* (Gravenhorst). This is another frequent species in *Sphagnum* bogs, though it is also found in moss and litter in other wetland habitats. It can be sampled readily by sifting *Sphagnum* moss. It appears to be largely a lowland species, but is nonetheless distributed widely across Britain.

A *Erichsonius ytenensis* (Sharp) **RDBI.** A great rarity, which has not been seen in Britain since 1933, when it was last recorded from the New Forest. Otherwise, there are old records from Surrey, Sussex and Berkshire. It is thought to be exclusively associated with acid mires, with the beetles being found in *Sphagnum* hummocks. Listed by Hammond (2003) as a "lowland heath" species.

B *Philonthus nigrita* (Gravenhorst). With *L. terminatum* and *O. fracticorne*, this species forms the third of a group of rove beetles that are collectively characteristic of *Sphagnum*-dominated acid mires, where it can frequently be found by sieving or treading the moss cushions. It is a very widely distributed species in Britain, which is found in both lowland

and upland situations, wherever suitable habitat occurs. It can also be found in wet fenland, but is most frequently encountered in acid mires.

C *Gabrius trossulus* (Nordmann). The habitat requirements of *G. trossulus* are very poorly known currently, but it is listed by Lott (2003a) as a mire species, though it also occurs in a range of other wetland habitats. It has provisionally been included as an acid mire associate pending the collection of further information on its distribution and ecology.

B *Quedius boopoides* Munster. This is a quite widespread species in northern and western Britain, ranging from Dartmoor through Wales, northern England and Scotland. It is most often found on upland blanket bogs, but is sometimes found at lower altitudes in other bogs types. Occasionally it is also found in drier upland heath and grassland habitats, but overall it shows a high degree of fidelity to acid mires.

C *Quedius fulvicollis* (Stephens) **Nb.** Essentially *Q. fulvicollis* is a Scottish insect, but there are also some colonies in northern England, these being chiefly around the fringes of the Pennines. It has also been recorded in Cheshire, and in the northern half of Wales. This beetle has been found in rush-dominated poor fen. It has also occurred in wet leaf litter on the fringes of scrub woodland (Smith & Whitehead 1991).

A *Acylophorus glaberrimus* (Herbst) **RDB1.** This rarity was formerly known from three sites in Surrey, but is now only known from the New Forest. In the latter area, it seems to favour very wet areas of valley mire where there is an abundance of bare, poached peat created by stock trampling. It is frequently found here in association with another rare rove beetle, *Paederus caligatus*.

2.8.6 Scirtidae

C *Cyphon hilaris* Nyholm. This is the commonest scirtid in acid mire habitats in the uplands of northern and western Britain. It seems to particularly favour bog pools with *Sphagnum*, where it is often very common, though it can be found across the range of stagnant and flowing acid mire habitats. Nyholm (1972) states that this is a species of acid bogs, but in Britain, it appears more eurytopic, occurring in a range of wetland habitats (Skidmore 1985), though still being most abundant in acid mires.

A *Cyphon kongsbergensis* Munster **Na**. This species was first recorded in Britain from Scotland in 1981 (Skidmore 1985). It has subsequently been recorded from this country on further occasions (Owen 1989b), and also in Wales, where the WPIS found it at a number of sites. All its known sites are acid mires, with a high proportion of records being from bog pools in raised and blanket mires. It has also been found in association with acid, rushy flushes at some sites. It has not yet been recorded from England, but assiduous searching of ombrogenous mires in northern England is sure to result in its discovery, and for that reason it is included in this review. On the continent, this is a northern species, which, as in Britain, is progressively replaced by *C. hilaris* towards the south (Nyholm 1972).

C *Cyphon padi* (Linnaeus). Though this is a common beetle in a range of wetland habitats, it shows a preference for acid mires, where it is often found with *C. hilaris*, this also being the case on the continent (Nyholm 1972). It is widely distributed throughout Britain, where it is perhaps more characteristic of topogenous mires, such as valley bogs.

A *Cyphon punctipennis* Sharp **Na**. A very scarce beetle, which is restricted to the uplands of Wales, northern England and Scotland. This species shows a similar preference for ombrogenous mires to the last, but it seems to be exclusively an upland insect, which is usually found around bog pools on blanket mires. It has also been found near flushes in the uplands of Wales (Holmes and others 1991c).

2.8.7 Byrrhidae

A Mire Pill Beetle *Curimopsis nigrita* (Palm) **RDB1/BAP.** This tiny beetle is only known from the Crowle, Thorne and Hatfield Moors in south Yorkshire and north Lincolnshire. It was first discovered here in 1977 (Johnson 1978). It makes burrows in peat, from which it emerges to feed on small, acrocarpous mosses. There is a full Action Plan for this species in the UK BAP (UK Biodiversity Group 1999a). Because of its status as a BAP priority species, *C. nigrita* has been the subject of an English Nature-funded research project that aims to elucidate its ecology, distribution and conservation requirements (Eversham 1996).

2.8.8 Elateridae

C *Actenicerus sjaelandicus* (Muller OF). A widespread click beetle, found throughout England, Scotland and Wales. It is found in a range of wetland habitats, but shows a distinct preference for acid mires.

2.8.9 Cantharidae

C *Cantharis figurata* Mannerheim. This is a characteristic soldier beetle of rush pastures in northern and western Britain. Most records are from Scotland, northern England and Wales, though it has also been recorded on the fringes of Dartmoor. It also occurs in other wetland habitats, such as swamps and wet woodland.

B *Cantharis paludosa* Fallen. A moderately common soldier beetle in a range of acidic peatland habitats. It is found in both lowland and upland sites, and occurs through Scotland, northern England and Wales, with isolated colonies on Dartmoor and Exmoor in south-west England.

2.8.10 Chrysomelidae

C *Plateumaris discolor* (Panzer). Though it is found in a range of wetland habitats, *P. discolor* is particularly associated with acid mires, where it is most frequently found around bog pools with abundant Common Cottongrass *Eriophorum angustifolium*, the main foodplant of this species. It has a wide distribution in Britain, being especially common in the north and west, where it is found in both upland and lowland habitats (Menzies & Cox 1996).

C *Donacia obscura* Gyllenhal **Na.** Though it has a primarily northern distribution, *D. obscura* is also found at a few sites in southern England. This is a beetle of boggy swamps at the edge of standing water, with the primary foodplant being Bottle Sedge *Carex rostrata*, though it is also found on range of other Cyperaceae (Menzies & Cox 1996).

A *Cryptocephalus biguttatus* (Scopoli) **RDB2.** This is a very scarce species, found in areas of wet heath and bog in association with the larval foodplant, Cross-leaved Heath *Erica tetralix*. It has been recorded recently only in Dorset, Sussex, Surrey and Yorkshire, and

there are old records for Devon, Hampshire, Kent Staffordshire and Lancashire. It is not known from Wales or Scotland.

B *Cryptocephalus decemmaculatus* (Linnaeus) **RDB2/BAP.** This species has only been recorded recently in England from Wybunbury Moss, Cheshire, where it occurs on small birch saplings growing on quaking bogs. It is also known from one recent site in the Scottish Highlands. This is a priority species in the UK BAP, and a Species Statement has been prepared for it recommending that monitoring of the beetle be undertaken (UK Biodiversity Group 1999b).

A *Longitarsus nigerrimus* (Gyllenhal) **RDB1.** A tiny black flea beetle that is only currently known from South Hampshire (vc11), where it occurs in a number of bog pools in the New Forest, and at a single site near Hurn. Formerly, it was also known from bog pools on lowland heathland in Dorset, but it has not been re-found here despite recent searches. Older records from other areas of Britain are thought to refer to *L. plantagomaritimus* Dollman. *L. nigerrimus* feeds on emergent growth of Lesser Bladderwort *Utricularia minor*. This species has been the subject of a recent study by Booth (2000).

C *Chaetocnema confusa* (Boheman). A greeny-bronze flea beetle, with a wide but localised distribution across Britain. The ecology of *C. confusa* is still very poorly known, though it has been postulated that rushes may be the larval foodplants. In Wales, where this species is quite widespread, there is a strong association with acid mires, though it also occurs in other wetland habitats.

C *Chaetocnema subcoerulea* (Kutschera) **Nb.** A dark blue metallic flea beetle, which is thought to feed on various species of rushes. *C. subcoerulea* is a southern insect in Britain, having its stronghold on the lowland heaths of Devon, Dorset, Hampshire, Surrey and Sussex, where it is quite common in valley mires. It also occurs more locally further north as far as north-east England, and is additionally known from south Wales.

2.8.11 Apionidae

C *Apion genistae* Kirby **Na.** A very distinctive weevil of this large genus, which is chiefly characterised by the bands of whitish hairs that completely cover the third and fifth elytral intervals. In Britain, it appears to be exclusively associated with Petty Whin *Genista anglica*, and is found in widely scattered localities in the eastern half of Britain, from the lowland heaths of Dorset and Hampshire in the south, northwards as far as Moray in central Scotland. Larvae of *A. genistae* feed in the ripening pods of the hostplant. This weevil is an Atlantic species, with a very restricted range along the western seaboard of Europe.

2.8.12 Curculionidae

A *Bagous frit* (Herbst) **RDB3.** An aquatic weevil, which is one of a group of similar species. In England, the only sites for this rarity are in Dorset, Hampshire and Norfolk, where it has been found by sieving aquatic *Sphagnum* mosses. More recently pitfall sampling has revealed this species to be widespread, but very local in Wales. Continental studies have demonstrated that Bogbean *Menyanthes trifoliata* is the hostplant of this species. *B. frit* is found in northen and central Europe, but like other species of the genus, it is extremely scarce throughout its range.

A *Rhynchaenus iota* (Fabricius) **Nb.** A jumping weevil that has a very southern distribution in Britain, being largely confined to lowland heaths in southern England. Strongholds for this species are in the valley bogs of the New Forest, but it occurs elsewhere in scattered localities across southern and eastern England. The larva of this species is a leaf miner, which in Britain occurs exclusively on Bog-myrtle.

2.9 Aculeate Hymenoptera

The non-parasitic bees, wasps and ants are chiefly associated with dry habitats, with comparatively few wetland species, and only two showing a strong affinity for acid mires. The main source used to gather information on these has been Falk (1991a).

2.9.1 Formicidae

A Black Bog Ant *Formica candida* Smith **RDB1/BAP.** This is an extremely scarce species in Britain, which has its stronghold in the lowland valley mires of the New Forest and Dorset. Otherwise, the only British colonies are two isolated populations in south Wales. Nests are usually constructed from fragments of *Sphagnum* moss and grass, and are usually situated at the base of a *Molinia* tussock. This species is included in the UK BAP as a priority species (UK Biodiversity Steering Group 1995).

2.9.2 Eumenidae

C Heath Potter Wasp *Eumenes coarctatus* (Linnaeus) **Na.** Although very scarce nationally, this species can still be quite common on the lowland heaths of southern England, where it is found from Kent to W. Cornwall. As its name suggests, this species builds mud pots, in which a single egg is laid, and which are provisioned with small caterpillars for the developing grub to feed on. These distinctive spherical pots are usually constructed in the upper branches of heather plants. The requirement for wet mud means that this species often frequents wet heaths and mires, though it can also be found on drier heathland.

3. Invertebrate communities of acid mires

3.1 Key habitat features for acid mire invertebrates

The lists below must be regarded as highly provisional, pending more detailed and systematic data collection on English mire systems. However, they are a useful way of highlighting the key habitat features on acid mires in England. Seven key habitat features have been identified that encompass the broad habitat requirements of the vast majority of the key acid mire species identified in section 2 of this report. Exceptions are generally those species where we have inadequate information on their ecology currently. Section 3.1 runs through these seven habitat features, giving a brief definition and description of the more widespread key invertebrate species that characterise the assemblages of the various habitat features.

3.1.1 Open *Sphagnum* lawns (SL)

This habitat feature supports the greatest number of stenotopic invertebrates on acid mire systems, and is also the most important single habitat feature for species with a high nature conservation status (RDB or BAP). This habitat feature includes flat lawns of *Sphagnum* mosses growing in very wet situations in topogenous mires, such as basin mires, waterfringe mires and valley mires, and also hummock-hollow *Sphagnum*-dominated communities in ombrogenous raised and blanket mires. These two main types exhibit some important differences in their invertebrate fauna, which primarily relate to the degree of saturation of the *Sphagnum*, but there are enough similarities between their fauna to justify their inclusion in one "community". The other main source of variation in the *Sphagnum* invertebrate fauna relates to altitude, with a number of *Sphagnum* specialists showing strong upland or lowland distributions in England.

Two of the most constant associated species found here are the rove beetles *Lathrobium terminatum* and *Octhephilum fracticorne*. These can be found throughout both the geographical and altitudinal range of *Sphagnum* mires in Britain. Almost as widespread are a further rove beetle, *Philonthus nigrita* and the ground beetle *Agonum gracile*, though these tend to be preferential to wetter areas of mire. The ground beetles *Pterostichus diligens* and *Pterostichus rhaeticus* also occur throughout the range of *Sphagnum* invertebrate communities found in Britain, but the former species in particular is perhaps more characteristic of tussock and litter communities (see section 3.1.2. below), and the latter seems to occur with equal frequency in both situations.

3.1.2 Grass, rush, sedge tussocks and litter (GRS)

The title is self explanatory, with the habitat feature encompassing the range of microhabitats associated with tussocky vegetation on acid mires. Generally such microhabitats are much cooler and more shaded than those occurring on open *Sphagnum* mire. Though the number of invertebrates occupying this niche is lower than that in *Sphagnum*, drier tussocks may be very valuable over wintering habitat, and at least some of the *Sphagnum* community listed in Tables 1-6 below may also require the relatively sheltered, dry microclimate offered by tussocks of *Molinia* and other species over the winter months. Note that this habitat feature also includes phytophagous species that feed on grasses, sedges and rushes, such as the Large Heath butterfly (on Hare's-tail Cottongrass).

None of the key ground beetles associated with acid mires is found exclusively in the habitat feature, but *Pterostichus diligens* appears to be preferential, though it is also often present in *Sphagnum*. Amongst the rove beetles, species such as *Pselaphus heisei* also appear to be more common in tussock and litter habitats, as are some of the key money spiders, but the association is again not strong. It is amongst some of the rarer key species that stronger associations with this habitat feature are found.

3.1.3 Ericaceous dwarf shrubs (EDS)

This encompasses ombrogenous mire and wet heath communities in which there are well-developed stands of dwarf shrubs, principally Ling and Cross-leaved Heath (collectively referred to as "heather" elsewhere in this report).

