Hurst Quarry,
Biddulph

An Invertebrate Assessment

A Report for:
Renew Land Developments Ltd

19 September 2017

By:
Conops Entomology Ltd

Report Number: 19.09.17

Hurst Quarry,
Biddulph

An Invertebrate Assessment

Report Number: 19.09.17

By: Andy Jukes BSc (Hons) MCIEEM FRES
andy@conopsentomology.co.uk

Client contact: neil@renewland.com

Conops Entomology Ltd
Registered Office:
Sharkley Meadow Farm
58, Churnet Valley Road
Kingsley Holt
Staffordshire Moorlands
Staffordshire
ST10 2BQ
Company registered in England and Wales.
Company No. 07505919.
VAT Reg No. 159133995

Contents

1 Introduction

1.1 The aim was to undertake an assessment of invertebrates at Hurst Quarry, Biddulph in North Staffordshire (referred to as 'the site' from this point forward) prior to possible development. The assessment was to appraise the key habitats and/or features of the former sandstone quarry through the recording of invertebrates with particular emphasis on solitary bees and wasps. These data were to be used to assess the value to the invertebrates of those habitats or features in order to undertake an evaluation of the site for its importance as a resource to the invertebrates. 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 located at OS grid reference SJ90155952.

1.3 The site comprises open sandy ground, both compacted and loose, early successional swards, scrub fringe, and localized wet areas including small pools.

2 Methods and timings

2.1 The methods utilized for the assessment include bespoke methods and 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 for cataloguing a site's invertebrate resource.

Spot sampling

2.3 Spot sampling was employed to enable close security of bumblebees and the collection of any ambiguous specimens that could not be identified in the field.

Grubbing

2.4 Deadwood and piles of rotting timber were searched for deadwood beetles.

Beating

2.5 Tree limbs and deadwood on branches were tapped to dislodge any hiding beetles. These were collected from a white sheet held under the branch.

Survey timing

2.6 The site was visited on four dates:

26 June 2017: sunny 16–19°C
30 July 2017: sunny 17–21°C

23 August 2017: cloud and sun 18–21°C
2 September 2017: sunny 14–18°C

3 Results summary

The full list of species recorded is provided in Appendix IV, and the species of importance are listed in Table 1.

Table 1 Species of importance

Scientific name	Vernacular name	National status	Habitat preferences and species notes	Site notes
Tiphia minuta	a solitary wasp	Nationally Scarce A*	A parasite on dung beetles; seems to prefer structurally diverse sites with interfaces of habitats	Recorded from the northern end of the quarry
Crossocerus distinguendus	a solitary wasp	Nationally Scarce B	Patchy, sandy areas for nesting and scrub fringe for foraging for prey items	Recorded from the mounds
Gorytes laticinctus	a solitary wasp	Red Data Book 3	Sandy sites with grassland and scrub for foraging for prey items. First Staffordshire record	A single female recorded from rosebay willowherb
Tyria jacobaeae	cinnabar	NERC Act S41 – research only	Open habitats where there is ragwort	Anywhere where there is ragwort

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

3.1 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]) is used.

Resources for determining status

Alexander, K.N.A. and Denton, J.S. (2014) *A Review of the Beetles of Great Britain: The Darkling Beetles and Their Allies. Species Status No. 18*. Natural England Commissioning Reports, Number 148.

Bantock, T. (2016) *A Review of the Hemiptera of Great Britain: The Shield Bugs and Their Allies. Species Status No. 26*. Natural England Commissioning Reports, Number 190.

Falk, S.J., Ismay, J.W. and Chandler, P.J. (2016) *A Provisional Assessment of the Status of Acalyptratae Flies in the UK*. Natural England Commissioned Reports, Number 217.

Hubble, D.S. (2014) *A Review of the Scarce and Threatened Beetles of Great Britain: The Leaf Beetles and Their Allies. Species Status No. 19*. Natural England Commissioning Reports, Number 161.

Shirt, D.B. (1987) *British Red Data Books: 2. Insects*. Nature Conservancy Council, Peterborough.

Sutton, P. (2015) *A Review of the Orthoptera (Grasshoppers and Crickets) of Great Britain: Species Status No. 21*. Natural England Commissioning Reports, Number 187.

[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 on 28 May 2017].

Telfer, M.G. (2016) *A Review of the Beetles of Great Britain: Ground Beetles (Carabidae): Species Status No. 25*. Natural England Commissioning Reports, Number 189.

Results analysis

3.2 Table 2 has been generated using the Pantheon software package, an analytical tool developed by Natural England and the Centre for Ecology & Hydrology (CEH) 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.

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

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

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

Broad biotope	**Habitat**	**No. of species**	**Species with conservation status**	**Conservation status**
Open habitats	Tall sward and scrub	48	1	Section 41 Priority Species – research only: *Tyria jacobaeae*
Open habitats	Short sward and bare ground	33	3	NS A: *Tiphia minuta* NS B: *Crossocerus distinguendus* RDB 3: *Gorytes laticinctus*
Wetland	Peatland	14	–	–
Tree-associated	Shaded woodland floor	7	–	–
Wetland	Running water	5	–	–
Wetland	Marshland	5	–	–
Wetland	Wet woodland	3	–	–
Tree-associated	Wet woodland	3	–	–
Tree-associated	Arboreal	2	–	–
Tree-associated	Decaying wood	1	–	–

Table 3 List of aculeate hymenoptera (bees, wasps, and ants)

