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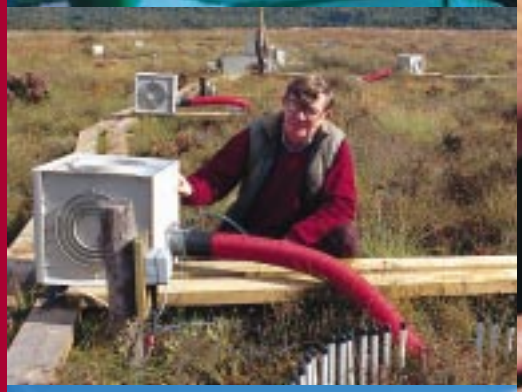

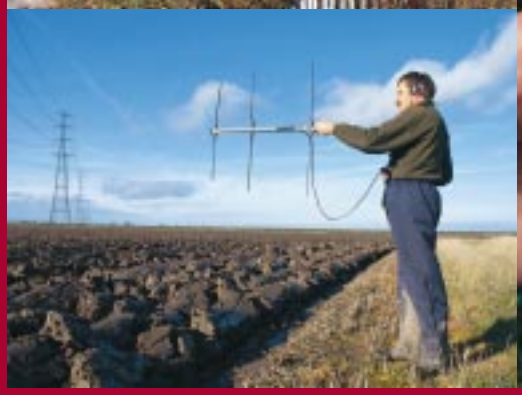

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A review of the invertebrate interest of coarse woody debris in England

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Summary

This report provides a description of the range of woody debris and its distribution within England. Although this review covers England, additional information on the habitat and its fauna elsewhere in Britain and mainland Europe is considered. Areas of England with the greatest interest are highlighted.

Details are provided of 147 species that are considered to be particularly associated with coarse woody debris, including those species that may benefit from changes in structure afforded by log jams and woody debris. Each of the major taxa have been discussed in turn. Wherever possible, ecological information has been tabulated including national status, regional distribution, wood species used, state of wood decay, size of woody material used, whether the species is an upland or lowland species, flow rate, fidelity and key references. The fidelity scores have been based on whether species are obligate or facultative xylophagous species or non-xylophagous species that utilise CWD. A total of 15 obligate xylophages have been identified along with 3 possible obligate xylophages, 48 facultative xylophages, 33 probable xylophages and 30 non-xylophages. Further checking and tightening-up of the species within these categories is required.

Recommendations for further work are provided.

Contents

Background

Coarse woody debris, including log jams and partially submerged wood is thought to be of importance for invertebrates, both directly as a resource and indirectly from the changes it has to the river and stream structure. Watercourses containing high amounts of woody debris, including log jams, are not particularly common throughout England as such wood is often seen as potentially hazardous and is removed.

One such species that requires woody debris and partially submerged logs is featured in the UK Biodiversity Action Plan. This is the cranefly *Lipsothrix nigristigma*, and English Nature has undertaken surveys of sites in areas where it has been recently recorded. Whilst the species has now been relocated in a number of areas (Godfrey 2000a, 2000b), there is still a scarcity of information on what other invertebrate species utilise woody debris in streamcourses.

The aim of this report is to gain more of an understanding of how important log jams and woody debris are to other invertebrates.

Aims

1. Description of the resource and its variations.
2. A review the invertebrate fauna associated with woody debris.
3. A list of species associated with woody debris including the degree of fidelity of species to the habitat.
4. Recommendation of further survey methods.

This report covers the following aspects:

- A description of the range of woody debris and its distribution within England. Although this review covers England, additional information on the habitat and its fauna elsewhere in Britain (and Europe) is considered. Areas of England with the greatest interest are highlighted.
- A list of all species and groups of species that are particularly associated with woody debris, including wherever possible those species that may benefit from changes in structure afforded by log jams and woody debris. Each of the major taxa have been discussed in turn. Wherever possible information listed below is included:

    1. Known ecology.
    2. National status – including any proposed changes to the national status.
    3. Regional confinement.
    4. Type of wood utilised – including species, amount of decay and size of debris.
    5. Watercourse type – lowland/upland, fast/slow-flowing, shaded, etc.
    6. A fidelity score for each species. A score has been used, which indicates a degree of association from obligate species through to those, which merely benefit from changes in structure.

The range of woody debris in streams in England

The term 'coarse woody debris' (or CWD) is often used to denote the input of fallen trees and other woody matter into watercourses. Other terms such as 'large organic debris (LOD), 'large woody debris' (LWD) or simply 'large wood' have been used to denote pieces of dead wood of a variety of sizes but now are generally accepted to refer to pieces larger than 10cm in diameter and 1m in length (Linstead and Gurnell 1999). These terms can therefore be taken to refer to entire trees, root boles, trunks, logs, branches and other pieces of wood that can accumulate within river systems.

Most of the research on CWD has been conducted in North America with relatively little until the 1990's coming out of the UK. The most useful hydrological and geomorphological work in England to date has come from Southampton University (Gregory, Gurnell and colleagues) largely based on studies undertaken in the New Forest. In recent years the hydrological, geomorphological and ecological importance of CWD in streams appears to have been recognised. A conference held in North America in 2000 (see Appendix 2 for some details) has created much interest and has involved the setting up of a website in March 2003 at

http: //riverwood.oregonstate.edu/html.

At the time of production of this report this website was not ready but it is expected to be running from March 2003.

An increasing amount of published work is appearing from the UK, mainland Europe, North America and elsewhere. Where possible reference has been made to English or European work but because of the much greater amount done in North America, reference to this is made where it is thought to be relevant and unavoidable.

The quantity and distribution of CWD within woodland river channels is controlled by the following:

- by the supply of CWD to the woodland floor and to the channel;
- the decay rates of the debris both on land and in the channel;
- the methods by which CWD is supplied to the channels.

Harmon *et al* (1986) reviewed the rates of input of CWD to the forest floor based mainly on North American examples. The smallest rates were from deciduous (*Quercus*) scrub and the largest rates from coniferous stands. In general, deciduous forests appeared to produce less CWD than coniferous forests. These authors noted that conifer stands tend to have greater accumulations of CWD compared with deciduous forests. Reasons for this discrepancy are the faster decay rates in deciduous forests as a result of the generally smaller size of the CWD and the predominant location of deciduous forests in areas where the climate is more favourable to decay. Since the availability of CWD is also dependant on the age of the stand, the history of the woodland has a major bearing on CWD volume and biomass.

The amount of CWD that reaches the river system is a product of the ability of the forest to generate CWD and deliver it to the watercourses. Important transport mechanisms include sliding down hillslopes, blowdown, transport of debris from upstream, debris torrents from tributaries and landslips.

The biomass of CWD in unmanaged old growth natural forests was tabulated by Gregory et al (1993) and shown to be a function of area. The biomass of CWD in forests has been shown to vary greatly from area to area even under the same type of forest which may reflect the influence of factors such as the age of the forest stand, catchment area and topography, channel size and gradient, the rate of decomposition of the debris, and the storm and flood frequency characteristics of the site (Gregory 1992). A number of studies have shown that the amount of CWD increases downstream. A major source of debris downstream is from large trees falling into the river as a result of bank undercutting. Such large CWD rarely moves even in floods because the extensive floodplain absorbs flood flows and reduces their velocity so that stream power is rarely sufficient to move the largest woody elements. As a result CWD accumulates behind these large elements. In steeper, higher-energy streams, the reverse trend of decreasing debris with increasing stream size usually applies Harmon et al (1986) stated that amounts of CWD are generally highest in the smallest streams and decrease with increasing stream size, given particular physiographic and forest settings.

Previous research has suggested that the density of debris dams per unit channel length decreases downstream, although forest management, including clearance, can either increase or decrease dam density. The causes of these trends are complex. In small streams, the pattern of CWD accumulations largely reflects the pattern of input, since the streams have insufficient power to remove any but the smallest pieces of debris. In intermediate sized streams, a greater proportion of CWD can be moved during floods. Pieces larger than the channel width can remain stable whilst smaller pieces accumulate behind these and behind other large objects such as boulders. In large channels, where the channel width exceeds the length of most of the CWD, virtually all the CWD can be moved during major floods. In such circumstances, accumulations of CWD rarely develop across the channel but accumulate at the sides or on mid-channel bars.

From the above, the spacing of CWD accumulations can be related to the mobility of pieces of CWD of differing size under varying stream power and channel roughness. This has implications not only for the size, spacing and location of CWD accumulations but also for their permanence. Gregory et al (1985) classified dams into active, complete and partial according to their influence on energy dissipation. Active dams present a complete barrier to water and sediment movement and so induce a step in the riverbed profile. Complete dams provide a continuous barrier across the river but do not produce a step in the riverbed profile. Partial dams only present a barrier across a part of the river width. In 1982, 287 debris dams in the main channel and two headwater streams within the mixed woodland of the Highland Water catchment (11.4km^2), New Forest, Hampshire were mapped and classified. Re-mapping 12 months later revealed that 36% of the dams had either moved or had changed class. Three later re-surveys following some in-channel debris clearance, a severe storm and six months after the storm, revealed major changes in dam type and location. CWD deposited in the channel after the storm was re-distributed in the following six months to produce a large number of new partial and complete dams. A major role of the dams is in buffering and delaying the movement of pieces of CWD and other organic matter down the channel. The New Forest study indicates the high mobility of CWD accumulations, but research in North

America on debris dams in mature forests with much larger trees suggests that the residence time of major dams can be as great as 200 years.

More complete accounts on the role of CWD in British river systems may be found in Gregory et al (1985, 1994), Gregory and Davis (1992), Gurnell et al (1995) and Linstead and Gurnell (1999). These authors make reference to the much greater amount of research undertaken in North America. A semi-popular account of the process of deadwood accumulation, transportation to and along streams and decomposition in North America is provided by Maser and Sedell (1984).

The distribution of woody debris in streams in England

So little work has been undertaken on CWD in England that it is difficult to discuss the distribution of CWD in streams in any detail. Linstead and Gurnell (1999) recently provided information on 'large woody debris' (abbreviated to LWD and including trees, large branches, etc) in British catchments based by analysing data from the Environment Agency's River Habitat Survey (RHS) database. Analysis of this data was used to provide baseline information on LWD in British headwaters as a whole. LWD is recorded in the RHS survey as debris dams whilst information on trees is also collected. Raven et al (1998) stated that LWD and debris dams are features associated with 'wild character' and habitat diversity but relatively few RHS sites have these features as a result of channel management for drainage, flood defence and fisheries.

