Cyfoeth Naturiol Cymru
Natural Resources Wales

Sands of LIFE: Pre-intervention invertebrate monitoring

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JBA Consulting

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Mae'r adroddiad yma yn cyflwyno canlyniadau arolwg infertebratau cyn-ymyrraeth ar gyfer prosiect Twyni Byw (Sands of LIFE). Mae'r llinell sylfaen infertebratau wedi'i sefydlu mewn wyth safle'r prosiect cyn ymyriadau sydd â'r nod o wella cyflwr cynefinoedd y twyni. Bydd y llinell sylfaen yn caniatáu cymharu newidiadau sy'n deillio o grafiadau llac twyni ac ychwanegiad cwningod i'r ardal.

Defnyddiwyd trapiau pyllau, rhwydi ysgubo a chwilio gweledol ar draws wyth safle yn y prosiect, sef Merthyr Mawr, Cenfig, Twyn Whitfordd, Twyn Pen-bre, Morfa Harlech, Morfa Dinlle, Niwbwrch a Thwyn Aberffraw ym mis Mai, Gorffennaf ac Awst 2019. Ym mhob safle prosiect, nodwyd nifer o leiniau arolwg mewn lleoliadau lle mae ymyriadau rheoli cadwraeth yn y dyfodol yn yr arfaeth, yn ogystal ag ardaloedd rheoli cyfagos. Y tacsis targed ar gyfer trapio cwymp oedd Coleoptera (Staphylinidae a Carabidae) ac Araneae, ac ar gyfer rhwydi ysgubo roedd Hymenoptera acleate a Coleoptera ffytophagous. Dynodwyd unigolion a oedd yn gaeth / arsylwyd i rywogaethau lle bynnag yr oedd hynny'n bosibl, a chasglwyd a chyflwynwyd data ar gyfer pob llain arolwg a'i gyflwyno i Pantheon, offeryn asesu cydosodiad infertebratau, i bennu'r cymunedau sy'n bresennol ar hyn o bryd.

Y cyfanswm o infertebratau unigol i'r teulu lleiaf a nodwyd oedd 14,374, gyda'r mwyafrif helaeth (93%) wedi'u nodi i lefel rhywogaeth. Unigolion a nodwyd yn cynnwys rhywogaethau o Coleoptera, Araneae, Hymenoptera, Opiliones, Hemiptera (Heteroptera), Diptera, Collembola, Mollusca, Lepidoptera, Orthoptera, Blattodea, Dermaptera ac Isopoda.

Roedd y casgliadau a oedd yn bresennol yn cynnwys rhywogaethau sy'n gysylltiedig yn bennaf â chynefinoedd uchel o dywarchen a phrysgwydd, gyda chyfran lai yn gysylltiedig â thywarchen fer a thir moel, yn ogystal â chynefinoedd gwlypdir sy'n gysylltiedig â choed. Roedd nifer o rywogaethau sy'n bresennol yn y casgliad tywod a sialc noeth, sy'n grŵp allweddol i'w dargedu gan yr ymyriadau rheoli, yn amrywio rhwng safleoedd a lleiniau arolygu ond yn gyffredinol isel. Dim ond dwy rywogaeth ar restr 'arloeswr llac twyni arloeswr' Cyfoeth Naturiol Cymru oedd yn bresennol, gan gynnwys y chwilen *Dryops nitidulus* sy'n brin yn genedlaethol ac sydd bron dan fygythiad, a ddarganfuwyd yn Tywyn Aberffraw a Merthyr Mawr, a'r chwilen *Gabrius osseticus* a geir ym Morfa Harlech.

Nodwyd sawl rhywogaeth cadwraeth arall o bwysigrwydd sydd â statws prin yn genedlaethol, megis y chwilen dom, *Onthophagus nuchicornis*, sy'n agored i niwed o Dwyni Cenfig a Pen-bre, y chwilen dywod corniog *Orthocerus clavicornis* yn nhwyni Merthyr Mawr a'r pryfyn hedfan Sciomyzid *Pherbellia knutsoni* yn Nhwyni Ben-bre.

Mae'r data yma yn darparu llinell sylfaen ar gyfer cymharu newidiadau yng nghymunedau infertebratau yn dilyn ymyriadau'r prosiect.

Executive Summary

This report presents the pre-intervention invertebrate survey results for the Sands of LIFE project. An invertebrate baseline has been established at eight of the project sites prior to interventions that are aimed at improving the condition of the dune habitats. The baseline will allow comparison of changes that result from dune slack scrapes and rabbit supplementation.

Pitfall trapping, sweep netting and visual searching was undertaken across eight project sites, namely Merthyr Mawr, Kenfig, Whiteford Burrows, Pembrey Burrows, Morfa Harlech, Morfa Dinlle, Newborough and Tywyn Aberffraw in May, July and August 2019. At each project site, a number of survey plots were identified in locations where future conservation management interventions are planned, as well as nearby control areas. Target taxa for pitfall trapping were Coleoptera (Staphylinidae and Carabidae) and Araneae, and for sweep netting were aculeate Hymenoptera and phytophagous Coleoptera. Individuals trapped/observed were identified to species wherever possible, and data for each survey plot collated and submitted to Pantheon, an invertebrate assemblage assessment tool, to determine the communities currently present.

In total, 14,374 individual invertebrates were identified to at least family, with the vast majority (93%) identified to species level. Individuals identified comprised species of Coleoptera, Araneae, Hymenoptera, Opiliones, Hemiptera (Heteroptera), Diptera, Collembola, Mollusca, Lepidoptera, Orthoptera, Blattodea, Dermaptera and Isopoda.

The assemblages present comprised species associated mainly with tall sward and scrub habitats, with a smaller proportion associated with short sward and bare ground, as well as tree-associated and wetland habitats. The number of species present within the bare sand and chalk assemblage, which is a key group to be targeted by the management interventions, varied between sites and survey plots but were generally low. Only two species on the NRW ‘pioneer dune slack specialist’ list were present, including the nationally rare and near threatened beetle *Dryops nitidulus*, found at Tywyn Aberffraw and Merthyr Mawr, and the beetle *Gabrius osseticus* found at Morfa Harlech.

Several other species of conservation importance were noted, predominantly with a nationally scarce status, but also included the nationally rare and vulnerable dung beetle *Onthophagus nuchicornis* from Kenfig and Pembrey Burrows, the nationally rare Brush-horned Sand Beetle *Orthocerus clavicornis* from Merthyr Mawr and the rare Sciomyzid fly *Pherbellia knutsoni* from Pembrey Burrows.

This data provides a baseline against which changes in invertebrate communities can be compared following project interventions.

Introduction

Sands of LIFE is a major conservation project to rejuvenate 2,400 hectares of sand dunes across Wales. The project aims to recreate movement in the dunes and revitalise habitats which support some of Wales's rarest wildlife. Sands of LIFE will reprofile areas of dune and create bare sand, promoting sand movement, lower the surface of dried-out dune slack to recreate pools and wet habitat, promote sustainable grazing by livestock and rabbits and remove scrub and invasive non-native species.

The project covers 10 sites across four Special Areas of Conservation (SAC). These are: Tywyn Aberffraw; Newborough Warren; Morfa Dinlle; Morfa Harlech; Morfa Dyffryn; Laugharne-Pendine Burrows; Pembrey Burrows; Whiteford Burrows; Kenfig and Merthyr Mawr. The project will run from September 2018 to December 2022.

This report presents the results of pre-intervention baseline invertebrate surveys undertaken in 2019.

Purpose of the invertebrate surveys

The purpose of the invertebrate surveys is to provide a detailed baseline assessment of the current invertebrate interest before the implementation of a programme of dune slack restoration and rabbit management. The surveys will be repeated following the completion of the interventions to assess the impact and success of the techniques used.

Dune slacks
The dune slack interventions will involve the creation or rejuvenation of slacks by vegetation stripping and lowering of the surface of a number overgrown and/or dry slacks to create damp bare sand substrate. SoLIFE aims to rejuvenate around 12 ha of dune slack habitat across six project sites. The primary aim is to improve the condition of the Annex I habitats H2190 Humid dunes slacks and H2170 Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*) (H2170), however, benefits to invertebrates are also anticipated.

Pioneer sand dune slack habitats support unique communities of invertebrates. Bare and sparsely vegetated pioneer dune slacks provide habitat for a range of species, several of which are of conservation importance nationally in Wales and in the UK. With the increased stabilisation of sand dunes due to changes in grazing management practices, establishment of invasive non-native species, decline in rabbit populations and other impacts, 86% of bare sand habitat has been lost in Welsh dune systems over the last 70 years (Howe, 2018).

Natural Resources Wales have identified 34 species of invertebrates associated with pioneer dune slacks, which include wet, sandy marginal habitats and bare and sparsely vegetated areas. This NRW 'pioneer dune slack specialist' list is shown in Appendix 2.

Previous management at Newborough Warren included excavation of vegetated slacks to recreate pioneer conditions. Following the management, nine of the 16

representative pioneer beetle species were identified post-intervention, with three of these species not previously recorded since the 1960s and three species rapidly colonising within two months (Howe, 2018). This suggests that conservation interventions such as this can be successful in aiding such species.

Rabbit management
SoLIFE will be carrying out management on seven project sites to increase rabbit populations, including constructing rabbit warrens, rabbit releases, and mowing. The primary aim is to improve the condition of the Annex I habitat H2130* Fixed dunes with herbaceous vegetation ("grey dunes"), however, the resulting short and diverse sward and increase in dung, bare sand and micro-habitats is expected to also be beneficial for invertebrates.

Rabbit grazing and activity such as burrowing and scraping produces a mosaic of vegetation structures and nutrient-enriched disturbed soil that can support nectar-rich plants. It also prevents the encroachment of scrub and rank vegetation that prevent the establishment of a more diverse sward.

A functional community of invertebrates is supported by dung habitats in sand dune systems. Species such as *Onthophagus nuchicornis*, a Vulnerable dung beetle known from only 14 populations in the UK and with declining populations, relies on dung from grazing animals for larval habitat (Watkins and Mann, 2018). The decline of and changes in grazing management, including use of avermectin-based parasiticides in veterinary treatments, is thought likely to be responsible for the population declines. A further Endangered dung beetle species, *Rhysothorax rufa*, is associated with mobile dunes, and both species likely rely on a mosaic of bare sand and low sward height, which can be missing where grazing is absent. *Onthophagus nuchicornis* and *Rhysothorax rufa* have been found at seven sites in Wales, with three of these considered to have a sympathetic grazing regime (Kenfig, Merthyr Mawr and Whiteford Burrows).

Project sites and intervention areas

Monitoring was undertaken in all project sites where slack intervention or rabbit management was planned, though not all intervention sites were surveyed. The intention was to provide directly comparable, quantitative records of changes in the invertebrate community in the areas of intervention and an adjacent control site based on a before-after-control-impact method.

Invertebrate surveys are being undertaken pre- and post-intervention across eight sites within four SACs (Figure 3-1):

- Y Twyni o Abermenai i Aberffraw / Abermenai to Aberffraw Dunes SAC (UK0020021):
  - Tywyn Aberffraw
  - Newborough
  - Morfa Dinlle
- Morfa Harlech a Morfa Dyffryn SAC (UK0030049):
  - Morfa Harlech
- Bae Caerfyrddin ac Aberoedd / Carmarthen Bay Dunes SAC (UK0020020):
  - Pembrey Burrows

    - Whiteford Burrows
- Cynffig / Kenfig SAC (UK0012566):
    - Kenfig
    - Merthyr Mawr

These sites (except for Morfa Dinlle) are also within Important Invertebrate Areas (IIAs), which include ‘nationally significant assemblages of species or support a single globally endangered, European endangered or national Critically Endangered species’ (Buglife, 2020):

- South Wales IIA:
    - Pembrey Burrows
    - Whiteford Burrows
    - Kenfig
    - Merthyr Mawr
- Snowdonia IIA:
    - Morfa Harlech
- Anglesey and North Wales Coast IIA:
    - Tywyn Aberffraw
    - Newborough Warren

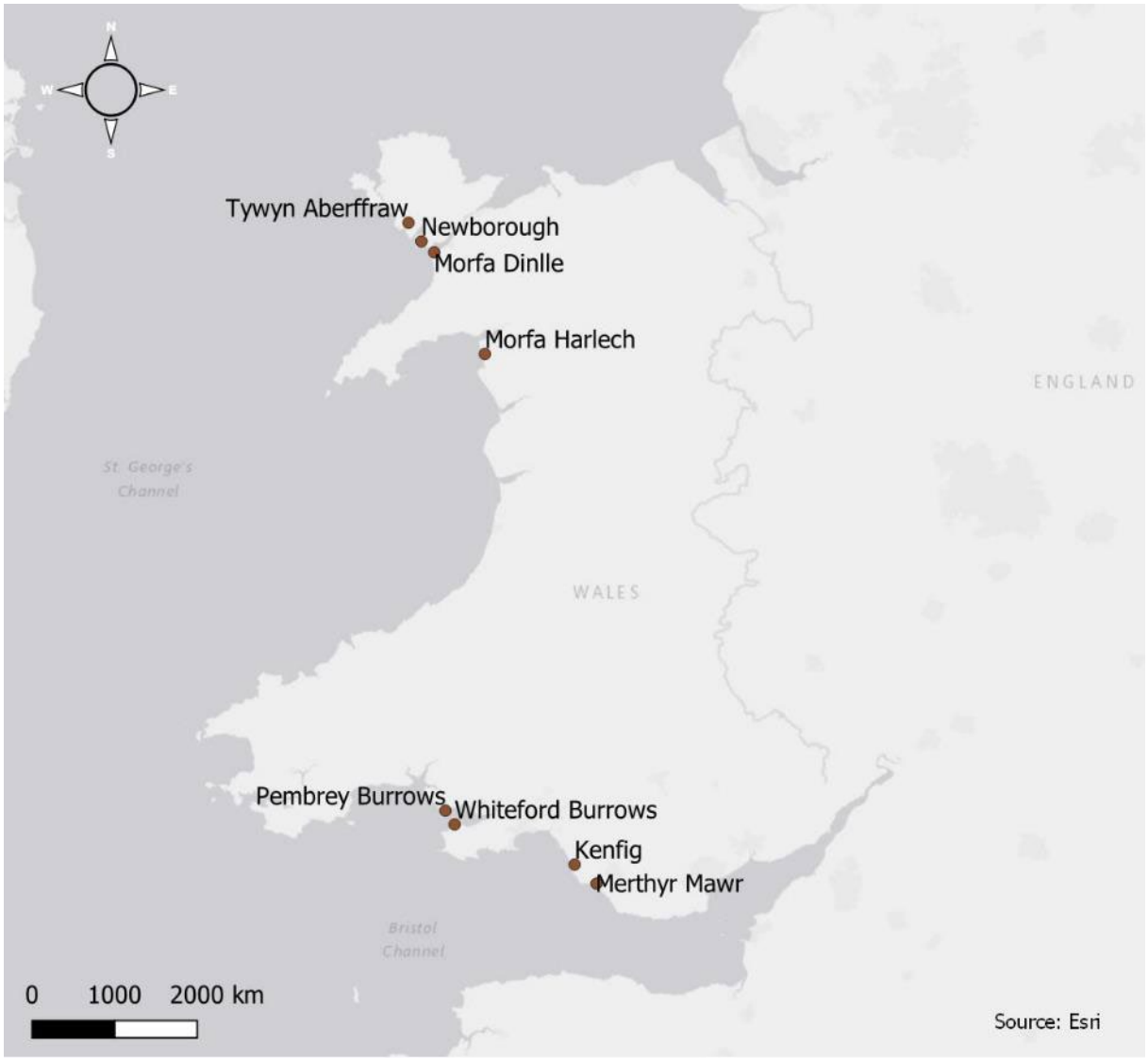

Figure 3-1. Location of project sites in which invertebrate monitoring was undertaken

Methods

Intervention area locations and timing

Within each of the eight project sites, slack intervention, rabbit intervention and control survey plots for invertebrate surveys were defined by NRW based on local knowledge of the sites (Table 4-1). Maps of the survey plots within each site are presented in Figures 4-1 to 4-8.

