

17 INVERTEBRATES

1 Introduction

1.1 Historical perspective

1.1.1 Invertebrates pose distinctive challenges to those working in biological conservation, on account of the numerous species with many specialised requirements, combined with the more limited knowledge available of their distribution, status and habitat needs than for vertebrate animals or vascular plants. However, many groups have been extensively studied by entomologists and other naturalists, especially from Victorian times onward, and there are good historical data for butterflies and larger moths, for some families of beetles, for molluscs and more locally for dragonflies and bees, wasps and ants. In many cases these data are sufficient to detect changes in distribution and status which have occurred in response to habitat loss or change or to variations in climate.

1.1.2 The great expansion of interest in natural history during the Victorian period, linked to the formation of extensive collections of specimens, greatly advanced knowledge of Britain's invertebrate fauna. However, although it became possible to study vertebrate animals and many higher plants without collecting specimens because of the increasing availability of accurate field guides, this trend has been less evident in entomology and other branches of invertebrate zoology. Although groups such as butterflies and dragonflies are sufficiently distinctive to allow accurate identification of live individuals in the field, many other groups contain large numbers of small, similar species which can be identified only by using a microscope and often only after dissection. This means that for surveying, sampling and studying the great majority of invertebrates collecting, killing and preserving specimens are essential. Some naturalists concerned with conserving other animals and plants view such collecting activities with suspicion or distaste, and such attitudes, combined with the relatively small number of entomologists and other invertebrate zoologists, have hindered the development of invertebrate conservation.

1.1.3 However, in recent years there has been a steady growth in knowledge of the British invertebrate fauna, with the publication of new, well-illustrated keys stimulating more studies and recording, and the development of over 40 national recording schemes co-ordinated by the Biological Records Centre providing the means to synthesise much of this information on a systematic national basis.

1.2 Characteristics of invertebrates

1.2.1 Most invertebrates have annual life cycles and, unlike plants, which can have dormant seed or resistant vegetative rootstocks, they cannot survive adverse conditions or periods when their habitat is unsuitable. Thus they are vulnerable to extinction in isolated habitat 'islands' such as SSSIs if the continuity of their life history requirements is broken even for a single year. This position is further complicated by the fact that many invertebrates, particularly insects, have complex life histories in which the early growing stages (e.g. larvae) typically have different needs from the more mobile, reproductive adult stage. A familiar example is the plant-feeding larva of a butterfly in contrast to the flower-visiting adult.

- 1.2.2 Invertebrates are small, and their body temperature - and hence their activity - is greatly influenced by the micro-climate where they live. Consequently, vegetation structure, as well as species composition, has a profound effect upon the distribution and numbers of many species. Bare ground or short vegetation enables many insects to bask in sunshine, raise body temperature and become more active. Conversely, longer vegetation and shaded conditions are cooler and provide more humid conditions favoured by those species susceptible to desiccation: many invertebrates lose water rapidly in warm temperatures.
- 1.2.3 Although many invertebrates are highly mobile and can rapidly colonise newly available habitats (for instance some butterflies and moths, dragonflies and caddis flies), others are sedentary and typically move only short distances. This can apply even to those species which have the ability to fly quite strongly, for example butterflies such as the heath fritillary and silver-studded blue. Such limited powers of dispersal greatly restrict the ability of these species to recolonise suitable sites after local extinctions.
- 1.2.4 Another characteristic of many invertebrates is their great specialisation: they are able to occupy narrow niches and exploit tiny micro-habitats within, for example, plant seeds or sap runs on mature trees, or they are the internal parasitoids of the eggs or later stages of other invertebrates. This specialisation enables many species to coexist within a habitat, but it can also mean that the rarest species, which tend to display the greatest specialisation, are vulnerable to local extinction if their precise habitat requirements and life cycle needs disappear for any reason. In a situation where habitats are declining and becoming increasingly fragmented, the combination of these factors (1.2.3 and 1.2.4) can lead to a reduction in range and status for many species.