Raven et al (1998) includes data derived from the RHS database on the extent of LWD both by region and using four example river types. Linstead and Gurnell (1999) estimated the percentage of upland and lowland sites in the UK with LWD, debris dams, fallen trees and at least one bank with trees. For England there is a greater percentage of lowland sites with LWD and extensive LWD than upland sites, reflecting the greater percentage of lowland sites with trees on either bank. Debris dams occur in approximately the same percentages of upland and lowland sites for England and they are about twice as frequent in England and Wales compared with Scotland.

The same authors analysed data for four river habitat types: steep streams, mountain valley rivers, chalk rivers and small, lowland riffle-dominated rivers. Together these four types represent about one fifth of RHS sites. For steep streams, LWD and fallen trees are not as abundant on semi-natural sites as on other sites, reflecting the smaller number of semi-natural sites with riparian trees. For the other three river habitats, LWD is more extensive on semi-natural sites.

Of the 4518 RHS sites in England and Wales analysed 47.8% had no LWD, 48.9% has LWD present and only 3.3% had extensive LWD. Information on debris dams was recorded for 3030 sites. Of these, debris dams were absent for 81.7% of sites, 18.3% has LWD present and only 0.06% had extensive LWD.

These results can be summarised thus:

- there are regional patterns related to regional variations in tree density;
- the distribution of LWD within regions varies between uplands and lowlands;

- the distribution of LWD within regions varies as a result of tree density, with lowland sites generally having a greater amount of LWD;
- LWD abundance is also related to river habitat type and the degree of anthropogenic alteration;
- three of the four river habitats had greater LWD on semi-natural sites.

Areas of England with the greatest interest of coarse woody debris

Despite the paucity of research on CWD in England, a number of areas stand out as being of particular interest. These are discussed below:

Welsh Borders

The Welsh Borders support the main British populations of *Lipsothrix nigristigma* (RDB1) and *Chalcosyrphus eunotus* (RDB2). Whilst the development in the wild in CWD has yet to be proven in the latter, the adults certainly have a close association with semi-submerged logs in streams. The map provided by Ball and Morris (2000) shows the majority of records are located along the Welsh Border. The area around Telford, Shrewsbury and, to a lesser extent has been surveyed for *Lipsothrix nigristigma* whilst parts of Monmouthshire have been surveyed for *Lipsothrix nervosa*. Other significant areas for CWD are likely to be the Wyre Forest and Forest of Dean.

Several of the records of the rare riffle beetle *Macronychus quadrituberculatus* are from the Welsh Borders (Foster in prep.).

Lancashire

The re-discovery of *Lipsothrix nigristigma* (RDB1) near Blackburn in 2001 added a second population centre for this rare species. Despite heavy modification and interference by man, the continued existence of this species after a gap of 75 years in Lancashire, indicates that CWD still occurs.

The *Lipsothrix errans* material reared by Brindle (1967) was also obtained from Lancashire.

New Forest

No invertebrate information is available from CWD in the New Forest, which reflects the absence of survey work. This area does however, represent one of the largest areas of semi-natural woodlands in England and has the highest number of debris dams per unit length of watercourse. Most of the hydrological and geomorphological work on CWD to date in England has been carried out here and therefore information is available on these which is absent elsewhere in England (see Gregory et al 1985, Gregory and Davis 1992, Linstead and Gurnell 1999).

Invertebrates associated with coarse woody debris

Invertebrates associated with decaying or diseased wood in terrestrial situations have been extensively studied in Britain and through Europe. Deadwood associated invertebrates include the largest number of rare and uncommon species in Britain and on the Continent. By contrast relatively few invertebrates are known to colonise fallen wood in streams or other watercourses. Very few studies have been undertaken in Britain or Continental Europe: these have been mostly concerned with studying particular taxa such as chironomids (Cranston 1982, Cranston and Oliver 1988) or *Lipsothrix* species (Godfrey 2000a, 2000b, 2001, 2002, Rotheray: no date). Some information is available from taxonomic studies, for example, Borkent (1984) on *Stenochironomus* and Noll (1985) on Tipuloidea. The recent special issue of *International Revue of Hydrobiology* on CWD provides the greatest source of information on European faunas and contains several relevant articles (see Appendix 2 for contents). Several key articles from this issue have not been available to consult from this issue including Spänhoff et al (2000) on the colonization of submerged twigs and branches by aquatic macroinvertebrates, Hering et al (2000) and Gerhard and Reich (2000).

The situation in North America is very different and a large amount of research on the ecology of invertebrates associated with CWD has been conducted for over fifty years. This literature is relevant to Britain and the remainder of Europe since many of the genera are the same, even if the species are unfamiliar. Amongst some of the more relevant literature are the publications of Anderson and Sedell (1979), Dudley and Anderson (1982) and Anderson (1984). Harmon et al's (1986) paper covers temperate regions but is mainly drawn from North American research.

Hoffman and Hering (2000) have recently listed wood-associated macroinvertebrates found in central European streams. Records have been combined with those of the present author and other records located from published and other sources. A list of all those species that are particularly associated with woody debris, including wherever possible those species that may benefit from changes in structure afforded by log jams and woody debris is included in Table 1. Each of the major taxa are discussed in a later section below.

Explanation of data presented on Table 1

Data are presented on 147 species recorded from or associated with CWD to a greater or lesser extent in Britain. Data are presented on species (or taxa), order (or equivalent), national status, regional distribution, wood species used, state of wood decay, size of woody material used, lowland or upland species, flow rate, fidelity and key reference(s). National statuses are taken from Recorder for Red Data Book and Notable (now Nationally Scarce) species. Regional distribution is presented by the presence of the species in north, south, east or west Britain/England and frequency/rarity is denoted by the use of upper case or lower case letters respectively. Wood species, state of decay and size of wood used are given where known. The author has additional information on these that has not been transcribed from rearing records due to lack of time. Lowland/upland species and flow are provided where known. Fidelity was indicated as follows:

a = obligate xylophagous species
b = possible obligate xylophagous species

c = facultative xylophagous species
d = probable facultative xylophagous species
e = non xylophagous species

These terms are described below.

Wood utilization by invertebrates

Dudley and Anderson (1982) recognised two main categories of invertebrate usage on wood debris in streams namely: (a) those that are largely dependent upon wood at some life stage or have a significant effect on wood degradation through feeding, and (b) those that are more opportunistically associated. The latter group include non-xylophagous species that use woody debris as a habitat during all or part of their life cycle. Direct ingestion of woody fragments plays a minor role in the feeding ecology although these species are able to feed from algae, bacteria and other materials on the surface of CWD. Hoffman and Hering (2000) divide the former into two further groups namely, facultative and obligate xylophagous species. Facultative xylophagous species include shredder species, which to some degree feed on wood. During certain periods in the life cycle, the gut content of these species is dominated by wood fragments. Obligate xylophagous species are those restricted to feeding solely on wood. In the alimentary tract of these species only wood fragments will be found. This group is dominated by miners but also include gougers and surface-tunnellers. These groups are discussed in more detail below.

A. Non-xylophagous species

CWD is attractive for invertebrates for a variety of reasons:

- CWD provides a large and solid substrate with a long residence time.
- The rough surfaces provide a complex microhabitat structure.
- There is a rich variety of microhabitats ranging from current-exposed sites (favoured for example, by *Simulium* spp), to deep pools immediately downstream of debris dams (favoured by certain Ephemeroptera as well as trout). CWD may trap leaf matter, fine particulate organic and inorganic matter and may be used as an attachment site by micro-organisms, algae, moss and higher plants.

Invertebrates in this group may use CWD as an attachment or pupation site, for emergence, oviposition, as a refuge and for foraging. Gurnell et al (1995) and Hoffman and Hering (2000) provide further details on the use of CWD by non-xylophagous aquatic invertebrates.

No research appears to have been undertaken on this group in Britain. A few records by the author have been combined with Continental records of British species in Table 1.

B. Facultative xylophagous species

Facultative aquatic xylophagous species mainly feed by gouging, chewing and mining. These invertebrates probably feed on micro-organisms such as fungi (aquatic hyphomycetes in particular), which colonize CWD and promote its breakdown. Taxa that feed this way include Plecoptera, Trichoptera and Diptera (Dudley and Anderson 1982). Due to its stability,

resistance and slow decomposition, wood is a constant substrate for comparatively long periods in running waters and offers a continuous nutrient supply for detrivorous groups.

C. Obligate xylophagous species

CWD in streams offers a number of advantages to invertebrates prepared to exploit it. These include:

- Submerged wood is protected from desiccation. This is particularly important in temporary or seasonal streams.
- Similarly, temperature fluctuations are less severe within pieces of wood, providing protection from freezing.
- Protection from fast currents and the possibility of being carried downstream.
- Protection from predators. Predation by *Dicranota* and *Tabanus* was noted by Brindle 1967 and Dudley & Anderson (1987). Similarly, the presence of *Dicranota* in CWD samples (for example, Godfrey 2001) suggests that these predate *Lipsothrix* and other limoniids. Living inside wood may afford some protection from these.
- Dispersal is minimised since many wood-mining insects spend their whole life cycle in a single piece of wood. Adults of many xylophagous aquatic insects seem to be poor fliers (i.e. *Macronychus*).

In order to exploit CWD, invertebrates must overcome a number of potential problems namely:

- The poor nutritional quality of wood.
- The texture of wood, particularly in the early stages of decay requires specialised mouthparts.
- The oxygen concentration in the interior of rotten wood is probably low, although little information is available on this.
- Small pieces of wood may be transported to terrestrial areas during floods or may be covered with sediment.

Relatively few obligate aquatic xylophagous species have been studied. Many wood-inhabiting species appear to have long growth rates and a comparatively long cycle. This may reflect the low nutrient content of wood or the constant and secure conditions, which allow for a long life cycle. Longer life cycles comparable with close relatives have been shown for *Lipsothrix* species (Dudley and Anderson 1987) and Chironomidae (Cranston 1982, Anderson 1989).

Mollusca

Aquatic and hygrophilous Mollusca may be frequent on CWD, which they presumably use for grazing. Hoffman and Hering (2000) list three facultative xylophagous species and two probably xylophagous species from Central Europe. All of these species are found in Britain.

The Dwarf pond snail *Lymnaea truncatula* was recorded on rotten logs lying over a stream in South Wales (Godfrey 2001). It was also were present on a log in the stream at Great Triley Wood, South Wales (Godfrey 2001).

Plecoptera

Plecoptera may be important users of CWD and have been frequently listed as such in the North American studies. Hoffman and Hering (2000) list non-xylophagous and as facultative xylophagous species most of which occur in Britain. *Capnia* nymphs were taken off a submerged log at Coed Y Cerrig, South Wales (Godfrey 2001).

Ephemeroptera

Mayflies are listed as users of CWD in the North American literature and by Hoffman and Hering (2000) from central Europe. Species listed by the latter all or mainly occur in Britain. Mayflies may indirectly benefit from the build-up of debris dams in that they often occur in the deep pools immediately below such dams. No British records are available of Ephemeroptera associated with CWD however.