Table 4-1. Number of slack intervention, rabbit intervention and control survey plots sampled during invertebrate surveys at each project site.

Project site	Slack intervention areas	Control areas for slack intervention	Rabbit intervention areas	Control areas for rabbit intervention
Tywyn Aberffraw	1	1	1	1
Newborough	2	2	1	1
Morfa Dinlle	-	-	1	1
Morfa Harlech	1	1	-	-
Pembrey Burrows	2	1	1	1
Whiteford Burrows	-	-	1	1
Kenfig	3	1	1	1
Merthyr Mawr	1	1	1	1

Pre-intervention baseline surveys were undertaken between 13th and 24th May, 1st and 12th July and 19th and 30th August 2019. The weather conditions during the sampling period are presented in Appendix 1.

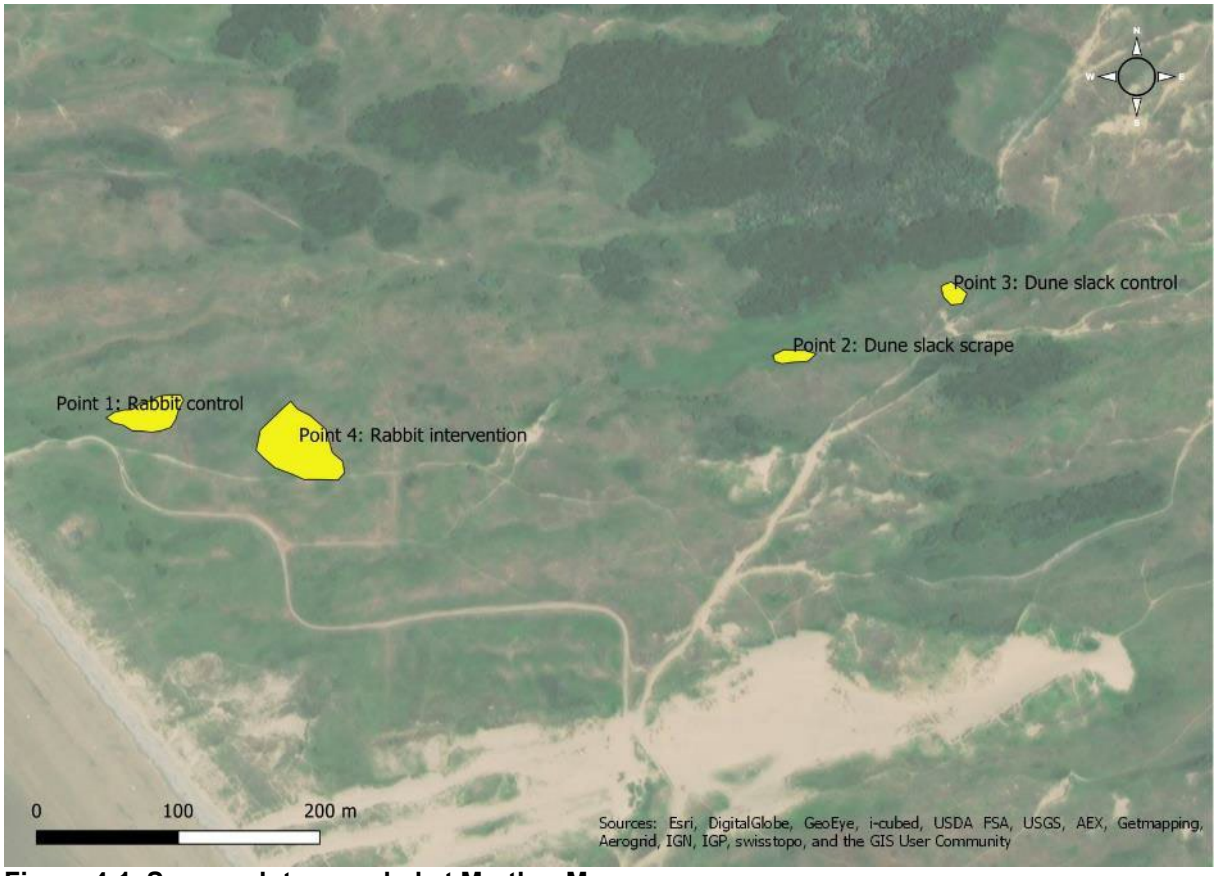

Figure 4-1. Survey plots sampled at Merthyr Mawr

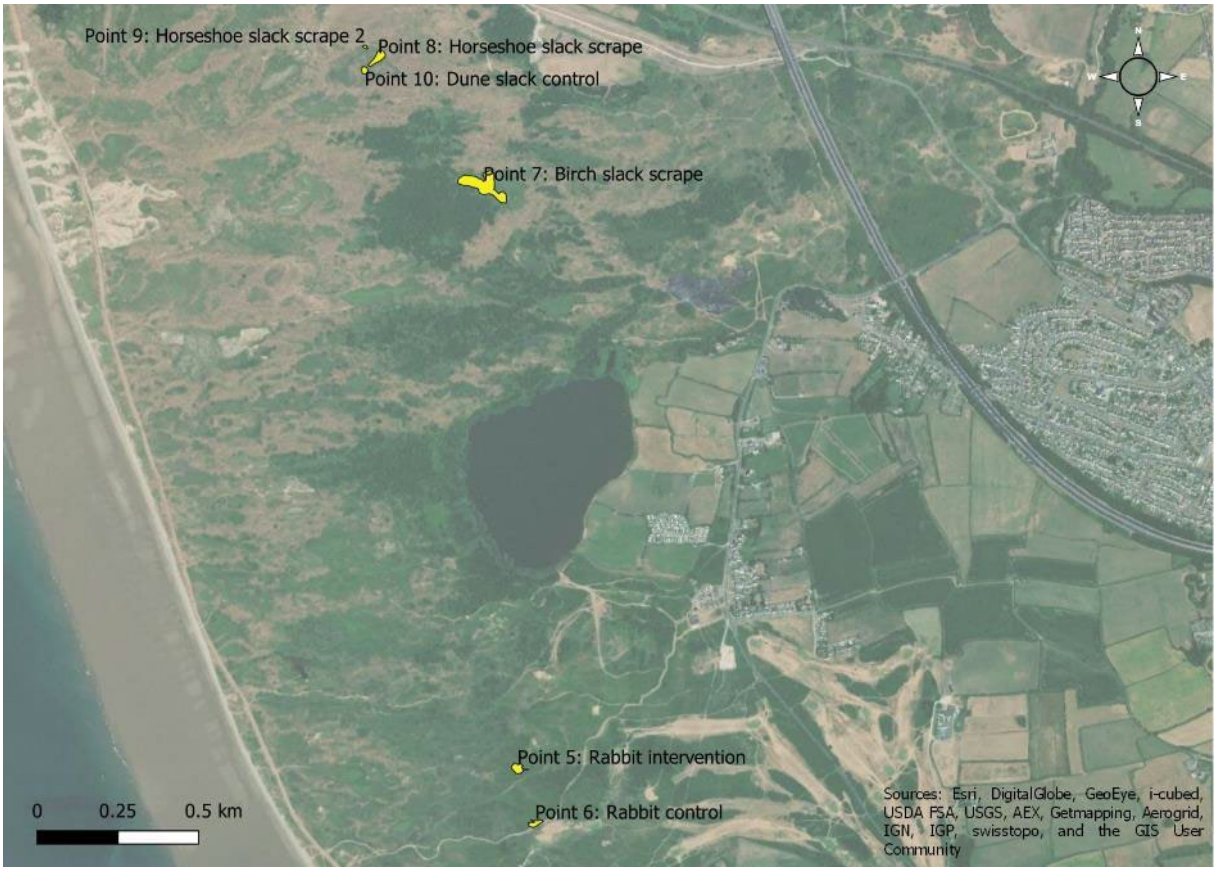

Figure 4-2. Survey plots sampled at Kenfig

Figure 4-3. Survey plots sampled at Whiteford Burrows

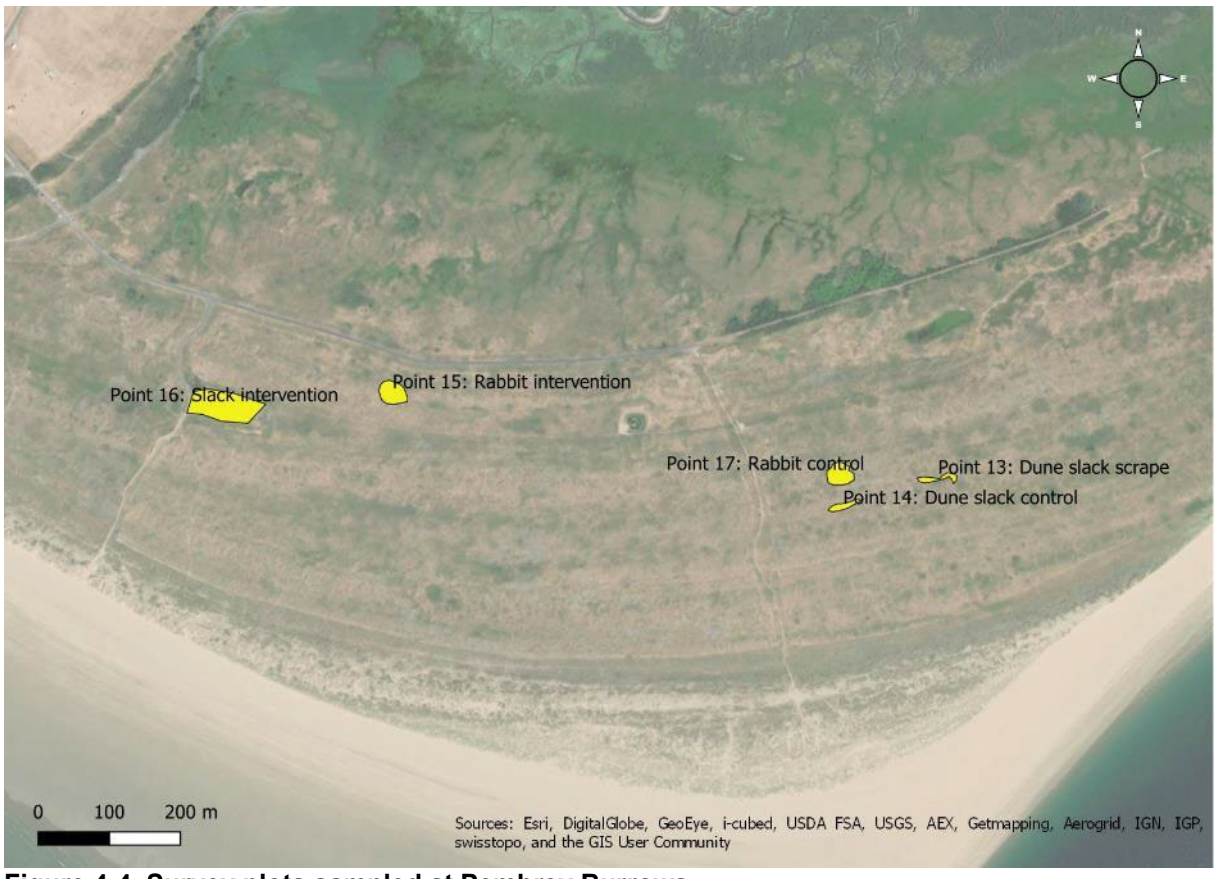

Figure 4-4. Survey plots sampled at Pembrey Burrows

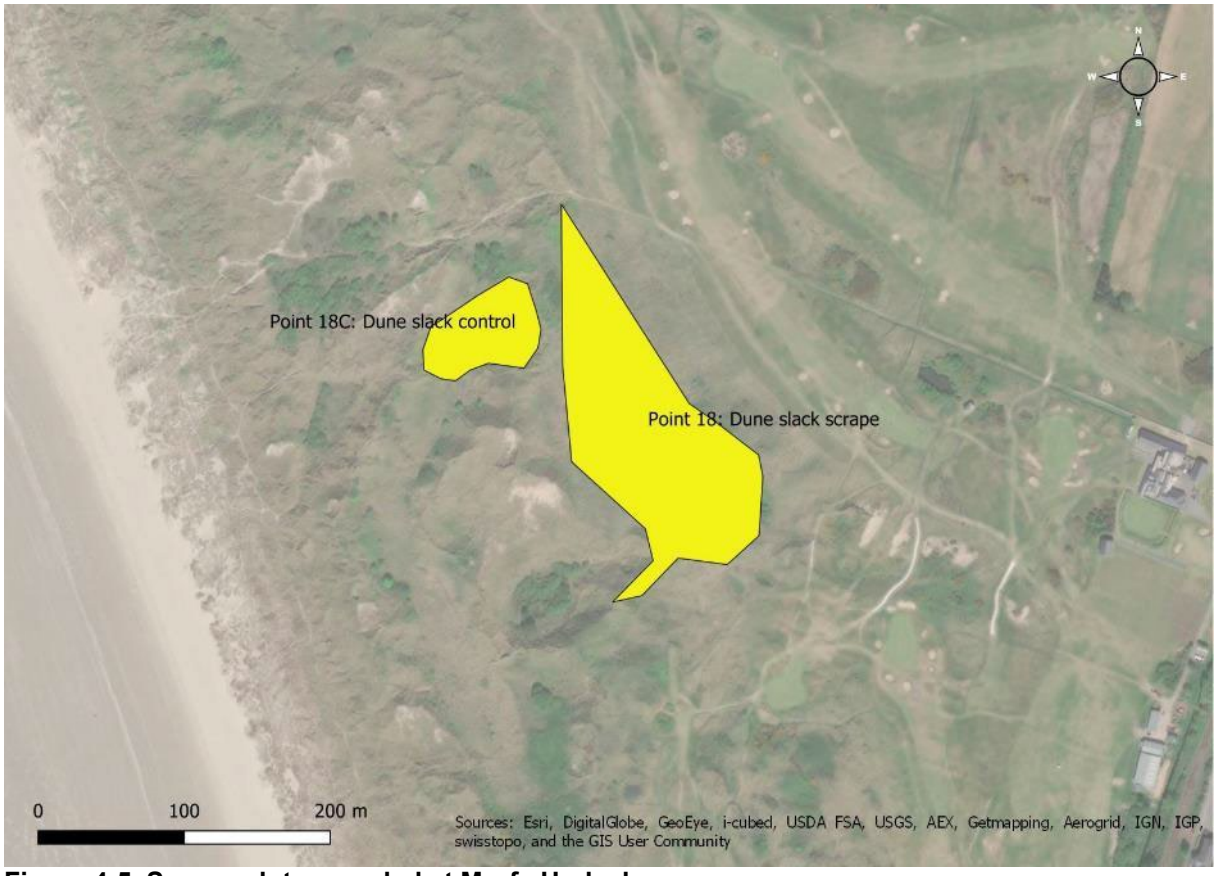

Figure 4-5. Survey plots sampled at Morfa Harlech

Figure 4-6. Survey plots sampled at Morfa Dinlle

Figure 4-7. Survey plots sampled at Newborough

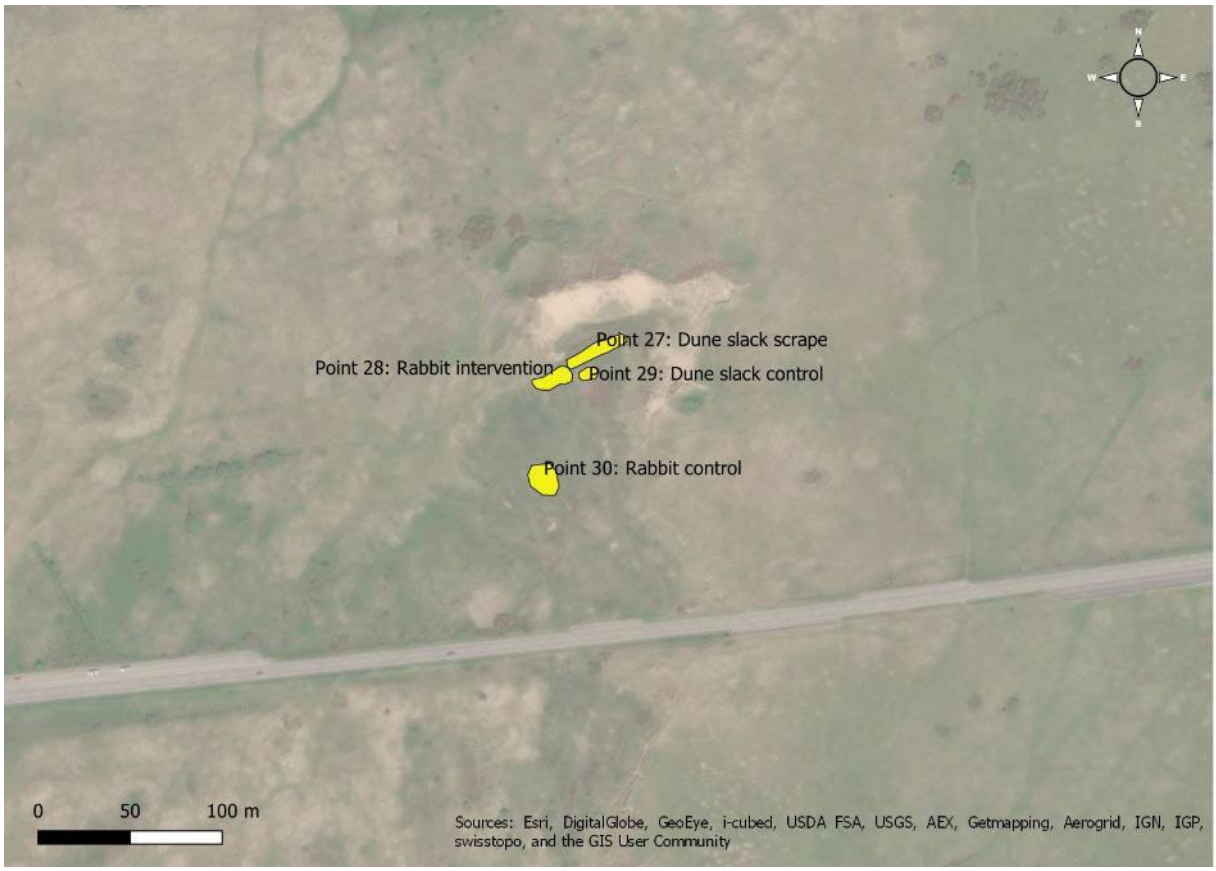

Figure 4-8. Survey plots sampled at Tywyn Aberffraw

Pitfall trapping

The target groups for pitfall trapping were Coleoptera (Staphylinidae and Carabidae) and Araneae. Pitfall traps were set by Elyssia Mayhead (JBA Consulting) and Paul Buckland (independent entomological sub-contractor) in May and Carly Benefer (JBA Consulting) in July and August. Traps were collected by Elyssia Mayhead, Tabitha Barker and Kristian Evans in May (all JBA Consulting), by Elyssia Mayhead and Tabitha Barker in July and by Elyssia Mayhead and Kristian Evans in August.

A linear array of five pitfall traps spaced 1m apart from east to west was installed in each slack scrape, rabbit intervention and control survey plot within each project site (Figure 4-1). Each pitfall trap comprised two 200ml white plastic cups, one inside the other, dug into the ground so that the top of the cup was flush with the top of the substrate. To avoid flooding, the outer cup was drilled with two small holes in the base, and the inner cup was drilled 6cm from the bottom. The pitfall traps were filled with approximately 5cm of a weak detergent solution to reduce surface tension and cause invertebrates to sink. Wire mesh (1.2cm holes) was used over the top of each trap to prevent unintentional vertebrate bycatch. A similar system was used in previous surveys at Morfa Dyffryn, Morfa Harlech and Newborough Warren in 2015 (Loxton, 2018) and is designed to allow for potential loss of traps, e.g. due to animal interference, and to ensure an adequate invertebrate catch whilst maintaining a manageable number of pitfall traps for processing and subsequent identification. GPS locations of each trap (accurate to within 80cm) was taken on installation through the use of an Arrow 100 DGPS, with georeferenced photographs also taken.

Figure 4-9. Pitfall traps in-situ at Merthyr Mawr in May 2019.

The traps were left in place for seven nights and then the invertebrates from each trap were collected and sieved through coffee filter papers by washing with water. The filter papers were placed into individual labelled 100ml sampling pots containing enough 70% ethanol to keep the filter paper moist. The sieving was undertaken over a tray to avoid spillage of detergent solution/ethanol. Samples were stored in a cool box while being transported to their final destination, where they were stored at room temperature until sorting and identification took place.

Sweep netting

Sweep netting was undertaken by Liam Olds (Colliery Spoil Biodiversity Initiative). The target groups for sweep netting (and visual searching – Section 4.4) were Aculeate Hymenoptera and phytophagous Coleoptera. Sweep netting was undertaken in one rabbit intervention and one control area in each of seven project sites (all sites listed in Table 4-1, except Morfa Harlech). One timed sweep of 10 minutes was undertaken in areas of suitable vegetation to obtain aerial invertebrate fauna and those on vegetation. After several sweeps (determined depending on amount of vegetation/invertebrate catch), the catch was inspected and an aspirator used to collect small invertebrate fauna, with larger specimens put directly into individual tubes. Identification was made at the time of sampling wherever possible (Figure 4-10) or individuals were euthanised and taken for later identification Photographs were also taken where necessary as an additional verification method.

Figure 4-10. Identification and labelling of sweep net and visual search samples in the rabbit intervention survey plot at Pembrey Burrows in July 2019.

Visual searching

Visual searches were undertaken by Rebekah Beaumont (JBA Consulting) at the same time as the sweep netting and consisted of searching the ground within three areas within the rabbit intervention and control survey plots for five minutes each (as adapted from Drake et al. 2007) for signs of burrowing invertebrates as well as those on the surface and vegetation. The target groups were Aculeate Hymenoptera and phytophagous Coleoptera. Individuals were captured in labelled tubes and identified at the time of sampling where possible, or euthanised and taken for later identification. Photographs were also taken where necessary as an additional verification method.

Invertebrate identification

Within each survey plot in each project site, samples were sifted to taxonomic order by Helen Kirk, with target taxa prioritised and sent to specialist entomologists for identification to species. Additional target taxa on the NRW pioneer dune slack species list (Appendix 2) included Diptera and Lepidoptera, which were also sent for identification, together with Hemiptera (Heteroptera) and Collembola, which were identified as non-target taxa. Coleoptera, excluding Aleocharinae, were identified by Paul Buckland, Aleocharinae were identified by Mike Denton, Araneae and Opiliones by Peter Smithers, Hymenoptera (bees and non-parasitic wasps) by Liam Olds, Diptera by Peter Chandler, Hemiptera (Heteroptera) by Liam Olds, Lepidoptera by Harry Beaumont and Collembola by Peter Shaw. Additional groups captured by sweep netting were identified by Liam Olds on an ad-hoc basis, where possible. All other taxa (including Diplopoda, Crustacea, Mollusca and Formicidae) were consolidated by survey plot and retained in 70% ethanol for later determination, if

required. Verification of difficult and/or rarer species was undertaken by appropriate specialists, with voucher specimens retained and deposited in an appropriate institution. Each target individual from each pitfall trap, sweep net or visual search survey in each intervention or control survey plot within each project site was identified to species (where possible) and the number of each species recorded.

Data analysis

Data on all individuals identified from all trapping months was collated into one Excel spreadsheet. The data for each sampling month was collated by survey plot and submitted to Pantheon (Webb et al. 2018; https://www.brc.ac.uk/pantheon/) in order to assess the communities currently present according to habitat preferences and species traits. Pantheon is an analytical database tool developed by Natural England and the Centre for Ecology and Hydrology to analyse invertebrate sample data. Lists of species can be imported into the tool, which attaches habitats and resources, assemblage types (adapted from the Invertebrate Species-habitat Information System) and conservation status, among other information. An assessment of site quality is made based on the number of species present that are indicative of good quality habitat (Webb et al., 2018).

