Woolley Colliery

An Invertebrate Assessment

A report for:
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Contents

1 Introduction

1.1 This report details the results of an invertebrate assessment of two parcels of land at the former Woolley Colliery, Woolley (referred to hereafter as 'the site') prior to proposed development. The assessment was to appraise the key habitats and/or features of the site through the recording of invertebrates. These data were to be used to assess the value to invertebrates of those habitats or features in order to evaluate the site for its importance as an invertebrate resource. From the collection of data and subsequent assessment and valuation, suitable recommendations could then be put forward in the event that some or all of those features or key habitats may be impacted by a proposed development.

1.2 The site is divided into two compartments.

- North site: SE3121510748

The compartment is characterized by developing habitats. These range from flower-rich short swards with kidney vetch (*Anthyllis vulneraria*) to taller swards with common knapweed (*Centaura nigra*) and yellow composites (Asteraceae). There are also areas of developing scrub and secondary woodland. Bare ground is present across the compartment.

- South site: SE3115410425

The compartment is dominated by short swards and bare ground with common bird's-foot trefoil (*Lotus corniculatus*) the most abundant flowering plant on the site. Areas of taller swards are also present, including ox-eye daisy (*Leucanthemum vulgare*) and, to a lesser extent, common knapweed. Kidney vetch is also present but only in discrete areas on the eastern edge of the site along the boundary bunds.

2 Methods and Timings

2.1 The methods utilized for the assessment are those recommended in the Natural England guidance document *Surveying Terrestrial and Freshwater Invertebrates for Conservation Evaluation* (Drake *et al.*, 2007). In some instances, the method has been made bespoke for the site assessment but still retains the overall approach to assessing features and habitats for conservation assessment.

Sweep netting

2.2 This method provides the main proportion of the survey element and is the most efficient method of cataloguing a site's invertebrate resource.

Spot sampling

2.3 Spot sampling is employed to collect large, conspicuous invertebrates such as bees and wasps from flowering plants, and to supplement the sweep samples. Spot sampling is often the most effective method of recording species from high-fidelity niches

Vacuum sampling

2.4 Beetles and other crawling invertebrates were sampled using a suction sampler.

Grubbing

2.5 Fallen deadwood, piles of rotting timber (for deadwood beetles), and short turf (for surface-running beetles) were fingertip-searched for any hiding or crawling invertebrates, principally beetles.

Beating

2.6 Trees and scrub were beaten using a long stick. The dislodged invertebrates were collected on a sheet positioned beneath the branch and the contents retained.

Survey timing

2.7 The site was visited on five occasions:

Diurnal visits
24 May 2019 – sunny, 18–21°C
20 June 2019 – sunny, 17–20°C
23 July 2019 – sunny, 21–27°C
19 August 2019 – sunny, 16–18°C
12 September 2019 – sunny, 16–17°C

3 Results Summary

3.1 A total of 189 species from the target groups were recorded during the surveys.

3.2 A total of 11 species recorded have a national status (see Table 1), and a further species has only recently been added to the British list and is likely to have a nationally significant status.

3.3 The full list of species recorded is provided in Appendix III.

Table 1. Species of importance recorded on site

Scientific name	Vernacular name	National/local status	Habitat preferences and species notes	Site notes
Agelastica alni	alder leaf beetle	Data Deficient*	Associated with scrubby areas including brownfield. No longer warrants any formal status owing to significant expansion in range and abundance	Abundant across both compartments on alder
Longitarsis dorsalis	a leaf beetle	Notable b	Open, sparse swards with ragworts (*Senecio* spp.)	North site
Acanthiophilus helianthi	a fruitfly	Notable*	A species of open warm sites with common knapweed (*Centaurea nigra*)	North site
Erynnis tages	dingy skipper	NERC Act	A species of open	Strong

Scientific name	Vernacular name	National/local status	Habitat preferences and species notes	Site notes
		section 41	short swards and bare ground with, in this area, common bird's-foot trefoil (*Lotus corniculatus*)	populations on both compartments
Coenonympha pamphilus	small heath butterfly	NERC Act section 41	Associated with varied sward grassland with patchy bare ground. Requires fine-leaved grasses including fescues (*Festuca* spp.) and bents (*Agrostis* spp.)	Present on both compartments
Cupido minimus	small blue	NERC Act section 41	A calcareous species with a total fidelity to kidney vetch (*Anthyllis vulneraria*) on sunny sites	Small discrete populations on both compartments. The northern compartment possesses the stronger of the two colonies

* More common than the status suggests. Requires revision.
The most up-to-date information and species reviews are used in the assessment. Where there is no up-to-date review, Pantheon (Webb *et al.*, 2017[1]) has been used.

Results analysis

3.4 Tables 2 and 3 have been generated using the Pantheon software package. Pantheon is an analytical tool developed by Natural England and the Centre for Ecology & Hydrology to assist invertebrate nature conservation in England. Site data in the form of species lists can be imported into Pantheon, which then analyses the species within the lists, assigning them to habitats and resources. Pantheon also consigns the most up-to-date national status to the species where it is available.

3.5 Pantheon is also capable of other outputs such as Specific Assemblage Types ('SATs'). See Tables 4 and 5.

3.6 A SAT is characterized by stenotopic species (those that can only withstand a narrow range of environmental conditions). SATs are therefore more tightly defined than 'habitats' or 'resources' and sit within a parent habitat or Broad Assemblage Type ('BAT'). More than one SAT can sit within a parent SAT.

[1] Webb, J., Heaver, D., Lott, D., Dean, H.J., van Breda, J., Curson, J., Harvey, M., Gurney, M., Roy, D.B., van Breda, A., Drake, M., Alexander, K.N.A. and Foster, G. (2017). *Pantheon – Database Version 3.7.4*. [online] Available at: http://www.brc.ac.uk/pantheon/ [Accessed 28 May 2017].

Example:

BAT: **F**2 – grassland and scrub matrix

SAT: **F**211 – herb-rich dense sward

F212 – dense scrub

3.7 The information obtained from Pantheon can then be used to assign quality to sites and their features, assist in management decisions, and also facilitate requirement for further surveys, where required and appropriate.