Trichoptera

Trichoptera comprise important users of CWD according to North American studies and Hoffmann and Hering (2000). The latter list ten non-xylophagous species, 16 facultative xylophagous species, two obligate xylophagous species (both *Lype* species) and four other probable xylophagous species. The presence of wood in the gut contents was used to classify these species accordingly. Most of the species listed are found in Britain.

The limnephilid *Hydatophylax infumatus* occurs amongst woody debris usually in flowing water (Wallace et al 1990). The larvae eat decaying submerged wood of branches, twigs and heather stalks (Wallace 1991). The adult is secretive and this may explain some of the scarcity of British records. However, the larva is relatively easy to recognise because unlike most caddis, it has one (combined) dorsal plate not two plates on the third thoracic segment. Both *Lype* species are also wood feeders: gut analysis has revealed the presence of wood debris (Wallace 1991). A paper on the association of the lepidostomatid *Lasiocephala basalis* with wood (Hoffmann 2000) has not been available to consult. This species is usually found in stony rivers and large streams and has a case initially of sand grains but by the fifth instar is usually mainly or entirely composed of plant or woody fragments (Wallace et al 1990).

Some caddis may use logs for pupation, for larval foraging and for other uses. The author found larvae of the Nationally Scarce caseless caddis *Metalype fragilis* on a submerged decorticated log in Coed Y Cerrig, South Wales (Godfrey 2001). Several caddis have been reared from CWD by the author but these were not identified because the focus of previous work was on *Lipsothrix* species and due to of lack of time.

Coleoptera

Several Coleoptera are associated with CWD in North America and elsewhere. The Elmididae (riffle beetles) and Drypodidae are the dominant families. Detailed ecological studies have been conducted on some of these species (for example, Brown 1973 and

Steedman and Anderson 1985. The former paper provides details on the laboratory rearing of these beetles.

Hoffmann and Hering (2000) list one non xylophagous species (*Orectophilus villosus*), one facultative xylophagous species (*Elodes marginata*), two obligate xylophagous species (one British: *Macronychus quadritubermaculatus*) and one probable xylophagous species (*Stenelmis canaliculata*). One potentially useful reference on protecting beetles in CWD in Germany has not been available to consult (Geiser 1994).

Three species are particularly associated with CWD in British streams. These are dealt with separately below:

***Cyanostolus aeneus* (Rhizophagidae)**

This beetle occurs in wet woodland, river margins and probably other wetland habitats. It is found at sap and in crevices in bark, usually in damp places. It is also found on floating or partially submerged timber. It has been recorded under the bark of *Ulmus*, *Fagus*, *Quercus* and occasionally *Alnus*, *Betula*, *Castanea*, *Pinus* and *Malus*. The beetle is probably predatory on bark beetles (Scolytidae) of the genus *Xyleborus*, *Scolytus* and *Hylesinus* (Peacock 1977).

Threats to this species include the loss of broad-leaved woodland through, for example, clear-felling and coniferisation. Another threat is through habitat loss, in particular, through the felling of trees, removal of dead wood from living trees and the destruction or removal of standing and fallen dead wood for reasons such as forest hygiene, aesthetic tidiness, public safety or for use as fire wood. Drainage and water abstraction schemes may be further threats to this species (Hyman and Parson 1992).

***Pomatinus substriatus* (Dryopidae)**

The dryopid *Pomatinus substriatus* is closely associated with deadwood in streams. It is found submerged in lowland streams, usually on logs or under stones, clods of earth or in masses of exposed tree roots. Olmi (1976) described the eggs, which are inserted into rotting tree branches under water. The wireworm-like larvae, which feed in wet, rotting wood, have been described by Olmi (1976) and others. Adults and larvae of this species were found to occupy different faunal groups in a synthesis of the coleopteran fauna of the Upper Rhône catchment (Richoux 1994), adults being associated with side streams and larvae with temporarily flooded banks. This species is capable of flight.

No distribution map is available for this species. It is mainly western in England, recorded from Devon to Cumberland, and from Wales. There are recent published records for East Sussex, East Suffolk, Carmarthen, and Cardigan. *P. substriatus* is a southern and central European species, known north to Sweden, east to the Aral Sea and south to North Africa.

Canalisation of rivers must constitute the greatest threat in that submerged timber will be removed and tree roots destroyed. This is one of the few species to benefit from partial shading of streams. Log accumulations in water should be retained wherever possible. The Upper Rhône study demonstrates the importance of maintaining the complete suite of riverine habitats in order to conserve individual species such as *P. substriatus*, as well as sustaining biodiversity overall.

***Macronychus quadrituberculatus* (Elmididae)**

This a rare lowland riffle beetle that is usually found clinging to submerged tree trunks in deep, permanent water in rivers. The larva is wireworm-like and burrows into wet wood.

Recent records for this species are for the River Taw, North Devon; East Stoke, Dorset; the River Medway; the Holybrook, Berkshire; the River Thames at Reading on the Berkshire/Oxfordshire border; the River Teme and the River Severn, Worcestershire; the River Severn in Shropshire; the River Trent, Burton-on-Trent, Staffordshire; and the River Wye in Monmouth and West Gloucester. *Macronychus quadrituberculatus* is a western European species reaching Morocco and Hungary, absent from Scandinavia, but found in Latvia and Lithuania.

Holland's map (1980) included records from 1960 onwards for six hectads and earlier records from another three hectads. The species has been recorded from ten hectads since 1980.

Because of the elmid method of plastron respiration, the major perceived threat to elmids is reduction in dissolved oxygen associated with pollution. This problem must be particularly acute in species living in deep, permanent water, but *M. quadrituberculatus* adults can be found on timber in oxygen-poor backwaters. Other threats to this species must come from canalisation of rivers and associated loss of natural log jams. Rehabilitation of river systems should include provision of submerged timber.

Other species

A batch of Coleoptera collected by the author from semi-submerged logs in streams whilst surveying for *Lipsothrix nervosa* in South Wales in 2000 was submitted to the coleopterist Mike Denton for identification. A copy of these records is given in Appendix 2. Several of the species recorded are vagrants but others appear to represent hygrophilous species that use the wet exposed parts of logs in streams for foraging or for other purposes. *Lesteva longoelytrata* was recorded at several sites and was frequently found on the wet exposed parts of logs in streams. A number of scirtids were recorded including *Cyphon coarctatus* and *Elodes kollari*, which are unsurprising given the aquatic lifestyle of the larvae. *Dryops ernesti* was recorded from two sites. Other records include common beetles found in a variety of habitats and wetland chrysomelids (*Hydrothassa marginella*, *Chrysolina polita*), which must be regarded as vagrants.

Pyrochroa larvae were found under the bark of a small log in a small stream at Coed Y Cerrig (Godfrey 2001). Larvae were also found in a log at the foot of a seepage at Dan Y Graig, South Wales (Godfrey 2001). *Platambus maculatus* were found exposed on a log in the stream at Great Triley Wood, South Wales where they had clearly been for some time (Godfrey 2001). The reason for this unusual behaviour is unclear but the record is best regarded as incidental.

Diptera

The Diptera form the largest invertebrate groups utilising CWD. Hoffmann and Hering (2000) list two non xylophagous species, no facultative xylophagous species, eleven obligate xylophagous species and 25 probable xylophagous species. The North American literature

(i.e. Dudley and Anderson 1982) list several taxa, many of which also occur in Britain and mainland Europe.

Tipulidae

Tipula larvae can be frequent under bark on semi-submerged logs in streams (see Godfrey 2000b). Larvae taken by the author have not been identified to species although specimens have been reared. Records of tipulids swept or taken by other means from streams with abundant coarse woody debris may be found in the author's previous reports (Godfrey 2000a, 2000b, 2001, 2002). Several *Tipula* species are likely to use CWD in streams and Hoffmann and Hering (2000) list seven probable xylophagous species including *T. signata* and *T. staegeri* mentioned below.

One North American species (*Tipula sacra*) is particularly associated with abandoned beaver ponds (Pritchard and Hall 1971).

Tipula signata

The larva and pupa of this species were described by Theowald (1967). This species was reared from rotten wood with moss taken from a debris dam in the stream at Loamhole Dingle, Shropshire (Godfrey 2000b).

Tipula staegeri

The pupa of this species was described by Theowald (1967). This species was reared from woody material taken from Coed Y Cerrig, South Wales by the author (Godfrey 2001).

Limoniidae

This is an important family of CWD users. Hoffmann and Hering list four obligate xylophagous species (all *Lipsothrix* species: *L. nervosa* is presumably absent because it has only recently been recorded from central Europe) and 12 probable xylophagous species. Most of their species are probably facultative xylophages whilst others are clearly opportunistic (i.e. *Limonia nubeculosa*, *Rhipidia duplicata*).

Most of the species dealt with below appear to have more than an incidental association with logs in streams in the view of the current author. Incidental records of limoniids associated with coarse woody debris in British streams include *Achyrolimonia decemmaculata* taken on a log in the stream at Cwm Nant Sere, South Wales (Godfrey 2001) and *Euphylidorea lineola* taken off a log in Loamhole Dingle, Shropshire (Godfrey 2000b). Records of limoniids swept or taken by other means from streams with abundant coarse woody debris may be found in the author's previous reports (Godfrey 2000a, 2000b, 2001, 2002).

Atypophthalmus inusta

The larva of this species was described by Beling (1878). The species was recorded by Caspers (1980) in emergence traps in Germany. This species was reared from a rotten (*Ulmus*?) log from the stream at Loamhole Dingle, Shropshire in 2000 (Godfrey 2000b). This species emerged from woody debris taken from a log across the stream for rearing from Whitwell Wood, Shropshire (Godfrey 2000b). It was also reared from woody material taken

from the stream, debris taken from Coed Byrrwyd, Montgomeryshire (Godfrey ibid). An adult was taken on a dead stump in wet woodland at Coed Y Cerrig, South Wales (Godfrey 2001).

Austrolimnophila ochracea

Brindle and Bryce (1960) and Brindle (1967) record the larvae of this species in the dry wood of fallen trees or branches, just below the surface. They also notes it occurs in "more rotten and softer wood" and often occurs with *Epiphragma ocellare*. Various other Continental authors have also described the larvae (see Oosterbroek and Theowald 1991 for these). This species has been recorded in emergence traps in Germany (see Noll 1985 for references). Hoffmann and Hering (2000) regarded it as a probable xylophage.