Scientific name	Vernacular name	Nesting habits	National Status or other designation
Andrena barbilabris	a mining bee	Open, mobile, or loose sands	–
Andrena bicolor	a mining bee	Compacted patchy bare ground	–
Andrena minutula	a mining bee	Compacted patchy bare ground	–
Anoplius concinnus	a spider-hunting wasp	Open sandy and patchy ground	–
Anoplius nigerrimus	a spider-hunting wasp	Open sandy and patchy ground	–
Arachnospila spissa	a spider-hunting wasp	Open sandy and patchy ground	–
Bombus lapidarius	a bumblebee	Underground in old vole/mouse holes	–
Bombus pascuorum	a bumblebee	Surface nester in tall tussocky grass	–
Bombus sylvestris	a cuckoo bee	Social parasite on *Bombus pratorum*	–
Bombus terrestris	a bumblebee	Underground in old vole/mouse holes	–
Bombus vestalis	a cuckoo bee	Social parasite on *Bombus terrestris*	–
Crossocerus distinguendus	a solitary wasp	Compacted patchy bare ground and deadwood	Nationally Scarce A
Crossocerus quadrimaculatus	a solitary wasp	Loose sands and sandy ground	–
Gorytes laticinctus	a solitary wasp	Compacted patchy bare ground, possibly loose sands	Red Data Book 3 First country record
Lasioglossum albipes	a mining bee	Compacted patchy bare ground	–
Lasioglossum cupromicans	a mining bee	Compacted patchy bare ground	–
Lasioglossum fratellum	a mining bee	Compacted patchy bare ground	–
Lasioglossum morio	a mining bee	Compacted patchy bare ground	–
Lasioglossum villosulum	a mining bee	Compacted patchy bare ground	–
Lasius niger	an ant	Open habitats	–
Lindenius albilabris	a solitary wasp	Compacted patchy bare ground	–
Mellinus arvensis	a solitary wasp	Compacted patchy bare ground	–

Myrmosa atra	a parasitic wingless wasp	Compacted patchy bare ground, loose sands for its hosts	–
Nomada fabriciana	a nomad bee	Compacted patchy bare ground, loose sands for its solitary bee hosts (*Andrena* species)	–
Osmia caerulescens	a mason bee	In deadwood and cavities in masonry, stone, bricks, etc.	–
Oxybelus uniglumis	a solitary wasp	Compacted patchy bare ground and loose sands	–
Pompilus cinereus	a spider-hunting wasp	Open, mobile, or loose sands	–
Sphecodes geoffrellus	a cuckoo bee	Parasite on small *Lasioglossum* species	–
Sphecodes monilicornis	a cuckoo bee	Parasite of *Halictus rubicundus* and *Lasioglossum* species	–
Tiphia minuta	a solitary wasp	Many places where their prey occur (dung beetle larvae)	Nationally Scarce B*
Trypoxylon attenuatum	a wood-boring wasp	Pre-existing cavities in wood and dry stems such as bramble and umbellifers	–

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

Limitations

3.5 The site was only visited from summer onwards (late June–September), and consequently the spring fauna of bees and species such as the dingy skipper's flight period had gone. The result of this is that the list of bees and possibly a few wasps and other spring fauna is not complete for this site, and it is suggested that at least a further three to six species of bee could be recorded from the site. Most of these are likely to be common or local species but do add to the overall value of the site to aculeates (bees, wasps, and ants).

4 Discussion

Habitats

4.1 A total of 120 species were recorded from the surveys. There are three biotopes associated with the site. These are open habitats, tree-associated, and wetland. The biotope with the greatest number of species associated with it is the open habitat biotope. In particular, it is the tall sward and scrub, and short sward and bare ground habitats, that are the most well-represented habitats across the site with a combined total of 81 species affiliated to the mosaic. This mosaic is represented across most of the site and includes open, sandy bare ground areas, mounds of spoil and sandy aggregate material, and all of the vegetated areas, including the small heathy fragments and scrub fringes.

4.2 All of the other habitats from the other biotopes are individually of lower status at the site, being represented by either a few species or common species. However, when combining the wetland habitats into a single assemblage, the combined total is 27 species, so it is of some local value.

4.3 There are other habitats present on the site, but these are not thought pertinent, as they are represented by few species, none of which are scarce or threatened, and the extent of the habitat is minimal.

Species

4.4 The site has a small resource of invertebrates (120 species). The majority of these are associated with bare ground and early successional vegetation or scrub fringes.

4.5 The species present on the site range from generalists of open habitats to those that are of higher fidelity to specific niches and are therefore not species likely to be recorded from the wider countryside. Many of these species are the solitary bees and wasps that nest in sandy ground and forage nearby on flowers or search for prey items on vegetation, such as scrub or grasses.

4.6 There are other species that are synonymous with sandy ground, thermophilic sites such as the green tiger beetle (*Cicindela campestris*), and a suite of hoverflies including *Chrysotoxum festivum* and *Paragus haemorrhous*. These species have a requirement for short or sparse swards and often with a sheltering component such as scrub; in the site's situation, high quarry cliffs help create a warm microclimate.

4.7 The site, owing to its location and elevation, also includes species associated strongly with heathlands and/or moorland. The solitary bees *Colletes succinctus* and *Lasioglossum fratellum* are species associated with heathland matrix habitats.

4.8 The site does hold some potential for the dingy skipper butterfly (*Erynnis tages*), a NERC Act Section 41 species; however, owing to the timescales of the survey, this species could not be adequately surveyed for. The species will however be accommodated for within any mitigation for the site.

Aculeate hymenoptera

4.9 Although only 120 species were recorded from the surveys, the majority of the focus was on recording and observing the solitary bee and wasp species, as this fauna was highlighted as the key fauna of the site that required evaluating.

