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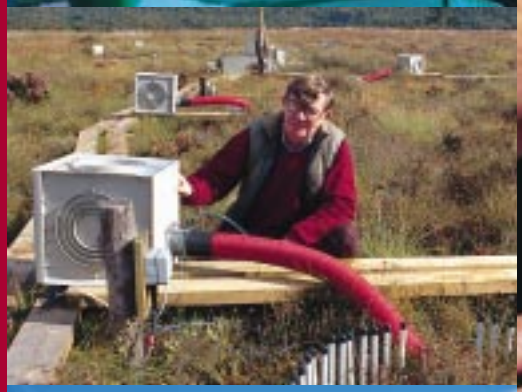

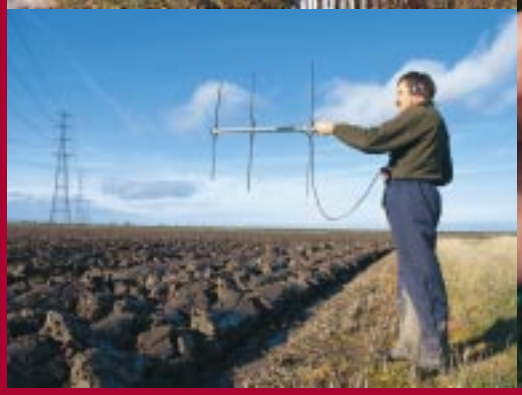

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Exotic plant species on brownfield land: their value to invertebrates of nature conservation importance

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Executive summary

This report reviews information on the status of invertebrate species of conservation concern within brownfield sites with the specific aim of assessing the value of exotic plant species in supporting populations of these invertebrates. In addition, this study aims to identify the key features of brownfield sites that play a role in sustaining populations of invertebrates of conservation importance. Recommendations are made for key principles for reclamation and management of brownfield sites to maximise their value for invertebrate fauna.

A desktop study was undertaken in order to collate published and unpublished data on the use of exotic plant species by invertebrate species of conservation concern. The key element of this study was consultation with a panel of expert field entomologists with experience in brownfield sites and their invertebrate fauna. Since published information on invertebrates of conservation concern using exotic plant species is scarce, consultation with these key entomological experts was an essential part of this research.

Although the data available is limited and often restricted to anecdotal reports, there are several examples of invertebrates of conservation concern using exotic plant species. This includes larvae and adults feeding on the vegetative parts of the plant, as in the case of some moths (Lepidoptera) and beetles (Coleoptera), as well as adult insects visiting the flowers to collect nectar and pollen as in the case of several species of fly (Diptera), bee and wasp (Hymenoptera). An evidence-based assessment of the value of exotic flora in sustaining populations of invertebrate groups of conservation importance and key species was undertaken, listing the plants as high, medium or low importance. Certain exotic plant species have been identified as being particularly valuable for providing foraging opportunities for invertebrates of conservation concern.

The role of exotic species within brownfield sites is just one of a number of factors involved in the importance of 'brownfield' sites with regard to their rich invertebrate assemblages. Recent studies have shown that brownfield sites can harbour high invertebrate species-diversity including several scarce or rare invertebrate species. In this report, a total of 194 invertebrate species of conservation importance were assessed as being typical of brownfield sites. Of these, 50 were Red Data Book species, 131 were Nationally Scarce species and 17 priority species within the UK Biodiversity Action Plan. These include species of bee and wasp (Hymenoptera), beetle (Coleoptera), butterfly and moth (Lepidoptera), fly (Diptera), cricket (Orthoptera) and dragonfly and damselfly (Odonata). Features that are considered as being particularly important in encouraging invertebrate biodiversity are the size of a site and the habitat complexity within it, providing both continuity and diversity of habitats. Floristic and structural diversity are particularly important elements of the habitat mosaic, as are the nature of the substrate, the topography of the landscape, the presence of patches of bare ground, damper areas and water bodies and areas of shelter created by scrub, rubble, wood and/or metal.

As invertebrates are one of the key animal groups on brownfield sites, strategies for their protection, enhancement and management should be at the core of nature conservation planning when considering brownfield development. Recommendations for the reclamation and management of brownfield sites to maximise their value for invertebrate conservation include adequate surveying of sites for their wildlife interest, site protection and monitoring, as well as specific recommendations for the management of bare ground, vegetation structure, floristic diversity and shelter.

Contents

1. Introduction

1.1 Background

1.1.1 New plant and invertebrate interactions on brownfield land

In recent years there has been an increasing interest in new plant and animal species and their interactions, in particular the role of species that have recently colonised the UK. In 2000, a workshop on 'recombinant' ecology was organised by the Urban Forum of the UK Man and Biosphere Committee, English Nature and the Centre for Ecology and Hydrology (Barker 2000). This workshop was particularly focussed on recombinant ecology in urban areas, including brownfield land, since urban centres provide the most obvious and common locations for the establishment of recently arrived plants and animals. This is largely due to high immigration rates of plant and animals in urban areas, which are the centres of human activity and because there is a wide range of artificial habitats, in particular on post-industrial and derelict land, that provide unique opportunities for colonisation.

Recombinant ecology was defined in the workshop after Soulé (1990) to be *'the ecology of communities of plants and animals, the constituent members of which are drawn from a wide range of global biogeographic zones'*. There is an increasing list of non-native plants that have become established in the wild in the UK. A few of these have attracted a great deal of attention because they are considered to be causing significant problems, but the majority and how they interact with animal populations have not been studied at all. In particular, the value of non-native plants to invertebrate communities is poorly understood.

Brownfield sites, particularly those characterised by early successional habitats in an urban environment, tend to contain a high proportion of exotic plant species (Shepherd and others unpublished data). Due to their alien origins and the prolific, invasive nature of certain species, the importance of these plants as food or habitat for invertebrates or other animals has been largely overlooked.

1.1.2 Aims of study

The aims of this study are as follows:

- To assess the value of plant species of exotic origin commonly found on previously developed land in supporting invertebrates.
- To reveal the role of such plants is sustaining populations of invertebrates of nature conservation importance as part of habitat mosaics at both the site and landscape level.
- To identify the key features of brownfield sites which play a role in sustaining invertebrates of conservation importance as part of the habitat mosaic.
- To recommend principles for the design, reclamation and management of brownfield sites to maximise their value for invertebrate conservation.

1.1.3 The conservation value of brownfield sites

In recent years, interest in the conservation importance of 'brownfield' sites has grown, particularly with regard to their rich invertebrate assemblages (Handley 1995, Gibson 1998, Box & Shirley 1999, Barker 2000, Harvey 2000 & Spalding 2005). In many cases,

brownfield sites have been found to harbour high invertebrate species-richness and to support several scarce or rare species (Plant & Harvey 1997 & Harvey 2000). The case of brownfield sites is particularly pertinent in terms of invertebrate conservation since these sites are often targeted and prioritised by government policies for redevelopment, leading to apparent conflict between the objectives for sustainable development and wildlife conservation (Box 1993, Box 1999 & Box & Shirley 1999).

The importance of brownfield sites for nature conservation has been recognised through their designation. Some brownfield sites are designated for their wildlife value, both as statutory sites (Sites of Special Scientific Interest (SSSI) or Local Nature Reserves (LNR), for example Collyweston Quarries SSSI in Northamptonshire and Ruxley Gravel Pits SSSI in Greater London) and as non-statutory sites (sites of importance for nature conservation or wildlife sites). There are around 700 active and disused quarries which have been notified as SSSIs in Britain (Box 1999), both for their geological and biological interest.

In addition, brownfield sites are included within the UK Biodiversity Action Plan for urban areas (Biodiversity Steering Group 1995). Amongst other habitats, this plan highlights the biodiversity value of urban and post-industrial sites, particularly in terms of their invertebrate fauna.

"Naturally seeded urban areas or industrial sites such as demolition sites, disused railway lands or unexploited industrial land. These areas can be particularly rich in species, often reflecting the complex mixture of features. In the early stages of colonisation, ephemeral species are favoured and include many uncommon species including some bees and wasps for which urban areas are now their stronghold and early successional carabid beetles. Later stages of succession – short perennial, tall ruderal and then through to woodland – equally contain many uncommon invertebrates with flies, bees, wasps, including some parasitic species and sawflies. The lichens of disused land include several rare species. Both plant and animal communities contain recently established species, some of which are virtually confined to urban areas but a few of which have also established in rural situations."
(Biodiversity Steering Group 1995).

The value of brownfield sites for invertebrates is promoted through specific characteristics of the sites such as their size, the time they have remained undeveloped, the nature of the previous development, neighbouring land use, soil structure, nutrient levels, toxicity and the complexity of the micro-habitats within the wider habitat mosaic (S. Falk unpublished data, Box 1993, Box & Shirley 1999, Box 1999). The close-knit nature of this mosaic within such sites is suitable for many invertebrate species which have a complex life history, with specific habitat requirements at different stages of their life cycle. In many cases, invertebrates require two or more habitats or microhabitats to coexist in close proximity. The existence of these habitat mosaics is often essential to the survival of the species. The temperature and microclimate of a habitat is a particularly important feature, since the development and activity of invertebrates is dependent on the temperature of their environment. Vegetation structure and bare areas of ground are an important influencing factor on the temperature of a site.

Brownfield sites can offer a combination of these habitat characteristics, which are often lacking in other natural or semi-natural habitats. As a testimony to the potential conservation importance of brownfield sites, it has been considered that invertebrate rarity and biodiversity

for some brownfield sites are only equalled by those for some ancient woodlands (Barker 2000).

1.1.4 Threats to brownfield habitats

Possibly the most prominent threat to brownfield sites is redevelopment. Redevelopment of land, or the restoration of contaminated land, may result in the loss of species present at a site through habitat loss, degradation and fragmentation. In addition, a lack of awareness of the nature conservation value of brownfield sites may be a contributing factor to their loss or damage through redevelopment (Gibson 1998, Thomas 2004). Sites may be redeveloped simply because there is little consideration of the biodiversity value of areas viewed as 'wastelands', with little or no value. Development which may impact upon a seemingly more 'natural' habitat may be more likely to be conditioned to ensure appropriate protection or mitigation (Box & Shirley 1999). Similarly, some brownfield sites may be subject to programmes of enhancement to 'improve' their nature conservation value without first appreciating or ascertaining the existing value of the site (Harvey 2000, Key 2000). Restoration schemes within developments often aim to create formal amenity areas or 'countryside' habitats such as wildflower meadows or woodlands. This often results in the loss of the mosaic of habitats typical of brownfield land.

Invertebrate habitat requires positive management and may disappear from brownfield sites through succession, as open conditions are lost to scrub and woodland. It may be necessary in certain cases to undertake management works such as scrub clearance, grazing or even scraping the ground to create bare ground in order to delay vegetational succession and keep the habitat open for invertebrates (Key 2000). Proposed management for nature conservation within any site needs to determine the key aims and objectives of the management. This may need greater vision within brownfield and post-industrial sites since the direction of the succession is often not clear (Clarkson & Garland 1988) and the appearance and disappearance of notable species may contradict predictions based on other habitat types (Box 1999).

Threats to brownfield sites with importance to wildlife conservation have been highlighted within the UK Biodiversity Action Plan for urban areas (Biodiversity Steering Group 1995) and include:

- the reclamation or redevelopment of disused land to a uniform landuse;
- management of greenspaces such as clearing of shrubs, filling in ponds and levelling land with hillocks and hollows making them less attractive to wildlife;
- changes in industrial processes and mining activities and the end of many producing large quantities of waste means that the distinctive communities and uncommon species associated with many waste and spoil tips will decline.

1.2 Definitions

1.2.1 Brownfield site

The term 'brownfield' has come into usage through the planning process after the announcement in February 1998 by the Government of a national target of 60% of all new housing developments to be sited on 'brownfields'. As no widely accepted multidisciplinary

definition of the term 'brownfield' existed, the National Brownfield Sites Project (2000), after extensive research and consolation, developed the definition quoted below.

"A brownfield site is any land or premises which has previously been used or developed and is not currently fully in use, although it may be partially occupied or utilised. It may also be vacant, derelict or contaminated. Therefore a brownfield site is not necessarily available for immediate use without intervention."

Brownfield land is synonymous with the term for 'previously developed land', which is defined within the Planning Policy Guidance 3 (PPG3 2000) as land which *"is or was occupied by a permanent structure (excluding agricultural or forestry buildings), and associated fixed surface infrastructure"*. Under this planning definition brownfield land may occur in both built-up and rural settings. The definition includes buildings, post-industrial land and land used for mineral extraction and waste disposal. The definition excludes land and buildings that are currently in use for agricultural or forestry purposes, and land in built-up areas which has not been developed previously (eg parks, recreation grounds, and allotments - even though these areas may contain certain urban features such as paths, pavilions and other buildings). Also excluded is land that was previously developed but where the remains of any structure or activity have blended into the landscape in the process of time (to the extent that it can reasonably be considered as part of the natural surroundings), and where there is a clear reason that could outweigh the re-use of the site (such as its contribution to nature conservation) or it has subsequently been put to an amenity use and cannot be regarded as requiring redevelopment (Brownfield Sites Project 2000).

For the purposes of this study, the definition of 'brownfield' follows closely that outlined above. This includes a wide variety of sites and previous site uses including vacant and derelict buildings, disused railway land, gravel, clay, chalk and brick pits, spoil heaps, disused industrial land, quarries, mines and vacant urban land.

1.2.2 Exotic plant species

For the purposes of this study, exotic plants are those that have become established as a result of purposeful or accidental human intervention. This includes a potentially long list of species, although the emphasis has been placed on those which are commonly or characteristically found on brownfield sites. In general these are neophytes (their introduced origins dating from after AD 1500 or they have undergone a significant range expansion during the same period) and are not 'casual' species (ie they do not require repeated introduction in order to persist). However, the list does include some archaeophytes, which are particularly typical of brownfield habitats. Archaeophytes are defined as plant species introduced into the British Isles by mankind before AD 1500.

A full list of the plant species considered as exotics within this report, please refer to Appendix 1.

1.2.3 Invertebrates of conservation importance

The phrase 'invertebrates of conservation importance' used within this report is taken to include those species which are protected by statute; recognised as of conservation importance within the UK Biodiversity Action Plan (UK Biodiversity Steering Group 1999); or listed as Nationally Scarce or Red Data Book species in the various published reviews.

Appendix 4 gives a summary of the status definitions and criteria for measures of invertebrate rarity.

2. Methodology

2.1 Desk study

A desktop study was undertaken to review the literature concerning the invertebrate fauna of brownfield sites and to identify key groups and species for which previously developed land provides significant habitat. This was accompanied by consultation with several key experts in the field of invertebrate ecology in England.

2.2 Sources of information

2.2.1 Published literature

A search was made for existing published literature concerning brownfield land and its importance as a habitat for invertebrates. Specific searches were made for studies describing the use of exotic plant species by invertebrates, particularly those of conservation importance.

2.2.2 Invertebrate conservation organisations

Invertebrate conservation organisations were contacted with regard to acquiring data on the importance of brownfield sites for invertebrates of conservation concern and to inform the consultation with specialist advisors. These included the Royal Entomological Society, Buglife (The Invertebrate Conservation Trust) and Butterfly Conservation. Consultations with these organisations were particularly fruitful in gaining up-to-date information on publications and specific case studies.

2.2.3 National and Local Biodiversity Action Plans

National and Local Biodiversity Action Plans were consulted to provide background and information on the conservation status of relevant habitats and species.

2.2.4 National invertebrate specialists

Experienced field ecologists, with long-standing and recognised expertise in invertebrate ecology of brownfield habitats were consulted with regard to the creation of a database of invertebrates of conservation importance that are typically or frequently associated with brownfield sites.

This process involved the following stages:

1. Contact consultee.
2. Consultee asked to produce a ‘short-list’ of the invertebrate species of conservation importance they would typically associate with brownfield sites. Included with this species list is associated data of known plant and microhabitat associations (eg bare-ground, ephemeral standing water, sandy substrates).

3. Short-lists collated into a 'long-list' of candidate invertebrates of conservation importance.
4. Know larval host plants and nectar plants (including data gained from the PIDB, see Section 2.2.5) of the resulting long-list compared with a prepared list of candidate exotic plant species.
5. Exotic plant species ranked as high, medium or low importance to invertebrates of conservation importance (see Section 2.3).

2.2.5 Phytophagous Insect Data Bank (PIDB)

The Centre for Ecology and Hydrology's Phytophagous Insect Data Bank (PIDB), holds detailed records of 182 families of plant-eating insects and their specific foodplants within 117 plant families. This data bank was interrogated in order to determine the invertebrate herbivores of certain exotic plant species associated with brownfield sites.

2.2.6 Internet searches

A search on the Internet was undertaken for any information on brownfield sites, invertebrates of conservation concern or exotic plants species. In particular, the Internet was used to try and access information on the use of exotic plant species by invertebrates, information that often does not appear in the published literature. The Amateur Entomologists' Society website was used to post a bulletin with their 'Bug Club' asking for assistance in locating anecdotal information.

2.3 Database creation

Once information had been gathered from the above sources it was incorporated within a database including habitat associations of each species of conservation concern. Each entry to the database included the following information:

- Species name
- Common name
- Order
- Conservation status (UKBAP, RDB etc.)
- Broad habitat associations
- Larval hostplant (if applicable)
- Adult food plant, including vegetative parts, nectar and pollen (if applicable)
- Specific habitat associations (bare ground, sandy substrate etc.)

The database was interrogated to provide an evidence-based assessment of the value of exotic flora in sustaining populations of invertebrate groups of conservation importance and key species, listing the plants as high, medium or low importance. This focussed on their value as pollen and nectar sources, but also on the food value of their vegetative parts for adult and larval stages and the use in a living or dead state for over-wintering or other shelter, where significant. Exotic plants known to provide a food source to one or more species or groups of conservation importance were rated 'high'. This included plants whose vegetative parts provided food for phytophagous invertebrates as well as invertebrate foraging on nectar and pollen. A 'medium' value was given to those plant species that are known to provide nectar and pollen to foraging insects in general or provide structural diversity to the habitat mosaic. A 'low' value was given to those exotic species which were deemed to be of little importance

in terms of providing foraging opportunities to invertebrates, or for which no information was available. Certain species of exotic plant were noted for their invasive nature and tendency to reduce the value of sites for invertebrates through their removal of certain key elements of the habitat mosaic (eg bare ground, structural diversity).

This database was also used to identify key features of brownfield sites which play a complementary role to that of exotic flora in sustaining invertebrates of conservation importance as part of the habitat mosaic.

A full copy of the database can be found in Appendix 2 of this report.

3. Results

3.1 The value of exotic flora to invertebrates of conservation importance

Exotic plant species may be used by invertebrates in various ways; as larval host plants for those species that have phytophagous larval stages and as food sources for those species that feed off leaves, nectar and pollen as adults.

3.1.1 Vegetative parts as forage for larvae and adults

Available data on the use of exotic plant species as larval hosts appears to be very limited. Few dedicated studies of the use of exotic plant species as larval host plants exist and the information available tends to come from the observations and specialist knowledge of expert field entomologists.

Mugwort *Artemisia vulgaris* (an archaeophyte) is a common and characteristic species of perennial tall herb plant communities on urban derelict land. This is reflected by its use in the title of the phytosociological class *Artemisietea vulgaris* in the National Vegetation Classification (NVC). No plant communities within this class are described within the NVC, but it includes perennial and thistle-rich sub-xerophilous communities of temperate and Mediterranean regions (Rodwell, 2000). These communities are common on hot dry areas of derelict and urban and post-industrial land (Shepherd, 1998). Mugwort is known to support several species of tumbling flower beetle *Mordellistena* spp. (RDBK) and a species of hoverfly *Triglyphus primus* (N). The tumbling flower beetles nest in stems of herbaceous vegetation, including thistles, mugwort and the closely related wormwood *Artemisia absinthium* (another archaeophyte) (P. Harvey pers. comm.). The larvae of the hoverfly *Triglyphus primus* appear to specific to galls induced by an aphid on mugwort, and can be frequently found on brownfield sites (S. Falk & P. Harvey pers. comm., Whiteley 1988).

Oxford ragwort *Senecio squalidus* (a neophyte) was first recorded growing wild on a wall in Oxford in 1794. It is now one of the most characteristic plants of urban centres in the UK growing on walls, pavements, gutters, derelict land and flower beds an is a regular component of the vegetation of recently disturbed ground. The picture winged flies *Campiglossa malaris* (RDB3) and *Merzomyia westermanni* (N) are known to use Oxford ragwort as a larval host plant, amongst other species. Oxford ragwort is also a host plant for the Nationally Scarce leaf beetle *Longitarsus ochroleucus* (Nb) as well as a source of abundant nectar and pollen (see Section 3.1.2).

A few exotic plant species are known to be larval foodplants for commoner moths and butterflies (eg the mullein moth *Cucullia verbasci* feeding off *Verbascum* spp. and *Buddleja davidii* (Gibson 1998)). Evidence of scarce species of Lepidoptera feeding off exotic plants is uncommon, although the larvae of the striped lychnis moth *Cucullia lychnitis* (UKBAP), are known to occasionally feed from *Verbascum* species other than the native dark mullein *Verbascum nigrum* (PIDB), perhaps including exotic species of the genus *Verbascum*.

