

Appendix 7F

Invertebrate Report



**NANT HELEN AND ONLLWYN INVERTEBRATE SURVEY,
MAY – SEPTEMBER 2019 - FINAL REPORT**

David Boyce

DC Boyce
Ecologist
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1. INTRODUCTION

This report details the findings of an invertebrate survey carried out under contract to Arup. It aims to assess the importance for invertebrates of a large area of land lying to the north-east of Ystradgynlais, the location of which is shown on Figure 2.1. This land is in the ownership of Celtic Energy and comprises two blocks: the Onllwyn Washery, lying at the north-eastern end and to the south-west, a second much larger block centred on the Nant Helen opencast coal mine. For the sake of brevity, the site is hereafter referred to simply as 'Nant Helen'.

It is a very large site that straddles the border between the counties of Brecon and Glamorgan (Watsonian vice counties 42 and 41 respectively). A central grid reference approximates to SN818109. It includes parts of four Ordnance Survey 10km grid squares (hectads) namely: SN70, SN71, SN80 and SN81, with most of the area lying within the latter two hectads.

The Nant Helen block consists of the gently sloping ridge of Mynydd y Drum, which reaches a height of 298 metres and is oriented in a north-east to south-west direction. On its eastern margin, it runs down into the valley of the Afon Dulas. To the west, it is bounded by Cwm Tawe, falling to approximately 125 metres at its south-western extremity. All of this land lies in the catchment of the Afon Tawe, but much of the Onllwyn block drains north-east by way of Gors Llwyn into the Afon Pyrdin. Indeed, the fen habitat at WY10 and WY11 is the source of much of the water irrigating the very important soligenous wetland at Gors Llwyn, Onllwyn SSSI.

There are no statutory nature conservation designations covering the site. However, the Gors Llwyn, Onllwyn Site of Special Scientific Interest (SSSI) lies adjacent to its north-eastern boundary, being separated from it by the A4221 road. The SSSI has been notified for its stands of fen and acid bog habitat, with the latter including a rather degraded area of raised mire. This block of wetland habitat is continued and fed by water from the very extensive area of wetland that occupies the northern part of the Onllwyn sub-site (units WY10 and WY11 on Figure 2.1). The vegetation in these two units is very diverse, including stands of transition mire, species-rich poor fen, marshy grassland and willow scrub. The areas of ungrazed transition mire in WY11 are of outstanding ecological interest, with a very high water table and a diverse plant assemblage that includes abundant water horsetail *Equisetum fluviatile*, marsh cinquefoil *Potentilla palustris*, bogbean *Menyanthes trifoliata* and bottle sedge *Carex rostrata*, plus frequent water mint *Mentha aquatica*, yellow loosestrife *Lysimachia vulgaris*, locally abundant devil's-bit scabious *Succisa pratensis* and a range of other wetland plants. This vegetation is referable to the S27 type of the National Vegetation Classification (NVC). Towards the central drainage line, the vegetation is at first transitional towards taller fen dominated by greater tussock-sedge *Carex paniculata*, slender sedge *Carex lasiocarpa* and common reed *Phragmites australis* and then to grey willow *Salix cinerea* carr.

On somewhat drier ground in WY11, the wet fen described in the preceding paragraph grades towards superb stands of species-rich fen-meadow with abundant rushes *Juncus* spp., common valerian *Valeriana officinalis*, ragged robin *Lychnis flos-cuculi*, southern marsh

orchid *Dactylorhiza praetermissa*, common sorrel *Rumex acetosella*, common vetch *Vicia sativa* and many other species.

WY10 has a mixture of very heavily grazed marshy and acid-neutral grassland and poor fen with shallow runnels. The latter areas are kept very open by the considerable pony grazing pressure and have a short, open sward of rushes, water mint, lesser spearwort *Ranunculus flammula* brooklime *Veronica beccabunga* and marsh lousewort *Pedicularis palustris*, with much bare, poached mud between the clumps of low vegetation. Runnels here have NVC M29-type vegetation dominated by floating mats of bog pondweed *Potamogeton polygonifolius* and emergent growth of marsh St. John's-wort *Hypericum elodes* and bulbous rush *Juncus bulbosus*.

In both WY10 and WY11, there are some more oligotrophic nuclei marked out by the appearance of frequent acidophiles such as common cottongrass *Eriophorum angustifolium* and bog-mosses *Sphagnum* spp. The northern edge of WY11 also has a large stand of rank, species-poor purple moor-grass *Molinia caerulea* bog, which is much less floristically diverse than the other wetland communities in this unit, though it does have a good population of marsh violet *Viola palustris*.

On the Nant Helen block, there are smaller stands of grazed mesotrophic fen in L2 and spring-fed soligenous mires in O2 and O3. These are dominated by a field layer of rushes over a ground layer of 'brown mosses' such as *Calliergon cuspidatum*, *Philonotis fontana* and *Scorpidium scorpioides*.

In addition to the fragments of acid mire vegetation within the Gors Llwyn complex, there is a very high-quality stand of acidic bog on the Nant Helen block, around the pools in survey unit B1. This has carpets of bog-mosses and bulbous rush *Juncus bulbosus* around pool margins, plus drier bog with tussocks of both common and hare's-tail cottongrass *Eriophorum vaginatum*, purple moor-grass, ling *Calluna vulgaris* and cross-leaved heath *Erica tetralix*. Similar vegetation is found on the edge of the pool at R1. Around the margins of the main block of unimproved moorland on Mynydd y Drum (primarily in units O1 and P1) there are numerous acid flushes with *Sphagna*, sharp-flowered rush *Juncus acutiflorus*, soft rush *J. effusus* and small sedges *Carex* spp., such as small yellow sedge *C. demissa*, star sedge *C. echinata* and carnation sedge *C. panicea*.

Across much of the actively worked area of the Nant Helen opencast workings and the Onllwyn Washery, there are areas of sparsely vegetated spoil generated as a result of the mining activity here. Similar habitats are also found locally along track edges through the recently felled coniferous forestry block in survey unit J1. The vegetation in these areas shows a characteristic post-disturbance succession. Initially, the bare ground is colonised by very sparse, rather species-poor growth of early-successional specialists such as coltsfoot *Tussilago farfara*.

Following this, more recognisable mesotrophic grassland with species such as bird's-foot trefoil *Lotus corniculatus*, red clover *Trifolium pratense*, common vetch *Vicia sativa*, tufted vetch *V. cracca*, common dog-violet *Viola riviniana*, hardheads *Centaurea nigra* and oxeye daisy *Lecanthemum vulgare* becomes established. In many places, these more mature

swards have a strong marshy grassland element, with frequent ragged robin, southern marsh-orchid, sedges and rushes. There is also a strong representation of ruderal specialists such as hop trefoil *Trifolium campestre*, lesser trefoil *Trifolium dubium* and black medick *Medicago lupulina* and at this stage, the sward is still short and open, with frequent patches of bare ground. On the Onllwyn Washery, there are unusually species-rich stands of ruderal grassland that have calcicolous species, such as kidney vetch *Anthyllis vulneraria*, ribbed melilot *Melilotus officinalis*, fairy flax *Linum catharticum*, glaucous sedge *Carex flacca* and bee orchid *Ophrys apifera*.

As the sward becomes a little more mature and the spoil is leached of nutrients, the vegetation in turn begins to be colonised by open-structured grass-heath, with increasing representation of acidophilous specialists such as ling, bell heather *Erica cinerea*, western gorse *Ulex gallii*, tormentil *Potentilla erecta*, wavy hair-grass *Deschampsia flexuosa*, common bent *Agrostis capillaris*, and sheep's fescue *Festuca ovina*. In time, this continues to mature towards fairly typical dry heath dominated by ling and bell heather, with abundant cushions of pleurocarpous mosses such as *Hylocomium splendens*, *Hypnum jutlandicum* and *Pleurozium schreberi* in the ground layer.

Along the valley of the Afon Dulas in units K3 and L2, there are stands of typical mesotrophic grassland referable to the NVC MG5 community in which there is a high density of herbs such as greater bird's-foot trefoil, red clover and hardheads. The latter unit has particularly rich stands of the relatively acidic MG5c sub-community in which there is abundant devil's-bit scabious and frequent betony *Stachys officinalis*.

At its south-western edge, the site includes a small part of the Wildlife Trust of South and West Wales' (WTSWW) Ystradfawr Nature Reserve. Much of this has high-quality marshy grassland (known in Wales as rhôs pasture), which supports an important population of the marsh fritillary butterfly *Euphydryas aurinia*. However, the small area of the Reserve lying within the Nant Helen site comprises woodland and dry grassland that is unsuitable for the butterfly.

Though there are large expanses of marshy grassland at Nant Helen (especially in units H1, L3, N4 and O1), these have been degraded by drainage, burning and other forms of agricultural 'improvement'. As a result, they are, for the most part, species-poor and dominated by a few grasses such as bents *Agrostis* spp., purple moor-grass, tufted hair-grass *Deschampsia cespitosa* and soft rush.

The plateau of Mynydd y Drum (unit P1) also has some extensive areas of species-poor rush-pasture and *Molinia* grassland, as well as large areas of unimproved acid grassland (NVC U4, U5 and U6 communities) dominated by common bent, sheep's fescue, mat grass *Nardus stricta* and heath rush *Juncus squarrosus*. There is also a little bilberry *Vaccinium myrtillus* and ling in the sward, but growth of Ericaceous dwarf-shrubs here is strongly suppressed by heavy grazing pressure from cattle, ponies and sheep. Around the fringes of unit P1, as elsewhere on Nant Helen, a feature of stands of unimproved grassland is the abundance of yellow meadow ant *Lasius flavus* nest mounds, indicating the grassland has been subject to very little recent disturbance.

Woodland habitats are generally not well represented on Nant Helen. The most important areas are the wood-pasture in unit G1 and the small stands of semi-natural ash *Fraxinus excelsior* – sessile oak *Quercus petraea* woodland on the steep sides of the Nant Ystalwyn (unit K1) and nearby slopes above the Afon Dulas (unit K2). The steeply sloping gulley in unit N1 also has a small area of sessile oak woodland. Unit K2 also has stands of flushed wet woodland with a low sub-canopy of grey willow and alder *Alnus glutinosa*. Around springs here, the ground and field layers have typical wetland species such as hemlock water-dropwort *Oenanthe crocata* and opposite-leaved golden-saxifrage *Chrysosplenium oppositifolium* and there are also dripping bryophyte-covered rock faces here. Elsewhere, there are numerous small stands of willow carr, with the most significant areas being in units H1, I1 and WY11.

The area of wood-pasture in unit G1 have a mix of open-grown mature to over-mature sessile oak and ash with scattered rowan *Sorbus aucuparia*, hawthorn *Crataegus monogyna*, grey willow, alder and hazel *Corylus avellana*. The old trees here have well-developed dead wood (saproxylic) habitat features, such as heart rot, fallen branches and saproxylic fungi. Open areas between the trees here have stands of unimproved marshy or dry acid grassland with the latter having particularly well-developed anthills. An additional feature of this unit and I1 to the south is the presence of small streams with waterfalls.

The less recently disturbed areas of mine workings on Nant Helen have open scrub in which grey willow and downy birch *Betula pubescens* are the most frequent constituents, with some hawthorn, blackthorn *Prunus spinosa* alder and hazel, as well as patches of broom *Cytisus scoparius*, European gorse *Ulex europaeus* and bramble *Rubus fruticosus*.

2. METHODS

Survey work in 2019 was undertaken in four blocks spaced out over the period from spring till early-autumn, with the timing of the visits aiming to collect samples across most of the peak period for adult invertebrate activity. For example, the May session coincided with the main flight period of the dingy skipper butterfly and the June visit with that of the marsh fritillary butterfly. A preliminary visit was made on the 10th of May in order to undertake a walk-over of as much of the site as possible and also to receive a site induction setting out required safe working practices on the site. Because it was a large site, it was not feasible to survey the whole area in detail for invertebrates. Rather, by using the results of the initial walkover, the range of invertebrate habitats present on the site could be identified and it was then possible to prioritise those areas where more detailed invertebrate surveys would be undertaken during subsequent visits. The first sampling session was carried out from the 13th till the 16th of May, with the following three visits being on the 17th to 20th of June, 8th till 11th of July and the 4th to the 7th of September.

The main emphasis for more detailed invertebrate surveys was on those habitats likely to have the greatest invertebrate interest (eg. species-rich fen; acid bogs and bog pools; marshy grassland; species-rich neutral grassland; short, ruderal vegetation; semi-natural woodland with dead wood features). Other less promising habitat types (eg. species-poor semi-improved grassland; young secondary scrub; coniferous plantations) were also surveyed in less detail, with the aim being to ensure complete coverage of the whole range of main invertebrate habitats represented across the site.

In addition to general spot-searching techniques, some more specialised sampling methods were used to ensure all potentially important habitat features were sampled effectively. Grassland, wetland and ruderal vegetation was mostly sampled by sweeping the vegetation with a heavy-duty entomological sweep net and tapping tall herbaceous plants over a white plastic tray. Ground-active invertebrates in grass tussocks and litter were sampled by shaking them out over a white plastic tray. Aquatic habitats were either sampled with a pond net or, in shallow margins, with a sieve. Additionally, moth-trapping using an actinic light trap was undertaken on the June, July and September sampling sessions.