4.10 The bee and wasp fauna comprises 31 species, 23 of which are regarded as ground-nesting. These species dig or use holes in the ground in which they construct a nest to raise their offspring. The species comprise common, local and nationally significant species, including one species that has so far not been recorded from any other locality in Staffordshire or the wider-recording Vice-County 39 (VC39)[2].

4.11 *Gorytes laticinctus* is a Red Data Book 3 species of solitary wasp that, until recently, was very scarce, being recorded only from the south and south-east of England. It has had an expansion in range over recent years becoming more frequently recorded, but it is still likely to be of some national significance, and it has been suggested that a lower status such as nationally scarce may be applied to it in the upcoming 2018 national review of bees and wasps. It is unlikely that this record constitutes the only site for this species in Staffordshire or VC39, but it is highly likely that there are fewer than 10 sites in Staffordshire where it is recorded; however, this site in north Staffordshire, at this elevation and latitude, is significant for the district and county.

4.12 The Staffordshire Wildlife Trust Site of Biological Importance (SBI) criteria (2014[3]) detail specific criteria for the selection of SBIs in relation to invertebrates and also sites that possess an assemblage of ground-nesting bees and wasps, which are also included on the Staffordshire Biodiversity Action Plan (SBAP).

The SBI criteria that are required to be met are as follows:

'An SBW+ (Solitary Bee and Wasp) site includes its core breeding ground and any outlying habitat which is used for hunting/foraging when this area can be easily identified e.g. a small ruderal and scrubby habitat surrounded by improved grassland or where its food plant/foraging area can be identified and located.

SBIs
All sites that supports an established breeding population of any nationally scarce (notable) or Red Data Book species of SBW+.

1. All sites that support an established breeding population of SBW+ which are rare or scarce in the county, i.e. species known from fewer than 10 localities, but only where the county distribution of that species has been adequately recorded.

2. Any site with an assemblage of 18 or more breeding species of SBW+.

3. Any site with an Archer index (1997) score of 1.6 or over.[4]'

(taken from Webb *et al*., 2014)

---

[2] Webb, J., Bloxham, M. and Slawson (2005) updated by Jukes, A, Cartright, R. (2014) *The Bees and Wasps (Hymenoptera) of Staffordshire*. Available at: http://www.staffs-ecology.org.uk/html2015/index.php?title=Search_the_Atlas&atlasid=W [Accessed on 19 September 2017].
[3] Webb, J., Lawley, S., Cadman, D., Slawson, C., Smith, J. and Weightman, J. (2014) Guidelines for the selection of sites of county biological importance in Staffordshire. Available at: http://www.staffs-ecology.org.uk/html2015/images/1/17/Staffordshire_SBI_Guidelines.pdf. [Accessed on 18 September 2017].
[4] Archer, M.E. (1997) "Status and quality coding – part 2 & 3. *BWARS Newsletter*, Spring 1997, 4–5 & Autumn 1997, 8.

4.13 In particular, points 1 and 2 are the most relevant, as the Archer score may be out of date in 2017 and may need revising.

4.14 Based on the above information and criteria, the site qualifies on both bullet point 1 and point 2 as an SBI in Staffordshire. See Table 4 for supporting information.

Table 4 Aculeate hymenoptera breakdown and qualification for SBI status

	Total number of aculeate species recorded	**Total number of SBI qualifying ground-nesting species (inc. parasites and associates)**	**Threshold for SBI status**	**Total number of scarce species recorded**	**Threshold for SBI status**
Number of species	31	23 breeding species	18+ breeding species	2 genuinely scarce breeding species	1 genuinely scarce breeding species
		Qualifies		**Qualifies**	

5 Assessment summary

Site assessment

5.1 The site is a disused sandstone quarry with a range of ground features, from open bare sands that are compacted to loose piles of sandy deposits. The landforms are varied across the site, and this complexity gives rise to many opportunities for invertebrates. This is complemented by the range of successional status on the site, from short swards with yellow composites and heather stands to established scrub fringes and ruderals.

5.2 Other habitats are also present, including wetland features including surface running water, pools, and wet grassy areas.

5.3 The habitats of primary value, however, are those associated with the sandy ground, as this is the area where most of the key species breed, namely the solitary bees and wasps. The site assemblage of bees and wasps comprises a typical range of species one would find in a sandstone quarry, from common and ubiquitous species of open habitat to those that have a more exacting requirement from a site, such as mobile sands or compacted patchy ground with adjacent flowery patches. This list also includes one species that was not expected and is a first county record, *G. laticinctus*.

5.4 Thirty-one aculeate species in total were recorded, and 23 of these are regarded as ground-nesting. This ground-nesting group of solitary bees and wasps includes a range of common species that can be found in a wide range of situations such as parks and gardens to others that are more bespoke in their requirements requiring specific features such as loose sandy ground (*Pompilus cinereus* and *Andrena barbilabris*) or compacted ground (most of the *Andrena* and solitary wasp species). Many of the solitary bees are specific to a particular range of flowering plants or even a single plant family or species, placing further demands on a site. For these reasons, a large number of solitary bees and wasps are scarce or threatened and in decline, either at the local level or nationally. The solitary bees and wasps fauna is therefore included on the SBAP as an SBAP species group and also forms part of the Staffordshire Wildlife Trust's SBI criteria.

5.5 The wider invertebrate resource is typical of low-nutrient flowery sites with a range of features. The small wetland resource includes a number of specialist flies such as the hoverflies *Orthonevra nobilis* and *Lejogaster metallina* that are restricted to wetland areas or features, and the scrub fringe is a dynamic feature that is favoured by many fly species and leaf beetles.

Site evaluation

5.6 The site is a former sandstone quarry. It possesses a range of features that offer opportunity to invertebrates owing to the complexity of the landforms. In particular, the site is noted for its solitary bees and wasps.