Larvae of the wormwood moth *Cucullia absinthii* (Nb) are known to feed off *Artemisia vulgaris* and *A. absinthium*, both of which are archaeophyte plant species and both regularly occur on urban derelict and post-industrial land. The larvae of the toadflax brocade moth *Calophasia lunula* (RDB3, UKBAP) feed off plants of the genus *Linaria*, which at inland sites usually involves the non-native purple toadflax *Linaria purpurea* (a neophyte) rather than the native *Linaria vulgaris* that is used on south coast shingle beach sites. The larvae of the four-spotted moth *Tyta luctuosa* (RDB2, UKBAP) have been recorded to feed off exotic species of bindweed *Calystegia* spp. in addition to their native foodplant field bindweed *Convolvulus arvensis* (PIDB).

Some rare beetle larvae are also known to feed on exotic plant species. The leaf beetles *Longitarsus dorsalis* (Nb) and *L. ochroleucus* (Nb) have been recorded feeding on neophyte species of *Helianthus* and *Matricaria* respectively (PIDB). The henbane flea beetle *Psylliodes hyoscyami* (RDB1) is associated with the plant henbane *Hyoscyamus niger* (an archaeophyte) which occurs on calcareous soils on wasteland sites and derelict land. The larvae of the beetle eat the roots, stems and leaf-bases of the plant.

The available data on adult phytophagous stages feeding from exotic plant species is also scarce and only a few examples were found for inclusion in this report. These examples involve leaf-feeding beetles. Flixweed *Descurainia sophia* (an archaeophyte) is known to support both the flixweed leaf beetle *Psylliodes sophiae* (UKBAP, RDB3) and the weevil *Ceutorhynchus pulvinatus* (Na) (P. Hodge pers. comm.). The latter species is also known to feed off hedge mustard *Sisymbrium officinale* (an archaeophyte). This plant is a regular component of annual plant communities in urban areas growing along the base of walls, by hedges, on earth mounds and other disturbed ground.

The Nationally Scarce weevil *Ceutorhynchus resedae* (Nb) feeds off weld *Reseda luteola* (an archaeophyte) (P. Kirby pers. comm.) and white mignonette *Reseda alba* (a neophyte) (PIDB). Another rare weevil, *Omphalapion beuthini* (RDB3) feeds off pineappleweed *Matricaria discoidea* and scentless mayweed *Tripleurospermum inodorum*, both of which are neophytes (P. Hodge pers. comm.). All of these plant species are common components of disturbed land in urban and post-industrial habitats.

3.1.2 Sources of nectar and pollen

As with the evidence of phytophagy of exotic plant species, there is little published information on invertebrates of conservation importance using exotic plant species as nectar and pollen sources. Available data comes from field observations by expert field entomologists and tends to focus on the more obvious species and groups including the aculeate Hymenoptera, butterflies and hoverflies. Having said this, the conspicuousness of feeding bees, wasps and butterflies means there are relatively large amounts of observational data on these species groups.

Species of hawksbeard *Crepis* spp., including the neophyte beaked hawksbeard *Crepis vesicaria,* are known to be nectar and pollen sources for several species of mining bee *Andrena* spp., the blue carpenter bee *Ceratina cyanea* (RDB3), a cuckoo bee *Stelis ornatula* as well as the picture wing fly *Tephritis matricariae* (Nb) (P. Harvey pers. comm.). Non-native species of rocket *Sisymbrium* spp. are known to be sources of nectar and pollen for the mining bee *Andrena nigrospina* (pRDB2) as are the flowers of rape *Brassica napus.* Several species of tumbling flower beetles *Mordellistena spp*. are also known to feed from the flowers of these rocket species. The brown-banded carder bee *Bombus humilis* (UKBAP) has been known to feed from several exotic, leguminous plant species, the queens visiting the flowers of lucerne *Medicago sativa* (a neophyte), black horehound *Ballota nigra* (an archaeophyte), melilots *Melilotus* spp. (neophytes) in particular. The workers favour flowers of bladder senna *Colutea arborescens* (a neophyte) and broad-leaved everlasting pea *Lathyrus latifolius* (a neophyte) along with native species of Leguminoseae including *Lotus corniculatus, Trifolium pratense* and *Ulex europeaus* (P. Harvey pers. comm.).

Several other species of aculeate Hymenoptera that have been observed to forage on exotic plant species, including weld *Reseda luteola* (an archaeophyte), which is a nectar plant of the Nationally Scarce large yellow-faced bee *Hylaeus signatus* (P. Harvey pers. comm.). This *Reseda* species, along with the flowers of fennel *Foeniculum vulgare* (an archaeophyte), are also known to be forage for the solitary wasp *Cerceris quinquefasciata* (RDB3, UKBAP). Mining bees of the genus *Colletes* are known to feed from the flowers of feverfew *Tanacetum parthenium* (an archaeophyte) as are species of fly and butterfly (S. Falk pers. comm.). Russian comfrey *Symphytum x uplandicum* (a neophyte) is a major forage plant of the large garden bumblebee *Bombus ruderatus*, a UK Biodiversity Action Plan species (S. Falk pers. comm.). Bees of the genus *Lasioglossum*, which includes three rare species typical of brownfield sites (*L. pauperatum*, *L. pauxillum* & *L. xanthopum*), are known to use fox-and-cubs *Pilosella aurantiaca* (a neophyte) to forage for nectar and pollen (S. Falk pers. comm.). Species of melilot *Melilotus* spp. are very popular with bees of the genera *Bombus* and *Andrena*, whilst smaller bees of the genera *Lasioglossum* and *Sphecodes* forage from the flowers of pineappleweed *Matricaria discoidea* (a neophyte) (S. Falk pers. comm.). The endangered fly *Aphaniosoma socium* (RDB1) collects nectar and pollen from species of bindweed *Calystegia* spp. (neophytes).

Perhaps of particular importance are exotic plants which provide a profusion of flowers, providing a continuity of foraging opportunities for species of Hymenoptera, Diptera and Lepidoptera. This includes *Buddleja davidii* (a neophyte) (Owen & Whiteway 2003), Oxford ragwort *Senecio squalidus* (a neophyte) and Canadian goldenrod *Solidago canadensis* (a neophyte) (S. Falk pers. comm.). In particular, Oxford ragwort is known to be a nectar source for the mining bee *Lasioglossum xanthopum* (Nb) and the picture winged fly *Merzomyia westermanni* (N). Certain exotic plants can be valuable nectar and pollen sources early in the season, for example honesty *Lunaria annua* (a neophyte), or late in the season, for example Michaelmas daisies *Aster* spp. (neophytes) and the flowers of the Russian vine *Fallopia baldscuanica* (a neophyte). Night flying insects, particularly moths, may be attracted to forage on the flowers of red valerian *Centranthus ruber* (a neophyte), evening primrose *Oenothera* spp. (neophytes) and dame's violet *Hesperis matronalis* (a neophyte) (Essex Wildlife Trust 2005).

3.1.3 Parasites

Certain parasitic invertebrate species may be linked to exotic plant species through their hosts. For example, the rare parasitic fly *Clytiomya continua* is a parasite on the shieldbug *Eurydema oleracea* which feeds off various species of crucifer, including horseradish *Armoracia rusticana* (an archaeophyte). The fly *Helina concolor* (RDB3) and the cuckoo wasp *Hedychrum niemelai* (RDB3) are both cleptoparasitic on wasps of the genus *Cerceris*, which are known to feed on nectar and pollen of exotic flowers. Similarly, *Andrena praecox* and *Sphecodes niger*, which are the host bees of the cuckoo bees *Nomada ferruginata* (RDB1, UKBAP) and *Sphecodes niger* (RDB3) respectively, are known to forage on several exotic plant species within brownfield sites.

3.1.4 Discussion

Although the evidence of rare invertebrates using exotic plant species as food sources is scant, it appears that exotic plant species play a key role in the ecology of brownfield sites as they can represent significant elements of the habitat mosaic. Exotics are often the first colonisers of brownfield land and are often some of the few plant species that can tolerate stressed conditions. As such, they provide essential structure to the habitat, including shelter and foraging opportunities for a range of taxa, particularly those that depend upon nectar and pollen.

An evidence-based assessment of the value of exotic flora in sustaining populations of invertebrate groups of conservation importance and key species, listing the plants as high, medium or low importance is given in Appendix 3. This focuses on their value as pollen and nectar sources, but also considers the food value of their vegetative parts and the use of living or dead tissue for over-wintering or providing shelter.

3.2 The importance of brownfield sites for invertebrate conservation

It is becoming increasingly recognised that brownfield sites are amongst the most important sites in the UK for rare invertebrates. Research by Buglife has revealed that 15% of all Red Data Book species occur on brownfield sites with at least 40 invertebrate species largely or wholly confined to such sites. This includes at least 18 of the priority species named within the UK Biodiversity Action Plan (M. Shardlow pers. comm.).

The definition of brownfield covers a wide range of diverse sites and former landuses from vacant buildings and post-industrial areas to quarries and spoil heaps. Despite this diversity, there are several characteristic features common to these sites which provide habitat that supports a high diversity of invertebrates including rare or localised species. Above all, it is a structural and floristic diversity within a mosaic of habitats which influences the resultant invertebrate diversity. The key features of this mosaic are:

- Floristic and habitat diversity
- Bare ground
- Soil type and structure
- Shelter
- Topography
- Disturbance

- Succession
- Surrounding landuse

3.2.1 Floristic and habitat diversity

Many invertebrates require a foraging area where nectar and pollen may be gathered. Some forage on many different flowers, others are highly plant-specific. It follows that the larger and more diverse the flora of an area, the more species of invertebrate it will be able to support. Similarly, many herbivorous invertebrates feed, either in the larval or adult stages, on the vegetative parts of particular plant species. Thus, the presence of a variety of plant species will tend to increase the invertebrate biodiversity of a site (Kirby 1992, Falk 1995). Having said this, it has been stressed by many researchers that vegetation structure is also of great importance. The position of certain key plants and the mosaic of microhabitats within the larger habitat are responsible for the diverse invertebrate assemblages rather than strictly the number of plant species present (Greenstone 1984, Kirby 1992, Falk 1995).

In a study of the bee and wasp faunas of calcareous quarries and spoilheaps in Warwickshire, Falk (unpublished data) found that the most invertebrate-rich sites tend to be characterised by having large expanses of floristically-rich limestone grassland and early successional habitats with extensive stands of many key forage plants. Bumblebee species such as *Bombus ruderatus* (UKBAP, Nb) and *Bombus humilis* (UKBAP) appear to specifically require large areas of flower-rich habitat and depend heavily on plants such as common bird's-foot trefoil *Lotus corniculatus* (Falk, unpublished data). In addition, a number of bee species forage only amongst a restricted range of flowers of ruderal conditions (Key 2000). Falk observed that the poorest habitats for bees and wasps tend to be characterised by relatively small areas of flower-rich habitat or by a lack of floristic diversity or key forage plants.

Brownfield sites tend to have a high floral diversity (Shepherd and others unpublished data, Barker 2000) due to the variety of soils, aspect, hydrology and disturbance. Low nutrient status and contamination also promote diversity by slowing colonisation and reducing the dominance of certain species that thrive in nutrient-rich conditions (Gilbert 1989). Drought and heat-stressed plants are often much more floriferous than plants of the same species growing in more lush conditions (Key 2000). Harvey (2000) considered that the most important feature of habitats within the East Thames Corridor, a region particularly noted for its invertebrate biodiversity and rarity, is the diversity of unmanaged, flower-rich grasslands with sparsely vegetated areas that have developed on the stressed substrates. He suggests that it is the lack of traditional grassland management that allows a continuity of forage and nesting habitats. The poor, dry and well-drained substrate curtails succession, allowing the diversity of invertebrate fauna to colonise and develop over time (Harvey 2000).

The size of some post-industrial sites, particularly workings such as pits, quarries and spoil heaps means that there is often a large expanse of continuous suitable habitat for invertebrates with high plant and structural diversity over a large area encompassing a mosaic of microhabitat and vegetation types.

Invertebrate groups for which floristic diversity is a particularly important element of the habitat mosaic include:

- Hymenoptera (bees, wasps etc.)
- Diptera (flies)

- Coleoptera (beetles)
- Lepidoptera (butterflies and moths)
- Heteroptera (bugs)

3.2.2 Bare ground

Brownfield sites often provide a range of bare-ground habitats that support rich invertebrate faunas (eg quarries, pits & spoilheaps) (Spalding 2005). Vegetational succession on post-industrial sites can be slow due to a combination of regular disturbance and stressed substrates (low nutrients, contaminants, summer parching) that restrict vegetation colonisation and succession, creating areas of bare-ground. Bare soil has a number of benefits for invertebrates. In particular, it warms up rapidly in the sunshine, especially if dark in colour, and very warm microclimates can occur close to the exposed soil. All invertebrates derive their body heat from their surroundings and must achieve high body temperatures to carry out their lifecycle and daily activities. Bare ground is often necessary to provide these warm microclimates (Kirby 1992, Falk 1995, Key 2000). The warmth of exposed soil is also important for reproduction as it provides heat for the incubating of eggs, both laid on nearby host plants, as in the case of the silver-spotted skipper *Hesperia comma* (RDB3) (Thomas and others 1986), or within burrows, as in many aculeate Hymenoptera (Key 2000, Harvey 2000).

A dependence on bare ground habitats may be particularly relevant to species which reach their northern range limit in the British Isles, which are dependent on higher temperatures for development and activity.

As well as providing habitat for burrowing and ground nesting invertebrates, bare ground also provides a clear visual field for invertebrate predators. Some predatory invertebrate species, for example species of tiger beetle *Cicindela* spp. and the purse-web spider *Atypus affinis*, hunt in the open areas of exposed soil or use burrows in bare ground to ambush their prey (Key 2000).

Invertebrate groups for which bare ground is a particularly important element of the habitat mosaic include:

- Hymenoptera (bees, wasps etc)
- Diptera (flies)
- Coleoptera (beetles)
- Lepidoptera (butterflies and moths)
- Araneae (spiders)

3.2.3 Soil type and structure

A variety of soil substrates and densities are necessary to provide the different conditions needed by various species, particularly those that burrow within the soil for nesting or for hunting (Kirby 1992). These invertebrates require substrates that are sufficiently friable to enable the animals to burrow, but firm enough to prevent collapse. Similarly, some disturbance is often necessary to maintain areas of bare ground and to loosen soil for burrowing, however, too loosely compacted soils or frequent disturbance can cause burrows to collapse through soil movement (Key 2000).

Some species can be very specific in their preference for a particular particle size of substrate as well as the particular slope, aspect and patch size of bare ground (Falk 1995, Key 2000). Aculeate Hymenoptera are a specific group for which the nature of the substrate is key due to the requirement for nest burrows by some species. Many bees and wasps favour light sandy soils for this very reason. Softer sand and soil are necessary for some species such as the larvae of certain stiletto flies *Thereva spp.* which move through the surface of loose sand in search of prey on the surface above (Key 2000). A study of urban 'wasteland' sites in Leicester (Woodhead 1989) revealed several carabid beetle species (*Notiophilus substriatus, Calathus erratus* & *Amara tibalis*) associated with dry, open and sparsely vegetated, ruderal habitats. Several species of staphylinid beetles were also discovered, including *Staphylinus ater*, a species which is abundant by the coast. The occurrence of some coastal species on brownfield sites inland was noted by Sheppard (1992) who suggested that the sand, gravel and boulder habitats that the species frequent with their coastal range are simulated by the piles of rubble, sand and gravel within many urban post-industrial sites. The bug *Chorosoma schillingi*, and the weevils *Apion confluens* and *Ceutorhynchus terminatus* (nationally notable b) were all recorded from pulverised fuel ash mounds in the centre of Nottingham in 1991 (Shepherd, Jenkins and Rieley, unpublished). All of these species were new records for Nottinghamshire and all are normally recorded from coastal habitats or inland sand dunes.

Invertebrate groups for which soil structure is a particularly important element of the habitat mosaic include:

- Hymenoptera (bees, wasps etc.)
- Diptera (flies)
- Coleoptera (beetles)

3.2.4 Shelter

Although bare ground is necessary for many invertebrate species, nearby shelter is also an essential factor of the habitat mosaic (Kirby 1992). This may be provided by variations within the substrate itself such as stones, pebbles and cracks within dried soils or banksides. Features of the vegetation such as leaf litter, dead wood, hollow stems and foliage that can be found in woodland, scrub, unmanaged grassland and tall herb communities can provide important foraging habitats and provide nest sites for a variety of invertebrates (Harvey 2000, Key 2000). Within urban and post-industrial sites in particular, additional 'man-made' features such as bits of wood, plastic, bricks and metal may provide cover for species within the wider habitat. The vegetated margins of unvegetated areas also provide necessary cover for invertebrates favouring bare-ground habitats. Ruderal plants that initially colonise patches of bare ground can be important not only for shelter, but also for foraging, both by adults collecting nectar and pollen and by larvae. Larval development may be favoured by the warm microclimate generated by a plant growing adjacent to warm, bare soil.

Scrub can be a valuable component of the habitat mosaic through the fact that it provides shelter and that many insects use it as one of several requirements during their life cycle. Birch, blackthorn, hawthorn, sallow and elder scrub support a large array of phytophagous species, and the latter together with gorse and broom produce valuable spring and early summer blossom for bees, butterflies and flies (Falk 1995). The leaf litter beneath scrub is utilised by various ground dwelling insects, hibernating insects and many types of insect larvae.

Invertebrate groups for which shelter is a particularly important element of the habitat mosaic include:

- Hymenoptera (bees, wasps etc.)
- Diptera (flies)
- Coleoptera (beetles)
- Lepidoptera (butterflies and moths)
- Heteroptera (bugs)

3.2.5 Topography

Brownfield sites, particularly those which are derived from large-scale excavations such as quarries, gravel, clay and sand pits or industrial land that has been used for numerous different land uses, can give rise to sites with a hugely varied topography. Different substrates can be exposed within quarries as well as varying aspects created within the cuttings and spoil heaps, resulting in an often complex mosaic of habitat types and microclimates (Kirby 1992). Quarrying operations can result in landforms of varying age and composition, with differing times of abandonment resulting in a staggered succession of vegetation, once again adding to the structural diversity of a site (Key 2000).

Damper or wetter areas created by variations in topography such as ditches, puddles and pools can provide extra elements to the habitat diversity which are important for certain rare species. Several species such as the spider *Clubonia juvenis* (RDB2) and fly *Dolichopus signifer* (RDB2) are associated with damper areas and *Phragmites* reedbeds within brownfield sites. The diving beetle *Hydroglyphus pusillus* (Nb) requires silts ponds and clay puddles to complete its lifecycle and calcareous seepages appear to be important for the survival of the soldier fly *Oxycera pygmaea* (N).

3.2.6 Disturbance

Disturbance is often important for invertebrates since it tends to encourage many of the habitat features that have already been discussed. Disturbance can create and maintain open patches of bare ground within a habitat and encourage the establishment of ruderal species which can be important nectar and foraging sources. Larger scale disturbance can prevent the encroachment of scrub and woody species and delay succession. It may also create variation with the topography of a site, perhaps creating sunny banks, sheltered hollows or shallow pools and puddles within a close mosaic, all of which add to the habitat diversity, and thus the species diversity, of a site.

Disturbance can result from a variety of processes, both natural and man-made. Erosion often occurs on old quarry or pit sites where the soils are thin and the vegetation too sparse to hold it in place. Land slippage can give rise to small and large cliff faces and expose underlying substrates, which may favour ground-nesting species. Animal poaching, overgrazing and erosion can also give rise to bare ground as well as preventing encroachment of scrub and woodland. Recreational and unofficial use of brownfield sites, particularly those in an urban or urban fringe environment can produce significant disturbance through footpath erosion, motor-bike scrambling and fire (Harvey 2000, Key 2000).

3.2.7 Succession

The habitat features that tend to favour invertebrate diversity are those associated with early successional habitats (Small and others 2002). In many post-industrial sites this early successional status is somewhat maintained by the harshness of the conditions (such as dry, thin soils, large expanses of bare-ground or scree, contaminated or nutrient-poor soils) (Spalding 2005) or by continued disturbance.

In many habitats, natural plant succession is the most significant threat to the maintenance of bare ground habitats. A number of exotic plant species are particularly rapid in eliminating bare ground as they colonise a site.

3.2.8 Surrounding landuse

As with any patch of habitat, the extent and quality of surrounding habitats can be highly influential on the colonisation of the site by plant and animal species and hence the diversity of species a site supports. Woodland, scrub and tall herb communities can provide important foraging habitats and nest sites for a variety of species. Habitats such as flower-rich road margins, field margins, disused railway lines can boost the diversity of a site since they often support stands of forage plants that are scarce or absent within the sites themselves (Falk, in press).

Brownfield sites, which offer patches of unimproved habitat, are becoming increasingly important in the modern landscape due to the intensity of farming and changes in land use (Harvey 2000). Improvement of grasslands, through the use of fertilisers and herbicides reduces the variety of plant species leading to a reduction in invertebrate diversity. Spraying of insecticides has a similar, more direct effect on invertebrate biodiversity. Due to their lack of use for agriculture and amenity, brownfield sites often escape the negative effects of intensive management and can offer a refuge of semi-natural habitat for many species. At a larger scale, the mosaic of brownfield habitats is important in supporting regionally important invertebrate assemblages, for example along the East Thames Corridor (Harvey 2000).

3.2.9 Case studies

The importance of brownfield sites, with a mosaic of habitat features, can be illustrated by the following recent case studies.