This species was reared from larvae found in a log in a seepage at Dan Y Graig, South Wales (Godfrey 2001). It was also reared from woody material taken for rearing from Mercyfield Wood and Old Park Wood, Blackburn, Lancs (A. Godfrey unpublished). It was reared from wet wood 8-10cm above the stream and from a rotten (*Ulmus*?) log in the stream at Loamhole Dingle, Shropshire (Godfrey 2000b). Adults were found in an Owen emergence trap filled with semi-submerged logs from the main stream at Loamhole Dingle, Shropshire (Godfrey 2000b).

Dicranomyia chorea

Reusch (1988) described the larvae of this species. The species was recorded by Mendl (1975) and others in emergence traps in Germany (see Noll 1985 for references). This species emerged from woody debris taken from a log across the stream at Whitwell Wood, Shropshire in 2000 (Godfrey 2000b). A female of this common species was reared from woody debris taken from the main stream at Old Park Wood, Blackburn, Lancashire in 2001 (Godfrey pers. obs.). An adult was found in an Owen emergence trap filled with semi-submerged logs from the main stream at Loamhole Dingle, Shropshire (Godfrey 2000b).

Epiphragma ocellare

Brindle and Bryce (1960) and Brindle (1967) state that the larva of this species occurs in the dry wood of fallen trees, mainly in the cortical wood just below the surface. He also notes it occurs in "more rotten and softer wood". This species has been recorded in emergence traps in Germany (Mendl 1975). Hoffmann and Hering (2000) regarded it as a probable xylophage. According to Teskey (1976) Epiphragma larvae have mandibles well equipped for tunnelling and actively penetrate into woo, in some cases quite hard wood.

The author has reared this species from semi-submerged wood in streams from Bannister's Coppice, Shropshire and it was observed emerging from a log in a stream at Cwm Y Wydden, Montgomeryshire (Godfrey 2000b). It has been reared from wet woody debris taken at Dean Wood, Huddersfield, West Yorkshire (Godfrey 2002b). The author has several other rearing records or records of teneral adults or pupal exuviae from logs in streams. Pupal exuviae were found in a small log at Coed-Y-Cerrig, in a large log wedged into a bank at Cwm Taf Fechan, in rotten (*Alnus*?) logs in the stream at Great Triley Wood, South Wales and in damp, rotten and decorticated trunk on Livox Wood, South Wales (Godfrey 2001).

An adult of this species was found in an Owen emergence trap filled with semi-submerged logs from the main stream at Loamhole Dingle, Shropshire (Godfrey 2000b).

Helius longirostris

The larva of this species was described by Brindle (1967) but nothing is mentioned of the larval ecology. The larvae of *Helius flavus* and *H. pallirostris* were found between the leaves of marsh plants such as *Iris* and *Typha* according to Brindle (1967). Various Continental authors have also described the larvae or larval ecology of *Helius longirostris* (see Oosterbroek and Theowald 1991 for a list of these). This species was recorded in emergence traps in Germany (see Noll 1985 for references).

This species was reared from a wet decorticated log in a very wet area in Coed Y Cerrig, South Wales (Godfrey 2001). This is a non xylophagous species and the larva was probably within mud adhering to the woody debris taken for rearing.

Ilisia maculata

The larva of this species was described by Beling (1878) from wet earth, by Crisp and Lloyd (1954) who extracted it by flotation from mud taken in woodland and Brindle (1967) who gave no details of the larval ecology. This species has been recorded in emergence traps in Germany (see Noll 1985 for references). A female emerged from a wet wood sample taken for rearing from Whitwell Coppice, Shropshire (Godfrey pers. obs.). Like the above, this species is almost certainly non xylophagous and was probably present in mud adhering to the woody sample taken for rearing.

***Limonia* species**

Limonia larvae have been described by Brindle (1967) and various Continental authors listed by Oosterbroek and Theowald (1991). A male *Limonia flavipes* emerged from a sample taken for rearing from Cwm Nant Sere, South Wales (Godfrey 2001). Adults of *Limonia phragmitidis* were taken in an 'Owen' emergence trap filled with semi-submerged logs taken from the main stream in Loamhole Dingle, Shropshire (Godfrey 2000b). Hoffmann and Hering (2000) list three Limonia species as probable xylophage species: *L. macrostigma*, *L. nubeculosa* and *L. trimaculata*. The current author has occasionally reared *Limonia nubeculosa* from other saproxylic materials and it would appear to be an opportunistic facultative xylophage.

***Lipsothrix* species**

All *Lipsothrix* species develop in semi-submerged wood in stream. Survey work in England, Wales and Scotland has considerably added to the ecology of these species (Godfrey 2000a, 2000b, 2001, 2002, Rotheray: no date). Nearctic *Lipsothrix* species have been studied in much more detail (Rogers and Byers 1956, Hynes 1965, Dudley 1983 and Dudley and Anderson 1987. A provisional key to the larvae and pupae of all British species except the Scottish *L. ecucullata* was provided by Godfrey (2002).
All *Lipsothrix* species are listed as obligate xylophages by Hoffmann and Hering (2000) with the exception of *Lipsothrix nervosa,* which has only recently been found in central Europe (Stary et al 1997).

Lipsothrix ecucullata

Dr Graham Rotheray undertook a rearing programme for this Priority BAP species for Scottish Natural Heritage around 1999/2000. Eight localities were visited throughout Scotland, where the species is confined in Britain. The results of this rearing programme are not known.

Lipsothrix errans

The immature stages of this species were described by Beling (1886), Brindle (1967), Krivosheina (1969) and Savchenko (1982, 1986) according to Oosterbroek and Theowald (1991). Krivosheina and Mamaev (1967) also describe the larvae. This species was recorded by Mendl (1975) and Caspers (1980) in emergence traps in Germany.

Godfrey (2000b) reared this species from a survey of sites in Shropshire and Montgomeryshire and recorded it from eight sites.

Lipsothrix nervosa

This Priority BAP species is reasonably widespread in southern England, the south Midlands and Wales where it is associated with shaded seepages, spring lines and streams in deciduous woodland. The larvae develop in semi-submerged wood similar to other *Lipsothrix* species. Surveys for this species have been undertaken for the Countryside Council for Wales as part of the Species Recovery Programme and it has been reared or recorded from several sites (Godfrey 2001, 2002). It has also been reared from at least one site in Shropshire (Godfrey 2000b). This species was regarded as endemic in the UK Biodiversity Action Plan but has been recorded recently from Continental Europe (Stary et al 1997).

Lipsothrix nigristigma

No references to larval ecology are given by Oosterbroek and Theowald (1991) and the larval morphology and ecology is stated to be unknown by Noll (1985). The species was collected by emergence traps by Caspers (1980).

This species was described as new to science in 1938 by F.W.Edwards from a male collected by Harry Britten specimens taken from Clayton-le-Dale, Lancashire on 1st June 1924. The only records subsequent to this were from two sites on the outskirts of Telford in 1995 when it was discovered on a Dipterist's Field Meeting. A survey of sites in Shropshire in 1999 failed to record this Red Data Book one species. It was later realised that this was due to the survey taking place after the early flight season. A repeat survey in 2000 but undertaken earlier, resulted in *Lipsothrix nigristigma* being taken at eight sites all within Shropshire.

In 2001 a short survey was conducted of accessible woods in the vicinity of Clayton-le-Dale, Blackburn by the author. *L. nigristigma* was reared from semi-submerged logs found in the main stream at Mercyfield Wood, Blackburn. The exact location of the wood Harry Britten's specimen came from is unclear although there are a series of narrow wooded valleys in the vicinity of Clayton, on the north side of Blackburn. Unfortunately, Foot & Mouth Disease prevented a more thorough search of these woods for *Lipsothrix nigristigma*. However, the records from Mercyfield Wood (one of only two woods accessible in 2001), indicate that the species still exists in its type locality after a gap of 75 years. The fact that this species was

overlooked is surprising given the fact that a number of eminent cranefly specialists have lived in or worked this area in the intervening period including Alan Brindle, Harry Britten and Chris Cheetham.

This species was also regarded as endemic (UK Biodiversity Action Plan), but is considered synonymous with the Continental *Lipsothrix nobilis*. The author has compared specimens of both including the male genitalia (Godfrey 2000b) and concluded the two species are the same.

Lipsothrix remota

The immature stages of this species were described by Hinton (1955, 1967, 1968) and Brindle (1967). The statement that the larval morphology and ecology is unknown by Noll (1985) is therefore incorrect. The species was recorded by Mendl (1975), Caspers (1980) and others in emergence traps in Germany (see Noll 1985 for references).

The author has a relatively large number of rearing records of this species, which is the most common *Lipsothrix* species in Britain. As with other *Lipsothrix* species, it is closely associated with dead wood in streams and on seepages.

***Molophilus* spp**

Various authors have described the immature stages or larval ecology of Molophilus species including Crisp and Lloyd (1954) who extracted larvae from woodland mud Brindle (1967), Okely (1979) and Savchenko (1986). Various Molophilus species have been recorded in emergence traps in Germany (see Noll 1985 for references). Molophilus appendiculatus and M. medius were taken in an Owen emergence trap filled with semi-submerged logs from the main stream at Loamhole Dingle, Shropshire (Godfrey 2000b). Molophilus species are non xylophagous species and may have emerged from mud attached to woody debris in the emergence trap).

Numantia fusca

The immature stages and larval ecology of this species appear to be undescribed. The species was recorded by Caspers (1980) and Mendl (1975) in emergence traps in Germany. A female was observed emerging from its pupal case in a well rotten, decorticated log in a debris dam ay Coed Byrrwyd, Montgomeryshire (Godfrey 2000b). It was reared from a wet decorticated log in a very wet area at Coed Y Cerrig (Godfrey 2001). It was also reared from a log wedged in to the bank at Cwm Nant Sere (Godfrey ibid). An adult female was taken on a fallen branch in a seepage at Livox Wood (Godfrey ibid). In 2001 it was reared from woody debris taken from a seepage with *Lipsothrix remota* and *Dicranota* spp at Dean Wood, Huddersfield, West Yorkshire (Godfrey 2002b). Individuals have also been taken off logs in streams in the Habberley Valley and Loamhole Dingle, Shropshire (Godfrey 2000b). An adult was found in an Owen emergence trap filled with semi-submerged logs from the main stream at Loamhole Dingle, Shropshire (Godfrey 2000b).

Scleroprocta pentagonalis

The larvae of the similar *S. sorocula* were described by Brindle (1967) who states that the larvae occur in marshy soils near streams. Various unidentified *Scleroprocta* larvae have also

been described (see Oosterbroek and Theowald 1991). This species has been recorded in emergence traps in Germany (see Noll 1985 for references). Six adults of this species were taken in an Owen emergence trap filled with semi-submerged logs from the main stream at Loamhole Dingle, Shropshire (Godfrey 2000b).