Where subsequent microscopic examination was required in order to ensure an accurate identification, specimens were collected into tubes with either ethyl acetate or iso-propyl alcohol. Subsequently, all samples were identified down to species level. A range of invertebrate groups have been covered, with a full checklist of all species identified given in Table 3.1. The choice of invertebrate taxa collected for identification to species level focused on those groups known to include a high proportion of specialists associated with the habitats present on the site. For example dragonflies and damselflies, rove beetles (Coleoptera: Staphylinidae), craneflies (Diptera: Tipuloidea) and money spiders (Araneae: Linyphiidae) were key groups collected in wetland and wet woodland habitats; ground beetles (Coleoptera: Carabidae), phytophagous beetles (Coleoptera: Chrysomelidae and Curculionoidea) and butterflies (Lepidoptera: Rhopalocera) were sampled in ruderal grassland habitats and dead wood invertebrates in the area of wood-pasture.

For the purposes of this study, a series of survey units have been identified. These largely follow the boundaries of distinct areas of habitat, though in the case of some large homogeneous areas of disturbed ground with sparse, ruderal vegetation within the active opencast area (units C1, D1 and E1) they have been further sub-divided. These survey units are shown on Figure 2.1 below.

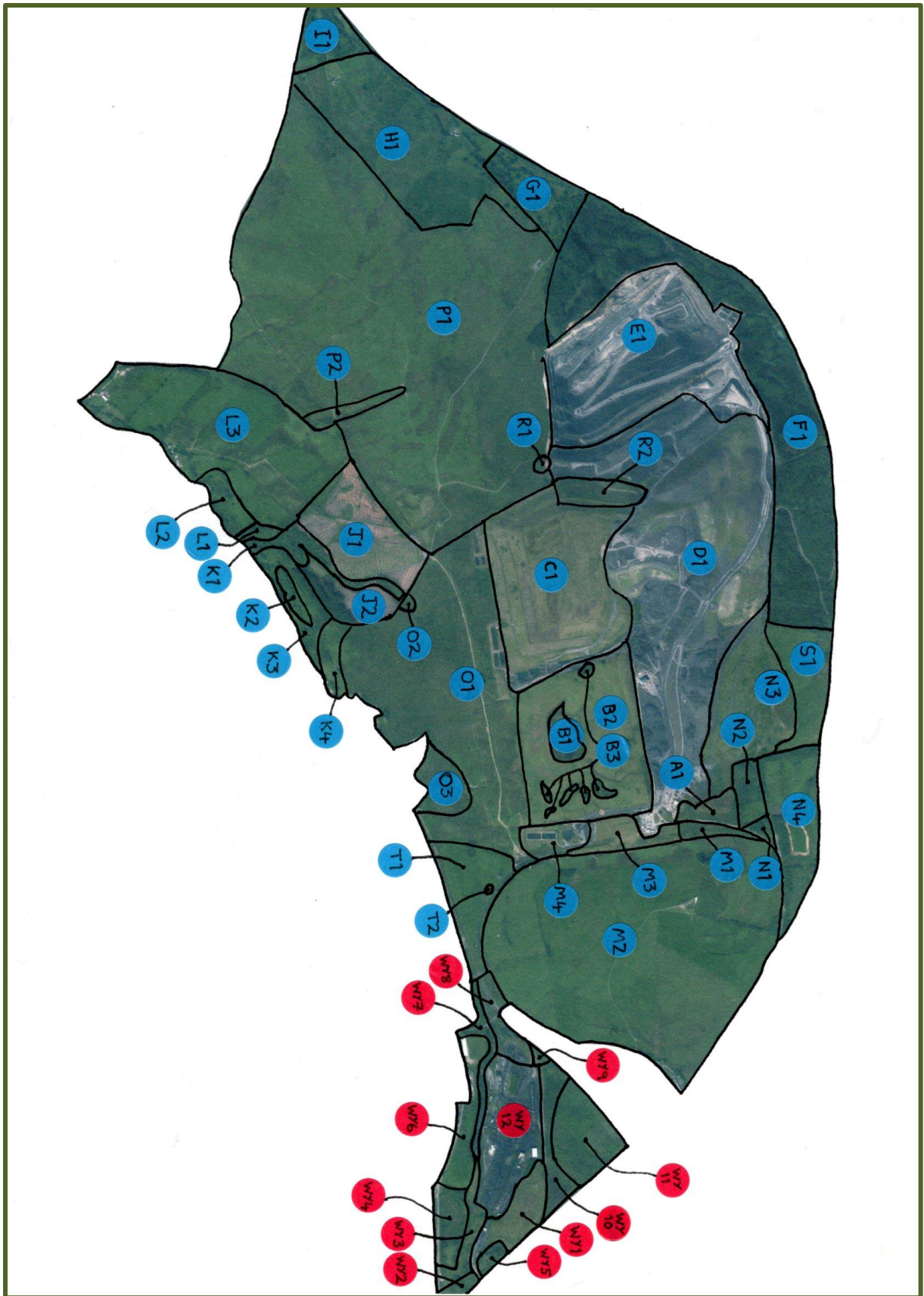


Figure 2.1. Location of invertebrate survey units at Nant Helen and Onllwyn, 2019

3. RESULTS

Table 3.1 below gives a checklist of all the invertebrates recorded during the fieldwork in 2019. Following this, sub-section 3.1 lists all of those with a formal conservation status that are regarded as key species when assessing the importance of the site for invertebrates. In sub-section 3.2, this list of key species is used to produce a list of key habitat features for invertebrates at Nant Helen. Key habitats are defined here as being those that support at least one of the key species identified in sub-section 3.1.

The codes in the final column of Table 3.1 refer to the survey units in which species were recorded in 2019. The location of these survey units is shown on Figure 2.1 above. Note that the record of scarce blue-tailed damselfly *Ischnura pumilio* from unit R1 is entered with a question mark. This record relates to probable larvae of this species and should be regarded as provisional pending identification of adults, because larvae are very difficult to reliably separate with certainty from the common blue-tail *I. elegans*.

The emboldened status categories given in the third column of Table 3.1 and also after the scientific name in sub-section 3.1 refer to those species having a formal rarity/threat status ascribed to them by the UK government conservation agencies. These are defined as follows:

NT - IUCN UK Red List, Near Threatened. A taxon is Near Threatened when it has been evaluated against the IUCN criteria and does not currently qualify for Critically Endangered, Endangered or Vulnerable status, but is close to qualifying, or is likely to do so soon.

RDB2 – Red Data Book Category 2 – Vulnerable. Taxa which are known from 15 or fewer 10 km squares of the National Grid and which are decreasing and will become endangered in the near future if the causal factors continue operating.

RDB3 – Red Data Book Category 3 - Rare. Taxa with small populations that are not at present Endangered or Vulnerable, but are at risk.

S7 – Species of Principal Importance for the maintenance and enhancement of biodiversity in Wales that are listed in Section 7 of the Environment (Wales) Act, 2016.

Na – Nationally Scarce Category A. Taxa thought to occur in between 30 to 16 10 km squares of the National Grid.

Nb – Nationally Scarce Category B. Taxa thought to occur in between 30 and 100 10 km squares of the National Grid.

N – Nationally Scarce. Taxa which are estimated to occur within the range of 16 to 100 10km squares, but where division into Na or Nb status has not been attempted due to limited availability of information on British distribution. Second status review not yet completed and status therefore taken from first review.

NS – Nationally Scarce. In more recent second status reviews, the Na and Nb sub-divisions have been subsumed into a single category covering species occurring in 16 to 100 10km squares of the National Grid. Unlike the previous 'N' category, which covered the same range, the amalgamation does not necessarily result from inadequate information on the British distribution.

pNS – Provisional Nationally Scarce. The rove beetles *Hadrognathus longipalpis* and *Zyras collaris* will almost certainly be accorded Nationally Scarce status in the forthcoming Review of this group, but they have no formal conservation status currently.

Table 3.1. Checklist of invertebrates recorded at Nant Helen and Onllwyn, 2019

Species scientific name	Species English name	Status	Survey units
<i>Acroloxus lacustris</i>	Lake limpet		L2
<i>Deroceras reticulatum</i>	Netted field slug		E1,J1,N3,O1
<i>Deroceras laeve</i>	Marsh slug		J1,O2,WY2,11
<i>Arion ater</i>	Large black slug		J1,K3,N3,O3,R2,WY9,11
<i>Arion subfuscus</i> agg.	Dusky slug		N3
<i>Arion intermedius</i>	Hedgehog slug		R2,WY11
<i>Cochlicopa lubrica</i>	Slippery moss snail		WY11
<i>Euconulus alderi</i>	A Euconulid snail		O2,WY11
<i>Euconulus fulvus</i>	A Euconulid snail		J1
<i>Zonitoides excavatus</i>	Hollowed glass snail		J1
<i>Zonitoides nitidus</i>	Shiny glass snail		WY11
<i>Arianta arbustorum</i>	Copse snail		WY11
<i>Cepaea hortensis</i>	White-lipped snail		WY2
<i>Cepaea nemoralis</i>	Brown-lipped snail		J1,K3,WY1,9,11
<i>Lehmanna marginata</i>	Tree slug		E1,K1
<i>Galba truncatula</i>	Dwarf pond snail		L2,WY10,11
<i>Lymnaea palustris</i> agg.	Marsh pond snail		L2,WY10,11
<i>Radix balthica</i>	Wandering pond snail		L2
<i>Aegopinella nitidula</i>	Dull glass snail		WY11
<i>Aegopinella pura</i>	Delicate glass snail		J1,WY11
<i>Oxychilus alliarius</i>	Garlic snail		A1,K1
<i>Nesovitrea hammonis</i>	Rayed glass snail		A1,L2,M1,N3,O2,WY11
<i>Gyraulus crista</i>	Nautilus ram's-horn snail		L2
<i>Succinea putris</i>	Large amber snail		WY10,11
<i>Lestes sponsa</i>	Common emerald damselfly		K3,R1,WY11
<i>Pyrrhosoma nymphula</i>	Large red damselfly		B1,WY2,11

Coenagrion puella	Azure damselfly		WY1,10
Enallagma cyathigerum	Common blue damselfly		B1,R1
Ischnura pumilio	Scarce blue-tailed damselfly	NT.	R1?,WY10
Cordulegaster boltonii	Golden-ringed dragonfly		H1
Libellula depressa	Broad-bodied chaser		WY11
Libellula quadrimaculata	Four-spotted chaser		B1,WY1,10,11
Orthetrum cancellatum	Black-tailed skimmer		WY1
Orthetrum coerulescens	Keeled skimmer dragonfly		WY10
Sympetrum danae	Black darter dragonfly		WY10
Sympetrum striolatum	Common darter dragonfly		G1,J1,L2,WY1,10
Coconcephalus discolor	Long-winged conehead		L2
Omocestus viridulus	Common green grasshopper		G1,H1,K3,WY1,2,9,11
Chorthippus brunneus	Field grasshopper		G1,J1,R2,WY3,9,10
Chorthippus parallelus	Meadow grasshopper		G1,H1,J1,L1,M1,O2,R2,WY3,11
Myrmeleotettix maculatus	Mottled grasshopper		R2
Forficula auricularia	Common earwig		G1,K1,N4,WY2
Acanthosoma haemorrhoidale	Hawthorn shieldbug		G1,L2,N4
Elasmucha grisea	Parent bug		K1
Dolycoris baccarum	Hairy shieldbug		E1,WY11
Palomena prasina	Common green shieldbug		J1
Pentatoma rufipes	Forest shieldbug		G1,N4,WY1
Picromerus bidens	Spiked shieldbug		J1
Piezodorus lituratus	Gorse shieldbug		WY10
Rhacognathus punctatus	Heather shieldbug		B1
Troilus luridus	Bronze shieldbug		L2
Zicrona caerulea	Blue shieldbug		B1,WY2,10
Eurygaster testudinaria	Tortoise shieldbug		L2,WY10,11
Pachybrachius fracticollis	A ground bug		B1,L2,WY10,11

<i>Peritrechus geniculatus</i>	A ground bug		N3
<i>Scolopstethus decoratus</i>	A ground bug		A1,L2,WY9
<i>Stygnocoris sabulosus</i>	A ground bug		J1,R2,WY3
<i>Trapezonotus desertus</i>	A ground bug		A1
<i>Pithanus maerkeli</i>	A Mirid bug		J1,K3,N3,WY1,3
<i>Dictyla convergens</i>	A lacebug		WY10
<i>Tingis ampliata</i>	Creeping thistle lacebug		WY2,10
<i>Tingis cardui</i>	Spear thistle lacebug		WY10
<i>Hebrus ruficeps</i>	A Hebrid water bug		L2,O2,WY11
<i>Microvelia reticulata</i>	A Microveliid water bug		R1
<i>Gerris lacustris</i>	A pond skater		R1
<i>Nepa cinerea</i>	Water scorpion		R1,WY10
<i>Ranatra linearis</i>	Water stick insect		R1
<i>Ilyocoris cimicoides</i>	Saucer bug		R1
<i>Plea minutissima</i>	A Pleid water boatman		R1
<i>Hespercorixa castanea</i>	A water boatman		R1
<i>Sigara scotti</i>	A water boatman		R1
<i>Chartoscirta cincta</i>	A shore bug		O3
<i>Livia juncorum</i>	A Psyllid bug		L2
<i>Cercopis vulnerata</i>	Red-and-black froghopper		WY10
<i>Gyrinus substriatus</i>	A whirligig beetle		R1
<i>Agabus sturmii</i>	A diving beetle		R1
<i>Agabus bipustulatus</i>	A diving beetle		L2,R1,WY10
<i>Agabus paludosus</i>	A diving beetle		WY10
<i>Ilybius aenescens</i>	A diving beetle		R1
<i>Ilybius ater</i>	A diving beetle		R1
<i>Ilybius fuliginosus</i>	A diving beetle		L2
<i>Dytiscus semisulcatus</i>	A great diving beetle		WY10

