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A review of the scarcer Ephemeroptera and Plecoptera of Great Britain
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A review of the scarcer Ephemeroptera and Plecoptera of Great Britain

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Contents

Introduction 3
Acknowledgements 7
Threat category definitions and criteria 7
Abbreviations 8
List of threatened taxa 9
Data sheets
Heptagenia longicauda 10
Heptagenia fuscogrisea 11
Paraleptophlebia werneri 12
Potamanthus luteus 13
Ephemera lineata 14
Taeniopteryx nebulosa britannica 16
Rhabdiopteryx acuminata 17
Brachyptera putata 18
Nemoura dubitans 19
Capnia vidua anglica 20
Isogenus nubecula 21
Isoperla obscura 22
List of additional species of interest 24
Data sheets
Siphlonurus alternatus 25
Baetis digitatus 25
Ephemerella notata 26
Brachycercus harrisella 27
Caenis pusilla 28
Protonemura montana 28
Amphinemura standfussi 29
References 31
Index 39
Introduction

The Ephemeroptera (mayflies) and Plecoptera (stoneflies) are two closely related orders of primitive insects. It is convenient to treat them together in this review, as there are many ecological similarities, and the specialist in one usually has a more than passing interest in the other. In Kloet & Hincks (1964) they constitute orders V and VII respectively, separated by the Odonata. There are 47 species of Ephemeroptera and 33 Plecoptera definitely recorded from Britain. Neither order was included in the Red Data Book covering British insects (Shirt 1987) nor did they receive full treatment in Ball (1986), so this small review fills a gap in the insect conservation literature. It has been compiled mainly from published sources and fruitful discussions with some of the leading workers in these orders, but an extensive search of museum collections and trawl of privately held records has not been undertaken. It is unfortunate that neither order has an active national recording scheme from which data could be collected. The species and subspecies have been assigned to threat categories now widely used for British invertebrates. These are the Red Data Book categories used in Shirt (1987) and the Nationally Notable category established by the NCC. These are defined on pages 7-8. However, this document is not a Red Data Book and the threat categories designated here should be considered provisional until they are published in a Red Data Book. It is hoped that by producing this review, scrutiny of the contents by entomologists and freshwater biologists will act as vetting, providing a more sound basis for a future Red Data Book version.

A data sheet is given for each species and subspecies falling within the Notable or Red Data Book categories. Seven additional species were strongly considered for the Notable category but it was eventually decided that it would be wrong to place them in this category on the evidence available. Their status needs to be kept under review and, to aid this, data sheets are also presented for these species.

The inclusion of endemic taxa is not a new step. They were listed in Shirt (1987) for the orders covered by that work, and the case for including endemics in Red Data Books was well argued by Collar (1987). The listing of a species as endemic does not necessarily imply that it is threatened. It is nonetheless worthwhile to focus attention on those elements of an area's fauna which are unique to that area as there is clearly a strong onus to maintain viable populations of those species. It is hoped that listing endemics even when they are not immediately threatened will help to avoid their ever being in the more acutely threatened categories. In this review, one species and two subspecies of Plecoptera are considered to be endemic to Great Britain.

There is one species in each order with an unsubstantiated claim to a place on the British list. The ephemerid Arthroplea congestion Bengtsson was recorded from Stanmore, Middlesex, in 1920, as Haplogenia southi, a genus and species new to science (Blair 1929). Only a single adult male was found despite further searches of the area. Elliott, Humphesch & Macan (1988) describe the record as "doubtful". The plecopteran Xanthoperla (formerly Chloroperla) apicalis (Newman) is included in Kloet & Hincks (1964) on the basis of three possibly British specimens which lack locality labels and the comment by Newman that it "abounds in Herefordshire, frequenting the alders by the sides of the trout streams" (Kimmins 1936). Kimmins goes on to suggest that Newman may have accidentally mixed his British and Continental specimens. If a population of A. congestion or X. apicalis were to be discovered in Great Britain, it would qualify for Red Data Book status.

In Ephemeroptera and Plecoptera the young stages are aquatic and may be referred to as nymphs or larvae. Pupae do not occur in either order. The adult stage is often referred to as the imago. In the Plecoptera it emerges direct from the mature nymph. The Ephemeroptera are unique in having an intermediate stage, the subimagio, which closely resembles the adult. Though of short duration, the subimagio is frequently encountered on the water surface and emergent vegetation. Lengths of life-cycles vary from less than a year to three years in both orders and a single species will show variations in life cycle in different parts
of its range. Macan (1969) presented a readable introduction to the Ephemeroptera, dealing largely with the variations in life-cycle found among the British species. This was later updated and expanded to include the Plecoptera (and Trichoptera) (Macan 1982). It is interesting that in the later publication Macan mentions the need for conservation of these groups and stresses the importance of studying and safeguarding the lowland rivers which, despite their not rivalling the richest upland watercourses, are regarded as being the more severely threatened. Brinck (1949) is also a useful introduction to stonefly biology and deals in a large part with the British species despite being based on Swedish studies.

All the nymphs of British Ephemeroptera are herbivores and/or detritivores. Various forms of detritus make up the diet of many species, and the nymphs play a major part in the nutrient cycling in aquatic habitats. British plecopteran nymphs include detritivores and predators on other aquatic invertebrates. Adult Ephemeroptera and most Plecoptera do not feed, though some of the latter have been shown to require a diet of epiphytic algae or lichen if they are to produce eggs. One species, Chloroperla tripunctata (Scopoli), has been recorded feeding on a live sawfly (Rotheray & Liston 1985). Adults of Nemoura cinerea (Reitzius) have been found on hawthorn blossom (A.C. Warne pers. comm.) and it is possible that they gain nutrition from the nectar. It is not surprising that the adults of both orders are short-lived, though the widespread belief that adult mayflies live for only six hours is an underestimation.

Representatives of both orders can be found in still water, but the greatest diversity of species and all the rarities with Notable or higher status are associated with flowing water. Some are filter-feeders as nymphs and require a water flow to deliver their food supply. However, the most immediate necessity for flowing water is often for increased oxygen exchange, and nymphs of some species cannot tolerate still water even when it is well oxygenated. This reliance on oxygen-rich water has led to both orders being used extensively for pollution monitoring. A stretch of river in which oxygen-demanding species are abundant must have been consistently free from organic pollution for at least the age of the nymphs. This could not be deduced from, say, a series of monthly chemical analyses, which might straddle a short-lived dose of pollution passing along the river.

The lower reaches of a river are the most threatened by pollution since this is the region most likely to be navigable, on which industry is likely to be concentrated and through which all the waterborne pollution from the whole catchment passes. Several of the more threatened species in this review are to be found only in the larger rivers, and their problems are compounded by lack of nearby populations from which recolonisation could occur. Unfortunately, conservation using the SSSI system does not work as effectively with riverine sites as with the more compact and discrete habitats because opportunities for river pollution occur throughout the river’s catchment. The difficulties of conserving riverine wildlife are demonstrated by the statistics of decline in European Plecoptera: fourteen of the Netherlands’ twenty-four species are thought to be extinct; all the species found in larger rivers or streams in Italy are thought to be extinct or severely threatened; half the species in the industrial and agricultural regions of Switzerland have become extinct since 1949 (Claessens 1981; Costello 1988, citing Ruttan & Nicolai 1983 and Aubert 1984). Against this background, losses from the British stonefly fauna may appear slight, but there have undoubtedly been many losses on a local scale and it is thought that one species has become extinct nationally.

Over much of Britain, where waters are base-poor, acidification is the most widespread form of pollution and can be very damaging to communities of Ephemeroptera and Plecoptera (e.g. Stoner, Gee & Wade 1984; Engblom & Lingdell 1984). The precise effects of acidification are not yet fully understood. Ephemeroptera are often more seriously affected by acidification than are Plecoptera and it has been suggested that acidification acts partly by eliminating the food supply of herbivores while leaving carnivores relatively unscathed (Sutcliffe & Carrick 1973). There is also evidence of direct toxic effects of low pH and raised levels of aluminium, and recent work suggests that the true picture is a complex
interaction of several factors, with food quality being of great importance (Ormerod, Wade & Gee 1987; Willoughby & Mappin 1988). Conifer afforestation causes or exacerbates the acidification of watercourses in areas on base-poor soils by raising the acidity of the precipitation as it passes down the trees and by producing an acidic humus layer. It also causes damage because the initial ploughing releases silt into the rivers. Subsequent treatment of the plantations with pesticides and fertilisers also threatens the aquatic life in the area.

Fish-farming is an expanding industry which can have severe effects on riverine wildlife. Fish-farms require large volumes of clean water, and abstraction from a river can greatly reduce the volume of flow below the abstraction point. This water is usually returned to the river after passing through the rearing tanks, by which time it is enriched with nutrients. This can cause eutrophication problems and lower the oxygen content in the receiving river.

Some practices of watercress farms may be damaging to the invertebrate community downstream. There is some evidence that the use of zinc sulphate to treat a fungal disease of watercress can eliminate the freshwater shrimp Gammarus pulex (L.) in the watercourse below the cress bed and there is the potential for similar harm to populations of other detritivores, including nymphs of Ephemeroptera and Plecoptera.