Northwick Road, Canvey Island

The Northwick Road site on Canvey Island, Essex has received considerable interest in recent years because of the rich and rare invertebrate assemblage that it contains as well as the pressure it has come under from development (Buglife 2004). This site covers 27.5 hectares and was originally an area of coastal grazing marsh. Prior to its development as an oil refinery site in the 1970s much of the area had been used to dump sediments dredged from the Thames. This material is varied in size, resulting in silty, sandy and gravely areas. The oil refinery built on the site was never used and, as a result of the crash in oil prices, was dismantled in the 1990s. This has left and area which is varied in structure with wet and reedy areas, ditches, ponds, sallow carr, bramble patches, sparsely vegetated gravels, sandy banks, dry grassland, wet grassland and bare concrete. This mixture of habitats offers a diversity of plant species for foraging resources, a structural vegetation mosaic, bare and sparsely

vegetated ground, wet areas and a continuity of resources which lead to a high invertebrate diversity (Buglife 2004).

Recent surveys show that the site has a rich invertebrate fauna, with 32 Red Data Book invertebrates, 120 Nationally Scarce species, 4 priority species under the UK Biodiversity Action Plan and 2 species known from nowhere else in the UK, the Canvey Island ground beetle *Scybalicus oblongiusculus* and the Morley weevil *Sitona cinerascens*. Also included in this species list are the scarce emerald damselfly *Lestes dryas* (RDB2), the shrill carder bee *Bombus sylvarum* (UKBAP), the brown-banded carder bee *Bombus humilis* (UKBAP), fen sac-spider *Clubiona juvenis* (RDB2), golden-girdle jumper *Bianor aurocinctus* (Na) saltmarsh shortspur *Anisodactylus poeciloides* (RDB3, UKBAP), tumbling flower beetles *Mordellistena* spp. (RDBK), big-spotted cleg *Haematopota bigoti* (RDB3), long-horned cleg *Haematopota grandis* (RDB3), rose plume *Cnaemidophorus rhododactyla* and twin-spot honey *Aphomia zelleri* (Buglife 2004).

The East Thames Corridor

Northwick Road lies within the East Thames Corridor, an area which as been recognised as having a nationally important invertebrate fauna, particularly within a network of brownfield sites in the region (Benton 2000, Harvey 2000, Harvey 1999, Plant & Harvey 1997). Surveys of some invertebrate groups of the East Thames Corridor since 1993 have produced evidence for the national importance of this region. This may be a result of the specific combination of climatic and ecological conditions present within south-east Anglia.

The East Thames Corridor contains a remarkable concentration of rare and scarce invertebrate species, holding 96% of the Essex aculeate Hymenoptera and 74% of the national fauna including the Biodiversity Action Plan bumblebees, the shrill carder bee and the brown-banded carder bee (Harvey 2000). Although the aculeate Hymenoptera fauna is especially well represented in the region, rare and characteristic species are not confined to this group. There are rare species in other groups such as spiders (Araneae), beetles (Coleoptera), flies (Diptera) and bugs (Heteroptera). Some species of bees and wasps are cleptoparasitic and parasitic, often on other aculeate Hymenoptera, and require suitable habitat and established populations of their host species. Thus, in regions where invertebrate diversity is already high, trophic interactions such as these can produce even higher species diversity. Parasitic species occur in taxa other than the aculeate Hymenoptera. For example, the parasitic fly *Gymnosoma nitens* (RDB1) which as been recorded from 13 sites in the East Thames Corridor (Harvey 2000).

Experience from the East Thames Corridor suggests that the most important invertebrate communities are found where there are extensive areas of relatively unmanaged, undisturbed and flower-rich grassland for foraging and hunting, combined with open sandy ground and south-facing banks and slopes for nesting (Harvey 2000). In the East Thames Corridor this continuity of suitable habitat is created by both brownfield and remnant natural sites, creating a regionally important area for invertebrates.

Calcareous quarries of Warwickshire

In a study of the bee and wasp fauna of Warwickshire's calcareous quarries and spoilheaps Falk (unpublished data) found that 186 species of bee and wasp from fourteen study sites. This level of diversity is not far short of that associated with lowland heathland in the West

Midlands Region. The most species-rich site within this study supported a total of 128 species with two Red Data Book species and eleven Nationally Scarce species of bee and wasp. Overall, the species list for the quarry sites surveyed included species currently found nowhere else in Warwickshire, as well as populations of UK Biodiversity Action Plan species, including the large garden bumblebee *Bombus ruderatus* (UKBAP) and the brown carder bee *Bombus humilis* (UKBAP).

Falk considers that the factors influencing the species diversity at these quarry sites include the extent of the floristically diverse habitats, the variety and extent of the surrounding habitats, geology and site history and the topography of the site.

3.3 Features of brownfield sites which favour invertebrates of conservation importance

3.3.1 Hymenoptera

The aculeate Hymenoptera (bees, wasps etc.) are a group whose habitat requirements are typically found on brownfield sites such as dry, flower-rich grasslands with patches of bare ground and scrub. Open bare ground and the nature of the substrate are particularly important for ground-nesting wasps and mining bees (eg several rare species in the genus *Andrena*) along with their parasites (Falk 1995). Nectar-rich foraging opportunities are also important for these bees (P. Harvey pers. comm.). The Biodiversity Action Plan bumblebees *Bombus sylvarum* and *Bombus humilis* are also dependent on flower-rich, open grasslands (UK Biodiversity Steering Group 1999).

The brown carder bumblebee *Bombus humilis* makes its nest on the surface of the ground at the base of long vegetation, often under accumulated plant litter. It has most often been recorded as associated with areas of grassland supporting a large number of plant species with long corolla flower types, notably those belonging to the dead nettle (Lamiaceae) and pea families (Fabaceae). It is one of a number of bumblebee species to have undergone a drastic reduction in range and abundance, as a result of the loss of this habitat in the modern agricultural landscape (UK Biodiversity Steering Group 1999).

The shrill carder bee *Bombus sylvarum* was widespread and common in the 19th and early 20th centuries, especially in southern England. However, post-1960 records suggest a decline to only one third of the previous distribution by the 1970s, with just seven sites reliably identified in the south and east of the British Isles in the 1980s. This decline has been attributed to changes in agricultural practices resulting in the loss of foraging and nesting sites in herb-rich rough grasslands (UK Biodiversity Steering Group 1999).

Predatory species such as the weevil-hunting wasps *Cerceris quadricincta* (RDB1, UKBAP) and *C. quinquefasciata* (RDB3, UKBAP) require a habitat mosaic of open sandy ground for nesting with tall grassland and scrub for foraging. Both species are medium-sized yellow-and-black wasps which nest gregariously in areas of bare sand in places exposed to the sun. Their nests are provisioned with weevils which they forage from grass and scrub vegetation (UK Biodiversity Steering Group 1999).

Other features that may be important for specific species are areas of drought-stressed bramble, the dead stems of which form nesting opportunities for species such as the blue

carpenter bee *Ceratina cyanea* (RDB3) and the solitary bee *Heriades truncorum* (RDBK) which nests in pre-existing cavities in dead wood and hollow stems (P. Harvey pers. comm.).

Some species appear to be using habitat features specific to some post-industrial sites. In many of these instances, the surrounding habitats play an important role in determining the presence of the species. For example, the mining bee *Colletes halophilus* uses sand, silt and pulverised fuel ash (PFA) for nesting where these substrates occur adjacent to saltmarsh (P. Harvey pers. comm.). Other species that require substrates of a particular nature can also be found on sites with friable substrates such as PFA or a habitat mosaic developed on river silt dredgings (silt lagoons) such as the mining bees *Colletes marginatus* (Nb) and *Megachile leachella* (Nb) (P. Harvey pers. comm.).

Certain parasitic species of Hymenoptera are linked to brownfield sites through their hosts, which favour brownfield habitats. For example, *Nomada ferruginata* is a species of cuckoo bee that is the special cleptoparasite of the early spring mining bee *Andrena praecox*. The host bee is strongly associated with the male flowers of sallows *Salix* spp., which provide the only pollen source for provisioning the nest cells. Nest burrows of the host bee are constructed, usually singly, in patches of bare ground (UK Biodiversity Steering Group 1999). Other cleptoparasitic bees found on brownfield sites include *Specodes niger* (RDB3) which parasitises the solitary bee *Lasioglossum morio* and the bees *Stelis ornatula* (RDB3) and *S. phaeoptera* (RDB2) which parasitise *Hoplitis* and *Osmia* bees. The wasp *Hedychrum niemelai* (RDB3) is a cleptoparasite on other wasps of the genus *Cerceris*, themselves restricted to the hot, dry, flower-rich grasslands which can develop on brownfield sites.

Table 1. Hymenoptera of conservation importance typically associated with 'brownfield' sites.

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Andrena bucephala	A mining bee	Na	• flower-rich grassland • scrub • sandy/soft substrate • bare ground
Andrena florea	A mining bee	RDB3	• flower-rich grassland • scrub • sandy/soft substrate • bare ground
Andrena fulvago	A mining bee	Na	• flower-rich grassland • scrub • sandy/soft substrate • bare ground
Andrena humilis	A mining bee	Nb	• flower-rich grassland • scrub • sandy/soft substrate • bare ground
Andrena nigrospina	A mining bee	pRDB2	• flower-rich grassland • scrub • sandy/soft substrate • bare ground

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Andrena nitidiuscula	A mining bee	RDB3	• flower-rich grassland • scrub • sandy/soft substrate • bare ground
Andrena proxima	A mining bee	RDB3	• flower-rich grassland • scrub • sandy/soft substrate • bare ground
Andrena tibialis	A mining bee	Na	• *Salix* scrub • sandy/soft substrate • bare ground
Bombus humilis	Brown-banded carder bee	UKBAP	• flower rich grassland • sand/soft substrate
Bombus ruderatus	Large garden bumblebee	UKBAP	• flower rich grassland • sand/soft substrate
Bombus rupestris	A cuckoo bumblebee	Nb	• flower rich grassland • sand/soft substrate
Bombus sylvarum	Shrill carder bee	UKBAP	• flower rich grassland • sand/soft substrate
Ceratina cyanea	Blue carpenter bee	RDB3	• flower-rich grassland • scrub incl. bramble for nesting
Cerceris quadricincta	A solitary wasp	RDB1, UKBAP	• hot, dry, flower-rich grasslands • bare ground
Cerceris quinquefasciata	A solitary bee	RDB3, UKBAP	• hot, dry, flower-rich grasslands • bare ground
Colletes halophilus	A mining bee	Na, Internationally important	• flower-rich grassland • sandy/soft substrate • close to saltmarsh
Colletes marginatus	A mining bee	Nb, Rare in Europe	• habitat mosaic • silt substrate
Dasypoda hirtipes	A mining bee	Nb	• flower-rich grassland • sandy/soft substrate • bare ground
Hedychrum niemelai	A cuckoo wasp	RDB3	• hot, dry, flower-rich grasslands • bare ground
Heriades truncorum	A solitary bee	RDBK	• open grassland • scrub • bare ground • drought-stressed bramble

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Hylaeus cornutus	A solitary bee	Na	• flower-rich grassland • scrub • sandy/soft substrate • bare ground
Hylaeus signatus	A yellow-faced bee	Nb	• flower-rich grassland • sandy/soft substrate • bare ground
Lasioglossum pauperatum	A mining bee	RDB3	• flower-rich grassland • sandy/soft substrate • bare ground
Lasioglossum pauxillum	A solitary bee	Na	• flower-rich grassland • sandy/soft substrate • bare ground
Lassioglossum xanthopum	A solitary bee	Nb	• flower-rich grassland • sandy/soft substrate • bare ground
Megachile leachella	A mining bee	Nb	• flower-rich grassland • sandy/soft substrate • bare ground
Nomada ferruginata	A cuckoo bee	RDB1, UKBAP	• *Salix* scrub • sandy/soft substrate • bare ground
Nomada fucata	A cuckoo bee	Na	• flower-rich grassland • soft substrate • bare ground
Nomada lathburiana	A cuckoo bee	RDB3	• flower-rich grassland • soft substrate • bare ground
Nysson dimidiatus	A digger wasp	Nb	• bare ground • soft substrate
Osmia bicolor	Red-tailed mason bee	Nb	• flower-rich grassland • soft substrate • bare ground
Passaloecus clypealis	A solitary wasp	RDB3	• ephemeral waterbodies • dry reedbeds
Philanthus triangulum	Bee-killing wasp	RDB2	• flower-rich grassland • bare ground
Sphecodes crassus	A cuckoo bee	Nb	• flower-rich grassland • sandy/soft substrate • bare ground
Sphecodes niger	A cuckoo bee	RDB3	• flower-rich grassland • sandy/soft substrate • bare ground

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Sphecodes reticulatus	A cuckoo bee	Na	• flower-rich grassland • sandy/soft substrate • bare ground
Stelis ornatula	A cuckoo bee	RDB3	• flower-rich grassland • bramble scrub for nesting • bare ground
Stelis phaeoptera	A cuckoo bee	RDB2	• flower-rich grassland • bramble scrub for nesting • bare ground
Tiphia minuta	A solitary wasp	Nb	• bare ground • tall grassland • scrub

Key

RDB 1, 2, 3, K	Red Data Book
Na	Nationally Scarce Category A - Notable A
Nb	Nationally Scarce Category B - Notable B
N	Nationally Scarce - Notable
LRns	Lower Risk Nationally Scarce
UKBAP	Priority species within the UK Biodiversity Action Plan

See Appendix 4 for a full explanation of these categories

3.3.2 Diptera

Several species of rare fly (Diptera) are associated with brownfield habitats. As with the bees and wasps, flies feeding on nectar and pollen tend to require the flower-rich grasslands and ruderal habitats that occur on many brownfield sites. A varied topography and patches of bare ground also appear important for maintaining the correct microclimate for certain fly species.

Of particular note amongst the Diptera is the number of parasitic species which are associated with brownfield sites through their hosts which favour the particular mosaic of habitat types. Several flies are parasitic on shield bugs and plant bugs which occur in flower-rich grasslands, for example *Gymnosoma nitens* (RDB1) parasitises the scarce shieldbug *Sciocorus cursitans* and *Cistogaster globosa* (RDB3) parasitises the shieldbug *Aelia acuminata* (P. Kirby & P. Harvey pers. comm.). Certain species are parasitic on mining bees, which, as previously described, require bare ground and friable substrates for nesting.

The Biodiversity Action Plan dotted bee-fly *Bombylius discolor* (UKBAP, N) is a parasitoid of some of the larger solitary bees (probably in the genus *Andrena*), which are active in the spring, although the exact hosts have yet to be determined. The host bees have specific nesting sites, usually involving bare ground into which they burrow. As well as having the host bee present, the bee-fly also requires flowers for nectar. It is almost certain that the bee-fly can only thrive where large congregations of nesting bees of certain species are established. This seems to be reflected in the fact that the dotted bee-fly underwent a major

decline and retraction in range at the time that many species of solitary bees crashed during the 1960s-1970s (UK Biodiversity Steering Group 1999).

The flesh fly *Miltogramma germari* (RDB3) occurs on dry grassland, sandy heaths and dunes, but also within brownfield habitats which provide similar habitat characteristics. This species is also associated with mining bees and it is thought to feed off their food stores (P. Harvey pers comm.).

The Biodiversity Action Plan picture winged fly *Dorycera graminum* (UKBAP, RDB3) is associated a mosaic of habitats is favoured, including flower-rich grassland of an open nature some patches of wet grassland or marsh. Larval ecology is unknown, but rotting vegetation has been suggested as the most likely larval habitat (UK Biodiversity Steering Group 1999).

Ephemeral waterbodies and damp areas are believed to be important for other species of fly. A mosaic of wet ground and bare ground is important for the Nationally Scarce fly *Chrysotus suavis* (N) which has been frequently recorded from clay, sand and gravel pits (P. Kirby pers. comm.). Similar wet and bare ground habitat mosaics are favoured by the snail-killing fly *Colobea punctata*, the fly *Ditaeniella griscens* and the soldier flies *Stratiomys potamida* (N) and *S. singularior* (N) (P. Kirby pers. comm.). The soldier fly, *Oxycera pygmaea* (N) favours seepages within limestone quarries, especially where willow scrub creates a dense shade (S. Falk pers. comm.). The fly *Dolichopus signifer* (RDB2) has been recorded from post-industrial land and grassland where reedbeds of *Phragmites australis* have developed on river silt (P. Harvey pers. comm.). The picture winged fly *Myopites inulaedyssentericae* (RDB3) has larvae that induce a gall to form on fleabane *Pulicaria dysenterica* and so favour the damper grasslands where this plant tends to grown (M. Drake & P. Harvey pers. comm.).

Table 2. Diptera of conservation importance typically associated with 'brownfield' sites.

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Aphaniosoma socium	A fly	RDB1	• bare ground
Blaesoxipha plumicornis	A flesh fly	N	• flower-rich grassland • sandy/soft substrate • bare ground
Bombylus discolor	A bee-fly	BAP, N	• flower-rich grassland • sandy/soft substrate • bare ground
Campiglossa malaris	A picture winged fly	RDB3	• flower-rich grassland • sandy/soft substrate • bare ground
Catharosia pygmaea	A parasitic fly	Handful of British records. No official status.	• flower-rich grassland • sandy/soft substrate • bare ground
Chamaepsila luteola	A fly	RDB3	• bare ground
Cheilosia velutina	A hoverfly	N	• flower-rich grassland • sandy/soft substrate • bare ground
Chlorops laetus	A fly	N	• dry grasslands

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Chorisops nagatomii	A soldier fly	N	• flower-rich grassland • bare ground • ephemeral waterbodies
Chrysotus suavis	A fly	N	• bare ground • wet ground
Cistogaster globosa	A parasitic fly	RDB3	• Flower-rich grassland • sandy/soft substrate • bare ground
Clytiomya continua	A parasitic fly	Handful of British records. No official status.	• flower-rich grassland • sandy/soft substrate • bare ground
Coenosia atra	A fly	N	• bare ground • soft substrate
Colobaea punctata	A snail-killing fly	N	• aquatic habitats • wet ground • tall, herb-rich grassland
Ditaeniella grisescens		N	• aquatic habitats • wet ground • tall, herb-rich grassland
Dolichopus signifer	A fly	RDB2	• flower-rich grassland • sandy/soft substrate • ephemeral waterbodies with *Phragmites*
Dorycera graminum	A picture winged fly	RDB3, BAP	• grassland mosaic • bare ground
Eggisops pecchiolii		N	• bare ground • soft substrate
Epistrophe diaphana	A hoverfly	N	• flower rich grassland • tall herbage • scrub and developing woodland
Fiebrigella palposa	A fly	N	• bare ground • soft substrate
Gymnosoma nitens	A parasitic fly	RDB1	• flower-rich grassland • bare ground
Haematopota bigoti	big-spotted cleg	RDB3	• bare ground • soft substrate
Haematopota grandis	long-horned cleg	RDB3	• bare ground • soft substrate
Helina concolor	A fly	RDB3	• flower-rich grassland • sandy/soft substrate • bare ground
Hercostomus chalybeus	A fly	N	• wet ground • tall, herb-rich grassland

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Homoneura interstincta	A fly	RDB3	• flower-rich grassland • *Salix* scrub • bare ground
Homoneura patelliformis	A fly	N	• flower-rich grassland • *Salix* scrub • bare ground
Homoneura thalhammeri	A fly	Nb	• flower-rich grassland • *Salix* scrub • bare ground
Lasiambia brevibucca	A fly	N	• flower-rich grassland • sandy/soft substrate • bare ground
Lithophasia hyalipennis	A fly	extinct	• bare ground
Merzomyia westermanni	A picture winged fly	N	• flower-rich grassland • sandy/soft substrate • bare ground
Micromorphus albipes	A fly	N	• bare ground • wet ground
Micropeza lateralis	A fly	N	• scrub
Miltogramma germari	A flesh fly	RDB3	• flower-rich grassland • sandy/soft substrate • bare ground
Myopites Inulaedyssentericae	A picture-wing fly	RDB3	• flower-rich grassland • wet grassland • bare ground
Oscinimorpha arcuata	A fly	N	• bare ground • soft substrate
Oxyna nebulosa	A fly	RDB3	• flower-rich grassland • sandy/soft substrate • bare ground
Oxyna parietina	A fly	N	• flower-rich grassland • bare soil
Oxycera pygmaea	A soldier fly	N	• *Salix* scrub • wet seepages • bare ground
Paroxyna absinthii	A picture-wing fly	Nb	• flower-rich grassland • bare ground
Pherbellia dorsata	A fly	N	• bare ground • wet ground
Pherbellia nana	A fly	N	• bare ground • wet ground
Pipizella virens	A hoverfly	N	• flower-rich grassland • sandy/soft substrate • bare ground

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Siphonella oscinina	A fly	N	• dry grassland • soft substrate
Stratiomys potamida	A soldier fly	N	• bare ground • wet ground
Stratiomys singularior	A soldier fly	N	• flower-rich grassland, bare ground, brackish ditches.
Tephritis matricariae	A picture-wing fly	Nb	• dry grassland • damp grassland • bare ground
Terellia longicauda	A fly	N	• flower-rich grassland • bare ground
Thereva fulva	A stiletto fly	RDB3	• flower-rich grassland • sandy/soft substrate • bare ground
Thereva plebeja	A stiletto fly	N	• flower-rich grassland • sandy/soft substrate • bare ground
Trachysiphonella scutellata	A fly	N	• soft substrate
Triglyphus primus	A hoverfly	N	• flower-rich grassland • sandy/soft substrate • bare ground
Volucella inanis	A fly	N	• scrub
Volucella zonaria	A fly	N	• scrub

Key

RDB 1, 2, 3, K	Red Data Book
Na	Nationally Scarce Category A - Notable A
Nb	Nationally Scarce Category B - Notable B
N	Nationally Scarce - Notable
LRns	Lower Risk Nationally Scarce
UKBAP	Priority species within the UK Biodiversity Action Plan

See Appendix 4 for a full explanation of these categories

3.3.3 Coleoptera

Several species of beetle (Coleoptera) of conservation importance are associated with brownfield sites, particularly ground beetles, which prefer the open habitat structure and patches of bare ground afforded by brownfield habitats (Small and others 2002, Eyre and others 2003). Ground beetles found to be associated with disused clay, sand and gravel pits and colliery spoil heaps include *Bembidion quadripustulatum* (Nb), *Ophonus ardosiacus* (Nb) and *Amara praetermissa* (Nb) (P. Kirby pers. comm.). The Nationally Scarce ground beetle *Bembidion saxatile* (Nb) is particularly associated with habitats containing areas of open, damp gravel, while *Tachys parvulus* (Nb) prefers bare ground and *Notiophilus*

quadripunctatus (Nb) open patches of sand and gravel (M. Drake & S. Falk pers. comm.). A study of beetles on urban sites in Leicester (Lott & Daws 1995) found that the most ecologically interesting beetle communities are associated with demolition sites whose vegetational structure is retarded by soil factors including exposures of bare mineral substrate, piles of rubble, cinders and ash, heavy metal contamination or disturbance. Similarly, urban derelict sites in Birmingham were found to support a diversity of Carabid beetles including Nationally Scarce species (Small and others 2002).