As the presence of pioneer dune slack specialist species is of particular interest to this project and is one of the targets of the dune slack interventions, the presence of species within the F111 bare sand and chalk specific assemblage type (SAT) (https://www.brc.ac.uk/pantheon/lexicon/bare-sand-chalk) was determined using Pantheon. This SAT contains species that are associated with hot, dry soil conditions normally found in bare ground in early successional habitats, including sand dunes and is closely associated with the F112 open short sward habitat that can also be found in sand dune systems (Webb et al., 2018). A benchmark score consisting of the presence of 19 of any of the ecologically specialist species in this list determined whether the survey plot was in favourable or unfavourable condition (Webb et al., 2018) (though see section 4.7).

Descriptive analysis only has been undertaken at this pre-intervention baseline stage, with the aim of understanding the composition of the assemblages currently present before management takes place.

Limitations

The weather during the sweep net and visual search surveys in Morfa Dinlle and Tywyn Aberffraw in May was sub-optimal, with gusty winds and light rain on some sampling days. There were also high wind speeds at Merthyr Mawr, Morfa Dinlle and Tywyn Aberffraw during August. Due to the limited survey window available it was not always possible to wait for the weather to improve, so the species list is likely to have been affected, particularly for sweep net samples and Hymenoptera, on these days.

The pitfall sampling locations changed in some survey plots between the May and July trapping due to initial errors in setting the traps and changes made by NRW in the survey plots to be sampled. These were corrected during the sampling undertaken in July and trapping locations then remained the same in August. In most cases, given that the habitat in these incorrect locations was very similar to the survey plots intended to be sampled, and that invertebrates are likely to be using the wider environment, not just the sampled survey plots, this is not considered a

significant limitation. However, data for May has not been included in the Pantheon analysis for survey plots which have changed location substantially, including Merthyr Mawr survey plot 4, Pembrey Burrows survey plot 16, and Newborough survey plots 22, 23, and 24-26. This will have led to an underestimation in both species diversity and abundance for these survey plots.

Some pitfall traps were lost due to animals uprooting them. In May, a trap in survey plot 26 at Newborough was removed, and at survey plot 27 at Tywyn Aberffraw all traps were disturbed, with only a small number of individuals recovered. In July, in Pembrey Burrows survey plot 13 all the traps were disturbed by cows and in Newborough one trap was missing in survey plot 23. This may have resulted in a reduced species and underestimation of abundance for these sites.

Where data could not be assigned to a specific survey plot (55 records) this data has not been included in the analysis. These data were mainly sweep netting and visual search data for which label information was misplaced/could not be interpreted. Given that the species affected by this issue were already recorded in other known locations this is not considered to significantly impact the species lists for these sites/survey plots.

Collembola could only be identified from May pitfall samples, as they became degraded quickly in the July and August samples, which contained more material. This was not a target group for the project, only an additional group identified on a voluntary basis, so this is not considered a significant constraint. Another group that was identified on a voluntary basis only and that is not a target group for the project is the Hemiptera. Data presented here only includes the Heteroptera, with Auchenorrhyncha samples currently in the process of being identified (on a voluntary basis).

Not all the species on the lists for each survey plot were recognised by Pantheon. A summary of the proportion of the species list used to assess the communities present in each site is in Table 4-2. Some of the names submitted were only genus or family level, which are not recognised by Pantheon, inevitably leading to an underestimation of the species present for all survey plots. Most of the individuals that could only be identified to family were Diptera, particularly Phoridae and smaller Sphaeroceridae, which would be time consuming to deal with and provide limited useful information. In addition to the females of some groups that are not identifiable, especially Sarcophaga species and Anthomyiidae, most of which are believed likely to belong to species of which the males have been identified (Peter Chandler, pers.comm.). None of these groups are on the NRW pioneer dune slack specialist species target list. Overall, this is not considered to significantly impact the results as the majority of individuals were identified to species, giving a good overall approximation of the community present.

It should be noted that Pantheon was developed based on invertebrate communities in England, so caution has been used in interpreting results, and the pioneer dune slack species list provided by NRW (Appendix 2) is referred to in addition to the results from this database.

Table 4-1. Proportion of the species list analysed for each survey plot in Pantheon. Sample size = number of taxa (identified to species, family or genus). *Survey plots 4, 16 and 22 – 26 only contain data from July and August.

Site	Survey plot	Sample size	Proportion of species list analysed (%)
Merthyr Mawr	1	121	81
Merthyr Mawr	2	78	90
Merthyr Mawr	3	50	86
Merthyr Mawr	4*	71	83
Kenfig	5	66	71
Kenfig	6	109	70
Kenfig	7	67	88
Kenfig	8	58	83
Kenfig	9	60	90
Kenfig	10	75	89
Whiteford Burrows	11	120	88
Whiteford Burrows	12	117	84
Pembrey Burrows	13	63	94
Pembrey Burrows	14	55	87
Pembrey Burrows	15	86	84
Pembrey Burrows	16*	44	80
Pembrey Burrows	17	82	83
Morfa Harlech	18	94	79
Morfa Harlech	18C	85	71
Morfa Dinlle	19	74	73
Morfa Dinlle	20	72	71
Newborough	21A	71	89
Newborough	21B	72	79
Newborough	22*	27	70
Newborough	23*	25	72
Newborough	24*	50	84
Newborough	25*	83	83
Newborough	26*	85	80
Tywyn Aberffraw	27	58	81
Tywyn Aberffraw	28	98	82
Tywyn Aberffraw	29	72	89
Tywyn Aberffraw	30	109	84

Results

In total, 14,374 individual invertebrates were identified to at least family (93%) level. Individuals identified comprised species of the target taxa Coleoptera, Araneae and Hymenoptera, as well as Opiliones, Hemiptera (Heteroptera), Diptera, Collembola, Mollusca, Lepidoptera, Orthoptera, Blattodea, Dermaptera and Isopoda. The results are based on all taxa identified. The complete dataset is presented in Appendix 3.

In total, 4517 individuals of 1786 species were collected in May, 4824 individuals of 1854 species were collected in July and 5033 individuals of 1709 species were collected in August over the three collection methods combined (Figure 5-1). Most of the individuals captured were Coleoptera, Araneae or Diptera. The number of Hymenoptera observed/captured was relatively low, though observations made when walking between survey plots did reveal a greater species list. This has been discussed where appropriate for the relevant project sites. An analysis of the indicative communities currently present in each survey plot is given below.