The effects on invertebrate communities of river regulation in its various forms have not been well studied in the United Kingdom. Starting from the premise that the natural river community adapted to the natural river flow pattern is the ideal in conservation terms, all regulation could be branded as damaging. However, artificially increased flow rates can be beneficial to conservation by ameliorating other damage, such as by flushing away silt resulting from river engineering work or diluting pollution from a sewage outflow. The effects of river regulation on invertebrate communities in British rivers were reviewed by Boon (1988), who highlighted a number of aspects. Responses to impoundment are highly variable within and between taxonomic groups, but impoundment is generally damaging to both Ephemeroptera and Plecoptera. In the Plecoptera, the Perlodidae and Chloroperlidae are more likely to be affected than the Nemouridae or Leuctridae. During dam construction, high silt levels in the water may completely eliminate Ephemeroptera and Plecoptera just downstream of the construction site. When this silt is flushed away by release of water from the reservoir, the aquatic community may recover its former diversity, but there is obviously the risk of localised populations of uncommon species being exterminated during the silted period and of no other populations existing within colonising distance. Dams also act as a barrier to downstream drift of invertebrates and thus may prevent complete recolonisation of the river below the dam. Siltation often increases permanently below an impoundment, to the detriment of the stone-dwelling invertebrates, and the periodic flushing away of accumulated silt by release of water from the reservoir may disrupt the silt-dwelling community. The scouring of the river channel by sudden discharges from hydro-electric schemes may eliminate aquatic vegetation and its associated invertebrates from the channel near the dam, and erratic changes in water level may leave stranded any eggs laid in shallow water during periods of high flow. If the water discharged is taken from the depths of the reservoir, pronounced chemical differences are likely compared to river water. These include low oxygen tension in the impounded water, which is potentially very damaging to Ephemeroptera and Plecoptera communities. The temperature regime of a river is usually altered downstream of a reservoir, with warmer winter water and cooler summer water. This can disrupt the life-cycles of aquatic invertebrates, for example by preventing successful development or removing the factors controlling synchronised emergence of adults. Water abstraction direct from a river has the opposite effect on temperature, increasing the maxima and lowering the minima, but the effects on invertebrates have not been studied. Inter-basin transfers of water through pipelines can have many of the effects of a reservoir (lessening of temperature peaks, erratic fluctuations of water level, alteration of water chemistry and changes in silt-loading) and have the added danger of introducing species from one catchment to another, with subsequent alteration of the invertebrate community.
The popularity of angling has played a role in lessening the widespread pollution and disruption of our watercourses and has thus probably aided the survival of Britain's Ephemeroptera and Plecoptera. However, there is the possibility that rivers artificially stocked with fish at high population densities could suppress invertebrate populations and small populations of the scarcer species could be eliminated. The study by Allan (1982) goes some way to allaying these fears. He removed 75-90% of the fish (trout) from a section of stony infertile stream and, although Ephemeroptera and Plecoptera constituted a large proportion of the trout diet, no significant increase in these invertebrates was detected. Macan (1966, 1977) found that trout predation in a moorland fishpond markedly reduced numbers of open water prey species such as the water boatman Notonecta but that most species, especially those found amongst vegetation, were unaffected by the trout. In any case, it would be impossible to define natural fish population levels for British rivers, and fish predation is by no means the most serious threat to Ephemeroptera and Plecoptera. Other aspects of managing a river sport fishery need assessing for their importance to invertebrate conservation. The ponding-back or excavation of riffles to produce pools will alter the spectrum of species which utilise that stretch of river. Also, the cutting of vegetation such as the aquatic Ranunculus spp. in chalk streams is a common practice but one which causes upheaval in the invertebrate community. It removes the matrix of plant stems upon which many Ephemeroptera occur and causes loss or redistribution of silt beds which support Ephemerida spp., Brachycentrus harrisiella Curtis and other species. As this disruption is to the species forming the staple food of the fish, its value to the fishery is also open to question where extensive stretches of river are cleared at one time (Wright 1973). There is scope for improving the weed-cutting regimes employed on British rivers, with autumn cutting or cutting of only part of the river's width offering more economical and effective alternatives to traditional practices (Dawson 1989).

The richest assemblages of Ephemeroptera and Plecoptera are to be found north of the Tees-Exe line, ten or more species of one order being not unusual in a short length of clean watercourse (e.g. Brinkhurst 1957; Elliott 1967; Bird 1983, the last recording fifteen species of Plecoptera at recording stations on the River Clwyd, in Denbighshire, and the River Carron, in West Ross).

Newsletters, Eatonia and Perla, are produced which specialise in the Ephemeroptera and Plecoptera respectively. They consist mainly of literature searches and reviews, taxonomic changes and address lists of workers in these orders, with short notes on other topics also included. These newsletters are international in scope. To be added to the mailing list for Eatonia, contact the Editor, P.O. Box 111, Florida A. & M. University, Tallahassee, Florida 32307, and for Perla, contact Dr R.W. Baumann, Monte L. Bean Life Science Museum, Brigham Young University, Provo, Utah 84602.

The Nature Conservancy Council is maintaining data files on all British Red Data Book and Notable species and would be pleased to receive modern records and biological information concerning any of the species dealt with here, as well as views on the inclusion, exclusion or grading of any species. The biology and habitat requirements of many species are insufficiently known. This information is urgently needed to allow the correct management to be defined and where possible implemented for the conservation of these species. Please address all correspondence to Invertebrate Site Register, Nature Conservancy Council, Northminster House, Peterborough, PE1 1UA.
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Threat category definitions and criteria

Extinct

Taxa which formerly had breeding populations in Great Britain but which are now believed to have completely died out.

Endangered (RDB 1)

Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Taxa whose numbers have been reduced to a critical level or whose habitats have been so dramatically reduced that they are deemed to be in immediate danger of extinction. Included are taxa which are known only as a single population in only one 10 km square, taxa which only occur in habitats known to be especially vulnerable, or taxa which have shown a continuous decline over the last twenty years and now exist in five or fewer 10 km squares.

Vulnerable (RDB 2)

Taxa believed likely to move into the Endangered category in the near future. Included are taxa of which most or all of the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously depleted and whose ultimate security is not yet assured; and taxa with populations that may still be abundant but are under threat from serious adverse factors throughout their range.

Rare (RDB 3)

Taxa with small populations which are not at present Endangered or Vulnerable, but are at risk. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range. Usually, such taxa are not likely to exist in more than fifteen 10 km squares of the National Grid. This criterion may be relaxed where populations are likely to exist in over fifteen 10 km squares but occupy small areas of especially vulnerable habitat.
Out of danger (RDB 4)

Taxa formerly meeting the criteria of one of the above categories but which are now considered relatively secure owing to effective conservation measures or the removal of the previous threat to their existence. (No taxa in this report fall within this category, but it is nevertheless available for future use.)

Endemic (RDB 5)

Taxa which are thought not to occur naturally outside the British Isles. Taxa within this category may also be in any other threat category or not be seriously threatened at all.

Nationally Notable (= Nationally Scarce)

Taxa which do not fall within RDB categories 1-3 but which are none-the-less uncommon in Great Britain and thought to occur in fewer than a hundred 10 km squares of the National Grid.

Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>BM(NH)</td>
<td>British Museum (Natural History), now renamed the Natural History Museum</td>
</tr>
<tr>
<td>LNR</td>
<td>Local Nature Reserve</td>
</tr>
<tr>
<td>NNR</td>
<td>National Nature Reserve</td>
</tr>
<tr>
<td>RDB</td>
<td>Red Data Book</td>
</tr>
<tr>
<td>SSSI</td>
<td>Site of Special Scientific Interest</td>
</tr>
</tbody>
</table>
Taxa of Ephemeroptera and Plecoptera judged to be in one of the above threat categories

Ephemeroptera

Endangered (RDB 1)

Heptageniidae

Heptagenia longicauda (Stephens)

Vulnerable (RDB 2)

Potamanthidae

Potamanthus luteus (L.)

Ephemeridae

Ephemer a lineata Eaton

Rare (RDB 3)

Leptophlebiidae

Paraleptophlebia werneri Ulmer

Nationally Notable

Heptageniidae

Heptagenia fuscogrisea (Retzius)

Plecoptera

Extinct

Perlodidae

Isoperla obscura (Zetterstedt)

Vulnerable (RDB 2)

Perlodidae

Isogenus nubecula Newman

Endemic (RDB 5)

Taeniopterygidae

Taeniopteryx nebulosa (L.) ssp. britannica Hynes

Brachyptera putata (Newman) (Also Nationally Notable)

Capnidae

Capnia vidua Klapálek ssp. anglica Aubert

Nationally Notable

Taeniopterygidae

Rhabdiopteryx acuminata Klapálek

Brachyptera putata (Newman) (Also Endemic)

Nemouridae

Nemoura dubitans Morton
HEPTAGENIA LONGICAUDA

Order Ephemeroptera

Family HEPTAGENIIDAE

*Heptagenia longicauda* (Stephens, 1835), previously known as *H. flavipennis* (Dufour). There has been some taxonomical and nomenclatural confusion in the past (e.g. Blair 1930) but records of *Ecdyonurus longicauda* (Stephens), such as in Kimmins (1932, 1933a), actually refer to *E. dispar* (Curtis). This is explained by Kimmins (1942).

**Identification** The nymph is included in the key of Macan (1979), though the feature by which it is 'distinguished' applies equally to *H. sulphurea* (Müller) as figured. The distinction is made clearer by Elliott, Humphesch & Macan (1988). Elliott & Humphesch (1983) provide a key to the adults.

**Distribution** Recorded in Britain on only three occasions, these being 1868 near Reading on the Kennet and Holybrook Canal, Berkshire; 1904 at Staines, Middlesex; and 1933 by the R. Wey between Tilford and Elstead, Surrey (Kimmins 1933b; Macan 1953). Kimmins (1972) mentions the Thames, presumably referring to the record from Staines. This species has been widely recorded in Europe but not from Fennoscandia (Puthz 1978).