Floristically rich grasslands and a vegetation mosaic is important for other species such as Adonis' ladybird *Adonia variegata* (Nb), the ladybird *Platynaspis luteorubra* (Na) and the tumbling flower beetles *Mordellistena* spp. (RDBK), which nest in plant stems (P. Kirby & P. Harvey pers. comm.). For the tumbling flower beetles, open grassland with a continuity of dead herbaceous stems, bare ground and sparsely vegetated mosaics is the preferred habitat (P. Harvey pers. comm.). Bare ground and a variety of flowering plants are important for the seed weevils *Catapion pubescens* (Nb), *Diplapion stolidum* (Nb) and *Protapion dissimile* (Nb) (P. Kirby pers. comm.). Many species of weevil are associated with the sparsely vegetated mosaics that are common within brownfield land. The variety of weevil species include *Baris picicornis* (Nb), *Ceutorhynchus resedae (*Nb) and *Orthochaetes setiger* (Nb) (P. Kirby pers. comm.).

As with the Diptera, certain species benefit from the presence of wetland habitats or ephemeral waterbodies. The saltmarsh shortspur *Anisodactylus poeciloides* (RDB3, UKBAP) is a species associated with upper saltmarshes, the margins of saline lagoons or brackish ditches (RSPB 2005). Both larvae and adults are probably mainly seed feeders (UK Biodiversity Steering Group 1999). It has been recorded from brownfield sites that contain pulverised fuel ash (PFA) lagoons close to brackish water habitats (P. Harvey pers. comm.). During this century, *Anisodactylus poeciloides* has occurred along the southern English coast from Cornwall to Essex, but since 1970 it has been recorded from only four sites in Kent and one in Sussex (UK Biodiversity Steering Group 1999). Several aquatic species are also associated with brownfield sites where suitable wetland habitats occur, particularly flooded sand, gravel and chalk pits (P. Kirby pers. comm.). Specific examples include the water beetles *Haliplus varius* (RDBK) and *Hydrochus carinatus* (RDB2) which frequent waterbodies within former sand, clay and gravel pits and chalk quarries (P. Kirby pers. comm.) The diving beetle *Hydroglyphus pusillus* (Nb) can be found within brownfield sites where silt ponds and clay puddles occur (S. Falk pers. comm.).

Table 3. Coleoptera of conservation importance typically associated with 'brownfield' sites.

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Adonia (Hippodamia) variegata	Adonis' ladybird	Nb	• flower-rich grassland • sandy/soft substrate • bare ground
Amara equestris	A ground beetle	Nb	• bare ground
Amara praetermissa	A ground beetle	Nb	• bare ground
Anacaena bipustulata	A water beetle	LRnsB	• waterbodies
Anisodactylus poeciloides	A ground beetle	RDB3, BAP	• flower-rich grassland • brackish waterbodies
Baris picicornis	A weevil	Nb	• bare ground

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Bembidion argenteolum	A ground beetle	RDBK, UKBAP	• bare ground • damp, fine sand • waterbodies
Bembidion fumigatum	A ground beetle	Nb	• wet ground • tall grassland and herbs
Bembidion quadripustulatum	A ground beetle	Na	• wet ground • bare ground
Bembidion saxatile	A ground beetle	Nb	• flower-rich grassland • gravely substrate • damp bare ground
Berosus affinis	A water beetle	LRnsB	• waterbodies
Berosus signaticollis	A water beetle	LRnsB	• waterbodies
Bromius obscurus	A leaf beetle	RDB1	• flower-rich grassland • bare ground
Calosirus terminatus	A beetle	Nb	• bare ground
Catapion pubescens	A seed weevil	Nb	• bare ground
Cercyon sternalis	A beetle	LRnsB	• aquatic habitats • wet ground • tall grassland with herbs
Cercyon tristis	A beetle	LRnsB	• aquatic habitats • wet ground • tall grassland with herbs
Ceutorhynchus angulosus	A weevil	Na	• bare ground • ephemeral waterbodies
Ceutorhynchus pulvinatus	A weevil	Na	• bare ground • sandy substrate
Ceutorhynchus resedae	A weevil	Nb	• tall grassland and herbs
Chaetarthria seminulum	A water beetle	LRnsB	• aquatic habitats • wet ground
Cryptocephalus aureolus	Green pot beetle	Na	• flower-rich grassland • bare ground
Demetrias imperialis	A beetle	Nb	• wet ground • tall grassland and herbs
Diplapion stolidum	A beetle	Nb	• bare ground
Dyschirius obscurus	A ground beetle	RDB2	• bare ground • damp sand • ephemeral waterbodies
Enochrus melanocephalus	A water beetle	LRnsB	• waterbodies
Gronops lunatus	A beetle	Nb	• bare ground
Gymnetron veronicae	A weevil	Nb	• wet ground • bare ground
Gymnetron villosulum	A weevil	Nb	• wet ground • bare ground

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Gyrinus paykulli	A beetle	LRnsA	• waterbodies
Haliplus varius	A water beetle	RDBK	• waterbodies, flooded pits
Harpalus froelichi	A ground beetle	RDB2, UKBAP	• dry, bare ground • sandy soils • sparse vegetation
Harpalus obscurus	A ground beetle	RDB1	• bare ground
Hydraena testacea	A water beetle	LRnsB	• waterbodies
Hydrochus carinatus	A water beetle	RDB2	• waterbodies
Hydroglyphus geminus	A diving beetle	LRnsB	• waterbodies
Hydroglyphus pusillus	A diving beetle	Nb	• silt ponds and clay puddles
Hylobius transversovittatus	A weevil	RDB1	• bare ground • ephemeral waterbodies
Ilybius fenestratus	A water beetle	LRnsB	• waterbodies
Laccobius sinuatus	A water beetle	LRnsB	• bare ground • waterbodies
Limnebius papposus	A water beetle	LRnsB	• waterbodies
Longitarsus dorsalis	A leaf beetle	Nb	• bare ground
Longitarsus ochroleucus	A leaf beetle	Nb	• flower-rich disturbed grassland • bare ground • soft substrate
Mantura rustica	A leaf beetle	Nb	• flower-rich grassland • sandy/soft substrate • bare ground
Microplontus campestris	A beetle	Nb	• bare ground
Mordellistena spp.	Tumbling flower beetles	Mostly RDBK	• flower-rich grassland • sandy/soft substrate • bare ground
Notaris scirpi	A weevil	Nb	• bare ground
			•
Notiophilus quadripunctatus	A ground beetle	Nb	• flower-rich grassland • sandy/soft substrate • bare ground
Olibrus pygmaeus	A beetle	Nb	• bare ground
Omophron limbatum	A ground beetle	RDB1	• bare ground • wet sand • waterbodies
Omphalapion beuthini	A weevil	RDB3	• bare, chalky ground
Ophonus ardosiacus	A ground beetle	Nb	• bare ground
Ophonus azureus	A ground beetle	Nb	• bare ground
Ophonus rupicola	A ground beetle	Nb	• bare ground
Orthochaetes setiger	A beetle	Nb	• bare ground

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Oulema erichsoni	A beetle	RDB1	• bare ground • ephemeral waterbodies
Oxystoma cerdo	Tufted vetch weevil	Nb	• flower-rich grassland • bare ground
Phytoecia cylindrica	A beetle	Nb	• flower-rich grasslands • scrub patches
Platyderus ruficollis	A ground beetle	Nb	• bare ground
Platynaspis luteorubra	A ladybird	Na	• flower-rich grassland • sandy/soft substrate • bare ground
Podagrica fuscicornis	A beetle	Nb	• bare ground • tall, flower-rich grassland
Protapion dissimile	A seed weevil	Nb	• bare ground • soft substrate
Protapion filirostre	A weevil	Nb	• bare ground
Psylliodes hyoscyami	Henbane flea beetle	RDB1	• bare ground
Psylliodes sophiae	A leaf beetle	RDB3, UKBAP	• flower-rich grassland • sandy/soft substrate • bare ground
Rhantus suturalis	A water beetle	LRnsB	• waterbodies
Sibinia primita	A beetle	Nb	• bare ground
Squamapion cineraceum	A weevil	Na	• bare ground
Stenolophus teutonus	A beetle	Nb	• bare ground • wet ground
Tachys parvulus	A ground beetle	Nb	• flower-rich grassland • bare ground
Trachys scrobiculatus	Ground ivy jewel beetle	Na	• bare ground
Trichosirocalus barnevillei	A beetle	Nb	• bare ground
Tychius pusillus	A beetle	Nb	• bare ground

Key

RDB 1, 2, 3, K	Red Data Book
Na	Nationally Scarce Category A - Notable A
Nb	Nationally Scarce Category B - Notable B
N	Nationally Scarce - Notable
LRns	Lower Risk Nationally Scarce
UKBAP	Priority species within the UK Biodiversity Action Plan

See Appendix 4 for a full explanation of these categories

3.3.4 Lepidoptera

Butterflies and moths (Lepidoptera) benefit from the combination of habitat features that are often common within brownfields sites such as a diversity of larval foodplants and nectar sources for adults along with areas of bare ground and shelter that provide the right conditions for warmth-loving species (Butterfly Conservation 2004a, 2004b). Around 30 species of butterfly are associated with brownfield sites including many common species such as the red admiral *Vanessa atalanta*, peacock *Inachis io* and small tortoiseshell *Aglais urticae*. Brownfield sites are also key habitats for declining species such as the dingy skipper *Erynnis tages*, grizzled skipper *Pyrgus malvae* (Butterfly Conservation 2005), green hairstreak *Callophrys rubi*, small blue *Cupido minimus*, silver-studded blue *Plebejus argus* (UKBAP) and grayling *Hipparchia semele*. Although many of the species are named within Local Biodiversity Action Plans, only the silver-studded blue is a priority species within the UK Biodiversity Action Plan. It is also classified as being Nationally Scarce.

The silver-studded blue occurs on lowland heathland and calcareous grassland. In all habitats, the species requires the presence of ant species of the genus *Lasius*, open ground for breeding, and either bare soil or short vegetation. The preferred conditions produce warm microclimates at ground level for the larvae. Early successional stages are preferred, particularly where succession is held in check by grazing. Most heathland colonies exist on sites that have been either recently disturbed, such as sand pits, quarries and firebreaks, or burnt. The silver-studded blue has undergone a severe decline in range this century, estimated at 80%. It has become extinct in Scotland and northern England, and throughout most of central, eastern and south-eastern England (UK Biodiversity Steering Group 1999).

Many species of moth are also found on brownfield sites, including the burnet companion *Euclidia glyphica*, mother shipton *Callistege mi*, latticed heath *Chiasmia clathrata*, six-spot burnet *Zygaena filipendulae*, as well as scarcer species such as the Nationally Scarce wormwood shark *Cucullia absinthii* (English Nature 2002, Butterfly Conservation 2004a) and the Biodiversity Action Plan species the chalk carpet *Scotopteryx bipunctaria* (S. Falk pers. comm.). Again, areas of bare ground, created by occasional disturbance, seem to be important features of the habitat mosaic for these species. The chalk carpet occurs on chalk and limestone grasslands and can therefore occur on disused chalk pits and limestone quarries. The main habitats occupied are short-grazed areas that have bare ground, including embankments, cliffs, quarries and sheep tracks. Populations can be quite large and persist for decades. The larvae feed at night on bird`s-foot trefoil *Lotus corniculatus* and other trefoils and clovers, such as black medick *Medicago lupulina,* horse-shoe vetch *Hippocrepis comosa*, red clover *Trifolium pratense* and white clover *T. repens* (UK Biodiversity Steering Group 1999).

Open, sunny sites with abundant bare ground patches are also important for the four-spotted moth *Tyta luctuosa* (UKBAP, RDB2), the six-belted clearwing *Bembecia ichneumoniformis* (Nb) (P. Kirby pers. comm.) and the striped lychnis moth *Cucullia lychnitis* (UKBAP). The four-spotted moth is a grassland species typically found on south-facing banks on well-drained soils with sparse vegetation and bare earth. The larvae feed on field bindweed *Convolvulus arvensis*, preferring the flowers and seeds initially (UK Biodiversity Steering Group 1999) and can also feed from *Calystegia* spp. (neophytes) (PIDB). Striped lychnis larvae feed on the flowers of dark mullein *Verbascum nigrum* (which is mostly found on soft limestone) and occasionally other *Verbascum* and *Scrophularia* species, preferring sunny open sites (UK Biodiversity Steering Group 1999).

Table 4. Lepidoptera of conservation importance typically associated with 'brownfield' sites.

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Bembecia ichneumoniformis	Six-belted clearwing moth	Nb	• bare ground • flower rich grassland
Calamotropha paludella	A moth	Nb	• ephemeral waterbodies • patches of *Typha* spp.
Calophasia lunula	Toadflax brocade moth	UKBAP, RDB3	• disturbed ground • bare ground • sandy, gravely substrate
Cucullia absinthii	Wormwood shark moth	Nb	• flower-rich grassland • sandy/soft substrate • bare ground
Cucullia lychnitis	Striped lychnis moth	UKBAP, N	• bare ground • soft limestone substrate
Idaea vulpinaria	Least carpet	N	• *Clematis* scrub
Plebejus argus	Silver-studded blue butterfly	UKBAP, N	• flower-rich grassland • sandy/soft substrate • bare ground
Scotopteryx bipunctaria	Chalk carpet moth	UKBAP, N	• flower-rich grassland • sandy/soft substrate • bare ground
Tyta luctuosa	Four-spotted moth	UKBAP, RDB2	• bare ground • dry, free-draining soil • sparse vegetation

Key

RDB 1, 2, 3, K	Red Data Book
Na	Nationally Scarce Category A - Notable A
Nb	Nationally Scarce Category B - Notable B
N	Nationally Scarce - Notable
LRns	Lower Risk Nationally Scarce
UKBAP	Priority species within the UK Biodiversity Action Plan

See Appendix 4 for a full explanation of these categories

3.3.5 Hemiptera

Several nationally scarce bugs can be found on brownfield sites. These species tend to favour sites which have a variety of microhabitats including bare ground, herb-rich grassland and scrub. These conditions can be typically found on clay, gravel and sand pits, railway land and post-industrial land. The bug *Agnocoris reclairei* (Nb) is specifically associated with white willow *Salix alba* scrub on disused sand and gravel pits, on railway land and post-industrial sites (P. Kirby pers. comm.). Herb-rich grasslands with the host plant black medick *Medicago lupulina* are important for the bug *Bathysolen nubilus*, which has been recorded from clay,

sand, gravel pits, railway land and colliery spoil heaps (P. Kirby pers. comm.). The plant hopper *Asiraca clavicornis* (Nb) is a species of open grasslands with sparsely vegetated habitat mosaics (P. Harvey pers. comm.).

Table 5. Hemiptera of conservation importance typically associated with 'brownfield' sites.

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Agnocoris reclairei	A bug	Nb	• scrub
Asiraca clavicornis	A plant hopper	Nb	• open grassland • scrub • bare ground • sparsely vegetated mosaics
Bathysolen nubilus	A bug	Nb	• bare ground • herb-rich grassland
Euscelidius variegatus	A bug	Nb	• bare ground
Megalonotus sabulicola	A bug	Nb	• bare ground
Saldula opacula	A bug	Nb	• bare ground • wet ground
Stictopleurus abutilon	A bug	extinct	• bare ground • tall, herb rich grassland
Stictopleurus punctatonervosus	A bug	extinct	• bare ground • tall, herb rich grassland

Key

RDB 1, 2, 3, K	Red Data Book
Na	Nationally Scarce Category A - Notable A
Nb	Nationally Scarce Category B - Notable B
N	Nationally Scarce - Notable
LRns	Lower Risk Nationally Scarce
UKBAP	Priority species within the UK Biodiversity Action Plan

See Appendix 4 for a full explanation of these categories

3.3.6 Araneae

Certain species of rare spider (Araneae) are associated with brownfield sites, and require a similar mixed habitat mosaic to the insect groups already mentioned. The Nationally Scarce golden girdle jumping spider *Bianor aurocinctus* (Na) requires open grassland with stony bare ground within sparsely vegetated mosaics. A similar stony habitat mosaic is required by the Nationally Scarce spider *Zodarion italicum.* In contrast, the Red Data Book spider *Clubiona juvenis* favours habitats with wet *Phragmites* reedbeds. Suitable habitats for this species are known to have developed on river silt dredgings (silt lagoons) and on peat in old sand extraction sites (P. Harvey pers. comm.).

Table 6. Araneae of conservation importance typically associated with 'brownfield' sites.

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Bianor aurocinctus	The golden-girdle jumping spider	Na	• open grassland • bare ground • stones
Clubiona juvenis	A spider	RDB2	• wet *Phragmites* reedbeds • silt dredgings • peat
Zodarion italicum	A spider	Na	• open grassland • bare ground • stones

Key

RDB 1, 2, 3, K	Red Data Book
Na	Nationally Scarce Category A - Notable A
Nb	Nationally Scarce Category B - Notable B
N	Nationally Scarce - Notable
LRns	Lower Risk Nationally Scarce
UKBAP	Priority species within the UK Biodiversity Action Plan

See Appendix 4 for a full explanation of these categories

3.3.7 Odonata

Due to their lifecycle, dragonflies and damselflies (Odonata) are linked to aquatic habitats. Where ponds, ditches and pools occur within brownfield sites, there is the potential for these species to colonise.

Species of conservation concern that may be found on brownfield sites include the scarce emerald damselfly *Lestes dryas* (RDB2) and the ruddy darter *Sympetrum sanguineum* (Nb) (P. Kirby pers. comm.).

The scarce emerald damselfly can occur in two types of habitat in the UK. It is usually found within the dense vegetation of shallow pools and drainage channels. Lakes or ponds that are near the end of their natural cycle, supporting dense vegetation, are particularly suitable and breeding sites always appear to be well vegetated with submerged and emergent vegetation. The ruddy darter uses similar well-vegetated pools for breeding. The scarce emerald damselfly can also be found in seasonal water bodies, which may subject to a temporary drying out period at the height of summer. The occasional drying out of both types of habitat stops the presence of fish, which are major predators of the larvae (Smallshire & Swash 2004). The decline of both species is thought to be a result of habitat loss and pollution.

Table 7. Odonata of conservation importance typically associated with 'brownfield' sites.

Scientific name	Common name	Conservation status	Key features of brownfield habitats
Lestes dryas	The scarce emerald damselfly	RDB2	• shallow pools • dense aquatic vegetation
Sympetrum sanguineum	The ruddy darter	Nb	• shallow pools • dense aquatic vegetation

Key

RDB 1, 2, 3, K	Red Data Book
Na	Nationally Scarce Category A - Notable A
Nb	Nationally Scarce Category B - Notable B
N	Nationally Scarce - Notable
LRns	Lower Risk Nationally Scarce
UKBAP	Priority species within the UK Biodiversity Action Plan

See Appendix 4 for a full explanation of these categories

3.3.8 Other invertebrate groups

Certain other species of conservation concern from other invertebrate groups are considered to be typically associated with brownfield sites. The long-winged conehead *Conocephalus discolor* (Na) and Roesel's bush cricket *Metrioptera roeselii* (Nb) are two species of Orthoptera that are associated with dry grasslands and have been found within brownfield sites that include features such as bare ground, sparse vegetation, flower-rich herbage and scrub (P. Kirby & D. Gibbs pers. comm.). In addition, Lesne's earwig *Forficula lesnei* (Nb) (Dermaptera) has been recorded from several brownfield sites in the Bristol area (D. Gibbs pers. comm.). These sites have a complex mosaic of habitat types including concrete hardstanding, rubble from demolished buildings, old railway embankments and have tended to develop flower-rich grasslands with interspersed patches of scrub.

