Cyfoeth Naturiol Cymru
Natural Resources Wales

An Invertebrate Survey of Llangennith Moors in October 2018

Martin Willing & David Boyce

NRW Evidence Report No. 583

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We work to support Wales' economy by enabling the sustainable use of natural resources to support jobs and enterprise. We help businesses and developers to understand and consider environmental limits when they make important decisions.

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1. Crynodeb gweithredol

Mae cors bori Rhos Llangynydd ar ben gorllewinol eithaf Penrhyn Gŵyr ym Morgannwg. Cyn yr arolwg hwn, ychydig oedd yn hysbys am infertebratau'r safle; cynhaliwyd yr unig arolwg blaenorol ym mis Gorffennaf 1991 ac roedd yn canolbwyntio ar urdd Diptera. Oherwydd y prinder gwybodaeth am infertebratau'r safle ac absenoldeb cymharol unrhyw waith i gynnal a chadw'r ffosydd yno ers y 1990au, comisiynodd Cyfoeth Naturiol Cymru arolwg o infertebratau ffosydd a ffeniau a gwaith i chwilio am ddwy falwoden droellog o bwysigrwydd Ewropeaidd, sef y Falwoden Droellog Gegfain *Vertigo angustior* (sydd i'w gweld yn Nhwyni Whiteford a Thwyni Oxwich gerllaw) a Malwoden Droellog Desmoulin *Vertigo moulisiana,* sydd i'w gweld mewn cynefin tebyg ar arfordir deheuol Pen Llŷn yng ngogledd Cymru. Nod yr arolygon oedd gweld beth oedd y sefyllfa bresennol o ran infertebratau Rhos Llangynydd ar ôl i'r môr dorri drwy'r morglawdd yn Rhos Cwm Ivy a arweiniodd at gilio rheoledig a cholli cors bori i forfa heli. Cynhaliwyd arolygon Llangynydd ar yr un pryd gan ddau arolygydd ym mis Hydref 2018.

Cofnododd yr arolwg o infertebratau'r ffosydd a'r ffeniau 142 o dacsonau o infertebratau, gyda'r rhan fwyaf yn rhywogaethau cyffredin ac eang eu dosbarthiad. Dim ond pedair rhywogaeth o arwyddocâd cadwraethol a gofnodwyd, gan gynnwys tair chwilen (*Badister dilatatus*, *Lathrobium impressum* a *Notaris scirpi*) a chorryn (*Theridiosoma gemmosum*); mae'r rhain i gyd yn gysylltiedig â dolydd ffen a gwernydd o safon uchel. Prin iawn oedd ffawna'r ffosydd gan fod y rhwydwaith ffosydd ar hyn o bryd yn cynnwys ffosydd sydd wedi sychu neu wedi'u tagu'n llwyr â llystyfiant ifanc tal. Er bod llawer o gynefin a allai fod yn addas yn bodoli (ymylon ffosydd y ffen a dolydd ffen), ni chofnodwyd *V. moulinsiana*. Ni chafwyd hyd i *V. angustior* chwaith, gan nad oedd ardal yr arolwg yn cefnogi unrhyw ardaloedd o gynefin llaith ond y mae dŵr yn llifo drwyddo'n rhwydd, sef yr hyn sydd ei angen ar falwod troellog. **Ar hyn o bryd, mae'r infertebratau sydd o ddiddordeb – sydd yn weddol gyfyngedig – wedi'u cyfyngu i ddolydd y ffen a'r gwernydd, yn hytrach na'r rhwydwaith ffosydd.**

Y casgliad, felly, yw ei bod yn annhebygol y byddai ffawna di-asgwrn-cefn y gwlyptiroedd yn Rhos Llangynydd yn elwa'n fawr o ailgyflwyno rhaglen clirio ffosydd. Yn wir, gallai hyn niweidio'r broses o 'ailwlychu' cynefinoedd ffen a'r amrywiaeth gyfoethog o infertebratau'r tir sy'n gysylltiedig â nhw. Mae'n hanfodol ailgyflwyno pori a/neu dorri cymedrol er mwyn cynnal a gwella cyflwr y safle ar gyfer infertebratau'r gwlyptiroedd.

Awgrymir y dylid ystyried y system dwyni fawr gyfagos yn Nhwyni Llangynydd ar gyfer gwaith i arolygu *V. angustior* yn y dyfodol gan ei bod yn cynnwys cynefin llaciau twyni sy'n cefnogi'r falwoden droellog yn Nhwyni Whiteford nid nepell i'r gogledd.

2. Executive summary

Llangennith Moors grazing marsh lies at the extreme western end of the Gower Peninsula in Glamorgan. Before this survey, the invertebrate interest of the site was little known, with the only previous survey having been carried out in July 1991 which had a focus upon Diptera. Due to the minimal invertebrate knowledge of the site and relative absence of ditch maintenance there since the 1990s, Natural Resources Wales commissioned a survey of ditch and fen invertebrates and a search for two whorl snails of European importance, the Narrow-mouthed Whorl Snail *Vertigo angustior* (which is found on the nearby Whiteford Burrows and Oxwich Burrows) and Desmoulin's Whorl Snail *Vertigo moulinsiana*, which is found in similar habitat on the south Llŷn coast in north Wales. The surveys were aimed at determining the current invertebrate interest of Llangennith Moors following a sea wall breach and subsequent managed retreat at Cwm Ivy Marsh and the loss of grazing marsh to saltmarsh. The Llangennith surveys were undertaken simultaneously by two surveyors in October 2018.

The ditch and fen invertebrate survey recorded 142 invertebrate taxa, most being common and widespread species. Only four species of conservation significance were recorded including three beetles (*Badister dilatatus*, *Lathrobium impressum* and *Notaris scirpi*) and a spider (*Theridiosoma gemmosum*), all of which are associated with high quality fen meadow and swamp. The ditch fauna was very impoverished as the ditch network is currently mostly composed of ditches that are dried out or completely choked with tall emergent vegetation. Despite the presence of abundant potentially suitable habitat (fen ditch margins and fen meadow), *V. moulinsiana* was not recorded. *V. angustior* was also not found as the survey area did not support any areas of the humid but free-draining habitat required by the whorl snail. **Current, somewhat limited, invertebrate interest is currently restricted to fen meadow and swamp rather than the ditch network.**

It is therefore concluded that the wetland invertebrate fauna of Llangennith Moors is unlikely to benefit considerably from the reintroduction of a ditch clearance programme. Indeed, this may be detrimental to the 're-wetting' of fen habitats and their rich associated terrestrial invertebrate fauna. Re-instatement of moderate-level grazing and/or cutting are imperative to maintain and enhance the interest of the site for wetland invertebrates.