3.8 For more information on this new resource, see http://www.brc.ac.uk/pantheon/.

3.9 Not all species of importance are expressed in the following tables, as they do not form part of the Pantheon analysis and/or their specific requirements are not yet fully understood.

Table 2. North site – resource-usage table (taken from Webb *et al.*, 2017)

Broad biotope	Habitat	No. of species	No. of species with conservation status (excluding research-only moths)	Conservation status
open habitats	tall sward & scrub	90	3	*Acanthiophilus helianthi* – N* *Erynnis tages* – S41 *Cupido minimus* – S41
open habitats	short sward & bare ground	34	3	*Longitarsus dorsalis* – Nb *Acanthiophilus helianthi* – N* *Coenonympha pamphilus* – S41
tree-associated	shaded woodland floor	13	–	–
tree-associated	arboreal	10	1	*Agelastica alni* – DD
wetland	marshland	4	–	–
tree-associated	decaying wood	4	–	–
wetland	peatland	4	–	–
wetland	running water	2	–	–
tree-associated	wet woodland	1	–	–
wetland	wet woodland	1	–	–

*More common than the status suggests. Requires revision.

Table 3. North site – SAT table (taken from Webb *et al.*, 2017)

Broad biotope	Habitat	SAT	SAT code	No. of associated species	Status
open habitats	–	rich flower resource	F002	17	Favourable
open habitats	–	scrub edge	F001	6	Unfavourable
tree-associated	decaying wood	bark &	A212	3	Unfavourable

Broad biotope	Habitat	SAT	SAT code	No. of associated species	Status
		sapwood decay			
open habitats	short sward & bare ground	open short sward	F112	3	Unfavourable
open habitats	short sward & bare ground	bare sand & chalk	F111	2	Unfavourable
open habitats	–	scrub-heath & moorland	F003	1	Unfavourable

Table 4. South site – resource-usage table (taken from Webb *et al.*, 2017)

Broad biotope	Habitat	No. of species	No. of species with conservation status (excluding research-only moths)	Conservation status
open habitats	tall sward & scrub	72	2	*Erynnis tages* – S41 *Cupido minimus* – S41
open habitats	short sward & bare ground	37	–	–
tree-associated	shaded woodland floor	7	–	–
tree-associated	arboreal	5	–	–
tree-associated	decaying wood	4	–	–
wetland	marshland	3	–	–
wetland	peatland	3	–	–
wetland	running water	1	–	–

*More common than the status suggests. Requires revision.

Table 5. South site – SAT table (taken from Webb *et al.*, 2017)

Broad biotope	Habitat	SAT	SAT code	No. of associated species	Status*
open habitats		rich flower resource	F002	19	Favourable*
tree-associated	decaying wood	bark & sapwood decay	A212	4	Unfavourable
open habitats	short sward & bare ground	open short sward	F112	4	Unfavourable
open habitats		scrub edge	F001	3	Unfavourable
open habitats		scrub-heath & moorland	F003	1	Unfavourable
open habitats	short sward & bare ground	bare sand & chalk	F111	1	Unfavourable
open habitats	short sward & bare ground	open short sward	F002	19	Favourable

*Reported condition – this has a low confidence rating (of the three ratings: high, medium, and low), as the sampling undertaken on the site was not SIS-compliant, that being of a more freeform active sampling method that was not time-limited in order to obtain a more thorough list of species from the site. Therefore, the status of each SAT is to be used as a guide and should not be interpreted as definitive. Where pertinent, greater detail is provided in the text to support or endorse the reported condition status in the SAT table.

4 Discussion

North site – habitat

4.1 The compartment is represented by a range of habitats broadly covering three broad biotopes, ‘open habitats’, ‘tree-associated’, and also ‘wetland’.

4.2 It is the open habitats biotope, however, that dominates the compartment in terms of species associations and physical extent of each habitat.

4.3 The habitats that are the most prominent across all areas of the site are the tall swards, and short sward and bare ground habitats with a combined total of 124 species of association. These are dominated by beetles, bees and wasps, and flies, and are the habitat biotopes that include all of the species of genuine national significance.

4.4 The tall sward and scrub includes 90 species, and the short ward and bare ground hold a resource of 34 species.

4.5 The tree-associated habitats (arboreal, decaying wood, and shaded woodland floor) are only represented by 26 species, as highlighted by Pantheon. This is to be expected on the compartment, as it is predominantly open, and the tree cover is not extensive or well developed.

4.6 Despite a lack of waterbodies, there is a wetland element to the compartment. This is due to intermittently wet areas on the eastern side of the site. It is highlighted by 14 species, none of which are scarce, and the habitat is not thought to be intrinsic to the compartment but does serve to increase species.

South site – habitat

4.1 The compartment is represented by a range of habitats broadly covering three broad biotopes, ‘open habitats’, ‘tree-associated’, and ‘wetland’.

4.2 It is the open habitats biotope, however, that dominates the compartment in terms of species associations and physical extent of each habitat.

4.3 The habitats that are the most prominent across all areas of the site are the tall swards and short sward and bare ground habitats with a combined total of 110 species of association. These are dominated by beetles, bees and wasps, and flies, and are the habitat biotopes that include all of the species of genuine national significance. The tall sward and scrub habitats include 72 species, and the short sward and bare ground habitats include 37 species.

4.4 The tree-associated habitats (arboreal, decaying wood, and shaded woodland floor) are only represented by 16 species, as highlighted by Pantheon. This is to be expected on the compartment, as it is predominantly open, and the tree cover is not extensive or well developed.

4.5 There is a small common reed (*Phragmites australis*)-dominated reedbed on the western boundary of the compartment that enables a small wetland associated fauna to be present. This is, however, only highlighted by 11 species of association and is therefore not significant and does not include any species of conservation importance.

North site – SATs

4.6 The site is represented by a range of assemblage types typical of post-industrial-type sites, with one, the rich flower resource (code: F002), that is regarded as being in a 'favourable condition' with a score of 17 (where the threshold is 14). This definition is a threshold at which the resource is deemed to be optimal and of greater significance than those that do not reach this threshold. However, given that the site was surveyed using non-standardized methods, there is a low confidence rating to this status. However, it is suggested that given the abundant flowers from a wide range of plant families on the compartment, the invertebrates associated with these rich flower resources are likely to be of value to the site.