**Habitat and ecology** Very little is known of this species in Britain. Kimmins (1933b), quoting Eaton (1888a), says the subimago emerges chiefly after sunset, though the single subimago found by Kimmins was beaten from a birch by the R. Wey at about 6.30 pm on May 28th, well before sunset. The Berkshire record, presumably of an adult, was from June (Macan 1953). Elliott & Humphesch (1983) give the flight period as late May to June, with swarming in this genus often taking place at dusk, and say the nymphs of *H. longicauda* are found mainly in large rivers. They feed by scraping up periphyton and gathering organic detritus from the sediment (Elliott, Humphesch & Macan 1988).

**Status** This species is clearly very rare and may be extinct in Britain. The Reading area and the R. Wey have been searched for it without success (Macan 1958). However, as it may be on the wing during the hours of darkness, it could be surviving overlooked.

**Threats** Many rivers and canals in lowland Britain have passed through a period of increased pollution in the last fifty years caused by industrial and urban expansion, and many are still in no state to support a rich mayfly fauna. This could explain the probable loss of this species, though there may be other contributory factors. High levels of boat traffic cause the water column to be permanently clouded by suspended silt, which has adverse effects on the aquatic community, particularly acting to prevent photosynthesis except close to the water surface. Severe dredging of long stretches of canal is damaging, as is complete neglect leading to *Glyceria maxima* and other emergents choking the channel.

**Conservation** Nothing can be recommended until a population of this species is found, and to this end surveys of its old localities could be implemented, May and June being the most propitious months. Suitable management of its sites is likely to be in line with more general good management of rivers for wildlife, including minimising pollution from agriculture, industry and sewage; sympathetic dredging work where unavoidable, including working from one bank only in order to preserve marginal vegetation and preferably dredging only short stretches in rotation; and-curbing the levels of pleasure boat traffic where this adversely affects the water clarity (important for the growth of periphyton) and erodes the marginal vegetation. Guidelines for minimising the impact of canal management on wildlife have been published (British Waterways Board & Nature Conservancy Council 1986).

**Author** J.H. Bratton.
HEPTAGENIA FUSCOGRISEA

Brown May Dun

Order Ephemeroptera

Family Heptageniidae

Heptagenia fuscoegrisea (Retzius, 1783), synonymous with H. voltians Eaton.


Distribution There are British records from the Kennet and Avon Canal near Reading, Berkshire (Macan 1958); R. Thames above Pangbourne (Harris 1956) and the Thames near Cookham in 1987 (J. Biggs pers. comm.), both on the Berkshire border; minor channels of the R. Nene near Oundle, Northamptonshire, in 1953 or 1954 (Lowe 1967); a stream draining Loch Fell and Loch Hempton, Mochrum, Wigtownshire, in 1972 (Shires & Wallace 1973); West Beck, R. Hull, South-east Yorkshire, in 1980 (M.A. Palmer pers. comm.); and the R. Derwent at Low Hutton, Yorkshire, in the 1980s (Yorkshire Water Authority in litt.).

Habitat and ecology Nymphs are found chiefly on the stony substratum, but also in the vegetation, of calcareous rivers and lakes. They feed by scraping up periphyton and gathering organic detritus (Elliott, Humphesch & Macan 1988). In the R. Nene, H. fuscoegrisea occurred in the faster, shallower stretches. It overwinters in the nymphal stage, with one generation per year. The flight period is May to June, and swarms of males can be found from morning to afternoon. In Norway, tiny nymphs are found in July, the month following emergence of the adults (Brittain 1974, cited in Macan 1979). This species is quite tolerant of acidification. It was one of three species surviving in streams of pH 4.0 to 5.0 in Sweden, though it did not tolerate water below pH 4 (Johansson & Nyberg 1981, cited in Elliott, Humphesch & Macan 1988).

Status Uncommon in Great Britain, though commoner in Ireland. In view of the wide scattering of its few records, it has been placed at Notable rather than a higher threat category, to allow for the possibility of under-recording. If there are no or few other sites than those listed, it would qualify for a place in the Red Data Book.

Threats Industrial and urban development in the catchment of the R. Nene is increasing rapidly, and with it the risk of water pollution. The water quality was only graded fair (class 2) in 1985 (Department of the Environment & Welsh Office 1986). River engineering works aimed at increasing river flow often eliminate side channels, and this could threaten H. fuscoegrisea in the R. Nene and possibly the R. Hull. The latter site suffers some pollution from fish-farm effluent despite its SSSI status, a situation made worse by water abstraction for the three fish-farms currently operating. The flow of water in one section of the main river channel can almost disappear in some summers owing to diversion through the farms. Applications for further abstraction for expansion of the fish-farms continue to threaten this stretch of river. The Loch Fell site lies close to but outside an SSSI, so afforestation in the area, with its associated silt loading and acidification, is a threat.

Conservation Little positive management is required, averting the above threats probably sufficient to safeguard this species. Management of the river margin and river bank vegetation should aim to ensure the presence of shelter for the adult stages. The R. Hull populations are within the R. Hull SSSI, which improves the chances of further effluent discharge being prevented. Extension of the Mochrum Lochs SSSI to include Lochs Fell and Hempton and the stream in question could be considered.

**PARALEPTOPHLEBIA WERNERI**

Order EPHEMEROPTERA  
Family LEPTOPHLEBIIDAE

*Paraleptophlebia werneri* Ulmer, 1919, formerly known as *P. tumida* Bengtsson.

**Identification** Nymphs can be identified by using Macan (1979) or Elliott, Humphesch & Macan (1988); adults by using Kimmins (1972) or Elliott & Humphesch (1983).

**Distribution** The first British records were from the Allen River and the River Till, Wiltshire, in 1939 (Macan & Macan 1940). Macan (1970) gives the known distribution as Hampshire, Wiltshire and Cambridgeshire. However, Kimmins (1972) refers only to two localities in Hampshire and a winterborne stream in Cambridgeshire, while Macan (1979) only mentions records from "Lambourn, Kennet and tributaries" (Wiltshire and Berkshire? The Lambourn is a tributary of the Kennet), "Gussage" (Dorset?) and "Avon", the last referring to the R. Avon, Figheldean, South Wiltshire, where a single subimago was recorded in 1961 (Kite 1962). The previous inclusion of Cambridgeshire may have been caused by records from the R. Kennet being wrongly attributed to the R. Kennett, Cambridgeshire. According to Harris (1956), this species is known from Lincolnshire, but he may be mistakenly attributing one of the Wiltshire records to the R. Till, Lincolnshire. Abroad, it is recorded from the Alps, central Europe to north of the Caspian Sea, and Fennoscandia (Puthz 1978).

**Habitat and ecology** The nymphs are chiefly to be found in calcareous streams with abundant vegetation, which are sometimes winterbornes. The sites of the original discovery were described as "reaches which were completely overgrown by such plants as grasses, *Mentha, Caltha, Ranunculus, etc*", and in both cases *P. werneri* was abundant and the only ephemeropteran found (Macan & Macan 1940). This genus generally inhabits areas of swift current (Mattingly 1987). The flight period is May and June (Elliott & Humphesch 1983). There is one generation per year and overwintering is in the nymphal stage (Macan 1979). The nymphs live in burrows (Elliott, Humphesch & Macan 1988). Nymphs of two American species of *Paraleptophlebia* have been shown to feed on suspended organic particles, periphyton growing on stones, and the faecal pellets of other detritivorous invertebrates, and to be able to shred and ingest leaves (Mattingly 1987), though Elliott, Humphesch & Macan (1988) describe *P. werneri* as a "collector-gatherer", meaning it feeds by gathering fine organic detritus from the sediment.

**Status** Known from very few sites. It can be abundant but the single specimen recorded by Kite (1962) on a river intensely sampled by him for a number of years suggests that this species can also occur at very low density. Alternatively, Kite's specimen may have been displaced from higher up in the river system.

**Threats** More efficient land drainage and increasing water abstraction may reduce the frequency and period of flow in winterborne rivers. Flow in the Rivers Kennet and Lambourn are decreasing owing to groundwater abstraction by the Water Authority. Where the rivers run through areas of arable agriculture, insecticide drift or run-off is a potential threat to the adults and nymphs respectively. Chalk streams often have a high value as sport fisheries and this may preserve suitable habitat for *P. werneri*, but winterbornes do not share this high regard, so statutory protection, preferably as part of a larger site incorporating much of the catchment, may be necessary. "Reaches completely overgrown by grasses, *Mentha, Caltha, Ranunculus, etc*" (see above) do not meet the requirements of a fishery, and weed-cutting or dredging may be desired by the proprietor. Until more is known of the ecological requirements of *P. werneri*, such gross alteration of vegetation structure should be avoided.
Conservation In addition to avoiding the above threats, the possible importance of marginal and riverbank vegetation should not be overlooked. This is likely to provide emergence sites and shelter for the adult stages. Maintenance work liable to damage this component should be carried out only on one bank, and preferably on only short stretches of, say, 50 metres in each 200 metres in any one year.

Author J.H. Bratton.

POTAMANTHUS LUTEUS VULNERABLE

Order EPHEMEROPTERA Family POTAMANTHIDAE

Potamantus luteus (Linnaeus, 1767). The nymph was described under the name Baetis mellea Curtis.

Identification Nymphs can be identified by using Macan (1979) or Elliott, Humpesch & Macan (1988); adults by using Kimmins (1972) or Elliott & Humpesch (1983).