A complete list of the invertebrate species of conservation importance considered within this report can be found in Appendix 2.

4. Recommendations

This study has highlighted the importance of brownfield sites for the conservation of invertebrates. In this report, a total of 194 invertebrate species of conservation importance were assessed as being typical of brownfield sites. Of these, 50 were Red Data Book species, 131 were Nationally Scarce species and 17 priority species within the UK Biodiversity Action Plan.

Although there has been much recent interest in the value of brownfield sites for invertebrates, there remains much that is poorly understood about the ecology of brownfield sites and there appears to be little recognition of the value of such sites to nature conservation objectives. In fact, the Government's policy of having 60% of all new housing developments

on brownfield sites specifically targets brownfield land for re-development in preference to greenfield habitats (PPG3 2000). This is despite the UK Biodiversity Action Plan for urban areas emphasising these key recommendations for brownfield sites (UK Biodiversity Steering Group 1999):

- Survey and evaluate the full range of urban habitats (including buildings) in terms of their importance in maintaining wildlife interest.
- Protect sites important for wildlife from changes in landuse.
- Implement strategies to enable the use of vacant and derelict land, either temporarily or permanently as wildlife habitats.
- Incorporate the conservation and enhancement of wildlife into the management of urban greenspace.
- Encourage community action to survey, plan for and manage wildlife habitats.
- Promote wild space in urban areas as educational resource to inform communities about local wildlife.

As invertebrates are one of the key animal groups on brownfield sites, strategies for their protection, enhancement and management should be at the core of nature conservation planning.

4.1 The importance of adequate surveying

When addressing whether any site is important for nature conservation the initial starting point is appropriate surveying. In the context of brownfield sites, it is clear that invertebrates are one of the key biotic groups and surveying should be targeted towards assessing species richness, species rarity and habitat features that may be important to these species. Although there has been an increase in interest in the ecology post-industrial sites (Shepherd and others unpublished data, Plant 2000, Plant & Harvey 1997), a standard methodology for site-specific assessment that also enables the relative importance of sites to be assessed, does not exist (Gibson 1998).

In his report on the value of artificial habitats for uncommon invertebrates, Gibson (1998) considered existing standard methods of habitat surveying (eg Phase 1 Habitat Survey (JNCC1990)) to be inadequate for an assessment of artificial habitats, including brownfield sites. He argues that being vegetation-based, the methods over-simplify the structural components which are known to be important to invertebrates (Kirby 1992). The key components considered in need of attention by Gibson are as follows.

- An estimate of age and/or succession rate. The best sites appear to be those which support a patchy, but species-rich vegetation, which is maintained in an open state for long periods because of nutrient, toxicity and disturbance limits on succession, without grazing or cutting management which keeps a site open but removed plant architecture components needed by invertebrates.
- A measure of the substrate particle size (ie clay, silt, sand, stones, cracked rock, walls or concrete).
- The nature of the substrate material and, if possible, a direct measure of pH. Besides being important in determining vegetation, it is likely to affect some species directly.
- The aspect of habitat component, slopes exposed to the south having a hotter microclimate earlier in the year.

- Shelter factors, small pits or glades in scrub having an extra bonus for early warmth.
- Any clear limiting toxicity or pollution of substrate.

It is considered by Gibson that there has been considerable under-recording of invertebrates on brownfield land in the past due to inadequate surveying and the disappearance of sites before they have been surveyed. Gibson considers the main factors affecting the success of surveys is the lack of entomological expertise compared with the number of brownfield habitats that need to be surveyed. The rate of species recording is itself constrained by the phenology of insects, with species only accessible to sampling at certain times of the year and the natural year-to-year fluctuations in insect populations, meaning that they may only be readily detectable in some years (Gibson 1998).

On a more general note, assumptions about site status should not be made until an appropriate assessment is made of the ecology of a site. The term 'brownfield' gathers a range of sites under one definition (from post-industrial and derelict buildings to quarries and gravel pits), a definition that in itself may carry connotations of ecological impoverishment. Specific ecological evaluation is perhaps the most important first step when assessing the value of any site. Seeking conservation advice at the earliest planning stages enables retention of important habitats within development plans, saving time and money by avoiding later redesign.

4.2 Site protection

Some of the most valuable wildlife sites in the UK are protected by SSSI designations. In addition, the planning system has safeguards that protect many of the remaining sites important for nature conservation from development and ensure that mitigation measures are undertaken to maintain the favourable conservation status of valuable species and habitats. Specific invertebrate groups, namely butterflies and dragonflies, have clear thresholds for SSSI designation. However, the site designation system often fails the most important sites for invertebrate biodiversity or rarity since there are no clear guidelines and thresholds for site designations outside these taxa. Designation has relied on the entomological knowledge of officers of statutory nature conservation organisations and the opinion of other individuals (M. Shardlow pers. comm.). There are some local examples of guidelines on the selection of non-statutory sites that are of importance for invertebrates. Some of these recognise the importance of habitat mosaics and habitat structure to invertebrates and try to reflect this in site selection (North Yorkshire SINC Panel, 2002).

It is important that the second step, after adequate site assessment, is the adequate protection of sites that are deemed to be important both on a national and local scale in terms of their invertebrate species and assemblages. The third step is to ensure that this interest is not lost through the adoption of an in-appropriate management regime.

4.3 Management

An important rule with all development plans is to maintain and enhance existing habitat features wherever possible. When brownfield sites are redeveloped, there is the potential for valuable invertebrate habitat to be lost. Retaining areas of semi-natural vegetation within the development area may allow fragments of existing habitat to survive. This will not only help to maximise the number of species that are able to persist within the remaining habitat, but will also allow animals to recolonise the site following development.

A clear relationship exists between the number of species and the area of a given site (MacArthur & Wilson 2001) and this has been found to be true of aculeate Hymenoptera on brownfield sites (Archer 1995, Archer & Burn 1995). It follows therefore that the larger the site is, or the larger the area of suitable habitat retained within the development plans, the more species will be able to survive post-development. With the loss of habitat through development, fragmentation of retained patches will be inevitable. Many of the scarcer and more restricted invertebrates appear to have limited powers of dispersal and do not seem to be able to move easily from one site to another. As habitats become more fragmented, recolonisation becomes less likely. Sites will therefore benefit from the retention of maximum habitat area and diversity as well as the maintenance of connected fragments of habitat to allow persistence and colonisation of species. It is therefore important to consider how a site relates to other brownfield habitats on a landscape scale.

Often, nature conservation is recognised as a legitimate afteruse of brownfield land (Handley 1995). However, care must be taken not to manage or 'restore' sites in such a way as to destroy their inherent conservation value, particularly for often overlooked groups such as invertebrates. Restoration schemes within developments often create amenity grassland or woodland, which does not support the open, varied habitats of brownfield land (Lazenby 1988, Box 1999, Key 2000). Remedial treatments to rework the land surface to remove varied topography and create a 'tidier' landscape often remove some of the more subtle habitat features that are so valuable for invertebrates. The value of natural regeneration is often overlooked in favour of landscaping and planting schemes (Box 1999). Activities such as resurfacing eroded paths, covering bare patches of ground with fertile topsoil, reseeding and planting shade-producing trees can also reduce the availability of invertebrate habitat. In cases such as these, if a survey is undertaken as a preliminary measure within the restoration plans, an appropriate management can be formulated and often costly 'restoration' schemes can be avoided.

Habitat management is often necessary for the persistence of certain key habitat features, and this is especially true of the early successional habitats so characteristic of brownfield sites. In complex situations such as these, management plans will have to take into account the status of the site and attempt to cater for the all-important subtleties in the habitat mosaic. Even with less complex habitats, a rigidly predetermined management regime is rarely suitable for the long-term maintenance of invertebrate interest (Kirby 1992, Scott 1995).

4.3.1 Management for structural diversity

A varied vegetation structure is perhaps the most important habitat features for maintaining invertebrate diversity (Kirby 1992). Particularly important within brownfield sites is the close-knit nature of the habitat mosaic which provides foraging opportunities, shelter and nesting sites in close proximity. Management that seeks to maintain and enhance vegetation structure will be of maximum benefit to invertebrate biodiversity (Kirby 1992).

Microclimate is of particular importance to invertebrates and in this respect areas of bare ground, which tend to warm up to a greater extent than their surroundings, are of particular importance. Variation in topography also plays an important role in creating variation in microclimate, which will also aid in buffering populations from weather fluctuations. For example, in times of extreme heat and drought, northerly-facing aspects may provide more suitable habitat than the hotter, southerly-facing slopes.

Habitat features must be present in order to support species throughout there life cycles and in this respect the presence of soft and sandy substrates and wetter areas is often essential. Ground nesting species that burrow into the soil will require particular nature of substrate. Wetter areas, ephemeral waterbodies, puddles, ponds and pools may provide habitats for aquatic species, or species which rely on wetter habitats at some part of their lifecycle.

The importance of dead wood, scrub and leaf litter should not be overlooked as the invertebrates associated with the decay of timber are very diverse and of exceptional value to conservation (Kirby 1992). Although features such as ancient trees and large fallen logs are unlikely to be common on brownfield sites, finer material such as twigs and branches may be managed to create significant invertebrate habitats. The availability of dead and broken stems for stem-nesting species can be enhanced by occasional scrub damage or scrub control (Harvey 2000). Tightly bound bundles of brushwood can tidy up small material from scrub clearance operations and provide shelter and foraging habitat for invertebrates (Kirby 1992).

Broad management objectives should aim to provide the following features within the habitat mosaic.

- Varied topography
- Scrub
- Dry grassland
- Wet grassland
- Ruderal vegetation
- Bare ground
- Exposed soft/sandy/gravely substrate
- Ephemeral waterbodies/ditches/ponds
- Dead wood/brash

4.3.2 Maximising floral diversity

Herbivorous invertebrates, including those that feed on plants as larvae and those that forage on nectar and pollen as adults, benefit from floral abundance and diversity amongst the vegetation. Floral diversity is obviously linked to structural and vegetational diversity and management for the former will tend to promote the latter.

On post-industrial sites, it is often the contamination of soil or the presence of highly stressed substrates that restricts succession and the encroachment of dense vegetation and ultimately, the underlying nature of the soils and topography will influence the development of a diverse flora. Management should not generally seek to change the soil chemistry or augment soil nutrient status. Natural regeneration is favourable to planting and sowing of plants and flowers (Box 1999), even if this means a high proportion of exotic species. In fact, ruderal vegetation on brownfield sites, which may contain a high proportion of exotics, can be a valuable source of nectar flowers.

Invertebrate habitat may require positive management to prevent the open habitat mosaic from disappearing from brownfield sites as open conditions are lost to scrub and woodland. To prevent flower-rich grassland and bare ground habitats from disappearing, occasional disturbance or scrub clearance may be required as well as grassland management to prevent excessive scrub encroachment.

Regular mowing or cutting of species rich grasslands is likely to result in the depletion of the invertebrate fauna, particularly cutting in summer which will deplete the food availability at a critical time of year. Even cutting once a year during the autumn or winter will affect invertebrates which nest and overwinter in dead herbaceous stems and seedheads (Harvey 2000). On sites where the nutrient status of the soil allows a more continuous grassland to develop, grazing may be the best management option (Kirby 1992). With grazing, the intensity is all-important and should be tailored to the specific conditions on site. Moderate grazing should provide a good range of habitat types, with a vegetation structure including patches of bare ground, patchy short turf and areas of taller, tussocky grassland in certain areas. The timing and nature of the grazing stock, as well as the intensity of grazing is crucial to the success of this management technique (Kirby 1992).

4.3.3 Management for bare ground

In many habitats, natural plant succession is the most significant threat to the maintenance of bare ground habitats. Active management measures that limit succession such as cutting and grazing may be necessary in some cases to prevent the loss of bare ground habitats.

It is important to appreciate that even the smallest areas of bare-ground can be valuable habitats for invertebrates. Acceptance of small-scale erosion and activities such as rabbit grazing, limited poaching by livestock and minor land-slippage can create the correct microhabitats to encourage a wider diversity of invertebrates. It may be necessary to prevent the encroachment of scrub and create bare areas by more active management (Key 2000). Open nesting areas on the more established sites are often promoted by low-level grazing or occasional local disturbance (Harvey 2000). Grazing regimes for the maintenance of bare ground habitats should be carefully controlled to avoid overgrazing of vegetation, which may result in the loss of foraging and nesting opportunities.

A number of exotic plant species are particularly rapid in eliminating bare ground as they colonise a site. Canadian golden rod *Solidago canadensis* and common fiddleneck *Amsinckia micrantha* may be particularly problematic in dry, sandy situations (Key 2000). Rapid growing exotic plant species such as Japanese knotweed *Fallopia japonica* and Russian vine *Polygonum baldschuanicum* can form dense stands which shade out other plant species and cover areas of bare ground. The woody, dead stems of Japanese knotweed persist throughout the winter and new shoots grow up amongst these the following spring to form dense thickets. Furthermore, the dead stems and leaf litter decompose very slowly and form a deep organic layer which prevents native seeds from germinating. Once present at a site, Japanese knotweed increases in area very rapidly and soon forms monoculture stands. Prevention and control of these exotic species may be necessary to maintain suitable habitats for invertebrates.

4.4 Monitoring

With the lack of long-term data on the invertebrate fauna of brownfield sites it is essential that monitoring of sites is integrated into the management plans for brownfield sites. Most importantly, it is important that a range of sites are studied, including those that have no development, those that have been developed and experienced much habitat loss as well as those sites that have undergone ‘restoration’ or habitat enhancements either specifically for invertebrates or for other species (Box 1999).

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Appendix 1 - Exotic plant species considered within this report

Neophytes		
Generic	**Specific**	**Common**
Acer	*pseudoplatanus*	Sycamore
Acer	*platanoides*	Norway Maple
Aconitum	*napellus*	Monkshood
Aesculus	*hippocastanum*	Horse chestnut
Ailanthus	*altissima*	Tree of Heaven
Alcea	*rosea*	Hollyhock
Alchemilla	*mollis*	Lady's mantle
Amaranthus	*retroflexus*	Common amaranth
Amaranthus	*hybridus*	Green amaranth
Amelanchier	*spp.*	Juneberrys
Anchusa	*arvensis*	Bugloss
Antirrhinum	*majus*	Snapdragon
Artemisia	*verlotiorum*	Chinense mugwort
Aster (N. American)	*spp.*	Michaelmas daisies
Aubretia	*deltoidea*	Aubretia
Avena	*sterilis*	Winter wildoat
Barbarea	*intermedia*	Medium-flowered wintercress
Barbarea	*verna*	American wintercress
Berberis	*darwinii*	Darwins Barberry
Berberis	*thunbergii*	Thunbergs Barberry
Borago	*officinalis*	Borage
Brassica	*napus*	Rape
Buddleja	*davidii*	Buddleja
Bunias	*orientalis*	Warty cabbage
Calystegia	*pulchra*	hairy bindweed
Calystegia	*silvatica*	large bindweed
Campanula	*persicifolia*	Peach-leaved bellflower
Centranthus	*ruber*	Red valerian
Cerastium	*tomentosum*	sweet william
Chamaecyparis	*lawsoniana*	Lawsons Cypress
Claytonia	*sirbirica*	Pink purslane
Cochlearia	*danica*	Danish scurvey grass
Colutea	*arborescens*	Baldder senna
Consolida	*ajacis*	larkspur
Conyza	*canadensis*	Canadian fleabane
Conyza	*sumatrensis*	Guernsey Fleabane
Coronopus	*didymus*	lesser swine cress
Cotoneaster	*spp.*	Cotoneasters

Neophytes		
Generic	**Specific**	**Common**
Crepis	*vesicaria*	Beaked hawk's beard
Crocosmia	*x crocosmiiflora*	Monbretia
Cupressus	*macrocarpa*	Monterey cypress
Cymbalaria	*muralis*	lvy-leaved toadflax
Datura	*stramonium*	Thorn apple
Diplotaxis	*muralis*	annual wall rocket
Echinochloa	*crus-galii*	Cockspur
Epilobium	*ciliatum*	American willowherb
Euphorbia	*x pseudovirgata*	Twiggy spurge
Euphorbia	*cyparissias*	Cypress spurge
Fagopyrum	*esculentum*	Buckwheat
Fallopia	*baldscuanica*	Russina vine
Fallopia	*japonica*	Japanese knotweed
Fallopia	*sachalinensis*	Giant knotweed
Galanthus	*nivalis*	Snowdrop
Galega	*officinalis*	Goat's-rue
Galinsoga	*qudriradiata*	Shaggy soldier
Galinsoga	*parviflora*	Gallant soldier
Geranium	*pyrenaicum*	Hedgerow cranes bill
Geranium	*phaeum*	Dusky cranes bill
Helianthus	*annuus*	Sunflower
Heracleum	*mantegazzianum*	Giant hogweed
Hesperis	*matronalis*	Dames violet
Hirschfeldia	*incana*	hoary mustard
Hyoscyamus	*niger*	Henbane
Hypericum	*calycinum*	Rose of sharon
Impatiens	*spp.*	Balsams
Juglans	*regia*	Walnut
Laburnum	*anagyroides*	Laburnum
Lamium	*maculatum*	Spotted dead nettle
Lathyrus	*latifolius*	Broadleaved everlasting pea
Lepidium	*draba*	Hoary cress
Leucanthemum	*x superbum*	Shasta daisy
Ligustrum	*ovalifolium*	Garden privet
Linaria	*purpurea*	Purple toadflax
Linum	*usitatissimum*	Flax
Lobelia	*erinus*	Garden lobelia
Lobularia	*maritima*	Sweet Alison
Lolium	*multiflorum*	Italian rye-grass
Lunaria	*annua*	Honesty
Lupinus	*arboreus*	Tree lupin

Neophytes		
Generic	**Specific**	**Common**
Lupinus	*polyphyllus*	Garden Lupin
Lupinus	*x regalis*	Russell Lupin
Lychnis	*coronaria*	Rose campion
Lycium agg.		Tea plants
Lycopersicon	*esculentum*	Tomato
Lysimachia	*punctata*	Dotted loosestrife
Mahonia	*aquifolium*	Oregon Grape
Matricaria	*discoidea*	Pineapple weed
Medicago	*sativa subsp sativa*	Lucerne
Melilotus	*albus*	White melilot
Melilotus	*altissimus*	Tall melilot
Melilotus	*officinalis*	Ribbed melilot
Melilotus	*indicus*	Small melilot
Melissa	*officinalis*	Balm
Mentha	*spp.*	Mints
Oenothera	*spp.*	Evening primroses
Oxalis	*spp.*	Yellow sorrels
Oxalis	*spp.*	Pink sorrels
Panicum	*milliaceum*	Common millet
Papaver	*somniferum*	Opium poppy
Pentaglottis	*sempervirens*	Green alkanet
Persicaria	*wallichii*	Himalayan knotweed
Petasites	*fragrans*	Winter heliotrope
Phalaris	*canariensis*	Canary grass
Philadelphus	*coronarius*	Mock orange
Pilosella	*aurantiaca*	Fox and cubs
Platanus	*x hispanica*	London Plane
Populus	*nigra italica*	Lombardy poplar
Populus	*spp*	Hybrid black poplars
Potentilla	*recta*	Sulphur cinquefoil
Prunus	*lusitanica*	Portugal laurel
Prunus	*laurocerasus*	Cherry laurel
Pseudofumaria	*lutea*	Yellow corydalis
Pulmonaria	*officinalis*	Lungwort
Quercus	*cerris*	Turkey oak
Quercus	*ilex*	Holm oak
Rapistrum	*rugosum*	Bastard cabbage
Ribes	*sanguineum*	Flowering currant
Robinia	*pseudoacaia*	False acacia
Rosa	*rugosa*	Japanese rose
Rumex	*cristatus*	Greek dock

Neophytes		
Generic	**Specific**	**Common**
Sedum	*rupestre*	Reflexed stonecrop
Senecio	*inaequidens*	Narrow-leaved ragwort
Senecio	*squalidus*	Oxford ragwort
Senecio	*viscosus*	Sticky groundsel
Sisymbrium	*loeselii*	False london rocket
Sisymbrium	*orientale*	Eastern rocket
Sisymbrium	*altissimum*	Tall rocket
Solanum	*physalifolium*	Green nightshade
Soleirolia	*soleirolii*	Mind your own business
Solidago	*gigantea*	Early goldenrod
Solidago	*canadensis*	Canadain goldenrod
Sorbus	*intermedia*	Swedish whitebeam
Spartium	*junceum*	Spanish broom
Spirea	*spp.*	Brideworts
Symphytum	*x uplandicum*	Russian comfrey
Symphytum	*orientale*	White comfrey
Syringa	*vulgaris*	Lilac
Trifolium	*hybridum*	Alsike clover
Verbascum	*spp.*	Mulleins
Vinca	*major*	Greater periwinkle
Vinca	*minor*	Lesser periwinkle
x Cupressocyparis	*leylandii*	Leyland Cypress

Archaeophytes		
Generic	**Specific**	**Common**
Aegopodium	*podagraria*	Ground elder
Alopecurus	*myosuroides*	Black grass
Anisantha	*sterilis*	Sterile brome
Arctium	*lappa*	Burdock
Armoracia	*rusticana*	Wild horseradish
Artemisia	*vulgaris*	Mugwort
Artemisia	*absinthium*	Wormwood
Avena	*fatua*	Wild oat
Ballota	*nigra*	Black horehound
Brassica	*rapa*	Wild turnip
Capsella	*bursa pastoris*	Shepherds purse
Chenopodium	*spp.*	Goosefoots
Chichorium	*intybus*	Chicory
Conium	*maculatum*	Hemlock