4.7 None of the other SATs are well developed with associated species to each SAT in single figures. This highlights the lack of niche development on the compartment and also the extent of each specific feature. Most of the key features, such as bare ground and short turf, are only present in small quantities, consistent with the character of the compartment.

South site – SATs

4.8 The site is represented by a range of assemblage types, with one rich flower resource that is regarded as being in a 'favourable condition' with a score of 19 (where the threshold is 14). This definition is a threshold at which the resource is deemed to be optimal and of greater significance than those that do not reach this threshold.

4.9 The resource is largely associated with the extensive short flowery swards that are dominated by common bird's-foot trefoil, ox-eye daisy, and yellow composites.

4.10 As with the compartment north, there are other SATs highlighted by Pantheon, but they do not reach favourable status and are represented by very few indicator species.

North site – species

4.11 The survey recorded 170 species of invertebrates from the site with six species listed in Pantheon as being of value; however, two no longer warrant a nationally significant status.

4.12 The Data Deficient (DD) alder leaf beetle (*Agelastica alni*) is now very frequent and abundant in the north Midlands and further afield so no longer warrants a nationally significant status. The fruitfly *Acanthiophilus helianthi* (Notable) is now regarded by fly-recording societies as being more frequent than the status suggests and is likely to be downgraded in future reviews. However, it may still hold some local significance given the geographical location of the compartment.

4.13 The presence of the small blue butterfly (NERC Act Section 41 species) is the most significant species on the compartment. It is, however, only present on one small area of the compartment. This is an access track bund and southerly aspect slope, where a small number of kidney vetch plants grow. The colony is small, with seven to nine individuals recorded in the June visit, and as the resource of kidney vetch is reasonably small, the colony therefore could be described as fragile.

4.14 Both dingy skipper (S41) and small heath (S41) were also recorded from the compartment, but given the obvious lack of common bird's-foot trefoil on the compartment, only a few, three or four, individuals of the dingy skipper were recorded.

4.15 Other species of note include the solitary wasp *Odynerus spinipes* and its associated cleptoparasite wasp *Chrysis viridula*. These species are restricted in their distribution and only recorded from brownfield sites now owing to a lack of complex mosaics in the wider landscape. The juxtaposition of wet areas, calcareous deposits, and clay all within a few metres of one another enables the solitary wasp to breed on the site, and a large aggregation of nests was recorded. This large host population is what has enabled the cleptoparasite to establish and also be present in good numbers.

4.16 Overall, the list of species recorded is comparatively small. This is in part due to the small area of the compartment and also the lack of variation across the compartment, which limits feature diversity and therefore the number of species that can be recorded.

South site – species

4.17 The survey recorded 149 species of invertebrates from the site with four species listed in Pantheon as being of value; however, the DD alder leaf beetle (*Agelastica alni*) is now very frequent and abundant in the north Midlands and further afield, so no longer warrants a nationally significant status.

4.18 The most obvious species on the compartment are the butterflies, in particular the discrete colony of small blue (S41 species) that is present along the roadside bund. Only five or six individuals were recorded during the June visit. This is thought to be reflective of the colony size given the limited resource of kidney vetch in this compartment.

4.19 The dingy skipper (S41 species) is also present in the compartment, and as the habitat is dominated by common bird's-foot trefoil, the numbers are robust with 11 individuals recorded in the June visit, and it is likely that, owing to the extent of the optimal habitat, the colony is robust.

4.20 The overall list of species recorded is small. This is in part due to the small area of the compartment and also the lack of variation across the compartment, which limits feature diversity and therefore the number of species that can be recorded.

Species comparison

4.21 The north site holds a richer resource of invertebrates than the south site. It also includes a greater resource of species associated with the key habitats, namely the short sward and bare ground, and also tall swards and scrub. Both compartments have weakly developed specific assemblages, with the southern compartment having the more 'valuable' rich flower resource and also short sward and bare ground.

4.22 Both compartments include the key butterfly species (small blue, dingy skipper, and small heath), and the northern compartment includes other species of value including *Odynerus spinipes* and *Acanthiophilus helianthi*.

4.23 Therefore, it is suggested that both compartments are of comparable value, but the north site has the slightly richer fauna that includes more species of interest.

5 Assessment summary

Site assessment

5.1 Both compartments include a range of habitats, from open bare ground and early succession to scrub fringe. They both have a slight wetland element brought about by intermittently wet depressions.

5.2 They also have plentiful flowers as part of the early successional short swards and also taller, more established flowery swards.

5.3 The habitats, although not of significant size or variation, are of value to invertebrates. Most notably, the calcareous influence that gives rise to a rich flora including kidney vetch is of significant value, as it has enabled the small blue butterfly to establish and form colonies, albeit small.

5.4 Although the two compartments, principally the early succession and flowery mosaic, are not directly connected, they are highly likely to interact with one another, and the discrete populations of species, including the S41 butterflies, will intermingle and help support one another. Thus, although each compartment's colonies are small and reasonably fragile, together they provide some robustness from environmental effects such as drought, fire, and wet.

5.5 Even though there is a wider early successional resource to the west of the two compartments, given the close approximation of these two compartments, the loss of one of the compartments may have a direct impact or potentially influence species robustness on the other remaining compartment.

5.6 The site, and the two compartments, are moderately complex mosaics. It is the above habitats and features that are the driving force behind the site's value, and the juxtaposed habitats and features should be retained wherever possible on both compartments. If any of the key features cannot be retained, they should be adequately and optimally replicated as part of a mitigation scheme on the other compartment or in other surrounding and suitable land.

5.7 The features that are considered to be of principal importance are:

- short wards and bare ground
- tall flowery swards
- calcareous and concrete deposits with kidney vetch
- boundary bunds (southern compartment)
- access track bunds and southerly aspect bund (northern compartment)

Site evaluation

5.8 As the site and its compartments are likely to interact with, and depend upon, one another for the purpose of this evaluation, they are appraised as a single site.

5.9 There are six 'important' species associated with the site and recorded during these surveys. Two of these, however, do not warrant their current status and are likely to be downgraded.

5.10 The valuation of the site takes into consideration the range of species recorded, the overall assemblages, and the importance of the habitats to the species. The valuation also takes into consideration the likelihood of other species of importance being recorded from the site.

