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IMPORTANT INVERTEBRATE AREA SURVEYS: BALLYOGAN AND SLIEVE CARRAN, CO. CLARE

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An Roinn Tithíochta,
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Front cover, small photographs from top row:

Limestone pavement, Bricklieve Mountains, Co. Sligo, Andy Bleasdale; **Meadow Saffron** *Colchicum autumnale*, Lorcan Scott; **Garden Tiger** *Arctia caja*, Brian Nelson; **Fulmar** *Fulmarus glacialis*, David Tierney; **Common Newt** *Lissotriton vulgaris*, Brian Nelson; **Scots Pine** *Pinus sylvestris*, Jenni Roche; **Raised bog pool**, Derrinea Bog, Co. Roscommon, Fernando Fernandez Valverde; **Coastal heath**, Howth Head, Co. Dublin, Maurice Eakin; **A deep water fly trap anemone** *Phelliactis* sp., Yvonne Leahy; **Violet Crystalwort** *Riccia huebeneriana*, Robert Thompson

Main photograph:

Burren Green *Calamia tridens*, Brian Nelson

Important Invertebrate Area Surveys: Ballyogan and Slieve Carran, Co. Clare

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Executive Summary

Buglife Services Ltd. was commissioned to document and assess the invertebrate assemblages of the National Parks and Wildlife Service (NPWS) owned and managed properties at Ballyogan and Slieve Carran in the Burren, Co. Clare. The sites protect areas of habitat that are typical of the eastern Burren including limestone pavement, calcareous grassland, lakes, fen and Hazel woodland. Both sites are included within Special Areas of Conservation.

The survey methodology targeted the bees (Hymenoptera), beetles (Coleoptera), butterflies and moths (Lepidoptera), dragonflies and damselflies (Odonata), grasshoppers and crickets (Orthoptera), slugs and snails (Mollusca), spiders (Araneae), true bugs (Heteroptera) and two-winged flies (Diptera) and all species in these groups were identified. Species in other invertebrate groups were also identified if they were encountered, but they were not specifically targeted in the survey.

The results show that both sites hold exceptional invertebrate assemblages including many of the Burren-restricted species of insect and invertebrate. In total, almost 1,000 species of invertebrate were identified across the two sites. Twelve species new to Ireland were recorded and just over 10% of the species listed were considered notable in an Irish context, which is quite remarkable and significantly higher than any other study with a similar scope and scale. One group of species worthy of highlighting are the insects that are wholly or mainly confined to Ireland within the biogeographical area of Britain and Ireland. These include the beetles *Philonthus furcifer* and *Pterostichus aterimus,* the damselfly *Coenagrion lunulatum,* the flesh-fly *Sarcophaga discifera*, the hoverflies *Cheilosia ahenea* and *Paragus constrictus,* and the moths, *Calamia tridens, Platyptilia tesseradactyla* and *Pyrausta sanguinalis.* All these species were discovered on one or other of the sites.

Analysis of the species lists showed clear differences in the fauna of the two sites that was related to the habitats present. Ballyogan is a diverse site and includes fen, lake edge and open water, limestone pavement, calcareous grassland and wet and dry scrub. Wetland species were the largest component of its fauna. Grassland and scrub species also made up a significant proportion. The Slieve Carran property, although significantly larger, is mainly composed of limestone pavement, Hazel *Corylus avellana* woodland and a mosaic of scrub and grassland. At Slieve Carran, wet habitats are confined to modest seepage features. The fauna at Slieve Carran comprised mainly open habitat species with a significant element of woodland species.

Most of the notable species recorded in this survey were associated with either the open habitats of grassland and scrub or the wetland habitats. The invertebrate community associated with the closed canopy woodland at Slieve Carran was comparatively of less conservation interest. The reason for that is not entirely clear but it may be related to historic phases of woodland clearance. Removal of the habitat will have negatively impacted woodland invertebrate communities and, as the species tend to be slow at recolonizing sites, the fauna may show a significant degree of impoverishment. The comparatively low diversity of trees in the woodland coupled with a species-poor field layer under the closed canopy will also play a part.