5.7 The site is in an area where there are very few sandstone quarries, most being found in the south and south-east of the district near Cheadle. The site therefore may represent a key location for solitary bees and wasps within the western half of the Staffordshire Moorlands district.

5.8 The site is of considerable size, consisting of all the features the invertebrates require to fulfil their life cycles from breeding to foraging. This is with the exception of the bumblebees, which tend towards landscape-scale foraging. The solitary bee and wasps species recorded on the site therefore are also thought to be breeding there.

5.9 The site has been proven to hold a resource of ground-nesting bees and wasps that fulfils adequately the SBI guidelines having 23 breeding species and two species of genuine scarcity.

5.10 The valuation of the site therefore takes into consideration the above factors along with the range of species recorded accounting for the potential for others to be found in spring, the scarce species, and the importance of the habitats to the species and context of the site in relation to the surrounding landscape and its use. 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 Chartered Institute of Environmental Managers and Ecologists (Appendix III), it is suggested that the site should be considered to be of **district (low) importance** (Plant, 2009).

5.11 In relation to the Staffordshire Wildlife Trust guidelines (2014), the site should be considered to be of **SBI quality**.

5.12 The site is considered to be of district (low) importance, owing to the range of species recorded, including a county first record, but also acknowledging that it is likely to be recorded at other sandy quarry locations, though these are probably in the south of the county. The valuation is also thought to be appropriate, as sandstone quarries in this district are few, and as noted, quarries are particularly important to invertebrates, often of much greater value than any surrounding land.

5.13 A higher category of County (medium) importance is not thought to be appropriate for the site, despite the qualifying SBI status, as the species composition is typical of quarries and sandy places in Staffordshire (other than *G. laticintus*) and as such is not unique or special at the county level, but this should not detract from the value of any site containing an assemblage of solitary bees and wasps.

5.14 Given that the site is considered to be of some value to the district, it is suggested that, should any of the features of value be impacted, optimally created and subsequently managed habitats should be provided to ensure resources are still available at the site.

6 Recommendations

6.1 The success of any mitigation will be dependent on incorporating the following habitats and features that are both extensive and optimal. They should also be managed appropriately.

6.2 All invertebrate mitigation should be created on *low-fertility* soils to enable a rich flowering resource to establish. No topsoil or rich organic material should be used.

6.3 Finally, to produce robust and rich invertebrates mitigation, all of the features should be as a mosaic and juxtaposed to one another.

Flower-rich acid grassland/heath

6.4 Flowering areas should be sown with an appropriate mix of flowering plants and be indicative of the area, and so a heathy and acid grassland bias is suggested to benefit the range of nectivorous species found on the site, especially the solitary bees and wasps, and should include some or all of the following:

- bell heather (*Erica cinerea*)
- common bird's-foot trefoil (*Lotus corniculatus*)
- harebell (*Campanula rotundifolia*)
- hawkbits (*Leontodon* spp.)
- ling (*Calluna vulgaris*)
- other yellow composites (common cat's-ear, etc.)
- tormentil (*Potentilla erecta*)

6.5 Any pond, wetland areas, swales, and attenuation pools could be planted with suitable marginal plants to benefit pollinators, too.

- marsh marigold (*Caltha palustris*)
- marsh woundwort (*Stachys sylvatica*)
- water figwort (*Scrophularia auriculata*)
- water mint (*Mentha aquatica*)

Early successional mosaic (short turf and bare sandy ground)

6.6 This mosaic is the key habitat for many of the species of value to the site, including the bee and wasp assemblage and also the potential presence of the dingy skipper butterfly.

6.7 The bare sandy ground and a flowery turf mosaic should approximate to 50% bare ground and 50% vegetation cover. The material used can be varied, and the use of on-site materials (sands and gravels) is ideal. The presence of open and friable sands is the important feature of this habitat mosaic.

6.8 It is important that all of the features present in the mosaic are in close proximity to one another and are in an optimal state. This will be relatively easily achieved on the nutrient poor subsoils and exposed bare sands present at the site.

6.9 The bare ground constituent of the mitigation should include both southerly facing vertical and near vertical exposures and also open sandy horizontal planes that are exposed to full sun for much of the day, including the key period between 10:00 and 16:00 h.

6.10 More than one vertical exposure is suggested, and they should be slightly different from each another to increase the variation across the exposure resource. Some slumping of the vertical faces is permissible, and for some species a desirable characteristic, and should not be viewed negatively. Each exposure should be at least 50 cm high and 4 m long.

6.11 The bare ground should comprise sandy open ground, some friable and loose other patches compacted. To form a mosaic, areas of patchy open swards should be sown or allowed to succeed from the bare ground. The ground surface can be uneven, with divots and shallow depressions. The microtopography is an important feature, as it increases the value of the mitigation. Overworking of the material should be avoided, as this tends to result in an even surface, which is undesirable for invertebrate mitigation.

6.12 Early successional swards are readily replicated through the very sparse sowing of key flowering plants and fine-leaved grasses. The mix should include:

- Bent grasses (*Agrostis* spp.)
- Common bird's-foot trefoil (*Lotus corniculatus*)
- Common cat's ear (*Hypochoeris radicata*)
- Fescue grasses (*Festuca* spp.)
- Other hawkbits (*Leontondon* spp.)
- Ox-eye daisy (*Leucantheum vulgare*)

Other suitable native species could be included to complement the mix.

6.13 Management of the resource should be in the form of rotational scraping of the bare ground features over a long cycle of approximately 7 years, depending on the rates of succession. The best way to achieve this is to divide the bare ground features into management units, thus enabling easily achievable management in each year. Further advice on managing early successional habitats can be required.