Archaeophytes		
Generic	**Specific**	**Common**
Coronopus	*squamatus*	Swine cress
Descurainia	*sophia*	Flixweed
Diplotaxis	*tenuifolia*	Perennial wall rocket
Erodium	*moschatum*	Musk storks bill
Foeniculum	*vulgare*	Fennel
Geranium	*dissectum*	Cut-leaved cranesbill
Hordeum	*murinum*	Wall Barley
Lactuca	*serriola*	Prickly lettuce
Lamium	*purpureum*	Purple dead nettle
Lamium	*album*	White dead nettle
Lepidium	*campestre*	Field pepperwort
Lepidium	*ruderale*	Narrow-leaved pepperwort
Malva	*sylvestris*	Common mallow
Onopordum	*acanthium*	Cotton thistle
Picris	*echioides*	Bristly ox-tongue
Raphanus	*raphaniastrum*	Wild radish
Reseda	*luteola*	Weld
Sambucus	*ebulus*	Dwarf elder
Saponaria	*officinalis*	Soapwort
Sedum	*album*	White stonecrop
Sinapsis	*arvensis*	Charlock
Sinapsis	*alba*	White Mustard
Sisymbrium	*officinale*	Hedge Mustard
Stachys	*arvensis*	Field woundwort
Symrnium	*oluastrum*	Alexanders
Tanacetum	*parthenium*	Feverfew
Thlaspi	*arvense*	Field penny-cress
Tripleurospermum	*inodorum*	Scentless mayweed
Veronica	*agrestis*	Green field speedwell
Vulpia	*myuros*	Rat's-tail fescue

Appendix 2 - Invertebrates of conservation importance frequently associated with brownfield land

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
1	*Adonia (Hippodamia) variegata*	Adonis' ladybird	Coleoptera	Nb	clay, gravel and sand pits, railway land, chalk and limestone quarries, colliery spoil and post-industrial land			+	+			+	open grassland and scrub with bare ground and sparsely vegetated mosaics
2	*Agnocoris reclairei*	a bug	Hemiptera	Nb	clay, gravel and sand pits, railway land and post-industrial land	*Salix alba*						+	
3	*Amara equestris*	a ground beetle	Coleoptera	Nb	colliery spoil			+					
4	*Amara praetermissa*	a ground beetle	Coleoptera	Nb	colliery spoil, gravel/sand pits			+					
5	*Anacaena bipustulata*	a water beetle	Coleoptera	LRnsB	clay, sand and gravel pits						+		aquatic habitats
6	*Andrena bucephala*	a mining bee	Hymenoptera	Na	dry grasslands								
7	*Andrena florea*	a mining bee	Hymenoptera	RDB3	dry sandy grasslands with scrub		*Bryonia dioica*	+	+			+	open grassland and scrub with bare ground and sparsely vegetated mosaics for nesting
8	*Andrena fulvago*	a mining bee	Hymenoptera	Na	dry grasslands		yellow Asteraceae, especially *Crepis* spp.	+	+			+	open grassland and scrub with bare ground and sparsely vegetated mosaics for nesting

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
9	*Andrena humilis*	a mining bee	Hymenoptera	Nb	dry grasslands		yellow Asteraceae, especially *Crepis* spp.	+	+			+	open grassland and scrub with bare ground and sparsely vegetated mosaics for nesting
10	*Andrena nigrospina*	a mining bee	Hymenoptera	pRDB2	dry sandy grasslands with scrub		Crucifers incl. *Cardaria draba, Sisymbrium, Rubus fruticosus*	+	+				open grassland with bare ground and sparsely vegetated mosaics for nesting
11	*Andrena nitidiuscula*	a mining bee	Hymenoptera	RDB3	dry grasslands								
12	*Andrena proxima*	a mining bee	Hymenoptera	RDB3	dry grasslands			+	+				open grassland with bare ground and sparsely vegetated mosaics for nesting
13	*Andrena tibilais*	a mining bee	Hymenoptera	Na	quarries and post-industrial land		*Salix* spp.	+	+			+	*Salix spp.*scrub
14	*Anisodactylus poeciloides*	a ground beetle	Coleoptera	RDB3, UKBAP	brackish grasslands			+	+		+ (brackish, adjacent to grasslands)		e.g on pulverised fuel ash (PFA) lagoons
15	*Aphaniosoma socium*	a fly	Diptera	RDB1	post-industrial		*Calystegia* spp.	+					
16	*Asiraca clavicornis*	a planthopper	Hemiptera	Nb	clay pits, chalk/limestone quarries, railway land			+	+			+	open grassland and scrub with bare ground and sparsely vegetated mosaics
17	*Baris picicornis*	a weevil	Coleoptera	Nb	clay pits, railway land, colliery spoil and post-industrial land	*Linaria vulgaris*		+					

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
18	*Bathysolen nubilus*	a bug	Hemiptera	Nb	clay, sand, gravel pits, railway land and colliery spoil	Black medick *Medicago lupulina*		+					
19	*Bembecia ichneumoniformis*	six-belted clearwing	Lepidoptera	Nb	clay, sand and gravel pits, chalk and limestone, railway land, spoil heaps and post-industrial land		*Lotus corniculatus* & *Lotus glaber*	+					
20	*Bembidion argenteolum*	a ground beetle	Coleoptera	RDBK, UKBAP	sandy beaches on the margins of large waterbodies			+	+		+		sand pits with damp, fine sand at the margins of waterbodies
21	*Bembidion fumigatum*	a ground beetle	Coleoptera	Nb	clay pits, railway land			+			+		wet ground, tall grassland and herbs
22	*Bembidion quadripustulatum*	a ground beetle	Coleoptera	Na	clay, sand and gravel pits, chalk/limestone quarries, colliery spoil			+			+		wet ground
23	*Bembidion saxatile*	ground beetle	Coleoptera	Nb	open damp gravel			+	+				
24	*Berosus affinis*	a water beetle	Coleoptera	LRnsB	clay, sand and gravel pits, chalk and limestone quarries						+		aquatic habitats
25	*Berosus signaticollis*	a water beetle	Coleoptera	LRnsB	clay, sand and gravel pits, chalk and limestone quarries						+		aquatic habitats

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
26	*Bianor aurocinctus*	a jumping spider	Araneae	Na	dry grasslands			+	+				open grassland with bare ground, sparsely vegetated mosaics and stones
27	*Blaesoxipha plumicornis*	a flesh fly	Diptera	N	heaths and commons			+	+				post-industrial land
28	*Bombus humilis queens*	brown-banded carder bee	Hymenoptera	UKBAP	tall herbaceous flower-rich grasslands		*Odontites verna, Lotus glaber, Lotus corniculatus, Trifolium pratense, Trifolium repens, Medicago sativa, Ballota nigra, Cirsium vulgare, Centaurea nigra, Echium vulgare, Melilotus sp., Lamium album,* Runner Bean		+		+ (*Lotus glaber*)		tall open flower-rich herbaceous
29	*Bombus humilis workers*	brown-banded carder bee	Hymenoptera	UKBAP	tall herbaceous flower-rich grasslands		*Lotus corniculatus, Trifolium pratense, Vicia villosa, Colutea arborescens, Lathyrus latifolius, Ballota nigra, Ulex europeaus*		+		+ (*Lotus glaber*)		tall open flower-rich herbaceous
30	*Bombus ruderatus*	large garden bumblebee	Hymenoptera	UKBAP, Nb	tall herbaceous flower-rich grasslands				+				tall open flower-rich herbaceous

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
31	*Bombus rupestris*	a cuckoo bee	Hymenoptera	Nb	tall herbaceous flower-rich grasslands			+	+				tall open flower-rich herbaceous
32	*Bombus sylvarum queens*	shrill carder bee	Hymenoptera	UKBAP	tall herbaceous flower-rich grasslands		*Trifolium pratense, Vicia villosa, Vicia sativa, Colutea arborescens, Lathyrus latifolius, Lamium album, Ballota nigra.* Other species for nectar only.		+		+ (*Lotus glaber*)		tall open flower-rich herbaceous
33	*Bombus sylvarum workers*	shrill carder bee	Hymenoptera	UKBAP	tall herbaceous flower-rich grasslands		*Odontites verna, Lotus glaber, Lotus corniculatus, Trifolium pratense, Trifolium repens, Ballota nigra, Cirsium vulgare, Centaurea nigra, Echium vulgare, Lamium album, Rhinathus minor, Clinopodium vulgare, Clinopodium calamintha*		+		+ (*Lotus glaber*)		tall open flower-rich herbaceous
34	*Bombylius discolor*	a bee fly	Diptera	N, UKBAP	calcareous quarries		Spring blossoms for mining bee hosts	+	+				

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
35	*Bromius obscrurus*	a leaf beetle	Coleoptera	RDB1		rosebay willowherb							disused railway lines
36	*Calamotropha paludella*	a moth	Lepidoptera	Nb	reedbeds	larvae mine leaves of bulrush *Typha* spp.					+	+	coarse grassland, sallow scrub, rough herbage, swampy grassland and pools
37	*Calophasia lunula*	the toadflax brocade moth	Lepidoptera	UKBAP, RDB3	road verges, wasteground, dunes and shingle	yellow toadflax *Linaria vulgaris*, *Linaria* spp. & small toadflax *Chaenorhinum minus*.		+	+				disturbed areas of ground where the sandy, gavely substrate is exposed and the host plant grows
38	*Calosirus terminatus*	a beetle	Coleoptera	Nb	clay pits, railway land, post-industrial land	wild carrot *Daucus carrota*		+					
39	*Campiglossa malaris*	a picture winged fly	Diptera	RDB3	dry grasslands	hostplants include *Senecio squalidus*		+	+				sandy or other friable substrates such as PFA with bare nesting habitat and flower-rich herbaceous grasslands
40	*Catapion pubescens*	a seed weevil	Coleoptera	Nb	clay pits, sand and gravel pits, railway land	Black medick *Medicago lupulina*		+					
41	*Catharosia pygmaea*	a parasitic fly	Diptera	handful of British records. Not yet an official status, probably RDB	dry grasslands	parasite on certain bugs	*Daucus carota*	+	+				sandy or other friable substrates such as PFA with bare nesting habitat and flower-rich herbaceous grasslands
42	*Ceratina cyanea*	blue carpenter bee	Hymenoptera	RDB3	dry sandy grasslands with scrub	nests in dead bramble stems	*Rubus fruticosus* agg., *Hieracium pilosella, Crepis, Picris* and variety of other species	+	+			+	open grassland and scrub with bare ground and drought-stressed bramble to provide dead stems for nesting

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
43	*Cerceris quadricincta*	a solitary wasp	Hymenoptera	RDB1, UKBAP	hot dry herbaceous flower-rich grasslands	hunts various weevils associated with herbaceous plants, gorse and scrub	Unknown, probably similar to *C. quinquefasciata*	+	+				tall open grassland with sparsely vegetated mosaics
44	*Cerceris quinquefasciata*	a solitary wasp	Hymenoptera	RDB3, UKBAP	hot dry herbaceous flower-rich grasslands	hunts various weevils associated with herbaceous plants and gorse	eg Yarrow, thistles, *Reseda, Daucus carota, Foeniculum vulgare, Pastinaca sativa*	+	+				tall open grassland with sparsely vegetated mosaics
45	*Cercyon sternalis*	a beetle	Coleoptera	LRnsB	clay, sand and gravel pits, chalk and limestone quarries, railway land						+		aquatic habitats, wet ground, tall grassland with herbs
46	*Cercyon tristis*	a beetle	Coleoptera	LRnsB	clay, sand and gravel pits, chalk and limestone quarries, railway land, post-industrial land						+		aquatic habitats, wet ground, tall grassland with herbs
47	*Ceutorhynchus angulosus*	a weevil	Coleoptera	Na	peat workings	*Galeopsis tetrahit*		+					peat workings on the Somerset Levels
48	*Ceutorhynchus pulvinatus*	a weevil	Coleoptera	Na	disturbed ground on sany soil	*Sisymbrium sophia*		+	+				areas of disturbed ground in the Breckland

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49	*Ceutorhynchus resedae*	a weevil	Coleoptera	Nb	clay, sand and gravel pits, chalk and limestone quarries and post-industrial land	*Reseda luteola*		+					tall grassland and herbs
50	*Chaetarthria seminulum*	a water beetle	Coleoptera	LRnsB	clay, sand and gravel pits, chalk and limestone quarries			+			+		aquatic habitats, wet ground
51	*Chamaepsila luteola*	a fly	Diptera	RDB3									
52	*Cheilosia velutina*	a hoverfly	Diptera	N	dry grasslands	prossibly a ruderal species	*Daucus carota* and other white umbellifers	+	+				sandy or other friable substrates such as PFA with bare nesting habitat and flower-rich herbaceous grasslands
53	*Chlorops laetus*	a fly	Diptera	N	post-industrial								dry grassland
54	*Chorisops nagatomii*	a soldier fly	Diptera	N	ponds			+			+		Grassland with bare soil. Abandonded quarries which have been left to develop flower rich calcareous grassland
55	*Chrysotus suavis*	a fly	Diptera	N	clay, sand and gravel pits			+			+		wet ground and bare ground
56	*Cistogaster globosa*	a parasitic fly	Diptera	RDB3	dry grasslands	parasite on shieldbug *Aelia acuminata*	*Daucus carota*	+	+				sandy or other friable substrates with sparsely vegetated and tall herbaceous mosaic

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
57	*Clubiona juvenis*	a spider	Araneae	RDB2	wet *Phragmites* reedbeds				+		+		wet Phragmites beds developed on river silt dregings (silt lagoons) and on peat in old sand extraction sites
58	*Clytiomya continua*	a parasitic fly	Diptera	handful of British records. Not yet an official status, probably RDB	dry grasslands	parasite on shieldbug *Eurydema oleracea*, which feeds on crucifers including Horse radish	*Daucus carota, Heracleum spondylium*	+	+				sandy or other friable substrates with sparsely vegetated and tall herbaceous mosaic
59	*Coenosia atra*	a fly	Diptera	N	post-industrial sites and quarries			+	+				
60	*Colletes halophilus*	a mining bee	Hymenoptera	Na Internationally important	upper saltmarsh		Sea Aster and also other Asteraceae	+	+		+		Uses sand, silt and PFA for nesting where adjacent to saltmarsh
61	*Colletes marginatus*	a mining bee	Hymenoptera	Nb. A rare species in Europe.	dune			+	+				habitat mosaic developed on river silt dregings (silt lagoons)
62	*Colobaea punctata*	a snail-killing fly	Diptera	N	clay, sand and gravel pits, chalk and limestone quarries			+			+		aquatic habitats, wet ground, tall, herb-rich grassland
63	*Conocephalus discolor*	long-winged conehead	Orthoptera	Na	clay, sand and gravel pits, chalk and limestone quarries			+	+				tall open grassland with sparsely vegetated mosaics
64	*Cryptocephalus aureolus*	green pot beetle	Coleoptera	Nb	hot dry herbaceous flower-rich grasslands			+	+			+	coarse and flower rich calcareous grassland, scrub, bare soil and sparsely vegetated areas,

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65	*Cucullia absinthii*	the wormwood moth	Lepidoptera	Nb	quarries, wasteground, road verges	*Artemisia absinthium, Artemisia vulgaris*		+	+				habitat mosaic including bare ground where the host plants grow
66	*Cucullia lychnitis*	the striped lychnis moth	Lepidoptera	UKBAP, N	limestone quarries	black mullein *Verbascum nigrum, Verbascum spp.*		+	+				open, sunny sites, often on soft limestone, where the larval foodplants grow
67	*Dasypoda hirtipes (altercator*	a mining bee	Hymenoptera	Nb	dry grasslands		Yellow Asteracae incl. *Picris*	+	+				sandy or other friable substrates such as PFA with bare nesting habitat and flower-rich herbaceous grasslands
68	*Demetrias imperialis*	a beetle	Coleoptera	Nb	clay, gravel and sand pits, post-industrial land						+		wet ground, tall grassland and herbs
69	*Diplapion stolidum*	a beetle	Coleoptera	Nb	clay pits, chalk/limestone pits, railway land	*Leucanthemum vulgare*		+					
70	*Ditaeniella grisescens*	a fly	Diptera	N	clay, sand and gravel pits, chalk and limestone quarries			+			+		aquatic habitats, wet ground, tall, herb-rich grassland
71	*Dyschirius obscurus*	a ground beetle	Coleoptera	RDB2	bare , damp sand in sand pits	lives in burrows of rove beetles of the genus *Bledius*		+	+		+		damp sand in sand pits
72	*Dolichopus signifer*	a fly	Diptera	RDB2					+		+		recorded from post-industrial land and grassland/Phragmites developed on river silt
73	*Dorycera graminum*	a picture winged fly	Diptera	RDB3, UKBAP	post-industrial, quarries with grasslands, rank to flower-rich	unknown	*Cardaria draba, Barbarea* spp., *Heracleum sphondylium*		+				tall open grasslands

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
74	*Eggisops pecchiolii*	a fly	Diptera	N	calcareous post-industrial sites, cement quarries, disused railway lines			+	+				larvae are parasitoids of terrestrial snails
75	*Enochrus melanocephalus*	a water beetle	Coleoptera	LRnsB	sand, clay and gravel pits						+		aquatic habitats
76	*Epistrophe diaphana*	a hoverfly	Diptera	N				+	+				coarse and flower rich grassland, tall herbage, scrub and developing woodland
77	*Eubrychius velutus*	a water weevil	Coleoptera	Nb	clay, sand and gravel pits	*Myriophyllum spicatum* & *M. verticillatum*					+		permanent wetlands with aquatic host plants
78	*Euscelidius variegatus*	A bug	Hemiptera	Nb	clay, sand and gravel pits, chalk and limestone quarries			+					
79	*Forficula lesnei*	Lesne's earwig	Dermaptera	Nb				+	+			+	rough grassland, herbage, very flower rich, scrub/thicket bare soil and sparsely vegetated areas
80	*Fiebrigella palposa*	a fly	Diptera	N	post-industrial and quarries	predator of grasshopper eggs		+	+				
81	*Graptodytes granularis*	a diving beetle	Coleoptera	LRnsB	clay pits and railway lines						+		aquatic habitats
82	*Gronops lunatus*	a beetle	Coleoptera	Nb	sand and gravel pits, chalk/limestone quarries, spoil heaps railway land & post-industrial land	*Arenaria serpyllifolia*, *Sagina* sp.		+					

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83	*Gymnetron veronicae*	a weevil	Coleoptera	Nb	clay, sand and gravel pits	*Veronica anagallis-aquatica, V. catenata*		+			+		wet ground
84	*Gymnetron villosulum*	a weevil	Coleoptera	Nb	sand and gravel pits, chalk/limestone quarries	*Veronica anagallis-aquatica, V. catenata*		+			+		wet ground
85	*Gymnosoma nitens*	a parasitic fly	Diptera	RDB1	chalk & limestone quarries, spoil heaps	host shieldbug the nationally scarce *Sciocorus cursitans*	umbellifers eg *Daucus carota, Heracleum sphondylium*	+	+				open grassland with sparsely vegetated mosaics
86	*Gyrinus paykulli*	a beetle	Coleoptera	LRnsA	clay, sand and gravel pits, railway land						+		aquatic habitats
87	*Haematopota bigoti*	big-spotted cleg	Diptera	RDB3	post-industrial sites			+	+				
88	*Haematopota grandis*	long-horned cleg	Diptera	RDB3	post-industrial sites			+	+				
89	*Haliplus varius*	a water beetle	Coleoptera	RDBK	flooded pits						+		flooded extraction pits
90	*Harpalus froelichi*	a ground beetle	Coleoptera	RDB2, UKBAP	disturbed sandy ground			+	+				sandy soils on dry bare ground with partial vegetation cover
91	*Harpalus obscurus*	a ground beetle	Coleoptera	RDB1					+				quarries
92	*Hedychrum niemelai*	a cuckoo wasp	Hymenoptera	RDB3	hot dry herbaceous flower-rich grasslands	cleptoparasite of *Cerceris* spp.	eg Yarrow, thistles, *Daucus carota, Foeniculum vulgare, Pastinaca sativa*	+	+				tall open grassland with sparsely vegetated mosaics

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
93	*Helina concolor*	a fly	Diptera	RDB3	limestone quarries							+	Patches of scrub & woodland
94	*Heriades truncorum*	a solitary bee	Hymenoptera	RDBK	dry sandy grasslands with scrub	nests in pre-existing cavities in dead wood and hollow stems such as *Rubus*	*Senecio jacobaea.* Falk also lists thistles, *Taraxacum, Pulicaria dysenterica, Sonchus arvensis,* cultivated *Helenium and Gypsophila* and abroad a large number of composites	+	+			+	open grassland and scrub with bare ground and drought-stressed bramble to provide dead stems for nesting
95	*Hercostomus chalybeus*	a fly	Diptera	N	clay pits						+		wet ground and tall, herb-rich grassland
96	*Homoneura interstincta*	a fly	Diptera	RDB3	sallow scrub					+			decaying vegetable matter
97	*Homoneura patelliformis*	a fly	Diptera	N	post-industrial sites, disused railway lines, old tips					+		+	*Salix* scrub, decaying vegetable matter
98	*Homoneura thalhammeri*	a fly	Diptera	Nb	sallow scrub					+		+	*Salix* scrub, decaying vegetable matter
99	*Hydraena testacea*	a water beetle	Coleoptera	LRnsB	clay, sand and gravel pits, railway land						+		aquatic habitats
100	*Hydrochus carinatus*	a water beetle	Coleoptera	RDB2	clay, sand and gravel pits, chalk and limestone quarries						+		aquatic habitats