It was concluded that both sites have an appropriate grazing regime which is crucial to maintaining the invertebrate communities. There were few obvious problems with invasive species, other than occasional shrubs of *Cotoneaster* species. Monitoring these problematic species is required in order to implement early eradication and minimise control costs. Setting limits on the extent and type of scrub is important, and considering the most effective scrub-control techniques (in an efficacy and cost sense). Narrow belts of scrub providing plenty of 'edge' and structural diversity are important for invertebrate communities on both sites.

Monitoring programmes are recommended for both sites to help inform site management practices.

Acknowledgements

We would like to acknowledge the assistance provided by the park ranger Emma Glanville in accessing the sites and her advice. The contract was set up by Dr Brian Nelson, Invertebrate Ecologist for NPWS, who also provided *ad hoc* support and advice throughout. Ryan Mitchell and Anna Hart assisted with fieldwork and some taxonomic input to the project. Peter Chandler undertook identification of the majority of the dipteran samples. Valuable records were provided by Áine O Connor and Ferdia Marnell (NPWS).

We are also indebted to Mel Bellingham and Huw John for agreeing to provide data from their moth-trapping at Slieve Carran which coincidentally took place during the survey period of the project.

Figure 1 View across the Slieve Carran property with species-rich grassland and limestone pavement. The ridge line visible in the photograph is the eastern boundary of the site.

1 Introduction

The Burren region of Co. Clare and Co. Galway represents the largest area of limestone pavement and calcareous grassland in Ireland. It also contains significant areas of other habitats including turloughs, marl lakes, scrub and Hazel *Corylus avellana* woodland. Much of the region is covered by Special Area of Conservation (SAC) designations. Areas of state ownership including the Burren National Park and a number of statutory nature reserves are managed by National Parks and Wildlife Service. This includes Keelhilla (Slievecarran) Nature Reserve and land adjoining it and a property at Ballyogan. These areas were selected for survey of their insect and other invertebrate assemblages in 2018 under the umbrella title of the Important Invertebrate Area Surveys. These surveys were initiated in 2015 and are commissioned from suitably qualified experts.

Buglife Services Ltd. were successful in tendering for this survey which had the following specific aims

- Conduct an invertebrate survey at an appropriate scale for the site, reflecting the habitats listed for the site and targeting the groups that are considered most appropriate for assessing the condition of the site
- Produce a final report detailing the findings
- Assess the impact of current management on invertebrate assemblages
- Suggest a monitoring protocol using invertebrate species/groups and simple, repeatable methods to assess potential changes to the ecological status of the nature reserves,

and the following minimum outcomes

- A description of the invertebrate assemblages of the site with emphasis on the characteristic, notable and rare species
- A complete list of the species recorded with all associated occurrence data
- Where appropriate, reference to relevant historical records
- Analysis of the associations of the invertebrates to habitats and management practices
- Assessment of the condition of the site and its habitats with regard to the invertebrates
- Any management recommendations
- Recommendations and descriptions of monitoring protocols
- A statement for the site synopsis that describes the invertebrate assemblage(s) and highlights rare, notable and characteristic species
- Voucher specimens for selected species (mandatory for any species new to Ireland) supplied to the National Museum for Ireland.

1.1 Slieve Carran

The property at Slieve Carran includes the Keelhilla (Slievecarran) Nature Reserve. The nature reserve is a statutory reserve declared under S.I. 346 of 1986 and covering an area of 145.5 ha. Adjoining land to the east of the statutory nature reserve is also owned by NPWS and together these are managed as one unit. The boundary of the NPWS land holding is indicated in Figure 2 and this whole area is collectively referred to as 'Slieve Carran' in this report. The NPWS owned land comprises approximately 6% of the East Burren Complex Special Area of Conservation (SAC).