6.14 Prior to any management plan being completed and implemented, an experienced invertebrate ecologist should be consulted on the final document to ensure that it is fit for purpose.

Scrub

6.15 Scrub is an important structural element of a bee and wasp site. This should be on the northern side of any flower-rich areas or bare-ground breeding areas so as to not cast shade. The scrub should include species indicative of the area but also contribute to the invertebrates on site. Therefore, the use of native flowering scrub species is recommended and horticultural versions not recommended, particularly those that are double-flowered that have no value to nectar- and pollen-dependent invertebrates.

The species could include:

- hawthorn (*Crataegus monogyna*)
- blackthorn (*Prunus spinosa*)
- field maple (*Acer campestre*)
- goat willow (*Salix caprea*)
- gorse (*Ulex europaeus*)

7 References and bibliography

Alexander, K.N.A. (2014) *A Review of the Beetles of Great Britain: The Soldier Beetles and Their Allies. Species Status No. 16*. Natural England Commissioning Reports, Number 134.
Alexander, K.N.A. and Denton, J.S. (2014) *A Review of the Beetles of Great Britain: The Darkling Beetles and Their Allies. Species Status No. 18*. Natural England Commissioning Reports, Number 148.
Anon. (2008) *Acalyptratae Keys*. Unpublished Test Keys. Dipterists Forum.**Ball, S. (2005)** *Hoverfly Recording Scheme*. Available at: www.hoverfly.org.uk [Accessed on 6 September 2017].
Bantock, T. (2016) *A Review of the Hemiptera of Great Britain: The Shield Bugs and Their Allies. Species Status No. 26*. Natural England Commissioning Reports, Number 190.
d'Annis Fonseca, E.C.M. (1978) *Diptera Orthorrhapha Brachyycera – dolichopodidae*. Royal Entomological Society of London, London.
Drake, C.M. *et al*. (2007) *NERR005. Surveying Terrestrial and Freshwater Invertebrates for Conservation Evaluation*. Natural England, Peterborough.
Falk, S. (2015) *Field Guide to the Bees of Great Britain and Ireland*. British Wildlife Publishing, Totnes.
Hubble, D.S. (2014) *A Review of the Scarce and Threatened Beetles of Great Britain: The Leaf Beetles and Their Allies. Species Status No. 19*. Natural England Commissioning Reports, Number 161.
Lott, D. *et al*. (2007) *ISIS. Invertebrate Species–Habitat Information System, 2010 Build*. Natural England, Peterborough.
Plant, C. (2009) *Invertebrates and Ecological Assessment.* http://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/SoSM/Colin_Plant_-_Invertebrates.pdf [Accessed on 6 September 2017].
Richards, O.W. (1980) *Scolioidea, Vespoidea and Sphecoidea. Hymenoptera, Aculeata*. Royal Entomological Society, London.
Shirt, D.B. (1987) *British Red Data Books: 2. Insects*. Nature Conservancy Council, Peterborough.
Stubbs, A.E. (2002) *British Hoverflies*. British Entomological and Natural History Society, Reading.
Stubbs, A.E. and Drake, M. (2001) *British Soldierflies and Their Allies*. British Entomological and Natural History Society, Reading.
Sutton, P. (2015) *A Review of the Orthoptera (Grasshoppers and Crickets) of Great Britain: Species Status No. 21*. Natural England Commissioning Reports, Number 187.
Telfer, M.G. (2016) *A Review of the Beetles of Great Britain: Ground Beetles (Carabidae): Species Status No. 25*. Natural England Commissioning Reports, Number 189.

8 Appendices

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

Appendix I: Red Data Book definitions

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 fifteen 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: International Union for Conservation Nature definitions

REGIONALLY EXTINCT (RE) A taxon is Extinct when there is no reasonable doubt that the last individual has died. In this review, the last date for a record is set at 50 years before publication.
CRITICALLY ENDANGERED (CR) A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered.
ENDANGERED (EN) A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered.
VULNERABLE (VU) A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable.
NEAR THREATENED (NT) A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered, or Vulnerable now, but is close to qualifying for, or is likely to qualify for, a threatened category in the near future.
LEAST CONCERN (LC) A taxon is of Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable, or Near Threatened. Widespread and abundant taxa are included in this category.
DATA DEFICIENT (DD) A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.
NOT EVALUATED (NE) A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

Appendix III: 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 (Ratcliffe, 1989[5]) 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	–	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

[5] Ratcliffe, D.A., ed. (1989) *Guidelines for Selection of Biological SSSIs*. Nature Conservancy Council, Peterborough.

(low importance)		Nationally Local species

SSSI: Site of Special Scientific Interest.