1.3 Britain's invertebrate fauna

- 1.3.1 Approximately 22,500 insect species have been recorded in Britain, and there are estimated to be about 7,500 species within other invertebrate groups such as the spiders, molluscs, woodlice, millipedes, centipedes and crustaceans. Additional British species are still being discovered every year, mainly in those groups with large numbers of similar species whose identification remains the province of relatively few specialists. Among the national recording schemes co-ordinated by the Biological Records Centre, those for butterflies, dragonflies and molluscs now have excellent coverage for much of Britain, and larger moths, bumble bees, social wasps, grasshoppers and crickets, ground beetles, water beetles, craneflies and hoverflies are also well recorded. The publication of distribution atlases, which often include information on the biology and habitat preferences of the species recorded, is one output from these recording schemes, and these contribute greatly to our knowledge of the status of individual species.
- 1.3.2 Apart from the approximately 30,000 'macro-invertebrates' discussed above, there are also large numbers of 'micro-invertebrates' such as mites (about 2,000 species) and nematodes (about 1,000 species), where the current state of knowledge on the ecology, status and distribution of the individual species does not permit any rational conservation strategy to be attempted, apart from the general policy of attempting

to conserve the full range of major habitat types within the SSSI series.

1.3.3 British Red Data Books: 2. Insects (Shirt 1987) lists nearly 1,800 species whose survival in Britain is believed to be threatened. A further Red Data Book treating macro-invertebrates other than insects, such as spiders, molluscs, centipedes, millipedes and woodlice, is in preparation. It is possible that as many as 3,000 species will be included eventually on these Red Data Book lists. The status of these species must be kept under constant review in order to detect further declines in the status of individual species or expansions in range of others. Improved knowledge of some species from more extensive recording may also change the status attributed to them.

1.4 The Invertebrate Site Register

1.4.1 The Invertebrate Site Register (ISR) was launched by the NCC in 1980 with the objective of bringing invertebrates into mainstream nature conservation. Since 1985 the ISR has developed a computer database, which has enabled information on a large number of sites (over 6,700) and species (about 15,000) to be stored and readily updated. The identification and documentation of the most significant invertebrate sites and of the most threatened or scarcest species have proved a complex and challenging process. However, better utilisation of the available information and readier access for those working in conservation who do not have a specialist knowledge of invertebrate zoology are both essential if invertebrate conservation is to develop in future.

1.4.2 The ISR has produced two types of reviews. County reviews seek to identify the most important sites for invertebrates in each part of Great Britain, and national species group reviews aim to summarise the available data on the biology, habitat requirements and status of the scarcer and more threatened species. Data are incorporated from individual specialists, local records centres, the Biological Records Centre and the published literature. These two types of reviews are now closely interlinked through the computer database, which allows changes in the status of individual sites or species to be rapidly updated. ISR reports are now circulated more widely to outside organisations and individuals, but records classed as confidential are excluded from these reports. A series of regional overviews will be published, to make the key points on the most important sites and species understandable in a wider context and to draw attention to gaps in our knowledge.

1.4.3 The Invertebrate Site Register is the major data source on which the NCC bases decisions about which sites are most important for conserving invertebrates in Britain. While many of these sites have already been identified as significant for the conservation of other biological groups, some important exceptions occur, and these are discussed further in 3 below. It will be necessary to continue to initiate new research projects to build on and complement the approach of the ISR, and it is also essential to continue to improve the ways in which the data are used to conserve invertebrates, both within SSSIs and in the wider countryside.

2 International aspects of conserving invertebrates in Great Britain

- 2.1 Knowledge of Britain's invertebrate fauna is difficult to place in context in relation to the fauna of North-West Europe and the Western Palaearctic because of the lack of consistent recording and data for parts of the continent. Although Britain's invertebrate fauna is less rich, in terms of the total number of species in most of the major groups, than that of nearby European countries, it is also in general better documented. Additionally, specific measures to conserve invertebrates are being implemented to varying degrees in European countries, so it is not easy to generalise about developments in this field on an international basis.
- 2.2 As knowledge of invertebrates improves, it is likely that a number of features of invertebrate populations in Great Britain will be recognised as being of some international conservation significance. Currently, the dead wood invertebrate faunas of Windsor Forest and the New Forest are regarded as being of international importance, as is the exceptional assemblage of invertebrates on coastal shingle at Dungeness (which includes some unique and distinctive subspecies). Other habitats in Britain which support distinctive assemblages of invertebrates that in future may be regarded as of some international significance include wetlands, uplands, heathlands and possibly some types of woodlands. However, further studies are required to assess the invertebrate faunas of prime examples of such habitats, both in Britain and abroad, before sites can be evaluated and then designated as being of international conservation importance.
- 2.3 The Council of Europe has supported a number of initiatives to conserve threatened invertebrates, including accounts of threatened European butterflies and dragonflies, and the saproxylic (dead wood) fauna has also recently been assessed. The 'Bern' Convention (see B, 3.2.3) now includes invertebrates in its appendices, and the 'Ramsar' Convention (see B, 3.2.1) now has provision for designating sites on the basis of a wide range of wildlife including invertebrates (see C.14, Appendix A). These developments are evidence of an increased awareness of the need to conserve invertebrates; with greater international co-operation there will be further opportunities to advance invertebrate conservation in Britain in a wider European context.