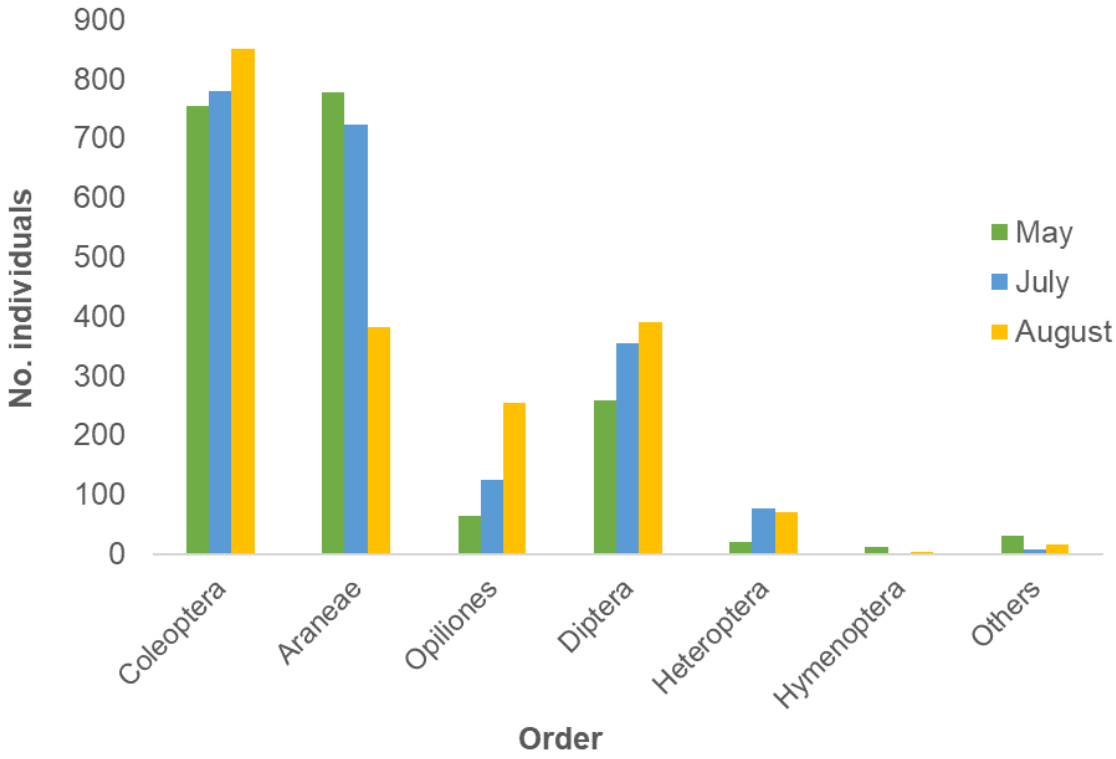

Figure 5-1. Number of individuals captured across all sampling methods, months and sites in each invertebrate Order

Merthyr Mawr

In all survey plots, the species recorded primarily consisted of those associated with tall sward and scrub in open habitats, followed by short sward and bare ground associated species (Table 5-1). All survey plots contained tree-associated species, and survey plot 1, 2 and 4 contained species associated with wetlands, although these were captured/observed in smaller numbers.

Additional species encountered within the site included Grizzled Skipper *Pyrgus malvae*, Sandpit Mining Bee *Andrena barbilabris* and Small Blue *Cupido minimus* (in May) (Figure 5-2).

Figure 5-2. *Andrena barbilabris* observed in Merthyr Mawr during May sampling (photo credit Liam Olds)

Table 5-1. Typical habitat associations of the species captured/observed at Merthyr Mawr in 2019 at each survey plot, as derived from Pantheon.

Survey plot	Type	Broad biotype	Habitat	% of capture
1	Rabbit control	Open habitats	Tall sward and scrub	57
1	Rabbit control	Open habitats	Short sward and bare ground	20
1	Rabbit control	Tree associated	Shaded woodland floor	14
1	Rabbit control	Tree associated	Wet woodland	2
1	Rabbit control	Wetland	Marshland	4
1	Rabbit control	Wetland	Peatland	2
1	Rabbit control	Wetland	Running water	2
2	Dune slack intervention	Open habitats	Tall sward and scrub	49
2	Dune slack intervention	Open habitats	Short sward and bare ground	17
2	Dune slack intervention	Open habitats	Upland	2
2	Dune slack intervention	Tree-associated	Shaded woodland floor	9
2	Dune slack intervention	Tree-associated	Arboreal	3
2	Dune slack intervention	Tree-associated	Wet woodland	3
2	Dune slack intervention	Wetland	Peatland	8

Survey plot	Type	Broad biotype	Habitat	% of capture
2	Dune slack intervention	Wetland	Marshland	5
2	Dune slack intervention	Wetland	Running water	3
2	Dune slack intervention	Wetland	Wet woodland	2
3	Dune slack control	Open habitats	Tall sward and scrub	56
3	Dune slack control	Open habitats	Short sward and bare ground	39
3	Dune slack control	Open habitats	Upland	3
3	Dune slack control	Tree-associated	Shaded woodland floor	3
4	Rabbit intervention	Open habitats	Tall sward and scrub	49
4	Rabbit intervention	Open habitats	Short sward and bare ground	27
4	Rabbit intervention	Open habitats	Upland	1
4	Rabbit intervention	Tree-associated	Shaded woodland floor	8
4	Rabbit intervention	Tree-associated	Arboreal	2
4	Rabbit intervention	Tree-associated	Decaying wood	2
4	Rabbit intervention	Tree-associated	Wet woodland	2
4	Rabbit intervention	Wetland	Marshland	3
4	Rabbit intervention	Wetland	Peatland	2
4	Rabbit intervention	Wetland	Running water	2

Information derived from Pantheon on the specific assemblage type (SAT) for each survey plot (Table 5-2) suggest that while species of bare sand and chalk habitats are present in each survey plot, the condition of the plot is ‘unfavourable’ due to the low number of representative species in the assemblage. Survey plot 4 contained the most representative species.

Table 5-2. Number of species associated with F111 bare sand and chalk SAT in each survey plot in Merthyr Mawr, and the current condition based on number of representative species of the assemblage present, as derived from Pantheon.

Survey plot	No. of species (out of 19)	Reported SAT condition
1	6	Unfavourable
2	4	Unfavourable
3	5	Unfavourable
4	13	Unfavourable

Several species with a nationally rare or scarce, or nationally notable, status were captured across the survey plots, primarily associated with short sward and bare ground habitats (Table 5-3). The Carabid *Syntomus truncatellus,* which is associated with tall sward and scrub and the spider *Argenna subnigra*, associated with short sward and bare ground, were found across a number of the survey plots, potentially suggesting a widespread distribution at the site. One individual of the nationally rare *Dryops nitidulus*, which is on the NRW pioneer dune slack specialist list, was captured in survey plot 2. Notably, the Drosophilid *Drosophila suzukii* was found in a pitfall trap in August in survey plot 1. This species was first recorded in Britain in 2012 and to date there are few records of it from Wales (Chandler, 2018), though more recently individuals have been recorded from the Wye Valley in Monmouthshire (Peter Chandler, Pers.Comm.)

Table 5-3. Species with a conservation status captured/observed in each survey plot at Merthyr Mawr in 2019, as derived from Pantheon.

Survey plot	Habitat	Order	Species	Conservation status
1	Short sward and bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
1	Short sward and bare ground	Araneae	*Sarcophila latifrons*	Nationally scarce (provisional)
2	Short sward and bare ground	Araneae	*Argenna subnigra*	Nationally scarce
2	Short sward and bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
2	Short sward and bare ground	Araneae	*Xerolycosa miniata*	Nationally scarce
2	Short sward and bare ground	Diptera	*Herina palustris*	Nationally scarce (provisional)
2	Wetland	Coleoptera	*Dryops nitidulus*	Nationally rare and nationally threatened
2	Wetland	Araneae	*Pirata piscatorius*	Nationally scarce
3	Tall sward and scrub	Coleoptera	*Syntomus truncatellus*	Nationally scarce
3	Short sward and bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
3	Short sward and bare ground	Araneae	*Argenna subnigra*	Nationally scarce
4	Short sward and bare ground	Araneae	*Zelotes electus*	Nationally scarce
4	Short sward and bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
4	Short sward and bare ground	Araneae	*Xerolycosa miniata*	Nationally scarce

Survey plot	Habitat	Order	Species	Conservation status
4	Short sward and bare ground	Coleoptera	*Orthocerus clavicornis*	Nationally rare
4	Short sward and bare ground	Diptera	*Sarcophila latifrons*	Nationally scarce (provisional)
4	Tall sward and scrub	Coleoptera	*Syntomus truncatellus*	Nationally scarce
4	Decaying wood	Coleoptera	*Enicmus fungicola*	Notable
4	Shaded woodland floor	Diptera	*Pelidnoptera nigripennis*	Notable

Kenfig

In all survey plots, the species primarily consisted of those associated with tall sward and scrub in open habitats (Table 5-4). Survey plots 5 and 6 were typical of late-successional habitats on stable sand with a high cover of Bracken *Pteridium aquilinum*. Short sward and bare ground and shaded woodland floor associated invertebrate species were prominent. In survey plots 7 ('birch slack') and 8 ('horseshoe slack') wetland (marshland and peatland) associated species were also present as a greater proportion of the assemblage than the other survey plots. These slacks were observed to have a higher water table than most of the other survey plots. It is also noted that some slacks within Kenfig contain fen rather than dune-associated vegetation communities, likely due to the accumulation of organic matter, which may have influenced the presence of certain marshland and peatland associated invertebrate species.

During the August pitfall setting and sweep netting/visual searches, a Shrill Carder Bee *Bombus sylvarum* (Figure 5-3) was noted foraging close to Kenfig Castle. Kenfig National Nature Reserve is a known key site for this species in south Wales (Stewart and Roberts, 2013). Additional notable species were recorded within the site at Kenfig Burrows dunes, Kenfig Pool and at the mouth of River Kenfig by Barry Stewart in July 2019 during NVC surveys as part of the Sands of LIFE project, including the Coastal Leaf-cutter Bee *Megachile maritima* and the 'nationally notable' Grey Bush Cricket *Platycleis albopunctata.*

Table 5-4. Typical habitat associations of the species captured/observed at Kenfig in 2019 at each survey plot, as derived from Pantheon.

Survey plot	Type	Broad biotype	Habitat	% of capture
5	Rabbit intervention	Open habitats	Tall sward & scrub	63
5	Rabbit intervention	Open habitats	Short sward & bare ground	8
5	Rabbit intervention	Tree-associated	Shaded woodland floor	18
5	Rabbit intervention	Tree-associated	Arboreal	5
5	Rabbit intervention	Wetland	Peatland	5
5	Rabbit intervention	Wetland	Running water	3
6	-	Open habitats	Tall sward & scrub	71

Survey plot	Type	Broad biotype	Habitat	% of capture
6	-	Open habitats	Short sward & bare ground	5
6	-	Tree-associated	Shaded woodland floor	16
6	-	Tree-associated	Arboreal	4
6	-	Wetland	Peatland	4
7	Dune slack intervention	Coastal	Brackish pools & ditches	2
7	Dune slack intervention	Open habitats	Tall sward & scrub	32
7	Dune slack intervention	Open habitats	Short sward & bare ground	7
7	Dune slack intervention	Tree-associated	Shaded woodland floor	12
7	Dune slack intervention	Tree-associated	Wet woodland	5
7	Dune slack intervention	Tree-associated	Arboreal	2
7	Dune slack intervention	Wetland	Peatland	22
7	Dune slack intervention	Wetland	Marshland	15
7	Dune slack intervention	Wetland	Wet woodland	3
7	Dune slack intervention	Wetland	Running water	2
8	Dune slack intervention	Open habitats	Tall sward & scrub	38
8	Dune slack intervention	Open habitats	Short sward & bare ground	11
8	Dune slack intervention	Open habitats	Upland	2
8	Dune slack intervention	Tree-associated	Shaded woodland floor	9
8	Dune slack intervention	Tree-associated	Decaying wood	2
8	Dune slack intervention	Tree-associated	Wet woodland	2
8	Dune slack intervention	Wetland	Marshland	17
8	Dune slack intervention	Wetland	Peatland	17
8	Dune slack intervention	Wetland	Wet woodland	2
9	Dune slack intervention	Coastal	Brackish pools & ditches	2
9	Dune slack intervention	Open habitats	Tall sward & scrub	30
9	Dune slack intervention	Open habitats	Short sward & bare ground	19
9	Dune slack intervention	Open habitats	Upland	2
9	Dune slack intervention	Tree-associated	Shaded woodland floor	16
9	Dune slack intervention	Tree-associated	Wet woodland	4
9	Dune slack intervention	Tree-associated	Arboreal	2

Survey plot	Type	Broad biotype	Habitat	% of capture
9	Dune slack intervention	Wetland	Peatland	12
9	Dune slack intervention	Wetland	Marshland	7
9	Dune slack intervention	Wetland	Running water	4
9	Dune slack intervention	Wetland	Wet woodland	4
10	Dune slack control	Open habitats	Tall sward & scrub	42
10	Dune slack control	Open habitats	Short sward & bare ground	19
10	Dune slack control	Open habitats	Upland	1
10	Dune slack control	Tree-associated	Shaded woodland floor	13
10	Dune slack control	Tree-associated	Wet woodland	4
10	Dune slack control	Wetland	Peatland	7
10	Dune slack control	Wetland	Running water	7
10	Dune slack control	Wetland	Marshland	4
10	Dune slack control	Wetland	Wet woodland	3

Figure 5-3. Shrill Carder Bee *Bombus slyvarum* observed at Kenfig (photo credit Liam Olds).

Information derived from Pantheon on the SATs for each survey plot (Table 5-5) suggested that very low numbers of representative species of bare sand and chalk habitats are present in each survey plot. No species on the NRW pioneer dune slack specialist list were observed/captured.

Table 5-5. Number of species associated with F111 bare sand and chalk SAT in each survey plot in Kenfig, and the current condition based on number of representative species of the assemblage present, as derived from Pantheon.

Survey plot	No. of species (out of 19)	Reported SAT condition
5	1	Unfavourable
6	1	Unfavourable
7	2	Unfavourable
8	2	Unfavourable
9	3	Unfavourable
10	5	Unfavourable

Several species with a nationally scarce or notable status were captured across the survey plots, primarily associated with short sward and bare ground habitats, but there were also several associated with wetland habitats (Table 5-6). For example, the weevil *Grypus equiseti*, which feeds on and develops within Horsetail species (*Equisetum* sp.) was captured in survey plots 7 and 10. *Pardosa agrestis* was noted in several survey plots across the site, suggesting it may be widespread here. Notably, the Hemipteran *Acalypta platycheila* was recorded in a pitfall trap in survey plot 7 in Kenfig. This is seemingly the second record for Wales and the first for Glamorgan (VC41) and South Wales (Liam Olds, Pers. Comm.). The relatively new-to-Britain *Drosophila suzukii* was also found in survey plot 5 and 6 in August in pitfall traps.

Table 5-6. Species with a conservation status captured/observed in each survey plot at Kenfig in 2019, as derived from Pantheon.

Survey plot	Habitat	Order	Species	Conservation status
5	Short sward & bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
5	Short sward & bare ground; tall sward & scrub	Diptera	*Acanthiophilus helianthi*	Notable
6	Tall sward & scrub	Coleoptera	*Syntomus truncatellus*	Nationally scarce
7	Tall sward & scrub	Hemiptera	*Acalypta platycheila*	Notable B[1]
7	Peatland	Araneae	*Pirata piscatorius*	Nationally scarce
7	Marshland; peatland; running water; short sward & bare ground	Coleoptera	*Grypus equiseti*	Notable B (out of date)
7	Peatland	Coleoptera	*Philonthus fumarius*	Notable B
7	Brackish pools & ditches; marshland	Araneae	*Pardosa proxima*	Nationally scarce
7	Short sward & bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
8	Short sward & bare ground	Araneae	*Zelotes electus*	Nationally scarce
8	Short sward & bare ground	Diptera	*Herina palustris*	Nationally scarce (provisional)
8	Peatland	Diptera	*Colobaea punctata*	Notable
9	Short sward & bare ground	Coleoptera	*Licinus depressus*	Nationally scarce

[1] A further division of 'Nationally Scarce' used when there is sufficient information on distribution: species found in between 31 and 100 hectads.