Most of the commoner associates of this habitat feature are phytophagous species that are not covered by this report (eg micro-lepidoptera), with the only heather-feeding key species included here being a number of macromoths (*Chlorissa viridata*, *Carsia sororiata*, *Selidosema brunnearia*, *Dyscia fagaria*, *Acronicta menyanthidis* and *Heliothis maritima*) and the leaf beetle *Cryptocephalus biguttatus*. Otherwise, most of the key species included in the following Tables are spiders that favour the well-developed vegetation structure provided by the heather plants.

3.1.4 Still water (SW)

A definition of the kinds of still water bodies included in this report has already been provided in section 1.1.2. Main constituents of the key fauna of bog pools are water beetles, with *Hydroporus gyllenhalii*, *H. obscurus*, *H. tristis*, *Agabus affinis*, *Agabus montanus*, *Helophorus flavipes* and *Hydroporus melanarius* being the most constant across the range of acid mires. The latter two species are perhaps preferential towards peaty, seasonal bog pools with little aquatic vegetation, whilst the remainder are associated with more permanent *Sphagnum* pools. Temporary water bodies are also important for some of the caddis flies included here.

3.1.5 Running water (RW)

This category includes a range of flushes, runnels, springs and soakways, where these are sufficiently acid, and where the substrate is peaty, rather than having a mineral bottom. There are fewer consistently common key species in this habitat feature, though in more "lowland" areas the water beetle *Laccobius atratus* and the hoverflies *Chrysogaster virescens* and *Melanogaster aerosa* are quite frequent.

3.1.6 Scattered trees and scrub (TS)

A definition of the scope of this category has already been provided in section 1.1.2. None of the key species can be found consistently across the range of acid mire habitats, with most being rare and localised. Only the Ruddy Highflyer moth is relatively widespread, though this is predominantly a northern and western species, which is of very patchy occurrence on acid mires in southern and eastern England.

3.1.7 Bare peat (BP)

Areas of wet, bare peat are extremely important for a range of invertebrates, especially dolichopodid, tabanid and tipulid flies, whose larvae are thought to develop in bare, semi-aquatic peat at the edge of peat pools and flushes. Amongst the long-headed flies, there are a number of widespread acid mire species that are thought to be associated with this habitat feature. Examples include *Dolichopus atratus*, *D atripes*, *D vitripennis*, *Hercostomus aerosus* and *Rhaphium longicorne*. Key acid mire craneflies that have a wide distribution in this habitat feature include *Limonia dilutior*, *Molophilus occultus* and *Ormosia pseudosimilis*.

3.2 Invertebrate communities of hydrotopographical mire types

In the following section, the acid mire associated invertebrates of the seven key habitat features outlined above are discussed in relation to the main hydrotopographical bog types discussed in section 1.2.2. For each hydrotopographical type, a list of the NVC communities to which it is related is also provided. Almost all of the acid mire associates listed in section 2 show no clear relationship with individual NVC communities. The rare exceptions to this rule are discussed below.

3.2.1 Lowland raised bogs

NVC communities M18 and M15, plus bog pool communities M1, M2, M3 and M4
Active raised bogs (M1, M2, M3, M18, M19 and M20) and Degraded Raised Bogs are priority habitats in the EC Habitats and Species Directive.

This is probably the scarcest of the main hydrotopographical mire types present in Britain, with most remaining English examples being in the north-west, in Lancashire and Cumbria. Elsewhere, the most significant lowland raised bogs are at Fenn's, Whixall and Bettisfield Moss, on the Shropshire/Wales border and at Thorne, Hatfield and Crowle Moors on the Lincolnshire/Yorkshire border.

Because they are comparatively dry, and have deep and extensive peat deposits, lowland raised bogs have been heavily exploited by the peat extraction industry. Almost all of the remaining lowland raised bogs in England are heavily influenced by past and present peat extraction, which alters the hydrology and water chemistry of the mire. A number of England's lowland raised bogs have been completely destroyed, either by peat extraction or drainage to facilitate intensive agriculture. For example, there were formerly areas of raised mire in the Cambridgeshire and Huntingdonshire fens, which had already been lost to agricultural intensification by the beginning of the twentieth century. Similarly, on the Somerset Levels, peat extraction has almost completely obliterated the areas of raised mire that formerly occurred here, with only one small, highly damaged fragment now remaining, at Westhay Moor.

This is one of the least diverse acid mire types for invertebrates, a reflection of the extremely oligotrophic and acidic conditions existing in lowland raised bogs. Though poor in species, there are a number of very rare specialists on lowland raised bogs, as can be seen from the list in Table 1 below. Of the key habitat features, the most important for invertebrates on acid mires is *Sphagnum* lawns. Relatively undisturbed lowland raised bogs often have an almost continuous carpet of *Sphagnum*, and this usually exhibits a well-marked "hummock-hollow"

microtopography, which means that a wide range of humidity conditions can exist within the moss cushions.

Wetter lawns of *Sphagnum* around the fringes of bog pools have extremely hygrophilous species such as the beetles *Agonum gracile*, *Philonthus nigrita*, *Gymnusa brevicollis* and the spider *Pirata piscatorius*. At Whixall Moss, wet *Sphagnum* lawns host the very rare money spider *Carorita limnaea*. In the upper part of *Sphagnum* hummocks, species favouring somewhat drier conditions, such as the beetles *Pterostichus diligens*, *Actobius cinerascens* and *Tachyporus transversalis* may occur. The latter is an example of a species more often found on wet heathland, and the relatively dry environment on the hummock tops, with abundant dwarf shrubs, also provides suitable habitat for a range of more eurytopic species of generally drier heath and grassland habitats. For example, a number of heather-feeding moths that are more characteristic of drier heaths, such as the Northern Eggar, are also found on lowland raised bogs. The common red ants *Myrmica ruginodis* and *M. scabrinodis* are often abundant on the drier hummocks, and with them very frequently is the myrmecophilous rove beetle *Drusilla canaliculata*, another species that is very common on drier heathland and grassland habitats in western Britain.

Molinia and *Eriophorum* tussocks may have a somewhat different fauna, with *P. diligens* being especially abundant here, along with the rove beetle *Pselaphus heisei*. A number of money spiders appear to especially favour *Molinia* litter, with examples that occur regularly on lowland raised bogs including the common *Walckenaeria alticeps* and the very scarce *Glyphesis servulus*. Around the edge of the raised lens of the mire, there is usually a "lagg" zone, with thinner peat, some water movement and somewhat higher water nutrient status. On some raised mires, the Raft Spider can be found in this lagg zone, with adults utilising *Sphagnum* mats at the edge of pools, whilst juveniles are found in the dense *Molinia* poor fen that is a characteristic feature of raised mire lagg. This also seems to be the larval habitat of the Endangered caddisfly *Hagenella clathrata*, which is found at Fenn's, Whixall and Bettisfield Mosses in the very gently flowing pools that occur between the *Molinia* tussocks.

Bog pools frequently form in the hollows of intact raised mire surfaces. These support a typical acidophilous water beetle fauna, including the acid mire associates *Hydroporus gyllenhalii*, *H. melanarius*, *H. obscurus*, *H. tristis*, *Agabus affinis*, *Agabus montanus*, *Rhantus suturellus*, *Helophorus flavipes* and *Helochares punctatus*. The much more uncommon dytiscid *Acilius canaliculatus* is found on some lowland raised bogs in north-west England. This beetle appears to particularly favour acid pools created as a result of past peat cutting. Also present in bog pools on lowland raised bogs are the larvae of the marsh beetle *Cyphon hilaris*, and sometimes its much rarer cousin *C. kongsbergensis*, the latter having a strong affinity for lowland raised bogs throughout its British range. The reed beetle *Plateumaris discolor* will usually be present where the bog pools have its foodplant, *Eriophorum angustifolium* growing in them. Acid bog pools on lowland raised bogs are also important for Odonata. The commonest of the acid mire associates is the Black Darter, though the Common Hawker is also quite frequent and the uncommon White-faced Darter is present in a few places in Cumbria, and also at Fenn's, Whixall and Bettisfield Mosses.

Many of the Diptera listed in Table 1, including rarities such as the horseflies *Atylotus plebeius* and *Hybomitra lurida* have larvae that are thought to live in saturated peat. Patches of bare, wet peat are probably important for many of the flies found on raised bogs, particularly species of cranefly. On relatively undamaged raised mires, the natural microtopography tends to ensure that there is an abundance of bare peat, especially on the

drawdown zone around the edge of bog pools. On damaged raised mires however, drying of the peat results in the establishment of a dense mantle of *Molinia* and dwarf shrubs. The ground beetle *Agonum ericeti* is also often found on patches of bare peat. It is a specialist species of ombrogenous mires, which is found quite widely in Britain on both raised and blanket bogs. Bare peat patches provide it with a warm, open microclimate ideal for diurnal hunting. However, it is also frequently found amongst *Sphagnum*, and optimal habitat for this species probably requires the mosaic of bare peat and wetter moss hummocks found on undamaged raised mires.

Whilst active peat working on raised bogs is generally considered to be detrimental to the invertebrate fauna, there are two notable exceptions on Thorne, Hatfield and Crowle Moors, the ground beetle *Bembidion humerale* and the Mire Pill Beetle. Both of these species are found commonly on actively cut-over bog, and *B. humerale* actually appears to prefer the sparsely vegetated dry substrates resulting from peat extraction.

Table 1: Invertebrates associated with lowland raised bogs

Species	SL	GRS	EDS	SW	RW	TS	BP	Notes
Theonoe minutissima	✓							Northern species
Walckenaeria alticeps		✓				✓		
Walckenaeria nodosa	✓							
Glyphesis servulus		✓						
Carorita limnaea	✓							
Maro lepidus	✓	✓						
Centromerus levitarsis	✓					✓		
Bathyphantes setiger	✓	✓						
Singa hamata		✓						
Pirata piscatorius	✓							
Dolomedes fimbriatus	✓	✓						
Sitticus floricola	✓	✓						
Aeshna juncea				✓				
Sympetrum danae				✓				
Leucorrhinia dubia				✓				
Metrioptera brachyptera		✓	✓					
Hebrus ruficeps	✓							
Notonecta obliqua				✓				
Hespercorixa castanea				✓				
Coenonympha tullia		✓						On *Eriophorum vaginatum*
Chlorissa viridata			✓			✓		
Hydriomena ruberata						✓		On *Salix*
Rheumaptera hastata						✓		On *Betula* and *Myrica*
Carsia sororiata			✓					On *Vaccinium* spp
Selidosema brunnearia			✓					
Dyscia fagaria			✓					
Acronicta menyanthidis			✓					Northern species
Celaena haworthii		✓						Northern species
Deltote uncula		✓						
Hypenodes humidalis								Foodplant unknown
Hagenella clathrata				✓	✓			
Limnephilus coenosus				✓	✓			
Limnephilus elegans				✓				
Limonia aperta	✓						✓	
Molophilus occultus							✓	
Phylidorea heterogyna							✓	
Phylidorea pulchella							✓	
Tipula melanoceros				✓				
Campsicnemus alpinus	✓							
Campsicnemus compeditus	✓							
Chrysotus obscuripes	✓							
Dolichopus atratus							✓	
Dolichopus atripes							✓	
Dolichopus lepidus							✓	
Hercostomus aerosus							✓	

Species	SL	GRS	EDS	SW	RW	TS	BP	Notes
Hercostomus angustifrons							✓	
Rhaphium longicorne							✓	
Atylotus plebeius							✓	
Hybomitra lurida							✓	
Hybomitra montana							✓	
Tabanus sudeticus							✓	
Bembidion humerale							✓	
Pterostichus diligens	✓	✓						
Pterostichus rhaeticus	✓	✓						
Agonum ericeti	✓						✓	
Agonum gracile	✓							
Hydroporus gyllenhalii				✓				
Hydroporus melanarius				✓				
Hydroporus obscurus				✓				
Hydroporus tristis				✓				
Agabus affinis				✓				
Agabus congener				✓				
Agabus montanus				✓				
Rhantus suturellus				✓				
Acilius canaliculatus				✓				
Helophorus flavipes				✓	✓			
Helochares punctatus				✓				
Enochrus affinis				✓				
Enochrus fuscipennis				✓				
Eusphalerum minutum								On flowers
Bibloplectus ambiguus	✓	✓						
Bibloplectus spinosus	✓							
Bibloplectus tenebrosus	✓							
Pselaphus heisei		✓						
Tachyporus transversalis	✓	✓						
Gymnusa brevicollis	✓							
Oxypoda procerula	✓	✓						
Schistoglossa aubei	✓	✓						
Atheta strandiella	✓							
Euaesthetus laeviusculus	✓	✓						
Lathrobium terminatum	✓							
Ochthephilum fracticorne	✓							
Erichsonius cinerascens	✓	✓						
Philonthus nigrita	✓							
Cyphon hilaris				✓				
Cyphon kongsbergensis				✓				
Curimopsis nigrita							✓	
Plateumaris discolor				✓	✓			On *Eriophorum angustifolium*
Chaetocnema confusa		✓						On *Juncus*

3.2.2 Blanket bogs

NVC communities: M17, M18, M19, M20 plus M15 and M25, plus bog pool communities M1, M2, M3 and M4.
Blanket Bogs (M17, M18, M19, M20 & M25) are a priority habitat in the EC Habitats Directive.

The other main ombrogenous mire type, blanket bogs, are restricted to upland areas, with large expanses along the Pennine chain, in the Lake District and in the Scottish border counties, where the Northumberland "border mires" provide perhaps the best examples in England. There are also regionally important blanket mires in south-west England on Dartmoor, with very small areas also remaining on Exmoor and Bodmin Moor. The largest expanses of this habitat type are in Scotland, and many of the invertebrates listed in Table 2 have their main British populations north of the border.

Unsurprisingly, a majority of the key invertebrates associated with blanket bogs themselves have a northern, or montane distribution in Britain. As with raised bogs, the *Sphagnum* fauna of blanket bogs is rich. Many of the commoner *Sphagnum* and litter species, such as the ground beetles *Agonum gracile*, *Pterostichus diligens* and *Pterostichus rhaeticus* and the rove beetles *Oxypoda procerula*, *Philonthus nigrita* and *Lathrobium terminatum* can also be found here, but a number of the more lowland elements of this fauna are absent, and may be replaced by upland species such as the ground beetles *Carabus nitens*, *Trechus rivularis* and *Cymindis vaporariorum* and the rove beetles *Olophrum fuscum*, *Stenus brevipennis* and *Quedius boopoides*.