Distribution Recorded from the R. Thames at Lalcham (1902) and Weybridge (1878), both Surrey; R. Usk at Monkwood (1955) and Abergavenny (1979), both Monmouthshire; and the R. Wye near Hereford (1957 and 1959), at several places between Builth Wells, Radnorshire, and Monmouth (1975 to 1979), and near Ross-on-Wye, Herefordshire, in 1989 (McLachlan 1878; Harrisson 1958; Brooker & Morris 1980c; J.A.D. Murray-Bligh pers. comm.). Brooker & Morris (1980c) also mention an unconfirmed (and unlikely) record from the Chichester Canal, West Sussex, in 1969. Bainbridge (1933) recorded P. luteus from New Reservoir, Colne, South Lancashire, the specimen (stage not given) having been seen by M.E. Mosely, D.E. Kimmins or H. Britten. However, as this record does not appear in any later accounts of the distribution of P. luteus, it is best regarded as unconfirmed. A definitely spurious record of this species from the R. Itchen near Eastleigh, South Hampshire, (Lucas 1906b) was corrected by Blair (1927). P. luteus is widespread from North Africa throughout Europe but not yet recorded from Scandinavia (Puthz 1978).

Habitat and ecology Nymphs are found in large rivers and sometimes occur at the same sites as Ephemera lineata Eaton. In the R. Wye, Harrisson (1958) gives the habitat as small pools almost cut off from the main river but inundated at times of flood. These pools were floored by stones and fine silt and the nymphs were usually clinging to the undersides of the stones. He reports that T.T. Macan found nymphs in a similar situation in the R. Usk where they were inhabiting the silt. Nymphs collected from the R. Wye by Brooker & Morris (1980c) were from riffles with substrata of stones and gravel or from deeper slow-flowing stretches with consolidated gravel beds. The latter produced the highest density of nymphs, 50 per square metre at one site. All other sites where it was found supported 5-20 per square metre. Specimens were collected at water depths ranging from 0.11 to 0.35 metres and current velocities of 0.15 to 0.78 metres per second. Some water chemistry data were also presented. In Europe, this species has one generation per year, most nymphal growth occurs in the autumn, and the winter is passed as a large nymph (Landa 1968, cited in Macan 1979). The limited British data also suggest that this species is univoltine and the nymphs overwinter (Brooker & Morris 1980c). The nymphs are strong swimmers. They feed on organic detritus gathered from the sediment. Emergence occurs at dusk from a stone or stem projecting from the water surface or from the water surface itself. The flight period is from May to July. Adults are active mainly at night and can be attracted to lights.
**Status** One of the rarest British mayflies. All recent records except one are confined to the R. Wye, despite recent survey work in the Thames, Usk and Severn (the last rising close to the source of the Wye) (Brooker & Morris 1980c).

**Threats** Industrial development along major rivers increases both the chronic pollution load and the risk of a catastrophic pollution accident. River bed disturbance such as during river engineering work can also be detrimental, even when carried out many miles upstream, by increasing the silt load of the water for a period. This can clog the gills of invertebrates or, where it settles, bury them. These threaten a broad spectrum of aquatic life, not specifically Ephemeroptera. Removal of the marginal vegetation in which the adults of *P. luteus* emerge and possibly shelter is likely to lessen the chances of successful breeding. The siting of lights, such as road lights, close to breeding sites could possibly lure the adult *P. luteus* away from the river in sufficient numbers to cause a slump in the breeding population.

**Conservation** The high value of the fishing rights on rivers such as the Wye and Thames has helped preserve their water quality. The R. Wye is an SSSI.


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**EPHEMERA LINEATA**  
**VULNERABLE**

Order Ephemeroptera  
Family Ephemерidae

*Ephemera lineata* Eaton, 1870.


**Distribution** There are old records from the Thames at Weybridge (1874), Reading (1888), Teddington (1901) and Laleham (1902) (Macan 1953); Kingston on Thames (1901) (Malden 1902); and Walton-on-Thames, Surbiton (undated) and possibly Little Marlow (1902) (Blair 1927). A specimen was caught at a light trap west of Reading in 1953, about half a mile from the Thames, but could have originated in nearby clay-pits. Near Reading it has also been recorded from the Kennet (Eaton 1871) and Holy Brook (Eaton 1888b). It was suggested that an adult caught in Knight's Park, Kingston on Thames, in 1906 may have emerged from Hogg's Mill Stream (Lucas 1906a). Its continued survival in the Thames is proven by two nymphs caught near Cookham, Berkshire, in 1987 (J. Biggs pers. comm.). Harrisson (1958) found two nymphs in the R. Wye near Hereford, probably in 1957.

Kimmins (1972) mentions records from the R. Wye in 1968, but this may be a misquote of the year Harrisson's records were published. In addition to these widely quoted localities, the Victoria County Histories for Cornwall and Devon include this species on their county lists, but without further details (Page 1906a, b). The Rev. A.E. Eaton is credited with much of the early recording of Ephemeroptera in southern Devon, so these records could well be his, but he makes no mention of records for these counties in his monograph (Eaton 1888a). No subsequent records from Devon or Cornwall have been found. A record of an adult female from Sark, Channel Islands, in 1890 (Mclachlan 1892) also requires confirmation. A nymph recorded from Ashdown Forest, East Sussex, (Townsend, Hildrew & Francis 1983) is "almost certainly a misidentification" (A.G. Hildrew pers. comm.). Abroad, *E. lineata* is known from most of Europe, but a record from northern Russia is probably not valid (Puthz 1978).
**Habitat and ecology** It is unclear whether nymphal development takes one year or two, and it is likely both can occur. Nymphs are found in large rivers, those found by Harrisson (1958) being in a bed of fine sand in deep water. They burrow into the river sediments and feed by filtering fine organic detritus from the water column. Kimmins (1972) gives the flight period of the adults as July. One of the records listed by Macan (1953) is from June, but it is unclear whether it refers to an adult or nymph. This species and *Potamanthus luteus* (L.) tend to occur at the same sites.

**Status** Extremely uncommon. Water Authority surveys have thoroughly sampled the ephemeropteran fauna of our larger rivers and it is unlikely to be greatly under-recorded.

**Threats** Similar to those to *Potamanthus luteus*, namely water pollution, disturbance associated with river engineering works, and destruction of the marginal vegetation. Probably also the siting of lights close to the mayfly’s breeding area, as this could attract the adults away from the river. The Thames is heavily used by pleasure boats in its middle reaches, which can cause erosion of the banks and loss of the marginal vegetation. Boat traffic also causes the suspension of sediments in the water column, but it is harder to predict the effect of this on nymphs of *E. lineata* in view of their filter-feeding habits.

**Conservation** The R. Wye is an SSSI. River engineering, especially dredging, should avoid disruption to more than a small fraction of a breeding area in any one year. As a prerequisite to implementing this recommendation, the positions of breeding sites need to be precisely known.

**Author** J.H. Bratton, using information from Harrisson (1958), Kimmins (1972), Macan (1979) and S.M. Turk (pers. comm.).
TAENIOPTERYX NEBULOSA BRITANNICA  

Order PLECOPTERA  
Family TAENIOPTERYGIDAE

Taeniopteryx nebula (Linnaeus, 1758) subspecies britannica Hynes, 1957, formerly in the genus Nepheleopteryx.

Identification Hynes (1977) and Lillemammer (1988) provide keys to adults and nymphs. Hynes (1957) described the main differences between the British subspecies and the continental form of this species. Subspecies britannica differs from the nominate subspecies in adult males having the epiproct narrower than the cerci (illustrated by Hynes 1957) and tending to be short-winged (though long-winged males have been found in Britain); both sexes having a faint bar across the wing; and nymphs having well-developed humps on the front and rear of the pronotum.

Distribution Widespread in England, Wales and Scotland though possibly absent from south-east England and East Anglia. A vice-county distribution map is given in Hynes (1977), in which the shading of part of South Kerry is a printing error. This species has not been recorded in Ireland (Costello 1988). T. nebula sensu lato occurs over most of Europe.

Habitat and ecology A riverine species. The nymphs feed on leaf fragments and detritus. In Fennoscandia this species has a one year life-cycle and most growth of the nymphs takes place in summer, autumn and early winter. Hynes (1977) described the habitat as emergent vegetation such as sedge, reeds or grass, occasionally moss. In the R. Wye catchment, Wales, Ormerod (1988) found T. nebula nymphs mainly in the river margins rather than the central channel, but P. Kirby (pers. comm.) has found the nymphs in three large rivers, where they were most abundant in mid-stream. Work in Lincolnshire led Langford & Bray (1969) to suggest that the young nymphs occur in the upper reaches of streams but move further downstream as they age until, just prior to emergence, they can be found over a wide altitudinal range. Adults can sometimes be found in large numbers underneath river bridges. They are on the wing from February to May but are unusual after March.

Status A widespread species, common enough not to be under threat at present. Subspecies britannica is endemic to Great Britain.

Threats River pollution in its many guises is likely to be the main threat to this species. Over-severe bank maintenance which fails to preserve marginal emergent vegetation is also likely to be damaging.

Author J.H. Bratton, using information from Hynes (1977) and Lillemammer (1988).

Rhabdiopteryx acuminata  

Order PLECOPTERA  
Family TAENIOPTERYGIDAE

Rhabdiopteryx acuminata Klapálek, 1905, formerly known as R. anglica Kimmins and confused in the past with R. neglecta (Albarda).
**Identification** Hynes (1977) and Lillehammer (1988) give keys to nymphs and adults. The latter uses head suture shape to separate nymphs of *R. acuminata* from those of *Brachypiera* spp., an improvement on the earlier key.

**Distribution** The known distribution in Britain is the R. Nidd at Knaresborough, Mid-west Yorkshire, (collected in 1914 but thought no longer to occur there); Jugger Beck (= Jugger Howe Beck) in Harwood Dale (1927), Pickering Beck (1942) and the R. Rye at Helmsley (abundant in 1955), all in North-east Yorkshire; Clywedog Brook at Cross Gates (1956) and two sites on the R. Wye (mid-1970s), all in Radnorshire; the Rivers Ystwyth and Rheidol (mid-1970s), Cardigan; R. Lune, probably Cumbria, between 1977 and 1982; and Montgomeryshire. Abroad, this species is known from eastern Europe and the Alps (Illies 1978), and Lillehammer (1988) records it from Helsinki and Joensuu, Finland.