Hydroporus gyllenhalii	A diving beetle		R1
Hydroporus obscurus	A diving beetle		R1
Hydroporus pubescens	A diving beetle		R1
Hygrotus inaequalis	A diving beetle		R1
Nebria salina	A ground beetle		D1,R2
Carabus problematicus	A ground beetle		J1
Cicindela campestris	Green tiger beetle		E1,J1
Elaphrus cupreus	A ground beetle		P2,WY10
Bembidion tibiale	A ground beetle		K3
Bembidion genei	A ground beetle		E1
Bembidion mannerheimii	A ground beetle		N4
Ocys harpaloides agg.	A ground beetle		K1
Abax parallelepipedus	A ground beetle		G1
Poecilus cupreus	A ground beetle		P1
Pterostichus vernalis	A ground beetle		E1
Pterostichus diligens	A ground beetle		B1,O3,WY11
Pterostichus niger	A ground beetle		E1,N3
Pterostichus rhaeticus	A ground beetle		B1,L2,O3,WY11
Pterostichus madidus	A ground beetle		L2
Amara plebeja	A ground beetle		B1
Amara aenea	A ground beetle		N3
Amara lunicollis	A ground beetle		N3
Bradycellus harpalinus	A ground beetle		A1,J1
Bradycellus ruficollis	A ground beetle		A1
Olisthopus rotundatus	A ground beetle		A1,N3
Agonum marginatum	A ground beetle		WY10
Agonum fuliginosum	A ground beetle		O3
Agonum gracile	A ground beetle		B1,O3,P2,WY10

<i>Agonum thoreyi</i>	A ground beetle		WY11
<i>Agonum emarginatum</i>	A ground beetle		O3
<i>Agonum viduum</i>	A ground beetle		L2,N4,P2,WY10
<i>Paranchus albipes</i>	A ground beetle		I1
<i>Dromius quadrimaculatus</i>	A ground beetle		G1
<i>Paradromius linearis</i>	A ground beetle		WY3,11
<i>Philorhizus melanocephalus</i>	A ground beetle		WY11
<i>Helophorus flavipes</i>	A water beetle		R1
<i>Hydrobius fuscipes</i>	A water beetle		O3
<i>Chaetarthria simillima</i>	A water beetle	NS.	L2
<i>Anacaena globulus</i>	A water beetle		N1,WY10,11
<i>Anacaena lutescens</i>	A water beetle		R1
<i>Enochrus testaceus</i>	A water beetle		L2
<i>Helochares punctatus</i>	A water beetle	NS.	R1
<i>Coelostoma orbiculare</i>	A water beetle		L2,O2,O3
<i>Catops kirbyi</i>	A Leiodid beetle		N1
<i>Leptinus testaceus</i>	A Leiodid beetle		N1
<i>Dropephylla ioptera</i>	A rove beetle		G1
<i>Eusphalerum torquatum</i>	A rove beetle		WY1,2
<i>Hadrognathus longipalpis</i>	A rove beetle	pNS.	A1,M1,R2
<i>Lesteva sicula</i>	A rove beetle		G1,N1
<i>Philorinum sordidum</i>	A rove beetle		J1,N3
<i>Megarthritis depressus</i>	A rove beetle		N1
<i>Proteinus brachypterus</i>	A rove beetle		N1
<i>Brachygluta fossulata</i>	A rove beetle		O3
<i>Bryaxis bulbifer</i>	A rove beetle		O3,WY11
<i>Bryaxis curtisii</i>	A rove beetle		O3
<i>Phloeocharis subtilissima</i>	A rove beetle		K1

<i>Sepedophilus nigripennis</i>	A rove beetle		WY3
<i>Tachyporus nitidulus</i>	A rove beetle		WY1
<i>Tachyporus dispar</i>	A rove beetle		N3,WY1
<i>Mycetoporus longulus</i>	A rove beetle		J1
<i>Mycetoporus rufescens</i>	A rove beetle		A1
<i>Lordithon trinotatus</i>	A rove beetle		G1
<i>Ocyusa picina</i>	A rove beetle		WY11
<i>Oxypoda vittata</i>	A rove beetle		N1
<i>Cypha laeviuscula</i>	A rove beetle		A1
<i>Myllaena brevicornis</i>	A rove beetle		B1
<i>Myllaena intermedia</i>	A rove beetle		L2,O3
<i>Myllaena minuta</i>	A rove beetle		B1
<i>Leptusa fumida</i>	A rove beetle		K1
<i>Leptusa ruficollis</i>	A rove beetle		G1,K1
<i>Agaricochara latissima</i>	A rove beetle		G1,K1
<i>Hygronoma dimidiata</i>	A rove beetle		P2,WY11
<i>Amischa analis</i>	A rove beetle		A1,WY3
<i>Amischa cavifrons</i>	A rove beetle		O3
<i>Atheta aquatica</i>	A rove beetle		N1
<i>Atheta crassicornis</i>	A rove beetle		K2
<i>Atheta indubia</i>	A rove beetle		N3
<i>Atheta obtusangula</i>	A rove beetle		B1
<i>Zyras collaris</i>	A rove beetle	pNS.	WY11
<i>Oxytelus laqueatus</i>	A rove beetle		WY10
<i>Carpelimus corticinus</i>	A rove beetle		N3
<i>Dianous coerulescens</i>	A rove beetle		I1
<i>Stenus impressus</i>	A rove beetle		A1,J1,L1,N3,O3,R2
<i>Stenus ossium</i>	A rove beetle		A1,E1,J1,R2,WY1

<i>Stenus cicindeloides</i>	A rove beetle		L2,WY2,10,11
<i>Stenus fulvicornis</i>	A rove beetle		J1
<i>Stenus latifrons</i>	A rove beetle		L2,O2,O3,WY10,11
<i>Stenus bifoveolatus</i>	A rove beetle		WY10
<i>Stenus binotatus</i>	A rove beetle		R1
<i>Stenus tarsalis</i>	A rove beetle		O2,WY10
<i>Stenus flavipes</i>	A rove beetle		B1
<i>Stenus nitidiusculus</i>	A rove beetle		L2,O2,O3,WY11
<i>Stenus picipennis</i>	A rove beetle		L2,O2,O3
<i>Stenus boops</i>	A rove beetle		L2
<i>Stenus clavicornis</i>	A rove beetle		WY10
<i>Stenus junco</i>	A rove beetle		O3,WY11
<i>Stenus melanarius</i>	A rove beetle		WY10
<i>Stenus nitens</i>	A rove beetle		O3
<i>Stenus providus</i>	A rove beetle		B1,L2,O3
<i>Stenus brunnipes</i>	A rove beetle		A1,J1
<i>Euaesthetus laeviusculus</i>	A rove beetle	pNS.	O2
<i>Euaesthetus ruficapillus</i>	A rove beetle		O3,WY11
<i>Lathrobium fulvipenne</i>	A rove beetle		B1
<i>Tetartopeus terminatus</i>	A rove beetle		B1,I1,L2,WY11
<i>Octhephilum fracticorne</i>	A rove beetle		B1,O2,O3,WY11
<i>Paederus riparius</i>	A rove beetle		L2
<i>Quedius maurus</i>	A rove beetle		N1
<i>Quedius fuliginosus</i>	A rove beetle		O3,WY11
<i>Quedius molochinus</i>	A rove beetle		WY11
<i>Quedius maurorufus</i>	A rove beetle		O3,WY11
<i>Quedius nitipennis</i>	A rove beetle		E1
<i>Quedius plancus</i>	A rove beetle	Na.	I1

<i>Bisnius puella</i>	A rove beetle		H1
<i>Philonthus albipes</i>	A rove beetle		H1
<i>Philonthus cognatus</i>	A rove beetle		R2
<i>Philonthus nigrita</i>	A rove beetle		B1,WY11
<i>Philonthus tenuicornis</i>	A rove beetle		H1
<i>Philonthus varians</i>	A rove beetle		H1,R2
<i>Gabrius breviventer</i>	A rove beetle		WY1
<i>Melinopterus sphacelatus</i>	A dung beetle		O1
<i>Hoplia philanthus</i>	A chafer beetle		WY1
<i>Odeles marginata</i>	A marsh beetle		I1,J1
<i>Contacyphon hilaris</i>	A marsh beetle		B1,O2WY11
<i>Contacyphon padi</i>	A marsh beetle		B1,O3,WY11
<i>Contacyphon variabilis</i>	A marsh beetle		B1
<i>Agriotes acuminatus</i>	A click beetle		G1
<i>Agriotes obscurus</i>	A click beetle		M1,N3,WY1
<i>Agriotes pallidulus</i>	A click beetle		H1
<i>Dalopius marginatus</i>	A click beetle		G1,H1
<i>Athous haemorrhoidalis</i>	A click beetle		G1,WY10
<i>Actenicerus sjaelandicus</i>	A click beetle		O2,WY10
<i>Aplotarsus incanus</i>	A click beetle		B1,G1
<i>Prosternon tessellatum</i>	A click beetle		G1
<i>Zorochochroa minimus</i>	A click beetle		E1
<i>Cantharis cryptica</i>	A soldier beetle		H1
<i>Cantharis decipiens</i>	A soldier beetle		G1,N3
<i>Cantharis flavilabris</i>	A soldier beetle		N3,O2
<i>Cantharis pallida</i>	A soldier beetle		M1
<i>Cantharis rufa</i>	A soldier beetle		L1
<i>Rhagonycha fulva</i>	A soldier beetle		H1,K3,WY1

Rhagonycha lignosa	A soldier beetle		G1
Rhagonycha nigriventris	A soldier beetle		G1,L1
Silis ruficollis	A soldier beetle		WY10
Malthodes marginatus	A soldier beetle		G1
Elateroides dermestoides	A Lymexylid beetle		J1
Biphyllus lunatus	A Biphyllid beetle		G1
Telmatophilus typhae	A Cryptophagid beetle		WY2,10
Cryptophagus dentatus	A Cryptophagid beetle		G1
Cryptophagus ruficornis	A Cryptophagid beetle	N.	G1
Micrambe ulicis	A Cryptophagid beetle		J1,N3,WY2
Psammoecus bipunctatus	A Silvanid beetle		WY11
Kateretes rufilabris	A Kateretid pollen beetle		J1,K1,L2,WY1
Epuraea distincta	A Nitidulid beetle	Na.	WY11
Meligethes aeneus	A pollen beetle		WY9
Meligethes atratus	A pollen beetle		H1
Meligethes brunnicornis	A pollen beetle		WY2
Meligethes carinulatus	A pollen beetle		J1,N3,WY11
Meligethes flavimanus	A pollen beetle		H1,J1,N3,WY10
Coccidula rufa	A ladybird		K3,L2,P2,WY10,11
Rhyzobius litura	A ladybird		J1,M1,N3,WY10
Chilocorus renipustulatus	Kidney-spot ladybird		B1,3,K1,N4
Aphidecta oblitterata	Larch ladybird		G1,K1
Adalia decempunctata	10-spot ladybird		G1,K1,N4,WY11
Coccinella septempunctata	7-spot ladybird		E1,G1,J1,WY1,3,11
Harmonia axyridis	Harlequin ladybird		K1,M1,WY2,10
Propylea quattuordecimpunctata	14-spot ladybird		N3,WY1
Calvia quattuordecimguttata	Cream-spot ladybird		K1,N4
Litargus connexus	A fungus beetle		G1

<i>Cis boleti</i>	A Ciid beetle		N4
<i>Cis festivus</i>	A Ciid beetle	Nb.	K1
<i>Cis vestitus</i>	A Ciid beetle		G1
<i>Ennearthron cornutum</i>	A Ciid beetle		G1
<i>Orchesia micans</i>	A false darkling beetle	NS.	K1
<i>Orchesia minor</i>	A false darkling beetle	NS.	G1
<i>Orchesia undulata</i>	A false darkling beetle		K1
<i>Mordellistena pumila</i>	A Mordellid beetle		WY11
<i>Oedemera lurida</i>	An Oedemerid beetle		J1,M1,WY1,3,11
<i>Oedemera nobilis</i>	An Oedemerid beetle		WY3
<i>Salpingus planirostris</i>	A Salpingid beetle		G1,L2,N4
<i>Rhagium bifasciatum</i>	A longhorn beetle		J1
<i>Grammoptera ruficornis</i>	A longhorn beetle		G1
<i>Tetrops praeustus</i>	A longhorn beetle		G1
<i>Donacia versicolore</i>	A reed beetle		R1,WY10
<i>Plateumaris discolor</i>	A reed beetle		B1,K3,L2,O2
<i>Plateumaris rustica</i>	A reed beetle	NS.	WY11
<i>Bruchidius varius</i>	A seed beetle		WY1
<i>Bruchidius villosus</i>	A seed beetle		WY1
<i>Cassida flaveola</i>	A tortoise beetle		L2,O2
<i>Cassida rubiginosa</i>	Thistle tortoise beetle		WY2
<i>Cassida vibex</i>	Knapweed tortoise beetle		WY1
<i>Cassida viridis</i>	A tortoise beetle		WY2,11
<i>Chrysolina polita</i>	A leaf beetle		K3,L2,WY2,10,11
<i>Chrysolina brunsvicensis</i>	A leaf beetle		WY10
<i>Chrysolina hyperici</i>	A leaf beetle		WY1
<i>Gastrophysa viridula</i>	Dock leaf beetle		WY1,3,10,11
<i>Phaedon armoraciae</i>	A leaf beetle		P2,WY10