Money spiders include a high proportion of upland species that are chiefly associated with blanket mires in Britain, and they are clearly a very important group to consider when carrying out invertebrate survey work on blanket mire systems. A number of these species are rare in Britain, and one, *Semljicola caliginosa* is currently believed to be endemic. The three *Erigone* species listed in Table 2 are all extremely hygrophilous, generally being found in very wet *Sphagnum* around the edges of bog pools.

The ground beetle *Agonum ericeti* shows a very high fidelity to ombrogenous bogs in both upland and lowland situations. It seems to particularly favour watershed blanket bogs, where there are well-developed peat haggs. These provide it with the combination of *Sphagnum* hummocks and warm, bare peat that this species favours. Peat haggs, or patches of bare peat around the margins of bog pools are also very important for a range of diptera, whose larvae develop in saturated peat. Examples on blanket mires may include the craneflies *Limonia dilutior*, *Molophilus ater* and *Ormosia pseudosimilis* and the long-headed flies *Dolichopus atratus*, *D. atripes*, *D. vitripennis* and *Hercostomus aerosus*. Most of these flies are widespread inhabitants of acid mires, but *M. ater* is more strictly confined to blanket bog. Burning is generally very detrimental to the invertebrate fauna of blanket mire communities, though there are a couple of species, the money spider *Leptothrix hardyi* and the water beetle *Helophorus tuberculatus* which have an affinity for burnt ground.

Bog pools have widespread acid mire water beetles such as *Hydroporus gyllenhalii*, *H. melanarius*, *H. obscurus*, *H. tristis* and *Agabus montanus*, but additionally they may support populations of northern species such as *Gyrinus minutus*, *Hydroporus morio*, *Agabus congener* and *Agabus arcticus*. *H. morio* may replace *H. gyllenhalii* completely on blanket mires at higher altitudes. In the relatively equable climate and lower altitudes of south-west

England, these upland species are all lacking from blanket mires, with lowland species such as *Helochares punctatus* still being present instead. Other aquatic bog pool beetles include the common scirtid *Cyphon hilaris*, and the much scarcer *C. kongsbergensis* and *C. punctipennis*. The latter species in particular seeming to be quite strongly associated with blanket mires in Britain.

Most of the above species (with the exception of *H. melanarius* and *G. minutus*) are primarily found in bog pools with abundant submerged *Sphagnum* and/or emergent Cyperaceae. However, there are another suite of invertebrates that favour bare, peat pools with little or no vegetation. Chief among this group are the water boatmen, with *Glaenocorisa propinqua*, *Arctocorisa carinata*, *Callicorixa wollastoni*, *Sigara scotti* and *Sigara semistriata*. Similar habitats are required by the caddis flies *Limnephilus coenosus* and *Rhadicoleptus alpestris*, with these species inhabiting shallow peaty pools that dry up over the summer months.

Table 2: Invertebrates associated with blanket bogs

Species	SL	GRS	EDS	SW	RW	TS	BP	Notes
Walckenaeria clavicornis	✓							Montane species
Pelecopsis mengei			✓					Northern species
Silometopus elegans	✓	✓						Northern species
Erigone capra	✓							Montane species
Erigone welchi	✓							Montane species
Erigone psychrophila	✓							Montane species
Latithorax faustus	✓							Northern species
Semljicola caliginosa	✓	✓						Montane species
Drepanotylus uncatus	✓	✓						Northern species
Leptothrix hardyi							✓	Northern species
Hilaira nubigena	✓	✓						Montane species
Hilaira pervicax	✓	✓						Montane species
Aphileta misera	✓	✓						Northern species
Meioneta mossica	✓							Northern species?
Centromerus levitarsis	✓							
Clubiona norvegica	✓							Northern species
Aeshna juncea				✓				
Sympetrum danae				✓				
Gerris costai				✓				Northern species
Glaenocorisa propinqua				✓				Northern species
Arctocorisa carinata				✓				Montane species
Callicorixa wollastoni				✓				Montane species
Sigara scotti				✓				Northern species
Sigara semistriata				✓				Northern species
Coenonympha tullia		✓						On *Eriophorum vaginatum*
Carsia sororiata			✓					On *Vaccinium* spp
Acronicta menyanthidis			✓					Northern species
Apamea zeta		✓						Montane species
Celaena haworthii		✓						Northern species
Agrypnia obsoleta				✓				Northern species
Limnephilus coenosus				✓	✓			Northern species
Oligotricha striata				✓				Northern species
Rhadicoleptus alpestris				✓				Northern species
Erioconopa diuturna								Habitat unknown
Euphylidorea meigeni				✓				Northern species
Phylidorea squalens				✓				Northern species
Phylidorea pulchella							✓	
Limonia dilutior							✓	
Molophilus ater							✓	Northern species
Molophilus occultus							✓	
Ormosia pseudosimilis							✓	

Species	SL	GRS	EDS	SW	RW	TS	BP	Notes
Tipula melanoceros				✓				
Tipula gimmerthali					✓			Montane species
Tipula grisescens	✓							Northern species
Tricyphona immaculata								Habitat unknown
Tricyphona schummeli								Habitat unknown
Campsicnemus alpinus	✓							
Campsicnemus compeditus	✓							
Chrysotus obscuripes	✓							
Dolichopus atratus							✓	
Dolichopus atripes							✓	
Dolichopus vitripennis							✓	
Hercostomus aerosus							✓	
Hydrophorus albiceps				✓				Northern species
Carabus nitens	✓	✓						
Trechus rivularis	✓							Northern species
Pterostichus diligens	✓	✓						
Pterostichus rhaeticus	✓	✓						
Agonum ericeti	✓						✓	
Agonum gracile	✓							
Cymindis vaporariorum	✓	✓						Northern species
Gyrinus minutus				✓				Northern species
Hydroporus gyllenhalii				✓				
Hydroporus melanarius				✓				
Hydroporus morio				✓				Northern species
Hydroporus obscurus				✓				
Hydroporus tristis				✓				
Agabus affinis				✓				
Agabus arcticus				✓				Montane species
Agabus congener				✓				Northern species
Agabus montanus				✓				
Ilybius aenescens				✓				
Rhantus suturellus				✓				
Helophorus flavipes				✓	✓			
Helophorus tuberculatus							✓	
Helochares punctatus				✓				
Olophrum fuscum	✓							Northern species
Bibloplectus ambiguus	✓	✓						
Bibloplectus spinosus	✓							
Pselaphus heisei		✓						
Gymnusa brevicollis	✓							
Oxypoda procerula	✓	✓						
Philhygra arctica	✓							
Atheta strandiella	✓							

Species	SL	GRS	EDS	SW	RW	TS	BP	Notes
Stenus brevipennis		✓						
Euaesthetus laeviusculus	✓	✓						
Lathrobium terminatum	✓							
Lathrobium zetterstedti	✓	✓						
Ochthephilum fracticorne	✓							
Philonthus nigrita	✓							
Quedius boopoides	✓							Northern species
Cyphon hilaris				✓				
Cyphon kongsbergensis				✓				
Cyphon punctipennis				✓				
Cantharis paludosa		✓						
Plateumaris discolor				✓				

3.2.3 Waterfringe bogs

NVC communities: M4, M5, A24 and S9.
Transition and quaking bogs (M4 & M5) are a priority habitat in the EC Habitats Directive.

Waterfringe bogs are floating mats of vegetation, usually dominated by Bottle Sedge *Carex rostrata* and bog-mosses, chiefly *Sphagnum recurvum* and *S. squarrosum* occurring at the edge of open water bodies. These communities are very closely related to sump mires (see 3.2.4. below), being an earlier stage in the open water → floating *Sphagnum* raft succession, and therefore it is not surprising that the invertebrate fauna of these two hydrotopographical habitat divisions is closely similar.

The relatively short list of key acid mire invertebrates listed in Table 3 reflects the limited amount of systematic sampling of this habitat that has taken place, rather than any lack of invertebrate interest. On the contrary, waterfringe wetlands are of very high invertebrate interest for a range of stenotopic invertebrates, including some that are extremely rare and threatened in Britain. Further systematic sampling of waterfringe bogs (and indeed more mesotrophic transition and quaking wetlands beyond the scope of this review) are a high priority in order to provide a better understanding of the invertebrate fauna of this SAC priority habitat.

Of the greatest interest is the very important invertebrate fauna associated with Bottle Sedge *Carex rostrata* and other Carices growing in swamp transitions to open water. The dung fly genus *Cordilura* contains six species that are primarily associated with this habitat, with *C. aemula*, *C. atrata*, *C. hyalipennis* and *C. rufimana* all being rarities in Britain. *Carex rostrata* is also the most common foodplant of the scarce reed beetle *Donacia obscura*. Floating rafts of *Sphagnum* mosses, chiefly *S. recurvum* and *S. squarrosum* support a rich, hygrophilous invertebrate fauna in which the rove beetles *Pselaphaulax dresdensis*, *Stenus opticus* and the very rare *Schistoglossa aubei* join more widespread elements of the wet *Sphagnum* fauna such as *Agonum gracile*, *Lathrobium terminatum* and *Philonthus nigrita*. The major British locus for much of this fauna is in more mesotrophic and calcicolous wetlands, which are beyond the scope of this report. For example, most of the *Cordilura* species cited above are probably chiefly found in such fen swamp communities, which are more typical of areas such as the Norfolk pingos, Norfolk Broads and the Anglesey fens, and their inclusion in this review must be regarded as provisional pending the collection of further information.

The water beetle fauna of this habitat is primarily comprised of typical species of vegetated lowland bog pools, such as *Hydroporus gyllenhalii*, *H obscurus* and *Agabus affinis*. However, this habitat type also provides a major British locus for the rare aquatic weevil *Bagous frit*, which feeds on Bogbean, and the flea beetle *Longitarsus nigerrimus*, which is associated with bladderworts *Utricularia* spp.

Table 3: Invertebrates associated with waterfringe bogs

Species	SL	GRS	EDS	SW	RW	TS	BP	Notes
Notioscopus sarcinatus	✓					✓		
Pirata tenuitarsis	✓							
Pirata piscatorius	✓							
Sympetrum danae				✓				
Gerris lateralis				✓				Northern species
Hespercorixa castanea				✓				
Idaea muricata								On *Potentilla palustris*
Hydriomena ruberata						✓		On *Salix*
Limnephilus elegans				✓				
Phalacrocera replicata	✓							
Phylidorea fasciata							✓	
Hydrophorus nebulosus				✓				
Anasimyia lunulata				✓				
Cordilura aemula				✓				
Cordilura atrata				✓				
Cordilura hyalipennis				✓				Northern species
Cordilura rufimana				✓				Northern species
Agonum gracile	✓							
Pterostichus rhaeticus	✓	✓						
Hydroporus gyllenhalii				✓				
Hydroporus obscurus				✓				
Agabus affinis				✓				
Rhantus suturellus				✓				
Helophorus flavipes				✓				
Helochares punctatus				✓				
Bibloplectus ambiguus	✓	✓						
Bibloplectus spinosus	✓							
Pselaphaulax dresdensis	✓							
Gymnusa brevicollis	✓							
Gymnusa variegata	✓							
Schistoglossa aubei	✓	✓						
Stenus opticus	✓	✓						
Stenus niveus		✓						
Euaesthetus laeviusculus	✓	✓						
Lathrobium terminatum	✓							
Ochthephilum fracticorne	✓							
Philonthus nigrita	✓							
Cyphon hilaris				✓				
Plateumaris discolor				✓				On *Eriophorum angustifolium*
Donacia obscura				✓				On *Carex* spp
Longitarsus nigerrimus				✓				On *Utricularia* spp
Bagous frit				✓				On *Menyanthes trifoliata*

3.2.4 Sump bogs (basin mires)

NVC communities: M1, M2, M3, M4, M5, M18 and S9.
Transition and quaking bogs (M4 & M5) are a priority habitat in the EC Habitats Directive.

Sump bogs, or basin mires, as they are more usually called in Britain, form on the site of stagnant water bodies such as ponds and lakes, and form part of a transition from open water to increasingly consolidated peat substrates. Basin mires mark the point in the transition when the original open water area has largely been covered with a raft of *Sphagnum*, though underneath this mat, the peat may still have an extremely liquid consistency. Such floating bogs are often referred to as quaking bogs or schwingmoors.

Generally, basin mires are extremely wet, and heavily dominated by *Sphagnum* mosses, and in this environment, the usual dominants are the more constant members of the *Sphagnum* invertebrate community, such as the ground beetles *Agonum gracile* and *Pterostichus rhaeticus*, plus the rove beetles *Ochthephilum fracticorne*, *Lathrobium terminatum*, *Philonthus nigrita*, *Oxypoda procerula* and *Gymnusa brevicollis* and spiders such as *Pirata piscatorius* and *P. tenuitarsis*.

In the "lagg" around the fringes of the basin, there is more water movement, and greater nutrient enrichment. In such situations, poor fen dominated by *Molinia* and rushes is usually the dominant vegetation. These areas support a rather different community to open areas of *Sphagnum* lawn. *Pterostichus diligens* is often the dominant carabid in these areas, and a few other species favouring tussocks and litter, can be found. Generally these areas are of much lower interest for invertebrates than the *Sphagnum* lawns, but on some basin mires, the Raft Spider occurs, this being a species that requires both dense *Molinia* lagg and open *Sphagnum* lawns.

Some of the most important invertebrate communities in British bogs are found in basin mires that have formed in glacial depressions such as pingos and kettleholes. Such glacial basins contain particularly important assemblages of acid mire invertebrates, with the outstanding English examples being the mosses and meres of the Cheshire Plain, including the cluster of sites in and around the Delamere Forest Cheshire, Wybunbury Moss NNR Cheshire and Chartley Moss, Staffordshire. This group of sites show a range of successional mire types from open water transition mires, through quaking bogs, to basin mires with ombrogenous vegetation communities, where peat accumulation has raised the bog surface above the groundwater table. The invertebrate fauna of these sites is astonishingly rich, as can be appreciated by reference to Appendix 1 of this report. Open *Sphagnum* lawns support a host of rarities, such as the spiders *Carorita limnaea*, *Glyphesis cottonae*, *Centromerus levitarsis*, *Gnaphosa nigerrima* and *Sitticus floricola*, plus the rove beetle *Lathrobium rufipenne*. These sites also have an exceptional dipteran fauna, including the RDB craneflies *Phylidorea fasciata* and *Prionocera pubescens* and the horseflies *Atylotus plebeius* and *Hybomitra montana*. The latter two species are both predominantly northern in their world distribution, and their colonies on the Cheshire mosses and meres may represent "relict" outposts, where they were stranded after the end of the last glaciation.