5.11 By using the experience of the surveyor, his knowledge of invertebrates, and the site assessment, and also by consulting the guidance notes prepared by Colin Plant Associates for the Chartered Institute of Environmental Managers and Ecologists (Appendix II), it is suggested that the site's key features should be considered to be of at least **District (low) importance** (Plant, 2009).

5.12 The site is considered to be of District importance owing to the limited number of significant species recorded during the surveys and also the overall and reasonably poor lists of species from both compartments. However, the lists do include two significant butterfly species (small blue and dingy skipper) and, to a lesser extent, the small heath butterfly (on compartment north only). The site is part of a much larger area of a former colliery that has a large population of small blue butterflies further afield and likely to hold other species that are also recorded from the site.

6 Recommendations

6.1 All invertebrate-related mitigation should be undertaken on low-fertility calcareous soils. Only peripheral ruderal areas can be created on nutrient-rich topsoils.

6.2 The success of any mitigation for loss of part or all of the site's key features will be dependent on incorporating key features in juxtaposition with one another and creating features that are both **extensive** and **optimal**.

6.3 As many of the species are associated with early successional mosaics, regular interventions will be required to suppress succession or reinvigorate pioneer plant species. As such, any mitigation strategy should include a management plan to suitably illustrate how a continuity of optimal features will be maintained effectively over time.

Open mosaic swards

6.4 The presence of an open, flowery sward with patches of bare ground is a notable feature of the site, and the inclusion of this feature in any suitable **sunny** location is advised to support the local pollinators and early successional species indicative of the site.

6.5 The low-fertility material used should be derived from the site wherever possible. Mosaics should include locations using calcareous material to encourage kidney vetch to establish.

6.6 To be successful, the flowery swards should be exposed to full sun for much of the day, including the key period between 10:00 and 16:00 h, and be created on nutrient-poor subsoils to promote a patchy sward dominated by flowering plants.

6.7 Bare ground should comprise approximately 50% of the habitat mosaic.

6.8 A mosaic of fine-leaved grasses and a range of flowering plants are required to fulfil the requirements of the open mosaics. It is likely that a commercially sourced seed mixture may not be suitable, but a bespoke mix should be specified to include the following species:

- common bird's-foot trefoil (*Lotus corniculatus*)
- hawkbits (*Leontodon* spp.)
  hawkweeds (*Hieracium* spp.)
- kidney vetch (*Anthyllis vulneraria*)
- other trefoils (Fabaceae)
- other vetches (*Vicia* spp.)
- red clover (*Trifolium pratense*)
- wild carrot (*Daucus carota*)

Invertebrate banks

6.9 A useful feature that benefits a wide range of open mosaic and flower-foraging invertebrates is an invertebrate bank.

- Invertebrate banks are essentially mounded materials. These features can vary, with some banks being partially compacted with machinery, whereas others can be allowed to settle naturally to encourage niche variation, through slumping, and retain lots of interstitial spaces between the aggregate material in which ground beetles can live.

- On-site low-fertility material can be used for these banks. The material should have an alkali pH derived from calcareous material.

- The banks should be optimally in a southerly facing aspect for greatest sun exposure and in a crescent or sinuous shape, which further elevates the microclimate and niche variation of the feature.

- Ideally, the banks should be sown with a suitable flower mix, allowed to colonize naturally, or topped with existing flower-rich turf from on site. A mixture of all three options can also be undertaken.

- Fine-material-created banks can be further diversified through the creation of small cliff faces dug into the bank to provide nesting locations for solitary bee and wasp species.

- Banks should be at least 10 m in length and range in height from 1 to 3 m. A minimum of three of these features are suggested.

Flowering swards

6.10 The companion habitat for the early succession is a flower-rich tall sward. This should be created alongside the invertebrate banks and/or early succession, and can include some or all of the following:

- common bird's-foot trefoil (*Lotus corniculatus*)
- hawkbits (*Leontodon* spp.)
- hawkweeds (*Hieracium* spp.)
- kidney vetch (*Anthyllis vulneraria*)
- labiates (Lamiaceae)
- meadow vetchling (*Lathyrus pratensis*)
- mignonettes (*Reseda* spp.)
- other trefoils (Fabaceae)
- other vetches (*Vicia* spp.)
- red clover (*Trifolium pratense*)
- St. John's wort (*Hieracium* spp.)
- wild carrot (*Daucus carota*)

6.11 The flowering swards should have a high density of flowers. Most standard mixes do not have a high enough proportion of flowering plants that are suitable for invertebrate mitigation, so a bespoke mix or additional ordering of supplementary flower seed is advised.

Scrub fringe

6.12 Scrub is an important interface with open flowery habitats and should be retained or replicated where possible to provide shelter, spring flower foraging, and structure.

6.13 Scrub, or specifically spring blossom, is also an integral part of a healthy and functioning invertebrate site. It is a key provider of pollen and nectar in spring from March to late June before the grassland flowers dominate. A range of species that provide flowers through this period are recommended, including willows (*Salix* spp.).

6.14 Scrub, or any shrubs or trees, should not be planted or encouraged on any flowery habitats. It should also not be planted or encouraged on the southern side of any flowery habitats or butterfly banks where it may shade the other feature.

6.15 A succession of blossom species are suggested for across the site, including any formal areas, and can include:

- apples (*Malus domestica* agg.)
- blackthorn (*Prunus spinosa*)
- cherry plum (*Prunus cerasifera*)
- field maple (*Acer campestre*)
- hawthorn (*Crataegus monogyna*)
- plums (*Prunus domestica* agg.)
- rowan (*Sorbus aucuparia*)
- willows (*Salix* spp.)

Deadwood

6.16 There are likely to be a number of deadwood-nesting bees and wasps recorded from the site including *Hylaeus* species. Provision of deadwood in sheltered sunny situations can be easily provided through the reworking of any felled on-site material. This can be inserted into the ground as upright posts and holes of various sizes from 2 mm to 9 mm bored into the southerly face of the timber. For optimal occupancy, the posts should be located near flower-foraging areas and not be shaded for the majority of the day (10:00 h to 16:00 h).

6.17 Areas of felled trees would also be beneficial for other deadwood species. These can be felled and left *in situ* or moved into sunlit areas and inserted vertically to replicate standing deadwood (minimum height – 1 m).