It is suggested that the large adjacent dune complex at Llangennith Burrows should be considered for future *V. angustior* survey work as it includes dune slack habitat that supports the whorl snail at Whiteford Burrows only a short distance to the north.

3. Introduction

Llangennith Moors (central OS Grid Reference SS416915) is a 40-ha grazing marsh with associated ditches, lying between Llangennith Burrows and Rhossili Down on Gower (Figure 1) which is grazed by cattle and sheep. The site lies very close to sea level, at the north-western tip of the Gower peninsula, immediately to the west of the village of Llangennith in the county of Glamorgan (Watsonian vice county 41). The ditches were periodically cleared to prevent flooding until the 1990s but have received little management attention since (Kerry Rogers, pers. comm.). A botanical survey of the ditches was undertaken by the Countryside Council for Wales (CCW) in August 1991 and found them to be rather impoverished, with just seven aquatic species recorded (*Alisma plantago-aquatica*, *Hippuris vulgaris*, *Myriophyllum verticillatum*, *Potamogeton natans*, *Potamogeton pusillus*, *Ranunculus aquatilis* and *Sparganium emersum*) as well as *Callitriche* spp. (Barneveld & Hamley, 1991). *Hippuris vulgaris* is Near Threatened in Wales and *Myriophyllum verticillatum* is Vulnerable in Great Britain and Wales (Dines, 2008). Both species had very restricted distributions on Llangennith Moors at that time. The 1991 report concluded that ditch management would enhance the aquatic floral interest of the site.

3.1. Ditch invertebrates

A one-day survey of Llangennith Moors for invertebrates in July 1991 recorded 74 species including 72 flies, one solitary wasp and a single sawfly (Gibbs, 1991). Most were widespread species of wetland and other habitats, with only the soldierflies *Nemotelus nigrinus* and *Oplodontha viridula* noteworthy. Gibbs (1991) concluded that Llangennith Moors "is not an important site for invertebrates ……. and many of the ditches have silted up and disappeared." Subsequent casual recording has added a handful of more significant species including the flies *Psacadina verbekei*, *Scatophaga scybalaria* and *Tropidia scita* and the beetles *Georissus crenulatus*, *Silis ruficollis* and most importantly *Limnichus pygmaeus*. The latter is Nationally Scarce and restricted to just three sites in Wales and is a SSSI qualifying feature on Margam Moors SSSI and Tywyn Aberffraw SSSI (Howe, 2021). However, the ditches have become increasingly vegetated over the last 30 years, with little open water, and the water table across the marsh appears to have increased. This has resulted in the development of flower-rich fen meadow, with abundant rushes, Meadowsweet *Filipendula ulmaria* and Yellow Flag *Iris pseudacoris*, but a likely diminution in the floristic value of the ditches.

The breaching of the sea wall at Cwm Ivy Marsh in 2014 and subsequent tidal inundations has resulted in the decision to allow a managed retreat on this part of Gower. Over the last few years, freshwater grazing marsh has been replaced by saltmarsh. As a consequence, Natural Resources Wales wanted to consider other unprotected grazing marshes within the Area of Search (West Glamorgan & Llanelli) as a way of replacing what had been 'lost' within the SSSI series. As Llangennith Moors was seen as a potential candidate, NRW commissioned a survey of the ditch invertebrate fauna in autumn 2018 undertaken by David Boyce. Ditch invertebrate faunas of national importance in Wales are currently found on the eight SSSIs comprising the Gwent Levels, Margam Moors SSSI to the east of Swansea and probably Malltraeth Marsh (Cors Ddyga) on Anglesey.

3.2. Whorl Snails

A visit to Llangennith Moors by NRW staff in July 2018 suggested that the fen meadow in its current condition had the potential to support populations of two whorl snail species of European importance, the Narrow-mouthed Whorl Snail *Vertigo angustior* and Desmoulin's Whorl Snail *Vertigo moulinsiana*. Both species are categorised as Vulnerable in the UK (Seddon *et al.*, 2014), listed on Annex II of the EU Habitats & Species Directive (92/43/EEC) and included as Section 7 'Species of Principal Importance'. Both have poor dispersal powers and may not have been able to colonise suitable habitat if the grazing marsh has historically been drier, less floristically rich or heavily grazed by livestock. As a result of the current condition on Llangennith Moors a speculative search for the two species was considered worthwhile. This element of the work, which also included a more general survey of the mollusc fauna, was undertaken by Martin Willing over two days in October 2018.

3.2.1. Narrow-mouthed Whorl Snail

Vertigo angustior is found mostly in damp, but free-draining habitats beneath short vegetation often in places that quickly warmed by the sun (Cameron *et al.* 2003; Kerney, 1999). In the UK, many locations are maritime being transition zones on the edge of sand dunes or, in East Anglia, on sea defence embankments. The whorl snail is found on the nearby Whiteford Burrows and Oxwich Burrows on Gower (e.g. Holyoak & Willing, 1999; Killeen, 1993; Willing, 2020) and in Pembrey Forest and on Pembrey Aerial Firing Range on the Carmarthenshire Coast (Harper, 2007, 2014).

3.2.2. Desmoulin's Whorl Snail

Vertigo moulinsiana is found mostly in old or semi-natural open, calcareous fen and wetlands, usually adjacent or close to rivers, streams, lakes and ponds. In the UK, it is chiefly distributed in a broad band of country from central-southern England to East Anglia (Kerney, 1999). Outlying populations also exist in north and mid-Wales, the north-west English Midlands and north Cornwall. It is not currently known from Gower but occurs on the Afon Penrhos floodplain near Pwllheli on the Llŷn peninsula (Willing, 2017, 2018) in similar habitat to Llangennith Moors. It is otherwise restricted in Wales to Cors Geirch SSSI on Llŷn and Rhos Goch NNR in Radnorshire (Willing, 2016).