<i>Phaedon cochleariae</i>	A leaf beetle		WY2
<i>Prasocuris glabra</i>	A leaf beetle		WY10
<i>Prasocuris marginella</i>	A leaf beetle		K3,P2,WY10
<i>Prasocuris junci</i>	A leaf beetle		WY10
<i>Prasocuris phellandrii</i>	A leaf beetle		K3
<i>Gonioctena olivacea</i>	A leaf beetle		WY1
<i>Luperus longicornis</i>	A leaf beetle		B3,WY11
<i>Galerucella californiensis</i>	A leaf beetle		WY11
<i>Galerucella pusilla</i>	A leaf beetle		K1
<i>Galerucella tenella</i>	A leaf beetle		WY11
<i>Lochmaea caprea</i>	A leaf beetle		J1,M1,WY1,4,11
<i>Lochmaea crataegi</i>	A leaf beetle		G1
<i>Lochmaea suturalis</i>	Heather beetle		A1,N3,R2
<i>Luperus longicornis</i>	A leaf beetle		WY11
<i>Sphaeroderma testaceum</i>	A flea beetle		WY1,2
<i>Mantura rustica</i>	A flea beetle	NS.	WY11
<i>Crepidodera fulvicornis</i>	A flea beetle		B1,3,J1,K1,M1,WY11
<i>Psylliodes laticollis</i>	A flea beetle		WY2
<i>Aphthona euphorbiae</i>	A flea beetle		WY1
<i>Neocrepidodera transversa</i>	A flea beetle		J1,L1,L2,N3,WY1,3
<i>Hippuriphila modeeri</i>	A flea beetle		WY11
<i>Longitarsus holsaticus</i>	A flea beetle		WY10
<i>Phyllotreta atra</i>	A flea beetle		WY2
<i>Temnocerus nanus</i>	A Rhynchitid beetle		B3,M1,WY11
<i>Caenorhinus mannerheimii</i>	A Rhynchitid weevil		B1
<i>Apion haematodes</i>	A weevil		L1
<i>Apion rubens</i>	A weevil		N3
<i>Perapion curtirostre</i>	A weevil		J1,K3,N3,O2,WY1,3

Perapion hydrolapathi	A weevil		WY1
Perapion marchicum	A weevil		J1,K3
Exapion ulicis	A weevil		J1,N3
Catapion seniculus	A weevil		WY1
Eutrichapion ervi	A weevil		K3,WY3,9
Eutrichapion viciae	A weevil		WY9
Ischnopterapion loti	A weevil		WY3
Ischnopterapion modestum	A weevil		J1,K3,L2,WY10,11
Protapion apricans	A weevil		J1,K3,WY1,3
Protapion assimile	A weevil		WY1
Protapion filirostre	A weevil	Nb.	WY
Protapion nigritarse	A weevil		N3,WY1
Protapion trifolii	A weevil		WY1,3
Nanophyes marmoratus	A weevil		WY11
Stenopelmus rufinasus	A weevil		R1
Limnobaris dolorosa	A weevil		WY11
Anoplus plantaris	A weevil		B1
Anthonomus brunnipennis	A weevil	Nb.	N3
Anthonomus pedicularius	A weevil		G1,N3,N4
Cionus hortulanus	A figwort weevil		WY2
Cionus scrophulariae	A figwort weevil		WY2
Archarius salicivorus	A weevil		WY11
Dorytomus rufatus	A weevil		K1
Gymnetron beccabungae	A weevil	Nb.	L2
Gymnetron veronicae	A weevil	Nb.	WY10
Mecinus labilis	A weevil		WY3
Mecinus pascuorum	A weevil		J1,WY1,3
Mecinus pyraister	A weevil		WY3

<i>Rhamphus pulicarius</i>	A weevil		M1,WY11
<i>Tychius picirostris</i>	A weevil		J1,WY1
<i>Bagous lutulentus</i>	A weevil	Nb.	WY11
<i>Amalorrhynchus melanarius</i>	A weevil		WY2
<i>Coeliodinus rubicundus</i>	A weevil		B1
<i>Microplontus campestris</i>	A weevil	Nb.	WY1
<i>Mogulones asperifoliarum</i>	A weevil		WY1
<i>Poophagus sisymbrii</i>	A weevil		WY2
<i>Trichosirocalus troglodytes</i>	A weevil		WY1,3
<i>Pelenomus waltoni</i>	A weevil	Nb.	N3
<i>Rhinoncus perpendicularis</i>	A weevil		WY11
<i>Rhinoncus pericarpus</i>	A weevil		WY11
<i>Strophosoma melanogrammum</i>	A weevil		G1,K1
<i>Phyllobius argentatus</i>	A weevil		N4
<i>Phyllobius glaucus</i>	A weevil		N4
<i>Phyllobius roboretanus</i>	A weevil		B1
<i>Phyllobius pyri</i>	A weevil		B1,G1,J1
<i>Polydrusus formosus</i>	A weevil	Na.	WY11
<i>Polydrusus pilosus</i>	A weevil		N4
<i>Polydrusus pterygomalis</i>	A weevil		G1,N4
<i>Andrion regensteiniense</i>	A weevil		WY1
<i>Coelositona cambricus</i>	A weevil		L2,WY10
<i>Sitona lineatus</i>	A weevil		WY10
<i>Sitona obsoletus</i>	A weevil		WY1
<i>Sitona striatellus</i>	A weevil		J1,WY1
<i>Sitona suturalis</i>	A weevil		K3,WY3,11
<i>Brachypera zoilus</i>	A weevil		N3
<i>Hypera nigrirostris</i>	A weevil		WY1,3

<i>Hypera plantaginis</i>	A weevil		J1
<i>Hypera postica</i>	A weevil		WY1
<i>Hypera venusta</i>	A weevil		N3
<i>Magdalis carbonaria</i>	A weevil	Nb.	N4
<i>Hylesinus varius</i>	A bark beetle		G1
<i>Scolytus intricatus</i>	A bark beetle		G1
<i>Sialis lutaria</i>	An alderfly		B1
<i>Korscheltellus lupulina</i>	Common swift moth		N3,WY1
<i>Korscheltellus fusconebulosa</i>	Map-winged swift moth		B1,M1
<i>Pandemis heparana</i>	Dark fruit-tree tortrix moth		M1
<i>Bembecia ichneumoniformis</i>	6-belted clearwing moth	Nb.	WY3
<i>Zygaena trifolii</i>	5-spot burnet moth		H1,L2,WY3,11
<i>Erynnis tages</i>	Dingy skipper butterfly	S7.	E1,J1,N3,WY1
<i>Thymelicus sylvestris</i>	Small skipper		H1,K3,WY1
<i>Ochlodes sylvanus</i>	Large skipper		H1,O1,WY1,3,9
<i>Anthocharis cardamines</i>	Orange tip butterfly		E1,G1,J1,N3
<i>Pieris brassicae</i>	Large white butterfly		WY2
<i>Pieris rapae</i>	Small white butterfly		WY3
<i>Pieris napi</i>	Green-veined white butterfly		G1,H1,J1,K3,N3,O2,WY2,11
<i>Gonepteryx rhamni</i>	Brimstone butterfly		WY3
<i>Pararge aegeria</i>	Speckled wood butterfly		G1,J1,N3
<i>Coenonympha pamphilus</i>	Small heath butterfly	S7.	J1,N3,O2,WY1,3
<i>Aphantopus hyperantus</i>	Ringlet butterfly		O1,WY1,9
<i>Maniola jurtina</i>	Meadow brown butterfly		B3,L1,O1,WY1,2
<i>Hipparchia semele</i>	Grayling butterfly	S7.	WY3
<i>Boloria selene</i>	Small pearl-bordered fritillary	S7.	WY1
<i>Argynnis aglaja</i>	Dark green fritillary butterfly		WY1
<i>Vanessa atalanta</i>	Red admiral butterfly		G1,L2,WY3

Vanessa cardui	Painted lady butterfly		H1,J1,R2,WY3,10
Aglais io	Peacock butterfly		B1,J1,P1,WY9
Aglais urticae	Small tortoiseshell butterfly		J1,WY1,9,10
Lycaena phlaeas	Small copper butterfly		WY11
Cupido minimus	Small blue butterfly	S7.	WY1
Polyommatus icarus	Common blue butterfly		J1,K3,N3,R2,WY1,3,9
Pyrausta despicata	A Pyralid moth		WY3
Elophila nymphaeata	Brown china-mark moth		R1
Thyatira batis	Peach blossom moth		M1
Euthrix potatoria	Drinker moth		G1,L2,M1
Saturnia pavonia	Emperor moth		J1
Laothoe populi	Poplar hawk-moth		B1
Deilephila elpenor	Elephant hawk-moth		M1
Deilephila porcellus	Small elephant-hawkmoth		M1
Idaea aversata	Riband wave moth	S7.	M1
Timandra comae	Blood-vein moth		WY1
Scotopteryx luridata	July belle moth		H1
Xanthorhoe montanata	Silver ground carpet moth		G1,WY1,2,9
Epirrhoe tristata	Small argent and sable moth		H1,M1
Epirrhoe alternata	Common carpet moth		N3
Hydriomena furcata	July highflyer moth		M1
Gandaritis pyraliata	Barred straw moth		L2
Colostygia pectinataria	Green carpet moth		G1,K3
Lomaspilis marginata	Clouded border moth		B1,M1
Chiasmia clathrata	Latticed heath moth		A1
Biston betularia	Peppered moth		M1
Ematurga atomaria	Common heath moth		A1,M1,N3
Cabera pusaria	Common white wave		B3

Cabera exanthemata	Common wave moth		M1
Campaea margaritata	Light emerald moth		M1
Ptilodon capucina	Coxcomb prominent		M1
Spilosoma lutea	Buff ermine moth	S7.	B1
Spilosoma lubricipeda	White ermine moth	S7.	B1
Arctia caja	Garden tiger moth	S7.	B1
Tyria jacobaeae	Cinnabar moth	S7.	WY1
Eilema lurideola	Common footman		M1
Euclidia glyphica	Burnet companion moth		J1,K3,N3,WY1,11
Euclidia mi	Mother Shipton moth		P1
Autographa gamma	Silver Y moth		J1,R2,WY9,11
Syngrapha interrogationis	Scarce silver Y moth		B1
Deltote pygarga	Marbled white spot moth		H1,M1
Deltote uncula	Silver hook moth		O2
Acronicta rumicis	Knot grass moth		WY10
Stilbia anomala	Anomalous moth		B1
Hoplodrina blanda	Rustic moth		B1,M1
Denticucullus pygmina	Small wainscot moth		M1
Apamea monoglypha	Dark arches moth		B1,M1
Oligia strigilis	Marbled minor moth		M1
Oligia fasciuncula	Middle-barred minor moth		WY1
Aporophyla lutulenta	Deep-brown dart moth	S7.	N3
Polia nebulosa	Grey arches moth		M1
Ceramica pisi	Broom moth		B1
Mamestra brassicae	Cabbage moth		N3
Mythimna turca	Double line moth	NS.	M1
Mythimna pallens	Common wainscot moth		B1
Mythimna impura	Smoky wainscot moth		G1,M1

Mythimna ferrago	Clay moth		M1
Agrotis exclamationis	Heart and dart moth		B1,M1
Axylia putris	Flame moth		M1
Diarsia brunnea	Purple clay moth		B1
Diarsia mendica	Ingrailed clay moth		B1,M1
Diarsia rubi	Small square-spot moth		M1
Lycophotia porphyrea	True lover's knot moth		B1
Noctua pronuba	Large yellow underwing moth		B1,M1,WY1
Xestia triangulum	Double square-spot moth		M1
Prionocera pubescens	A Tipulid crane fly	RDB2.	B1
Prionocera turcica	A Tipulid crane fly		B1
Tipula fascipennis	A Tipulid crane fly		B1, K3
Tipula marginella	A Tipulid crane fly	RDB3.	O2, WY11
Erioconopa trivialis	A Limoniid crane fly		O2
Erioptera flavata	A Limoniid crane fly		O2
Erioptera fuscipennis	A Limoniid crane fly		O2
Eloeophila submarmorata	A Limoniid crane fly		K3
Euphyllidorea meigenii	A Limoniid crane fly		B1
Phyllidorea ferruginea	A Limoniid crane fly		B1, O2
Pilaria discicollis	A Limoniid crane fly		O2
Dicranomyia lucida	A Limoniid crane fly	N.	K3
Dicranomyia aquosa	A Limoniid crane fly	N.	K3
Helius flavus	A Limoniid crane fly		O2
Helius longirostris	A Limoniid crane fly		O2
Thaumastoptera calceata	A Limoniid crane fly	N.	K3
Bibio marci	St. Mark's fly		N3,P1,P2
Ptychoptera lacustris	A Ptychopterid crane fly		K3
Chrysopilus cristatus	A snipe fly		H1,J1,N3,WY11

Rhagio scolopacea	Downlooker snipe fly		H1
Rhagio tringarius	A snipe fly		WY1
Haematopota crassicornis	A horsefly		WY10
Haematopota pluvialis	A horsefly		H1,O2,WY2,10
Tabanus sudeticus	A horsefly		WY10
Chloromyia formosa	Broad centurion soldierfly		K3
Stratiomys potamida	Banded general soldierfly	N.	WY10
Machimus atricapillus	Kite-tailed robberfly		G1
Tachydromia aemula	A dance fly		N3
Empis tessellata	A dance fly		B1
Dolichopus atratus	A long-headed fly		O2
Dolichopus pennatus	A long-headed fly		O2
Dolichopus vitripennis	A long-headed fly		O2
Hercostomus aerosus	A long-headed fly		O2
Rhaphium auctum	A long-headed fly		O2
Baccha elongata	A hoverfly		K3
Cheilosia illustrata	A hoverfly		K3
Chrysotoxum bicinctum	A hoverfly		WY1,11
Episyrphus balteatus	A hoverfly		O2,WY2,10
Eristalis arbustorum	A drone fly		L2,WY1,10,11
Eristalis horticola	A drone fly		WY1,11
Eristalis interruptus	A drone fly		WY11
Eristalis intricarius	A drone fly		WY11
Eristalis pertinax	A drone fly		J1,WY11
Eristalis tenax	A drone fly		J1,R2,WY1,2,11
Ferdinandea cuprea	A hoverfly		J1
Helophilus pendulus	A sun-fly		J1,K3,M1,WY10,11
Meliscaeva auricollis	A hoverfly		WY1