9	Short sward & bare ground	Coleoptera	*Onthophagus nuchicornis*	Nationally Rare; Vulnerable
9	Short sward & bare ground	Diptera	*Herina palustris*	Nationally scarce (provisional)
9	Brackish pools & ditches; marshland	Araneae	*Pardosa proxima*	Nationally scarce
10	Short sward & bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
10	Short sward & bare ground	Coleoptera	*Licinus depressus*	Nationally scarce
10	Marshland; peatland; running water; short sward & bare ground	Coleoptera	*Grypus equiseti*	Notable B (out of date)
10	Short sward & bare ground	Coleoptera	*Onthophagus nuchicornis*	Nationally Rare; Vulnerable
10	Short sward & bare ground	Diptera	*Herina palustris*	Nationally scarce (provisional)

Whiteford Burrows

Both survey plots were relatively similar in the assemblages they contained, with tall sward and scrub associated species predominating, but with relatively even proportions of short sward and bare ground, and shaded woodland floor and peatland species present (Table 5-7). Survey plot 12 was partially vegetated with trees, with wet areas noted in close proximity.

Table 5-7. Typical habitat associations of the species captured/observed at Whiteford Burrows in 2019 at each survey plot, as derived from Pantheon.

Survey plot	Type	Broad biotype	Habitat	% of capture
11	Rabbit control	Open habitats	Tall sward and scrub	41
11	Rabbit control	Open habitats	Short sward and bare ground	14
11	Rabbit control	Tree associated	Shaded woodland floor	10
11	Rabbit control	Tree associated	Arboreal	2
11	Rabbit control	Tree associated	Wet woodland	2
11	Rabbit control	Tree associated	Decaying wood	2
11	Rabbit control	Wetland	Marshland	7
11	Rabbit control	Wetland	Peatland	14
11	Rabbit control	Wetland	Running water	2
11	Rabbit control	Wetland	Wet woodland	2
11	Rabbit control	Coastal	Brackish pools & ditches	3
11	Rabbit control	Coastal	Saltmarsh	2
11	Rabbit control	Coastal	Sandy beach	1
12	Rabbit intervention	Open habitats	Tall sward and scrub	36
12	Rabbit intervention	Open habitats	Short sward and bare ground	14
12	Rabbit intervention	Open habitats	Upland	1
12	Rabbit intervention	Tree-associated	Shaded woodland floor	12
12	Rabbit intervention	Tree-associated	Arboreal	2
12	Rabbit intervention	Tree-associated	Wet woodland	2
12	Rabbit intervention	Tree-associated	Decaying wood	1
12	Rabbit intervention	Wetland	Marshland	8
12	Rabbit intervention	Wetland	Peatland	14

12	Rabbit intervention	Wetland	Wet woodland	2
12	Rabbit intervention	Wetland	Running water	3
12	Rabbit intervention	Coastal	Brackish pools & ditches	2
12	Rabbit intervention	Coastal	Saltmarsh	2

Information derived from Pantheon on the specific assemblage type (SAT) for each survey plot (Table 5-8) suggested that low numbers of representative species of bare sand and chalk habitats are present in each survey plot. No species on the NRW pioneer dune slack specialist list were observed/captured.

Table 5-8. Number of species associated with F111 bare sand and chalk SAT in each survey plot in Whiteford Burrows, and the current condition based on number of representative species of the assemblage present, as derived from Pantheon.

Survey plot	No. of species (out of 19)	Reported SAT condition
11	2	Unfavourable
12	5	Unfavourable

Fewer species with a nationally scarce or other status were captured across these two survey plots than other project sites. The relatively new-to-Britain *Drosophila suzukii* was also found in survey plot 12 (one individual in each of two separate pitfall traps) in August.

Table 5-9. Species with a conservation status captured/observed in each survey plot at Whiteford Burrows in 2019, as derived from Pantheon.

Survey plot	Habitat	Order	Species	Conservation status
11	Peatland	Diptera	*Chrysotus pulchellus*	Nationally scarce
12	Short sward and bare ground	Araneae	*Alopecosa cuneata*	Nationally scarce
12	Short sward and bare ground	Araneae	*Xerolycosa miniata*	Nationally scarce
12	Short sward and bare ground	Muscidae	*Coenosia verralli*	Provisionally nationally scarce
12	Peatland	Diptera	*Chrysotus pulchellus*	Nationally scarce

Pembrey Burrows

In all survey plots, the species primarily consisted of those associated with tall sward and scrub in open habitats, followed by short sward and bare ground, though in survey plot 14 short sward and bare ground species dominated (Table 5-10). This survey plot was noted to contain a much shorter sward at the time of sampling, with higher levels of rabbit/cattle grazing activity noted here than in the other survey plots. Species associated with other habitats are present in much lower proportions of the overall assemblage. In general, the survey plots within Pembrey Burrows were less heavily vegetated than in the other sites surveyed.

Table 5-10. Typical habitat associations of the species captured/observed at Pembrey Burrows in 2019 at each survey plot, as derived from Pantheon.

Survey plot	Type	Broad biotype	Habitat	% of capture
13	Dune slack intervention	Coastal	Saltmarsh	2
13	Dune slack intervention	Open habitats	Tall sward & scrub	56
13	Dune slack intervention	Open habitats	Short sward & bare ground	35
13	Dune slack intervention	Open habitats	Upland	2
13	Dune slack intervention	Tree-associated	Shaded woodland floor	2
13	Dune slack intervention	Tree-associated	Wet woodland	2
13	Dune slack intervention	Wetland	Marshland	2
14	Dune slack control	Open habitats	Short sward & bare ground	51
14	Dune slack control	Open habitats	Tall sward & scrub	28
14	Dune slack control	Tree-associated	Arboreal	5
14	Dune slack control	Tree-associated	Decaying wood	5
14	Dune slack control	Tree-associated	Shaded woodland floor	5
14	Dune slack control	Wetland	Marshland	5
14	Dune slack control	Wetland	Running water	2
15	Rabbit intervention	Open habitats	Tall sward & scrub	57
15	Rabbit intervention	Open habitats	Short sward & bare ground	35
15	Rabbit intervention	Open habitats	Upland	2
15	Rabbit intervention	Tree-associated	Shaded woodland floor	3
15	Rabbit intervention	Wetland	Marshland	2
15	Rabbit intervention	Wetland	Peatland	2
16	Dune slack intervention	Open habitats	Tall sward & scrub	58
16	Dune slack intervention	Open habitats	Short sward & bare ground	18
16	Dune slack intervention	Tree-associated	Shaded woodland floor	9
16	Dune slack intervention	Tree-associated	Wet woodland	3
16	Dune slack intervention	Wetland	Peatland	6
16	Dune slack intervention	Wetland	Marshland	3
16	Dune slack intervention	Wetland	Running water	3
17	Rabbit control	Open habitats	Tall sward & scrub	35
17	Rabbit control	Open habitats	Short sward & bare ground	18
17	Rabbit control	Open habitats	Upland	2

17	Rabbit control	Tree-associated	Shaded woodland floor	3
17	Rabbit control	Tree-associated	Decaying wood	1
17	Rabbit control	Tree-associated	Wet woodland	1
17	Rabbit control	Wetland	Marshland	1
17	Rabbit control	Wetland	Peatland	1
17	Rabbit control	Wetland	Running water	1

Information derived from Pantheon on the specific assemblage type (SAT) for each survey plot (Table 5-11) suggested that representative species of bare sand and chalk habitats are present in each survey plot, with survey plots 14 and 15 containing the most species. These sites were observed to have the highest rabbit activity. Nevertheless, as for the previous sites, the condition is considered 'unfavourable' due to the overall lack of these species present. No species on the NRW pioneer dune slack specialist list were observed/captured.

Table 5-11. Number of species associated with F111 bare sand and chalk SAT in each survey plot in Pembrey Burrows, and the current condition based on number of representative species of the assemblage present, as derived from Pantheon.

Survey plot	No. of species (out of 19)	Reported SAT condition
13	9	Unfavourable
14	10	Unfavourable
15	10	Unfavourable
16	3	Unfavourable
17	6	Unfavourable

Several species with a nationally scarce or rare status were captured across the survey plots, primarily associated with short sward and bare ground habitats (such as *Onthophagus nuchicornis*; Figure 5-4), and tall sward and scrub (Table 5-12). Notably, the nationally scarce spider *Argenna subnigra* (Harvey et al., 2017) was found across most survey plots, suggesting it has a wide distribution across the site. This species is associated with sparsely vegetated grasslands and dunes (Dawson et al., 2020), which was the observed habitat when sampling in these areas. The beetle *Saprinus aeneus,* associated with tall sward and scrub, was found across all sites, again suggesting that although this is a 'nationally scarce' species it is widely distributed here.

Table 5-12. Species with a conservation status captured/observed in each survey plot at Pembrey Burrows in 2019, as derived from Pantheon.

Survey plot	Habitat	Order	Species	Conservation status
13	Saltmarsh	Araneae	*Argenna patula*	Nationally scarce
13	Tall sward & scrub	Coleoptera	*Syntomus truncatellus*	Nationally scarce
13	Tall sward & scrub	Coleoptera	*Saprinus aeneus*	Nationally scarce
13	Short sward & bare ground	Araneae	*Argenna subnigra*	Nationally scarce
13	Short sward & bare ground	Araneae	*Zelotes electus*	Nationally scarce
13	Short sward & bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
13	Short sward & bare ground	Araneae	*Xerolycosa miniata*	Nationally scarce
13	Short sward & bare ground	Coleoptera	*Onthophagus nuchicornis*	Nationally Rare; Vulnerable

13	Short sward & bare ground	Coleoptera	*Opatrum sabulosum*	Nationally scarce
13	Short sward & bare ground	Diptera	*Sarcophila latifrons*	Nationally scarce [provisional]
14	Short sward & bare ground	Araneae	*Argenna subnigra*	Nationally scarce
14	Short sward & bare ground	Araneae	*Zelotes electus*	Nationally scarce
14	Short sward & bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
14	Short sward & bare ground	Araneae	*Xerolycosa miniata*	Nationally scarce
14	Short sward & bare ground	Coleoptera	*Amara praetermissa*	Nationally scarce
14	Short sward & bare ground	Coleoptera	*Saprinus planiusculus*	Notable B; Nationally scarce
14	Short sward & bare ground	Coleoptera	*Onthophagus nuchicornis*	Nationally Rare; Vulnerable
14	Short sward & bare ground	Coleoptera	*Opatrum sabulosum*	Nationally scarce
14	Short sward & bare ground	Diptera	*Sarcophila latifrons*	Nationally scarce [provisional]
14	Tall sward & scrub	Coleoptera	*Syntomus truncatellus*	Nationally scarce
14	Tall sward & scrub	Coleoptera	*Saprinus aeneus*	Nationally scarce
15	Tall sward & scrub	Coleoptera	*Saprinus aeneus*	Nationally scarce
15	Short sward & bare ground	Araneae	*Argenna subnigra*	Nationally scarce
15	Short sward & bare ground	Araneae	*Zelotes electus*	Nationally scarce
15	Short sward & bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
15	Short sward & bare ground	Coleoptera	*Opatrum sabulosum*	Nationally scarce
15	Short sward & bare ground	Diptera	*Sarcophila latifrons*	Nationally scarce [provisional]
15	Marshland; peatland	Diptera	*Pherbellia knutsoni*	Red Data Book Category 3 - rare
16	Tall sward & scrub	Coleoptera	*Syntomus truncatellus*	Nationally scarce
16	Short sward & bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
16	Short sward & bare ground	Diptera	*Sarcophila latifrons*	Nationally scarce [provisional]
17	Tall sward & scrub	Coleoptera	*Syntomus truncatellus*	Nationally scarce
17	Tall sward & scrub	Coleoptera	*Saprinus aeneus*	Nationally scarce
17	Tall sward & scrub	Coleoptera	*Ocypus fuscatus*	Nationally scarce
17	Tall sward & scrub	Lepidoptera	*Tyria jacobaeae*	Section 41 Priority Species - research only
17	Short sward & bare ground	Araneae	*Argenna subnigra*	Nationally scarce
17	Short sward & bare ground	Araneae	*Zelotes electus*	Nationally scarce
17	Short sward & bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
17	Short sward & bare ground	Coleoptera	*Onthophagus nuchicornis*	Nationally Rare; Vulnerable

17	Short sward & bare ground	Diptera	*Coenosia verralli*	Nationally scarce [provisional]
17	Short sward & bare ground	Diptera	*Sarcophila latifrons*	Nationally scarce [provisional]

Figure 5-4. The Nationally Rare and Vulnerable *Ontophagus nuchicornis* captured in a pitfall trap in Pembrey (photo credit Paul Buckland)

Morfa Harlech

Both survey plots primarily contained species associated with tall sward and scrub habitats, with a smaller proportion associated with shaded woodland floor and short sward and bare ground (Table 5-13). These survey plots had a rank, tussocky sward of fixed, ungrazed dune grassland at the time of sampling, with little bare ground habitat present. However, in the wider site there were areas of more mobile sand, including areas that had been previously scraped, and heavily grazed dune grassland.

Table 5-13. Typical habitat associations of the species captured/observed at Morfa Harlech in 2019 at each survey plot, as derived from Pantheon.

Survey plot	Type	Broad biotype	Habitat	% of capture
18	Dune slack intervention	Open habitats	Tall sward and scrub	62
18	Dune slack intervention	Open habitats	Short sward and bare ground	8
18	Dune slack intervention	Open habitats	Upland	2
18	Dune slack intervention	Tree associated	Shaded woodland floor	15

18	Dune slack intervention	Tree associated	Arboreal	3
18	Dune slack intervention	Wetland	Marshland	5
18	Dune slack intervention	Wetland	Peatland	2
18	Dune slack intervention	Wetland	Running water	5
18C	Dune slack control	Open habitats	Tall sward and scrub	64
18C	Dune slack control	Open habitats	Short sward and bare ground	9
18C	Dune slack control	Open habitats	Upland	3
18C	Dune slack control	Tree-associated	Shaded woodland floor	14
18C	Dune slack control	Tree-associated	Arboreal	2
18C	Dune slack control	Tree-associated	Wet woodland	2
18C	Dune slack control	Wetland	Marshland	2
18C	Dune slack control	Wetland	Peatland	2
18C	Dune slack control	Wetland	Running water	2
18C	Dune slack control	Wetland	Wet woodland	2

Information derived from Pantheon on the specific assemblage type (SAT) for each survey plot (Table 5-14) suggested that very few representative species of bare sand and chalk habitats are present in each survey plot. As described above, the slacks are heavily vegetated so this may be expected.

Table 5-14. Number of species associated with F111 bare sand and chalk SAT in each survey plot in Morfa Harlech, and the current condition based on number of representative species of the assemblage present, as derived from Pantheon.

Survey plot	No. of species (out of 19)	Reported SAT condition
18	2	Unfavourable
18C	1	Unfavourable

Species with a nationally scarce or notable status were captured within the two survey plots, and despite the heavily vegetated nature of the slacks, three of these were associated with short sward and bare ground (Table 5-15). The 'nationally scarce' Staphylinid beetle *Gabrius osseticus* was trapped in survey plot 18. This species is on the NRW list of pioneer dune slack species to be targeted.

Table 5-15. Species with a conservation status captured/observed in each survey plot at Morfa Harlech in 2019, as derived from Pantheon.

Survey plot	Habitat	Order	Species	Conservation status
18	Short sward and bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
18	Short sward and bare ground	Coleoptera	*Gabrius osseticus*	Nationally scarce
18	Scrub-heath and moorland	Araneae	*Maro minutus*	Nationally scarce
18	Running water	Coleoptera	*Atheta aquatilis*	Notable
18C	Short sward and bare ground	Araneae	*Zelotes electus*	Nationally scarce
18C	Running water	Coleoptera	*Atheta aquatilis*	Notable

Morfa Dinlle

Both survey plots primarily contained species associated with tall sward and scrub habitats, with a smaller proportion associated with short sward and bare ground (Table 5-16). Survey plot 19 also contained a small proportion of species associated with coastal saltmarsh and brackish pools and ditches. These survey plots had a short grassy sward with sheep grazing prevalent throughout this site, but with dense, tussocky Marram on dune slopes in the vicinity of the survey plots.