At Chartley Moss and Wybunbury Moss, young birches have become established on parts of the basin. These scattered saplings support the only extant English populations of the leaf beetle *Cryptocephalus decemmaculatus*, another species that like the two horseflies mentioned previously is otherwise a northern species. Scattered scrub of this type on basin

mires can also support colonies of the scarce money spider *Notioscopus sarcinatus*, which occurs in wet litter under the bushes, though this species is also found in other mire habitats.

Surprisingly, bog pools on basin mires do not seem to support "glacial relict" water beetles, but rather have a fauna typical of lowland acidic mire. This includes the commoner lowland Hydropori, along with species such as *Agabus affinis*, *Agabus montanus*, *Rhantus suturellus* and *Helochares punctatus*. It is on the meres and mosses of north-west England that the most interesting bog pool invertebrates are found in sump bogs. Most important is the RDB1 caddisfly *Hagenella clathrata*, which occurs at Chartley Moss in shallow pools in lagg habitats on the fringes of the basin. Also of great note are the populations of White-faced Darter dragonfly that are found on a number of the mosses and meres, where the nymphs invariably inhabit *Sphagnum* pools on acid basin mires.

Table 4: Invertebrates associated with sump bogs

Species	SL	GRS	EDS	SW	RW	TS	BP	Notes
Walckenaeria kochi		✓						
Hypselistes jacksoni	✓	✓						
Satilatlas britteni	✓							
Notioscopus sarcinatus	✓					✓		
Glyphesis cottonae	✓							
Carorita limnaea	✓							
Maro lepidus	✓	✓						
Centromerus levitarsis	✓					✓		
Bathyphantes setiger	✓	✓						
Taranucnus setosus		✓	✓					
Pirata tenuitarsis	✓							
Pirata piscatorius	✓							
Dolomedes fimbriatus	✓	✓						
Gnaphosa nigerrima	✓							
Sitticus floricola	✓	✓						
Sympetrum danae				✓				
Leucorrhinia dubia				✓				
Hebrus ruficeps	✓							
Hespercorixa castanea				✓				
Idaea muricata								On *Potentilla palustris*
Hydriomena ruberata						✓		On *Salix*
Carsia sororiata			✓					On *Vaccinium* spp
Dyscia fagaria			✓					
Celaena haworthii		✓						Northern species
Coenobia rufa		✓						On rushes
Deltote uncula		✓						
Hypenodes humidalis								Foodplant unknown
Hagenella clathrata				✓	✓			
Limnephilus elegans				✓				
Rhadicoleptus alpestris				✓				
Phalacrocera replicata	✓							
Phylidorea fasciata							✓	
Phylidorea pulchella							✓	
Prionocera pubescens	✓							
Prionocera turcica								Habitat unknown
Tipula melanoceros				✓				
Campsicnemus alpinus	✓							
Campsicnemus compeditus	✓							
Chrysotus obscuripes	✓							
Dolichopus atratus							✓	
Dolichopus atripes							✓	
Dolichopus lepidus							✓	
Dolichopus vitripennis							✓	

Species	SL	GRS	EDS	SW	RW	TS	BP	Notes
Hercostomus aerosus							✓	
Rhaphium longicorne							✓	
Atylotus plebeius							✓	
Hybomitra lurida							✓	
Hybomitra montana							✓	
Tabanus sudeticus							✓	
Anasimyis lunulata				✓				
Orthonevra geniculata							✓	
Pterostichus diligens	✓	✓						
Pterostichus rhaeticus	✓	✓						
Agonum gracile	✓							
Hydroporus gyllenhalii				✓				
Hydroporus obscurus				✓				
Hydroporus tristis				✓				
Agabus affinis				✓				
Agabus congener				✓				Northern species
Agabus montanus				✓				
Ilybius aenescens				✓				
Rhantus suturellus				✓				
Helophorus flavipes				✓				
Helochares punctatus				✓				
Enochrus affinis				✓				
Enochrus fuscipennis				✓				
Bibloplectus ambiguus	✓	✓						
Bibloplectus spinosus	✓							
Pselaphaulax dresdensis	✓							
Gymnusa brevicollis	✓							
Gymnusa variegata	✓							
Stenus opticus	✓	✓						
Euaesthetus laeviusculus	✓	✓						
Lathrobium terminatum	✓							
Lathrobium rufipenne	✓							
Ochthephilum fracticorne	✓							
Erichsonius cinerascens	✓	✓						
Philonthus nigrita	✓							
Cyphon hilaris				✓				
Cyphon padi				✓				
Cantharis paludosa		✓						
Plateumaris discolor				✓				
Cryptocephalus decemmaculatus						✓		
Bagous frit				✓				On *Menyanthes trifoliata*

3.2.5 Spring-fed bogs and soakways

NVC communities: M4, M6, M23, M29, M31, M32, M35.

This and the following hydrotopographical category of run-off bogs together encompass a wide range of topogenous mires, most of which would be recognised by British botanists as valley bogs of one sort or another. The current category only includes those elements of the invertebrate fauna that occur within aquatic habitats in such systems, or are strongly associated with the fringes of such waterbodies. More general terrestrial elements of the valley mire fauna are dealt with separately in section 3.2.6. This is an example where the hydrotopographical mire categories of Wheeler and Shaw (1995) fail to provide an easy fit with invertebrate communities present on valley mires and other sloping bogs. The combination of Tables 5 and 6 gives a better overall picture of the invertebrate fauna of valley bog systems.

Because this category covers flushes, runnels and soakways, it is not surprising that there are a number of species that are associated with running water. Most of these species have already been discussed in the earlier review of acid seepages included in Boyce (2002a). However, within valley mire systems, there are often very wet areas on shallow slopes with bog pools that may have little or no discernable water flow, and such areas are also discussed here.

The water beetle community of pool areas and slow-flowing soakways in lowland valley mires includes most of the still-water aquatic beetles discussed in the various sections above. However, in faster flowing acid flushes, the fauna is given a different character by the presence of *Laccophilus atratus* and *Paracymus scutellaris*. Amongst the marsh beetles, this habitat is particularly favoured by *Cyphon padi*, though *C. hilaris* is still quite abundant in slower flowing systems. Shallow peat pools with little vegetation in the lowland valley mires of Dorset support populations of the rare Atlantic dytiscid *Hydroporus necopinatus*. In this very limited area of Dorset, it replaces the much commoner *H. melanarius*, though the latter species is quite widespread in lowland valley bogs elsewhere in southern England. By contrast deeper peat pools in the same area of Dorset provide a southern outpost for the northern whirligig beetle *Gyrinus minutus*.

The valley mires of southern England support "relict" populations of a number of such invertebrates that otherwise have an exclusively northern and/or upland distribution in Britain. For example, at Thursley Common in Surrey, a population of the White-faced Darter occurs, as do the water boatmen *Sigara scotti* and *Glaenocorisa propinqua*. The latter species is only known from one other site in southern England (Priddy in Somerset), otherwise being a species of pools at high altitudes in northern England and Scotland. Further examples of this phenomenon are provided in section 3.3.6 below. "Relict populations of this type are of the greatest interest biogeographically, and also as potentially hyper-sensitive indicators of climate change, where we would expect that the predicted increases in temperature over the coming century would gravely imperil their continued survival. For these reasons, the conservation of "relict" populations of this type should be afforded a high priority.

In addition to *Hydroporus necopinatus*, discussed above, flushes on lowland valley mires support two further invertebrates included in the UK BAP as priority species, these being the Southern Damselfly *Coenagrion mercuriale* and the Bog Hoverfly *Eristalis cryptarum*. Both

of these species occur in very shallow boggy runnels that are kept open by cattle and pony grazing. The maintenance of the populations of these important species is largely predicated on the maintenance of adequate stocking levels around the breeding flushes in which they occur. It is very likely that the same would apply to a number of the other invertebrates included in Table 5, but for most we have inadequate information about their ecology to assess the importance of grazing and other forms of management.

Moving away from lowland systems, to flushes in the uplands of northern and western Britain, we find a number of different species are present. Prominent amongst these are the craneflies, with *Tipula gimmerthali*, *T. limbata*, *T. subnodicornis*, *Limonia distendens* and *Oligotricha striata* all being characteristic of acid flushes in the English uplands. Amongst the water beetles, the most characteristic additional species of upland flushes is *Hydroporus longicornis*, though it may also be met with occasionally in lowland situations.

Table 5: Key invertebrates associated with spring-fed bogs and soakways

Species	SL	GRS	EDS	SW	RW	TS	BP	Notes
Erigone welchi	✓							Montane species
Pirata tenuitarsis	✓							
Pirata piscatorius	✓							
Dolomedes fimbriatus				✓				
Ceriagrion tenellum				✓	✓			
Coenagrion mercuriale					✓			
Orthetrum coerulescens					✓			
Aeshna juncea				✓				
Sympetrum danae				✓				
Leucorrhinia dubia				✓				Northern species
Notonecta obliqua				✓				
Glaenocorisa propinqua				✓				Northern species
Hespercorixa castanea				✓				
Sigara scotti				✓				Northern species
Hagenella clathrata				✓	✓			
Limnephilus elegans				✓				
Limonia distendens					✓			Northern species
Oligotricha striata				✓				Northern species
Phalacrocera replicata	✓							
Tipula melanoceros				✓				
Tipula gimmerthali					✓			Montane species
Tipula holoptera					✓			
Tipula limbata					✓			Northern species
Tipula subnodicornis					✓			Northern species
Hydrophorus nebulosus				✓				
Chrysogaster virescens				✓	✓			
Eristalis cryptarum					✓			
Melanogaster aerosa				✓	✓			
Gonatherus planiceps					✓			Montane species
Gyrinus minutus				✓				Northern species
Hydroporus gyllenhalii				✓				
Hydroporus longicornis					✓			Northern species
Hydroporus melanarius				✓				
Hydroporus obscurus				✓				
Hydroporus necopinatus				✓				
Hydroporus tristis				✓				
Agabus affinis				✓	✓			
Agabus congener				✓				Northern species
Agabus montanus				✓				
Ilybius aenescens				✓				
Rhantus suturellus				✓				

Species	SL	GRS	EDS	SW	RW	TS	BP	Notes
Helophorus flavipes				✓	✓			
Paracymus scutellaris				✓	✓			
Anacaena lutescens				✓	✓			
Laccobius atratus					✓			
Helochares punctatus				✓				
Enochrus affinis				✓				
Enochrus fuscipennis				✓				
Cyphon hilaris				✓				
Cyphon padi				✓				

3.2.6 Run-off bogs

NVC communities: M6, M21, M15, M16 M23 and M25.
High quality North Atlantic wet heaths (M15 and M16) and Temperate Atlantic wet heaths (M21) are priority habitats in the EC Habitats Directive.

This is the most wide-ranging of the hydrotopographical mire categories, and includes the whole range of lowland and upland valley mire types. It also includes areas of wet heath and *Molinia* grassland which, while they can often occur in valley mires, are also characteristic of gentle slopes on the fringes of upland plateaux, or in the case of the latter vegetation type, are highly characteristic of former wet heath and blanket mire communities that have been ecologically degraded by repeated, uncontrolled burning.

The small, diffuse watercourses (soakways) that meander through the valley bottom and the spring-fed flushes that run down off of the valley slopes have been dealt with in the previous section. However, all the remaining acid mire invertebrate communities are dealt with here. A classic zonation in a lowland valley mire system would have very wet swamp and pool communities on the lowest ground around the watercourse, then upslope from this zones of *Sphagnum* bog, wet heath and humid heath, before moving beyond the range of mire communities into dry heathland (Rose 1953). Each of these zones on a lowland valley bog supports distinct assemblages of invertebrates, which are outlined below.

Nutrients are concentrated in the wettest ground along the valley bottom, and where this is the case, there are quite often scattered trees and patches of willow scrub. Saturated litter under scrub on lowland mire systems is particularly favoured by the money spiders *Walckenaeria alticeps* and *Notioscopus sarcinatus* and the cranefly *Tipula yerburyi*. Very wet swamp and bog pools are usually interspersed with tall tussocks of *Molinia* and Sharp-flowered Rush *Juncus acutiflorus*. Tussocks and litter of these species are important for a range of mire invertebrates, with common elements of the fauna including the ground beetle *Pterostichus diligens* and the rove beetles *Erichsonius signaticornis*, *Pselaphus heisei* and *Bibloplectus ambiguus*. Rarities found in this microhabitat include the spiders *Glyphesis servulus*, *Singa hamata*, *Dolomedes fimbriatus* and *Sitticus caricis*, plus the rove beetle *Stenus kiesenwetteri* and the Black Bog Ant, the latter two species generally occurring in *Molinia* tussocks in a handful of lowland valley mires in southern England.

The importance of stock grazing, particularly cattle and ponies that create areas of bare ground by their poaching has already been alluded to in the previous section. These comments apply with equal force to the terrestrial fauna of lowland valley mires, with many of the flies listed in Table 6 requiring areas of bare, saturated peat in which the larvae of these species develop. Amongst the craneflies, widespread acid mire species associated with bare peat such as *Limonia dilutior*, *Molophilus occultus* and *Ormosia pseudosimilis* occur, and in some places are joined by rarities such as *Erioptera nielseni* and *Phylidorea abdominalis*. The long-headed flies of acid mires reach their greatest diversity in the valley bogs of southern England, with the widespread *Dolichopus atratus*, *D. atripes*, *D. vitripennis*, *Hercostomus aerosus* and *Rhaphium longicorne* being joined by scarcer species such as *Dolichopus lineatopunctatus*, *Hercostomus angustifrons* and *Tachytrechus consobrinus*. Larvae of horseflies are thought to develop in areas of bare, wet peat, with *Atylotus fulvus*, *Chrysops caecutiens*, *Hybomitra montana* and *Tabanus sudeticus* all having significant

populations on lowland run-off bogs, though *C. caecutiens* is a great rarity, which, in England, is only known from a handful of valley mires in Dorset and Hampshire.

The two very rare rove beetles *Paederus caligatus* and *Acylophorus glaberrimus* also favour open, poached valley mires, and it is therefore no surprise that their British strongholds lie in the New Forest, one of the few areas of lowland valley mire in southern England that is still actively grazed. Without adequate grazing, much of the bare peat in valley mires becomes choked with dense rushes and *Molinia*, and this is a key factor in maintaining the diversity of these sites.