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7 Appendices

Appendix I: Red Data Book definitions
Appendix II: Criteria for defining invertebrate sites of significance, taken from Plant (2009)
Appendix III: Survey results

Red Data Book category 1 (RDB 1) – Endangered
Species that are known or believed to occur as only a single population within one 10-km square of the National Grid.

Red Data Book category 2 (RDB 2) – Vulnerable
Species declining throughout their range or in vulnerable habitats.

Red Data Book category 3 (RDB 3) – Rare
Species that are estimated to exist in only 15 or fewer post-1970 10-km squares. This criterion may be relaxed where populations are likely to exist in over 15 10-km squares but occupy small areas of especially vulnerable habitat.

Nationally Notable (Scarce) category A (NS A) – Notable A
Taxa that do not fall within the RDB category but that are nonetheless uncommon in Great Britain and thought to occur in 30 or fewer 10-km squares of the National Grid or, for less well-recorded groups, between eight and 20 vice counties.

Nationally Notable (Scarce) category B (NS B) – Notable B
Taxa that do not fall within the RDB category but that are nonetheless uncommon in Great Britain and thought to occur in 31–100 10-km squares of the National Grid or, for less well-recorded groups, between eight and 20 vice counties.

Nationally Notable (Scarce) (N) – Notable
Species that are estimated to occur within the range of 16–100 10-km squares. The subdividing of this category into Notable A and Notable B has not been attempted for many species in this part of the review.

Appendix II: Criteria for defining invertebrate sites of significance, taken from Plant (2009)

Importance	Description	Minimum qualifying criteria
International (high) importance	European important site (i.e. SAC)	Internationally important invertebrate populations present or containing RDB 1 (Endangered) species or containing any species protected under European legislation or containing habitats that are threatened or rare at the European level (including, but not exclusively so, habitats listed on the EU Habitats Directive).
National (high) importance	UK important site (SSSI)	Achieving SSSI invertebrate criteria (NCC, 1989) or containing RDB 2 (Vulnerable) or containing viable populations of RDB 3 (Rare) species or containing viable populations of any species protected under UK legislation or containing habitats that are threatened or rare nationally (Great Britain).
Regional (medium) importance (for border sites, both regions must be taken into account)	Site with populations of invertebrates or invertebrate habitats considered scarce or rare or threatened in south-east England	Habitat that is scarce or threatened in the region or that has, or is reasonably expected to have, the presence of an assemblage of invertebrates including at least 10 Nationally Notable species or at least 10 species listed as Regionally Notable for the English Nature region in question in the Recorder database or elsewhere or a combination of these categories amounting to 10 species in total.
County (medium) importance (for border sites, both counties must be taken into account)	Site with populations of invertebrates or invertebrate habitats considered scarce or rare or threatened in the county in question	Habitat that is scarce or threatened in the county and/or that contains, or is reasonably expected to contain, an assemblage of invertebrates that includes viable populations of at least five Nationally Notable species or viable populations of at least five species regarded as Regionally Scarce by the county records centres and/or field club.
District (low) importance	Site with populations of invertebrates or invertebrate habitats considered scarce or rare or threatened in the administrative district	A rather vague definition of habitats falling below county significance level, but which may be of greater significance than merely Local. They include sites for which Nationally Notable species in the range from one to four examples are reasonably expected but not yet necessarily recorded and where this omission is considered likely to be partly due to under-recording.
Local (low) importance	Site with populations of invertebrates or invertebrate habitats considered scarce or rare or threatened in the affected and neighbouring parishes (except Scotland, where the local area may best be defined as being within a radius of 5 km)	Habitats or species unique or of some other significance within the local area.
Importance within the context of the site only (low importance)	–	Although almost no area is completely without significance, these are the areas with nothing more than expected 'background' populations of common species and the occasional Nationally Local species.

Appendix III: Survey results

Only species with a national status have been annotated. All others are common or local species.

North site

Scientific name	Order	Date first recorded	National Status
Acanthiophilus helianthi	Diptera	23-Jul-19	N
Aelia acuminata	Hemiptera	24-May-19	
Agelastica alni	Coleoptera	20-Jun-19	DD*
Aglais urticae	Lepidoptera	23-Jul-19	
Agriotes sputator	Coleoptera	23-Jul-19	
Andrena humilis	Hymenoptera	20-Jun-19	
Andrena nigroaenea	Hymenoptera	20-Jun-19	
Anomoia purmunda	Diptera	23-Jul-19	
Anoplius nigerrimus	Hymenoptera	24-May-19	
Anthonomus rubi	Coleoptera	23-Jul-19	
Atractotomus mali	Hemiptera	23-Jul-19	
Austrolimnophila ochracea	Diptera	24-May-19	
Bellardia pandia	Diptera	11-Sep-19	
Bembecia ichneumoniformis	Lepidoptera	23-Jul-19	
Bembidion properans	Coleoptera	23-Jul-19	
Betulapion simile	Coleoptera	23-Jul-19	
Bibio pomonae	Diptera	20-Aug-19	
Bicellaria sulcata	Diptera	20-Aug-19	
Bombus hortorum	Hymenoptera	20-Jun-19	
Bombus lapidarius	Hymenoptera	23-Jul-19	
Bombus pascuorum	Hymenoptera	24-May-19	
Bombus pratorum	Hymenoptera	24-May-19	
Bruchidius varius	Coleoptera	23-Jul-19	
Bruchus loti	Coleoptera	24-May-19	
Bruchus rufimanus	Coleoptera	24-May-19	
Calliopum aeneum	Diptera	20-Aug-19	
Calliphora subalpina	Diptera	20-Jun-19	
Cantharis rustica	Coleoptera	24-May-19	
Cassida rubiginosa	Coleoptera	23-Jul-19	
Ceratapion onopordi	Coleoptera	23-Jul-19	
Cercopis vulnerata	Hemiptera	24-May-19	
Chaetorellia jaceae	Diptera	20-Jun-19	
Chloromyia formosa	Diptera	20-Jun-19	
Chorthippus parallelus	Orthoptera	20-Jun-19	
Chrysis viridula	Hymenoptera	20-Jun-19	
Chrysotoxum bicinctum	Diptera	20-Jun-19	
Cicadella viridis	Hemiptera	23-Jul-19	
Closterotomus norwegicus	Hemiptera	23-Jul-19	