Microdon myrmicae	A hoverfly		WY11
Neoascia podagrica	A hoverfly		O2
Platycheirus albimanus	A hoverfly		WY1
Platycheirus granditarsus	A hoverfly		K3,L2,M1,WY4
Platycheirus rosarum	A hoverfly		K3,O2,WY1,2,11
Rhingia campestris	A hoverfly		WY11
Scaeva pyrastris	A hoverfly		WY1,11
Sericomyia silentis	A hoverfly		J1,R2,WY11
Sphaerophoria scripta	A hoverfly		L2
Syrirta pipiens	A hoverfly		K3,L2,WY11
Volucella bombylans	A hoverfly		M1,WY2,9
Volucella pellucens	A hoverfly		J1,K3,WY1,2
Xanthogramma citrofasciatum	A hoverfly		WY1
Sicus ferrugineus	A Conopid fly		K3
Coremacera marginata	A snail-killing fly		K3
Pherbina coryleti	A snail-killing fly		O2,WY11
Sepedon sphegea	A snail-killing fly		WY2
Tetanocera fuscinervis	A snail-killing fly		O2
Mesembrina meridiana	A house fly		G1,P1
Paykullia maculata	A Rhinophorid fly		G1
Gymnocheta viridis	A parasite fly		N1
Abia sericea	A Cimbicid sawfly		L2
Tenthredo scrophulariae	A Tenthredinid sawfly		WY2
Apis mellifera	Honeybee		B3,E1,N3,WY11
Bombus lucorum agg.	White-tailed bumblebee		J1,N3,WY1,11
Bombus lucorum	Buff-tailed/white-tailed bumblebee workers		J1,K3,N3,WY1,2,9,11
Bombus hortorum	Garden bumblebee		B1,WY1
Bombus lapidarius	Red-tailed bumblebee		E1,J1,K3,M1,N3,WY1,2,10,11

<i>Bombus hypnorum</i>	Tree bumblebee		I1,M1,WY11
<i>Bombus monticola</i>	Mountain bumblebee		E1
<i>Bombus pratorum</i>	Early bumblebee		N3,WY1,9
<i>Bombus pascuorum</i>	Common carder bumblebee		G1,J1,K3,N3,R2,WY1,2,11
<i>Formica lemani</i>	Northern negro ant		B1,J1,N4,R2,WY9
<i>Lasius flavus</i>	Yellow meadow ant		A1,G1,H1,J1,N3,O1,P1,R2,WY1,9,11
<i>Lasius niger</i>	Black garden ant		A1,B1,3,G1,J1,M1,N3,O1,R2,WY1,10
<i>Myrmica ruginodis</i>	A red ant		E1,G1,H1,N3,O3,R2,WY3,11
<i>Myrmica scabrinodis</i>	A red ant		L2,M1,N3,O3,R2,WY1,10,11
<i>Gammarus pulex</i>	Freshwater shrimp		WY10
<i>Asellus aquaticus</i>	A water louse		L2,WY10
<i>Trichoniscus pusillus</i>	Common pigmy woodlouse		M1,O2,R2,WY2,11
<i>Oniscus asellus</i>	Common shiny woodlouse		E1,G1,J1,L1,M1,O3,R2,WY11
<i>Philoscia muscorum</i>	Common striped woodlouse		M1
<i>Porcellio scaber</i>	Common rough woodlouse		E1,G1,L2,N3
<i>Nemastoma bimaculatum</i>	A harvestman spider		WY11
<i>Harpactea hombergi</i>	A Dysderid spider		G1
<i>Ero cambridgei</i>	A Mimetid spider		O3
<i>Ero furcata</i>	A Mimetid spider		B1
<i>Theridiosoma gemmosum</i>	A Theridiosomatid spider	NS.	WY10
<i>Episinus angulatus</i>	A Theridiid spider		WY11
<i>Pholcomma gibbum</i>	A Theridiid spider		A1
<i>Ceratinella brevipes</i>	A money spider		O3
<i>Walckenaeria antica</i>	A money spider		B1
<i>Walckenaeria kochi</i>	A money spider	NS.	B1
<i>Walckenaeria vigilax</i>	A money spider		B1
<i>Gnathonarium dentatum</i>	A money spider		A1,L2,WY10,11
<i>Hypomma bituberculatum</i>	A money spider		O2

Metopobactrus prominulus	A money spider		O3
Pepononcranium ludicrum	A money spider		A1
Pocadicnemis pumila	A money spider		O3
Hypselistes jacksoni	A money spider	NS.	B1,L2,WY10
Oedothorax gibbosus	A money spider		O3
Silometopus elegans	A money spider		B1,O2,O3
Cnephalocotes obscurus	A money spider		B1
Lophomma punctatum	A money spider		O3
Gongylidiellum vivum	A money spider		O3
Erigonella ignobilis	A money spider	NS.	O2,O3
Diplocephalus permixtus	A money spider		B1
Erigone atra	A money spider		WY11
Aphileta misera	A money spider		B1,O3
Agyneta decora	A money spider		O3
Agyneta olivacea	A money spider	NS.	B1,O2
Centromerita concinna	A money spider		B1
Saaristoa firma	Triangle hammock-spider	S7./NS.	A1
Tenuiphantes tenuis	A money spider		B1
Palliduphantes ericaeus	A money spider		O2
Microlinyphia pusilla	A money spider		B1
Araneus diadematus	Garden cross spider		J1,R1
Araneus quadratus	An orb-weaving spider		J1,R1,WY11
Larinioides cornutus	An orb-weaving spider		B1,H1
Nuctenea umbratica	An orb-weaving spider		G1,K1
Agalenatea redii	An orb-weaving spider		H1,L2,R1,WY11
Araniella cucurbitina	An orb-weaving spider		B1,3,G1,J1,K3,M1,WY1,10,11
Hypsosinga pygmaea	An orb-weaving spider		B1
Cyclosa conica	An orb-weaving spider		G1

Pisaura mirabilis	Nursery web spider		H1,K3,L2,N4,R2,WY2,11
Antistea elegans	A Hahniid spider		N4,O2,WY11
Dictyna arundinacea	A Dictynid spider		B1
Clubiona trivialis	A Clubionid spider		B1
Clubiona diversa	A Clubionid spider		A1
Clubiona subtilis	A Clubionid spider		O3
Heliophanus flavipes	A jumping spider		N3

3.1. Key invertebrates at Nant Helen and Onllwyn, 2019

Key species are defined as belonging to one of the following status categories:

- EC Annex II Species Directive (EC II);
- IUCN UK threatened or near threatened;
- Section 7 Species of Principal Importance in Wales;
- Red Data Book (RDB), Nationally Rare (NR) or Nationally Scarce (Na, Nb, N, NS).

593 invertebrate species have been recorded at Nant Helen and Onllwyn in 2019. Of these, 40 are key species as defined above. Note that seven Section 7 butterflies and moths recorded here this year; the small heath butterfly and riband wave, buff ermine, white ermine, garden tiger, cinnabar and deep-brown dart moths, have not been included in the key species list. This is because, though they have declined in parts of the English lowlands, they are still relatively common and do not appear to have decreased so markedly in the western part of their range. The rove beetles *Hadrognathus longipalpis*, *Zyras collaris* and *Euaesthetus laeviusculus* have been listed here as key species though they have no formal conservation status currently. This is because they are very likely to be accorded Nationally Scarce status in the forthcoming Species Status Review of this group (Boyce, *in prep.*). Conversely, the weevil *Polydrusus formosus* is listed as Nationally Scarce 'A' in the last review of this group (Hyman & Parsons, 1992). At that time it was only known from wood edges and clearings in a handful of southern English counties. Since then, it has spread across much of England and Wales and is also now known from southern Scotland. It will certainly lose its conservation status in the updated Review of Curculionoidea currently in preparation.

3.1.1. Scarce blue-tailed damselfly *Ischnura pumilio* (Charpentier, 1825). NT.

The scarce blue-tailed damselfly is very similar to the much commoner blue-tailed *I. elegans*. Males are most readily distinguished from each other by reference to the differing distribution of blue colouration on the apical abdominal segments. In *I. pumilio* the blue band straddles segments eight and nine, whereas in *I. elegans*, it is confined to segment 8. The shape of the pronotum provides an additional means by which both sexes may be distinguished. The scarce blue-tailed damselfly has a very restricted distribution across southern England and Wales, where it is found in shallow pools and runnels in both natural and man-made habitats. Larval development is very swift, which is thought to be an adaptation to the somewhat ephemeral waterbodies it frequently occupies. Five adults were seen in the northern part of Onllwyn unit WY10 (SN84941076) and a further seven adults were recorded on the southern section of this unit (SN84391075). In both cases, they were flying over heavily pony-poached acid-neutral runnels characterised by bog pondweed and marsh St. John's-wort of the NVC M29 type. Two probable larvae of this species were also recorded by pond netting in the shallow, acidic pool on the edge of the Nant Helen opencast workings (unit R1). This record should be regarded as provisional pending the collection of adults.

3.1.2. A water beetle *Chaetarthria simillima* (Herbst, 1797). NS.

Until recently, this species was known as *C. seminulum*, but it has been shown that in Britain, this includes two very closely related species only readily separable by examination of the male genitalia. It is a tiny, black water beetle with a globular body shape. The true *C. seminulum* is a species of fen habitats, while *C. simillima* is a specialist of shallow seepages in acid mires. It appears to be widely but locally distributed across Britain. At Nant Helen, specimens were found by shaking out moss in the wet basin in survey unit L2.

3.1.3. A water beetle *Helochares punctatus* (Baudi, 1848). NS.

This water beetle can be distinguished from similar *Enochrus* species by the lack of sutural striae on the elytra and its straighter palps. From the two other British *Helochares*, it differs in its darker colouration, less dense elytral puncturation and the form of the male genitalia. *H. punctatus* is one of the characteristic water beetles of acid bog pools, where it is most frequently found amongst floating rafts of bog-mosses. It is a lowland species, which has its largest populations in southern England and Wales, though it does also occur north as far as southern Scotland. In 2019, it was collected amongst saturated *Sphagnum* at Nant Helen in the shallow margins of the pool at Nant Helen unit R1.

3.1.4. A rove beetle *Hadrognathus longipalpis* (Mulsant & Rey, 1851). pNS.

H. longipalpis is a small, reddish-brown Staphylinid beetle that is easily distinguished by the sharply angled, strongly protruding mandibles. Its largest British populations are found in an area of south-central Wales, stretching from the Gower peninsula, Glamorgan, north as far as Radnorshire. Elsewhere, there are single records from Cumbria and the Midlands. It is usually found in open, semi-natural habitats, such as bogs, heaths and acid grassland. It was only found in Britain for the first time in 1987 and has provisionally been listed in the forthcoming second status review of the larger British rove beetles as Nationally Scarce (Boyce, *in press*). At Nant Helen, it appears to be quite frequent, with individuals recorded in survey units A1, M1 and R2.

3.1.5. A rove beetle *Zyras collaris* (Paykull, 1800). pNS.

Z. collaris is a medium-sized rove beetle with a red thorax and abdomen and the last three antennal segments yellow. The rest of the body is black, with the elytra having a distinct bluish reflection. It is a very scarce species of open wetlands, including fens, marshy grassland, wet heaths and bogs. Like other members of the genus, it is an obligate myrmecophile that is associated with red ants of the genus *Myrmica*. The British distribution covers a very thin scatter of sites north as far as Cumbria. It is absent from many sites that appear to have suitable habitat. At Nant Helen, a single specimen was collected in wet litter in the transition mire at WY11.

3.1.6. A rove beetle *Euaesthetus laeviusculus* Mannerheim, 1844. pNS.

There are three British species of *Euaesthetus*, all of which are very small pitchy-reddish rove beetles. *E. laeviusculus* can be distinguished from its congeners by the relatively fine and undifferentiated puncturation of the thorax and elytra. The thoracic foveae are much less well-marked than in the commoner *E. ruficapillus* (also found at Nant Helen in 2019) and the form of both the male last abdominal sternite and aedeagus is also diagnostic. It is the scarcest of the three British species, with a very widely scattered distribution across much of Britain. It is found in saturated moss and litter and shows a strong affinity for high quality acid bogs, including raised and blanket mires. At Nant Helen, a single male was collected in mesotrophic brown moss flushes in unit O2.

3.1.7. A rove beetle *Quedius plancus* Erichson, 1840. Na.

Within the large rove beetle genus *Quedius*, *Q. plancus* is recognised by a combination of the variegated yellow pubescence on the abdomen, unmetallic elytra, blackened tibiae and the presence of a pair of seta-bearing punctures on the head between the eyes. It is a very scarce insect that is found in a handful of sites in southern England and Wales. It is usually found in coarse, twiggy, flood litter at the edge of fast-flowing woodland streams and rivers. At Nant Helen, a single male was collected in May 2019, from a twig dam at the edge of the small stream in survey unit I1.