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
101	*Hydroglyphus geminus*	diving beetle	Coleoptera	LRnsB	clay, sand and gravel pits, chalk and limestone quarries and railway land with standing water						+		aquatic habitats
102	*Hydroglyphus pusillus*	diving beetle	Coleoptera	Nb	silt ponds and clay puddles						+		
103	*Hyleaus cornutus*	a solitary bee	Hymenoptera	Na	clay pits, chalk and limestone quarries, railway land		White umbellifers, especially *Daucus carota*	+	+				open grassland with continuity of dead herbaceous stems, bare ground and sparsely vegetated mosaics
104	*Hyleaus signatus*	a solitary bee	Hymenoptera	Nb	chalk and limestone quarries, railway land, colliery spoil and post-industrial land		*Reseda lutea, Reseda luteola*	+	+				open grassland with continuity of dead herbaceous stems, bare ground and sparsely vegetated mosaics
105	*Hylobius transversovittatus*	a weevil	Coleoptera	RDB1	peat workings	purple loosestrife *Lythrum salicaria*		+					peat working on the Somerset Levels
106	*Ilybius fenestratus*	a water beetle	Coleoptera	LRnsB	clay, sand and gravel pits						+		aquatic habitats
107	*Laccobius sinuatus*	a water beetle	Coleoptera	LRnsB	clay, sand and gravel pits, chalk and limestone quarries			+			+		aquatic habitats
108	*Lasiambia brevibucca*	a fly	Diptera	N	post-industrial sites			+	+				

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
109	*Lasioglossum pauperatum*	a mining bee	Hymenoptera	RDB3	dry sandy grasslands		probably various yellow Asteraceae	+	+				open grassland with bare ground and sparsely vegetated mosaics for nesting
110	*Lasioglossum pauxillum*	a bee	Hymenoptera	Na	dry places with disturbed,open ground			+	+				
111	*Lasioglossum xanthopum*	a solitary bee	Hymenoptera	Nb	limestone quarries		*Senecio spp., Anthyllis vulneraria*	+	+				
112	*Lestes dryas*	scarce emerald damselfly	Odonata	RDB2	quarries, post-industrial sites with ponds and ditches						+		permanent and seasonal waterbodies with dense vegetation.
113	*Limnebius papposus*	a water beetle	Coleoptera	LRnsB	clay, sand and gravel pits, chalk and limestone quarries, railway land						+		aquatic habitats
114	*Lithophasia hyalipennis*	a fly	Diptera	extinct	quarries			+					probably a parasite on Heteroptera
115	*Longitarsus dorsalis*	a leaf beetle	Coleoptera	Nb	clay, sand and gravel pits, chalk/limestone quarries, railway land, colliery spoil and post-industrial sites	Oxford ragwort *Senecio squaldius*		+					
116	*Longitarsus ochroleucus*	a leaf beetle	Coleoptera	Nb	disturbed grassland	Oxford ragwort *Senecio squaldius*		+	+				flower-rich disturbed grassland eg chalk quarries
117	*Mantura rustica*	leaf beetle	Coleoptera	Nb	dry sandy places	*Rumex acetosa, R. acetosella, R. obtusifolius*		+	+				

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
118	*Megachile leachella (dorsalis)*	a mining bee	Hymenoptera	Nb	dune			+	+				habitat mosaic developed on river silt dregings (silt lagoons)
119	*Megalonotus sabulicola*	a bug	Hemiptera	Nb	clay, sand and gravel pits, railway land, post-industrial sites			+					
120	*Merzomyia westermanni*	a picture winged fly	Diptera	N	tall herbaceous flower-rich grasslands	develops in *Senecio*	*Senecio jacobaea, S. erucifolius*	+	+				
121	*Metrioptera brachyptera*	the bog bush cricket	Orthoptera	Nb	clay, sand and gravel pits, chalk and limestone quarries, railway land								dry sites with long grass
122	*Metrioptera roeselii*	Roesel's cricket	Orthoptera	Nb	dry sites with long grass								long grass
123	*Micromorphus albipes*	a fly	Diptera	N	clay pits			+			+		wet ground
124	*Micropeza lateralis*	a fly	Diptera	N	sand and gravel pits, chalk and limestone quarries, railway land	*Cytisus scoparius, Ulex europaeus*						+	
125	*Microplontus campestris*	a beetle	Coleoptera	Nb	clay pits, colliery spoil and railway land	*Leucanthemum vulgare*		+					
126	*Miltogramma germari*	a flesh fly	Diptera	RDB3	dry grasslands, dunes, sandy heaths and chalk downland	larvae are believed to feed on the food stores of mining bees		+	+				

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
127	*Mordellistena spp.*	tumbling flower beetles	Coleoptera	mostly RDBK	dry tall herbaceous flower-rich grasslands	stem nesters eg in wormwoods, thistles	*Daucus carota, Heracleum sphonylium, Sisymbrium*	+	+				open grassland with continuity of dead herbaceous stems, bare ground and sparsely vegetated mosaics
128	*Myopites inulaedyssenter icae*	a picture winged fly	Diptera	RDB3	flower-rich grasslands	larvae induce a gall in the capitulum of Fleabane *Pulicaria dysenterica*		+	+		+		grasslands with damper areas
129	*Nomada ferruginata*	a cuckoo bee	Hymenoptera	RDB1 & UKBAP	limestone quarries	*Andrena praecox* is the host species.		+	+				bare ground with friable substrate for mining bee hosts, flower-rich grasslands
130	*Nomada fucata*	a cuckoo bee	Hymenoptera	Na	clay, sand and gravel pits, chalk and limestone quarries, colliery spoils with flower-rich grasslands	*Andrena flavipes* is the host species		+	+				bare ground with friable substrate for mining bee hosts, flower-rich grasslands
131	*Nomada lathburiana*	a cuckoo bee	Hymenoptera	RDB3	flower-rich grasslands	*Andrena cineraria* is the host species		+	+				bare ground with friable substrate for mining bee hosts, flower-rich grasslands
132	*Notaris scirpi*	a weevil	Coleoptera	Nb	clay, sand and gravel pits, post-industrial land						+		tall grass and herbs
133	*Notiophilus quadripunctatus*	ground beetle	Coleoptera	Nb	open sand and gravel			+	+				
134	*Nysson dimidiatus*	a digger wasp	Hymenoptera	Nb	sand and gravel pits, railway land, colliery spoil and post-industrial land			+	+				

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
135	*Olibrus pygmaeus*	a beetle	Coleoptera	Nb	gravel and sand pits, railway land, colliery spoil	*Filago vulgaris, F. minima*		+					
136	*Omophron limbatum*	a ground beetle	Coleoptera	RDB1	sand and gravel pits			+	+		+		bare ground with wet sand in sand and gravel pits
137	*Omphalapion beuthini (Apion dispar)*	a weevil	Coleoptera	RDB3	chalky soils	*Matricaria* & *Tripleurospermum*		+					on chalky soils in East Kent
138	*Ophonus ardosiacus*	a ground beetle	Coleoptera	Nb	clay, gravel and sand pits, chalk/limestone			+					
139	*Ophonus azureus*	a ground beetle	Coleoptera	Nb	clay pits, chalk/limestone and post-industrial land			+					
140	*Ophonus rupicola*	a ground beetle	Coleoptera	Nb	clay pits			+					
141	*Orthochaetes setiger*	a beetle	Coleoptera	Nb	clay, sand and gravel pits, chalk and limestone quarries, railway land			+					
142	*Oscinimorpha arcuata*	a fly	Diptera	N	post-industrial and quarries			+	+				
143	*Osmia bicolor*	red-tailed mason bee	Hymenoptera	Nb	quarries and cuttings on limestone								
144	*Oulema erichsoni*	a leaf beetle	Coleoptera	RDB1	peat workings	*Glyceria fluitans*					+		peat workings on the Somerset Levels
145	*Oxyna nebulosa*	a tephritid fly	Diptera	RDB3	limestone quarries	*Leucanthemum*		+	+				

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
146	*Oxyna parietina*	a tephritid fly	Diptera	N				+	+				coarse grassland, tall herbage, bare clay soil, bramble scrub
147	*Oxycera pygmaea*	a soldier fly	Diptera	N	seepages in limetsone quarries			+	+		+	+	Calcareous seepages, esp. under *Salix* scrub
148	*Oxystoma cerdo*	tufted vetch weevil	Coleoptera	Nb	flower-rich grasslands	tufted vetch *Vicia cracca*		+	+			+	coarse and flower-rich grassland, scrub and developing woodland
149	*Paroxyna absinthii*	picture-wing fly	Diptera	Nb	usually saltmarsh but inland on disturbed and rank grassland		*Artemisia maritima* (in native saltmarsh), *A. absinthi* at inland sites	+					
150	*Passaloecus clypealis*	a solitary wasp	Hymenoptera	RDB3	dry *Phragmites* reedbeds	nests in *Lipara* galls in *Phragmites* stems			+		+		appears to need Phragmites growing in relatively dry conditions, e.g on river silt dredgings and pulverised fuel ash (PFA) lagoons
151	*Pherbellia dorsata*	a fly	Diptera	N				+			+		aquatic habitats, wet ground
152	*Pherbellia nana*	a fly	Diptera	N				+			+		aquatic habitats, wet ground
153	*Philanthus triangulum*	a bee-killing wasp	Hymenoptera	RDB2	caly, sand and gravel pits, chalk and limestone quarries, railway land, spoil heaps and flower-rich grasslands in post-industrial land			+	+			+	very flower rich grassland with developing scrub

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
154	*Phytoecia cylindrica*	a beetle	Coleoptera	Nb	flower-rich grasslands with scrub patches			+				+	open grassland and scrub with bare ground and sparsely vegetated mosaics
155	*Pipizella virens*	a hoverfly	Diptera	N	dry grasslands	possible association with aphids on the roots of umbellifers (Stubbs & Falk 2002)	*Daucus carota*	+	+				sandy or other friable substrates such as PFA with bare nesting habitat and flower-rich herbaceous grasslands
156	*Platyderus ruficollis*	a ground beetle	Coleoptera	Nb	clay, sand and gravel pits, chalk/limestone quarries and post-industrial land			+					
157	*Platynaspis luteorubra*	a ladybird	Coleoptera	Na	dry grasslands	associated with ants?		+	+			+	open grassland and scrub with bare ground and sparsely vegetated mosaics
158	*Plebejus argus*	silver-studded blue butterfly	Lepidoptera	UKBAP	calcareous quarries	gorse *Ulex* spp., heather *Calluna* spp., common rockrose *Helianthemum nummularium*, bird's-foot-trefoil *Lotus corniculatus*		+	+			+	open grassland and scrub with bare ground and sparsely vegetated mosaics
159	*Podagrica fuscicornis*	a beetle	Coleoptera	Nb	clay, sand and gravel pits, chalk/limestone quarries, railway land	common mallow *Malva sylvestris*		+					tall, flower-rich grassland

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
160	*Protapion dissimile*	a seed weevil	Coleoptera	Nb	gravel/sand pits, chalk/limestone quarries, railway land	*Trifolium arvense*		+	+				
161	*Protapion filirostre*	a weevil	Coleoptera	Nb	clay pits, railway land, chalk/limestone quarries, post-industrial land	Black medick *Medicago lupulina*		+					
162	*Psylliodes hyoscyami*	henbane flea beetle	Coleoptera	RDB1		henbane *Hyoscamus niger*		+					
163	*Psylliodes sophiae*	a leaf beetle	Coleoptera	RDB3, UKBAP	disturbed sandy ground	*Sisymbrium sophia*		+	+				
164	*Rhantus suturalis*	a water beetle	Coleoptera	LRnsB	clay, sand and gravel pits, chalk and limestone quarries, railway land						+		aquatic habitats
165	*Saldula opacula*	a bug	Hemiptera	Nb	clay, sand and gravel pits			+			+		aquatic habitats, wet bare ground
166	*Scotopteryx bipunctaria*	chalk carpet moth	Lepidoptera	UKBAP	chalk pits			+	+				
167	*Sibinia primita*	a beetle	Coleoptera	Nb	clay, sand and gravel pits, chal and limestone quarries, railway land and colliery spoil	Sagina sp.		+					
168	*Siphonella oscinina*	a fly	Diptera	N	post-industrial and quarries				+				dry grassland

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
169	*Sphecodes crassus*	a cuckoo bee	Hymenoptera	Nb	flower-rich grasslands	cleptoparasite of *Lasioglossum* spp.		+	+				open grassland with bare ground and sparsely vegetated mosaics
170	*Sphecodes niger*	a cuckoo bee	Hymenoptera	RDB3	dry sandy grasslands	cleptoparasite of *Lasioglossum morio*		+	+				open grassland with bare ground and sparsely vegetated mosaics
171	*Sphecodes reticulatus*	a cuckoo bee	Hymenoptera	Na	flower-rich grasslands	cleptoparasite of mining bees		+	+				open grassland with bare ground and sparsely vegetated mosaics
172	*Squamapion cineraceum*	a weevil	Coleoptera	Na	clay pits, chalk/limestone pits	*Prunella vulgaris*		+					
173	*Stelis ornatula*	a cuckoo bee	Hymenoptera	RDB3	dry sandy grasslands with scrub	cleptoparasite of *Hoplitis*	Falk (1991) lists *Potentilla, Crepis, Lotus, Rubus, Veronica chamaedrys*	+	+			+	open grassland and scrub with bare ground and drought-stressed bramble to provide dead stems for nesting
174	*Stelis phaeoptera*	a cuckoo bee	Hymenoptera	RDB2	dry sandy grasslands with scrub	cleptoparasite of *Osmia/Hoplitis*	White umbellifers; Falk lists *Lotus, Veronica, Cirsium vulgare, Hieracium, Centaurea, Crepis*	+	+			+	open grassland and scrub with bare ground and drought-stressed bramble to provide dead stems for nesting
175	*Stenolophus teutonus*	a beetle	Coleoptera	Nb	clay, sand and gravel pits, chalk/limestone quarries			+			+		wet ground
176	*Stratiomys potamida*	a soldier fly	Diptera	N	clay, sand and gravel pits, chalk and limestone, railway land			+			+		wet ground, bare ground

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
177	*Stratiomys singularior*	a soldier fly	Diptera	N	clay, sand and gravel pits, chalk and limestone			+			+		wet ground, bare ground
179	*Stictopleurus abutilon*	a bug	Hemiptera	extinct	chalk and limestone pits								
180	*Stictopleurus punctatonervosus*	a bug	Hemiptera	extinct	clay, sand and gravel pits, chalk and limestone quarries, railway land & post-industrial land			+					tall, herb-rich grassland
181	*Sympetrum sanguineum*	the ruddy darter	Odonata	Nb	flooded clay, sand and gravel pits, chalk and limestone quarries, railway land						+		aquatic habitats such as well vegetated pools, can tolerate brackish conditions
182	*Tachys parvulus*	ground beetle	Coleoptera	Nb	bare ground			+	+				
183	*Tephritis matricariae*	picture-wing fly	Diptera	Nb	disturbed dry and damp ground (e.g on clay spoil heaps)		*Crepis*	+					
184	*Terellia longicauda*	a fly	Diptera	N				+				+	coarse and flower rich calcareous grassland with scrub
185	*Thereva fulva*	a stiletto fly	Diptera	RDB3	dry sandy grasslands with scrub			+	+			+	open grassland and scrub with loose sandy ground and sparsely vegetated mosaics for egg laying

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
186	*Thereva plebeja*	a stiletto fly	Diptera	N	dry grasslands			+	+				sandy or other friable substrates such as PFA with bare nesting habitat and flower-rich herbaceous grasslands
187	*Tiphia minuta*	a solitary wasp	Hymenoptera	Nb	clay, sand and gravel pits, post-industrial land			+				+	tall grassland and scrub
188	*Trachys scrobiculatus*	ground ivy jewel beetle	Coleoptera	Na	colliery spoil, chalk/limestone quarry	ground ivy *Glechoma hederacea*		+					
189	*Trachysiphonella scutellata*	a fly	Diptera	N	post-industrial and quarries				+				
190	*Trichosirocalus barnevillei*	a beetle	Coleoptera	Nb	clay pits, railway land	yarrow *Achillea millefolium*		+					
191	*Triglyphus primus*	a hoverfly	Diptera	N	dry grasslands	larvae appear to be specific to galls induced by an aphid on mugwort *Artemisia vulgare* (Stubbs & Falk 2002)	*Daucus carota*	+	+				sandy or other friable substrates such as PFA with bare nesting habitat and flower-rich herbaceous grasslands
192	*Tychius pusillus*	a beetle	Coleoptera	Nb	gravel and sand pits, railway land			+					
193	*Tyta luctuosa*	the four-spotted moth	Lepidoptera	UKBAP, RDB2	dry grasslands	field bindweed *Convolvulus arvensis, Calystegia* spp.		+	+				south-facing banks with well-drained soils, typically with sparse vegetation.
194	*Volucella inanis*	a fly	Diptera	N	post-industrial sites & quarries		*Buddleja davidii*					+	scrub, larvae develop within wasp nests
195	*Volucella zonaria*	a fly	Diptera	N	post-industrial sites & quarries		*Buddleja davidii*					+	scrub, larvae develop within wasp nests

No.	Species name	Common name	Taxonomic group	Conservation status	General habitat type	Larval hostplant (if applicable)	Nectar/pollen plant (if applicable)	Bare ground	Sandy/ soft substrate	Leaf litter	Ephemeral water bodies/wet ground	Scrub	Other
196	*Zodarion italicum*	a spider	Araneae	pNa	dry grasslands	feeds on ants		+	+				open grassland with bare ground, sparsely vegetated mosaics and stones

Appendix 3 - Assessment of exotic plant species for their value to invertebrates of conservation importance

Generic	Specific	Common	Neophyte /Archaeophyte	High	Medium	Low	Value	Associated invertebrate groups/species
Acer	*pseudoplatanus*	Sycamore	Neophyte			*		
Acer	*platanoides*	Norway Maple	Neophyte			*		
Aconitum	*napellus*	Monkshood	Neophyte			*		
Aegopodium	*podagraria*	Ground elder	Archaeophyte			*		
Aesculus	*hippocastanum*	Horsechestnut	Neophyte			*		
Ailanthus	*altissima*	Tree of Heaven	Neophyte			*		
Alcea	*rosea*	Hollyhock	Neophyte			*		
Alchemilla	*mollis*	Ladys mantle	Neophyte			*		
Alopecurus	*myosuroides*	Black grass	Archaeophyte			*		
Amaranthus	*retroflexus*	Common amaranth	Neophyte			*		
Amaranthus	*hybridus*	Green amaranth	Neophyte			*		
Amelanchier	*spp.*	June berrys	Neophyte			*		
Anchusa	*arvensis*	Bugloss	Neophyte			*		
Anisantha	*sterilis*	Sterile brome	Archaeophyte			*		
Antirrhinum	*majus*	Snapdragon	Neophyte		*		Nectar and pollen	Nectar and pollen forage plant for larger Hymenoptera
Arctium	*lappa*	Burdock	Archaeophyte			*		
Armoracia	*rusticana*	Wild horseradish	Archaeophyte		*			The rare parasitic fly *Clytiomya continua* is a parasite on shieldbug *Eurydema oleracea*, which feeds on crucifers including horseradish
Artemisia	*absinthium*	Wormwood	Archaeophyte	*			Vegetative parts	Larval hostplant for *Mordellistena* spp.(RDBK)

Generic	Specific	Common	Neophyte /Archaeophyte	High	Medium	Low	Value	Associated invertebrate groups/species
Artemisia	*verlotiorum*	Chinense mugwort	Neophyte			*		
Artemisia	*vulgaris*	Mugwort	Archaeophyte	*			Vegetative parts	Larval hostplant for *Mordellistena* spp.(RDBK) and *Triglyphus primus* (N) feed off aphids specific to *A. vulgaris*
Aster (N. American)	*spp.*	Michaelmas daisies	Neophyte		*		Nectar and pollen	
Aubretia	*deltoidea*	Aubretia	Neophyte			*		
Avena	*fatua*	Wild oat	Archaeophyte			*		
Avena	*sterilis*	Winter wildoat	Neophyte			*		
Ballota	*nigra*	Black horehound	Archaeophyte	*			Nectar and pollen	*Bombus humilis* (UKBAP)
Barbarea	*intermedia*	Medium-flowered wintercress	Neophyte	*			Nectar and pollen	*Dorycera graminum* (RDB3, UKBAP)
Barbarea	*verna*	American wintercress	Neophyte	*			Nectar and pollen	
Berberis	*darwinii*	Darwins Barberry	Neophyte			*		
Berberis	*thunbergii*	Thunbergs Barberry	Neophyte			*		
Borago	*officinalis*	Borage	Neophyte		*		Nectar and pollen	Flowers are foraged on by various species of Hymenoptera
Brassica	*napus*	Rape	Neophyte	*			Nectar and pollen	Mining bees eg. *Andrena nigrospina* (RDB2)
Brassica	*rapa*	Wild turnip	Archaeophyte			*		
Buddleja	*davidii*	Buddleja	Neophyte	*			Nectar and pollen	Various species of Hymenoptera, Lepidoptera, Diptera (incl. *Volucella zonaria* (N) & *Volucella inanis* (N))
Bunias	*orientalis*	Warty cabbage	Neophyte			*		