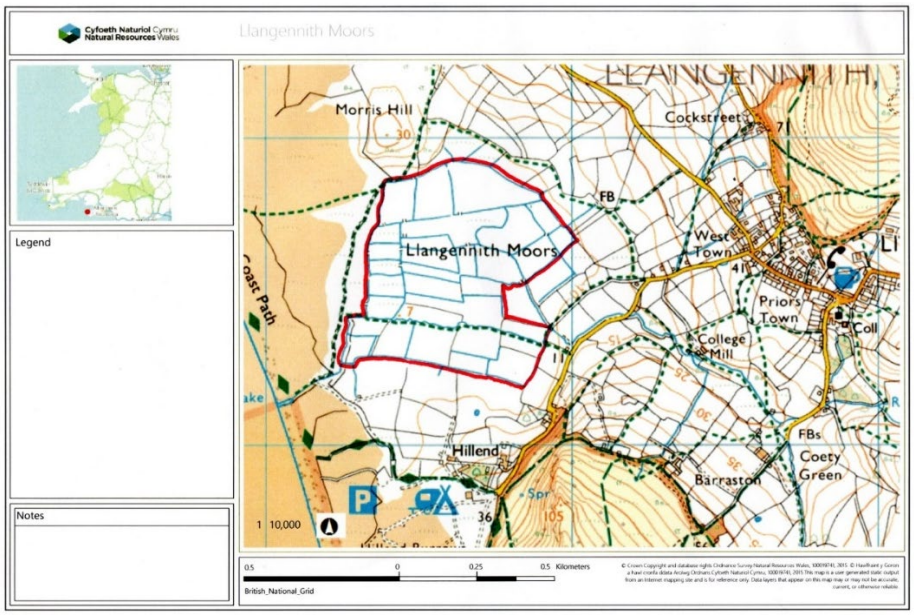

Figure 1. Location of Llangennith Moors.

4. Methods

Survey work was undertaken by the two contractors on 15th and 16th October 2018. The site is divided by the ditch network into several fields. These fields were each assigned a survey unit code, which was used as the basis for recording the invertebrate fauna (Figure 2). Many of the fields supported species-poor, improved, or semi-improved grassland of low ecological interest. The ditch network was mostly composed of ditches that were dried out or completely choked with tall emergent vegetation. As these improved fields and choked ditches had only a relatively low potential to support important wetland invertebrate assemblages, they were not the subject of more detailed follow-up invertebrate survey. Rather, survey effort was targeted towards those areas of the site that had semi-natural fen or marshy grassland and/or more open ditches with permanent standing water. A brief summary of the habitat present in each of the survey units is provided in Appendix 9.1.

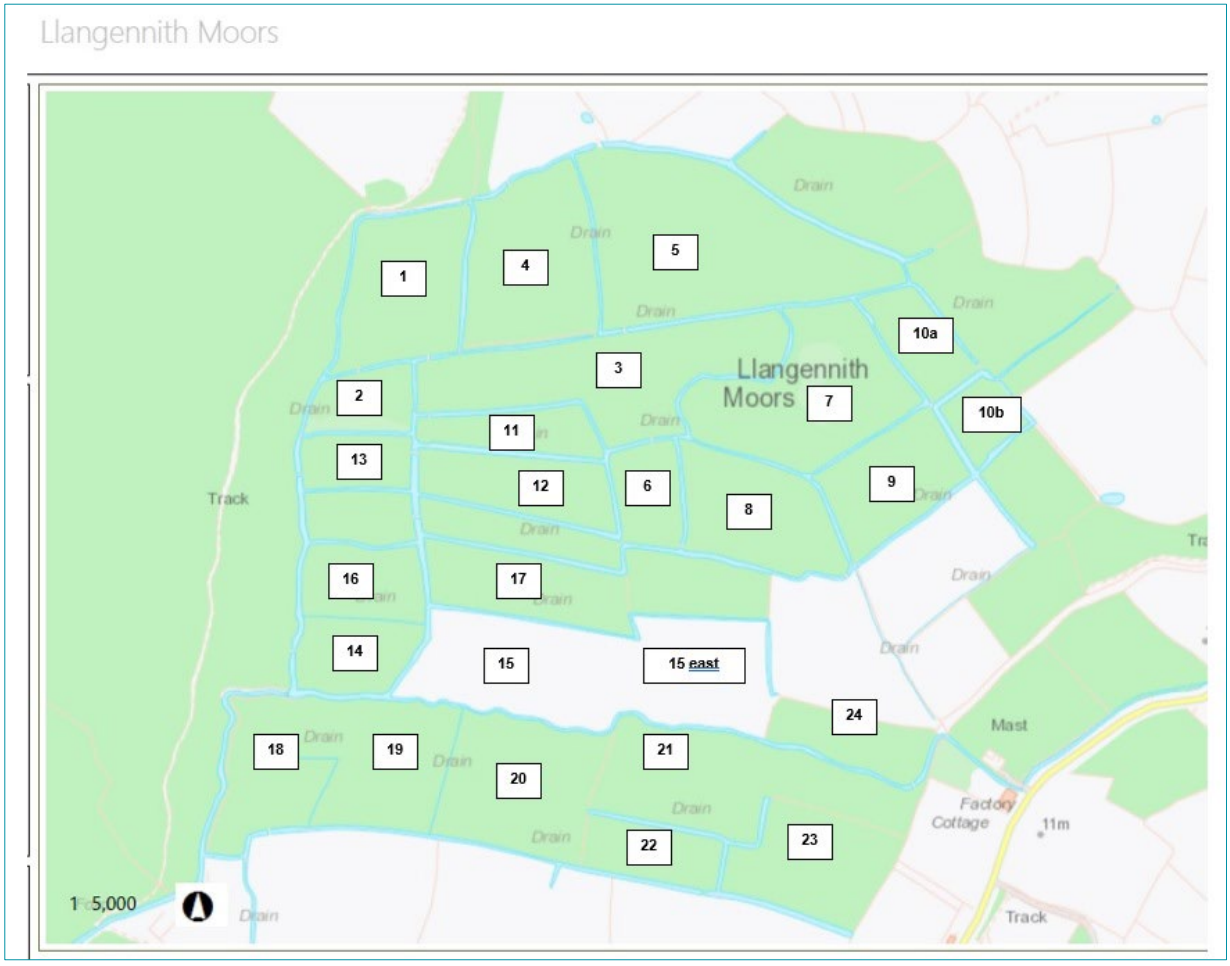

Figure 2. Location of invertebrate survey units at Llangennith Moors, October 2018.