Appendix IV: Survey results

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

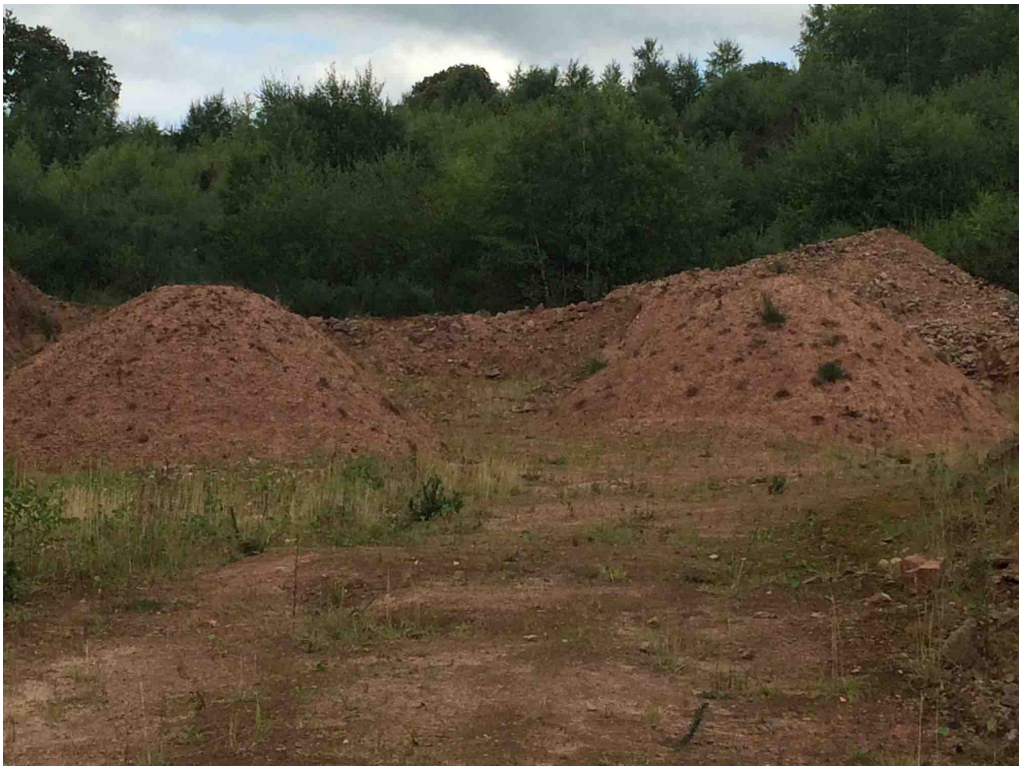
Taxon	Vernacular name	Date first recorded	Status
Andrena barbilabris	a mining bee	26-Jun-17	–
Andrena bicolor	Gwynne's mining bee	26-Jun-17	–
Andrena minutula	a mining bee	26-Jun-17	–
Anomoia purmunda	a fruitfly	30-Jul-17	–
Anoplius concinnus	a spider-hunting wasp	30-Jul-17	–
Anoplius nigerrimus	a spider-hunting wasp	26-Jun-17	–
Anthocoris nemorum	a bug	30-Jul-17	–
Anthonomus rubi	strawberry blossom weevil	01-Aug-17	–
Aphantopus hyperantus	ringlet	26-Jun-17	–
Arachnospila spissa	a spider-hunting wasp	30-Jul-17	–
Beris vallata	a soldierfly	26-Jun-17	–
Bombus lapidarius	large red-tailed bumble bee	26-Jun-17	–
Bombus pascuorum	common carder bee	26-Jun-17	–
Bombus sylvestris	a bumblebee	26-Jun-17	–
Bombus terrestris	buff-tailed bumble bee	26-Jun-17	–
Bombus vestalis	a bumblebee	26-Jun-17	–
Cantharis nigra	a soldier beetle	26-Jun-17	–
Cantharis rufa	a soldier beetle	26-Jun-17	–
Chorthippus brunneus	common field grasshopper	30-Jul-17	–
Chorthippus parallelus	meadow grasshopper	23-Aug-17	–
Chrysopilus cristatus	a snipefly	26-Jun-17	–
Chrysotoxum festivum	a hoverfly	30-Jul-17	–
Cicadella viridis	a leafhopper	30-Jul-17	–
Cicindela campestris	green tiger beetle	26-Jun-17	–
Closterotomus norwegicus	a bug	30-Jul-17	–
Coccinella septempunctata	seven-spot ladybird	23-Aug-17	–
Colletes succinctus	a mining bee	30-Jul-17	–
Crossocerus distinguendus	a digger wasp	26-Jun-17	NSA
Crossocerus quadrimaculatus	four-spotted digger wasp	26-Jun-17	–
Dolichopus ungulatus	a dolyfly	26-Jun-17	–
Empis livida	a dancefly	26-Jun-17	–
Episyrphus balteatus	a hoverfly	26-Jun-17	–

Eristalis abusiva	a hoverfly	26-Jun-17	–
Eristalis tenax	a hoverfly	26-Jun-17	–
Eupeodes corollae	a hoverfly	26-Jun-17	–
Eupeodes luniger	a hoverfly	26-Jun-17	–
Eupeodes luniger	a hoverfly	26-Jun-17	–
Forficula auricularia	common earwig	30-Jul-17	–
Gorytes laticinctus	a digger wasp	30-Jul-17	RDB3
Haematopota pluvialis	a horsefly	26-Jun-17	–
Helophilus pendulus	a hoverfly	26-Jun-17	–
Herina lugubris	a fruitfly	26-Jun-17	–
Heterotoma planicornis	a bug	30-Jul-17	–
Lasioglossum albipes	a mining bee	26-Jun-17	–
Lasioglossum cupromicans	a mining bee	26-Jun-17	–
Lasioglossum fratellum	a mining bee	30-Jul-17	–
Lasioglossum morio	brassy mining bee	26-Jun-17	–
Lasioglossum villosulum	shaggy mining bee	26-Jun-17	–
Lasius niger sens. lat.	an ant	30-Jul-17	–
Lasius niger sens. str.	an ant	30-Jul-17	–
Lejogaster metallina	a hoverfly	23-Aug-17	–
Leptogaster cylindrica	a robberfly	26-Jun-17	–
Leptopterna dolabrata	a bug	30-Jul-17	–
Limnia unguicornis	a snail-killing fly	23-Aug-17	–
Lindenius albilabris	a digger wasp	30-Jul-17	–
Lycaena phlaeas	small copper	30-Jul-17	–
Maniola jurtina	meadow brown	26-Jun-17	–
Melanostoma mellinum	a hoverfly	26-Jun-17	–
Mellinus arvensis	field digger wasp	30-Jul-17	–
Mesembrina meridiana	a fly	23-Aug-17	–
Micropeza corrigiolata	a stil-legged fly	26-Jun-17	–
Minettia fasciata (=*rivosa*)	a lauxanid fly	23-Aug-17	–
Myrmosa atra	black-headed velvet ant	30-Jul-17	–
Neoascia podagrica	a hoverfly	30-Jul-17	–
Neolygus contaminatus	a bug	30-Jul-17	–
Nephrotoma scurra	a cranefly	26-Jun-17	–
Nomada fabriciana	a cuckoo bee	26-Jun-17	–
Notostira elongata	a bug	30-Jul-17	–
Nysius huttoni	a weevil	30-Jul-17	–
Oedemera lurida	a thick-thighed beetle	26-Jun-17	–
Omocestus viridulus	common green grasshopper	26-Jun-17	–
Opomyza florum	a seedfly	23-Aug-17	–
Orthonevra nobilis	a hoverfly	26-Jun-17	–
Osmia caerulescens	a mason bee	26-Jun-17	–