3 Site selection requirements

- 3.1 On the basis of current knowledge it can be assumed that the commoner invertebrate species will occur in viable populations on sites selected on the basis of habitat representation or will occur sufficiently widely elsewhere not to need protection by site-based conservation measures. It is, therefore, the rarer, more specialised invertebrate species that need particular attention, especially where there is evidence that their macro- or micro-habitat requirements are not represented within the existing SSSI series. It has become apparent that features such as ancient trees with dead and decaying wood, large river shingle banks, south-facing bare ground or sandy exposures and unstable soft rock coastal cliffs have been insufficiently represented in the past. Each of these micro-habitats can support a rich assemblage of invertebrates, including many specialist species not found elsewhere, and sites containing the best examples of such features within each AOS are candidates for selection as SSSIs.
- 3.2 Another requirement of many invertebrates is habitat mosaics, both in terms of a variety of structural conditions within a habitat type (e.g. open,

sunny rides and clearings in woodland) and also through the occurrence of different habitats such as grassland, woodland and wetland in close proximity. This is because some invertebrates live in situations which may be classed as transitional between habitat types or because there is a need for different habitat conditions at different stages of the life history. Most of the SSSI series has been chosen to represent examples of the major habitat types. Sites with mosaics, where the individual component habitats do not qualify for SSSI selection in their own right, have largely been omitted from the SSSI series. The increasing fragmentation and isolation of many semi-natural habitats poses particular problems for invertebrates which require habitat mosaics, as well as diminishing the chances of local movement or recolonisation for those invertebrates associated with a single habitat type. (See also B, 6.)

- 3.3 The butterflies and dragonflies are sufficiently well known in Britain to merit separate treatment within these guidelines (C.18 and C.19), the remaining groups being treated at a more general level. As our knowledge of the status and distribution of the less well known invertebrate groups improves, the significance of additional habitat features or particular combinations of ecological conditions will continue to be revealed. This may necessitate the consideration of SSSI designation for a small number of additional sites which contain the best examples of such features. Because many invertebrates are good indicators of the past continuity of particular ecological conditions (as a result of their annual life cycles, specialised requirements and limited mobility), many of the sites identified as being of importance for their macro-invertebrate fauna should also support significant assemblages of micro-invertebrates which will remain undocumented for the foreseeable future.

3.4 Representation of rare and scarce species

3.4.1 The rarer and more threatened invertebrates, which typically have narrow and unusual habitat requirements, deserve special attention to ensure that their strongest populations are conserved. Highest priority should be given to species included in the Red Data Book categories "endangered", "vulnerable", "rare" and "endemic", with species listed as "out of danger" also remaining important. The status of these species will be regularly assessed and revised where necessary.

3.4.2 Nationally scarce species, known or estimated to occur in 16-100 10 km grid squares in Britain (see C.11, 1.1), should also be represented, where possible, in the SSSI series within each AOS where they occur. In practice, assemblages of nationally scarce species may be identified as of significance, and, additionally, in some parts of the country it has proved possible to identify regionally scarce species which may be common in some parts of Britain but are scarce elsewhere.

3.4.3 Where a series of sites of similar habitat within an AOS have received similar levels of recording, they can be ranked according to an 'invertebrate index', which allocates points to individual species on the basis of their status (currently 100 for Red Data Book, 50 for nationally scarce and 20 for regionally scarce species), but this is seen as only one element in the site selection process. It is currently impracticable to define thresholds of minimum points for SSSI selection, but future refinement on a habitat-by-habitat and region-by-region basis will enable progress to be made in this direction. Overall, the methodology and validity of such scoring systems for

assisting selection of important invertebrate sites require further testing and development, and in the mean time they must be used with caution.