4.1. Ditch and Fen invertebrate surveys

Because of the timing of fieldwork, ground-active and aquatic invertebrates were the main focus of recording effort. In addition to the molluscs, the other target terrestrial group collected was wetland beetles (Coleoptera), with particular emphasis on the ground beetles (Carabidae) and rove beetles (Staphylinidae). Water snails, water beetles (Dytiscidae and Hydrophiloidea) and water bugs (various aquatic Heteroptera families) were the main aquatic groups sampled. The ground-active terrestrial invertebrate assemblage was primarily sampled by shaking out or sieving wet litter,

tussocks and moss into a white plastic tray. Some tapping of tall sedges and other monocotyledons over the tray was also undertaken. Aquatic habitats were either sampled with a pond net or, in shallow margins, with a sieve. Catches were collected into tubes with either ethyl acetate or iso-propyl alcohol. Subsequently, all samples were identified down to species level.

4.2. Whorl Snail surveys

The survey days gave the dry conditions needed to undertake sampling. Surveys focussed on locating and, assessing populations of *Vertigo moulinsiana* and *V. angustior*.

For *V. moulinsiana*, the survey methodology followed the techniques detailed in Willing (2016, 2017, 2018). Consequently, searches for *V. moulinsiana* climbing upon wetland vegetation were carried out by the well-established technique of beating herbaceous fen vegetation onto a gridded white plastic tray. Surves for *V. angustior* are largely dependent upon the collection of bulk samples for later laboratory processing (after drying and sieving). As no areas of potentially suitable habitat were located during the survey, no bulk samples were removed or processed. The two *Vertigo* surveys were undertaken simultaneously with the ditch and fen invertebrate surveys and all sites were digitally photographed, and GPS bearings taken.

5. Results

5.1. Ditch and Fen invertebrate surveys

Table 1 provides a checklist of all the invertebrates recorded by the two surveyors during the two survey days in October 2018. A total of 142 species were recorded including 19 molluscs, 19 water beetles, 15 ground beetles and 43 rove beetles. Most of these were common or local, with only four Nationally Scarce species found – the beetles *Badister dilatatus*, *Lathrobium impressum* and *Notaris scirpi* and the spider *Theridiosoma gemmosum* (see Subsection 5.3).

Table 1. Invertebrates recorded at Llangennith Moors in October 2018. Molluscan nomenclature follows the recent revisions of Anderson & Rowson (2020).

Species	Vernacular name	Status	Survey units
Potamopyrgus antipodarum	Jenkin's spire snail	-	1,23
Galba truncatula	Dwarf pond snail	-	1
Lymnaea stagnalis	Great pond snail	-	1
Lymnaea palustris agg.	Marsh pond snail	-	5, 18
Ampullaceana balthica	Wandering pond snail	-	1, 23
Aplexa hypnorum	Moss bladder snail	-	1, 18
Anisus leucostoma	Button ram's-horn snail	-	1, 18
Euglesa (Pisidium) personata	Red-crusted pea mussel	-	18
Euglesa (Pisidium) subtruncata	Short-ended pea mussel	-	1, 23
Sphaerium corneum	Horny orb mussel	-	1
Succinea putris	Large amber snail	-	1, 2
Zonitoides nitidus	Shiny glass snail	-	3, 5, 19, 23
Euconulus alderi / fulvus	Tawny glass snail	-	2, 3, 19
Nesovitrea hammonis	Rayed glass snail	-	11
Deroceras leave	Marsh slug	-	2, 19, 23
Vertigo pygmaea	Common whorl snail	-	3
Vertigo antivertigo	Marsh whorl snail	-	3, 19

Species	Vernacular name	Status	Survey units
Cepaea nemoralis	Brown-lipped snail	-	23
Cepaea hortensis	White-lipped snail	-	1
Glossiphonia complanata	a leech	-	3
Pyrrhosoma nymphula	Large red damselfly	-	5
Coenagrion puella	Azure damselfly	-	5
Sympetrum striolatum	Common darter dragonfly	-	23
Pholidoptera griseoaptera	Dark bush-cricket	-	14
Pachybrachius fracticollis	a ground bug	-	19
Scolopostethus thomsoni	a ground bug	-	19, 23
Sigara nigrolineata	a water boatman	-	18
Hydrometra stagnorum	Water measurer	-	11
Nepa cinerea	Water scorpion	-	5
Chartoscirta cincta	a shore bug	-	14, 23
Saldula saltatoria	Common shore bug	-	2
Velia caprai	Water cricket	-	1
Gyrinus substriatus	a whirligig beetle	-	1,23
Haliplus lineatocollis	a diving beetle	-	5
Agabus sturmii	a diving beetle	-	1
Ilybius fuliginosus	a diving beetle	-	3,18
Ilybius quadriguttatus	a diving beetle	-	1
Colymbetes fuscus	a diving beetle	-	5,18
Dytiscus semisulcatus	a great diving beetle	-	5
Hydroporus angustatus	a diving beetle	-	3
Hydroporus palustris	a diving beetle	-	1
Hydroporus planus	a diving beetle	-	5
Hydroporus pubescens	a diving beetle	-	5
Carabus granulatus	a ground beetle	-	3
Clivina fossor	a ground beetle	-	23
Dyschirius globosus	a ground beetle	-	11,19
Bembidion assimile	a ground beetle	-	3,19,20
Pterostichus diligens	a ground beetle	-	11
Pterostichus minor	a ground beetle	-	3,14,19
Badister dilatatus	a ground beetle	**NS**	2,19
Acupalpus dubius	a ground beetle	-	3,14,20
Bradycellus sharpi	a ground beetle	-	23
Agonum fuliginosum	a ground beetle	-	19
Agonum gracile	a ground beetle	-	11
Agonum thoreyi	a ground beetle	-	11,14,20
Demetrias atricapillus	a ground beetle	-	3,19
Paradromius linearis	a ground beetle	-	3,14
Philorhizus melanocephalus	a ground beetle	-	3,14
Helophorus grandis	a water beetle	-	5
Helophorus brevipalpis	a water beetle	-	1,5,18
Helophorus flavipes agg.	a water beetle	-	5
Laccobius bipunctatus	a water beetle	-	1
Hydrobius fuscipes	a water beetle	-	1
Anacaena limbata	a water beetle	-	18
Cercyon convexiusculus	a water beetle	-	20
Hydraena riparia	a water beetle	-	18
Lesteva sicula	a rove beetle	-	7
Rybaxis longicornis	a rove beetle	-	14
Fagniezia impressa	a rove beetle	-	11
Sepedophilus marshami	a rove beetle	-	20