Symplecta stictica

The immature stages of this species have been described by Brindle (1967), Houlihan (1969) and Reusch (1988). This species has been recorded in emergence traps in Germany (see Noll 1985 for references). This species emerged from woody debris taken from a log across the stream in Whitwell Wood, Shropshire in 2000 (Godfrey 2000b). The current author has once reared either this species or *S. hybrida* from rotholes suggesting it is a facultative xylophage.

Thaumastoptera calceata

The larva of this species was described by Brindle (1967) who stated that it occurs amongst detritus in limey mud near small woodland streams. Various Continental authors have also described the larvae (see Oosterbroek and Theowald 1991). The species was recorded by Caspers (1980) in emergence traps in Germany.

A male of this species was reared from a large decorticated and rotten log at Cwm Taf Fechan (Godfrey 2001). Two males were reared from similar circumstances from wood taken from a seepage at Dan Y Graig (Godfrey ibid). This species is non xylophagous and larvae were probably attached to woody debris taken for rearing.

Pediicidae

***Dicranota* spp**

The larvae of this genus comprise very active carnivores and can predate wood-mining limoniids (Brindle 1967). Dudley and Anderson (1982) found them to be fiercely predatory on aquatic wood-inhabiting insects in their laboratory rearing. A large unidentified *Dicranota* larva (too big to be *Paradicranota*) was found in a log in seepage at Dan Y Graig, South Wales (Godfrey 2001).

Dicranota (Paradicranota) simulans

The larva and larval ecology of this species appear undescribed. This species was reared from logs used by *Lipsothrix* species and wedged in debris dams in Cwm Nant Sere, South Wales (Godfrey 2001). An adult was also taken on a log in Cwm Nant Sere, South Wales (Godfrey ibid). This species may be prove to be predatory on *Lipsothrix* larvae.

Tricyphona immaculata

The larva of this species was described by Brindle (1962, 1967), Okely (1979) and various Continental authors listed by Oosterbroek and Theowald (1991). This species has been recorded in emergence traps in Germany (see Noll 1985 for references). This species was reared from a sample of woody material taken from the stream at Loamhole Dingle, Shropshire (Godfrey 2000b). It was also reared from woody debris taken from the main stream at Old Park Wood, Blackburn, Lancashire in 2001 (Godfrey pers. obs.). Individuals

have also been taken off logs in streams, for example, a female on wood in a seepage in the Hope Valley, Shropshire (Godfrey 2000b).

Ptychopteridae

Ptychoptera albimana

Ptychoptera larvae and pupae are adapted to live submerged, but near the surface, in streams, pond margins and seepages. Adults of *Ptychoptera albimana* were taken in an Owen emergence trap filled with semi-submerged logs taken from the main stream in Loamhole Dingle, Shropshire (Godfrey 2000b).

Simuliidae

Adults were found in an Owen emergence trap filled with semi-submerged logs from the main stream at Loamhole Dingle, Shropshire (Godfrey 2000b). The immature stages were presumably using the logs for attachment.

Chironomidae

Many Chironomidae have been recorded from immersed woody substrates but the nature of the wood association is unclear. For example, many of the genera listed by Dudley and Anderson (1982) appear to be no more than casual visitors using either wood as resting sites or for feeding. Zvereva (1950) described five larval species associated with submerged wood substrates in the genera *Smittia*, *Brillia*, *Psectrocladius* and *Glyptotendipes* (possibly belonging to *Polypedilum*). Most of these larvae appear to be adventitious and not mining in the wood. Cranston (1982) recorded the following either on the surface or in the space below loose bark on submerged branches in the stream flowing through Crowborough Warren, East Sussex: *Brillia modesta*, *Brillia longifurca*, *Metriocnemus* cf *hygropetricus*, *Polypedilum pedestre*, *Polypedilum* sp and *Thienemannimyia* sp. Cranston and Oliver (1988) stated that *Stenochironomus* and *Polypedilum* are strongly suspected of being obligate xylophages, only being found in immersed wood and with their guts consistently filled with wood fibres. *Glyptotendipes* spp may be obligate xylophages but confirmation is lacking. Taxa with distinct associations with immersed wood but are either unsubstantiated miners and/or having a wood diet are: *Polypedilum* spp including the Palaearctic *P. pedestre* and *Brillia* particularly the *flavifrons* group.

Several additional taxa have been recorded from wooded streams in the Nearctic taxa mentioned by Cranston and Oliver (1988) have been omitted from this account even where they include European genera. Anderson (1989) and Kaufman and King (1987) have studied xylophagous Chironomidae in a North American streams.

The present author has occasionally reared chironomids from woody debris taken from streams (Godfrey 2000b). These have not been identified. Eighty-seven adult chironomids were found in an Owen emergence trap filled with semi-submerged logs from the main stream at Loamhole Dingle, Shropshire making this by far the most abundant family present (Godfrey 2000b).

Hoffmann and Hering (2000) list seven chironomid species as obligate xylophages and four species as probable xylophages.

Micropsectra notescens

Cranston (1982) found tubes of this species on the surface and beneath loose bark, particularly where the wood was anchored in slow flowing areas in the Crowborough Warren stream.

Glyptotendipes gripekovani

Gripekoven (1914) found larvae of this species (as *Tendipes gripekovani*) in hard wood.

Glyptotendipes glaucus

Burtt (1940) found the larvae of this species mining occasionally in rotting submerged timber.

***Stenochironomus* sp**

Cranston (1982) found larvae mining in wood similar to that used by *Symposiocladius lignicola* in the Crowborough Warren stream.

Stenochironomus gibbus

Kalugina (1958) observed that the larvae from which she reared *S. gibbus* adults were common in dead submerged wood. She also noted that some larvae were recovered from plant material other than wood. Borkent (1984) suggested that two species may be represented in Kalugina's material. However, Meeschkat (1936) described larvae probably of *S. gibbus* that were mining the dead stems of *Phragmites*, so S. gibbus may be ecologically plastic.

A single fourth stage larva from Britain came from submerged wood, near Marsh Green, England (Cranston pers. comm. in Borkent 1984).

Fourth stage larvae presumed to be this species have also been collected from the River Alz at Hollthal near Truchlaching, West Germany. Larvae were abundant in branches of *Alnus* and other unidentified wood. In a few cases, larvae were present in unusually (for the genus) soft wood and in such instances, larvae were located further from the wood surface.

Stenochironomus fascipennis

Uncertainties in larval descriptions do not allow description of specific habitats in which immature stages may be located. (Borkent 1984). The purported larvae of this species have been described under bark of submerged branches and in the leaves of *Carex gracilis* (Zabolotskii 1939). However, it is likely that two species are involved here (Borkent ibid).

Stenochironomus hibernicus

The larval stages are unknown and the larval ecology uncertain (Borkent 1984).

Symposiocladius lignicola

Larvae of this species were found by Botnariuc and Cure (1956) in immersed wood in a backwater of the River Sebesului in Romania and, although a few larvae have been taken in benthic samples and drift nets, the greatest numbers have been found in submerged wood. In Crowborough Warren stream, Ashdown Forest, East Sussex, larvae were found in submerged *Alnus glutinosa* and *Corylus avellana* whilst larvae have also been found by Art Borkent in *Acer* in Quebec and *Alnus* (British Columbia). Physicochemical parameters of the stream in Crowborough Warren are provided by Cranston (1982).

Borkent (unpublished) found the larvae in branches firmly lodged against the shore of a stream less than a metre deep. He also confirmed that the larvae are only found in chambers in the outer wood layer, in branches of no more than 6cm in diameter and without a bark layer. Larvae have only been found in firm wood, not in waterlogged branches.

Larval gut contents from all British localities contained numerous wood fibres, and larvae kept in the laboratory were observed to ingest wood particles. The pupal exuviae remained in the wood only when emergence took place from a tube above the water line.

Anisopodidae

Sylvicola cinctus was reared from woody debris taken in a stream from Saplin's Wood, Shropshire in 2000 (Godfrey pers. obs.).

Ceratopogonidae

Unidentified ceratopogonids have occasionally been reared by the author from woody samples taken from streams. Examples include Loamhole Dingle, Shropshire in 2000 (Godfrey pers. obs.).

Psychodidae

Undetermined psychodids have been reared from logs or woody samples taken from watercourses by the author. These include Coed Y Cerrig and Cwm Nant Sere, South Wales, Lydbrook Dingle and Loamhole Dingle, Shropshire and Dean Wood, Huddersfield, West Yorkshire (Godfrey 2000b, 2001 and 2002b). An adult was found in an Owen emergence trap filled with semi-submerged logs from the main stream at Loamhole Dingle, Shropshire (Godfrey 2000b).

Sciaridae

This family is closely associated with decomposing wood in most situations. The lack of records from wood in streams reflects the lack of studies in this field as well as taxonomic uncertainty and the unpopularity of the family. Several species are likely to utilise dead wood in streams but may not be obligate species. An adult was found in an Owen emergence trap filled with semi-submerged logs from the main stream at Loamhole Dingle, Shropshire (Godfrey 2000b).

Ditomyiidae

Symmerus annulatus (det: Peter Chandler) was reared from a log in a seepage at Dan Y Graig, South Wales (Godfrey 2000). This is a widespread species in Britain and is associated with rotting logs (Hutson et al 1980).

Thaumaelidae

Larvae of *Thaumalea testacea* were taken off a submerged log at Coed Y Cerrig (Godfrey 2001). These larvae almost certainly were using the logs for foraging.

Empididae

A female *Chelifera* sp was reared from a small log in a small stream at Coed Y Cerrig (Godfrey 2001). Hemerodromids typically have semi-aquatic or aquatic larvae and may use logs for emergence.

Hybotidae

Tachypeza truncorum was reared from a log from Coed Y Cerrig, South Wales (Godfrey 2001). An adult *Euthyneura gyllenhali* was taken on a dead stump in carr (Godfrey ibid) and members of this genus develop in deadwood. A relatively small number of hybotids use decomposing wood for development e.g. *Platypalpus*, *Oedalea*, *Drapetis*, etc. Other species might occasionally be expected from wet wood in or near streams.

Xylophagidae

Xylophagus ater emerged from a pupa taken from under Fagus bark on a log in a largely dry stream channel at Bron-Y-Buckley Wood, Welshpool (Godfrey 2000b). This species is usually associated with dry wood.

Athericidae

Atrichops crassipes is included here because it has been thought to be associated with the submerged roots of *Alnus* in streams (Stubbs and Drake (2001). It is not saproxylic and the link with *Alnus* is uncertain. Hoffmann and Hering (2000) list *Atherix ibis* and *A. marginata* as probable xylophages.

Rhagionidae

Chrysopilus cristatus was reared from a pupa were found under the bark of a small log in a small stream at Coed Y Cerrig in 2000 (Godfrey 2001).