Moving away from the centre of the valley, the next major zone comprises mire dominated by extensive *Sphagnum* lawns. Common *Sphagnum* species such as *Agonum gracile*, *Ochthephilum fracticorne*, *Philonthus nigrita* and *Lathrobium terminatum* are all common here, but in southern England they are joined by more uncommon species such as the rove beetles *Gymnusa variegata* and *Myllaena kraatzi*. The New Forest valley mires support outstanding wet *Sphagnum* mire assemblages that additionally support rarities such as the ground beetles *Elaphropus walkerianus* and *Acupalpus flavicollis* and the rove beetle *Erichsonius ytenensis*. *Sphagnum* in lowland valley mires also supports colonies of two important craneflies *Erioptera nielseni* and *Prionocera pubescens*.

Wet and humid heath communities are similarly diverse, with a number of spiders, such as *Taranucnus setosus*, *Hypsosinga sanguinea*, *Scotina palliardii* and *Evarcha arcuata* favouring the vegetation structure provided by the heather plants. Heathers are the foodplant of the rare leaf beetle *Cryptocephalus biguttatus*, as well as a diverse assemblage of specialist lepidoptera. The somewhat less waterlogged terrain in the wet heath zone favours the establishment of high densities of red ant colonies, with *Myrmica ruginodis* and *M scabrinodis* being the main species. This in turn results in the presence of myrmecophilous invertebrates that live with the ants. Of these the hoverfly *Microdon myrmicae* and the rove beetle *Ilyobates nigricollis* are included in this report, though a number of other myrmecophilous rove beetles including *Drusilla canaliculata*, *Platydracus latebricola* and *P fulvipes* are also found in these habitats with some frequency.

Though the distinction between the invertebrate communities of wet and humid heath is quite poorly marked, there are a number of species, such as the rove beetle *Tachyporus transversalis* and the spiders *Trochosa spinipalpis*, *Lathys nielseni*, and *Gnaphosa leporina* that seem to be preferential for humid heaths with relatively low cover of *Sphagnum*, rather than wet heath in which bog mosses are much more frequent. Most important amongst this suite of species is the ground beetle, *Tachys edmondsi*, which is found at a handful of humid heaths on the sheltered fringes of valley mires in the New Forest.

The presence of "relict" populations in the valley mires of Dorset, Hampshire and Surrey has already been discussed in the section above. A number of further examples of this phenomenon can be found amongst the terrestrial invertebrates of these sites. Examples include the money spiders *Silometopus elegans*, *Erigone welchi*, *Drepanotylus uncatus*, *Leptothrix hardyi* and *Aphileta misera*, plus the ground beetles *Carabus nitens* and *Agonum ericeti*.

Valley bogs in northern England share many of the commoner species found in lowland valley mires, but have a very distinctive upland element. This latter element includes a number of money spiders, including two rarities, *Hilaira nubigena* and *Hilaira pervicax* that

seem to be particularly attached to stands of rushes around the fringes of upland flushes. Amongst the beetles, northern species found in this habitat include the rove beetles *Olophrum fuscum*, *Quedius boopoides*, and occasionally the scarce *Q. fulvicollis*.

Upland stands of wet heath that occur on shallow slopes below the moorland plateau have a community generally comprising only the commoner acid mire specialists, such as the ground beetle *Pterostichus diligens* and the rove beetles *Ochthephilum fracticorne* and *Lathrobium terminatum*. However, this is still quite diverse compared to the fauna of the species-poor *Molinia* grasslands that are such a feature of moorland in many parts of western Britain. The only species identified during this project that seems to show a preference for this habitat is the wolf spider *Pirata uliginosus*. Otherwise, most of the invertebrate fauna comprises eurytopic species with high dispersive ability, making this the least diverse invertebrate community of those looked at during the current study, and also one of the least interesting semi-natural invertebrate habitats in the British Isles. This vegetation is generally the product of repeated, uncontrolled burning of the *Molinia*, and this probably accounts for its low invertebrate interest.

Table 6: Invertebrates associated with run-off bogs

Species	SL	GRS	EDS	SW	RW	TS	BP	Notes
Theonoe minutissima	✓							Northern species
Walckenaeria alticeps		✓				✓		
Walckenaeria nodosa	✓							
Walckenaeria kochi		✓						
Hypselistes jacksoni	✓	✓						
Silometopus elegans	✓	✓						Northern species
Satilatlas britteni	✓							
Notioscopus sarcinatus	✓					✓		
Glyphesis cottonae	✓							
Glyphesis servulus		✓						
Drepanotylus uncatus	✓	✓						Northern species
Leptothrix hardyi							✓	Northern species
Hilaira nubigena	✓	✓						Montane species
Hilaira pervicax	✓	✓						Montane species
Aphileta misera	✓	✓						Northern species
Maro lepidus	✓	✓						
Bathyphantes setiger	✓	✓						
Taranucnus setosus		✓	✓					
Hypsosinga sanguinea			✓					
Singa hamata		✓						
Trochosa spinipalpis	✓	✓						
Pirata uliginosus		✓						
Dolomedes fimbriatus	✓	✓						
Lathys nielseni		✓						
Scotina palliardii		✓	✓					
Gnaphosa leporina		✓						
Zora armillata	✓	✓						
Thanatus formicinus		✓	✓					
Sitticus caricis		✓						
Evarcha arcuata		✓	✓					
Metrioptera brachyptera		✓	✓					
Stethophyma grossum	✓							
Hebrus ruficeps	✓							
Chlorissa viridata			✓			✓		
Hydriomena ruberata						✓		On *Salix*
Coenocalpe lapidata		✓						Montane species
Rheumaptera hastata						✓		On *Betula* and *Myrica*
Carsia sororiata			✓					On *Vaccinium* spp
Selidosema brunnearia			✓					
Cleora cinctaria						✓		
Dyscia fagaria			✓					
Acronicta menyanthidis			✓					Northern species
Apamea zeta		✓						Montane species

Species	SL	GRS	EDS	SW	RW	TS	BP	Notes
Celaena haworthii		✓						Northern species
Coenobia rufa		✓						On rushes
Heliothis maritima			✓					On heathers
Deltote uncula		✓						
Hypenodes humidalis								Foodplant unknown
Erioptera nielseni	✓						✓	
Limonia dilutior							✓	
Molophilus occultus							✓	
Ormosia pseudosimilis							✓	
Phylidorea abdominalis							✓	
Phylidorea pulchella							✓	
Prionocera pubescens	✓							
Prionocera turcica								Habitat unknown
Tipula yerburyi						✓		
Tricyphona immaculata								Habitat unknown
Campsicnemus alpinus	✓							
Campsicnemus compeditus	✓							
Chrysotus obscuripes	✓							
Dolichopus atratus							✓	
Dolichopus atripes							✓	
Dolichopus lepidus							✓	
Dolichopus lineatopunctatus							✓	
Dolichopus vitripennis							✓	
Hercostomus aerosus							✓	
Hercostomus angustifrons							✓	
Nematoproctus distendens								Habitat unknown
Rhaphium longicorne							✓	
Tachytrechus consobrinus							✓	
Atylotus fulvus							✓	
Chrysops sepulcralis							✓	
Hybomitra montana							✓	
Tabanus sudeticus							✓	
Microdon myrmicae	✓							*Myrmica scabrinodis*
Pelecocera tricincta								Habitat unknown
Orthonevra geniculata							✓	
Carabus nitens	✓	✓						
Elaphrus lapponicus	✓	✓					✓	Montane species
Elaphrus uliginosus	✓	✓					✓	
Tachys edmondsi	✓							
Elaphropus walkerianus	✓							
Pterostichus aterrimus		✓						
Pterostichus diligens	✓	✓						
Pterostichus rhaeticus	✓	✓						
Agonum gracile	✓							
Agonum sexpunctatum							✓	

Species	SL	GRS	EDS	SW	RW	TS	BP	Notes
Acupalpus flavicollis	✓	✓						
Helophorus tuberculatus							✓	
Olophrum fuscum	✓							Northern species
Eusphalerum minutum								On flowers
Hadrognathus longipalpus	✓	✓						
Bibloplectus ambiguus	✓	✓						
Bibloplectus spinosus	✓							
Bibloplectus tenebrosus	✓							
Pselaphus heisei		✓						
Tachyporus transversalis	✓	✓						
Gymnusa brevicollis	✓							
Gymnusa variegata	✓							
Myllaena kraatzi	✓							
Oxypoda procerula	✓	✓						
Ilyobates nigricollis	✓	✓						
Schistoglossa curtipennis	✓	✓						
Stenus lustrator		✓						
Stenus fuscipes		✓						
Stenus melanarius	✓	✓						
Stenus subdepressus		✓						
Stenus kiesenwetteri		✓						
Stenus oscillator	✓	✓						
Stenus niveus		✓						
Euaesthetus laeviusculus	✓	✓						
Paederus caligatus							✓	
Lathrobium terminatum	✓							
Ochthephilum fracticorne	✓							
Erichsonius cinerascens	✓	✓						
Erichsonius ytenensis	✓							
Philonthus nigrita	✓							
Gabrius trossulus		✓						
Quedius boopoides	✓							Northern species
Quedius fulvicollis		✓						Northern species
Acylophorus glaberrimus							✓	
Actenicerus sjaelandicus		✓						
Cantharis figurata		✓						
Cantharis paludosa		✓						
Cryptocephalus biguttatus			✓					
Chaetocnema confusa		✓						On *Juncus*
Chaetocnema subcoerulea		✓						On *Juncus*
Apion genistae								On *Genista anglica*
Rhynchaenus iota								On *Myrica gale*
Formica candida		✓						
Eumenes coarctatus			✓					

4. Future action for the invertebrate fauna of acid mires in England

- Invertebrate surveys of the mosses and meres of Cheshire, Shropshire and Staffordshire should be undertaken. These are of the highest importance for the conservation of the invertebrate fauna of acid mires, and support a large number of rare and/or threatened species known from few, if any, other British sites.
- Carry out invertebrate surveys of the lowland raised mires of Cumbria. This county has much the largest extent of relatively undamaged lowland raised bog in England, and though the butterfly and macromoth fauna of these sites is relatively well known, little systematic survey of other invertebrate taxa has yet been carried out.
- Carry out invertebrate surveys of transition mires and quaking bogs in England. Despite the status of these sites as a SAC Priority habitat, very little systematic survey of the invertebrate fauna of these areas has yet been carried out away from East Anglia. Information we do have suggests that they support an invertebrate fauna of very high interest that requires further investigation. Priority should be given to those English sites designated as cSACs for this habitat.
- Undertake invertebrate surveys of lowland valley mires in Dorset, Hampshire, Surrey, Sussex and Berkshire. Though some sites within these areas have been well surveyed, there are still a number of others for which we have very little invertebrate information. Given the high importance of the lowland valley bogs of southern England for the conservation of acid mire invertebrates, it is important that we improve our knowledge of the overall resource.
- Invertebrate surveys of the valley and blanket bogs of Dartmoor and Bodmin Moor. These two upland areas support extensive tracts of high quality acid mire habitat (mostly valley mires, wet heaths and blanket bog) for which there is currently virtually no invertebrate survey information available. It is very likely given further survey that they will be found to support an important invertebrate fauna.
- Carry out BAP actions for priority species associated with acid mires (Southern Damselfly, Bog Hoverfly, Edmond's Ground Beetle, *Pterostichus aterrimus*, *Hydroporus necopinatus* and Black Bog Ant).
- Revise the BAP priority species list during the review in 2005 to include/exclude acid mire invertebrates that meet criteria for inclusion.

  Possible examples might include:

  1. Remove the ground beetle *Pterostichus aterrimus* from the BAP priority list, as it is almost certainly extinct at its only British site. This beetle should only be re-admitted to the BAP priority list if an established breeding population is re-discovered in Britain.

  2. Consider adding *Atylotus plebeius* to the BAP priority list. This horsefly is restricted to a handful of sites on the Cheshire Plain and there are very few modern records. The English population has added interest as a probable glacial "relict" of what is generally a north European species.

3. Southern Damselfly, Bog Hoverfly, Edmond's Ground Beetle, *Hydroporus necopinatus* and Black Bog Ant should be retained on the BAP priority list for the next five-year period.

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Appendix 1: Important sites for acid mire invertebrates in England

The following section lists the most significant sites for the key acid mire invertebrates discussed in section 2 of this report. Sites are usually discussed by vice-county, and have generally been amalgamated into regional groups of acid mires, where the individual sites lie relatively close to each other (eg large upland areas such as Dartmoor and the North York Moors and lowland regions such as the New Forest and the Poole Basin, Dorset). With the two large upland sites in the North and South Pennines, listed at the end of this section, the area covered encompasses a number of vice counties. In several cases, the sites listed here follow the boundaries of candidate Special Areas of Conservation (SAC). Note that this list should not be regarded as comprehensive, and further sites will undoubtedly be added as information on the invertebrate fauna of acid mires accumulates.

West Cornwall (vc1)

Lizard – An outstanding site for dry heathland species. Wetter areas of heath and bog are also of interest, supporting key acid mire species such as the Small Grass Emerald moth. There are also a number of recent records of the RDB3 Shoulder-striped Clover moth from this site.

East Cornwall (vc2)

Bodmin Moor – Very little survey of the invertebrate fauna of the extensive valley mires and wet heaths of this area has yet taken place. No species of great note are known, but the site does support some northern acid mire species at their southern limits, such as the money spiders *Drepanotylus uncatus* and *Aphileta misera*.

Breney Common – Lying 5km to the south of Bodmin Moor, Breney Common comprises an extensive area of heath, acid grassland and mire communities. Key acid mire invertebrates recorded at this site include the Small Red Damselfly and the Silver Hook moth.

Goss & Tregoss Moor – A large area of acid mire and willow carr, this site is poorly known in respect of its invertebrate fauna, but the presence of Bog Bush-cricket and Small Red Damselfly, as well as the Ruddy Highflyer, Small Rufous and Silver Hook moths suggests that it may be of considerable interest given further surveys.

South Devon (vc 3)

Blackdown Hills – see South Somerset (vc5).

Bovey Basin heaths – Areas of dry lowland heath at Bovey Heathfield, Chudleigh Knighton Heath and Stover Park have some small areas of wet heath and acid mire that host a number of interesting species such as the hoverfly *Pelecocera tricincta* and the Bog Bush-cricket.