Generic	Specific	Common	Neophyte /Archaeophyte	High	Medium	Low	Value	Associated invertebrate groups/species
Calystegia	*pulchra*	Hairy bindweed	Neophyte	*			Vegetative parts, nectar and pollen	*Calystegia* spp. are forage plants for the fly *Aphaniosoma socium* (RDB1) and larval foodplant for the four-spotted moth *Tyta luctuosa* (RDB2, UKBAP)
Calystegia	*silvatica*	Large bindweed	Neophyte	*			Vegetative parts, nectar and pollen	*Calystegia* spp. are forage plants for the fly *Aphaniosoma socium* (RDB1) and larval foodplant for the four-spotted moth *Tyta luctuosa* (RDB2, UKBAP)
Campanula	*persicifolia*	Peach-leaved bellflower	Neophyte			*		
Capsella	*bursa pastoris*	Shepherds purse	Archaeophyte			*		
Centranthus	*ruber*	Red valerian	Neophyte		*		Nectar and pollen	
Cerastium	*tomentosum*	Sweet william	Neophyte			*		
Chamaecyparis	*lawsoniana*	Lawsons Cypress	Neophyte			*		
Chenopodium	*spp.*	Goosefoots	Archaeophyte			*		
Chichorium	*intybus*	Chicory	Archaeophyte			*		
Claytonia	*sirbirica*	Pink purslane	Neophyte			*		
Cochlearia	*danica*	Danish scurvey grass	Neophyte			*		
Colutea	*arborescens*	Bladder senna	Neophyte	*			Nectar and pollen	*Bombus humilis* (UKBAP)
Conium	*maculatum*	Hemlock	Archaeophyte			*		
Consolida	*ajacis*	larkspur	Neophyte			*		
Conyza	*canadensis*	Canadian fleabane	Neophyte			*		
Conyza	*sumatrensis*	Guernsey fleabane	Neophyte			*		
Coronopus	*didymus*	lesser swine cress	Neophyte			*		

Generic	Specific	Common	Neophyte /Archaeophyte	High	Medium	Low	Value	Associated invertebrate groups/species
Coronopus	*squamatus*	Swine cress	Archaeophyte			*		
Cotoneaster	*spp.*	Cotoneasters	Neophyte		*		Nectar and pollen	Popular late spring forage plant (attracts fauna similar to hawthorn)
Crepis	*vesicaria*	Beaked hawk's beard	Neophyte	*			Nectar and pollen	*Andrena* spp., *Ceratina cynea* (RDB3), *Stelis ornatula* (RDB3), *Tephritis matricariae* (Nb)
Crocosmia	*x crocosmiiflora*	Monbretia	Neophyte			*		
Cupressus	*macrocarpa*	Monterey cypress	Neophyte			*		
Cymbalaria	*muralis*	Ivy-leaved toadflax	Neophyte			*		
Datura	*stramonium*	Thorn apple	Neophyte			*		
Descurainia	*sophia*	Flixweed	Archaeophyte	*			Vegetative parts	Foodplant for the weevil *Ceutorhynchus pulvinatus* (Na), the leaf beetle *Psylliodes sophiae* (RDB3, UKBAP) and the geometrid moth *Lithostege griseata* (RDB3)
Diplotaxis	*muralis*	annual wall rocket	Neophyte			*		
Diplotaxis	*tenuifolia*	Perennial wall rocket	Archaeophyte			*		
Echinochloa	*crus-galii*	Cockspur	Neophyte			*		
Epilobium	*ciliatum*	American willowherb	Neophyte			*		
Erodium	*moschatum*	Musk storks bill	Archaeophyte			*		
Euphorbia	*x pseudovirgata*	Twiggy spurge	Neophyte			*		
Euphorbia	*cyparissias*	Cypress spurge	Neophyte			*		
Fagopyrum	*esculentum*	Buckwheat	Neophyte			*		
Fallopia	*baldscuanica*	Russina vine	Neophyte		*		Nectar and pollen	Popular forage plant for Diptera in late summer

Generic	Specific	Common	Neophyte /Archaeophyte	High	Medium	Low	Value	Associated invertebrate groups/species
Fallopia	*japonica*	Japanese knotweed	Neophyte			*		
Fallopia	*sachalinensis*	Giant knotweed	Neophyte			*		
Foeniculum	*vulgare*	Fennel	Archaeophyte	*			Nectar and pollen	*Cerceris quinquefasciata* (RDB3, UKBAP), *Hedychrum niemelai* (RDB3)
Galanthus	*nivalis*	Snowdrop	Neophyte			*		
Galega	*officinalis*	Goat's-rue	Neophyte			*		
Galinsoga	*qudriradiata*	Shaggy soldier	Neophyte			*		
Galinsoga	*parviflora*	Gallant soldier	Neophyte			*		
Geranium	*dissectum*	Cut-leaved cranesbill	Archaeophyte			*		
Geranium	*pyrenaicum*	Hedgerow cranes bill	Neophyte			*		
Geranium	*phaeum*	Dusky cranes bill	Neophyte			*		
Helianthus	*annuus*	Sunflower	Neophyte	*			Vegetative parts, nectar and pollen	Nectar and pollen source for bees, wasps and flies. Possible larval foodplant for the leaf beetle *Longitarsus dorsalis* (Nb)
Heracleum	*mantegazzianum*	Giant hogweed	Neophyte			*		
Hesperis	*matronalis*	Dames violet	Neophyte		*		Nectar and pollen	Attracts night-flying insects
Hirschfeldia	*incana*	hoary mustard	Neophyte			*		
Hordeum	*murinum*	Wall Barley	Archaeophyte			*		
Hyoscyamus	*niger*	Henbane	Neophyte	*			Vegetative parts	Foodplant for the henbane flea beetle *Psylliodes hyoscyami* (RDB1)
Hypericum	*calycinum*	Rose of sharon	Neophyte			*		
Impatiens	*spp.*	Balsams	Neophyte		*		Nectar and pollen	Attracts foraging bees
Juglans	*regia*	Walnut	Neophyte			*		

Generic	Specific	Common	Neophyte /Archaeophyte	High	Medium	Low	Value	Associated invertebrate groups/species
Laburnum	*anagyroides*	Laburnum	Neophyte			*		
Lactuca	*serriola*	Prickly lettuce	Archaeophyte			*		
Lamium	*album*	White dead nettle	Archaeophyte		*		Nectar and pollen	
Lamium	*maculatum*	Spotted dead nettle	Neophyte			*		
Lamium	*purpureum*	Purple dead nettle	Archaeophyte		*		Nectar and pollen	
Lathyrus	*latifolius*	Broadleaved everlasting pea	Neophyte	*			Nectar and pollen	*Bombus humilis* (UKBAP)
Lepidium	*campestre*	Field pepperwort	Archaeophyte			*		
Lepidium	*draba*	Hoary cress	Neophyte			*		
Lepidium	*ruderale*	Narrow-leaved pepperwort	Archaeophyte			*		
Leucanthemum	*x superbum*	Shasta daisy	Neophyte		*		Nectar and pollen	Diptera and aculeate Hymenoptera
Ligustrum	*ovalifolium*	Garden privet	Neophyte			*		
Linaria	*purpurea*	Purple toadflax	Neophyte	*			Vegetative parts, nectar and pollen	Favoured by smaller bees, may be a larval hostplant for the toadflax brocade *Calophasia lunula* (UKBAP, RDB3)
Linum	*usitatissimum*	Flax	Neophyte			*		
Lobelia	*erinus*	Garden lobelia	Neophyte			*		
Lobularia	*maritima*	Sweet Alison	Neophyte			*		
Lolium	*multiflorum*	Italian rye-grass	Neophyte			*		
Lunaria	*annua*	Honesty	Neophyte		*		Nectar and pollen	Attracts spring hoverflies
Lupinus	*arboreus*	Tree lupin	Neophyte			*		
Lupinus	*polyphyllus*	Garden Lupin	Neophyte		*		Nectar and pollen	
Lupinus	*x regalis*	Russell Lupin	Neophyte			*		
Lychnis	*coronaria*	Rose campion	Neophyte			*		
Lycium agg.		Tea plants	Neophyte			*		

Generic	Specific	Common	Neophyte /Archaeophyte	High	Medium	Low	Value	Associated invertebrate groups/species
Lycopersicon	*esculentum*	Tomato	Neophyte			*		
Lysimachia	*punctata*	Dotted loosestrife	Neophyte			*		
Malva	*sylvestris*	Common mallow	Archaeophyte		*		Nectar and pollen	
Mahonia	*aquifolium*	Oregon Grape	Neophyte			*		
Matricaria	*discoidea*	Pineapple weed	Neophyte	*			Vegetative parts, nectar and pollen	Foodplant for the weevil *Omphalapion beuthini* (RDB3) and for larval leaf beetles of the species *Longitarsus ochroleucus* (Nb). The flowers attract small bees of the genera *Lasioglossum* and *Specodes*
Medicago	*sativa subsp sativa*	Lucerne	Neophyte	*			Nectar and pollen	*Bombus humilis* (UKBAP)
Melilotus	*albus*	White melilot	Neophyte	*			Nectar and pollen	*Bombus humilis* (UKBAP)
Melilotus	*altissimus*	Tall melilot	Neophyte	*			Nectar and pollen	*Bombus humilis* (UKBAP)
Melilotus	*officinalis*	Ribbed melilot	Neophyte	*			Nectar and pollen	*Bombus humilis* (UKBAP)
Melilotus	*indicus*	Small melilot	Neophyte	*				
Melissa	*officinalis*	Balm	Neophyte			*		
Mentha	*spp.*	Mints	Neophyte		*		Nectar and pollen	
Oenothera	*spp.*	Evening primroses	Neophyte		*		Nectar and pollen	Attracts moths
Onopordum	*acanthium*	Cotton thistle	Archaeophyte			*		
Oxalis	*spp.*	Yellow sorrels	Neophyte			*		
Oxalis	*spp.*	Pink sorrels	Neophyte			*		
Panicum	*milliaceum*	Common millet	Neophyte			*		
Papaver	*somniferum*	Opium poppy	Neophyte		*		Nectar and pollen	
Pentaglottis	*sempervirens*	Green alkanet	Neophyte			*		
Persicaria	*wallichii*	Himalayan knotweed	Neophyte			*		
Petasites	*fragrans*	Winter heliotrope	Neophyte			*		

Generic	Specific	Common	Neophyte /Archaeophyte	High	Medium	Low	Value	Associated invertebrate groups/species
Phalaris	*canariensis*	Canary grass	Neophyte			*		
Philadelphus	*coronarius*	Mock orange	Neophyte			*		
Picris	*echioides*	Bristly ox-tongue	Archaeophyte	*			Nectar and pollen	*Ceratina cyanea* (RDB3), *Dasypoda hirtipes* (Nb)
Pilosella	*aurantiaca*	Fox and cubs	Neophyte		*		Nectar and pollen	Attracts bees of the genus *Lasioglossum*
Platanus	*x hispanica*	London Plane	Neophyte			*		
Populus	*nigra italica*	Lombardy poplar	Neophyte			*		
Populus	*spp*	Hybrid black poplars	Neophyte			*		
Potentilla	*recta*	Sulphur cinquefoil	Neophyte			*		
Prunus	*lusitanica*	Portugal laurel	Neophyte			*		
Prunus	*laurocerasus*	Cherry laurel	Neophyte			*		
Pseudofumaria	*lutea*	Yellow corydalis	Neophyte			*		
Pulmonaria	*officinalis*	Lungwort	Neophyte			*		
Quercus	*cerris*	Turkey oak	Neophyte			*		
Quercus	*ilex*	Holm oak	Neophyte			*		
Raphanus	*raphaniastrum*	Wild radish	Archaeophyte			*		
Rapistrum	*rugosum*	Bastard cabbage	Neophyte			*		
Reseda	*luteola*	Weld	Archaeophyte	*			Nectar and pollen	*Hylaeus signatus* (Nb) (sole food plant), *Cerceris quinequefasciata* (RDB3, UKBAP)
Ribes	*sanguineum*	Flowering currant	Neophyte			*		
Robinia	*pseudoacaia*	False acacia	Neophyte			*		
Rosa	*rugosa*	Japanese rose	Neophyte			*		
Rumex	*cristatus*	Greek dock	Neophyte			*		
Sambucus	*ebulus*	Dwarf elder	Archaeophyte			*		
Saponaria	*officinalis*	Soapwort	Archaeophyte			*		

Generic	Specific	Common	Neophyte /Archaeophyte	High	Medium	Low	Value	Associated invertebrate groups/species
Sedum	*album*	White stonecrop	Archaeophyte			*		
Sedum	*rupestre*	Reflexed stonecrop	Neophyte			*		
Senecio	*inaequidens*	Narrow-leaved ragwort	Neophyte			*		
Senecio	*squalidus*	Oxford ragwort	Neophyte	*			Vegetative parts, nectar and pollen	Foodplant for the leaf beetle *Longitarsus ochroleucus* (Nb). Flowers provide nectar and pollen possibly for *Lasioglossum xanthopum* (Nb)
Senecio	*viscosus*	Sticky groundsel	Neophyte			*		
Sinapsis	*arvensis*	Charlock	Archaeophyte			*		
Sinapsis	*alba*	White Mustard	Archaeophyte			*		
Sisymbrium	*loeselii*	False london rocket	Neophyte	*			Nectar and pollen	*Andrena nigrospina* (pRDB2), *Mordellistena* spp. *(RDBK)*
Sisymbrium	*officinale*	Hedge Mustard	Archaeophyte	*			Vegetative parts, nectar and pollen	Source of nectar and pollen for the mining bee *Andrena nigrospina* (pRDB2) Foodplant for adult weevils of the species *Ceutorhynchus pulvinatus* (Na)
Sisymbrium	*orientale*	Eastern rocket	Neophyte	*			Nectar and pollen	*Andrena nigrospina* (pRDB2), *Mordellistena* spp. *(RDBK)*
Sisymbrium	*altissimum*	Tall rocket	Neophyte	*			Nectar and pollen	*Andrena nigrospina* (pRDB2), *Mordellistena* spp. *(RDBK)*
Solanum	*physalifolium*	Green nightshade	Neophyte			*		
Soleirolia	*soleirolii*	Mind your own business	Neophyte			*		

Generic	Specific	Common	Neophyte /Archaeophyte	High	Medium	Low	Value	Associated invertebrate groups/species
Solidago	*gigantea*	Early goldenrod	Neophyte			*		
Solidago	*canadensis*	Canadain goldenrod	Neophyte		*		Nectar and pollen	Popular forage plant for Diptera, Lepidoptera and Hymenoptera
Sorbus	*intermedia*	Swedish whitebeam	Neophyte			*		
Spartium	*junceum*	Spanish broom	Neophyte			*		
Spirea	spp.	Brideworts	Neophyte			*		
Stachys	*arvensis*	Field woundwort	Archaeophyte			*		
Symphytum	*x uplandicum*	Russian comfrey	Neophyte	*			Nectar and pollen	Major forage plant of *Bombus ruderatus* (Nb, UKBAP)
Symphytum	*orientale*	White comfrey	Neophyte		*		Nectar and pollen	Major forage plant of *Bombus* spp.
Symrnium	*oluastrum*	Alexanders	Archaeophyte			*		
Syringa	*vulgaris*	Lilac	Neophyte			*		
Tanacetum	*parthenium*	Feverfew	Archaeophyte	*			Nectar and pollen	Popular forage plant for Diptera, Lepidoptera and Hymenoptera, especially *Colletes* spp.
Thlaspi	*arvense*	Field penny-cress	Archaeophyte			*		
Trifolium	*hybridum*	Alsike clover	Neophyte			*		
Tripleurospermum	*inodorum*	Scentless mayweed	Archaeophyte	*			Vegetative parts	Foodplant for the weevil *Omphalapion beuthini* (RDB3).
Verbascum	spp.	Mulleins	Neophyte	*			Vegetative parts, nectar and pollen	Attracts bees and hoverflies to forage on flowers. *Cucullia lychnitis* (N, UKBAP) larvae may use as a hostplant.

Generic	Specific	Common	Neophyte /Archaeophyte	High	Medium	Low	Value	Associated invertebrate groups/species
Veronica	*agrestis*	Green field speedwell	Archaeophyte			*		
Vinca	*major*	Greater periwinkle	Neophyte			*		
Vinca	*minor*	Lesser periwinkle	Neophyte			*		
Vulpia	*myuros*	Rat's-tail fescue	Archaeophyte			*		
x Cupressocyparis	*leylandii*	Leyland Cypress	Neophyte			*		

Appendix 4 - Status definitions and criteria for invertebrate rarity

This summary was taken from the East Sussex County Council website and was compiled by P. Hodge. Criteria for the selection of species into the Red Data Book categories follow Shirt (1987), with minor modifications that are italicised. Categories RDB K (insufficiently known) and RDB I (indeterminate) are based on the criteria used by Wells, Pyle & Collins (1983). Criteria for the selection of Nationally Notable species follow Eversham (1983).

Status categories

Red Data Book category 1 (RDB 1) - Endangered

Definition

Taxa in danger of extinction in Great Britain and whose survival is unlikely if the causal factors continue operating.

Included are those 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. Also included are some taxa that are possibly extinct.

Criteria

- Species which are known or believed to occur as only a single population within one 10 km square of the National Grid.
- Species which only occur in habitats known to be especially vulnerable.
- Species which have shown a rapid or continuous decline over the last twenty years and are now estimated to exist in five or fewer 10 km squares.
- Species which are possibly extinct but have been recorded this century and if rediscovered would need protection.

Red Data Book category 2 (RDB 2) – Vulnerable

Definition

Taxa believed likely to move into the endangered category in the near future if the causal factors continue operating.

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 are still abundant but are under threat from serious adverse factors throughout their range.

Criteria

- Species declining throughout their range.
- Species in vulnerable habitats.

Red Data Book category 3 (RDB 3) – Rare

Definition

Taxa with small populations in Great Britain that 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.

Criterion

- Species which are estimated to exist in only fifteen or fewer 10 km squares. 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

Red Data Book category 4 (RDB 4) - Out of Danger

Definition

Taxa formerly meeting the criteria of one of the above categories, but which are now considered relatively secure because effective conservation measures have been taken or the previous threat to their survival in Great Britain has been removed.

Red Data Book category 5 (RDB 5) – Endemic

Definition

Taxa which are not known to occur naturally outside Great Britain. Taxa within this category may also be in any of the other RDB categories or not threatened at all.

Red Data Book Appendix (RDB app.) – Extinct

Definition

Taxa which were formerly native to Great Britain but have not been recorded since 1900.

Red Data Book category I (RDB I) – Indeterminate

Definition

Taxa considered to be Endangered Vulnerable or Rare in Great Britain but where there is not enough information to say which of the three categories (RDB 1 to 3) is appropriate.

Red Data Book category K (RDB K) - Insufficiently Known

Definition

Taxa in Great Britain that are suspected but not definitely known, to belong to any of the above categories, because of lack of information.

Criteria

- Taxa recently discovered or recognised in Great Britain which may prove to be more widespread in the future.
- Taxa with very few or perhaps only a single known locality but which belong to poorly recorded or taxonomically difficult groups.
- Species known from very few localities but which occur in inaccessible habitats or habitats which are seldom sampled.
- Species with very few or perhaps only a single known locality and of questionable native status, but not clearly failing into the category of recent colonist, vagrant or introduction.

Nationally Scarce Category A - Notable A (Na)

Definition

Taxa which do not fall within RDB categories but which are none-the-less uncommon in Great Britain and are thought to occur in 30 or fewer 10 km squares of the National Grid or, for less well recorded groups, within seven or fewer vice-counties.

Nationally Scarce Category B - Notable B (Nb)

Definition

Taxa which do not fall within RDB categories but which are none-the-less uncommon in Great Britain and are thought to occur in between 31 and 100 10 km squares of the National Grid or for less well recorded groups, between eight and twenty vice--counties.

Nationally Scarce - Notable (N)

Definition

Taxa which do not fall within RDB categories but which arc none-the-less uncommon in Great Britain and are thought to occur in between 16 to 100 10 km squares of the National Grid. Species within this category are often too poorly known for their status to be more precisely estimated.

Lower Risk nationally scarce - LRns

The replacement for Nb and Na under recent IUCN criteria. There are published statuses under the new system only for water beetles. Taxa which do not qualify for Conservation Dependent or Near Threatened - in Britain defined as species occurring in 16 to 100 hectads but not CR, EN or VU. Nationally Scarce species are usually divided into lists A (**LRnsA** 16-30 hectads) and B (**LRnsB** 31-100 hectads) as in the previous system. This subcategory associates a level of threat with rarity status, whereas the previous National Scarcity listings

were based solely on rarity. Those species, the populations of which occasionally occupy more than 30 or 100 hectads as LRnsA and LRnsB respectively, can still be listed if it is thought that their baseline populations frequently fall below these thresholds, or if the habitats occupied are considered under threat.

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