Table 5-16. Typical habitat associations of the species captured/observed at Morfa Dinlle in 2019 at each survey plot, as derived from Pantheon.

Survey plot	Type	Broad biotype	Habitat	% of capture
19	Rabbit control	Coastal	Saltmarsh	4
19	Rabbit control	Coastal	Brackish pools & ditches	4
19	Rabbit control	Open habitats	Tall sward & scrub	58
19	Rabbit control	Open habitats	Short sward & bare ground	12
19	Rabbit control	Open habitats	Upland	4
19	Rabbit control	Tree-associated	Shaded woodland floor	8
19	Rabbit control	Tree-associated	Arboreal	2
19	Rabbit control	Wetland	Marshland	6
19	Rabbit control	Wetland	Running water	2
20	Rabbit intervention	Open habitats	Tall sward & scrub	70
20	Rabbit intervention	Open habitats	Short sward & bare ground	16
20	Rabbit intervention	Open habitats	Upland	5
20	Rabbit intervention	Tree-associated	Shaded woodland floor	5
20	Rabbit intervention	Tree-associated	Arboreal	2
20	Rabbit intervention	Wetland	Peatland	2

Information derived from Pantheon on the specific assemblage type for each survey plot (Table 5-17) suggested that few representative species of bare sand and chalk habitats are present in each survey plot. Areas of bare sand were noted during sampling, but the sample areas were fully vegetated, albeit in places with lichens and bryophytes dominating, so this may be expected.

Table 5-17. Number of species associated with F111 bare sand and chalk SAT in each survey plot in Morfa Dinlle, and the current condition based on number of representative species of the assemblage present, as derived from Pantheon.

Survey plot	No. of species (out of 19)	Reported SAT condition
19	4	Unfavourable
20	2	Unfavourable

Three species with a conservation status were captured within the two survey plots (Table 5-18). No species on the NRW list of pioneer dune slack species were captured/observed, as expected for this site which as a perched dune system over a shingle spit, does not naturally support these habitats.

Table 5-18. Species with a conservation status captured/observed in each survey plot at Morfa Dinlle in 2019, as derived from Pantheon.

Survey plot	Habitat	Order	Species	Conservation status
19	Short sward & bare ground	Araneae	*Zelotes electus*	Nationally scarce
19	Short sward & bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
20	Short sward & bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
20	Peatland	Araneae	*Hypomma fulvum*	Nationally scarce

Newborough

The survey plots primarily contained species associated with tall sward and scrub, and short sward and bare ground (Table 5-19). Survey plot 22 ('Gull slack') contained more species associated with running water wetland habitats than the other survey plots (although there is no running water nearby). Survey plots 22 and 23 ('Gull slack') were in the forest and surrounded by conifer plantation and were densely vegetated (particularly with Creeping Willow *Salix repens* and Dewberry *Rubus caesius*). The assemblages reflected this and contained higher proportions of species associated with shaded woodland floor habitats. The other survey plots on the Warren were more open and contained a range of short sward and taller areas of vegetation, which is reflected in the assemblages here. It should be noted that survey plots 21A and 21B were within the same intervention area boundary, with two sets of samples collected here as this survey plot was much larger than the others. However, it does appear that the assemblages are broadly similar.

Table 5-19. Typical habitat associations of the species captured/observed at Newborough in 2019 at each survey plot, as derived from Pantheon.

Survey plot	Type	Broad biotype	Habitat	% of capture
21A	Dune slack intervention	Open habitats	Tall sward and scrub	46
21A	Dune slack intervention	Open habitats	Short sward and bare ground	36
21A	Dune slack intervention	Open habitats	Upland	2
21A	Dune slack intervention	Tree associated	Shaded woodland floor	8
21A	Dune slack intervention	Wetland	Peatland	2
21A	Dune slack intervention	Wetland	Running water	2
21A	Dune slack intervention	Coastal	Saltmarsh	2
21A	Dune slack intervention	Coastal	Sandy beach	2
21B	Dune slack intervention	Open habitats	Tall sward and scrub	52
21B	Dune slack intervention	Open habitats	Short sward and bare ground	31

Survey plot	Type	Broad biotype	Habitat	% of capture
21B	Dune slack intervention	Open habitats	Upland	2
21B	Dune slack intervention	Tree-associated	Shaded woodland floor	8
21B	Dune slack intervention	Wetland	Marshland	2
21B	Dune slack intervention	Wetland	Running water	4
22	Dune slack intervention	Open habitats	Tall sward and scrub	25
22	Dune slack intervention	Tree associated	Shaded woodland floor	25
22	Dune slack intervention	Tree associated	Arboreal	17
22	Dune slack intervention	Tree associated	Wet woodland	4
22	Dune slack intervention	Wetland	Marshland	4
22	Dune slack intervention	Wetland	Peatland	8
22	Dune slack intervention	Wetland	Running water	13
22	Dune slack intervention	Wetland	Wet woodland	4
23	Dune slack control	Open habitats	Tall sward and scrub	57
23	Dune slack control	Tree-associated	Shaded woodland floor	29
23	Dune slack control	Wetland	Marshland	14
24	Dune slack control	Open habitats	Tall sward and scrub	45
24	Dune slack control	Open habitats	Short sward and bare ground	32
24	Dune slack control	Tree-associated	Shaded woodland floor	8
24	Dune slack control	Tree-associated	Wet woodland	5
24	Dune slack control	Tree-associated	Arboreal	3
24	Dune slack control	Wetland	Marshland	3
24	Dune slack control	Wetland	Running water	3
24	Dune slack control	Wetland	Wet woodland	3
25	Rabbit intervention	Open habitats	Tall sward and scrub	63
25	Rabbit intervention	Open habitats	Short sward and bare ground	23
25	Rabbit intervention	Open habitats	Upland	4
25	Rabbit intervention	Tree-associated	Shaded woodland floor	5
25	Rabbit intervention	Tree-associated	Wet woodland	2
25	Rabbit intervention	Tree-associated	Arboreal	2
25	Rabbit intervention	Tree-associated	Peatland	2
25	Rabbit intervention	Tree-associated	Running water	2
25	Rabbit intervention	Tree-associated	Wet woodland	2
26	Rabbit control	Open habitats	Tall sward and scrub	51
26	Rabbit control	Open habitats	Short sward and bare ground	22
26	Rabbit control	Open habitats	Upland	2
26	Rabbit control	Tree-associated	Shaded woodland floor	6
26	Rabbit control	Tree-associated	Wet woodland	2
26	Rabbit control	Tree-associated	Arboreal	3
26	Rabbit control	Tree-associated	Decaying wood	2
26	Rabbit control	Wetland	Peatland	5
26	Rabbit control	Wetland	Running water	2

Survey plot	Type	Broad biotype	Habitat	% of capture
26	Rabbit control	Wetland	Wet woodland	2
26	Rabbit control	Wetland	Marshland	2
26	Rabbit control	Coastal	Saltmarsh	2
26	Rabbit control	Coastal	Brackish pools and ditches	2

Information derived from Pantheon on the specific assemblage type for each survey plot (Table 5-20) suggested that the survey plots were varied in the representative species of bare sand and chalk habitats that they contained. For example, survey plot 22 contained no species of this community, which may be expected as it was in the forest and heavily vegetated, whereas survey plots 21A and 21B and 25 on the warren contained more of these species, which reflects the more open nature of this survey plot, and possibly the results of previous interventions such as frontal notches and slack scrapes within the wider site. No species on the NRW pioneer dune slack species list were present.

Table 5-20. Number of species associated with F111 bare sand and chalk SAT in each survey plot in Newborough, and the current condition based on number of representative species of the assemblage present, as derived from Pantheon.

Survey plot	No. of species (out of 19)	Reported SAT condition
21A	6	Unfavourable
21B	5	Unfavourable
22	0	Unfavourable
23	0	Unfavourable
24	4	Unfavourable
25	5	Unfavourable
26	2	Unfavourable

Several species with a nationally scarce and nationally rare status, including endangered/near threatened species, were captured across the survey plots (Table 5-21). As in other project sites, some of these were widespread across survey plots. For example, *Pardosa agrestis* was found in all survey plots, despite the varied habitat types and conditions represented. No species on the NRW list of pioneer dune slack species were captured/observed.

Table 5-21. Species with a conservation status captured/observed in each survey plot at Newborough in 2019, as derived from Pantheon.

Survey plot	Habitat	Order	Species	Conservation status
21A	Short sward and bare ground	Araneae	*Zelotes electus*	Nationally scarce
21A	Short sward and bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
21B	Short sward and bare ground	Araneae	*Argenna subnigra*	Nationally scarce
21B	Short sward and bare ground	Araneae	*Zelotes electus*	Nationally scarce
21B	Short sward and bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
24	Short sward and bare ground	Araneae	*Zelotes electus*	Nationally scarce

24	Short sward and bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
24	Short sward and bare ground	Araneae	*Xerolycosa miniata*	Nationally scarce
24	Short sward and bare ground	Coleoptera	*Amara praetermissa*	Nationally scarce
24	Short sward and bare ground	Hemiptera	*Megalonotus sabulicola*	Notable B
24	Shaded woodland floor	Diptera	*Medetera truncorum*	Data deficient
25	Short sward and bare ground	Araneae	*Zelotes electus*	Nationally scarce
25	Short sward and bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
26	Tall sward and scrub	Araneae	*Drassodes pubescens*	Nationally scarce
26	Short sward and bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
26	Short sward and bare ground	Coleoptera	*Scymnus schmidti*	Notable B
26	Decaying wood	Diptera	*Medetera jacula*	Data deficient
26	Shaded woodland floor	Diptera	*Medetera truncorum*	Data deficient

Tywyn Aberffraw

The survey plots primarily contained species associated with tall sward and scrub, and short sward and bare ground (Table 5-22). The communities were generally similar between each of the survey plots.

Table 5-22. Typical habitat associations of the species captured/observed at Tywyn Aberffraw in 2019 at each survey plot, as derived from Pantheon.

Survey plot	Type	Broad biotype	Habitat	% of capture
27[2]	Dune slack intervention	Coastal	Sandy beach	2
27[2]	Dune slack intervention	Coastal	Brackish pools & ditches	2
27[2]	Dune slack intervention	Open habitats	Tall sward & scrub	61
27[2]	Dune slack intervention	Open habitats	Short sward & bare ground	10
27[2]	Dune slack intervention	Open habitats	Upland	2
27[2]	Dune slack intervention	Tree-associated	Shaded woodland floor	2
27[2]	Dune slack intervention	Tree-associated	Wet woodland	2
27[2]	Dune slack intervention	Wetland	Marshland	7
27[2]	Dune slack intervention	Wetland	Running water	7

[2] Traps within survey plot 27 were disturbed in the May sampling and so this data is not included.

Survey plot	Type	Broad biotype	Habitat	% of capture
27[2]	Dune slack intervention	Wetland	Peatland	2
28	Rabbit intervention	Open habitats	Tall sward & scrub	69
28	Rabbit intervention	Open habitats	Short sward & bare ground	13
28	Rabbit intervention	Open habitats	Upland	1
28	Rabbit intervention	Tree-associated	Shaded woodland floor	6
28	Rabbit intervention	Tree-associated	Arboreal	1
28	Rabbit intervention	Wetland	Marshland	7
28	Rabbit intervention	Wetland	Running water	3
29	Dune slack control	Open habitats	Tall sward & scrub	58
29	Dune slack control	Open habitats	Short sward & bare ground	23
29	Dune slack control	Open habitats	Upland	2
29	Dune slack control	Tree-associated	Shaded woodland floor	6
29	Dune slack control	Tree-associated	Wet woodland	2
29	Dune slack control	Wetland	Running water	6
29	Dune slack control	Wetland	Peatland	2
29	Dune slack control	Wetland	Marshland	2
30	Rabbit control	Coastal	Brackish pools & ditches	1
30	Rabbit control	Coastal	Sandy beach	1
30	Rabbit control	Open habitats	Tall sward & scrub	58
30	Rabbit control	Open habitats	Short sward & bare ground	13
30	Rabbit control	Open habitats	Upland	1
30	Rabbit control	Tree-associated	Arboreal	5
30	Rabbit control	Tree-associated	Shaded woodland floor	4
30	Rabbit control	Tree-associated	Wet woodland	2
30	Rabbit control	Tree-associated	Decaying wood	1
30	Rabbit control	Wetland	Running water	4
30	Rabbit control	Wetland	Peatland	3
30	Rabbit control	Wetland	Marshland	3
30	Rabbit control	Wetland	Wet woodland	2

Information derived from Pantheon on the specific assemblage type (SAT) for each survey plot (Table 5-23) suggested that the survey plots contained low numbers of representative species of bare sand and chalk habitats. The ‘nationally rare’ and ‘near threatened’ beetle *Dryops nitidulus*, which is on the NRW pioneer dune slack species list, was found in pitfall traps in survey plots 29 (two individuals) and 30 in July, and survey plots 27 and 29 in August.

Table 5-23. Number of species associated with F111 bare sand and chalk SAT in each survey plot in Tywyn Aberffraw, and the current condition based on number of representative species of the assemblage present, as derived from Pantheon.

Survey plot	No. of species (out of 19)	Reported SAT condition
27	1	Unfavourable
28	5	Unfavourable
29	2	Unfavourable
30	5	Unfavourable

Several species with a nationally scarce, rare or notable status, including a near threatened species were captured across the survey plots (Table 5-24). As in other project sites, some of these were widespread across survey plots (for example, *Pardosa agrestis*). Some of these were associated with wetland habitats, including *Dryops nitidulus*.

Table 5-24. Species with a conservation status captured/observed in each survey plot at Tywyn Aberffraw in 2019, as derived from Pantheon.

Survey plot	Habitat	Order	Species	Conservation status
27	Brackish pools & ditches; running water; sandy beach	Diptera	*Dolichopus notatus*	Nationally scarce
27	Running water	Coleoptera	*Dryops nitidulus*	Nationally Rare; Near Threatened
28	Tall sward & scrub	Lepidoptera	*Tyria jacobaeae*	Section 41 Priority Species - research only
28	Short sward & bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
28	Short sward & bare ground	Araneae	*Xerolycosa miniata*	Nationally scarce
28	Marshland	Coleoptera	*Pterostichus gracilis*	Nationally scarce
29	Tall sward & scrub	Araneae	*Drassodes pubescens*	Nationally scarce
29	Short sward & bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
29	Short sward & bare ground	Araneae	*Xerolycosa miniata*	Nationally scarce
29	Running water	Coleoptera	*Dryops nitidulus*	Nationally Rare; Near Threatened
29	Running water	Coleoptera	*Gabrius bishopi*	Notable B
30	Brackish pools & ditches; running water; sandy beach	Diptera	*Dolichopus notatus*	Nationally scarce
30	Tall sward & scrub	Araneae	*Drassodes pubescens*	Nationally scarce
30	Short sward & bare ground	Araneae	*Pardosa agrestis*	Nationally scarce
30	Short sward & bare ground	Araneae	*Xerolycosa miniata*	Nationally scarce
30	Short sward & bare ground	Coleoptera	*Bembidion quadrimaculatum*	Section 41 Priority Species

30	Short sward & bare ground	Diptera	*Pamponerus germanicus*	Nationally scarce
30	Running water	Coleoptera	*Dryops nitidulus*	Nationally Rare; Near Threatened
30	Peatland	Diptera	*Chrysotus pulchellus*	Nationally scarce

Discussion

Baseline information

Using the combined methods of pitfall trapping, sweep netting and visual searching, targeting a range of habitats and functional groups, a representative baseline of the invertebrate assemblages currently present in these sites has been achieved. By GPS marking the pitfall trap positions, it will be possible to repeat the monitoring once the management interventions have been undertaken (scheduled for winter of 2020). This will allow a direct comparison of the invertebrate assemblages and provide an initial indication of the impact of these interventions. It would be expected that there would be an increase in the pioneer dune slack species, such as those listed by NRW, present in the managed slack survey plots after intervention, with those species associated with dung and rabbit grazing noted in the rabbit intervention plots.