Coenonympha pamphilus	Lepidoptera	24-May-19	S41
Colletes daviesanus	Hymenoptera	19-Aug-19	
Conops flavipes	Diptera	23-Jul-19	
Coriomeris denticulatus	Hemiptera	24-May-19	
Crossocerus capitosus	Hymenoptera	23-Jul-19	
Cryptocephalus fulvus	Coleoptera	23-Jul-19	
Cryptocephalus labiatus	Coleoptera	20-Jun-19	
Cupido minimus	Lepidoptera	20-Jun-19	S41
Cylindromyia interrupta	Diptera	23-Jul-19	
Deraeocoris (Deraeocoris) flavilinea	Hemiptera	23-Jul-19	
Deraeocoris (Deraeocoris) ruber	Hemiptera	19-Aug-19	
Dicyphus (Dicyphus) epilobii	Hemiptera	23-Jul-19	
Dilophus febrilis	Diptera	20-Aug-19	
Dioctria baumhaueri	Diptera	23-Jul-19	
Discomyza incurva	Diptera	24-May-19	
Dolichopus griseipennis	Diptera	20-Jun-19	
Dolycoris baccarum	Hemiptera	20-Jun-19	
Elasmostethus interstinctus	Hemiptera	19-Aug-19	
Eriothrix rufomaculata	Diptera	23-Jul-19	
Eristalis arbustorum	Diptera	19-Aug-19	
Eristalis pertinax	Diptera	19-Aug-19	
Erynnis tages	Lepidoptera	24-May-19	S41
Exorista rustica	Diptera	11-Sep-19	
Halictus tumulorum	Hymenoptera	24-May-19	
Harmonia axyridis	Coleoptera	23-Jul-19	
Hercostomus nanus	Diptera	23-Jul-19	
Herina lugubris	Diptera	19-Aug-19	
Heterotoma planicornis	Hemiptera	23-Jul-19	
Himacerus (Aptus) mirmicoides	Hemiptera	23-Jul-19	
Holotrichapion aethiops	Coleoptera	23-Jul-19	
Hybos grossipes	Diptera	20-Aug-19	
Hylaeus brevicornis	Hymenoptera	20-Jun-19	
Hylaeus signatus	Hymenoptera	20-Jun-19	
Hypera plantaginis	Coleoptera	23-Jul-19	
Hypera postica	Coleoptera	23-Jul-19	
Ischnodemus sabuleti	Hemiptera	23-Jul-19	
Kleidocerys resedae	Hemiptera	23-Jul-19	
Lagria hirta	Coleoptera	23-Jul-19	
Lasioglossum cupromicans	Hymenoptera	20-Aug-19	
Lasioglossum leucopus	Hymenoptera	20-Jun-19	
Lasioglossum leucozonium	Hymenoptera	20-Jun-19	
Lasioglossum villosulum	Hymenoptera	20-Jun-19	
Leptogaster cylindrica	Diptera	20-Jun-19	
Leptopterna dolabrata	Hemiptera	23-Jul-19	

Leptopterna ferrugata	Hemiptera	20-Jun-19	
Longitarsus dorsalis	Coleoptera	24-May-19	Nb
Lopus decolor	Hemiptera	23-Jul-19	
Lucilia caesar	Diptera	20-Aug-19	
Lygus rugulipennis	Hemiptera	23-Jul-19	
Macronychia dolini	Diptera	23-Jul-19	
Malachius bipustulatus	Coleoptera	24-May-19	
Maniola jurtina	Lepidoptera	20-Jun-19	
Mecinus pascuorum	Coleoptera	24-May-19	
Mecinus pyraster	Coleoptera	24-May-19	
Megachile versicolor	Hymenoptera	19-Aug-19	
Megaloceroea recticornis	Hemiptera	23-Jul-19	
Melanargia galathea	Lepidoptera	23-Jul-19	
Meligethes aeneus	Coleoptera	23-Jul-19	
Myrmica ruginodis	Hymenoptera	23-Jul-19	
Nabis (Nabicula) flavomarginatus	Hemiptera	11-Sep-19	
Neoascia podagrica	Diptera	23-Jul-19	
Neocrepidodera transversa	Coleoptera	20-Aug-19	
Neottiglossa pusilla	Hemiptera	23-Jul-19	
Noeeta pupillata	Diptera	23-Jul-19	
Nomada marshamella	Hymenoptera	23-Jul-19	
Notiophilus substriatus	Coleoptera	24-May-19	
Nysius huttoni	Hemiptera	23-Jul-19	
Ochlodes sylvanus	Lepidoptera	23-Jul-19	
Odynerus spinipes	Hymenoptera	23-Jul-19	
Oedemera lurida	Coleoptera	20-Jun-19	
Omocestus viridulus	Orthoptera	24-May-19	
Oncotylus (Oncotylus) viridiflavus	Hemiptera	20-Jun-19	
Opomyza florum	Diptera	23-Jul-19	
Orthetrum cancellatum	Odonata	20-Jun-19	
Osmia (Osmia) bicornis	Hymenoptera	23-Jul-19	
Paradromius linearis	Coleoptera	24-May-19	
Phasia obesa	Diptera	23-Jul-19	
Phasia pusilla	Diptera	19-Aug-19	
Physocephala rufipes	Diptera	19-Aug-19	
Phytocoris (Ktenocoris) ulmi	Hemiptera	23-Jul-19	
Phytocoris (Ktenocoris) varipes	Hemiptera	23-Jul-19	
Pieris rapae	Lepidoptera	23-Jul-19	
Pipizella viduata	Diptera	24-May-19	
Plagiognathus (Plagiognathus) arbustorum	Hemiptera	20-Jun-19	
Plagiognathus (Plagiognathus) chrysanthemi	Hemiptera	23-Jul-19	
Platycheirus clypeatus	Diptera	23-Jul-19	
Platymya fimbriata	Diptera	23-Jul-19	
Polygonia c-album	Lepidoptera	20-Aug-19	