Syrphidae

Hoffmann and Hering (2000) overlook the Syrphidae as associated with CWD in streams and fail to list any species associated with this habitat.

Chalcosyrphus eunotus

In 1977 a specimen was found sitting on a log in a shaded stream in the Wyre Forest, Worcestershire (Stubbs and Falk 2002), an observation, which has led to the discovery of many more adults in similar situations. The best technique for finding this species according to Stubbs and Falk (ibid) is, therefore, to search for adults sitting on or flying around semi-submerged logs in dappled shade along wooded streams, or to search sunlit foliage, e.g. *Urtica dioica* beds in the vicinity of such logs. Males patrol small territories from sunlit perches on wood or foliage.

Maibach and Goeldlin de Tiefenau (1992) described and figured the pupa of this rare species. The unique specimen described was obtained by inducing oviposition in an attractive artificial dendrolimnetic habitat (wet sawdust, rotting wood). This trap was deposited on the ground along a shaded stream in a *Fagus* grove.

Several records of this species were obtained whilst undertaking survey work for *Lipsothrix nigristigma* by walking along streams in wellingtons or waders and examining log piles in 2000 by the author (Godfrey 2000b). Records were obtained this way for five sites within a few days for the Betton Dingle, Habberley Valley, Loamhole Dingle, Lydbrook Dingle and Oak Dingle, all in Shropshire (Godfrey 2000b). Individuals were observed closely in Loamhole Dingle basking or perching on logs in streams.

***Sphegina* spp**

Hartley (1961) recorded the larvae of all three British species (as known then) under wet decaying bark. *Sphegina sibirica* has been added to the British list since and its ecology is unclear but assumed to be similar. Teneral *Sphegina* sp were present on a log in the stream at Great Triley Wood, South Wales (Godfrey 2001).

Sphegina clunipes

Rotheray (1990) found six larvae under the bark of fallen *Betula* and *Quercus* branches in a stream at Crichton Glen, Midlothian. He also found several larvae under the bark of fallen deciduous branches partially submerged in a stream at Newbattle Abbey, Midlothian. He also refers to larvae found in a sap run and under the bark of a recently fallen tree.

Sphegina elegans

This species has been reared from semi-submerged logs at Loamhole Dingle and Lydbrook Dingle, Shropshire (Godfrey 2000b). It has also been taken in similar conditions in South Wales (Godfrey 2001). It was also reared from woody debris taken from the stream at Dean Wood, Huddersfield, West Yorkshire in 2001 (Godfrey 2002b). An adult male of this species was found in an Owen emergence trap filled with semi-submerged logs from the main stream at Loamhole Dingle, Shropshire (Godfrey 2000b).

Xylota florum

This hoverfly occurs in woodland sites by water or in moist valleys and adults sit on fallen trees such as *Fagus sylvatica* or logs partly submerged in marsh. The larvae are associated with decaying wood and sap and were described by Dušek and Láska (1960).

The author reared this species from a puparium found on a large stranded log by the side of a stream at Bannister's Coppice, Shropshire (Godfrey 2000b). *Xylota florum* appeared to be breeding in submerged logs in *Fagus* woodland in Hampshire (East Hampshire District Council: no date).

Xylota segnis

Adults of this species in an Owen emergence trap filled with semi-submerged logs taken from the main stream in Loamhole Dingle, Shropshire by the author (Godfrey 2000b).

Muscidae

Lipsocephala spuria

This species was reared from wet sodden wood taken from the stream at Loamhole Dingle, Shropshire in 2001 (Godfrey 2000b). The significance of this record is unclear. The current author has reared a related *Coenosia* species previously from terrestrial deadwood. There are occasional published records of other coenosiids from rotting wood (i.e. Teskey 1976).

Discussion

Using the fidelity categories above, the following numbers of species were found:

Group	Category	Number of species identified
Obligate xylophagous species	a	15
Possible obligate xylophagous species	b	3
Facultative xylophagous species	c	48
Probable facultative xylophagous species	d	33
Non xylophagous species	e	30
Uncertain – included in more than one group at present	a/b, c/d, d/e	9
		TOTAL =147

Further consideration of the groups to which species have been placed should be given. Certain literature sources were not available during the write-up of this study and the potentially useful CWD conference website was not online.

Recommendations for future survey

Recommendations for survey emphasise the taxa most likely to yield useful information and the methods and times of year when work should best be conducted. The scale of such survey has been considered bearing in mind since this may be constrained by resources.

Lipsothrix nigristigma

The two surveys conducted to date have concentrated on trying to relocate this species in the area around Telford, Shrewsbury and Welshpool. The second survey was successful in finding the species and in locating several new sites. A brief survey in 2001 revealed its

continued existence in the type locality, Blackburn, Lancashire. It is suggested that future survey work for this Priority BAP and RDB1 species should be as follows:

- Survey work in the Telford-Shrewsbury area should try to elucidate larval ecology, by recording environmental parameters in more detail. Measurements should be taken on log diameter, state of decay, extent of shade, flow, water depth, etc. The rearing work done so far in this area was done as a bi-product of surveys for adults.
- Survey work for adult *L. nigristigma* should extend out into adjacent areas of the Welsh Borders. In addition, large areas of semi-natural woodland most notably the Wyre Forest, Forest of Dean and Weaver Valley in Cheshire, would be worth surveying. The latter lies between the two population centres in Telford-Shrewsbury and Blackburn.
- Surveys should be conducted of woodlands in the area around Blackburn to determine the extent and strength of populations here.

Other rare species

Survey work on other rare species is not suggested, since the work on *L. nigristigma* would produce information on all other *Lipsothrix* species (except the Scottish *ecucullata*) as well as other craneflies. Where possible leads on the ecology of *Chalcosyrphus eunotus* (RDB2) should be followed since this is one of the few high profile hoverflies in Britain whose larval ecology has yet to be determined.

Xylophagous invertebrates associated with CWD

Further work on *Lipsothrix nigristigma* will continue to provide data on other xylophagous species associated with CWD in England. In addition other methods such as the use of emergence traps should be used to sample the xylophagous insect fauna. Use of 'Owen' emergence traps as used previously in Loamhole Dingle (Godfrey 2000b) mainly sample xylophagous species which emerge from the woody debris placed in the trap (unlike open bottomed emergence traps suggested below).

Aquatic invertebrates associated with CWD

No work has been undertaken on the value of CWD for aquatic invertebrates in Britain. Collaborative work could be sought with either the Environment Agency or University of Southampton. A small-scale survey could be conducted as a precursor using the knowledge of sites and information gained on the *Lipsothrix nigristigma* work. This could involve use of drift nets immediately downstream of debris dams and disturbance of the dams for a set period (3 minutes for example). Open-bottomed emergence traps set on debris dams could be used to sample adult Ephemeroptera, Plecoptera, Trichoptera, Diptera and other orders emerging from either undisturbed woody debris or the underlying stream.

Identification of previously collected invertebrates from CWD

A small amount of invertebrate material sampled on the Lipsothrix surveys has not been identified because this represented non-target material at the time. This material includes adult Trichoptera and certain adult Diptera (Psychodidae, Chironomidae, etc). It would be worth identifying this material. With the exception of the Chironomidae, this material would

require one day to sort and identify. The Chironomidae would be best sent to a chironomid specialist.

Conclusions

This report provides a description of the range of woody debris and its distribution within England. Although this review covers England, additional information on the habitat and its fauna elsewhere in Britain and mainland Europe is considered. Areas of England with the greatest interest are highlighted.

Details are provided of 147 species that are considered to be particularly associated with coarse woody debris, including those species that may benefit from changes in structure afforded by log jams and woody debris. Each of the major taxa have been discussed in turn. Wherever possible, ecological information has been tabulated including national status, regional distribution, woos species used, state of wood decay, size of woody material used, whether the species is an upland or lowland species, flow rate, fidelity and key references. The fidelity scores have been based on whether species are obligate or facultative xylophagous species or non-xylophagous species that utilise CWD. A total of 15 obligate xylophages have been identified along with 3 possible obligate xylophages, 48 facultative xylophages, 33 probable xylophages and 30 non-xylophages. Further checking and tightening-up of the species within these categories is required.

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http: //riverwood.oregonstate.edu/html

Table 1: Invertebrates associated with CWD in Britain

Taxa	Order	Status	Region	Wood sp	Decay	Size	Low/up	Flow	Fidelity	Ref
Acroloxus lacustris	Mollusca	Local	NSEW				Lowland	Slow	c	Chergui and Pattee (1991)
Bithynia tentaculata	Mollusca	Local	NSEW				Lowland	Slow	c	Hoffmann and Hering (2000)
Ferrisia wautieri	Mollusca	Introduced	nSEw				Lowland	Slow	c	Chergui and Pattee (1991)
Lymnaea truncatula	Mollusca	Common	NSEW				Both	Still	d	Godfrey (2001)
Physa acuta	Mollusca	Introduced	NSEW				Lowland	Still/slow	c	Chergui and Pattee (1991)
Viviparus viviparus	Mollusca	Local	NSEW				Lowland	Still/slow	d	Hoffmann and Hering (2000)
Asellus aquaticus	Crustacea	Common	NSEW				Both	Still/slow	c	Chergui and Pattee (1991)
Corophium curvispinum	Crustacea	Introduced	nsew				Lowland	Slow	e	Hoffmann and Hering (2000)
Gammarus lacustris	Crustacea	Local	Nsew				Upland	Still	d	Moog (1995)
Gammarus pulex	Crustacea	Common	NSEW				Both	Fast	d	Moog (1995)
Electrogena affinis	Ephemeroptera	pRDB?	n				Upland	Moderate	e	Hoffmann and Hering (2000)
Ephemerella ignita	Ephemeroptera	Common	Widespread				Upland	Fast	e	Hoffmann and Hering (2000)
Heptagenia sulphurea	Ephemeroptera	Frequent	Widespread				Upland	Fast	e	Hoffmann and Hering (2000)
Paraleptophlebia submarginata	Ephemeroptera	Local	Widespread				Upland	Fast	e	Hoffmann and Hering (2000)
Calopteryx splendens	Odonata	Local	nSEW				Lowland	Slow	e	Hoffmann and Hering (2000)
Calopteryx virgo	Odonata	Local	nSeW				Upland	Fast	e	Hoffmann and Hering (2000)
Capnia bifrons	Plecoptera	Rare	NseW				Upland	Fast	d	Hoffmann and Hering (2000)
Capnia sp	Plecoptera						Upland	Fast	d	Godfrey (pers. obs.)
Leuctra fusca	Plecoptera	Common	NseW				Upland	Fast	e	Hoffmann and Hering (2000)
Nemoura cinerea	Plecoptera	Common	NSEW				Both	Still/slow	d	Hoffmann and Hering (2000)
Aphelocheirus aestivalis	Hemiptera	Local	nsew				Upland	Fast	e	Hoffmann and Hering (2000)
Adicella reducta	Trichoptera	Common	Widespread				?	Flowing	d	Dittmar (1955)
Agapetus fuscipes	Trichoptera	Common	Widespread				Upland	Fast	e	Dittmar (1955)
Anabolia nervosa	Trichoptera	Common	Widespread				Lowland	Still	c	Hoffmann and Hering (2000)
Beraea maura	Trichoptera	Common	Widespread				Both	Flowing	c	Dittmar (1955)
Beraea pullata	Trichoptera	Common	Widespread				Both	Flowing	c	Nielsen (1942)
Beraeodes minutus	Trichoptera	Local	Widespread				Both	Flowing	c	Moog (1995)
Brachycentrus subnubilus	Trichoptera	Common	Widespread				Both	Fast	e	Hoffmann and Hering (2000)
Chaetopteryx villosa	Trichoptera	Common	Widespread				Lowland	Still/flowing	c	Hoffmann and Hering (2000)
Crunoecia irrorata	Trichoptera	Common	Widespread				Both	Flowing	c	Nielsen (1942)
Halesus digitatus	Trichoptera	Common	Widespread				?	Flowing	c	Nielsen (1942)
Halesus radiatus	Trichoptera	Common	Widespread				?	Flowing	c	Hoffmann and Hering (2000)