3.1.8. A Cryptophagid beetle *Cryptophagus ruficornis* Stephens, 1830. N.

Cryptophagus is a large genus of small beetles, most of which are reddish in colour, and are generally difficult to identify without examination of the male genitalia. However, *C. ruficornis* is one of the more distinctive species, having black elytra bearing sub-erect pubescence and the thorax being quite parallel-sided with a strong hook-tooth on its lateral margins. This species is almost always found on cramp-ball fungus *Daldinia concentrica* growing on dead trunks and branches of ash trees. It is found very locally throughout Britain, though most sites lie to the south of a line from the Wash to the Mersey and it is absent from much of west Wales and south-west England. At Nant Helen, a single female *C. ruficornis* was beaten from a dead ash branch with *Daldinia* fruting bodies in the wood-pasture of survey unit G1.

3.1.9. A pollen beetle *Epuraea distincta* (Grimmer, 1841). Na.

E. distincta is a small, yellow-brown beetle with darker brown spots on the elytra. Amongst this difficult genus, this species is easily determined with a hand lens by its strongly notched pronotal hind angles. It is a very scarce beetle of wet woodland habitats, which is most frequently encountered in Wales and south-west England. The larvae appear to develop exclusively in the brackets of the maze-gill fungus *Daedaleopsis confragosa*, which is most often found on dead and dying branches of various willows *Salix* spp. At Nant Helen, a few adults were found in association with their host fungus in the central band of willow carr at survey unit WY11.

3.1.10. A Ciid beetle *Cis festinus* (Panzer, 1793). Nb.

The genus *Cis* currently includes 15 British species, most of which are small, nondescript brown beetles that are hard to distinguish from each other without careful microscopic examination. *C. festinus* has the outer edge of the front tibia and the pronotal sides rounded and the elytral bristles quite short. It can be distinguished from the very similar *C. vestitus* by the relatively well-marked fringe of bristles along the front margin of the pronotum, the pale antennal clubs, rich golden-brown colour of the body and the poorly defined fovea on the basal abdominal segment of males. It is widely, but locally distributed across Britain north as far as the southern Scottish Highlands. However, most sites are in Wales and southern England, south of a line between the Mersey and the Wash. Like all other Ciids, it feeds on fungi growing on dead trees, with *C. festinus* being a specialist of encrusting fungi of the genus *Stereum*. It is found most frequently on dead hazel branches, in association with *S. rugosum*, with a few adults being found at Nant Helen in September 2019 in this situation in the ash-oak woodland of survey unit K1.

3.1.11. A false darkling beetle *Orchesia minor* Walker, 1837. NS.

This is a small, elongate pitchy-brown beetle, without noticeably 'clubbed' antennae, and with strong spurs on the hind tibiae. It is a dead wood species, which is thought to feed on a range of wood-decaying fungi. *O. minor* is quite widely distributed in Britain, but is very local, and appears to be absent from much of Scotland and south-west England. Many of its sites are in wet woodland, though it can also be found in drier woodland types, especially in the west. A singleton was beaten from dead branches at Nant Helen in the wood-pasture of survey unit G1.

3.1.12. A false darkling beetle *Orchesia micans* (Panzer, 1793). NS.

O. micans is a small, elongate, pitchy-red beetle that jumps vigorously when disturbed. It has a wide, but very scattered distribution in woodland and parkland sites throughout Britain. The adults are most easily found by tapping old, decaying brackets of the fungus *Inonotus radiatus* on dead alder snags or *I. hispidus* brackets on ash, but it has also been recorded less frequently in association with a range of other bracket fungi. Adults were found at Nant Helen by beating dead ash and hazel branches in survey unit K1.

3.1.13. A reed beetle *Plateumaris rustica* (Kunze, 1818). NS.

P. rustica is a rather dull, metallic coppery-purple reed beetle with reddish-orange legs. The elytra lack well-defined impressions and the thorax has relatively straight sides. It is a very local insect that is confined to scattered sites across Britain, north as far as southern Scotland, though with the majority of sites in southern and central England. It is found in high-quality wetlands where there are an abundance of tall sedges and bur-reeds, these being the usual larval foodplants. Three adults were recorded at Nant Helen in June, from the species-rich fen in unit WY11.

3.1.14. A flea beetle *Mantura rustica* (Linnaeus, 1767). NS.

There are four British species of *Mantura*. They are all small, relatively elongate, metallic greenish or bluish flea beetles in which the latero-basal pronotal furrows are not joined by an impressed transverse line. *M. rustica* is very easily distinguished from all other members of the genus by the reddish colour of the apical third of the elytra. It is distributed throughout Britain, north as far as southern Scotland, but it is very local. It feeds on a range of docks and sorrels and is often found in bogs, poor fens and marshy grasslands though it can also be found in drier grassland habitats. A single specimen was swept from fen-meadow vegetation with abundant common sorrel at Nant Helen WY11 in June 2019.

3.1.15. A weevil *Protapion filirostre* (Kirby, 1808). Nb.

The genus *Protapion* is quite readily distinguished from other Apionid weevils by the highly domed form of the elytra. This is the only all-black species, its congeners otherwise having variable amounts of orange-yellow colouration on the legs. *P. filirostre* is a scarce insect, restricted to southern counties of England and Wales. It is found in grassland and short, ruderal vegetation, where there are large stands of its main foodplant, black medick. At Nant Helen, a single adult was tapped from this plant growing in species-rich ruderal grassland in unit WY1.

3.1.16. A weevil *Anthonomus brunnipennis* Curtis, 1840. Nb.

Within the genus *Anthonomus*, *A. brunnipennis* is one of only two species without a clear pattern of hairs on the elytra. It can be separated from the common *A. rubi* by its smaller size and broader second antennal segment. The elytra are often reddish-brown in colour. It is primarily a northern and western species, with its main populations in Scotland, northern England and Wales. There are also a few 'relict' populations in southern England. It is found in a range of open habitats, such as acid grassland, bogs, heaths and wood edges, where there are good stands of its main foodplant, tormentil. It is also believed to occasionally breed on other *Potentilla* species. A singleton was tapped from tormentil in an area of scrubby acid grass-heath in survey unit N3.

3.1.17. A weevil *Gymnetron beccabungae* (Linnaeus, 1760). Nb.

This is one of two species of *Gymnetron* that have a dense coating of yellowish scales on the sides of the pronotum. It can be distinguished from the closely similar *G. veronicae* by the more strongly rounded sides of the pronotum, the more extensive covering of yellowish scales on the thorax and the less conspicuous hair-like scales on the elytra. Also, the elytra of this species usually have a large red mark. It is widely but very locally distributed across the UK in wetlands where there are good populations of its foodplants. It feeds on wetland speedwells *Veronica* spp., with brooklime being especially favoured. At Nant Helen, a single individual was netted from the shallow pool in survey unit L2. Brooklime was frequent in this area.

3.1.18. A weevil *Gymnetron veronicae* (Germar, 1821). Nb.

Compared to the very similar *G. beccabungae*, which was also recorded at Nant Helen in 2019, this species can be distinguished by its less rounded pronotal side margins, the less extensive covering of yellowish scales on the thorax and the broader hair-like scales on the elytra. It has a very scattered distribution across England and Wales, with a handful of sites in southern Scotland. It is found on wet mud at the edge of waterbodies or in fens, where there are good populations of wetland speedwells. Like *G. beccabungae* it is most often found in association with brooklime. At Nant Helen, two specimens were tapped from this plant growing on sparsely vegetated mud in the heavily grazed fen in survey unit WY10.

3.1.19. A weevil *Bagous lutulentus* (Gyllenhal, 1813). Nb.

B. lutulentus is a small, dark brown weevil with two small white spots on the wing cases. It is one of a number of very similar species in this genus. It is characterised by the wide third tarsomere, relatively elongate form, small size and clearly transverse pronotum. Microscopic examination of the form of the male aedeagus provides an additional confirmatory character. Nationally, *B. lutulentus* has a very scattered distribution across England, Wales and southern Scotland. It is a very local inhabitant of wetlands where its foodplant, water horsetail, occurs. The larvae feed inside the stems of this plant and pupate in its upper parts. A single adult was found in wet litter in the transition mire in survey unit WY11.

3.1.20. A weevil *Microplontus campestris* (Gyllenhal, 1837). Nb.

M. campestris is a small, but very attractive weevil with a distinctive pattern of brown, black and white scales on the upper surface. Confirmatory characters for identifying this species include a strongly transverse thorax, which is markedly constricted towards the front and the asymmetric male genitalia. It is quite widely, but very locally distributed in the southern half of England and also across much of Wales, reaching the northern limit of its British range in Lincolnshire and Anglesey. It feeds exclusively on oxeye daisy, with the larvae feeding within the flower receptacles. Two adults were tapped from this plant in an area of very species-rich ruderal grassland in survey unit WY1 in June 2019.

3.1.21. A weevil *Pelenomus waltoni* (Boheman, 1843). Nb.

P. waltoni is a small weevil with an attractive pattern of brown, black and white scales. There are conspicuous teeth on the front margin and dorsum of the thorax, and the rostrum is much longer than its congeners. It is found in rather sparsely vegetated hollows that are at least seasonally wet. Typical habitats in Wales are in oxbows and other depressions in the floodplains of larger rivers, or at the margin of pools in wetlands and rhôs pastures. This species appears to be monophagous on water-pepper *Persicaria hydropiper*, with both adults and larvae feeding externally on the leaves. *P. waltoni* has a very scattered distribution across southern England and Wales, with a handful of records further north as far as Cumbria. In Wales, it has a wide but scattered distribution throughout the country. At Nant Helen unit N3, a single adult was tapped from stands of water-pepper growing in a sparsely vegetated damp, clayey hollow in an area of ruderal grassland and scrub.

3.1.22. A weevil *Magdalis carbonaria* (Linnaeus, 1758). Nb.

The genus *Magdalis* includes nine British species of small to mid-sized, usually matt black, weevils of elongate form. *M. carbonaria* can be distinguished from other members of the genus by dint of the prominent teeth on the underside of its front femora, its rounded pronotum and convex elytral interstices with broad striae. It is a saproxylic species, which is primarily an inhabitant of recently dead birch branches. *M. carbonaria* is very widely distributed across Scotland, Wales and England, though most sites are in northern and western Britain. A single adult was captured at Nant Helen, by beating alder branches on the edge of survey unit N4.

3.1.23. Six-belted clearwing moth *Bembecia ichneumoniformis* (Denis & Schiffermüller, 1775). Nb.

This very attractive clearwing is readily recognised by a combination of the six yellow bands on the abdomen and the orange markings on the wings. It is widely, but very sparsely distributed across England and Wales north as far as Yorkshire. Open habitats such as calcareous and coastal grassland, brownfield sites and pioneer heathland sites are favoured, often on south-facing aspects. Sites selected for breeding also have an abundance of bare ground, which creates the very warm, dry (xerothermic) micro-climate this species requires. The female lays her eggs on isolated clumps of common bird's-foot trefoil and kidney vetch. Many of the British sites of the six-belted clearwing are on the coast, but it also occurs inland where the habitat is suitable, as for example on the downs in south-east England. An adult was swept from species-rich ruderal grassland in survey unit WY3 at Nant Helen in July 2019.

3.1.24. Dingy skipper butterfly *Erynnis tages* (Linnaeus, 1758). S7.

This distinctive species is usually single brooded, flying between late-April and late-June, although partial second broods can occur in late-July and August. Larvae feed on common bird's-foot trefoil, horseshoe vetch and greater bird's-foot trefoil. The latter plant being utilised in damp meadows. Adults are frequently seen flying rapidly and low over the ground or basking on bare ground or low vegetation. The dingy skipper occurs in a wide range of habitats, including coastal dunes and undercliffs, chalk grassland, woodland rides, heathland and road verges. Very often breeding habitat includes areas of bare ground, which create xerothermic conditions favourable to the breeding success of this butterfly. It is still quite widely distributed in central and southern Britain but becomes scarcer to the north and east. Scottish and Irish populations are mainly coastal. Although remaining locally common across much of its range, the dingy skipper has disappeared from many of its British sites in recent years and for this reason, has been included on the Section 7 priority species list for Wales. There is clearly a large and important population of this butterfly at Nant Helen, with many sightings in areas of open, ruderal vegetation where there are stands of its foodplants. 2019 records are from survey units E1, J1, N3 and WY1.

3.1.25. Grayling butterfly *Hipparchia semele* (Linnaeus, 1758). S7.

The Grayling is the largest of the 'brown' butterflies found in Britain. The upper surface of the wings has attractive orange patches marked with prominent eyespots. However, these are never seen, as it invariably rests with its wings shut, so that it is the underside wing pattern of bands and spots of grey, brown and black that is invariably seen. This patterning makes the butterfly very well camouflaged when it rests on bare ground. It is still found widely across Britain but has undergone a severe decline over the last half century, with losses being particularly acute at its inland localities. For this reason, it is included on the Section 7 priority species list for Wales. Most modern sites are in dry, open, coastal grassland and heathland, though it still has strong populations inland on the lowland heaths of southern England. The larva feeds on a range of grasses, with wavy hair-grass, fine-leaved bents *Agrostis* spp. and fescues *Festuca* spp. being most frequently utilised. Low clumps of grass surrounded by bare ground are favoured, as this provides the very warm, dry microclimate required by the larva. In 2019, a few adults were found flying on dry, ruderal grassland and grass-heath in unit WY3.