Polyommatus icarus	Lepidoptera	23-Jul-19	
Propylea quattuordecimpunctata	Coleoptera	24-May-19	
Protapion apricans	Coleoptera	20-Jun-19	
Psylliodes chrysocephala	Coleoptera	23-Jul-19	
Psyllobora vigintiduopunctata	Coleoptera	23-Jul-19	
Pyronia tithonus	Lepidoptera	23-Jul-19	
Rhagonycha fulva	Coleoptera	19-Aug-19	
Rhinoncus pericarpius	Coleoptera	24-May-19	
Rhopalus (Rhopalus) subrufus	Hemiptera	23-Jul-19	
Rivellia syngenesiae	Diptera	24-May-19	
Sapromyza quadripunctata	Diptera	23-Jul-19	
Sarcophaga haemorrhoa	Diptera	23-Jul-19	
Sarcophaga teretirostris	Diptera	24-May-19	
Scaeva pyrastri	Diptera	20-Aug-19	
Scathophaga stercoraria	Diptera	23-Jul-19	
Scellus notatus	Diptera	11-Sep-19	
Sitona lineatus	Coleoptera	20-Jun-19	
Sphaeroderma rubidum	Coleoptera	20-Jun-19	
Sphecodes geoffrellus	Hymenoptera	24-May-19	
Stenodema (Stenodema) laevigata	Hemiptera	24-May-19	
Stenotus binotatus	Hemiptera	24-May-19	
Stictopleurus punctatonervosus	Hemiptera	23-Jul-19	
Strophosoma melanogrammum	Coleoptera	23-Jul-19	
Syrphus ribesii	Diptera	23-Jul-19	
Tachina fera	Diptera	23-Jul-19	
Temnocerus nanus	Coleoptera	19-Aug-19	
Tephritis cometa	Diptera	23-Jul-19	
Tephritis leontodontis	Diptera	11-Sep-19	
Tephritis neesii	Diptera	23-Jul-19	
Tetrix subulata	Orthoptera	23-Jul-19	
Tetrix undulata	Orthoptera	23-Jul-19	
Thymelicus sylvestris	Lepidoptera	23-Jul-19	
Tipula fascipennis	Diptera	23-Jul-19	
Trichosirocalus troglodytes	Coleoptera	24-May-19	
Trigonotylus ruficornis	Hemiptera	24-May-19	
Urophora stylata	Diptera	23-Jul-19	
Vanessa cardui	Lepidoptera	23-Jul-19	
Volucella bombylans	Diptera	19-Aug-19	
Volucella inanis	Diptera	19-Aug-19	
Volucella pellucens	Diptera	19-Aug-19	
Xantholinus elegans	Coleoptera	19-Aug-19	
Xantholinus linearis	Coleoptera	23-Jul-19	
Zygaena filipendulae	Lepidoptera	23-Jul-19	

South site

Scientific name	Order	Date first recorded	National Status
Aelia acuminata	Hemiptera	20-Jun-19	
Andrena bicolor	Hymenoptera	20-Jun-19	
Andrena haemorrhoa	Hymenoptera	20-Jun-19	
Andrena humilis	Hymenoptera	20-Jun-19	
Andrena minutula	Hymenoptera	23-Jul-19	
Andrena wilkella	Hymenoptera	24-May-19	
Anomoia purmunda	Diptera	20-Aug-19	
Anoplius nigerrimus	Hymenoptera	24-May-19	
Bellardia pandia	Diptera	11-Sep-19	
Bembecia ichneumoniformis	Lepidoptera	23-Jul-19	
Bibio pomonae	Diptera	20-Aug-19	
Bombus hortorum	Hymenoptera	24-May-19	
Bombus lapidarius	Hymenoptera	23-Jul-19	
Bombus pascuorum	Hymenoptera	24-May-19	
Bombus terrestris	Hymenoptera	20-Jun-19	
Bruchus loti	Coleoptera	20-Jun-19	
Bruchus rufimanus	Coleoptera	24-May-19	
Calliopum aeneum	Diptera	20-Aug-19	
Cantharis lateralis	Coleoptera	20-Jun-19	
Cantharis rustica	Coleoptera	24-May-19	
Chaetorellia jaceae	Diptera	20-Jun-19	
Chorisops tibialis	Diptera	23-Jul-19	
Chorthippus brunneus	Orthoptera	23-Jul-19	
Chorthippus parallelus	Orthoptera	20-Jun-19	
Chrysolina hyperici	Coleoptera	20-Jun-19	
Chrysotoxum bicinctum	Diptera	20-Jun-19	
Chrysotoxum festivum	Diptera	23-Jul-19	
Closterotomus norwegicus	Hemiptera	23-Jul-19	
Coccinella septempunctata	Coleoptera	24-May-19	
Colletes daviesanus	Hymenoptera	19-Aug-19	
Coriomeris denticulatus	Hemiptera	24-May-19	
Cryptocephalus fulvus	Coleoptera	20-Jun-19	
Cryptocephalus moraei	Coleoptera	23-Jul-19	

Cupido minimus	Lepidoptera	20-Jun-19	S41
Deraeocoris (Deraeocoris) ruber	Hemiptera	19-Aug-19	
Dichetophora obliterata	Diptera	20-Jun-19	
Dilophus febrilis	Diptera	20-Aug-19	
Dipogon variegatus	Hymenoptera	23-Jul-19	
Discomyza incurva	Diptera	23-Jul-19	
Dolichopus griseipennis	Diptera	23-Jul-19	
Dolycoris baccarum	Hemiptera	24-May-19	
Drymus (Sylvadrymus) sylvaticus	Hemiptera	19-Aug-19	
Elasmostethus interstinctus	Hemiptera	19-Aug-19	
Elasmucha grisea	Hemiptera	24-May-19	
Entomognathus brevis	Hymenoptera	20-Jun-19	
Eriothrix rufomaculata	Diptera	23-Jul-19	
Eristalis arbustorum	Diptera	19-Aug-19	
Erynnis tages	Lepidoptera	24-May-19	S41
Eupeodes corollae	Diptera	20-Jun-19	
Exorista fasciata	Diptera	11-Sep-19	
Formica lemani	Hymenoptera	24-May-19	
Harmonia axyridis	Coleoptera	20-Jun-19	
Helophilus pendulus	Diptera	19-Aug-19	
Herina lugubris	Diptera	23-Jul-19	
Heterogaster urticae	Hemiptera	20-Jun-19	
Hippodamia variegata	Coleoptera	23-Jul-19	
Hybos grossipes	Diptera	20-Aug-19	
Hydromya dorsalis	Diptera	20-Aug-19	
Hylaeus signatus	Hymenoptera	20-Jun-19	
Ischnopterapion loti	Coleoptera	20-Jun-19	
Lagria hirta	Coleoptera	23-Jul-19	
Lasioglossum cupromicans	Hymenoptera	20-Aug-19	
Lasioglossum leucopus	Hymenoptera	23-Jul-19	
Lasioglossum leucozonium	Hymenoptera	20-Jun-19	
Lasioglossum villosulum	Hymenoptera	23-Jul-19	
Lasius niger	Hymenoptera	24-May-19	
Leptogaster cylindrica	Diptera	24-May-19	
Leptopterna dolabrata	Hemiptera	23-Jul-19	