**Habitat and ecology** Small calcareous streams provide the habitat in Yorkshire. In the R. Rye, it occurred where the river was about 15 metres wide with riffles about 30 cm deep between deeper pools. The river here tends to dry out in some years, as it flows over limestone. The bed is of rough stones and gravel with the mosses *Fontinalis* and *Hypnum*. The descriptions of Pickering Beck and Jugger Howe Beck (Kimmins 1943c) are similar, adult specimens being found in the numerous alders growing along their banks. Nymphs have also been recorded in three oligotrophic softwater rivers in Wales. In the R. Wye, Morris & Brooker (1979) list *R. acuminata* among species colonising baskets of cobbles and coarse gravel in a riffle with a current velocity of approximately 0.5 metres per second, a typical salmon nursery area. The Rivers Rheidol and Ystwyth have similar water chemistry to the Wye, except that both suffer some metal pollution from disused mine workings (Brooker & Morris 1980b). Adults are on the wing between March and May. Nymphs of this family are said to be herbivorous.

**Status** The known range of this species has increased in the last two decades and it is probable that further sites for it will continue to be found. It can occur in abundance.

**Threats** River pollution and water abstraction are probably the main threats, the latter aggravating the effects of the former, and fish-farms frequently infest both on calcareous streams. Sewage and modern agriculture, particularly releases of silage clamp effluent, are other frequent sources of river eutrophication which would be likely to eliminate oxygen-loving invertebrates such as stoneflies. Chronic eutrophication of rivers can lead to dense growth of algae at the expense of higher plants, which is likely to have serious implications for *R. acuminata*, as the nymphs are herbivorous. It is not clear how important the presence of trees is for the adult stages. They may feed on epiphytic lichens and algae or simply use riverside trees for shelter. In either case, removal of trees is likely to be harmful for this species, but is an all too common occurrence along rivers (see Mason & MacDonald 1984).

**Conservation** The water quality in Pickering Beck, Jugger Howe Beck, R. Nidd, R. Rye and Clywedog Brook was classed as good (class 1) in 1985 (Department of the Environment & Welsh Office 1986). Jugger Howe Beck, Pickering Beck and the R. Rye have SSSI protection in the regions in which *R. acuminata* has been recorded.

**Author** J.H. Bratton, using information from Kimmins (1943c), Hynes (1957, 1977), Morris & Brooker (1979), Brooker & Morris (1980a, b) and Macan (1982).
BRACHYPTERA PUTATA

Order PLECOPTERA

Family TAENIOPTERYGIDAE

Brachyptera putata (Newman, 1838), previously falsely synonymised with B. trifasciata (Pictet). Specimens of B. starmachi Sowa from the Carpathians were at one time attributed to B. putata (Illies 1978).

Identification Hynes (1977) provides keys to adults and nymphs. However, on p. 88 Hynes stresses that the keys should be used in conjunction with more detailed descriptions referred to therein, and that identification of any stoneflies, especially nymphs, cannot be certain without reference to such a description.

Distribution Recorded last century and early this century from a few places on the R. Clyde, Lanarkshire, and the Rannoch area, Mid Perthshire. In the 1950s an adult was found at Kinloch Rannoch, Mid Perthshire, and adults and one nymph in Strath Oykell below Altassmore, Sutherland. Bird (1983) gave records of nymphs from two sites on the R. Dee in Angus and Kincardineshire; five sites along the R. Spey in Inverness-shire and Morayshire; and the Halladale River, West Sutherland. Kimmins (1944) identified a specimen in the Dale Collection collected at Leominster in 1864. The continued presence of this species in Herefordshire was confirmed between 1967 and 1977 (Hynes 1977), and single adult females were found near the R. Wye at Hereford in 1983 and 1984 (Cooter 1985). Hynes (1977) gives a vice-county distribution map.

Habitat and ecology Found in the slower reaches of rivers. The habitat in Sutherland was a broad lake-like river with a muddy bed partly covered by Littorella, the edge stony or fringed with Carex. In swifter regions upstream, where the bed was stony, this species could not be found. Adults are on the wing from February to April. Nymphs of this family are not predatory, and the closely related B. risi (Morton) is thought to feed by scraping algae and detritus from stones using the galea (Hynes 1941).

Status Uncommon, and seemingly endemic to Britain.

Threats Extensive conifer afforestation in the uplands and far north of Scotland could be detrimental to this and other riverine invertebrates, through long-term acidification and aluminium release in the catchment. The application of insecticide to conifer plantations could lead to insecticide reaching the rivers, with serious consequences for this and other aquatic invertebrates. Other forms of water pollution would also be damaging, such as industrial waste, sewage or agricultural eutrophication.

Conservation The water quality in the Rivers Dee, Spey, Halladale and Oykell was graded class 1 unpolluted in 1985 (Scottish Development Department 1987). Provided that this quality is maintained and the above-mentioned threats averted, the Scottish populations will probably flourish. The R. Wye is an SSSI and the high value of the fishing should ensure that the water quality is not allowed to deteriorate.

Author J.H. Bratton, using information from Morton (1896, 1911a) and Hynes (1957, 1977).
**NEMOURA DUBITANS**

*Order PLECOPTERA*  
*Family NEMOURIDAE*

*Nemoura dubitans* Morton, 1894.

**Identification** Hynes (1977) and Lillehammer (1988) provide keys to adults and nymphs, but it would be rash to base identifications solely on nymphs.

**Distribution** First recorded from West Stow, West Suffolk, in 1910 (Morton 1911b; Nurse 1912). Further specimens were found at Fritton marshes, East Suffolk, in 1936 (Morley 1936; Kimmins 1940). Elton (1956) reported populations in Wytham Woods in 1946 and at Cothill in 1950, both in Berkshire. It was refound in Berkshire, at Cothill Fen and Lashford Lane Fen, and found in Oxfordshire, at Spartum Fen, by K. Porter in 1987 and 1988. Blair (1947) found several adults on the Isle of Wight in 1947. This was near the town of Freshwater according to Hynes (1963b) and undoubtedly refers to Freshwater Marshes. Hynes (1963b) gave additional records as the R. Mimram, Herts; a wood in North Hampshire; and a single locality in East Norfolk. This last occurrence was probably referring to the Norfolk Broads, as Ellis (1965) wrote that this species had been found at Barton and Wheatfen Broads. Service (1968) recorded adults on Brownsea Island, Dorset, in the mid-1960s, and Wise (1974) mentioned "a fine hatch" at Brownsea in 1974. A.E. Stubbs (pers. comm.) collected adults in Surrey at Chobham Common, the Neck and Moon Alder Swamp on Thursley Common, and on Wisley Common, in the 1960s. Adults were recorded at Denny Bog and Holmsley Bog, New Forest, South Hampshire, in 1983 (Sheppard in prep.). In 1989 adults were found at Flitwick Moor, Bedfordshire (P. Kirby pers. comm.); Strumpshaw Marsh, East Norfolk (pers. obs.); Catfield Fen, Holt Lowes and Woodbastwick Marshes, East Norfolk, and Chippenham Fen, Cambridgeshire (A.P. Foster pers. comm.); and East Walton Common, West Norfolk (A.E. Stubbs pers. comm.). This species is also known from other parts of central and northern Europe, Denmark, Sweden and Finland (Lillehammer 1988).

**Habitat and ecology** The nymphs of this species remained undiscovered until 1960, when they were found at Wormstall Pond, Wytham. The site was a marsh partly overgrown by small *Salix*, in which very shallow water flowed through sedges and other marsh plants over a rich organic mud full of fallen leaves. The marsh was fed by a small seepage, which flowed in places through ill-defined channels. In 1961, a further six nymphs of *N. dubitans* were found at the head of the marsh near the seepage (Hynes 1963b). This marsh appeared to Hynes very similar to the site at Freshwater where Blair found adults of *N. dubitans*. It too had shallow water seeping through emergent plants, mostly *Phragmites*, amongst scattered willows. The site of the original discovery of *N. dubitans* at West Stow also sounds similar, described by Nurse (1912) as "a marshy spot, covered with reeds and rushes, and studded with trees and bushes of various kinds, it runs down to the river Lark". Shallow water trickling through sedge or reed beds is the usual habitat of the nymphs of this species, frequently the water source being a nearby spring. A substratum of fen peat also recurs several times in the descriptions of *N. dubitans* habitats. Some sites do not fit this generalisation. Chobham Common, Thursley Common, Wisley Common and the New Forest bogs are more acidic than the sites described above, but can have a higher base status than would be expected from their surrounding vegetation and should be categorised as poor-fen rather than acid bog (W. Fojt pers. comm.). At Fritton, *N. dubitans* adults were found on sallow bushes during the day and after dark (Morley 1936), near a field dyke which Hynes (1941) described four years later as "stagnant and full of rotting leaves and *Lemma trisulca*, and appeared to be a most unusual habitat for stoneflies". He found no nymphs or adults on that occasion. Adults of *N. dubitans* were numerous on alders and beeches at West Stow and were beaten from sallows at Wormstall Pond. At Strumpshaw Marsh adults were abundant on low vegetation along a raised path and could have emerged.
from any of a variety of wetland habitats in the vicinity, including *Phragmites* and *Carex* fen. The flight period lasts from April to June.

**Status** Seemingly one of our more scarce species, but, as it may occur as small populations in restricted areas of a few square metres, it may be easily overlooked. Prompted by the production of this review, searching in East Anglia and the East Midlands in 1989 revealed six unrecorded colonies, and there are undoubtedly more to be discovered. However, all the colonies of this species currently known are on sites recognised as having high conservation value; some are threatened or have recently suffered damage; and post-1960 records still represent only seventeen sites. It is felt that the Notable category is still justified.