Invertebrate assemblages present

In most survey plots, the communities present appeared to be dominated by species associated with tall sward and scrub, with a lower proportion associated with short sward and bare ground. Given the extensive vegetation cover (in many cases dominated by Creeping Willow in the slack intervention plots), and the general lack of bare ground present, this is unsurprising. Indeed, the selection of sites for rejuvenation has been based on this current, heavily vegetated condition.

However, areas of shorter sward produced by rabbit grazing were noted, together with areas of bare sand (often the result of trampling, particularly at sites such as Merthyr Mawr which are open to the public). Therefore, while the intervention areas sampled themselves do not on the whole currently provide this mobile bare sand habitat required for the pioneer communities, it is present in the wider area in most of the sites sampled. In all eight sites a number of F111 bare sand and chalk specific assemblage type community species were trapped/observed, suggesting that management interventions to open up the sward and re-create bare ground habitats are likely to result in colonisation from the wider area. This has been the case in previous studies at these sites (e.g. Howe, 2018, Loxton, 2018).

Species of interest and conservation value

Four nationally rare species were recorded from the project sites. The nationally rare and near threatened *Dryops nitidulus* was found at Tywyn Aberffraw and Merthyr Mawr, with four individuals in total trapped from Tywyn Aberffraw. This species has previously been recorded at Newborough Warren and Morfa Dyffryn (Loxton, 2018). As a pioneer slack specialist species on the NRW list of target species, this is promising for the colonisation of the intervention sites.

The other nationally rare species on the NRW list that was captured in Morfa Harlech by pitfall was *Gabrius osseticus*. This species was not previously recorded at this site by Loxton (2018), though it was recorded at Newborough Warren and Morfa Dyffryn. Of interest is that Loxton (2018) trapped this species in higher numbers in closed vegetation, with fewer found in the pioneer slack habitats. Here, it was trapped within a survey plot that was very heavily vegetated. Only one individual was trapped, and as this is an active predator its trapping location does not define its full habitat

requirements, but as Loxton (2018) suggests it may be that it is not primarily associated with pioneer dune slack habitats.

The nationally rare and vulnerable dung beetle *Onthophagus nuchicornis* was trapped in Kenfig survey plot 9 and Pembrey Burrows survey plots 13, 14 and 17 in May (one individual each), Pembrey Burrows survey plots 13 (eight individuals) and 17 (one individual) in July, and Kenfig survey plot 10 (two individuals), and Pembrey Burrows survey plots 13 (eight individuals), 14 (13 individuals) and 17 (21 individuals) in August. Verified data for this species is present from Kenfig, Merthyr Mawr, Morfa Harlech and Whiteford Burrows (Watkins and Mann, 2018). While no burrows of this species were found in the survey plots during the visual search surveys, at both Kenfig and Pembrey Burrows grazing cattle were present in close proximity, with dung present in large quantities in the surrounding area. At Pembrey Burrows rabbit activity was also noted. Watkins and Mann (2018) found that Kenfig was likely to be one of the best sites in Wales for the species. In the current study Pembrey Burrows had the highest number of individuals recorded (51 in total, with 40 of these trapped in August). Thirty-two individuals were recorded using baited pitfall traps at Pembrey Burrows in 2017, equating to a 'moderate' population (Watkins and Mann, 2018), so it appears that good numbers of the species are present across the site. Maintaining the current cattle grazing regime is key to maintain this population.

The nationally rare Brush-horned Sand Beetle *Orthocerus clavicornis* was trapped at Merthyr Mawr survey plot 4. There are records of this species from Merthyr Mawr from 1981 to 1992, and it has been found at many of the other project sites previously, including Kenfig, Whiteford Burrows, Pembrey Burrows, Newborough and Tywyn Aberffraw (Mike Howe, Pers.Comm). While the species was declining during the 20th century, there is no evidence that this decline is continuing (Alexander et al., 2014) and the new record shows the species has persisted at Merthyr Mawr.

The Sciomyzid *Pherbellia knutsoni*, classified as Red Data Book Category 3 – rare (though not reviewed since Falk, 1991), was found at Pembrey Burrows in survey plot 15 through sweep netting and in the wider site (though the survey plot is unknown) in a pitfall trap in May, and through sweep netting in survey plot 15 in August. The larvae of this species prey on terrestrial snails in dunes, including species of *Cochlicella acuta*, *Helicella caperata*, *H. itala* and *H. virgata* and have been trapped from locations with sparse grasses in rabbit enclosures in Weeting Heath National Nature Reserve in Norfolk (British Entomological and Natural History Society, 1989). Aggregations of snails of unknown species were noted on vegetation close to the path near survey plot 16. It is possible that the vegetated nature of the slacks makes these areas more suitable for snails than bare dry areas.

Considerations for future monitoring

Despite some initial complications in locating and establishing sampling sites (particularly for pitfall trapping), a robust methodology has been followed, using a variety of methods to trap a range of indicator species. These methods have identified a number of important species, including species previously found in these sites, providing additional data on the status of these populations. As such, at present it is not suggested to change the monitoring approach.

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Appendix 1: Weather conditions across the three sampling periods

May:

Site	Sample type	Date	General Conditions	Min temp (degrees C)	Max temp (degrees C)	Wind speed (mph)	Wind direction	Total rainfall (mm)	Cloud cover (%)	Humidity (%)
Merthyr Mawr	Pitfall	13/05/2019	Sunny with some clouds	8	16	13	ESE	0	6	60
Merthyr Mawr	Pitfall	14/05/2019	Sunny with some clouds	8	17	14	ESE	0	6	60
Merthyr Mawr	Pitfall	15/05/2019	Sunny with some clouds	9	17	11	ESE	0	5	64
Merthyr Mawr	Pitfall	16/05/2019	Cloudy with sunny spells	9	16	13	ESE	1.1	78	62
Merthyr Mawr	Pitfall	17/05/2019	Cloudy with rain showers	8	13	6	NE	2.7	100	88
Merthyr Mawr	Pitfall	18/05/2019	Cloudy with some sun and rain showers	9	14	3	SSW	0.1	70	75
Merthyr Mawr	Pitfall	19/05/2019	Cloudy with rain	8	16	9	WNW	1.1	100	71
Merthyr Mawr	Sweep and visual	20/05/2019	Sunny	9	16	14	SW	0.1	30	66
Kenfig	Pitfall	14/05/2019	Sunny with some clouds	9	16	16	ESE	0	6	61
Kenfig	Pitfall	15/05/2019	Sunny with some clouds	9	16	11	ESE	0	5	66
Kenfig	Pitfall	16/05/2019	Cloudy	10	16	14	ESE	0.3	80	63
Kenfig	Pitfall	17/05/2019	Cloudy with rain showers	8	13	5	NNE	0	100	87
Kenfig	Pitfall	18/05/2019	Cloudy	10	14	4	SSW	0	65	77
Kenfig	Pitfall	19/05/2019	Cloudy with some showers	9	15	10	WNW	0.1	93	74
Kenfig	Pitfall	20/05/2019	Sunny with some clouds	9	16	6	WNW	0	20	67
Kenfig	Sweep and visual	19/05/2019	Cloudy	9	15	9	NW	0.1	93	74
Whitford Burrows	Pitfall	14/05/2019	Sunny	8	17	14	ESE	0	6	60
Whitford Burrows	Pitfall	15/05/2019	Sunny	9	16	11	SE	0	7	65
Whitford Burrows	Pitfall	16/05/2019	Sunny	9	16	13	ESE	0.9	7	62
Whitford Burrows	Pitfall	17/05/2019	Light rain	5	12	7	N	4.6	100	90
Whitford Burrows	Pitfall	18/05/2019	Light rain	9	14	4	WNW	4.1	79	78
Whitford Burrows	Pitfall	19/05/2019	Sun with showers	8	15	10	NW	0.1	80	76
Whitford Burrows	Pitfall	20/05/2019	Sun with showers	8	15	7	NW	0.2	39	70
Whitford Burrows	Sweep and visual	18/05/2019	Sunny	8	15	4	NW	0.1	80	76
Pembrey	Pitfall	15/05/2019	Partrly cloudy	9	16	11	SE	0	7	66
Pembrey	Pitfall	16/05/2019	Sunny with showers	9	15	13	ESE	1	8	62
Pembrey	Pitfall	17/05/2019	Cloudy with showers	7	12	9	NNW	6	100	91
Pembrey	Pitfall	18/05/2019	Cloudy	9	14	4	WNW	4.2	83	78

Site	Sample type	Date	General Conditions	Min temp (degrees C)	Max temp (degrees C)	Wind speed (mph)	Wind direction	Total rainfall (mm)	Cloud cover (%)	Humidity (%)
Pembrey	Pitfall	19/05/2019	Sunny with showers	8	15	10	NW	0.2	79	76
Pembrey	Pitfall	20/05/2019	Sunny	8	15	8	NW	0.1	42	70
Pembrey	Pitfall	21/05/2019	Sunny	7	16	7	NNW	0	30	65
Pembrey	Sweep and visual	18/05/2019	Cloudy	9	14	9	SW	4.2	100	91
Morfa Dinlle	Pitfall	16/05/2019	Partly cloudy	9	17	9	ESE	0.5	77	56
Morfa Dinlle	Pitfall	17/05/2019	Light rain and clouds	7	16	13	NNE	4.7	92	68
Morfa Dinlle	Pitfall	18/05/2019	Patchy rain	8	14	7	NNW	0.2	97	78
Morfa Dinlle	Pitfall	19/05/2019	Showers	7	14	7	NW	0.7	81	78
Morfa Dinlle	Pitfall	20/05/2019	Showers	7	14	8	NNW	0.9	57	72
Morfa Dinlle	Pitfall	21/05/2019	Sunny	7	14	9	NW	0	6	63
Morfa Dinlle	Pitfall	22/05/2019	Rain showers	7	14	8	SW	1.5	100	78
Morfa Dinlle	Sweep and visual	17/05/2019	Light rain and clouds	7	16	17	NE	4.7	92	68
Morfa Harlech	Pitfall	16/05/2019	Sunny with clouds	7	15	11	ESE	0.7	93	53
Morfa Harlech	Pitfall	17/05/2019	Rain showers	6	15	11	NE	6	87	63
Morfa Harlech	Pitfall	18/05/2019	Cloudy with showers	6	13	4	NNW	1.6	99	81
Morfa Harlech	Pitfall	19/05/2019	Rain showers	6	13	5	NW	1.8	97	86
Morfa Harlech	Pitfall	20/05/2019	Sunny with showers	5	13	6	NNW	2.1	78	81
Morfa Harlech	Pitfall	21/05/2019	Partly cloudy	5	14	9	NW	0	4	57
Morfa Harlech	Pitfall	22/05/2019	Cloudy with showers	6	13	9	SW	0.5	100	73
Morfa Harlech	Pitfall	23/05/2019	Sunny with clouds	6	15	12	WSW	0	47	57
Newborough	Pitfall	17/05/2019	Rainy	7	16	15	NNE	4.7	92	68
Newborough	Pitfall	18/05/2019	Showers	8	14	7	NNW	0.2	97	78
Newborough	Pitfall	19/05/2019	Showers	7	14	7	NW	0.7	81	78
Newborough	Pitfall	20/05/2019	Showers	7	14	8	NNW	0.9	57	72
Newborough	Pitfall	21/05/2019	Sunny	7	14	9	NW	0	6	63
Newborough	Pitfall	22/05/2019	Cloudy with showers	7	14	8	SW	1.5	100	78
Newborough	Pitfall	23/05/2019	Sunny with clouds	8	15	9	SW	0	47	67
Newborough	Sweep and visual	16/05/2019	Sunny with some clouds	9	17	9	NW	0.5	77	56
Aberffraw	Pitfall	17/05/2019	Light rain	9	15	15	NNE	3.3	63	72
Aberffraw	Pitfall	18/05/2019	Cloudy	9	13	9	NNW	0	75	80
Aberffraw	Pitfall	19/05/2019	Sunny with showers	9	14	9	NW	0.7	48	76
Aberffraw	Pitfall	20/05/2019	Sunny with showers	9	14	9	NNW	0.1	30	73
Aberffraw	Pitfall	21/05/2019	Sunny with some clouds	9	13	9	NW	0	7	87
Aberffraw	Pitfall	22/05/2019	Showers	9	14	6	WSW	1.1	97	80
Aberffraw	Pitfall	23/05/2019	Cloudy	10	14	11	SW	0	84	73

Site	Sample type	Date	General Conditions	Min temp (degrees C)	Max temp (degrees C)	Wind speed (mph)	Wind direction	Total rainfall (mm)	Cloud cover (%)	Humidity (%)
Aberffraw	Sweep and visual	17/05/2019	Light rain	9	15	13	NE	3.3	63	72

July:

Site	Sample type	Date	General Conditions	Min temp (degrees C)	Max temp (degrees C)	Wind speed (mph)	Wind direction	Total rainfall (mm)	Cloud cover (%)	Humidity (%)
Merthyr Mawr	Pitfall	05/07/2019	Sunny	12	20	7	WSW	0	2	70
Merthyr Mawr	Pitfall	06/07/2019	Rain showers	12	19	9	W	0.4	100	80
Merthyr Mawr	Pitfall	07/07/2019	Sunny with some clouds	14	18	4	WSW	0	47	77
Merthyr Mawr	Pitfall	08/07/2019	Rain showers	12	19	6	S	0.5	77	73
Merthyr Mawr	Pitfall	09/07/2019	Partly cloudy	14	19	9	WSW	0	35	76
Merthyr Mawr	Pitfall	10/07/2019	Overcast	14	19	9	WSW	0	11	71
Merthyr Mawr	Pitfall	11/07/2019	Cloudy with showers	15	19	14	WSW	0.7	54	80
Merthyr Mawr	Sweep and visual	05/07/2019	Sunny	12	20	8	WSW	0	2	7
Kenfig	Pitfall	04/07/2019	Overcast	11	17	3	WSW	0	7	76
Kenfig	Pitfall	05/07/2019	Partly cloudy	14	18	6	W	0	4	77
Kenfig	Pitfall	06/07/2019	Cloudy with showers	13	18	11	WSW	0.1	100	85
Kenfig	Pitfall	07/07/2019	Cloudy	15	17	3	W	0	51	74
Kenfig	Pitfall	08/07/2019	Cloudy	13	17	5	S	0	75	79
Kenfig	Pitfall	09/07/2019	Sunny	10	18	9	WSW	0	36	81
Kenfig	Pitfall	10/07/2019	Sunny	15	18	9	WSW	0	10	77
Kenfig	Sweep and visual	04/07/2019	Overcast	11	17	8	W	0	7	76
Whitford Burrows	Pitfall	04/07/2019	Sunny with some clouds	13	18	4	WSW	0	17	77
Whitford Burrows	Pitfall	05/07/2019	Sunny with few clouds	12	19	7	WSW	0	2	75
Whitford Burrows	Pitfall	06/07/2019	Cloudy with showers	12	18	7	WNW	0.5	100	84
Whitford Burrows	Pitfall	07/07/2019	Overcast	12	18	2	WNW	0	67	73
Whitford Burrows	Pitfall	08/07/2019	Partly cloudy	10	17	5	SSW	0	49	76
Whitford Burrows	Pitfall	09/07/2019	Partly cloudy	15	18	9	WSW	0.1	60	84
Whitford Burrows	Pitfall	10/07/2019	Partly cloudy	14	18	11	SW	0	48	80
Whitford Burrows	Sweep and visual	04/07/2019	Sunny with clouds	13	18	5	S	0	17	77
Pembrey	Pitfall	03/07/2019	Partly cloudy	9	17	1	SW	0	12	64
Pembrey	Pitfall	04/07/2019	Partly cloudy	12	18	6	WSW	0	20	79
Pembrey	Pitfall	05/07/2019	Partly cloudy	12	19	8	WSW	0	2	79
Pembrey	Pitfall	06/07/2019	Showers	12	18	7	WNW	0.6	100	86
Pembrey	Pitfall	07/07/2019	Showers	12	17	2	W	0.3	90	74
Pembrey	Pitfall	08/07/2019	Partly cloudy	10	17	5	SSW	0	49	76
Pembrey	Pitfall	09/07/2019	Showers	14	18	9	WSW	0.2	57	87
Pembrey	Sweep and visual	03/07/2019	Partly cloudy	9	17	11	SW	0	12	64
Morfa Dinlle	Pitfall	01/07/2019	Partly cloudy	11	16	15	WNW	0.6	73	76
Morfa Dinlle	Pitfall	02/07/2019	Showers	8	16	8	NW	0.6	50	69