Taxa	Order	Status	Region	Wood sp	Decay	Size	Low/up	Flow	Fidelity	Ref
Hydatophylax infumatus	Trichoptera	Local	Widespread		Decaying	Branch/twigs	?	Flowing	a	Wallace (1991)
Hydropsyche pellucidula	Trichoptera	Common	Widespread				Both	Moderate	e	Hoffmann and Hering (2000)
Hydropsyche saxonica	Trichoptera	RDB1	sw				Lowland	Fast	e	Dittmar (1955)
Hydropsyche siltalai	Trichoptera	Common	Widespread				Upland	Fast	e	Hoffmann and Hering (2000)
Lasiocephala basalis	Trichoptera	Reg. Not.	Widespread				?	Flowing	c	Hoffmann and Hering (2000)
Lepidostoma hirtum	Trichoptera	Common	Widespread				?	Fast	c	Moog (1995)
Limnephilus rhombicus	Trichoptera	Common	Widespread				Lowland	Still/slow	c	Chergui and Pattee (1991)
Lype phaeopa	Trichoptera	Common	Widespread				Upland	Flowing	a	Wallace (1991)
Lype reducta	Trichoptera	Common	Widespread				Upland	Flowing	a	Wallace (1991)
Metalype fragilis	Trichoptera	Notable	Widespread				Both	Flowing	d	Godfrey (2001)
Philopotamus montanus	Trichoptera	Common	Widespread				Upland	Fast	e	Hoffmann and Hering (2000)
Potamophylax cingulatus	Trichoptera	Common	Widespread				Upland	Flowing	c	Hoffmann and Hering (2000)
Sericostoma personatum	Trichoptera	Common	Widespread				Upland	Fast	c	Nielsen (1942)
Wormaldia occipitalis	Trichoptera	Common	Widespread				Upland	Fast	e	Hoffmann and Hering (2000)
Anacaena sp	Coleoptera		Widespread				Both	Still/slow	d/e	Godfrey (pers. obs.)
Atrecus affinis	Coleoptera	Common	?		Rotten		?		d	Godfrey (pers. obs.)
Asaphidion curtum	Coleoptera	Common	nsew				Lowland		d	Godfrey (pers. obs.)
Cyphon coarctatus	Coleoptera	Common	?				?	?	c	Godfrey (pers. obs.)
Cyanostolus aeneus	Coleoptera	Notable	SNw	ABCFMQU	semi-subm		Upland	?	b/c	Peacock (1977)
Dianous coerulescens	Coleoptera	Local	Widespread				Upland	Fast	d/e	Godfrey (pers. obs.)
Dryops ernesti	Coleoptera	Local	NSEW				?	?	c	Godfrey (pers. obs.)
Elodes koelleri	Coleoptera	Local	?				?	?	c	Godfrey (pers. obs.)
Elodes marginata	Coleoptera	Local	?				?	?	c	Warmke & Hering (2000)
Eusphalerum minutum	Coleoptera	Common	?				?	Still	d/e	Godfrey (pers. obs.)
Hydraena gracilis	Coleoptera	Local	NSEW				?	Flowing	d	Godfrey (pers. obs.)
Lesteva heeri	Coleoptera	Common	Widespread				?		d/e	Godfrey (pers. obs.)
Lesteva longoelytrata	Coleoptera	Common	Widespread				?		d/e	Godfrey (pers. obs.)
Macronychus quadrituberculatus	Coleoptera	RDB3	sw				Lowland	Flowing	a	Holland (1972)
Orectochilus villosus	Coleoptera	Local	NSeW				?	Flowing	e	Hoffmann and Hering (2000)
Platambus maculatus	Coleoptera	Frequent	NSEW				Lowland	Flowing	d/e	Godfrey (2001)
Potaminus substriatus	Coleoptera	Notable	neW		rotting	branches	Lowland	Flowing	a/b	Foster (1995 & in prep.)
Pyrochroa sp	Coleoptera		SNWE				Lowland		c	Godfrey (2001)
Stenelmis canaliculata	Coleoptera	RDB2	nsew				Upland	Flowing	d	Hoffmann and Hering (2000)
Stenus clavicornis	Coleoptera	Common	Widespread				?		d/e	Godfrey (pers. obs.)

Taxa	Order	Status	Region	Wood sp	Decay	Size	Low/up	Flow	Fidelity	Ref
Trechus obtusus	Coleoptera	Common	NSEW				Both		d/e	Godfrey (pers. obs.)
Achyrolimonia decemmaculata	Diptera	Local	nsew		old	Logs	Both		c	Godfrey (2001)
Atherix ibis	Diptera	Local	nsw				Upland	Fast	d	Schmedtje & Colling (1996)
Atrichops crassipes	Diptera	RDB3	sw				Lowland	Moderate	d	Stubbs & Drake (2001)
Atypophthalmus inusta	Diptera	Notable	nSEW	U		Log	Lowland		c	Godfrey (2000b, 2001)
Austrolimnophila ochracea	Diptera	Common	NSEW	Deciduous		Logs	Both		c	Godfrey (2000b, 2001)
Brillia flavifrons (=longifurca)	Diptera	?	Nsw	AC?		branches	Upland	0-0.3m/sec	b	Cranston (1982)
Brillia modesta	Diptera	Common	NSEW	AC?		branches	Both	0-0.3m/sec	b	Cranston (1982)
Caricea spuria	Diptera	Uncommon	NW	Deciduous	sodden	Logs	Upland		c	Godfrey (2000b)
Ceratopogonidae indet	Diptera			Deciduous		Logs	Both		c	Godfrey (pers. obs.)
Chalcosyrphus eunotus	Diptera	RDB2	w	Deciduous		Logs	Upland?	Flowing	b	Godfrey (2000b)
Chelifera sp	Diptera			Deciduous		Log	Both		e	Godfrey (2001)
Chelifera precatoria	Diptera	Common	NSEW				Both		e	Warmke & Hering (2000)
Chrysopilus cristatus	Diptera	Common	NSEW	Deciduous		Log	Both		c	Godfrey (2001)
Dicranomyia chorea	Diptera	Common	NSEW	Deciduous	rotting	Log	Both		c	Godfrey (2000b)
Dicranota sp	Diptera			Deciduous		Logs	Both	Flowing	e	Brindle (1967), Godfrey (2001)
Dicranota simulans	Diptera	RDB3	nw	Deciduous		Logs	Upland	Flowing	e	Godfrey (2001)
Dictenidia bimaculata	Diptera	Frequent	Enw	BFQS	advanced		Lowland		d/c	Brinkmann (1991)
Epiphragma ocellare	Diptera	Common	NSEW	Deciduous		Logs	Both		c	Godfrey (2000b, 2001, 2002)
Euphylidorea lineola	Diptera		NSEW			Log	Both		d	Godfrey (200b)
Euthyneura gyllenhali	Diptera	Local	NSEW			Stump	Both		c	Godfrey (2001)
Glyptotendipes glaucus	Diptera	Common	NSEW		rotten		Both		a	Burtt (1940)
Glyptotendipes gripekoveni	Diptera	Frequent	NSEW		hard wood		Both		a	Gripekoven (1914)
Helius longirostris	Diptera	Frequent	NSEW	Deciduous		Log	Both		e	Godfrey (2001)
Ibisia marginata	Diptera	Local	W				Upland	Fast	d	Schmedtje & Colling (1996)
Ilisia maculata	Diptera	Common	NSEW	Deciduous		Log	Both		d/e	Godfrey (pers. obs.)
Limonia flavipes	Diptera	Common	NSEW	Deciduous		Log	Both		c	Godfrey (2001)
Limonia macrostigma	Diptera	Common	NSEW				Both		c	Brinkmann (1991)
Limonia nubeculosa	Diptera	Common	NSEW				Both		c	Brinkmann (1991)
Limonia phragmitidis	Diptera	Common	MSEW	Deciduous		Logs	Both		c	Godfrey (2000b)
Lipsothrix ecucullata	Diptera	RDB3	n				Upland	Flowing	a	Rotheray (no date)
Lipsothrix errans	Diptera	Notable	nw	Deciduous	decorticated	Logs	Upland	Flowing	a	Brindle (1967)
Lipsothrix nervosa	Diptera	Local	nSew	Deciduous	decorticated	Logs	Lowland	Flowing	a	Godfrey (2001, 2002)
Lipsothrix nigristigma/nobilis	Diptera	RDB1	nw	Deciduous	decorticated	Logs	Upland	Flowing	a	Godfrey (2000b)