**Threats** Intensification of agriculture, including land drainage and the realigning of streams and rivers, is likely to have eliminated many occurrences of suitable habitat. Water abstraction, causing chalk springs to cease or become seasonal, may also have been detrimental. The recorded habitat sounds prone to transformation to carr by natural succession of the vegetation in the absence of any restraining factors. Denny Bog and Freshwater Marshes have been damaged by drainage work in recent years, and there are difficulties with maintaining the water table at Chippenham Fen and Thursley Common. This last site suffered in the drought of 1976 and it is not known whether *N. dubitans* survived this. Flitwick Moor is suffering from a falling water table, eutrophication and heavy public use for recreation not always coupled with appreciation of its wildlife value.

**Conservation** Cothill Fen, Thursley Common and Chippenham Fen are NNRs and Woodbastwick Marshes are within the Bure Marshes NNR. Chobham Common and Freshwater Marshes have LNR and SSSI status. Flitwick Moor is an SSSI and reserve of the Bedfordshire and Huntingdonshire Trust. Brownsea Island is National Trust property and a reserve of the Dorset Trust. East Walton Common, the New Forest and Spartum Fen are SSSIs and Catfield Fen and Barton Broad lie within an SSSI. Wheatfen Broad is a nature reserve held as a memorial to E.A. Ellis within an SSSI, and Strumpshaw Marsh is an RSPB reserve within the same SSSI. Holt Lowes is an SSSI and Norfolk Trust reserve. Marshes where this species breeds may require some form of active management to prevent vegetational succession. However, if *N. dubitans* populations are occupying very restricted areas, it may not be possible to manage the occupied portion of the habitat without undue disruption of the stenophylo population. Where possible, it may be best to concentrate management on making adjacent areas appear suitable, with close monitoring over subsequent seasons to see if *N. dubitans* utilises them. Such management may involve manual scrub removal or moderate grazing pressure by cattle. The best guide to suitable management is usually to discover by what means the marsh has been kept open in previous decades.

**Author** J.H. Bratton.

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**CAPNIA VIDUA ANGLICA**

**ORDER** PLECOPTERA

**FAMILY** CAPNIIDAE

*Capnia vidua* Klapálek, 1904, subspecies *anglica* Aubert, 1950.

**Identification** Hynes (1977) and Lillehammer (1988) provide keys to adults and nymphs of the species. The slight differences between subspecies *anglica* and the nominate subspecies are in the shape of the supra-anal lobe of the adult male, and these were described and figured by Aubert (1950). Lillehammer (1988) noted that wide variation occurs in the
Fennoscandian populations, involving wing venation, the shape of the female subgenital plate and the shape of the male genital appendages.

**Distribution** The vice-county distribution map in Hynes (1977) shows records from northern England and Scotland. The wider distribution pattern of the species is shown in Lillehammer (1988). In Fennoscandia it has been found only north of the polar circle. It is also known from Iceland and is widespread in Europe.

**Habitat and ecology** Occurs at low density in small stony streams. Adults are found in March and April in Britain but later in the year elsewhere in the range. It probably has an annual life-cycle.

**Status** Subspecies anglica is thought to be endemic to Great Britain. The paucity of records of this species is probably due to its being found at low density. It would be necessary for a more thorough survey of the uplands to produce few further records before there would be justification for considering this subspecies to be threatened.

**Threats** It is not known how serious a threat to this species is posed by acidification of watercourses. It is possible that its habitat of upland streams in mainly base-poor areas of Britain could be severely affected by this process.

**Author** J.H. Bratton, using information from Hynes (1977) and Lillehammer (1988).

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**ISOGENUS NUBECULA**  
**VULNERABLE**

*Order PLECOPTERA*  
*Family PERLODIDAE*

*Isogenus nubecula* Newman, 1833.

**Identification** Hynes (1977) and Lillehammer (1988) provide keys to adults and nymphs.

**Distribution** There are collections containing old specimens of this species, probably from Britain but lacking data labels. Jones (1949a) recorded nymphs as possibly this species from the R. Rheidol, Cardiganshire, but these later proved to be *Diura bicaudata* (L.) (Hynes 1952). The first specimen considered authentically British was caught in 1958, probably in the Bettisfield/Whixall Moss area, Shropshire, but there remains some doubt about the precise locality and date even of this record (Brindle 1973). It is reliably known only from the R. Dee, Flintshire, (Hynes 1963a) where nymphs were recorded at Bangor-is-y-coed and Overton Bridge in February 1959 and again at Bangor in March and April of that year. A survey in the 1980s found nymphs along a 45 km stretch of the R. Dee, between Newbridge and the joining of the R. Alyn (Alun), with the greatest abundance close to the site of the original discovery (Mills & Andrew 1984). There is also an old unconfirmed record from Stoke-on-Trent (Morton 1934), and Hynes (1941) mentions an undated specimen in the McLachlan collection from the Burton-on-Trent district. As both of these are from Staffordshire, it is possible they refer to the same specimen. King & Halbert (1910, cited in Hynes 1941) stated that *Dictyopterygella* (now *Diura* bicaudata (L.)) was often erroneously identified as *I. nubecula* in early British collections. This is presumably the case with the occurrences recorded by King & Morton (1891) at Loch Rannoch and may be the case with the specimen in the collection of the British Entomological Society labelled "Rannoch 8.6.98". *I. nubecula* is widespread in Europe and reaches Siberia and Japan (Despax 1951).

**Habitat and ecology** Found in large stony lowland rivers. The adults are on the wing in March and April. The sites at which it occurred in the R. Dee had been studied regularly in
previous years, and it was suggested (Hynes 1963a) that during this period mild pollution had confined *I. nubecula* to deep water downstream. At Bangor, Hynes found nymphs only far out in the river where the flow was swift and deep. Mills & Andrew (1984) consider swift-flowing water, 25-30 cm in depth, over unstable cobbles and gravels to be the ideal habitat, nymphs not being found among extensive growths of aquatic *Ranunculus*, nor where the river becomes deeper with a substratum predominantly of sand and silt. Nymphs of this family are carnivores but also eat some vegetation. The adults are thought not to feed, though they do drink water.

**Status** The range and abundance in the R. Dee are thought to have increased between 1959 and 1982, but this is still the only river known to support a population of this species, despite searching in the tributaries of the Dee (Mills & Andrew 1984) and much other sampling of river invertebrates (e.g. Bird 1983). It may have been lost from several European countries. Claessens (1981) could find no records from Austria, Belgium, Switzerland or the Netherlands more recent than 1936 and considered Dutch rivers to be now too polluted to give hope of new records there.

**Threats** Water pollution is the most obvious threat to this species, and the numerous towns along the R. Dee afford plenty of scope for pollution, either industrial, sewage or accidental. Agricultural pollution also poses a serious threat, particularly slurry from factory farming and the leachate from silage clamps.

**Conservation** The water quality in the R. Dee was classed as good (class 1) in 1985 (Department of the Environment & Welsh Office 1986). It was suggested by Mills & Andrew (1984) that the regulated flow of the R. Dee, which has increased the minimum dry weather flow in the middle reaches to 6 cubic metres per second for 50% of the year, may be the factor creating suitable conditions for *I. nubecula* in this river alone.

**Author** J.H. Bratton, using information from Hynes (1977).

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**ISOPERLA OBSCURA**

**Order** PLECOPTERA

**Family** PERLODIDAE

*Isoperla obscura* (Zetterstedt, 1840), formerly known as *I. grisipennis* (Pictet), and at one time wrongly known as *Chloroperla venosa* Stephens. *C. venosa* is now considered a synonym of *I. grammatica* (Poda).

**Identification** Hynes (1977) and Lillehammer (1988) provide keys to adults and nymphs.

**Distribution** Known in Britain only from the Nottingham area, where several adults were found in 1911 and 1912 on the R. Trent between Stoke Bardolph and Radcliffe-on-Trent (Morton 1913). Further adults and a cast nymphal skin, the identity of the latter being confirmed by Hynes & MacPhee (1970), were collected near Nottingham in 1913 (Hynes 1941), and there are specimens in the BM(NH) taken in the Nottingham area in 1914, 1915 and 1920, the last being from Fiskerton and probably all from the R. Trent. This species occurs in Finland, Norway, Sweden, northern Germany and central Europe.

**Habitat and ecology** In Britain, recorded from a large lowland river. This is also the habitat on the continent in the southern part of its range, but further north it occurs in small streams and mountain lakes. Nymphs (in Fennoscandia) are carnivores but also eat some vegetation. The adults are thought not to feed at all, though they do drink water. All the British adults were found in May.
**Status** Apparently extinct in Britain. It has not been seen in the Trent since early this century and searches for it in 1940 were unsuccessful (Hynes 1941). It is also scarce in Europe but seems to be the dominant predatory stonefly in northernmost Fennoscandia.

**Threats** Hynes (1977) suggested that pollution was responsible for the demise of *Isoperla obscura* in Britain. He described the Trent in 1940 as "somewhat polluted" (Hynes 1941), and in 1985 the water quality was still only classed as fair (class 2) (Department of the Environment & Welsh Office 1986).

**Conservation** In the absence of a known population, the only recommendation can be for survey. The R. Derwent joins the R. Trent close to Nottingham and has suffered much less from industrial pollution than has the Trent, so the lower reaches of the Derwent may be the most likely area for *I. obscura* to have persisted (P. Kirby pers. comm.).