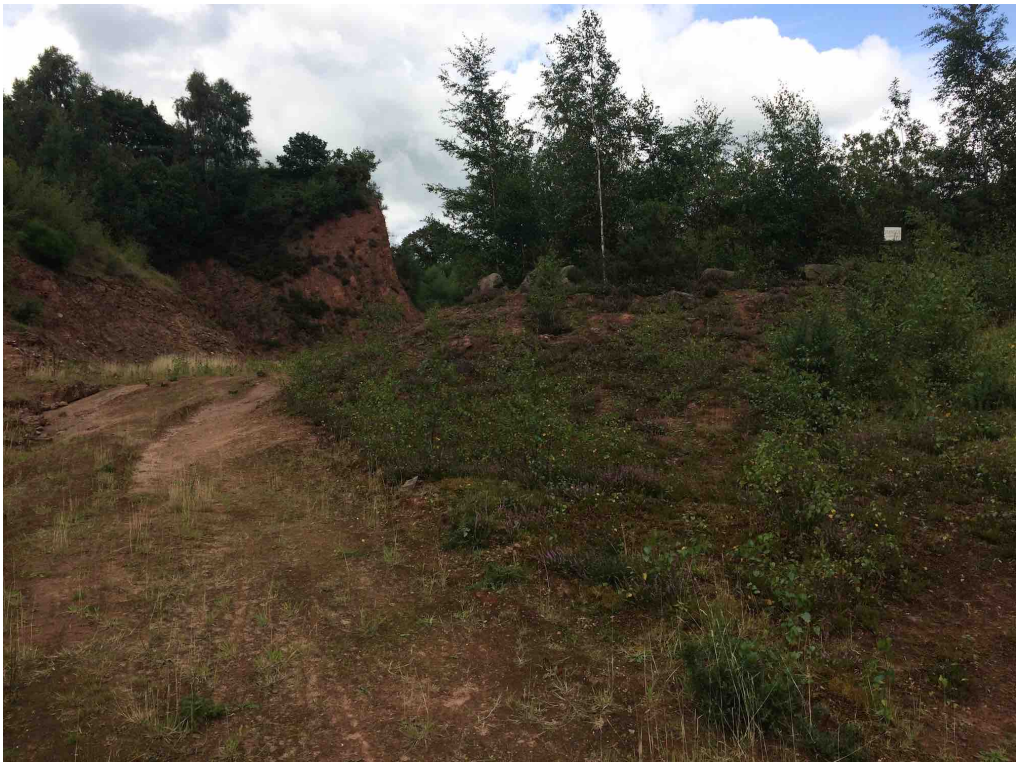
Oxybelus uniglumis	common spiny digger wasp	26-Jun-17	–
Oxycera rara	a soldierfly	26-Jun-17	–
Palomena prasina	common green shieldbug	23-Aug-17	–
Paragus haemorrhous	a hoverfly	26-Jun-17	–
Pararge aegeria	speckled wood	26-Jun-17	–
Perapion hydrolapathi	a weevil	30-Jul-17	–
Piezodorus lituratus	gorse shieldbug	30-Jul-17	–
Pipizella viduata	a hoverfly	26-Jun-17	–
Plagiognathus chrysanthemi	a bug	30-Jul-17	–
Platycheirus albimanus	a hoverfly	26-Jun-17	–
Platycheirus clypeatus	a hoverfly	26-Jun-17	–
Platycheirus granditarsus	a hoverfly	23-Aug-17	–
Platycheirus rosarum	a hoverfly	30-Jul-17	–
Polyommatus icarus	common blue	23-Aug-17	–
Pompilus cinereus	leaden spider wasp	26-Jun-17	–
Pyronia tithonus	gatekeeper	30-Jul-17	–
Rhagio tringarius	a snipefly	30-Jul-17	–
Rhagonycha fulva	a soldier beetle	26-Jun-17	–
Rhamphomyia variabilis	a dancefly	23-Aug-17	–
Rhingia campestris	a hoverfly	26-Jun-17	–
Rivellia syngenesiae	a fruitfly	26-Jun-17	–
Saldula saltatoria	a bug	30-Jul-17	–
Scellus notatus	a dolyfly	30-Jul-17	–
Sicus ferrugineus	a thick-headed fly	30-Jul-17	–
Sphecodes geoffrellus	a cuckoo bee	26-Jun-17	–
Sphecodes monilicornis	a cuckoo bee	23-Aug-17	–
Sphecodes spinulosus	a cuckoo bee	26-Jun-17	–
Syritta pipiens	a hoverfly	26-Jun-17	–
Syrphus ribesii	a hoverfly	23-Aug-17	–
Syrphus torvus	a hoverfly	26-Jun-17	–
Tephritis formosa	a fruitfly	23-Aug-17	–
Tephritis vespertina	a fruitfly	26-Jun-17	–
Terellia ruficauda	a fruitfly	26-Jun-17	–
Tetanocera elata	a snail-killing fly	26-Jun-17	–
Tetrix subulata	slender ground hopper	26-Jun-17	–
Tetrix undulata	common ground hopper	26-Jun-17	–
Tiphia minuta	the small tiphia	26-Jun-17	NSB
Tipula oleracea	a cranefly	30-Jul-17	–
Tipula paludosa	a cranefly	23-Aug-17	–
Trypoxylon attenuatum	slender wood-borer wasp	30-Jul-17	–
Tyria jacobaeae	cinnabar	26-Jun-17	S41