3.4.4 Schedule 5 species

All sites with populations of species listed in Schedule 5 of the Wildlife and Countryside Act 1981 qualify for consideration. The schedule is reviewed at five-yearly intervals in accordance with the provisions of the Act, and note should be taken of any additions or deletions.

3.4.5 Red Data Book species

Wherever possible, Red Data Book species should be conserved as part of rich invertebrate faunal assemblages. However, any locality supporting the strongest population in Great Britain of a Red Data Book species should be regarded as a candidate site, together with localities within each AOS supporting strong populations of Red Data Book species in well-recorded groups such as butterflies, macro-moths, grasshoppers and crickets, ground beetles, water beetles and hoverflies.

3.4.6 Nationally scarce and regionally scarce species

These too should generally be conserved as part of rich invertebrate faunal assemblages. Where possible, all nationally scarce species should be represented in the SSSI series within each AOS where they occur and all regionally scarce species within AOSs where they have this status.

3.5 Species assemblages

With the exception of dragonflies (see C.19), it is not currently possible to define the number of species within an invertebrate group which constitutes an outstanding assemblage. There will be considerable variation within each group, depending upon the habitat being reviewed and the geographical area concerned. More detailed studies are necessary to reveal the number and composition of species assemblages, based upon systematic sampling procedures and the use of community analysis techniques to identify and classify recurrent invertebrate assemblages. Such studies are underway for water beetles and for various other invertebrates in a limited range of habitats. The process of analysing species assemblages, combined with assessing the presence of rare species at localities within a major habitat type, is likely to provide a sound basis for selecting important invertebrate sites in future.

4 The limitations of site-based conservation for safeguarding invertebrates

- 4.1 Although evidence accumulating within the ISR database indicates that a high proportion of scarce and threatened invertebrates have populations in SSSIs, there are limitations in a site-based approach to conserving invertebrates. Many invertebrates are sedentary and apparently occur in highly localised colonies year after year (provided that the locality is appropriately managed), but some species, especially those which exploit early successional or rapidly changing and ephemeral situations, are highly mobile and opportunistic. Rotational management can regularly create suitable conditions for the fauna associated with, for example, ruderal

plants within a relatively localised area. However, other habitats, such as woodland rides, ditches in grazing-levels marshes or ancient parkland trees in improved grassland, are best represented within large sites. This can result in a need to include areas of lower biological richness within such large sites, if the features of special interest are to be successfully perpetuated through rotational management of long lengths of rides or ditches, or if sufficient ancient trees, together with younger trees, are to be retained in old parks. There is also a conceptual problem for those unfamiliar with the properties of such systems and the invertebrates which inhabit them. This is that a rare species, or an assemblage of species, is not continually associated with the same part of a site, and therefore it is impossible to define localised areas of high conservation importance on a map because these will change with time. Consequently, appropriate management regimes must be sustained over relatively large areas if the distinctive features of the systems are to be maintained.

- 4.2 There are also difficulties in the site-based approach to invertebrate conservation which are specific to particular areas of Britain. For instance, the richest invertebrate fauna occurs in south-east England and there is a general decrease in species-richness to the north. However, man has also modified semi-natural habitats to the greatest extent in the south-east through urban, agricultural and forestry developments. This has resulted in some areas with significant assemblages of scarce invertebrates becoming reduced to small, isolated sites. Further incursions into these sites must be opposed if their invertebrate fauna is to be successfully conserved. In contrast, within much of northern Britain large areas of semi-natural habitat remain, which may support invertebrate assemblages or communities of considerable interest. While some scarce species may here be associated with physical or vegetational features which can be recognised on the ground, others may have requirements which are less easy to define and identify. In these circumstances it is necessary to defend the integrity of large conservation sites if their full complement of scarce species and their characteristic assemblages of invertebrates are to be retained in future. (See also B, 5.)