3.1.26. Small pearl-bordered fritillary *Boloria selene* ([Denis & Schiffermüller, 1775]). S7.

The small pearl-bordered fritillary can be most easily distinguished from the closely similar pearl-bordered *B. euphrosyne* by the more extensive series of silvery-white spots and brown (rather than reddish) ground colour of the underside of the hindwings. Formerly, it was a common butterfly throughout Britain but has been lost from most places in the south and east of its range, which has led to its inclusion on the Section 7 priority species list for Wales. The considerable decline in its British populations relates primarily to the cessation of coppice woodland management in the latter half of the twentieth century, which has resulted in the loss of the warm, sheltered woodland glades with an abundance of common dog-violet, which was its main larval foodplant in such situations. It has remained more widely distributed in northern and western Britain, where it can be found in other habitats; chiefly bracken slopes where there are abundant dog-violets under the bracken canopy and mires and poor fens where it feeds on marsh violet. Only a single specimen was recorded in survey unit WY1 in 2019 and it seems possible that this may be a wanderer from the adjacent Gors Llwyn, Onllwyn SSSI, despite the presence of seemingly suitable habitat here (especially the *Molinia* bog in the northern part of WY11).

3.1.27. Small blue butterfly *Cupido minimus* (Linnaeus, 1767). S7.

The small blue is our smallest native butterfly. It has black-brown upperwings with a variable amount of blue dusting at their base. The underwings are silvery-white with small black spots. The small blue flies from late-May to late-June, with a partial second brood in southern England in late-July and August. The small blue shows a marked preference for chalk, limestone and coastal grasslands and man-made quarries, particularly where there is some disturbance to the soil, providing the bare ground favoured by kidney vetch, upon which the larvae feed. Colonies of this species tend to be small, occupying sheltered hollows where the micro-climate is particularly warm. Most sites for this species in northern England, Wales and Scotland are coastal, but in central southern England the small blue is also a species of inland calcareous grassland. A considerable decline has occurred, especially in northern England and the Midlands and for this reason, it is listed as a priority species in Wales under Section 7 of the Environment Act. It is a very rare butterfly inland in Wales, so the colony in species-rich ruderal grassland at WY1 is of considerable note.

3.1.28. Double line moth *Mythimna turca* (Linnaeus, 1761). Nb.

This is an easily recognised moth, in which the forewings are of a rich reddish-brown ground colour, speckled with fine black barring and two well-marked black transverse lines. There is also a small, but well-defined white discal spot. Formerly, this was designated a BAP Priority Species, but it has been found to be rather more widespread than previously thought and is no longer included on the Section 7 priority species list. Nonetheless, it remains a very local insect that is only encountered with any frequency in rough grassland and wood-edge habitats in south-west England and southern Wales. There are also much more scattered colonies across southern England between a line joining the Mersey estuary and Wash and beyond this, a handful of outlying populations as far north as Cumbria. Adults were abundant in a light trap set up in survey unit M1.

3.1.29. A Tipulid crane fly *Prionocera pubescens* Loew, 1844. RDB2.

There are just three British species of *Prionocera*, which lack the whorl of bristles on the antennal flagellum found in the very large genus *Tipula*. They have a dark grey-brown body colour with clear wings and are only distinguished with certainty by reference to the male abdomen, which have distinctively shaped processes on the ninth tergite and tenth sternite. *P. pubescens* is a stenotopic inhabitant of high-quality acid bogs, with most records coming from lowland sites. It has strong populations in north-west Scotland and in England it is well established on the heaths of Hampshire and Surrey and in the mires of Cheshire and Shropshire. It is also known from a few bogs in mid- and west Wales and in northern England. The larval ecology is poorly known, but there appears to be an association with *Sphagnum* bog pools, with the larvae probably being aquatic. A single male was collected at Nant Helen by sweeping the acid bog in unit B1.

3.1.30. A Tipulid crane fly *Tipula marginella* Theowald, 1980. RDB3.

The genus *Tipula* has over 60 British species, including some of our commonest and most familiar 'daddy long-legs'. *T. marginella* is placed in the sub-genus *Yamatotipula*, which are characterised by the basal whorl of bristles on the mid-antennal segments and the presence of a thick dark band on the pronotal disc. It is best distinguished from other members of the sub-genus by the shape of the processes on the ninth abdominal tergite of males and by the form of the male genitalia. It is a very scarce species, which is restricted to mesotrophic or acidic wetlands, such as bogs, wet heaths and poor fens, with the larvae being found in saturated mud or peat. There are scattered colonies across Britain, with most colonies being in southern England and south Wales. It is also known from a very few places in the Scottish Highlands. At Nant Helen, a few individuals were swept in the transition mire in unit WY11 and a single male was also swept from mesotrophic flushes in O2.

3.1.31. A Limoniid crane fly *Dicranomyia lucida* de Meijere, 1918. N.

D. lucida is a very attractive crane fly in which the wings have the tips darkened, with three strong black spots along the leading edge and crossvein m-cu level with the base of the discal cell. Additionally, the top of the thorax is glossy orange. It is quite widely distributed from Cumbria and north Yorkshire, southwards across England and Wales. It is an inhabitant of wet woodland, especially in sites where hemlock water-dropwort is present. At Nant Helen, an adult was swept in unit K2 from an area of seepages in wet woodland.

3.1.32. A Limoniid crane fly *Dicranomyia aquosa* Verrall, 1886. N.

The crane fly genus *Dicranomyia* includes a large number of mid-sized, rather drab species. *D. aquosa* is the only representative of the subgenus *Sivalimnobia* and can be distinguished from congeners by the form of the wing venation, especially the presence of an open discal cell, the absence of hairs on the apical part of the wing membrane, and the distinctive form of the male genitalia. It has a predominantly northern and western distribution in Britain, with most records coming from Scotland, northern England and Wales. There are also a handful of populations in south-west England, most of these being on Exmoor. It is an inhabitant of cliffs and rock outcrops, where the larvae live in wet mosses and liverworts. It can be found in both open situations, on coastal and inland cliffs, and in wooded valleys where there are rock exposures. A few adults were netted at Nant Helen from mossy rock outcrops with water dripping down them in survey unit K2.

3.1.33. A Limoniid crane fly *Thaumastoptera calceata* Mik, 1866. N.

There is only one British representative of this genus. It is a very small, lemon-yellow crane fly in which the wing has no discal cell and crossvein m-cu closes the lower basal cell well before the apex of the upper basal cell. The legs are yellow with blackened tips to the femora and tibiae. It is quite widely, but locally distributed across southern England and Wales, north as far as Cumbria and Yorkshire. The larvae construct a case of dead leaves and are found in woodland seepages, usually where the groundwater is at least mildly calcicolous. At Nant Helen, a male was swept from the area of wooded seepages in unit K2.

3.1.34. Banded general soldierfly *Stratiomys potamida* Meigen, 1882. N.

With its bold pattern of yellow abdominal bars and its large size, *S. potamida* is an unmistakable insect. It has a localised distribution in southern England and Wales as far north as the Scottish borders, though it is absent from much of the south-west peninsula and western Wales. It is predominantly a southern species, with its distribution in northern England being much more localised. It is found in a range of relatively base-rich wetland habitats, where there are areas of shallow water in which the larvae can complete their development. Though it does occur in still water, such as pond and ditch edges or flooded fenland, seepages appear to be the most favoured larval habitat. At Nant Helen, a single adult was recorded in flight over heavily poached mesotrophic seepages in survey unit WY10.

3.1.35. A Theridiosomatid spider *Theridiosoma gemmosum* (L. Koch, 1877). NS.

T. gemmosum is a small, but unmistakable spider with a globular abdomen marbled with black and white markings. It occurs across a range of lowland wetland habitats including bogs and fens, where it spins a small orb web low down amongst the vegetation. It is primarily a species of southern and eastern England and it also has strong colonies in south-west Wales and in the fens of the Llyn peninsula and Anglesey in north Wales. A single female was collected by tapping marsh cinquefoil in survey unit WY10 in 2019.

3.1.36. A money spider *Walckenaeria kochi* (O. P.-Cambridge, 1872). NS.

The genus *Walckenaeria* includes over 20 small to moderately large money spiders. *W. kochi* is one of the larger species, the carapace is black, the abdomen dark grey and the legs reddish-orange. The male has a characteristic bifurcated protuberance on the head and both this sex and the female can be reliably determined by microscopic examination of the sex organs. This is primarily a northern species that has its largest populations in Scotland, northern England and Wales, though there are some strong colonies on blanket mires on Exmoor and in the East Anglian fen country, as well as a handful of relict outpost elsewhere in southern England. It is found amongst moss and litter in a range of wetland habitats including saltmarshes, though the majority of its British populations are on acid bogs in both lowland and upland situations. At Nant Helen in 2019, a female was collected in wet moss and litter on the acid bog at survey unit B1.

3.1.37. A money spider *Hypselistes jacksoni* (O. P.-Cambridge, 1902). NS.

H. jacksoni is the only British species of the genus. It is a relatively distinctive money spider, in which the carapace and legs are usually bright orange-red and the shiny, coriaceous abdomen is deep black. The sternum is strongly edged with black and in the male, the head is strongly raised, with pitted grooves on each side of this elevation. Both the male palp and female epigyne are characteristic. This is a scarce, but widely distributed spider, which is usually found amongst moss and litter on lowland acid bogs and wet heaths. It has its British stronghold in Wales, with English populations in the Pennines, North York Moors, on the south-west peninsula, and the lowland valley mires of Dorset, Hampshire and Surrey. It also has a wide, but very scattered distribution in Scotland. There are a couple of isolated colonies on relict mire habitats in Norfolk. Two females were collected in wet moss and litter in the acid bog at B1, a single female was found in saturated moss in survey unit L2 and a further female was collected by tapping marsh cinquefoil in WY10.

3.1.38. A money spider *Erigonella ignobilis* (O. P.-Cambridge, 1871). NS.

The two British *Erigonella* species are small, rather nondescript reddish-brown to black money spiders in which the male head is moderately raised. *E. ignobilis* lacks the pit and groove on the side of the carapace that is present in the commoner *E. hiemalis*. They are best distinguished by microscopic examination of the male palp or female epigyne. It has a wide but very localised distribution across England and Wales, with a single old record from Scotland. It appears to be most frequent in western Britain and is absent from south-east England. It is found in moss and litter in a range of wetland habitats, though it appears to be most frequently recorded from acid mires. Female were recorded at Nant Helen in brown-moss seepages in survey units O2 and O3.

3.1.39. A money spider *Agyneta olivacea* (Emerton, 1882). NS.

The genus *Agyneta* includes six British species of drab-brown Linyphiids, in which the male head is not raised and has palps with a strong dorsal prominence on the cymbium. Reliable identification of them requires careful microscopic examination of the male palps or female epigyne, though the female of *A. olivacea* additionally has moderately inflated palps. It is a northern- and western-distributed species in Britain, with most records coming from Scotland, northern England and north Wales. The Brecon Beacons marks the southernmost limit of its British range. It is usually found in moss and litter in wetland habitats, though its ecology and distribution is still imperfectly known due to its very close similarity to *A. cauta*. Two females were found amongst wet moss and litter in the acid bog at survey unit B1 and a single female was collected in brown mosses in a mesotrophic flush-bog at Nant Helen O2 in 2019.

3.1.40. Triangle hammock-spider *Saaristoa firma* (O. P.-Cambridge, 1905). S7/NS.

The two British *Saaristoa* have an orange carapace and grey abdomen. In *S. firma*, there are only three long spines on the midline of the carapace behind the eyes. The form of both the female epigyne and male palps also enables this species to be distinguished quite easily from the more widespread *S. abnormis* and other Linyphiids. It is widely, but locally distributed across much of Britain, though it appears to be absent from much of the south-west peninsula. It is found in a range of damp, semi-natural habitats, such as bogs, heaths and fens, though it has also been collected in litter under both deciduous and coniferous woodland. Its British populations have undergone a very marked decline over the last few decades and for this reason it is listed as a Priority Species under Section 7 of the Environment (Wales) Act. A single female was collected in moss and litter on open-structured, young *Calluna* heath on an old spoil heap at survey unit A1.

3.2. Key invertebrate habitats at Nant Helen and Onllwyn, 2019

3.2.1. Transition mire and poor fen

Associated key species: Scarce blue-tailed damselfly; *Zyras collaris*; *Euaesthetus laeviusculus* *Plateumaris rustica*; *Chaetarthria simillima*; *Mantura rustica*; *Gymnetron beccabungae*; *Gymnetron veronicae*; *Tipula marginella*; banded general soldierfly; *Theridiosoma gemmosum*; *Hypselistes jacksoni*; *Erigonella ignobilis*; *Agyneta olivacea*.

This site supports a range of relatively mesotrophic mire, poor fen and marshy grassland communities that are of outstanding importance for invertebrates and constitute the most important invertebrate assemblage identified at Nant Helen during the 2019 survey. Especially noteworthy is the large area of fen, transition mire and willow scrub on the northern edge of the Onllwyn Washery. Hydrologically, this is part of the same block of habitat as the Gors Llwyn complex that lies immediately to the east of the A4221 road, outside the boundary of the 2019 survey area. The latter is notified as the Gors Llwyn, Onllwyn SSSI.

This area has been divided into two survey units, WY10 and WY11, which respectively correspond to the grazed and ungrazed stands of wetland vegetation. Though the level of grazing by ponies in those parts of unit WY10 with drier stands of acid and marshy grassland is excessive, it is resulting in a species-rich sward with patches of bare, poached mud in adjacent stands of poor fen and seepages. These areas support a very diverse invertebrate assemblage at Nant Helen. In particular, the relatively high grazing pressure is important in maintaining open, muddy runnels that are suitable habitat for larvae of the scarce blue-tailed damselfly and the banded general soldierfly. Bare, poached mud is providing a suitable habitat for colonisation by brooklime and this plant supports a breeding population of the weevil *G. veronicae* here. Areas of bare saturated mud are also important breeding habitat for the rare crane fly *T. marginella*.