Taxa	Order	Status	Region	Wood sp	Decay	Size	Low/up	Flow	Fidelity	Ref
Lipsothrix remota	Diptera	Common	NSEW	Q	decorticated	Logs	Both	Flowing	a	Hinton (1955), Godfrey (2000b)
Lonchoptera tristis	Diptera	Local	Nsew				Upland		e	Warmke & Hering (2000)
Metriocnemus cf *hygropetricus*	Diptera	Common	NSEW	AC?		Branches	Both	0-0.3m/sec	d	Cranston (1982)
Micropsectra notescens	Diptera	?	?	AC?		Bark	?	Slow	d	Cranston (1982)
Molophilus appendiculatus	Diptera	Common	NSEW	Deciduous		Logs	Both		e	Godfrey (2000b)
Molophilus medius	Diptera	Common	NSEW	Deciduous		Logs	Both		e	Godfrey (2000b)
Neolimonia dumetorum	Diptera	Common	NSEW				Both		d	Brinkmann (1991)
Nephrotoma quadrifaria	Diptera	Common	NSEW				Both		d	Brinkmann (1991)
Numantia fusca	Diptera	Local	NSEW	Deciduous	decorticated	Branch/log	Both		c	Godfrey (2000b, 2001, 2002b)
Ormosia haemorrhoidalis	Diptera	Uncommon	NW				Both		d	Dittmar (1955)
Phylidorea ferruginea	Diptera	Common	NSEW				Both		d	Brinkmann (1991)
Polypedilum sp	Diptera			AC?		Branches		0-0.3m/sec	d	Cranston (1982)
Polypedilum pedestre	Diptera	Frequent	NSEW	AC?		Branches	?	0-0.3m/sec	d	Cranston (1982)
Psectrocladius sp	Diptera					wood substrates			d	Zvereva (1950)
Psychodidae indet	Diptera			Deciduous		Logs	Both		e	Godfrey (2000b)
Ptychoptera albimana	Diptera	Common	NSEW	Deciduous		Logs	Both		e	Godfrey (2000b)
Rhipidia duplicata	Diptera	Common	NSEW				Both		d	Brinkmann (1991)
Rhypholophus varius	Diptera	Common	NSeW				Both		c	Brinkmann (1991)
Sciaridae indet	Diptera			Deciduous		Logs	Both		c	Godfrey (2000b)
Scleroprocta pentagonalis	Diptera	RDB3	nw	Deciduous		Logs	Upland		c	Godfrey (2000b)
Simuliidae indet.	Diptera			Deciduous		Logs	Both		e	Godfrey (2000b)
Smittia sp	Diptera								d	Zvereva (1950)
Sphegina clunipes	Diptera	Frequent	NSEW	BQ		Branches	Both		a/b	Rotheray (1990)
Sphegina elegans	Diptera	Local	NSEW	Deciduous		Logs	Both		a/b	Godfrey (2000b, 2001, 2002b)
Stenochironomus fascipennis	Diptera	?	SE			Branches?	Lowland		a	Borkent (1988)
Stenochironomus gibbus	Diptera	?	NSW	A	Soft wood	Branches	?		a	Borkent (1988)
Stenochironomus hibernicus	Diptera	?	?				?		a	Borkent (1988)
Sylvicola cinctus	Diptera	Common	NSEW	Deciduous	Rotting	Log	Both		c	Godfrey (pers. obs.)
Symmerus annulatus	Diptera	Common	NSEW	Deciduous		Log	Both		c	Godfrey (2001)
Symplecta stictica	Diptera	Common	NSEW	Deciduous		Log	Both		c	Godfrey (2000b)
Symposiocladius lignicola	Diptera	?	SW	AAcC	Firm wood	branches	Both	0-0.3m/sec	a	Cranston (1982)
Tachypeza truncorum	Diptera	Common	NSEW	Deciduous		Log	Both		c	Godfrey (2001)
Thaumalea testacea	Diptera	Frequent	NseW	Deciduous		Log			e	Godfrey (2001)
Thaumastoptera calceata	Diptera	Notable	nsew				Lowland		e	Godfrey (2001)

Taxa	Order	Status	Region	Wood sp	Decay	Size	Low/up	Flow	Fidelity	Ref
Thienemannimyia sp	Diptera			AC?		branches		0-0.3m/sec	d	Cranston (1982)
Tipula fascipennis	Diptera	Common	NSEW				Both		d	Brinkmann (1991)
Tipula flavolineata	Diptera	Frequent	nSEW				Both		c/d	Brinkmann (1991)
Tipula irrorata	Diptera	Frequent	NSEW	Deciduous		Under bark	Both		d	Brinkmann (1991)
Tipula oleracea	Diptera	Common	NSEW				Both		d	Schmedtje & Colling (1996)
Tipula signata	Diptera	Frequent	NSEW				Both		c	Godfrey (2000b)
Tipula staegeri	Diptera	Frequent	NSEW				Both		c	Godfrey (2001)
Tipula vittata	Diptera	Frequent	NSEW				Both	Flowing?	d	Brinkmann (1991)
Tricyphona immaculata	Diptera	Common	NSEW	Deciduous		Logs	Both		d/e	Godfrey (2000b)
Xylophagus ater	Diptera	Local	NSEW	BFQ		Log	Both		c	Godfrey (2000b)
Xylota florum	Diptera	Notable	NSEW	Deciduous		Log	Both	Flowing	a/b	Godfrey (2000b)
Xylota segnis	Diptera	Common	NSEW	Deciduous		Logs	Both		c	Godfrey (2000b)

N = North
S = South
E = East
W = West

u/case = common
l/case = uncommon

A = *Alnus*
Ac = *Acer*
B = *Betula*
C = *Corylus*
F = *Fagus*
M = *Malus*
Q = *Quercus*
S = *Salix*
U = *Ulmus*

a = obligate xylophages
b = possible obligate xylophages
c = facultative xylophages
d = probable xylophages
e = non xylophages

Appendix 1: International review of hydrobiology. Number 1 (2000). Contents of special issue devoted to coarse woody debris

Daniel Hering, Michael Mutz, Michael Reich. Woody debris research in Germany – an introduction. *Internat. Rev. Hydrobiol.,* **85** (2000) 1, 1-3.

Daniel Hering, Jochem Kail, Sabine Eckert, Marc Gerhard, Elisabeth I. Meyer, Michael Mutz, Michael Reich, Ilga Weiss. Coarse woody debris quantity and distribution in central European streams
/ coarse woody debris / central Europe / stream management / riparian forest /
Internat. Rev. Hydrobiol. **85** (2000), 1, 5-23.

Andreas Hoffmann, Daniel Hering. Wood-associated macroinvertebrate fauna in central European streams
/ wood debris / streams / xylophagy / macroinvertebrates /
Internat. Rev. Hydrobiol. **85** (2000), 1, 25-48.

Bernd Spänhoff, Christian Alecke, Elisabeth I. Meyer. Colonization of submerged twigs and branches of different wood genera by aquatic macroinvertebrates
/ wood debris / macroinvertebrate colonization / colonization experiment / lowland streams / freshwood / conditioned wood /
Internat. Rev. Hydrobiol. **85** (2000) 1, 49-66.

Sven Warmke, Daniel Hering. Composition, microdistribution and food of the macroinvertebrate fauna inhabiting wood in low-order mountain streams in central Europe
/ woody debris / low-order streams / wood associated fauna / xylophagy / *Lipsothrix* /
Internat. Rev. Hydrobiol. **85** (2000) 1, 67-78.

Andreas Hoffman. The association of the stream caddisfly *Lasiocephala basalis* (Kol.) (Trichoptera: Lepidostomatidae) with wood
/wood/stream/xylophagy / Trichoptera / *Lasiocephala* /
Internat. Rev. Hydrobiol. **85** (2000) 1, 79-93.

Björn Hendel, * Jürgen Marxsen. Extracellular enzyme activity associated with degradation of beech wood in a central European stream
/Stream/wood degradation/extracellular enzyme activity/β-glucosidase/phenoloxidase/
Internat. Rev. Hydrobiol. **85** (2000) 1, 95-105.

Michael Mutz. Influences of woody debris on flow patterns and channel morphology in a low energy, sand-bed stream reach
/sand-bed stream/woody debris/reach scale morphology/base-flow/flow pattern/
Internat. Rev. Hydrobiol. **85** (2000) 1, 107-121.

Marc Gerhard, Michael Reich. Restoration of streams with large wood: effects of accumulated and built-in wood on channel morphology, habitat diversity and aquatic fauna
/large woody debris/stream restoration/channel morphology/microhabitats/riparian zone /
Internat. Rev. Hydrobiol. **85** (2000) 1, 123-137.

Appendix 2: Coleoptera collected from coarse woody debris in streams in South Wales

The following species were collected by Andy Godfrey and identified by Mike Denton.

Livox Wood, Penallt. SO5111. 9/6/00

Atrecus affinis	(Paykull, 1789)	Common	

Great Triley Wood, Abergavenny. SO3118. 8/6/00

Asaphidion curtum	(Heyden, 1870)	Common	
Cyphon coarctatus	Paykull, 1799	Common	Males
Byturus tomentosus	(De Geerk 1774)	Common	
Adalia decempunctata	(Linnaeus, 1758)	Common	
Phyllobius glaucus	(Scopoli, 1763)	Common	
Notaris acridulus	(Linnaeus, 1758)	Common	

Coed & Cerrig, Stanton. SO2921. 6/6/00

Lesteva longoelytyrata	(Goeze, 1777)	Common	
Protapion fulvipes	(Geoffroy, 1785)	Common	

Coed Y Cerrig, Stanton. SO2921. 7/6/00

Eusphalerum minutum	(Fabricius, 1792)	Common	Males
Phyllopertha horticola	(Linnaeus, 1758)	Common	
Elodes koelleri	(Klausnitzer, 1970	Local	Male

This species was synonymised with *E. elongata* by Nyholm (the identity of *Elodes elongata* Tournier, 1868 (Coleoptera: Helodidae). *Ent. Scand*., 15: 435-441). As Nyholm's interpretation has not been accepted by central European workers, however, the species still stands.

Cyphon coarctatus	Paykull, 1799	Common	Males
Agriotes pallidulus	(Illiger, 1807)	Common	
Aridius bifasciatus	(Reitter, 1877)	Naturalised	
Chrysolina polita	(Linnaeus, 1758)	Common	
Hydrothassa marginella	(Linnaeus, 1758)	Common	
Rhamphus pulicarius	(Herbst, 1795)	Common	

Coed Byrrwyd, Berriew. SJ1604. 18/5/00

Hydraena gracilis	Germar, 1824	Local	Females
Stenus clavicornis	(Scopoli, 1763)	Common	Male
Dryops ernesti	des Gozis, 1886	Local	Females
Leiosoma deflexum	(Panzer, 1795)	Common	

Dan Y Graig. SO2390. 10/6/00

Trechus obtusus	Erichson, 1837	Common	

Mochre Dingle, Newtown. SO079873. 23/5/00

Dianous coerulescens	(Gyllenhal, 1810)	Local	
Dryops ernesti	des Gozis, 1886	Local	Males
Dalopius marginatus	(Linnaeus, 1758)	Common	
Gastrophysa viridula	(De Geer, 1775)	Common	

Aston Dingle, Aston. SO291918. 21/5/00

Lesteva longoelytrata	(Goeze, 1777)	Common	

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Front cover photographs:
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