Species	Vernacular name	Status	Survey units
Sepedophilus nigripennis	a rove beetle	-	23
Tachinus rufipes	a rove beetle	-	19
Tachyporus pallidus	a rove beetle	-	3,19
Tachyporus transversalis	a rove beetle	-	23
Habrocerus capillaricornis	a rove beetle	-	11,20
Ocyusa picina	a rove beetle	-	3,19
Oxypoda elongatula	a rove beetle	-	14
Hygronoma dimidiata	a rove beetle	-	3
Atheta fungi ss	a rove beetle	-	11
Pachnida nigella	a rove beetle	-	11,14
Cordalia obscura	a rove beetle	-	11
Carpelimus corticinus	a rove beetle	-	2
Carpelimus elongatulus	a rove beetle	-	11,14,19
Anotylus rugosus	a rove beetle	-	3,19
Stenus aceris	a rove beetle	-	21
Stenus latifrons	a rove beetle	-	2,14
Stenus solutus	a rove beetle	-	3,18
Stenus nitidiusculus	a rove beetle	-	3,23
Stenus bimaculatus	a rove beetle	-	11,15
Stenus juno	a rove beetle	-	2,14
Stenus providus	a rove beetle	-	14
Euaesthetus ruficapillus	a rove beetle	-	3
Lathrobium brunnipes	a rove beetle	-	21
Lathrobium elongatum	a rove beetle	-	23
Lathrobium geminum	a rove beetle	-	3
Lathrobium impressum	a rove beetle	**pNS**	14,15,19,20,23
Lathrobium longulum	a rove beetle	-	11
Rugilus erichsonii	a rove beetle	-	11
Octhephilum fracticorne	a rove beetle	-	11
Paederus littoralis	a rove beetle	-	23
Paederus riparius	a rove beetle	-	3,14
Xantholinus longiventris	a rove beetle	-	21
Quedius fuliginosus	a rove beetle	-	13,21
Quedius maurorufus	a rove beetle	-	23
Erichsonius cinerascens	a rove beetle	-	2,11
Philonthus micans agg.	a rove beetle	-	11,23
Philonthus nigrita	a rove beetle	-	19,21
Gabrius breviventer	a rove beetle	-	23
Gabrius trossulus	a rove beetle	-	3
Psammoecus bipunctatus	a silvanid beetle	-	3,14
Coccidula rufa	a ladybird	-	3,14
Rhyzobius litura	a ladybird	-	15
Phaedon cochleariae	a leaf beetle	-	14,20
Prasocuris phellandrii	a leaf beetle	-	19
Chrysolina polita	a leaf beetle	-	7,20
Psylliodes affinis	a flea beetle	-	7
Altica lythri	a flea beetle	-	19,20
Aphthona lutescens	a flea beetle	-	7,18
Aphthona nonstriata	Iris flea beetle	-	3,14
Apion frumentarium	a weevil	-	18
Perapion violaceum	a weevil	-	3
Eutrichapion ervi	a weevil	-	14
Ischnopterapion modestum	a weevil	-	7,14

Species	Vernacular name	Status	Survey units
Oxystoma subulatum	a weevil	-	18
Nanophyes marmoratus	a weevil	-	7,20
Notaris scirpi	a weevil	**NS**	3
Tanysphyrus lemnae	a weevil	-	3
Rhinoncus pericarpius	a weevil	-	19
Coelositona cambricus	a weevil	-	20
Sitona lineellus	a weevil	-	19
Hypera conmaculata	a weevil	-	3,15
Aglais urticae	Small tortoiseshell butterfly	-	1
Euthrix potatoria	Drinker moth	-	15
Helophilus pendulus	Sun fly	-	23
Elachiptera brevipennis	a Chloropid fly	-	13,19
Bombus terrestris	Buff-tailed bumblebee	-	23
Bombus pascuorum	Common carder bumblebee	-	23
Gammarus pulex	Freshwater shrimp	-	23
Trichoniscus pusillus	Common pigmy woodlouse	-	7
Oniscus asellus	Common shiny woodlouse	-	7
Nemastoma bimaculatum	a harvestman spider	-	11
Theridiosoma gemmosum	a theridiosomatid spider	**NS**	11

5.2. Whorl Snail surveys

Neither of the target species was found during the survey. No potentially suitable habitat for *Vertigo angustior* was located on Llangennith Moors which lacks the humid, short-grazed, calcareous and (most importantly) free-draining conditions required by the whorl snail. Although *Vertigo moulinsiana* was not found, numerous potentially suitable areas of habitat were located during the survey (Table 2). Suitable habitat includes areas of rank monocotyledon-dominant vegetation (primarily *Glyceria maxima*, *Carex* spp. & *Sparganium* spp.; to a lesser extent *Phragmites australis* & *Juncus* spp.) growing on damp or saturated ground, but not permanently pools of standing water.

Table 2. Habitat suitability for *Vertigo moulinsiana*.

Summary of potentially suitable habitat	Survey units
Little or no suitable habitat located	9, 10, 13
Suitable vegetation lying on some or all ditch margins	1, 3, 4 ,5, 11, 22
Suitable vegetation in survey unit field (in damp hollows and/or more extensively across the unit) some may also have suitable ditch margins)	2, 6, 7, 11, 12, 14, 15, 16, 17, 18, 19*, 20*, 21*, 23* (* these four units with potentially ideal conditions and bearing a seemingly close similarity to the habitat conditions supporting *V. moulinsiana* on the Afon Penrhos floodplain near Pwllheli on the Llŷn peninsula (Willing, 2017, 2018).

5.3. Key invertebrates on Llangennith Moors

Four key species (three beetles and a spider) were recorded at Llangennith Moors in 2018. The rove beetle *Lathrobium impressum* is now considered sufficiently

uncommon to warrant Nationally Scarce status (Boyce, in prep.) and has therefore been included as a key species.

A ground beetle *Badister dilatatus* (Fabricius, 1775) **NS**

B. dilatatus is one of a group of three very similar black-brown ground beetles (the other two are the even scarcer *B. collaris* and *B. peltatus*) that are most readily distinguished by examination of the male genitalia. It is also generally larger and has more rounded pronotal hind angles than those species. It is an inhabitant of eutrophic wetlands, which have a permanently high water table. Most British sites are in high-quality fens and coastal grazing marshes of south-east England and East Anglia. In south-west England and Wales, it is very scarce and restricted to a few coastal wetlands. Two specimens were collected at Llangennith Moors; from higher quality fen meadow and swamp habitats in survey units 2and 19 respectively.