**Author** J.H. Bratton, using information from Hynes (1977), Lillichammer (1988) and P.C. Barnard (pers. comm.).
Additional species

The following seven data sheets deal with species which were initially selected for inclusion in one of the main threat categories, but after collation of their data sheets it was decided they did not meet the criteria. Though not qualifying for the Notable or higher threat categories, they are nevertheless of interest through being scarce or having few published records and will be kept in mind as possible candidates for future editions of this review or the Red Data Books. To this end, further information concerning these species in Britain will be gratefully received by the NCC. The species dealt with in this way are:

Ephemeroptera

Siphlonuridae
Baetidae
Ephemerellidae
Caenidae

Siphlonurus alternatus Say
Baeatis digitatus Bengtsson
Ephemerella notata Eaton
Brachycercus harrisella Curtis
Caenis pusilla Navas

Plecoptera

Nemouridae

Protonemura montana Kimmins
Amphinemura standfussi Ris
SIPHONURUS ALTERNATUS

Order EPHEMEROPTERA  Family SIPHONURIDAE

*Siphlonurus alternatus* (Say, 1824), formerly known as *Siphurus linnaeanus* Eaton, *Siphlonurus linnaeanus* (Eaton) and *S. linnaeanus* (Eaton).


**Distribution** The first British record was of an adult collected in 1913 on the R. Tummel, Scotland (Moseley 1931). Further published records are few. The R. Cree, Scotland, was mentioned by Kimmins (1972). Macan (1979) added the R. Severn. Harris (1956) listed four of the Irish sites. This species is widespread in Europe (Puthz 1978).

**Habitat and ecology** Found in slow-flowing and still waters, possibly with a preference for calcareous conditions. The habitat in Ireland includes limestone lakes and slow deep river pools (Kimmins 1972). Adults are on the wing from May to August. The subimagines emerge during daylight. Swarming of the adult males has been reported at dawn and dusk. This phenomenon has been studied in southern Finland, where it was found that swarms developed over light-coloured patches in the river such as stones or water-lily leaves, the larger the marker, the larger being the swarm (Savolainen 1978).

**Status** Macan (1979) described this species as widespread but rarely encountered, adding that it is commoner in Ireland than any other country. A shortage of published records does not necessarily indicate a Notable mayfly, and it is thus not placed in this category at present.

**Author** J.H. Bratton, using information from Macan (1979) and Elliott & Humpesch (1983).


BAETIS DIGITATUS

Order EPHEMEROPTERA  Family BAETIDAE

*Baetis digitatus* Bengtsson, 1912.

**Identification** Adults are included in the keys of Elliott & Humpesch (1983) with the proviso that subimagines and female imagines cannot be separated from *B. niger* on current knowledge. Male imagines of these two species also resemble each other very closely (Macan 1979). Elliott, Humpesch & Macan (1988) provide a more convincing key for identifying nymphs than that of Macan (1979).

**Distribution** Known from a small number of rivers, including the R. Frome, Dorset, (Kimmins 1972) and the R. Teifi, Cardigan (Jenkins, Wade & Pugh 1984). The R. Frome record may strictly be referable to East Stoke millstream, which is fed by the Frome and where nymphs were found in this country for the first time during sampling lasting from 1964 to 1966 (Crisp & Gledhill 1970). Abroad, it has been recorded from the Alps, the Balkans, central Europe and Fennoscandia (Puthz 1978).
**Habitat and ecology** Larvae are found chiefly among vegetation, either aquatic weed or the submerged roots of marginal plants, in streams and rivers. The flight period is May to September. It sometimes occurs with *B. niger* (L.).

**Status** Unknown at present owing to possible confusion with *B. niger*. There is not sufficient justification for giving it Notable status.

**Conservation** It has been recorded within Cors Caron NNR, Cardigan.

**Author** J.H. Bratton, using information from Macan (1979), Jenkins, Wade & Pugh (1984) and J. Wright (pers. comm.).

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**EPHEMERELLA NOTATA**
Yellow Hawk, Yellow Evening Dun or Spinner

Order EPHEMEROPTERA Family EPHEMERELLIDAE

*Ephemera notata* Eaton, 1887.

**Identification** Nymphs can be identified by using Macan (1979) or Elliott, Humphesch & Macan (1988); adults by using Elliott & Humphesch (1983).

**Distribution** Kimmins & Frost (1943) reviewed the occurrences of this species, listing a small number of rivers in Yorkshire and Cumberland; Bovey Tracey, South Devon; and the R. Wey near Elstead, Surrey. A specimen labelled "south of Scotland" was also mentioned, and doubt cast on a record from the R. Ithon, Llandrindod Wells, Radnorshire, owing to its late month of capture (August). Perhaps there are grounds for similar doubts about the record by Hincks (1935) from Crummock Water, Cumberland, on 16 July 1931. There are more recent records from the R. Coquet, Northumberland, in 1968 and 1969 (Wise 1976, 1980); R. North Tyne, South Northumberland (Shires 1976); R. Severn (Macan 1979); the Rivers Annan, Dumfriesshire; Clun; Lugg/Wye; Monnow; Usk; and Teme (J. Wright pers. comm.); Ashdown Forest, East Sussex (Townsend, Hildrew & Francis 1983) (requires confirmation); Afon Clwyd, Denbighshire, several sites in the middle reaches of the R. Dee, Merionethshire and Denbighshire, between 1976 and 1981, and Afon Dulas, Denbighshire, in 1985 (Welsh Water unpublished). *E. notata* may be extending its range, as it was found in the R. Clyde at Wolfclyde, Lanarkshire, in 1978 and has since been found at four other stations on this river, but was not recorded in regular collections by the Clyde River Purification Board in the previous ten years (Doughty 1985). Jones (1948, 1949a, b. 1950) gave records from Nant Garw, R. Clydach and R. Sawdde, Carmarthenshire, and R. Rheidol, Cardiganshire. However, many of his specimens were collected at times of year when nymphs of *E. notata* would not be found or would be too small to identify (see Habitat and ecology section below); thus misidentifications seem likely. *E. notata* has been recorded from much of Europe but not from Fennoscandia (Puthz 1978).

**Habitat and ecology** This species breeds in moderately fast-flowing and usually calcareous rivers. Small beckas and streams, such as will support *E. ignita* (Poda), appear to be unsuitable. There is one generation per year. Overwintering may be in the egg stage (Wise 1980) or as very small nymphs (Hynes 1961, cited in Macan 1979), but in either case almost all growth occurs between March and May or June, when emergence occurs. The subimagio emerges soon after sunset. Imagines are on the wing in the afternoon in fine hot weather. Swarms of adults have also been reported at dusk. The nuptial flight occurs up to 200 metres from the water. The eggs are laid at the water surface in one mass. *E. notata* and *E. ignita* can occur in the same river, but the development and emergence of the former
are concluded before the appearance of the first instars of *E. ignita*; thus there is no competition between the nymphs of the two species (Wise 1980).

**Status** Infrequently recorded and possibly with rather exacting habitat requirements. Seems to be very widespread and so not placed in the Notable category, but quite uncommon none-the-less.


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**BRACHYCERCUS HARRISELLA**

Order EPHEMEROPTERA

**Family CAENIDAE**

*Brachycercus harrisella* Curtis, 1834.


**Distribution** There are published records from the R. Kennet near Reading, Berkshire, and Somerset (Eaton 1888a, b); the River Avon, Netheravon, South Wiltshire, and the East Stoke millstream, Dorset (Crisp & Gledhill 1970); Pocklington Canal, South-east Yorkshire, in 1945 (Hincks 1945); and the River Severn (Macan 1979). To these, unpublished Yorkshire Water Authority records from the 1970s add R. Ure at Aldwarke, R. Ouse at Nether Poppleton, R. Swale at Topcliffe, at Skipton and at Morton, Loadpit Beck, Costa Beck, and R. Derwent between Marlton and Elvington and at Low Hutton. D. Bilton (*in litt.*) recorded this species in the R. Lymn near Partney, North Lincolnshire, in 1984. It is known from central Europe and Fennoscandia (Puthz 1978).

**Habitat and ecology** This is thought to be a univoltine species which overwinters as an egg. Adults have been recorded only in July. The nymphs are found in rivers in banks of silt or mud and can be very numerous. Sampling suggested that over 1,600 nymphs passed down the East Stoke millstream between October 1964 and May 1966 in the invertebrate drift.

**Status** Though considered by many to be a rarity, the wide spread of the records and the numerous unpublished occurrences in eastern England suggest that this species is under-recorded and it has not been given Notable status. Unlike other species in the Caenidae, the nymphs of *B. harrisella* are easily recognisable; thus errors in identification should not occur.

**Threats** River improvement schemes, particularly the straightening of watercourses, may remove the banks of silt occupied by this species.

**Conservation** Most of the Pocklington Canal is an SSSI, but it is not known which stretch was the source of the record of *B. harrisella*. This species was not recorded in a subsequent survey of this site (Lawton, Blumenthal & Fisher 1974).

CAENIS PUSILLA

Order EPHEMEROPTERA  
Family CAENIDAE

*Caenis pusilla* Navas, 1913, synonymous with *C. rhenicola* Malzacher, 1976.

**Identification** Elliott, Humpsch & Macan (1988) provide a key to nymphs (as part of an improved key to the whole family). For adults, one needs to refer to Malzacher (1976) (who includes a figure of the male genitalia), Malzacher (1984) (in German, keys and figures of nymphs and both sexes of adults), Malzacher (1986) (a description, in German, but no figures) or Alba-Tercedor & Malzacher (1986) (a description in English and figures of the forceps and styliger-sclerite).

**Distribution** British sites are listed by Elliott, Humpsch & Macan (1988) as the Candover Brook, a tributary of the R. Itchen, North Hampshire; R. Frome, Dorset; and R. Wye, Wales. Also known from Spain, France, Italy, Greece, Tunisia, Germany, Switzerland and Czechoslovakia.