Dartmoor – There is very little information on the invertebrate fauna of Dartmoor, and no systematic surveys of moorland invertebrates have yet been undertaken here. However, casual records suggest that Dartmoor's mires could support an extremely important invertebrate fauna. For example, the rare money spider *Centromerus levitarsis* has recently

been recorded from blanket bog at Foxtor Mires and the RDB3 rove beetle *Paederus caligatus* occurs around heavily grazed acid flushes on the southern fringe of the moor. There are also two sites for the Southern Damselfly in the northern part of the National Park, at Moortown Bottom and Tor View Moor, and the former site also supports colonies of the Small Red Damselfly and the rove beetle *Stenus oscillator*. Of greatest importance are the populations of Bog Hoverfly that still occur in soligenous mires around the upland fringes of Dartmoor, these being the only extant populations of this BAP Priority species in Britain.

East Devon Pebblebed Heaths – A series of lowland heaths, with extensive areas of valley bog. The most important areas of mire and wet heath are on Aylesbeare Common, Bicton Common, Colaton Raleigh Common and Venn Ottery Common. Aylesbeare and Colaton Raleigh support colonies of the Southern Damselfly, and this species also formerly occurred at Venn Ottery Common, but has recently become extinct there due to lack of grazing management. Most of the heathland fell out of management during the middle of the last century, and encroachment of rank vegetation and scrub is one of the most serious management issues at this site. However, scattered birch scrub benefits some uncommon species such as the Small Grass Emerald moth. The very rare rove beetle *Stenus kiesenwetteri* has recently been collected from a valley mire on Bicton Common, the hoverfly *Pelecocera tricincta* is found on Aylesbeare Common and the Raft Spider occurs on Venn Ottery Common at one of only two Devon stations.

North Devon (vc4)

Exmoor – see South Somerset (vc5).

South Somerset (vc5)

Blackdown Hills – A number of areas of acid mire occur in this area, which lies on the border of South Somerset and South Devon. The main areas of acid mire in the Somerset Blackdowns are at Blackdown and Sampford Commons SSSI, Beacon Lane Farm, Ringdown Common, Deadman, Britty Common, Munty, Southey & Gotleigh SSSI, Longlye Common and Freshmoor. There are also a number of similar sites over the border into Devon, such as Bucehayes Common, Horner Hill, Huntshayes, Quantock & Featherlake Commons and Shore Bottom. Most of these sites are dominated by heath and acid grassland communities, with soligenous mires occurring around spring-heads and along runnels. The fauna of the Somerset Blackdowns has been surveyed by Drake (1989). The Diptera fauna of these sites is of considerable note, and includes species such as the dance fly *Syndyas nigripes* and the long-headed fly *Tachytrechus consobrinus*. The scarce money spider *Notioscopus sarcinatus* has also been recorded here. The fauna of the Devon sites is virtually unknown, but does include the Raft Spider.

Exmoor – The moors of Exmoor are mostly rather free draining, supporting drier heath and grassland communities, and plateau blanket bog is of very localised occurrence, generally being confined to the south western uplands, where precipitation is greatest. Otherwise, acid mire vegetation is largely restricted to the narrow bottoms of the steep, periglacial valleys that dissect the moorland plateau. There are also monotonous tracts of *Molinia*-dominated grassland on the Exmoor Forest, these being a product of over-frequent burning of upland heath and mire communities. Because of the limited extent of acid mire, and the over-frequent burning of many of the better areas of bog vegetation, Exmoor's acid mire invertebrate fauna is relatively limited, and lacks any outstanding rarities. Nonetheless, a

number of interesting species are present, including good populations of important species such as the hoverfly *Microdon myrmicae*. Also of note are a number of northern species, such as the money spiders *Pelecopsis mengei*, *Silometopus elegans* and *Drepanotylus uncatus*, that are at or very close to their southern limit of distribution here. Areas of species-poor Purple Moor-grass, which are a product of over-frequent burning, have a very poor invertebrate fauna, though one key species, the wolf spider *Pirata uliginosus* appears to favour these areas. Mire areas on Exmoor have been surveyed recently as part of an Exmoor Moorland Invertebrate Survey (Boyce 2004). This region straddles the Somerset/Devon border.

North Somerset (vc6)

Somerset peat moors – Most of the raised mire that formerly occurred in this area has long since been destroyed by agricultural improvement and peat extraction. However, small fragments still survive at Westhay Moor and Shapwick Heath. These areas still support some acid mire key species, such as the Raft Spider and the rove beetle *Paederus caligatus*. Formerly, the Somerset peat moors also supported colonies of the Large Marsh Grasshopper, but habitat degradation has led to the recent extinction of this species here.

Priddy – This site lies on the plateau of the Mendip Hills. It hosts a number of acidophilous water beetles that are now very scarce elsewhere in Somerset. There is also a "relict" population of the northern water boatman *Glaenocorisa propinqua*.

Dorset (vc 9)

Poole Basin – The lowland heaths of the Poole Basin include areas of valley mire that host an exceptional community of lowland acid mire invertebrates. Key sites for acid mire invertebrates in this area include Studland, Arne, Morden Bog, Hartland Moor, Creech Heath, Povington Heath, Slepe Heath, Winfrith & Tadnoll Heath, and other areas of mire within the Wareham Forest. Important invertebrates found in this area include BAP Priority species such as the Southern Damselfly and Large Marsh Grasshopper. Other rarities include the spider *Zora armillata*, the horsefly *Chrysops sepulcralis* and the rove beetles *Stenus kiesenwetteri* and *Paederus caligatus*. Peaty pools support populations of the diving beetle *Hydroporus necopinatus*, and a "relict" population of the northern whirligig beetle *Gyrinus minutus*.

South Hampshire (vc11)

Emer Bog – This area of transition mire in a very wet valley bottom supports colonies of the Small Grass Emerald and Marsh Oblique-barred moths.

New Forest – The New Forest has the largest expanse of lowland heath and mire habitat remaining in southern England. It is the single most important site for acid mire invertebrates in Britain, with many of those species with a southern distribution having their largest populations here. It also hosts "relict" populations of a number of species that otherwise have a largely northern distribution in Britain. Examples include the ground beetles *Carabus nitens* and *Agonum ericeti* and the money spider *Erigone welchi*. Amongst the ground beetles, rarities recorded include *Tachys edmondsi*, *Elaphropus walkerianus* and *Pterostichus aterrimus*, recent British records of all of these species being confined to the Forest. There

are old records of *Stenus subdepressus*, and other rare rove beetles known from the New Forest valley mires include *Stenus kiesenwetteri*, *Paederus caligatus* and *Acylophorus glaberrimus*, the latter at its only British station. Unusual acid mire Diptera found here include the cranefly *Prionocera pubescens* and the long-headed flies *Dolichopus lineatocornis* and *Nematoproctus distendens*. Three BAP Priority species, The Large Marsh Grasshopper, Southern Damselfly and Black Bog Ant have very large populations in the New Forest, and this outstanding site also supports large populations of many of the other acid mire associates listed in section 2 of this report. The New Forest have been well worked by entomologists, and the entomological literature contains many references to the mire invertebrate fauna of this area. The acid mires of the New Forest have also been the subject of a detailed survey by Sheppard (1987), and a recent LIFE-funded survey of the Coleoptera of the New Forest has generated a large number of records of acid mire associates.

North Hampshire (vc12)

Woolmer Forest & Shortheath Common – These two areas, which lie adjacent to each other, have extensive stands of wet heath and acid mire. A number of key acid mire species have been recorded from here, including the RDB2 rove beetle *Stenus kiesenwetteri*, the Raft Spider, Bog Bush-cricket and Small Red Damselfly.

East Sussex (vc14)

Ashdown Forest – A very large area of lowland heath, with valley mires containing wet heath and acid mire vegetation communities. An important area for lowland acid mire invertebrates, though the fauna is less diverse than that of the lowland valley mires of Dorset, Hampshire and Surrey. Important species recorded from this area include the crab spider *Thanatus formicinus*, the water beetle *Helophorus tuberculatus*, the ground beetle *Agonum sexpunctatum*, the rove beetle *Myllaena kraatzi* and the Bog Bush-cricket.

Surrey (vc17)

Ash Ranges – Lowland heath, with valley bog and wet heath. The ground beetle *Agonum sexpunctatum* and the RDB hoverfly *Pelecocera tricincta* are amongst the diverse assemblage of acid mire species occurring here.

Chobham Common – A large area of lowland heath, with extensive areas of valley mire and wet heath. Rarities recorded include the Shoulder-striped Clover, Purple-bordered Gold and Small Grass Emerald moths, the hoverfly *Pelecocera tricincta* and the leaf beetle *Cryptocephalus biguttatus*.

Esher Common – Areas of wet heath and valley bog at this site support a number of important acid mire species, such as the ground beetle *Agonum sexpunctatum*. The last British record of the rove beetle *Stenus subdepressus* was from this site.

Pirbright Ranges - A colony of the RDB hoverfly *Pelecocera tricincta* occurs here, and the Purple-bordered Gold moth has also been recorded.

Thursley Common – Both the White-faced Darter *Leucorrhinia dubia* and the water boatman *Glaenocorisa propinqua* are northern-distributed species in Britain, which have

"relict" populations at this site. The RDB2 tipulid *Prionocera pubescens* also occurs here. There is a 1982 record of the Shoulder-striped Clover moth from this site.

Whitmoor Common – This site has one of only three English populations of the caddisfly *Hagenella clathrata*, and there are also old records of the Shoulder-striped Clover moth from here.

West Norfolk (vc28)

Dersingham Bog and Roydon Common – These two sites comprise the largest area of acid mire surviving in East Anglia. Both sites are valley bogs that lie on the Lower Greensand, with vegetation dominated by extensive *Sphagnum* lawns. Despite their isolation from other acid mires, these two sites still support an interesting invertebrate fauna, which includes key acid mire species such as the Black Darter dragonfly and the Purple-bordered Gold and Marsh Oblique-barred moths.

Huntingdonshire (vc31)

Holme Fen – Though the vast majority of this site has fenland communities, there is one small area of acidic mire remaining on the reserve. The rare rove beetle *Bibloplectus tenebrosus* has been sieved from *Sphagnum* in this area.

Staffordshire (vc39)

Chartley Moss – This site is an outlier of the "mosses and meres" landscape of the Shropshire and Cheshire Plain. Like these sites, it is a large, wet basin that has formed in a hollow created by glacial meltwater at the end of the last glaciation. Also like the other mosses and meres, it has an outstanding invertebrate fauna, with the most important species being the caddis fly *Hagenella clathrata*, only known elsewhere in Britain from two sites. Also recorded are the rove beetle *Atheta strandiella*, and the leaf beetles *Cryptocephalus biguttatus* and *C decemmaculatus*, the latter having its only other English colony at Wybunbury Moss, Cheshire. The site also has a diverse macromoth fauna, including rarities such as the Marsh Oblique-barred and the Manchester Treble-bar, the latter being a northern species, for which this site is one of the most southerly outliers.

Cannock Chase – A large area of lowland acidic grassland and dry heath, with wet heath and acid mire in valley bottoms. A population of the Bog Bush-cricket occurs here at its main Staffordshire station. There is an old record of the scarce ground beetle *Cymindis vaporariorum*, which has an upland distribution in Britain.

Shropshire (vc40)

Fenn's, Whixall & Bettisfield Mosses – A very large area of lowland raised mire, most of which has been cut-over as a result of commercial peat extraction. Despite this, Fenn's, Whixall and Bettisfield Mosses is still one of the most important British sites for acid mire invertebrates. With Delamere Forest in Cheshire, it hosts a number of extremely rare species that are rarely if ever found away from this region. .Examples include the spiders *Carorita limnaea* and *Sitticus floricola*, the horseflies *Atylotus plebeius* and *Hybomitra lurida*, the cranefly *Phylidorea heterogyna*, the white-faced darter dragonfly and the caddisfly

Hagenella clathrata. The Manchester Treble-bar moth occurs here at the extreme southerly limit of its British range, and the very scarce Bordered Grey moth is also present.

North Lincolnshire (vc54)

Crowle, Thorne & Hatfield Moors – see South-west Yorkshire (vc63)

Cheshire (vc58)

Delamere Forest – This region includes a number of "meres and mosses", which occur in relatively close proximity to each other, and have therefore been considered as one ecological unit. Individual sites include Abbott's Moss, Black Lake, Flaxmere, Little Budworth Common and Petty Pool. This is one of the most important areas for the conservation of the acid mire invertebrate fauna in Britain, and with Wybunbury Moss and Fenn's, Whixall and Bettisfield Mosses in Shropshire, it hosts a number of extremely rare species that are rarely if ever found away from this region. Examples include the spiders, *Centromerus levitarsis*, *Gnaphosa nigerrima* and *Sitticus floricola* and the horseflies *Atylotus plebeius* and *Hybomitra lurida*. Two very rare craneflies, the RDB1 *Phylidorea fasciata* (Hatchmere) and the RDB2 *Prionocera pubescens*, (Abbot's Moss and Flaxmere) have also been recorded in this area. The vulnerable rove beetle *Lathrobium rufipenne* is known from Flaxmere and Petty Pool, and this area is also the main English stronghold for the White-faced Darter dragonfly.

Wybunbury Moss – This site has suffered considerable damage from attempted drainage and eutrophication caused by run-off from the surrounding land. The former factor has resulted in the open bog being invaded by pine and birch scrub, whilst the latter factor has resulted in the replacement of acid mire by fen communities. Despite this, the remaining areas of open, floating *Sphagnum* raft still support an outstanding acid mire invertebrate fauna. This includes the money spider *Carorita limnaea*, the jumping spider *Sitticus floricola* and the gnaphosid spider *Gnaphosa nigerrima*, the latter at its only British site. Also present here are the RDB2 rove beetle *Lathrobium rufipenne* and the leaf beetle *Cryptocephalus decemmaculatus*, making this a key British site for the conservation of our acid mire invertebrate fauna.

Manchester Mosses – A series of degraded lowland raised bogs lie on the flat ground to the south and west of Manchester. Most of these lie in Cheshire vice county, though some areas straddle the border into South Lancashire (vc59). The best remaining areas of mire are at Risley, Astley, Bedford and Holcroft Mosses, though all have been damaged by past agricultural drainage and peat extraction. The Chat Moss complex is another extensive area of heavily degraded raised bog in this area. Most of the remaining acid mire invertebrates are commoner, less stenotopic species, but the rare water beetle *Helophorus tuberculatus* has been recorded. The invertebrate fauna of part of this area has been surveyed by Shirt (1988).

South Lancashire (vc59)

Manchester Mosses – see Cheshire (vc58).

South-east Yorkshire (vc61)

Skipwith Common – This site has a large area of wet heath and valley mire. It supports a diverse invertebrate assemblage, including a number of key acid mire species, such as the Silver Hook moth and the rove beetle *Stenus niveus*.