The stands of ungrazed wetland vegetation in WY11 are equally important. Particularly noteworthy is the large area of NVC S27 transition mire, though the superb stands of fen-meadow and tall *Carex* fen into which this grades are hardly less interesting. The latter habitat has a strong population of the reed beetle *P. rustica*, which feed on large sedges. The rich flora here supports other scarce phytophagous species, including *B. lutulentus* (on water horsetail) and *M. rustica* (probably associated with *Rumex acetosa* here).

The invertebrate fauna recorded in WY10 and WY11 is of at least comparable interest to that present on the SSSI and is thought to be of regional importance for invertebrates.

Though WY10 is the largest and most important area of this habitat feature at Nant Helen, there are other high-quality stands of less heavily grazed fen in units L2, O2 and O3. A feature of all these areas is that they are fed by quite mesotrophic groundwater, with 'brown mosses' such as *Calliargon cuspidatum* replacing the bog-mosses that are more typical of acidic mires (see sub-section 3.2.4 below). As is the case with most of the habitats at Nant Helen, these fens are not pristine and many if not all have developed on sites affected or created by past mining activity. For example, the fen basin in L2 has developed

in an old man-made reservoir. It now supports a very interesting invertebrate fauna that includes a second Nationally Scarce *Gymnetron*, *G. beccabungae* and the money spider *H. jacksoni*. Brown moss seepages in units O2 and O3 have populations of the rare crane fly *T. marginella* and two other key money spiders: *E. ignobilis* and *A. olivacea*. These other mesotrophic wetlands are assessed to be of county importance in respect to their invertebrate fauna.

Grazing is the key management recommendation for these wetlands. Ideally, the grazing pressure in WY10 should be reduced, as the current level is detrimental to the drier grassland habitats here. However, it is very important that stock numbers are kept at a level that maintains the open, poached poor fen and runnel habitats in this unit. Conversely, the ungrazed wetland habitats in WY11 would benefit from the reintroduction of light grazing. There is already much scrub here and without browsing by stock, it is likely that this will continue to encroach into the very important open mire habitats. If re-stocking is impractical, scrub control could be undertaken, with stumps carefully spot-treated with a herbicide to prevent re-growth.

In addition to being an important invertebrate site in its own right, sensitive management of this area is important in maintaining high water quality in the soligenous wetlands of the Gors Llwyn, Onllwyn SSSI, which have a very similar invertebrate fauna to that recorded this year in WY10 and WY11 (Holmes, Boyce & Reed, 1991) and that are primarily irrigated with water originating here.

Probable larvae of the scarce blue-tailed damselfly were also recorded in survey unit R1 in a shallow pool created by past mining activity. It is therefore also included as an associated key species for that habitat feature (see sub-section 3.2.7).

3.2.2. Species-rich short ruderal grassland

Associated key species: *Protapion filiostre*; *Microplontus campestris*; six-belted clearwing; dingy skipper; small blue.

Away from wetlands, the most important invertebrate assemblage of invertebrates at Nant Helen is found in early- to mid-successional swards where there is at least a moderately diverse short sward interspersed with patches of bare ground. Such conditions produce a dry, warm (xerothermic) microclimate, which is a key component of the habitat required by many scarce invertebrates. All five key species associated with this habitat feature at Nant Helen are phytophagous: the six-belted clearwing and dingy skipper feeding on bird's-foot trefoil; the small blue on kidney vetch and the weevils *Protapion filiostre* and *M. campestris* on black medick and oxeye daisy respectively.

The relatively calcicolous, herb-rich stands of this vegetation on the Onllwyn block (WY1,2 and 8) are of particular note for their population of small blue butterfly and all of the other key species are also present here. The stands of this habitat on the Onllwyn Washery site are thought to be of county to regional importance. By contrast, only the dingy skipper was recorded in this habitat on the Nant Helen block. The largest stands of this habitat feature here are on the northern periphery of the active opencast in unit N3, with other significant expanses in units M3, M4 and along the rides through the felled forestry of unit J1. The

stands of this vegetation on the Nant Helen block are markedly less calcicolous and seem to move quickly towards acid grassland and heath post-disturbance. Nonetheless, the large colony of dingy skipper here is still of county importance.

This is an ephemeral habitat produced by mine working and processing activities. While these continue, new areas of this habitat will continue to be generated. However, if all or part of the site ceases to be managed in this way, then they will be quickly lost. Other forms of management, such as light to moderate grazing, periodic disturbance and rotational scrub control will then be required in order to maintain suitable conditions for this important invertebrate assemblage. Tree planting should not be undertaken in this habitat. Clearly, the key area in which to maintain and enhance short-sward ruderal grassland is the Onllwyn Washery, where there are more calcareous substrates.

3.2.3. Acidic bog and pools

Associated key species: *Helochares punctatus*; *Prionocera pubescens*; *Walckenaeria kochi*; *Agyneta olivacea*.

Though more fragmented than the mesotrophic wetlands described in sub-section 3.2.1, acid mires with bog-mosses, cottongrasses and purple moor-grass still have a diverse invertebrate fauna that includes four key species. The best area of acid bog surveyed this year is that in survey unit B1. The most important invertebrate recorded here is the Red Data Book crane fly *P. pubescens*, which probably breeds in saturated *Sphagnum* lawns around the edge of the bog pools. The two money spiders were found in both this habitat feature and in more mesotrophic fens and are therefore listed as associates for both. This habitat feature is assessed as being of county importance for invertebrates.

The water beetle *H. punctatus* was collected in a small area of floating *Sphagnum* on the northern margin of the pool in survey unit R1. This pool was also potentially important for scarce blue-tailed damselfly (see sub-section 3.2.7).

Unit B1 is currently fenced and ungrazed. As a result, pine, birch and willow scrub are colonising the drier areas of mire and heath. Ideally, much of the scrub would be removed and light grazing reinstated.

3.2.4. Acidic grass or heath

Associated key species: *Hadrognathus longipalpis*; *Anthonomus brunnipennis*; grayling; triangle hammock-spider.

Acidic vegetation dominated by species such as common bent, sheep's fescue, wavy hair-grass, ling and bell heather is quite frequent on areas of mine workings that have been left undisturbed for longer than the ruderal vegetation described in the preceding sub-section. In general, there is much less bare ground than in the short-sward ruderal areas, so xerothermic species are less evident. However, in practice these two habitat features form a successional continuum and are frequently found in mosaic with each other. There is therefore considerable overlap between the use of the two habitat features by key species, though I have assigned each key species to one or the other here based on its known autecology and 2019 records from the site.

The management issues are the same as those described in sub-section 3.2.2. There is the potential to create a considerable expanse of new heathland habitat here in areas that are no longer to be used. Tree planting should be avoided. Overall, this habitat feature is thought to be of county importance for invertebrates.

3.2.5. Dead wood

Associated key species: *Cryptophagus ruficornis*; *Epuraea distincta*; *Cis festivus*; *Orchesia micans*; *O. minor*; *Magdalis carbonaria*

Five dead wood (saproxylic) beetles were collected at Nant Helen in 2019. The most important site for saproxylic species here is the area of wood-pasture towards the south-western extremity of the site (survey unit G1), with three of the key species only found here. Of the three remaining, the Nitidulid *E. distincta* was found on *Daedaleopsis confragosa* brackets on dead willow in WY11, the Melandryid *O. micans* was beaten from dead ash branches in K1 and the weevil *M. carbonaria* was beaten from dead alder branches on the edge of unit N4.

The wood-pasture at G1 looked to have considerable potential for saproxylic invertebrates, with a good number of overmature and veteran oak and ash that have well-developed dead wood habitat features (eg. heart rot, fallen limbs, bracket fungi etc.). Given the high apparent quality of the habitat, the dead wood invertebrate fauna was rather disappointing, with none of the more exacting indicators of parkland and wood-pasture habitats recorded. This unit also looked to have considerable potential to support populations of the rare ground beetles *Carabus intricatus* and *Calosoma inquisitor*. None were found during a night search of the site in early-June, this being the optimum time and technique for recording these two species. Overall, the dead wood invertebrate fauna of Nant Helen is assessed as of no more than district importance.

3.2.6. Woodland seepages

Associated key species: *Dicranomya lucida*; *D. aquosa*; *Thaumastoptera calceata*

Sampling in the high-quality area of this habitat feature in unit K2 showed it to have a rich invertebrate fauna that included three key crane fly species. Woodland seepages at Nant Helen have an invertebrate fauna of district importance. No management of this habitat feature is required currently.

3.2.7. Shallow pools created by mining activity

Associated key species: Scarce blue-tailed damselfly

The scarce blue-tailed damselfly also occurs frequently in quarries and other industrial sites in shallow, sparsely vegetated pools, including somewhat ephemeral waterbodies such as deep vehicle ruts. The probable records from unit R1 come from a shallow pool on the edge of the active mine workings at Nant Helen. Confirmation of the presence of adults of this species here would justify an assessment of district importance for the invertebrate fauna of this habitat feature.

There is considerable scope for creating new areas of suitable habitat for this species on disused areas of the opencast mine and washery and indeed across much of the rest of the site (eg. within areas of agriculturally improved pasture or degraded stands of marshy grassland where the water table is sufficiently high to hold water).

3.2.8. Scrub and wood edges

Associated key species: Double line moth.

Scrubby 'soft' edge habitats, where open habitats grade into scrub and woodland are known to support a rich invertebrate assemblage nationally. Very extensive stands of this habitat feature are present at Nant Helen, with good examples in the open scrub habitats on the northern edge of the opencast at survey unit N3, the felled area of former conifer plantation in J1 and the scrub-heath mosaic in M1. The latter area produced the only key associate, the double line moth. Caterpillars of this species feed on various grasses growing in sheltered glades and other edge habitats. This habitat feature is assessed as being of local importance for invertebrates.

3.2.9. Streams

Associated key species: *Quedius plancus*.

The Nationally Scarce rove beetle *Q. plancus* was found in a twig and flood refuse dam in the small stream in unit I1. This habitat feature is thought to be of local importance for invertebrates.

3.3. Other invertebrate habitats at Nant Helen and Onllwyn, 2019

3.3.1. Marshy grassland

There are considerable expanses of rhôs pasture at Nant Helen. The largest areas are found on the margins of the central moorland ridge in survey units H1 and L3 and in the Onllwyn Washery block at WY4 and WY10. A major objective of the 2019 survey was to establish the status of the marsh fritillary butterfly, a species of European importance that has strong populations on the south Wales coalfield, including a colony adjacent to the site at the WTSWW Ystradfawr Reserve.

The marshy grassland habitats at Nant Helen were all searched during both the adult and larval activity period of the marsh fritillary. For the most part, these have been rather degraded by agricultural 'improvement' (drainage, over-frequent burning and probably use of herbicides and inorganic fertilisers) allied to heavy grazing pressure. They mostly have species-poor rush-dominated swards with little or no growth of the larval foodplant, devil's-bit scabious and are clearly unsuitable breeding habitat for this butterfly. The one exception to this was in L2, which had locally very high densities of *Succisa* in marshy to acid-neutral swards. However, despite diligent searching for both adults and larvae, no evidence of marsh fritillary could be found here, or elsewhere and it is concluded that there is not currently an established breeding population at the Nant Helen site.

Techniques have been developed for the restoration of rhôs pastures. Given the presence of a large resource of degraded marshy grassland at Nant Helen and the presence of nearby populations of the butterfly, there is considerable potential to increase the area of suitable habitat for this butterfly when planning the after-use of this site. Creation of new marshy grassland habitat suitable for marsh fritillary in unit H1 would be especially valuable. This area is close to the existing colony and still has a few small patches of better rhôs, with locally frequent devil's-bit scabious.

3.3.2. Improved and semi-improved grassland

In survey unit M2, at the northern end of the Nant Helen block, there is a very extensive area of agriculturally improved and semi-improved grassland and in unit S1 there is a smaller stand of the same vegetation. Parts of M2 have quite high cover of soft rush and are probably derived from former rhôs pastures. These areas are of low importance for invertebrates.

3.3.3. Coniferous plantations

The large block of conifers in unit F1 and the much smaller un-felled area of this habitat feature remaining in J2 are of low importance for invertebrates.

4. CONCLUSIONS

The Nant Helen site supports a diverse invertebrate fauna that includes many species with high conservation status. The area of fen at the northern edge of the Onllwyn Washery (WY10 and WY11) is of particular note, having an invertebrate fauna of comparable quality to the Gors Llwyn, Onllwyn SSSI. Flower-rich ruderal grassland, acid grass-heath and acid bog habitats also support significant invertebrate assemblages, including a large breeding colony of the dingy skipper and a small population of the small blue.

Dead wood, woodland seepages and streams and wood-edges also have diverse invertebrate assemblages that include important species. The survey found no evidence of any breeding populations of the marsh fritillary butterfly.

There is considerable scope in the after-use of the site to create new areas of marshy grassland habitat for this butterfly. It should also be possible to create shallow pools suitable for scarce blue-tailed damselfly and encourage development of flower-rich grassland and heathland habitats that will benefit dingy skipper, small blue and grayling butterflies as well as many other scarce invertebrates.

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6. REFERENCES

HOLMES, P. R., BOYCE, D. C., & REED, D. K. 1991. The Welsh Peatland Invertebrate Survey. Brecknock. *Report No. CCW 91/1/3*. Countryside Council for Wales, Bangor.