**Habitat and ecology** Virtually unknown in Britain. The three sites listed are flowing waters, as are most, if not all, its foreign localities.

**Status** Recognised in Britain only in 1986, so it is too early to suggest a status for this species, in view of the difficulties of identification in this genus. It was first discovered in northern Spain and described in 1913 but not found again for 65 years. Malzacher (1976) described *C. rhenicola* as a new species based on material collected from the Upper Rhine on the German/Swiss border in 1973 and 1974. When the type specimens of *C. pusilla* were subsequently discovered, it was realised that the two were synonymous.

**Conservation** The River Wye is an SSSI.

**Author** J.H. Bratton, using information from Alba-Tercedor & Malzacher (1986).

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PROTONEMURA MONTANA

Order PLECOPTERA  
Family NEMOURIDAE

*Protonemura montana* Kimmins, 1941.

**Identification** Hynes (1977) provides keys to adults and nymphs. However, records based on identification of nymphs should be treated with caution, as specimens have recently been found which are intermediate between the three British species as described by Hynes (J. Wright, pers. comm.).

**Distribution** There are records from Ffynon Caseg and Afon Caseg near Yr Elen, Caernarvonshire (J. Rees unpublished records); the Lewis Burn and R. Allen, South Northumberland (Sadler & Booth 1978); Moor House in the Pennines, Westmorland (Brown, Cragg & Crisp 1964); and the English Lake District and the Highlands and far north of Scotland (Kimmins 1941, 1943b, 1950; Minshall 1969; Hynes 1977). There are also records from the Balkan and Carpathian mountain ranges (Illies 1966, 1978).
Habitat and ecology Adults are found from July to September. The habitat is small stony streams above about 500 metres altitude. At Moor House it was found only in one stream, among stones, boulders and moss, in a torrential flow of permanently cold water at about 730 metres altitude, where it was numerous [Brown, Cragg & Crisp 1964]. In laboratory studies, Elliott (1988) found the percentage of eggs hatching was highest in water at around 60°C, falling to zero hatching around 22°C. Hatching took around 90 days at 4°C but only about fifteen days at 20°C, close to the upper temperature tolerance limits. The nymphs of this family are herbivores.

Status Hynes (1977) describes P. montana as "rare, frequent", but frequent here means found at low density. It is impossible to gauge from his vice-county distribution map how common this species is. Published records are few, but it is possibly to be found throughout much of the northern uplands.

Conservation Moor House is an NNR. Afon Caseg and Ffynnon Caseg are within the National Trust's holdings within the Snowdonia National Park.

Author J.H. Bratton, using information from Hynes (1977) and M.J. Morgan (pers. comm.).

AMPHINEMURA STANDFUSSI

Order PLECOPTERA Family NEMOURIDAE

Amphinemura standfussi Ris, 1902.

Identification Hynes (1977) gives keys to adults and nymphs. However, distinguishing between nymphs of this species and the more common A. sulcicollis (Stephens) is more difficult than it appears in the key. Keys are also provided by Lillehammer (1988).

Distribution Records have been published by Macan & Macan (1940), Hynes (1941), Graham (1941), Kimmins (1943a, 1944), Elton (1956), Brown, Cragg & Crisp (1964), Langford (1964) (nymphs only) and Langford & Bray (1969) (nymphs only), resulting in the vice-county map in Hynes (1977) showing records scattered through most of Great Britain. In 1979 adult females of both A. standfussi and A. sulcicollis were found in Colehayes Park, South Devon (P. Kirby pers. comm.). Bird (1983) recorded this species from 23 sites in 12 rivers, the determinations being based on nymphs. More recent records based on adults have come from East Kent, Huntingdonshire, Leicestershire and South Lincolnshire. This species has been recorded from much of Fennoscandia and Europe but is less common in the Mediterranean area (Lillehammer 1988).

Habitat and ecology A cold-water species usually found in small stony streams in the upper reaches of watercourses. Elliott (1988) found that the greatest percentage of eggs hatched in water around 5°C and that hatching fell to zero at about 13°C. At around 50°C, hatching took about 150 days. This long development time for the eggs serves to avoid competition between nymphs of this species and Nemoura erratica Claassen, which is also a cold-water stenotherm but whose eggs hatch in about 60 days at 50°C. Nymphs of A. standfussi are frequently associated with vegetable matter. In Daggons Brook, near Verwood, Dorset, nymphs (which were reared to adults) were found in accumulations of dead leaves in a small stream flowing over a sandy bed (Macan & Macan 1940; Hynes 1941), and in the R. Rase, North Lincolnshire, nymphs were found on the moss Eurhynchium riparioides (Hedw.) Jennings (Langford 1964). In Huntingdonshire and Leicestershire adults were reared from nymphs collected in narrow shallow streams devoid of aquatic macrophytes but including leaf packets and flowing through arable land,
outwardly very unpromising habitats. There are also records from the middle reaches of rivers. Nymphs of this family are all thought to be herbivores. Those of A. *stans/usus* have been raised to maturity in the laboratory on a diet of dead oak leaves (Hynes 1941). They are thought to chew off pieces of the leaves rather than feed on detritus produced by the decay of the leaf. In the field, adults are reportedly on the wing from June to September, though indoors they have emerged in late April and early May, only a few days after the nymphs were collected.

**Status** Despite the possibility of some records based on nymphs being misidentifications, this species seems to be more common than would justify its having Notable status. It is probably to be found in permanently cool streams throughout most of Great Britain. It was considered to be the second most abundant species of stonefly at Moor House (Brown, Cragg & Crisp 1964).

**Threats** The piping of springs and seepages as part of agricultural intensification is likely to have destroyed many sites capable of supporting this species in lowland Britain. As the typical habitat appears to be watercourses close to their source, the risk of water pollution should be less of a threat to this than to most species of Plecoptera.

**Conservation** It is recorded from Moor House NNR, Westmorland; Wyre Forest NNR, Worcestershire; Rostherne Mere NNR, Cheshire; and Dole Wood SSSI, a reserve belonging to the Lincolnshire and South Humberside Trust.

**Author** J.H. Bratton, using information from Hynes (1977) and C.M. Drake and P. Kirby (pers. comms).
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Index

This index includes all the scientific and vernacular names and synonyms of invertebrates mentioned in the text and lists. Data sheets are indexed in bold typeface.

acuminata, Rhabdiopteryx  9, 16
alternatus, Siphlonurus  24, 25
Amphinemura  24, 29
anglica, Capnia vidua  9, 20
anglica, Rhabdiopteryx  16
apicalis, Chloroperla  3
apicalis, Xanthoperla  3
Arthroplea  3
Baeitis  13, 24, 25
bicaudata, Dicyopterygella  21
bicaudata, Diura  21
Brachycercus  6, 24, 27
Brachyptera  9, 17, 18
britannica, Taeniopteryx nebulosa  9, 16
Brown May Dun  11
Caenis  24, 28
Capnia  9, 20
Chloroperla  3, 4, 22
cineria, Nemoura  4
congener, Arthroplea  3
Dicyopterygella  21
digitatus, Baeitis  24, 25
dispar, Ecdyonurus  10
Diura  21
dubians, Nemoura  9, 19
Ecdyonurus  10
Ephemerella  6, 24, 27
Ephemerella  24, 26
eroatica, Nemoura  29
flavipennis, Heptagenia  10
fuscogrisea, Heptagenia  9, 11
Gammarus  5
grammatica, Isoperla  22
griseipennis, Isoperla  22
Haplogenia  3
harrisella, Brachycercus  6, 24, 27
Heptagenia  9, 10-11
ignita, Ephemerella  26, 27
Isogenus  9, 21
Isoperla  7, 9, 22
lineata, Ephemerla  9, 13, 14
linnaeanus, Siphlonurus  25
linnaeanus, Siphliursus  25
linneanus, Siphlonurus  25
longicauda, Ecdyonurus  10
longicauda, Heptagenia  9, 10
luteus, Potamanthus  9, 13, 15
mellea, Baeitis  13
montana, Protonemura  24, 28
nebulosa, Nepheloptyrex  16
nebulosa, Taeniopteryx  9, 16
nebulosa, Taeniopteryx nebulosa  16
neglecta, Rhabdiopteryx  16
Nemoura  4, 9, 19, 29
Nepheloptyrex  16
niger, Baeitis  25, 26
notata, Ephemereella  24, 26
Notonecta  6
nubecula, Isoegenus  9, 21
obscura, Isoperla  9, 12
Paraleptophlebia  9, 12
Potamanthus  9, 13, 15
Protonemura  24, 28
pulex, Gammarus  5
pusilla, Caenis  24, 28
putata, Brachyptera  9, 18
Rhabdiopteryx  9, 16
rhenicola, Caenis  28
risi, Brachyptera  18
Siphlonurus  24, 25
Siphliursus  25
southi, Haplogenia  3
standfussi, Amphinemura  24, 26
starmachi, Brachyptira  18
sulcirostris, Amphinemura  29
sulphurea, Heptagenia  10
Taeniopteryx  9, 16
trifasciata, Brachyptera  18
tripunctata, Chloroperla  4
tumida, Paraleptophlebia  12
venosa, Chloroperla  22
vidua, Capnia  20
vidua, Capnia vidua  9, 20
volitans, Heptagenia  11
werneri, Paraleptophlebia  9, 12
Yellow Evening Dun  26
Yellow Evening Spinner  26
Yellow Hawk  26
Xanthoperla  3
‘Research & survey in nature conservation’ series


No. 4 A survey of the numbers and breeding distribution of the North Atlantic gannet Sula bassana and an assessment of the changes which have occurred since Operation Seafarer 1969/70. Sarah Wanless. 1987.


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