North-east Yorkshire (vc62)

North York Moors – This upland area has extensive blanket bog and wet heath, as well as numerous topogenous mires in the valleys running off the moorland plateau. Areas of blanket bog such as Fen Bog, Flaske Inn, Lockton Moor and May Moss support colonies of the ombrotrophic mire specialist Large Heath butterfly, and the latter site also has records for two rare water beetles, *Helophorus tuberculatus* and *Cyphon punctipennis*. Fen Bog has records for the RDB3 leaf beetle *Cryptocephalus biguttatus*, and a strong population of the Bog Bush-cricket, the latter being at one of its most northerly British stations.

Strensall Common – This site and Skipwith Common (see above) are the only two extensive areas of lowland heath remaining in the Vale of York. They both have large areas of wet heath and acid mire, with a diverse invertebrate fauna that includes the rove beetle *Lathrobium zetterstedti* and the Silver Hook moth.

South-west Yorkshire (vc63)

Crowle, Thorne & Hatfield Moors – A large expanse of lowland raised mire, most of which has been cut over for commercial peat extraction. This site straddles the border between Yorkshire and Lincolnshire, with the majority of the site being in the former county. It is the only surviving lowland raise mire in north-eastern England, and supports an outstanding invertebrate fauna. It is the only British site for both the ground beetle *Bembidion humerale* and the Mire Pill Beetle *Curimopsis nigrita*, both of which are priority species in the UK BAP. A number of other key mire species occur, including the ground beetles *Agonum ericeti* and *A. sexpunctatum*, the rove beetle *Lathrobium zetterstedti*, Bog Bush-cricket and Purple-bordered Gold moth. The site has been the subject of a detailed invertebrate survey (Heaver & Eversham 1991), and the two BAP beetles referred to above have been the subject of a detailed distributional and ecological study (Eversham 1996).

Mid-west Yorkshire (vc64)

Askham Bog – This site formerly supported areas of acid mire, all of which have now been lost as a result of drainage, eutrophication and scrub encroachment. Many of the invertebrates associated with these areas have also vanished, but a few acid mire associates, such as the rove beetle *Bibloplectus spinosus* and the ground beetle *Trechus rivularis*, continue to survive in other wetland habitats.

Malham Tarn Moss – A lowland raised bog that is owned by the National Trust. The rare money spider *Maro lepidus* occurs here.

Pen-y-Ghent - The rare money spider *Maro lepidus* occurs at this site.

North-west Yorkshire (vc65)

Austwick Moss – An area of lowland raised bog lying in the valley of the River Wenning. Like most lowland raised bogs in England, this site has been considerably modified by past peat extraction. Two extremely rare craneflies, *Limonia aperta* and *Prionocera pubescens* have been recorded here.

South Northumberland (vc67)

Border Mires, Kielder-Butterburn – Though many of the "border mires" occurring in this area have been planted up with coniferous forestry, there are still extensive open areas with superb blanket mire that support a diverse invertebrate fauna. Amongst the species recorded here are the money spider *Meioneta mossica*, the ground beetle *Trechus rivularis*, the rove beetle *Myllaena kraatzi* and the Large Heath butterfly. Recently, the very scarce Northern Arches has been discovered, this being the only occasion on which this moth has been recorded away from the Scottish Highlands and Islands.

Cheviot (vc68)

The Cheviot – The invertebrate fauna of this upland area is not well studied, but *Erigone psychrophila* is present on blanket mire here at its only English station.

Ford Moss – A small, but relatively undamaged raised bog lying in the rain shadow of the Cheviot. The invertebrate fauna of the site is poorly known, but does include the scarce rove beetle *Lathrobium zetterstedti*.

Westmorland (vc69)

Blelham Bog – This site is owned by the National Trust. The rare money spider *Maro lepidus* occurs here.

Duddon Mosses – A series of lowland raised bogs situated around the head of the Duddon estuary. In all, there are eight discrete raised domes included within this complex; Latter Rigg Moss, Black Moss, Heathwaite Moss, White Moss, Wreaks Moss, Little White/Bank End/Angerton Mosses, Herd House Moss and Arnaby/Shaw Mosses. Originally these mosses formed a continuous unit, running from the upland fringe to the coast. Most of these bogs have been affected by peat cutting to some extent, though extensive areas of intact raised mire still remain. Other negative influences on the mire have been the drainage of peripheral agricultural land and burning, both of which result in drying of the mire surface. These mosses support an interesting invertebrate fauna that includes a number of key acid mire species, such as the Large Heath butterfly and the Marsh Oblique-barred moth.

Holker Moss - This site supports a colony of the extremely local Bordered Grey moth.

Meathop Moss – An estuarine raised bog lying in the coastal lowlands at the head of Morecambe Bay. This site supports colonies of both the extremely scarce Bordered Grey moth and the Large Heath butterfly. There are also populations of the RDB3 jumping spider *Sitticus floricola* and the Bog Bush-cricket, the latter being near to the northern limits of its British range.

Roudsea Mosses – A National Nature Reserve. This site comprises five separate estuarine raised mires: Fish House Moss, Burnbarrow Moss, Deer Dike Moss, Stribers Moss and Ellerside Moss. They lie in the coastal lowlands at the head of Morecambe Bay, and are less damaged than the other main areas of lowland raised mire in south Cumbria (see Duddon Mosses SSSI above). The invertebrate fauna of this site is very rich, and includes key acid mire species such as the Large Heath butterfly, the Small Grass Emerald moth, the Bog Bush-cricket and the Raft Spider.

Rusland Moss – Part of this site is a National Nature Reserve. Much of this lowland raised mire is subject to commercial peat extraction, which is drying out the bog surface, resulting in encroachment of pine trees. Despite this, the rare money spider *Maro lepidus* still occurs here, as does the Raft Spider *Dolomedes fimbriatus*. This site also supports a colony of the Large Heath butterfly *Coenonympha tullia*.

Cumberland (vc 70)

Biglands Bog – Parts of this important site appear to be suffering eutrophication caused by run-off from surrounding agricultural land. The vulnerable money spider *Centromerus levitarsis* has recently been recorded here

Glasson Moss – A lowland raised mire, which was cut for peat up until the 1950s. There have also been a number of recent fires here, and these two adverse factors have resulted in degradation of the mire. Despite this, the vulnerable money spider *Centromerus levitarsis* has recently been recorded here.

Lake District High Fells – Though of somewhat lower quality than the bogs of the Pennines and Border Mires, this area still supports an important acid mire invertebrate fauna associated with blanket mire and upland/montane flushes. Species of note include the montane ground beetle *Elaphrus lapponicus* (old record only) at its only English station, the rove beetle *Lathrobium zetterstedti* and the endemic money spider *Semljicola caliginosus*.

Newton Reigny Moss – A wet basin lying just to the west of Penrith. This site has extensive areas of eutrophic and calcicolous fen swamp. There are also small pockets of acid mire, with the rare Red Data Book rove beetle *Schistoglossa aubei* recorded from here in the past.

Scaleby Moss – Lowland raised mire near Carlisle, with an old record of the money spider *Glyphesis cottonae*.

South Pennine Moors

Though lacking many of the montane rarities found on sites in the North Pennines, this area, which encompasses a number of vice counties, from Staffordshire in the south to Yorkshire in the north, still hosts a very important acid mire fauna, with the chief interest being associated with blanket bog and upland flushes. This area supports a diverse assemblage of

money spiders associated with acid mires, including uncommon species such as *Erigone welchi*. Amongst the ground beetles, acid mire specialists include nationally scarce species such as *Carabus nitens*, *Agonum ericeti* and *Cymindis vaporariorum*.

North Pennine Moors

This large area of northern England encompasses a number of vice counties, chiefly from Yorkshire in the south to Northumberland and Cumberland in the north and includes some of the most important acid mires sites for invertebrates in the country. The upland Diptera fauna has been particularly well studied, with rarites such as *Tipula grisescens* and *T limbata* present. The money spiders also include a number of important acid mire species, examples being *Erigone capra*, *Hilaira nubigena*, *H pervicax* and the endemic *Semljicola caliginosus*. The acid mire invertebrate fauna of the Moorhouse NNR is particularly well-studied, and is outstanding within this region, with an exceptional upland Diptera fauna associated with blanket bog and montane flushes. Rarities recorded here include the cranefly *Tipula gimmerthali* and the dungflies *Gonatherus planiceps*, *Cordilura aemula* and *C atrata*. Also present on the NNR are unusual acid mire rove beetles such as *Olophrum assimile*, *Quedius fulvicollis* and *Lathrobium zetterstedti*. Much of the invertebrate information for this area has been generated as a result of the work of Coulson & Butterfield (1985).

Appendix 2: Summary table for acid mire associated invertebrates

SPECIES	STATUS	FIDELITY	LRB	BB	WFB	SB	SFB	ROB
Theonoe minutissima		C	SL					SL
Walckenaeria alticeps		B	GRS, TS					GRS, TS
Walckenaeria nodosa		B	SL					SL
Walckenaeria kochi		C				GRS		GRS
Walckenaeria clavicornis		B		SL				
Hypselistes jacksoni		A				SL, GRS		SL, GRS
Pelecopsis mengei		C		EDS				
Silometopus elegans		C		SL, GRS				SL, GRS
Satilatlas britteni	Nb	B				SL		SL
Notioscopus sarcinatus	Nb	B			SL, TS	SL, TS		SL, TS
Glyphesis cottonae	Na	A				SL		SL
Glyphesis servulus	Na?	C	GRS					GRS
Erigone capra	Nb	B		SL				
Erigone welchi	Na	A		SL			SW	
Erigone psychrophila	Na	A		SL				
Latithorax faustus		A		SL				
Semljicola caliginosus	Nb, RDB5	A		SL, GRS				
Drepanotylus uncatus		C		SL, GRS				SL, GRS
Leptothrix hardyi		B		BP				BP
Hilaira nubigena	Na	A		SL, GRS				SL, GRS
Hilaira pervicax	Nb	A		SL, GRS				SL, GRS
Carorita limnaea	RDB1	A	SL			SL		
Aphileta misera		B		SL, GRS				SL, GRS
Meioneta mossica		A		SL				
Maro lepidus	RDB3	A	SL, GRS			SL, GRS		SL, GRS
Centromerus levitarsis	RDB2	A	SL, TS	SL		SL, TS		
Bathyphantes setiger		B	SL, GRS			SL, GRS		SL, GRS
Taranucnus setosus		C				GRS, EDS		GRS, EDS
Hypsosinga sanguinea	Nb	C						EDS

SPECIES	STATUS	FIDELITY	LRB	BB	WFB	SB	SFB	ROB
Singa hamata	**Nb**	**C**	**GRS**					**GRS**
Trochosa spinipalpis		**C**						**SL, GRS**
Pirata tenuitarsis		**B**			**SL, TS**	**SL**	**SW**	
Pirata uliginosus		**C**						**GRS**
Pirata piscatorius		**B**	**SL**		**SL**	**SL**	**SL**	
Dolomedes fimbriatus		**A**	**SL, GRS**			**SL,, GRS**	**SW**	**SL, GRS**
Lathys nielseni	**Na**	**B**						**GRS**
Scotina palliardii	**Na**	**C**						**GRS, EDS**
Clubiona norvegica	**Nb**	**A**		**SL**				
Gnaphosa nigerimma	**RDBI?**	**A**				**SL**		
Gnaphosa leporina		**B**						**GRS**
Zora armillata	**RDB3**	**C**						**SL, GRS**
Thanatus formicinus	**RDB2**	**A**						**GRS, EDS**
Sitticus caricis	**Nb**	**C**						**GRS**
Sitticus floricola	**RDB3**	**B**	**SL, GRS**			**SL, GRS**		
Evarcha arcuata	**Nb**	**B**						**GRS, EDS**
Ceriagrion tenellum		**A**					**SW, RW**	
Coenagrion mercuriale	**RDB3, ECII, BAP**	**B**					**RW**	
Aeshna juncea		**C**	**SW**	**SW**			**SW**	
Orthetrum coerulescens		**A**					**RW**	
Sympetrum danae		**B**	**SW**	**SW**	**SW**	**SW**	**SW**	
Leucorrhinia dubia		**A**	**SW**			**SW**	**SW**	
Stethophyma grossum	**RDB2, BAP**	**A**						**SL**
Metrioptera brachyptera	**Nb**	**A**	**GRS, EDS**					**GRS, EDS**
Hebrus ruficeps		**B**	**SL**			**SL**		**SL**
Gerris costae		**B**		**SW**				
Gerris lateralis		**C**			**SW**			
Notonecta obliqua		**C**	**SW**				**SW**	
Glaenocorisa propinqua		**B**		**SW**			**SW**	
Hespercorixa castanea		**B**			**SW**	**SW**	**SW**	
Arctocorisa carinata		**C**		**SW**				
Callicorixa wollastoni		**C**		**SW**				

SPECIES	STATUS	FIDELITY	LRB	BB	WFB	SB	SFB	ROB
Sigara scotti		C		SW			SW	
Sigara semistriata		C		SW				
Coenonympha tullia		A	GRS	GRS				
Chlorissa viridata	Na	C	EDS, TS					EDS, TS
Idaea muricata	Nb	C			NK	NK		
Hydriomena ruberata		C	TS		TS	TS		TS
Coenocalpe lapidata	Na	B						GRS
Rheumaptera hastata	Nb	C	TS					TS
Carsia sororiata	Nb	B	EDS	EDS		EDS		EDS
Selidosema brunnearia	Na	C	EDS					EDS
Cleora cinctaria	Na	C						TS
Dyscia fagaria		C	EDS			EDS		EDS
Acronicta menyanthidis		B	EDS	EDS				EDS
Apamea zeta		B		GRS				GRS
Celaena haworthii		B	GRS	GRS		GRS		GRS
Coenobia rufa		C				GRS		GRS
Heliothis maritima	RDB3	B						EDS
Deltote uncula		C	GRS			GRS		GRS
Hypenodes humidalis	Nb	B	NK			NK		NK
Agrypnia obsoleta		B		SW				
Hagenella clathrata	RDB1	A	SW, RW			SW, RW	SW, RW	
Oligotricha striata		B		SW			SW	
Limnephilus coenosus		A	SW, RW	SW, RW				
Limnephilus elegans		B	SW		SW	SW	SW	
Rhadicoleptus alpestris		A		SW		SW		
Erioconopa diuturna		B		NK				
Erioptera nielseni	N	A						SL
Euphylidorea meigenii		B						
Idioptera pulchella		B						
Limonia aperta	RDB1	A	SL, BP					
Limonia dilutior		B		BP				BP
Limonia distendens	N	B					RW	