Site	Sample type	Date	General Conditions	Min temp (degrees C)	Max temp (degrees C)	Wind speed (mph)	Wind direction	Total rainfall (mm)	Cloud cover (%)	Humidity (%)
Morfa Dinlle	Pitfall	03/07/2019	Partly cloudy	7	16	8	NNE	0	2	67
Morfa Dinlle	Pitfall	04/07/2019	Cloudy	9	18	5	WSW	0	96	67
Morfa Dinlle	Pitfall	05/07/2019	Sunny with clouds	10	18	6	W	0	25	71
Morfa Dinlle	Pitfall	06/07/2019	Showers	13	16	4	WNW	0.5	100	93
Morfa Dinlle	Pitfall	07/07/2019	Cloudy	8	16	7	WNW	0	33	68
Morfa Dinlle	Sweep and visual	01/07/2019	Partly cloudy	11	16	11	SW	0.6	73	76
Morfa Harlech	Pitfall	02/07/2019	Cloudy with showers	8	15	7	NW	0.3	73	74
Morfa Harlech	Pitfall	03/07/2019	Partly cloudy	7	17	4	N	0	3	61
Morfa Harlech	Pitfall	04/07/2019	Overcast	10	17	7	WSW	0	100	69
Morfa Harlech	Pitfall	05/07/2019	Sunny	9	18	6	W	0	19	69
Morfa Harlech	Pitfall	06/07/2019	Showers	11	14	3	WNW	0.2	100	94
Morfa Harlech	Pitfall	07/07/2019	Overcast	7	16	6	WNW	0	19	65
Morfa Harlech	Pitfall	08/07/2019	Showers	8	16	3	WSW	0.3	100	84
Morfa Harlech	Pitfall	09/07/2019	Overcast	12	18	10	SW	0.1	98	81
Newborough	Pitfall	02/07/2019	Cloudy	8	16	8	NW	0.6	50	69
Newborough	Pitfall	03/07/2019	Partly cloudy	7	16	8	NNE	0	2	67
Newborough	Pitfall	04/07/2019	Overcast	9	18	5	WSW	0	96	67
Newborough	Pitfall	05/07/2019	Sunny with clouds	10	18	6	W	0	25	71
Newborough	Pitfall	06/07/2019	Showers	13	16	4	NNW	0.5	100	93
Newborough	Pitfall	07/07/2019	Overcast	8	16	7	NW	0	33	68
Newborough	Pitfall	08/07/2019	Overcast	9	17	2	WNW	0.2	100	83
Newborough	Sweep and visual	02/07/2019	Cloudy	12	19	11	NW	0	79	81
Aberffraw	Pitfall	01/07/2019	Showers	11	15	16	WNW	0.5	81	78
Aberffraw	Pitfall	02/07/2019	Showers	10	15	10	NW	0.3	87	74
Aberffraw	Pitfall	03/07/2019	Partly cloudy	10	15	9	NNE	0	1	69
Aberffraw	Pitfall	04/07/2019	Cloudy	9	16	6	W	0	6	76
Aberffraw	Pitfall	05/07/2019	Overcast	13	16	7	W	0	32	77
Aberffraw	Pitfall	06/07/2019	Showers	12	15	7	N	1.7	100	92
Aberffraw	Pitfall	07/07/2019	Overcast	10	14	9	NW	0	61	73
Aberffraw	Sweep and visual	01/07/2019	Showers	11	15	16	WNW	0.5	81	78

August:

Site	Sample type	Date	General Conditions	Min temp (degrees C)	Max temp (degrees C)	Wind speed (mph)	Wind direction	Total rainfall (mm)	Cloud cover (%)	Humidity (%)
Merthyr Mawr	Pitfall	19/08/2019	Cloud with showers	13	16	20	W	6.2	71	78
Merthyr Mawr	Pitfall	20/08/2019	Sunny	11	16	14	W	0.7	42	65
Merthyr Mawr	Pitfall	21/08/2019	Partly cloudy	13	18	11	SW	1.8	83	71
Merthyr Mawr	Pitfall	22/08/2019	Cloud with showers	14	18	16	WSW	0.9	82	87
Merthyr Mawr	Pitfall	23/08/2019	Partly cloudy	15	22	7	SE	0	6	71
Merthyr Mawr	Pitfall	24/08/2019	Sunny	12	24	12	E	0	1	66
Merthyr Mawr	Pitfall	25/08/2019	Sunny	16	21	9	WSW	0	4	75
Merthyr Mawr	Sweep and visual	19/08/2019	Sunny	13	16	20	W	6.2	71	78
Kenfig	Pitfall	20/08/2019	Cloudy	12	16	14	W	1.6	52	66
Kenfig	Pitfall	21/08/2019	Cloudy, scattered with showers	15	17	11	SW	2.1	80	74
Kenfig	Pitfall	22/08/2019	Cloudy, scattered with showers	15	18	17	WSW	0.5	67	88
Kenfig	Pitfall	23/08/2019	Sunny	16	21	7	SE	0	3	77
Kenfig	Pitfall	24/08/2019	Sunny	14	23	15	ESE	0	0	69
Kenfig	Pitfall	25/08/2019	Sunny	17	20	9	WSW	0	5	83
Kenfig	Pitfall	26/08/2019	Sunny	1	19	5	W	0	9	79
Kenfig	Sweep and visual	20/08/2019	Sunny	12	16	14	NW	1.6	52	66
Whitford Burrows	Pitfall	20/08/2019	Partly cloudy	11	16	11	WSW	0.9	49	69
Whitford Burrows	Pitfall	21/08/2019	Cloudy, scattered with showers	13	17	16	SSW	4.4	52	84
Whitford Burrows	Pitfall	22/08/2019	Cloudy, scattered with showers	15	18	17	SW	2.8	89	90
Whitford Burrows	Pitfall	23/08/2019	Partly cloudy	16	21	6	SSE	0.1	11	77
Whitford Burrows	Pitfall	24/08/2019	Sunny	14	23	15	ESE	0	0	68
Whitford Burrows	Pitfall	25/08/2019	Sunny	16	20	8	SW	0	8	80
Whitford Burrows	Pitfall	26/08/2019	Partly cloudy	15	19	6	WSW	0	11	76
Whitford Burrows	Sweep and visual	20/08/2019	Cloudy with showers	11	16	11	SW	0.9	49	69
Pembrey	Pitfall	21/08/2019	Cloudy, scattered with showers	14	16	17	SSW	5	62	85
Pembrey	Pitfall	22/08/2019	Cloudy, scattered with showers	15	17	19	SW	3	96	90
Pembrey	Pitfall	23/08/2019	Cloudy	16	21	6	SSE	0.1	12	77
Pembrey	Pitfall	24/08/2019	Sunny	14	23	15	SE	0	0	69
Pembrey	Pitfall	25/08/2019	Partly cloudy	15	19	9	SW	0	11	82
Pembrey	Pitfall	26/08/2019	Partly cloudy	14	18	6	WSW	0	12	78
Pembrey	Pitfall	27/08/2019	Cloudy, scattered with showers	14	17	4	WSW	0.6	84	82
Pembrey	Sweep and visual	21/08/2019	Partly cloudy	14	16	17	SW	5	62	85
Morfa Dinlle	Pitfall	22/08/2019	Cloudy, showers	14	17	19	SSW	9.5	100	91
Morfa Dinlle	Pitfall	23/08/2019	Cloudy, scattered showers	14	20	12	SSW	0.6	84	86

Site	Sample type	Date	General Conditions	Min temp (degrees C)	Max temp (degrees C)	Wind speed (mph)	Wind direction	Total rainfall (mm)	Cloud cover (%)	Humidity (%)
Morfa Dinlle	Pitfall	24/08/2019	Partly cloudy	13	24	4	SE	0	20	53
Morfa Dinlle	Pitfall	25/08/2019	Sunny	15	21	5	SW	0	2	73
Morfa Dinlle	Pitfall	26/08/2019	Cloudy	12	19	7	SW	0	80	83
Morfa Dinlle	Pitfall	27/08/2019	Cloudy	12	18	7	SSW	0.3	100	80
Morfa Dinlle	Pitfall	28/08/2019	Cloudy, showers	8	15	11	WSW	2.1	94	82
Morfa Dinlle	Sweep and visual	22/08/2019	Cloudy	14	17	19	SW	9.5	100	91
Morfa Harlech	Pitfall	22/08/2019	Cloudy, showers	13	15	17	SW	15	100	96
Morfa Harlech	Pitfall	23/08/2019	Cloudy, scattered showers	15	19	9	SSW	0.5	90	86
Morfa Harlech	Pitfall	24/08/2019	Sunny	12	23	6	SSE	0	3	56
Morfa Harlech	Pitfall	25/08/2019	Sunny	14	21	5	SW	0	3	71
Morfa Harlech	Pitfall	26/08/2019	Partly cloudy	12	19	6	WSW	0	39	76
Morfa Harlech	Pitfall	27/08/2019	Cloudy, scattered showers	11	18	5	SSW	1.7	100	80
Morfa Harlech	Pitfall	28/08/2019	Cloudy, showers	4	14	11	SW	3.7	100	89
Morfa Harlech	Pitfall	29/08/2019	Cloudy, showers	10	14	17	SW	4.5	100	86
Newborough	Pitfall	23/08/2019	Cloudy, scattered showers	14	20	12	SSW	0.6	84	86
Newborough	Pitfall	24/08/2019	Partly cloudy	13	24	4	SE	0	20	53
Newborough	Pitfall	25/08/2019	Sunny	15	21	5	SW	0	2	73
Newborough	Pitfall	26/08/2019	Cloudy	12	19	7	SW	0	80	83
Newborough	Pitfall	27/08/2019	Cloudy, scattered showers	12	18	8	SSW	0.3	100	80
Newborough	Pitfall	28/08/2019	Cloudy, scattered showers	8	15	11	WSW	2.1	94	82
Newborough	Pitfall	29/08/2019	Cloudy, scattered showers	11	16	19	SSW	1.9	77	83
Newborough	Sweep and visual	23/08/2019	Cloudy	14	20	12	SW	0.6	84	86
Aberffraw	Pitfall	22/08/2019	Cloudy, scattered showers	15	16	24	SSW	7.9	94	89
Aberffraw	Pitfall	23/08/2019	Cloudy, scattered showers	15	18	16	SSW	1.4	64	89
Aberffraw	Pitfall	24/08/2019	Sunny	15	22	6	S	0	5	58
Aberffraw	Pitfall	25/08/2019	Sunny	16	19	9	SW	0	3	81
Aberffraw	Pitfall	26/08/2019	Cloudy	14	17	7	SW	0.1	71	83
Aberffraw	Pitfall	27/08/2019	Cloudy	14	17	11	SW	0.2	64	83
Aberffraw	Pitfall	28/08/2019	Cloudy with showers	14	15	9	WSW	2.9	97	82
Aberffraw	Sweep and visual	22/08/2019	Cloudy	15	16	24	SW	7.9	94	89

Appendix 2: NRW pioneer dune slack specialist target list

Species	Order	Family	Status
Dyschirius politus	Coleoptera	Carabidae	-
Dyschirius salinus	Coleoptera	Carabidae	-
Dyschirius thoracicus	Coleoptera	Carabidae	-
Asaphidion pallipes	Coleoptera	Carabidae	Nationally Scarce
Bembidion Pallidipenne	Coleoptera	Carabidae	Nationally Scarce
Bembidion clarki	Coleoptera	Carabidae	Nationally Scarce
Bembidion fumigatum	Coleoptera	Carabidae	Nationally Scarce
Bledius fergussoni	Coleoptera	Staphylinidae	-
Bledius fuscipes	Coleoptera	Staphylinidae	-
Bledius longulus	Coleoptera	Staphylinidae	-
Bledius opacus	Coleoptera	Staphylinidae	-
Bledius subniger	Coleoptera	Staphylinidae	-
Thinobius brevipennis	Coleoptera	Staphylinidae	Nationally Rare
Gabrius osseticus	Coleoptera	Staphylinidae	Nationally Scarce
Heterocerus flexuosus	Coleoptera	Heteroceridae	-
Dryops nitidulus	Coleoptera	Dryopidae	Nationally Rare
Dryops striatellus	Coleoptera	Dryopidae	Nationally Rare
Monochroa elongella	Lepidoptera	Gelechiidae	Nationally Rare
Nephrotoma quadristriata	Diptera	Tipulidae	Nationally Rare
Platypalpus excisus	Diptera	Hybotidae	Naturally Scarce
Hercostomus praetextatus	Diptera	Dolichopodidae	Naturally Scarce
Tachytrechus insignis	Diptera	Dolichopodidae	-
Syntormon filiger	Diptera	Dolichopodidae	Naturally Scarce
Pherbellia grisescens	Diptera	Sciomyzidae	Naturally Scarce
Pteromicra glabricula	Diptera	Sciomyzidae	Naturally Scarce
Pteromicra pectorosa	Diptera	Sciomyzidae	Naturally Rare
Spilogona scutulata	Diptera	Muscidae	Naturally Rare
Neolimnophora maritima	Diptera	Muscidae	Naturally Rare
Limnophora scrupulosa	Diptera	Muscidae	Naturally Scarce

Limnophora nigripes	Diptera	Muscidae	Naturally Scarce
Lispe caesia	Diptera	Muscidae	Naturally Scarce
Lispe nana	Diptera	Muscidae	Naturally Scarce
Lispocephala Rubricornis	Diptera	Muscidae	Naturally Rare
Coenosia atra	Diptera	Muscidae	Naturally Scarce

Data Archive Appendix

Data outputs associated with this project are archived in Sands of LIFE (SoLIFE) DMS folders (D1 Physical Monitoring) on server–based storage at Natural Resources Wales.

The data archive contains:

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

[B] Invertebrate data in Excel spreadsheet format for all sites and survey periods. Species records including date, site, sampling location, frequency, collection method etc.

[C] GIS layers of sample location, which is held on the central geo-spatial data store.

[D] A full set of maps produced in JPEG format.

[E] A full set of images produced in JPEG format.

Metadata for this project is publicly accessible through Natural Resources Wales' Library Catalogue https://libcat.naturalresources.wales (English Version) and https://catllyfr.cyfoethnaturiol.cymru (Welsh Version) by searching 'Dataset Titles'. The metadata is held as record no 124813.

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