A rove beetle *Lathrobium impressum* (Bernhauer, 1902) **pNS**

The genus *Lathrobium* includes 11 British representatives. *L. impressum* is a medium-sized beetle, which has the body all-dark and the antennae and legs reddish. It can easily be distinguished from all its congeners by the upturned styles at the apex of the abdomen. It has a very scattered distribution in fens and coastal grazing marshes across England and Wales, north as far as Yorkshire. Many of the sites in which it is found show strong seasonal fluctuations in the water table. It is a very scarce beetle in Wales, which has only been recorded in a handful of high-quality lowland fens. It has been afforded Nationally Scarce status in the forthcoming Review of this group (Boyce, in prep.). On Llangennith Moors, it was quite frequent in the wetter fields on mineral substrates along the southern margin of the site (survey units 14, 15, 19, 20 and 23).

A weevil *Notaris scirpi* (Bernhauer, 1902) **NS**

This is an elongate weevil, brown in colour, with obscure patches of golden scales and a pair of small white scale spots on the elytra. It is widely, but very locally distributed across much of England and Wales. *N. scirpi* is a wetland insect, with the larvae occurring at the rootstocks of various sedges *Carex* spp. and bulrushes *Typha* spp. A single specimen was collected from litter in a sedge bed in survey unit 3 on Llangennith Moors.

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

T. gemmosum is a small but unmistakeable spider with a globular abdomen marbled with black and white markings. It occurs across a range of 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, with a few additional sites in Wales. A single specimen of *T. gemmosum* was collected in *Carex paniculata* litter in survey unit 11 in 2018.

5.4. Key invertebrate habitats on Llangennith Moors

Key habitats are defined as those in which one or more of the key species listed in the Subsection 5.3 were recorded.

High-quality Fen Meadow and Swamp

Associated key species: *Badister dilatatus*; *Lathrobium impressum*; *Notaris scirpi*; *Theridiosoma gemmosum.*

The core area of high-quality fen on Llangennith Moors is in the central and southern parts of the site and comprises survey units 2, 3, 11, 12, 14, 15, 16, 17, 18, 19 and 20 (Figure 3). It also includes the two narrow, unsurveyed fields lying adjacent to the southern border of units 12 and 13.

All four key species are restricted to this area, except for a single specimen of *Lathrobium impressum* which was found in unit 23 and is considered most likely to be a stray from the core fen area described in the preceding paragraph. Though none of the site is pristine, the northern section of this fen area (survey units 2, 3, 11, 12 and 13) has the least disturbed fen habitats; this being indicated by the presence here of peatier substrates and large tussocks of *Carex paniculata*.

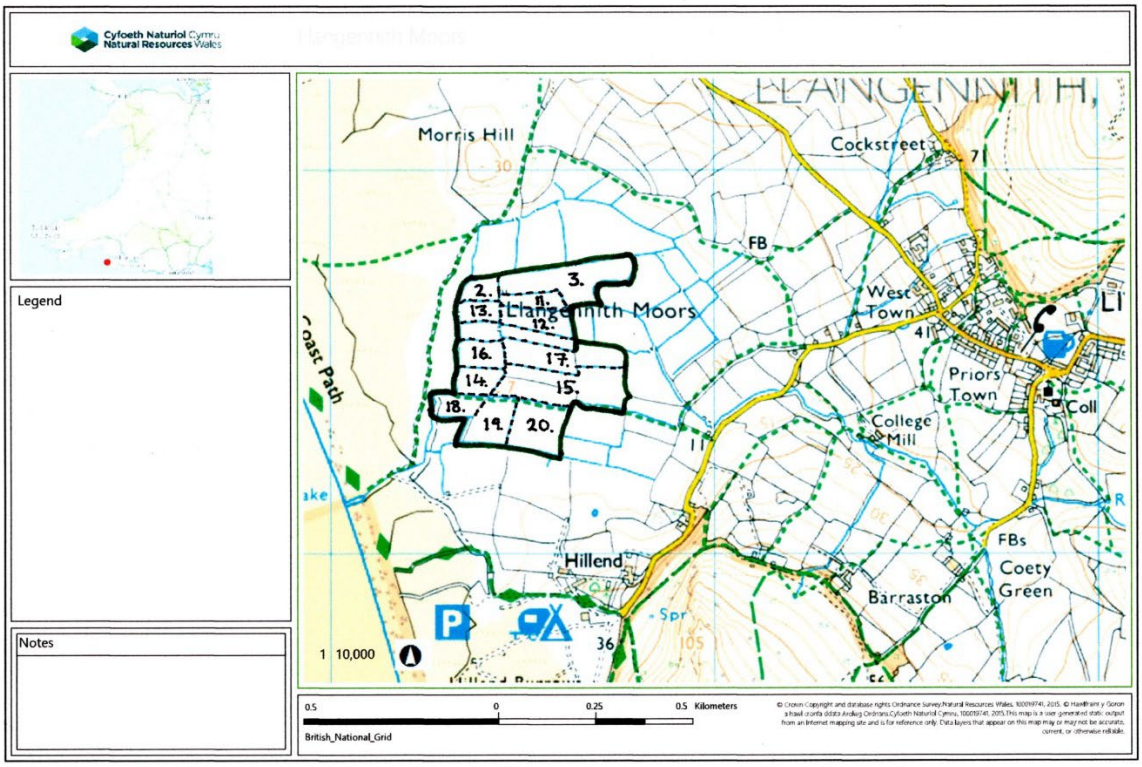

Figure 3. Location of survey units with fen and swamp habitats of importance for invertebrates.

5.5. Other invertebrate habitats on Llangennith Moors

This subsection briefly considers the other main habitats on the site where no key species were recorded in 2018.

Ditches

In the original contract specification, it had been intended that the wetland invertebrate survey would concentrate on the aquatic invertebrate fauna of the ditch network on Llangennith Moors. However, most ditches are now completely choked with tall emergents (primarily common reed and branched bur-reed) and detritus. Where it was possible to work a pond net, aquatic sampling was carried out on both days, but it quickly became apparent that the aquatic invertebrate fauna here is only

of low to moderate interest, being composed of common species typical of eutrophic late-successional or ephemeral waterbodies.

Semi-improved Rush Pastures

Away from the higher quality fen habitats, most of the fields have semi-improved grassland, frequently with abundant soft rush. These fields are thought to be of no more than moderate importance for invertebrates. However, it should be noted that wetland plants, including common reed appear to be colonising some of these fields, presumably because of the cessation of ditch clearance works. These may therefore have potential to improve if the current high water tables are maintained.