SPECIES	STATUS	FIDELITY	LRB	BB	WFB	SB	SFB	ROB
Molophilus ater		A		BP				
Molophilus occultus		C	BP	BP				BP
Ormosia pseudosimilis		B		BP				BP
Phalacrocera replicata	N	C			SL	SL	SL	
Phylidorea abdominalis	N	A						BP
Phylidorea fasciata	RDB1	A			BP	BP		
Phylidorea heterogyna	RDB1	A	BP					
Phylidorea pulchella	N	C	BP	BP		BP		BP
Phylidorea squalens		B		SW				
Prionocera pubescens	RDB2	A				SL		SL
Prionocera turcica		C				NK		
Tipula melanoceros		A	SW	SW		SW	SW	
Tipula gimmerthali	RDB3	C		RW			RW	
Tipula grisescens	RDB3	A		SL				
Tipula holoptera	N	B					RW	
Tipula limbata	RDB3	C					RW	
Tipula subnodicornis		A					RW	
Tipula yerburyi	N	C						TS
Tricyphona immaculata		C		NK				NK
Tricyphona schummeli		B		NK				
Campsicnemus alpinus		B	SL	SL		SL		SL
Campsicnemus compeditus		A	SL	SL		SL		SL
Chrysotus obscuripes		A	SL	SL		SL		SL
Dolichopus atratus		B	BP	BP		BP		BP
Dolichopus atripes		C	BP	BP		BP		BP
Dolichopus lepidus		C	BP			BP		BP
Dolichopus lineatocornis	LR	C						BP
Dolichopus vitripennis		B		BP		BP		BP
Hercostomus aerosus		C	BP	BP		BP		BP
Hercostomus angustifrons	N	A	BP					BP
Hydrophorus albiceps		A		SW				
Hydrophorus nebulosus		C			SW		SW	

SPECIES	STATUS	FIDELITY	LRB	BB	WFB	SB	SFB	ROB
Nematoproctus distendens	**LR**	**C**						**NK**
Rhaphium longicorne		**C**	**BP**			**BP**		**BP**
Tachytrechus consobrinus	**N**	**B**						**BP**
Atylotus fulvus	**N**	**A**						**BP**
Atylotus plebeius	**RDB1**	**A**	**BP**			**BP**		
Chrysops sepulcralis	**RDB1**	**A**						**BP**
Hybomitra lurida	**RDB3**	**B**	**BP**			**BP**		
Hybomitra montana		**A**	**BP**			**BP**		**BP**
Tabanus sudeticus		**B**	**BP**			**BP**		**BP**
Anasimyia lunulata	**N**	**C**			**SW**	**SW**		
Chrysogaster virescens		**C**					**SW, RW**	
Eristalis cryptarum	**RDB2, BAP**	**A**					**RW**	
Melanogaster aerosa	**N**	**C**					**SW, RW**	
Microdon myrmicae	**N**	**B**						**SL**
Orthonevra geniculata		**C**				**BP**		**BP**
Pelecocera tricincta	**RDB3**	**C**						**NK**
Gonatherus planiceps	**RDB3**	**B**					**RW**	
Cordilura aemula	**RDB3**	**C**			**SW**			
Cordilura atrata	**N**	**C**			**SW**			
Cordilura hyalipennis	**RDB1**	**A**			**SW**			
Cordilura rufimana	**N**	**C**			**SW**			
Carabus nitens	**Nb**	**B**		**SL, GRS**				**SL, GRS**
Elaphrus lapponicus	**Na**	**B**						**SL, GRS, BP**
Elaphrus uliginosus	**Nb**	**C**						**SL, GRS, BP**
Trechus rivularis	**RDB3**	**B**		**SL**				
Bembidion humerale	**RDB1, BAP**	**A**	**BP**					
Tachys edmondsi	**RDB1, RDB5, BAP**	**A**						**SL**
Elaphropus walkerianus	**RDB1**	**A**						**SL**
Pterostichus aterrimus	**RDB1, BAP**	**B**						**GRS**
Pterostichus diligens		**C**	**SL, GRS**	**SL, GRS**		**SL, GRS**		**SL, GRS**
Pterostichus rhaeticus		**B**	**SL, GRS**	**SL, GRS**	**SL, GRS**	**SL, GRS**		**SL, GRS**
Agonum ericeti	**Nb**	**A**	**SL, BP**	**SL, BP**				

SPECIES	STATUS	FIDELITY	LRB	BB	WFB	SB	SFB	ROB
Agonum gracile		C	SL	SL	SL	SL		SL
Agonum sexpunctatum	Na	B						BP
Acupalpus flavicollis	Na	C						SL, GRS
Cymindis vaporariorum	Nb	B		SL, GRS				
Gyrinus minutus	[LRnsB]	B		SW			SW	
Hydroporus gyllenhalii		B	SW	SW	SW	SW	SW	
Hydroporus longicornis	[LRnsB]	B					RW	
Hydroporus melanarius		C	SW	SW			SW	
Hydroporus morio		B		SW				
Hydroporus necopinatus	[EN], BAP	A					SW	
Hydroporus obscurus		B	SW	SW	SW	SW	SW	
Hydroporus tristis		C	SW	SW		SW		
Agabus affinis		B	SW	SW	SW	SW	SW, RW	
Agabus arcticus		C		SW				
Agabus congener		B	SW	SW		SW	SW	
Agabus montanus		B	SW	SW		SW	SW	
Ilybius aenescens	[LRnsB]	A		SW		SW	SW	
Rhantus suturellus		A	SW	SW	SW	SW	SW	
Acilius canaliculatus	[LRnsB]	B	SW					
Helophorus flavipes		C	SW, RW	SW, RW	SW	SW	SW, RW	
Helophorus tuberculatus	[LRnt]	C		BP				BP
Paracymus scutellaris	[LRnsB]	B					SW, RW	
Anacaena lutescens		C					SW, RW	
Laccobius atratus	[LRnsB]	A					RW	
Helochares punctatus	[LRnsB]	A	SW	SW	SW	SW	SW	
Enochrus affinis	[LRnsB]	A	SW			SW	SW	
Enochrus fuscipennis		B	SW			SW	SW	
Olophrum fuscum		C		SL				SL
Eusphalerum minutum		C						NK
Hadrognathus longipalpus	Nb?	C						SL, GRS
Bibloplectus ambiguus		C	SL, GRS	SL, GRS	SL, GRS	SL, GRS		SL, GRS
Bibloplectus tenebrosus	RDBK	B	SL					SL

SPECIES	STATUS	FIDELITY	LRB	BB	WFB	SB	SFB	ROB
Bibloplectus spinosus	**N**	**C**	**SL**	**SL**	**SL**	**SL**		**SL**
Pselaphaulax dresdensis	**N**	**C**			**SL**	**SL**		
Pselaphus heisei		**B**	**GRS**	**GRS**				**GRS**
Tachyporus transversalis		**B**	**SL, GRS**					**SL, GRS**
Gymnusa brevicollis		**A**	**SL**	**SL**	**SL**	**SL**		**SL**
Gymnusa variegata	**N**	**B**			**SL**	**SL**		**SL**
Myllaena kraatzi	**N**	**A**						**SL**
Oxypoda procerula		**B**	**SL, GRS**	**SL, GRS**				**SL, GRS**
Ilyobates nigricollis	**RDBK**	**C**						**SL, GRS**
Schistoglossa aubei	**RDBK**	**C**	**SL, GRS**		**SL, GRS**			
Schistoglossa curtipennis		**C**						**SL, GRS**
Philhygra arctica		**B**		**SL**				
Atheta strandiella	**N**	**B**	**SL**	**SL**				
Stenus lustrator		**C**						**GRS**
Stenus fuscipes		**C**						**GRS**
Stenus melanarius		**C**						**SL, GRS**
Stenus subdepressus	**RDBI**	**C**						**GRS**
Stenus opticus	**Na**	**C**			**SL, GRS**	**SL, GRS**		
Stenus kiesenwetteri	**RDB2**	**A**						**GRS**
Stenus oscillator	**Nb**	**B**						**SL, GRS**
Stenus brevipennis		**B**		**GRS**				
Stenus niveus	**Nb**	**C**			**GRS**			**GRS**
Euaesthetus laeviusculus		**C**	**SL, GRS**	**SL, GRS**	**SL, GRS**	**SL, GRS**		**SL, GRS**
Paederus caligatus	**RDB3**	**B**						**BP**
Lathrobium terminatum		**B**	**SL**	**SL**	**SL**	**SL**		**SL**
Lathrobium zetterstedti	**Nb**	**C**		**SL, GRS**				
Lathrobium rufipenne	**RDB2**	**C**				**SL**		
Ochthephilum fracticorne		**B**	**SL**	**SL**	**SL**	**SL**		**SL**
Erichsonius cinerascens		**C**	**SL, GRS**			**SL, GRS**		**SL, GRS**
Erichsonius ytenensis	**RDBI**	**A**						**SL**
Philonthus nigrita		**B**	**SL**	**SL**	**SL**	**SL**		**SL**
Gabrius trossulus		**C**						**GRS**

SPECIES	STATUS	FIDELITY	LRB	BB	WFB	SB	SFB	ROB
Quedius boopoides		**B**		**SL**				**SL**
Quedius fulvicollis	**Nb**	**C**						**GRS**
Acylophorus glaberrimus	**RDB1**	**A**						**BP**
Cyphon hilaris		**C**	**SW**	**SW**	**SW**	**SW**	**SW**	
Cyphon kongsbergensis	**Na**	**A**	**SW**	**SW**				
Cyphon padi		**C**				**SW**	**SW**	
Cyphon punctipennis	**Na**	**A**		**SW**				
Curimopsis nigrita	**RDB1, BAP**	**A**	**BP**					
Actenicerus sjaelandicus		**C**						**GRS**
Cantharis figurata		**C**						**GRS**
Cantharis paludosa		**B**		**GRS**		**GRS**		**GRS**
Plateumaris discolor		**C**	**SW**	**SW**	**SW**	**SW**		
Donacia obscura	**Na**	**C**			**SW**			
Cryptocephalus biguttatus	**RDB2**	**A**						**EDS**
Cryptocephalus decemmaculatus	**RDB2, BAP**	**B**				**TS**		
Longitarsus nigerrimus	**RDB1**	**A**			**SW**			
Chaetocnema confusa		**C**	**GRS**					**GRS**
Chaetocnema subcoerulea	**Nb**	**C**						**GRS**
Apion genistae	**Na**	**C**						**NK**
Bagous frit	**RDB3**	**A**			**SW**	**SW**		
Rhynchaenus iota	**Nb**	**A**						**NK**
Formica candida	**RDB1, BAP**	**A**						**GRS**
Eumenes coarctatus	**Na**	**C**						**EDS**

Notes on Appendix 2:

Columns 4-9 represent the 6 major hydrotopographical mire types discussed in section 3.2 of this report, **LRB** = Lowland Raised Bogs, **BB** = Blanket Bogs, **WFB** = Waterfringe Bogs, **SB** = Sump Bogs, **SFB** = Spring-fed Bogs & Soakways and **ROB** = Run-off Bogs. Presence of mire associates within these types is indicated by habitat feature abbreviations, which indicate the habitat(s) occupied by the species in question, these being as follows: **SL** = Open *Sphagnum* lawn, **GRS** = Grass, rush & sedge tussocks and litter, **EDS** = Ericaceous dwarf shrubs, **SW** = Still water, **RW** = Running water, **TS** = Scattered trees and scrub and **BP** = Bare peat. **NK** in columns 4-9 indicates that the species in question has not been categorised within one of the 7 key habitat features.

International/national status categories in column 2 are interpreted as follows:

ECII - Species included in Annex II of the EC Habitats Directive.

BAP - Priority species listed in the UK BAP (UK Biodiversity Steering Group 1995).

RDB1 – Red Data Book Category 1 – Endangered. Taxa in danger of extinction and whose survival is unlikely if causal factors continue operating.

RDB2 – Red Data Book Category 2 – Vulnerable. Taxa which are known from 15 or fewer 10 km squares of the National Grid and which are decreasing and will become endangered in the near future if the causal factors continue operating.

RDB3 – Red Data Book Category 3 - Rare. Taxa with small populations that are not at present Endangered or Vulnerable, but are at risk.

RDB5 – Red Data Book Category 5 – Endemic. Taxa which are not known to occur naturally outside of Britain.

RDBI – Red Data Book Category I – Indeterminate. Taxa considered to be Endangered, Vulnerable or Rare, but where there is insufficient information to say which of the three categories (RDB 1-3) is appropriate.

RDBK – Red Data Book Category K – Insufficiently Known. Taxa that are suspected but not definitely known to belong to one of the RDB categories, because of lack of information.

Na – Nationally Scarce Category A. Taxa thought to occur in 30 to 16 10 km squares of the National Grid.

Nb – Nationally Scarce Category B. Taxa thought to occur in between 30 and 100 10 km squares of the National Grid.

N – Nationally Scarce. Taxa which are estimated to occur within the range of 16 to 100 10km squares, but where division into Na or Nb status has not been attempted due to limited availability of information on British distribution.

EN – Endangered. A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.

LR – Lower Risk. A taxon is Lower Risk where it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the LR category can be separated into four subcategories.

LRnt – Lower Risk, near threatened. Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable - in Britain, defined as occurring in 15 or fewer hectads but not CR, EN or VU. The absolute count of hectads is, in this review, considered subordinate to evidence of decline on an extent not qualifying the species for CR, EN or VU.

LRns – Lower Risk, nationally scarce. Taxa which do not qualify for Conservation Dependent or Near Threatened - in Britain defined as species occurring in 16 to 100 hectads but not CR, EN or VU. Nationally Scarce species are usually divided into lists A (**LRnsA** 16-30 hectads) and B (**LRnsB** 31-100 hectads) as in the previous system. This subcategory associates a level of threat with rarity status, whereas the previous National Scarcity listings were based solely on rarity. Those species, the populations of which occasionally occupy more than 30 or 100 hectads as LRnsA and LRnsB respectively, can still be listed if it is thought that their baseline populations frequently fall below these thresholds, or if the habitats occupied are considered under threat.

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Top left: Using a home-made moth trap.
Peter Wakely/English Nature 17,396
Middle left: Co_2 experiment at Roudsea Wood and Mosses NNR, Lancashire.
Peter Wakely/English Nature 21,792
Bottom left: Radio tracking a hare on Pawlett Hams, Somerset.
Paul Glendell/English Nature 23,020
Main: Identifying moths caught in a moth trap at Ham Wall NNR, Somerset.
Paul Glendell/English Nature 24,888