5 The application of these guidelines and their future development

- 5.1 The overall approach adopted here is to aim to safeguard the strongest populations of threatened invertebrates and to protect those sites supporting assemblages of scarce, 'specialist' invertebrates (see 1.2.4), in order best to represent the range of variation of Britain's invertebrate fauna.
- 5.2 At this stage in the development of invertebrate conservation in Britain, it is not possible to apply strict numerical scoring systems to select SSSIs. However, estimates of population sizes are becoming available for some threatened species, particularly within well-studied groups such as butterflies, and for many groups the number of sites supporting rare species and their location are becoming better known. Therefore, in some cases it is now possible to select the strongest populations or sites with the best assemblages of scarce and threatened species, as is done for birds and vascular plants.
- 5.3 These guidelines should be used with discretion, and, where candidate invertebrate sites for SSSI notification are identified which do not qualify on the grounds of other biological interest, the CSD invertebrate specialists should be consulted.

5.4 It is expected that in future more detailed knowledge of the status and distribution of invertebrates, combined with improved understanding of the nature of the assemblages associated with the main habitat formations, will allow the development of more robust techniques for assessing the quality of sites for invertebrates. However, this will inevitably proceed faster for some invertebrate groups, as well as for some habitat types and geographical areas, than for others.

6 Reference

SHIRT, D.B., ed. 1987. British Red Data Books: 2. Insects. Peterborough, Nature Conservancy Council.

18 BUTTERFLIES

1 Introduction

- 1.1 Nearly 70 species of butterfly have been listed as British. At least 10 of these are believed to occur only as migrants, and of these only the red admiral and painted lady appear regularly and often abundantly, some of the others being rarities. Although most species show population fluctuations from year to year, some residents are widespread and usually common over much of Britain. Species-richness decreases very markedly from south to north, for most butterflies are warmth- and sun-loving creatures. For example, some southern English counties have over 40 species, but most of the far north of Scotland has less than 10 (Heath, Pollard & Thomas 1984). The common residents and migrants tend to occur in a wide variety of habitats, including roadside and railway verges, field edges, gardens and waste ground, as well as the semi-natural habitats which are of particular concern in SSSI selection. While these species are an integral part of the wildlife interest of any site and help to characterise the insect assemblage, it is mainly the less widespread butterflies that confer special interest.
- 1.2 Two former British residents, the mazarine blue and black-veined white, became extinct earlier this century, and it is unlikely that they could be re-established. The large copper and large blue occur as reintroductions after becoming extinct. There is some doubt as to whether the large tortoiseshell is still definitely a resident, rather than a migrant that breeds occasionally, but clearly its conservation should be given special attention if permanent breeding sites are located. The large blue and large tortoiseshell are listed as "endangered" in the Red Data Book for insects (Shirt 1987); "vulnerable" species are swallowtail, heath fritillary and high brown fritillary, while there are two "rare" species - Glanville fritillary and silver-spotted skipper; the black hairstreak and chequered skipper are listed as "out of danger". In Atlas of butterflies of Great Britain and Ireland (Heath, Pollard & Thomas 1984) seven other species have a nationally scarce distribution (occurring in no more than 100 10 km grid squares: see C.11, 1.1) - adonis blue, black hairstreak, chequered skipper, Lulworth skipper, mountain ringlet, northern brown argus and purple emperor. Most of these species have suffered a decline in part of their range, and only the Lulworth skipper can be regarded as abundant within most of its range. There are, however, other species that have been suffering a marked decline in the last two decades, so that the 1984 atlas, by showing presence since 1970, may not give the true distribution today. Thus the list of nationally scarce species here (2.3) includes brown hairstreak, Duke of Burgundy, marsh fritillary, pearl-bordered fritillary, silver-studded blue, white-letter hairstreak and wood white, to ensure that attention is given to these declining species.
- 1.3 There are problems in applying a scoring procedure to butterflies, especially where there is uncertainty as to whether a site supports, or could with the correct management support, a viable population of a species. However, the main limitation in evaluation of butterfly sites is that the British butterfly fauna is small, and hence the list of rare and scarce species is short. The difficulties are compounded by the marked reduction in species-richness northwards and by the fact that the rarer butterflies are spread over a variety of habitats, especially grassland, scrub and woodland, and often occur in sites with a mosaic of these habitats. This means that, over much of Britain and in the case of many individual habitats, it is seldom that any