Vanessa atalanta	red admiral	26-Jun-17	–
Volucella pellucens	a hoverfly	26-Jun-17	–
Xylota segnis	a hoverfly	26-Jun-17	–
Zygaena filipendulae	six-spot burnet	26-Jun-17	–

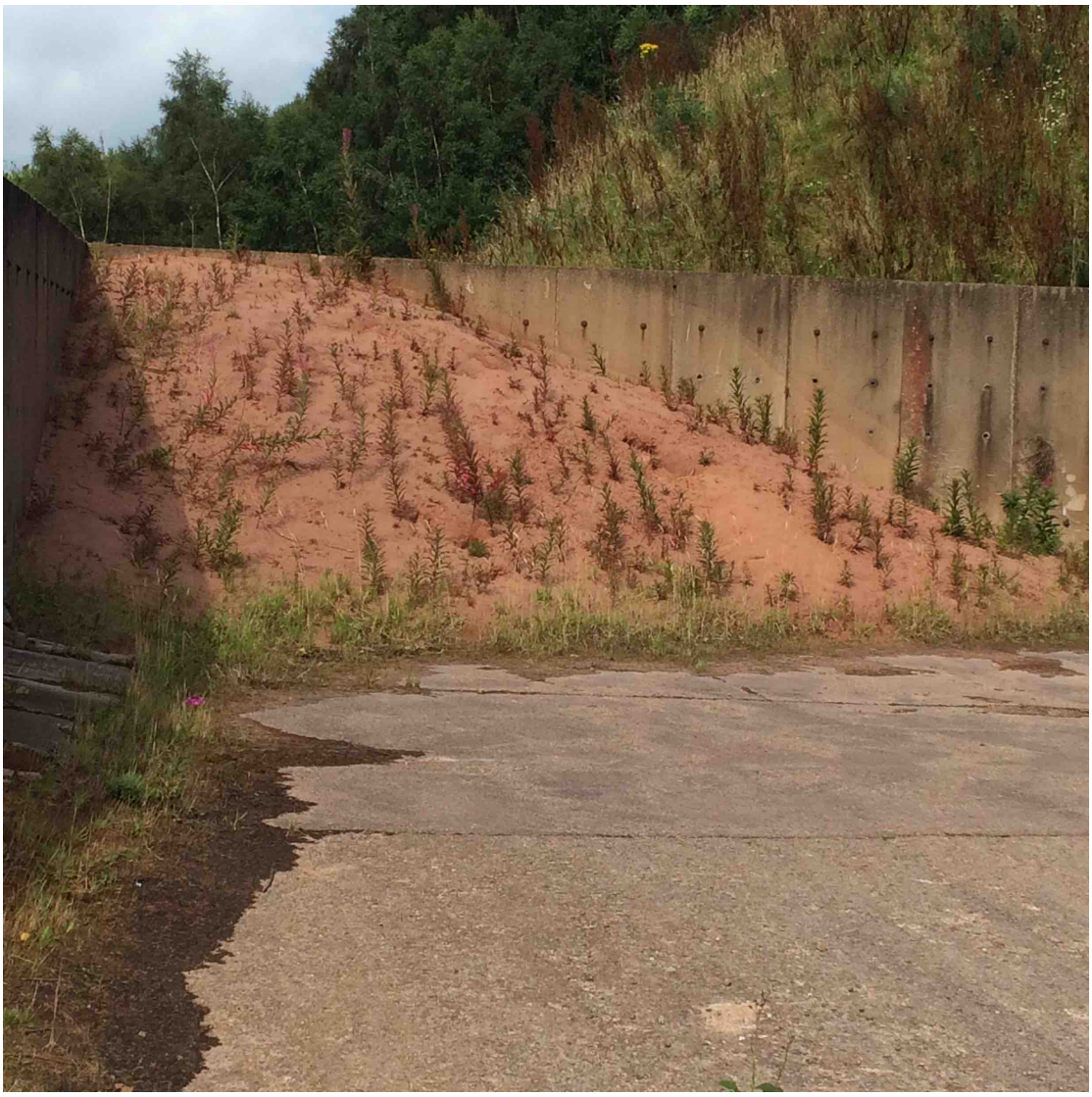
Appendix V: Photographs



Partly compacted mounds of sands and gravels: location of *Colletes succinctus* nesting aggregation.



Small area of heather, bare ground, and scrub: a key location for foraging bees and hunting wasps including the spider-hunting wasp *Arachnospila spissa*.



Key location for a number of nesting species, including *Mellinus arvensis* (field digger wasp), *Myrmosa atra* (black-headed velvet ant), *Andrena barbilabris* (a mining bee), *Crossocerus quadrimaculatus* (four-spotted digger wasp), and *Pompilus cinereus* (leaden spider-hunting wasp).