Lucilia caesar	Diptera	20-Aug-19	
Lucilia richardsi	Diptera	24-May-19	
Lucilia sericata	Diptera	23-Jul-19	
Lycaena phlaeas	Lepidoptera	24-May-19	
Maniola jurtina	Lepidoptera	20-Jun-19	
Mecinus pascuorum	Coleoptera	24-May-19	
Megachile versicolor	Hymenoptera	20-Jun-19	
Megachile willughbiella	Hymenoptera	20-Jun-19	
Megalonotus chiragra	Hemiptera	20-Jun-19	
Melanostoma mellinum	Diptera	11-Sep-19	
Meligethes aeneus	Coleoptera	19-Aug-19	
Melinda viridicyanea	Diptera	23-Jul-19	
Minettia fasciata	Diptera	19-Aug-19	
Myrmeleotettix maculatus	Orthoptera	24-May-19	
Myrmica rubra	Hymenoptera	23-Jul-19	
Myrmica ruginodis	Hymenoptera	24-May-19	
Myrmus miriformis	Hemiptera	19-Aug-19	
Nabis (Nabis) rugosus	Hemiptera	20-Jun-19	
Neoascia podagrica	Diptera	20-Aug-19	
Nephrotoma flavescens	Diptera	23-Jul-19	
Nomada flavoguttata	Hymenoptera	24-May-19	
Nomada striata	Hymenoptera	24-May-19	
Notiophilus substriatus	Coleoptera	20-Jun-19	
Nysius huttoni	Hemiptera	20-Jun-19	
Oedemera lurida	Coleoptera	24-May-19	
Omocestus viridulus	Orthoptera	23-Jul-19	
Oncotylus (Oncotylus) viridiflavus	Hemiptera	19-Aug-19	
Opomyza florum	Diptera	23-Jul-19	
Opomyza germinationis	Diptera	23-Jul-19	
Orchestes rusci	Coleoptera	24-May-19	
Palomena prasina	Hemiptera	23-Jul-19	
Paragus haemorrhous	Diptera	20-Jun-19	
Parydra coarctata	Diptera	20-Jun-19	
Phasia obesa	Diptera	19-Aug-19	

Phasia pusilla	Diptera	19-Aug-19	
Pherbellia cinerella	Diptera	24-May-19	
Phyto melanocephala	Diptera	23-Jul-19	
Phytocoris (Ktenocoris) varipes	Hemiptera	23-Jul-19	
Pieris napi	Lepidoptera	23-Jul-19	
Pipizella viduata	Diptera	24-May-19	
Plagiognathus (Plagiognathus) chrysanthemi	Hemiptera	19-Aug-19	
Platycheirus albimanus	Diptera	23-Jul-19	
Platycheirus clypeatus	Diptera	23-Jul-19	
Polydrusus cervinus	Coleoptera	24-May-19	
Polygonia c-album	Lepidoptera	23-Jul-19	
Polyommatus icarus	Lepidoptera	24-May-19	
Propylea quattuordecimpunctata	Coleoptera	20-Jun-19	
Pyronia tithonus	Lepidoptera	23-Jul-19	
Rhagonycha fulva	Coleoptera	23-Jul-19	
Rhopalus (Rhopalus) subrufus	Hemiptera	19-Aug-19	
Sapromyza quadripunctata	Diptera	23-Jul-19	
Sarcophaga nigriventris	Diptera	23-Jul-19	
Sarcophaga teretirostris	Diptera	20-Aug-19	
Sitona lineatus	Coleoptera	19-Aug-19	
Sphaeroderma testaceum	Coleoptera	20-Jun-19	
Sphaerophoria scripta	Diptera	23-Jul-19	
Sphecodes geoffrellus	Hymenoptera	23-Jul-19	
Sphecodes monilicornis	Hymenoptera	24-May-19	
Stenodema (Brachystira) calcarata	Hemiptera	20-Jun-19	
Syritta pipiens	Diptera	23-Jul-19	
Syrphus ribesii	Diptera	23-Jul-19	
Syrphus torvus	Diptera	11-Sep-19	
Tachyporus hypnorum	Coleoptera	19-Aug-19	
Tachysphex pompiliformis	Hymenoptera	20-Jun-19	
Tephritis formosa	Diptera	24-May-19	
Tephritis leontodontis	Diptera	11-Sep-19	
Tephritis neesii	Diptera	23-Jul-19	
Tetrix subulata	Orthoptera	20-Jun-19	
Tetrix undulata	Orthoptera	23-Jul-19	
Thymelicus sylvestris	Lepidoptera	23-Jul-19	
Tipula fascipennis	Diptera	24-May-	

		19	
Tipula vernalis	Diptera	24-May-19	
Trichosirocalus troglodytes	Coleoptera	24-May-19	
Trichrysis cyanea	Hymenoptera	24-May-19	
Tyria jacobaeae	Lepidoptera	20-Jun-19	S41 (research only)
Urophora stylata	Diptera	23-Jul-19	
Vanessa cardui	Lepidoptera	23-Jul-19	
Vespula germanica	Hymenoptera	24-May-19	
Volucella bombylans	Diptera	20-Jun-19	
Volucella pellucens	Diptera	19-Aug-19	
Zygaena filipendulae	Lepidoptera	23-Jul-19	

*Widely accepted as being much more common than this status suggests; likely to be downgraded.