6. Discussion

6.1. Ditch and Fen invertebrates

The results of this survey show the single-day Diptera assessment of Llangennith Moors by Gibbs (1991) as of low invertebrate interest should be revised upwards. Whilst the ditch fauna is very impoverished as the ditch network has either dried out dried out or is completely choked with tall emergent vegetation, the ground-active wetland invertebrate fauna (chiefly insect) of this site is diverse and includes a number of scarce, stenotopic species of high conservation status. It is likely that, in the period since the 1991 survey, this element of the fauna at least, has benefited from the lack of any recent ditch clearance works. The consequence of this is a raised water table, which has probably improved the condition of the fen and swamp habitats occupied by these invertebrates. The most important negative factor for the ground-active wetland invertebrate assemblage is the rapid spread of common reed into the open fen and swamp habitats that are of key importance for them. In part, this may also be a consequence of a raised water table, but the key factor promoting spread of *Phragmites* is the withdrawal of grazing from all the better stands of fen vegetation. The re-instatement of light to moderate grazing across at least those parts of the site with open, species-rich wetland communities is imperative if much of the site is not to continue to develop into relatively species-poor reedbed. Cutting could be considered as an alternative (albeit somewhat inferior) if the reintroduction of grazing is impractical.

The lack of ditch clearance works has probably been detrimental to the aquatic invertebrate fauna, which is much less diverse than the terrestrial wetland assemblage and includes no species of high conservation status. However, it should be borne in mind that without any baseline data it cannot be assumed that this small and isolated area of grazing marsh was ever of high importance for aquatic invertebrates. The aquatic species recorded this year do not justify the reinstatement of a rotational programme of ditch clearance. However, it would almost certainly be beneficial for aquatic invertebrates to create some new shallow pools and scrapes, especially in some of the semi-improved rushy fields of lower ecological interest.

It is therefore concluded that the wetland invertebrate fauna of Llangennith Moors is unlikely to benefit considerably from the reintroduction of a ditch clearance programme. Indeed, this may be detrimental to the ‘re-wetting’ of fen habitats and their rich associated terrestrial invertebrate fauna. Re-instatement of moderate-level grazing and/or cutting are imperative to maintain and enhance the interest of the site for wetland invertebrates.

6.2. Whorl Snails

Vertigo moulinsiana: Numerous potentially suitable areas of *V. moulinsiana* habitat were 'tray-beaten' for the snail in ideal, dry survey conditions. The technique's suitability was demonstrated by the fact that other *Vertigo* species, *V. antivertigo* and *V. pygmaea*, although not vegetation climbing species to the same degree as *moulinsiana*, were recorded at several locations. Four survey blocks (19, 20, 21, 23) bore close botanical similarities to areas of habitat at Afon Penrhos on Llŷn peninsula (Willing 2017, 2018) which supports abundant *V. moulinsiana*. Table 2 records blocks where potentially suitable *V. moulinsiana* habitat was present.

Vertigo angustior: No potentially suitable *V. angustior* habitat was observed on the Llangennith Moors 'walk-over' survey. This snail requires damp, usually highly calcareous free-draining habitat with short, often close-cropped vegetation on the maritime margins of sand dunes as is found on the eastward, inner-facing margins and in some drier dune slacks of the nearby Whiteford Burrows. MJW's experience of surveying *V. angustior* sites both on Gower (e.g. Holyoak & Willing, 1999; Preece & Willing, 1984; Willing, 2020) and elsewhere in England (Willing, 2011) and Scotland (Killeen *et al*., 2019) allows for the recognition of potentially suitable *V. angustior* habitat.

In light of the results of a wider survey for *V. angustior* on Whiteford Burrows in 2021 as part of a contract commissioned by Natural Resources Wales, a search should be undertaken of the extensive Llangennith Burrows dune system which lies immediately to the north-west of Llangennith Moors. Examination of aerial images of these dunes appear to show areas of dune-slacks that at the nearby Whiteford Burrows support numerous *V. angustior* populations.

7. Acknowledgements

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9. Appendices

9.1. Description of survey units on Llangennith Moors, October 2018

This subsection lists all the fields surveyed in 2018. There was insufficient time to survey all areas, and some have only been subject to a brief visual inspection from adjacent fields. Note that no access could be found to the two narrow fields to the south of survey units 12 and 13. From a visual inspection, they seemed to have similar wet, swampy vegetation to that in units 16 and 17, lying immediately to the south.

Survey unit 1 (SS 41499 91870 > SS 41387 91788)

Marshy grassland dominated by soft rush *Juncus effusus* with frequent yellow flag *Iris pseudacorus*. Bordering ditches mostly heavily choked with common reed *Phragmites australis* and branched bur-reed *Sparganium erectum* and/or shaded by scrub and bramble *Rubus* sp. However, the ditches marking the western and southern boundaries of this unit were a little more open, with a few places where it was possible to work a pond net and collect an aquatic invertebrate sample.

Survey unit 2 (SS 41399 91719)

Undisturbed fen meadow (very wet when surveyed) with soft rush *J. effusus* dominant overall, but also with stands of greater tussock-sedge *Carex paniculata* and invading common reed *P. australis*. This field surrounded by common reed-choked ditches. There is a band of willow *Salix* spp scrub running along the southern boundary of this unit.

Survey unit 3 (SS 41470 91714 > SS 41605 91748)

Relatively undisturbed fen meadow with soft rush *J. effusus*, very similar to unit 2, but of somewhat lower quality and greater tussock-sedge *C. paniculata* less frequent. All surrounding ditches completely choked with common reed *P. australis*. Towards its eastern end, there are some areas of sedge-bed *Carex riparia*, *Carex* spp.

Survey unit 4 (SS 41603 91903)

Species-poor semi-improved rather dry cattle-grazed grassland of low ecological interest. *S. erectum* ditch margins.

Survey unit 5 (SS 41677 91850)

Very similar to unit 4; species-poor soft rush *J. effusus* dominated marshy grassland. The ditch marking the western boundary of this field was mostly choked with branched bur-reed *S. erectum* and water horsetail *Equisetum fluviatile* but had sufficient open water to be sampled using a pond net.

Survey unit 6 (SS 41656 91608)

Not surveyed in detail; from adjacent field appeared to be marshy grassland dominated by soft rush *J. effusus*, but quite wet and with a reasonably diverse flora.

Survey unit 7 (SS 41765 91693)

This field has clearly been unmanaged for several years. It mostly comprises very rank, marshy grassland with an abundance of purple loosestrife *Lythrum salicaria,* water mint *Mentha aquatica* etc. There are also patches of willow scrub *Salix* sp. and clumps of *P. australis*.

Survey unit 8 (SS 41761 91623)
Very similar to unit 7; rather dry and species-poor soft rush *J. effusus* dominated pasture. Ditches surrounding this field very choked with common reed *P. australis* etc.

Survey unit 9 (SS 41885 91617)
Horse-grazed semi-improved grassland with abundant soft rush *J. effusus*.

Survey unit 10a (SS 41915 91751) and **10b** (SS 41966 91667)
Not surveyed. Inspection from an adjacent field showed it to be dry cattle-grazed species-poor soft rush *J. effusus* pasture of low ecological interest.

Survey unit 11 (SS 41456 91663)
Very wet (pools in places) soft rush-yellow flag *Iris pseudacorus* - greater tussock-sedge *C. paniculata* fen meadow on peaty soils.

Survey unit 12 (SS 41465 91631)
Very similar vegetation to survey unit 11, but with no greater tussock-sedge *C. paniculata* but yellow flag *I. pseudacorus* and with scattered, open growth of common reed *P. australis*.

Survey unit 13 (SS 41364 91652)
Rather dry marshy grassland dominated by soft rush *J. effusus* and with occasional patches of nettles *Urtica dioica* indicationg nutrient enrichment. However, the presence of scattered tussocks of greater tussock-sedge *C. paniculata* suggests this unit has had a long continuity of wetland conditions.

Survey unit 14 (SS 41440 91464)
Very wet swamp, mostly relatively open, with quite species-rich mixed fen vegetation dominated by soft rush *J. effusus*, water horsetail *E. fluviatile*, yellow flag *I. pseudacorus*, water mint *M. aquatica* and marsh pennywort *Hydrocotyle vulgaris* amongst others. Fronts of species-poor common reed *P. australis* appear to be advancing into this vegetation from the margins of the field, presumably because of lack of management. This vegetation is a continuation of very similar swamp in unit 15 to the east. The two units are separated by a deep, but very choked ditch.

Survey unit 15 (SS 41694 91418 [east])
Very wet and relatively open swamp, with species-rich mixed fen vegetation dominated by soft rush *J. effusus*, water horsetail *E. fluviatile,* yellow flag *I. pseudacorus*, water mint *M. aquatica* and marsh pennywort *H. vulgaris* amongst others. Fronts of species-poor common reed *P. australis* are present around the field margins and, with no management evident here are advancing into this vegetation, to the detriment of the interesting vegetation described above. There is some marsh cinquefoil *Potentilla palustris* in the wetter western half. To the east, the substrate becomes progressively drier and has more species-poor cattle-grazed marshy grassland with soft rush *J. effusus* and some yellow flag *I. pseudacorus*. The swamp community in the western half of the field is a continuation of similar fen in unit 20 to the west. he two units are separated by a deep, but very choked ditch.

Survey units 16 (SS 41405 91523) and **17** (SS 41510 91527)

Accesss to these two units was not possible due to dense *P. australis* beds and barbed wire (no gate located). These were seen to be similar to the wet swamp in adjacent fields 14 and 15 to the south. As is the case with those units, there is no evidence of management and common reed *P. australis* appears to be spreading into the fields from the adjacent ditches, all of which are completely choked with this plant. The two narrow unsurveyed fields lying immediately to the north of this area also appeared to have very similar vegetation.

Survey unit 18 (SS 41339 91399)

An area of rather dry, cattle-grazed, species-poor, semi-improved grassland that has been colonised by thin, low growth of common reed in places. The latter presumably results from lack of grazing and ditch clearing work. There was a shallow, grassy ditch running along the south edge of this unit that was sampled for aquatic invertebrates.

Survey unit 19 (SS 41417 91365)

Very wet, mixed open swamp vegetation, with soft rush, water horsetail and yellow flag being amongst the main dominant plant species. Within these stands, which were amongst the most botanically at Llangennith Moors, there were also patches of sedges (*C. riparia, C. rostrata*, *Carex* sp.) and some marsh cinquefoil *P. palustris*, meadow sweet *Filipendula ulmaria,* gipsywort *Lycopus europaeus* and marsh pennywort *H. vulgaris*. There is an invading front of common reed *P. australis* moving into the open fen from the south. As elsewhere across much of the site, the spread of *Phragmites* is thought most likely to be attributable to the lack of grazing and of periodic ditch clearance.

Survey unit 20 (SS 41488 91380)

Wet, mixed swamp vegetation, very similar to survey unit 19. A feature of this field is the abundance of purple loosestrife *L. salicaria*.

Survey unit 21 (SS 41634 91381)

Species-poor marshy grassland like survey units 19 and 20 dominated by soft rush *J. effusus*. The rushes have been cut recently.

Survey unit 22 (SS 41686 91277)

Unmanaged species-poor reed bed *P. australis.*

Survey unit 23 (SS 41787 91361)

Species-poor marshy grassland dominated by soft rush *J. effusus*, which has been cut recently. Very similar to the adjacent survey unit 21.

Survey unit 24 (SS 41839 91381)

Species-poor, semi-improved soft rush *J. effusus* pasture.

9.2. Selected survey site images

Figure 4. Survey unit 1.

Figure 5. Survey unit 2.

Figure 6. Survey unit 3a.

Figure 7. Survey unit 3b.

Figure 8. Survey unit 3c.

Figure 9. Survey unit 3d.

Figure 10. Survey unit 5.

Figure 11. Survey unit 7.

Figure 12. Survey unit 8.

Figure 13. Survey unit 9.

Figure 14. Survey unit 11.

Figure 15. Survey unit 12.

Figure 16. Survey unit 13.

Figure 17. Survey unit 14.

Figure 18. Survey unit 15 (west).

Figure 19. Survey unit 15 (east).

Figure 20. Survey units 16 & 17 (west). (looking from one into the other)

Figure 21. Survey unit 18.

Figure 22. Survey units 19.

Figure 23. Survey unit 20.

Figure 24. Survey unit 21a.

Figure 25. Survey unit 21b (showing boundary of unit 22 in distance).

Figure 26. Survey units 21c.

Figure 25. Survey unit 23.

10. Data Archive Appendix

The data archive contains:

[A] The final report in Microsoft Word and Adobe PDF formats.

[B] Species records, which are held on the NRW Recorder 6 database.

Metadata for this project is publicly accessible through Natural Resources Wales' Library Catalogue http://libcat.naturalresources.wales or http://catllyfr.cyfoethnaturiol.cymru by searching 'Dataset Titles'. The metadata is held as record no. 125154.