There are 17 Qualifying Interests for the East Burren Complex SAC (001926), 14 habitats and three species including the Marsh Fritillary *Euphydryas aurinia*. Habitats of relevance to the Slieve Carran site are

- [6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)
- [8240] Limestone pavements

In addition to the Annex I listed habitats above, the following are important habitat features for the invertebrate communities

- Grassland–scrub mosaic
- Hazel *Corylus avellana* woodland with a continuous canopy
- Temporary spring-lines/seepages
- Species-rich hedgerows

Apart from a reference to a 'large population of Marsh Fritillary' there is no mention of any insect or other invertebrate species in the site synopsis (NPWS, 2016).

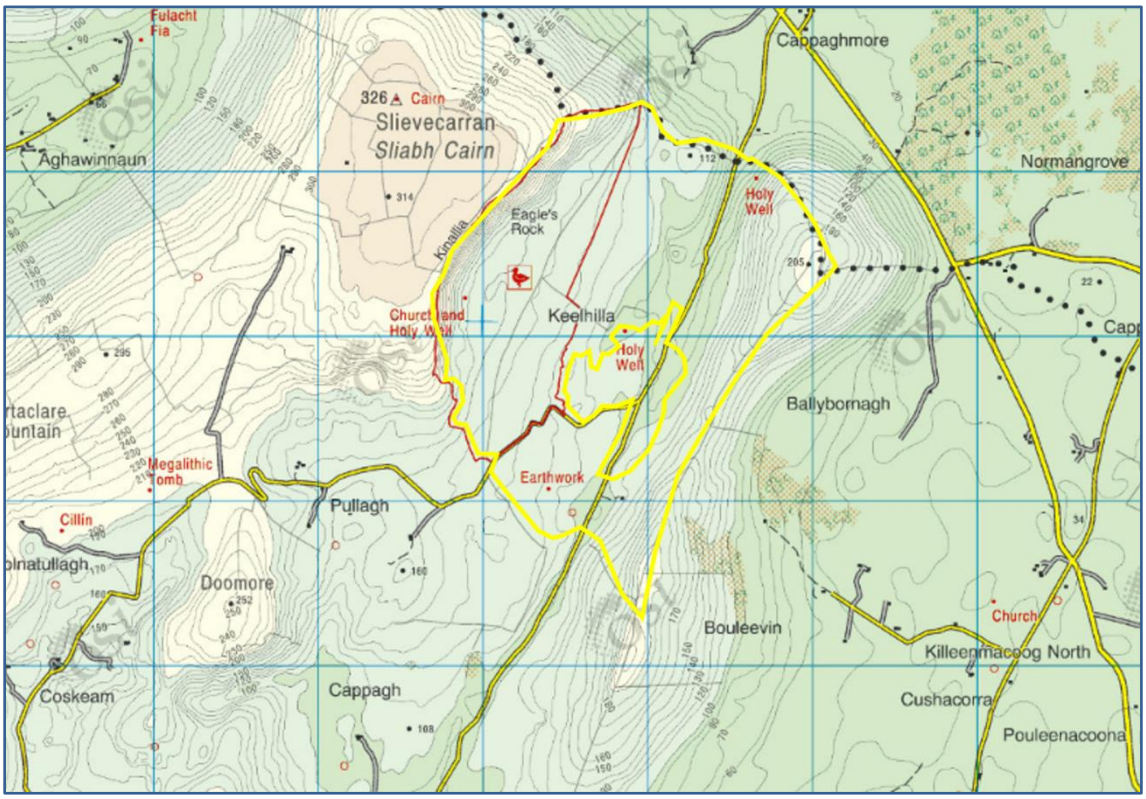

Figure 2 Map showing the approximate boundary in yellow of the NPWS property and study area at Slieve Carran. The nature reserve is the western side of the property.

The current management regime consists of the traditional 'winterage' which is practiced extensively across the Burren where cattle are grazed on Slieve Carran at a low intensity during the winter months. Evidence of manual scrub cutting was seen during the time of the visit around the margins of the Hazel woodland. Feral goats were observed in the area.

1.2 Ballyogan

The property at Ballyogan lies in the south-eastern part of the Burren. The approximate boundary of the study area is shown in Figure 3. This area of land is owned by NPWS and comprises part of the Ballyogan Lough SAC (000019) and the Burren National Park. This SAC is designated for *Cladium* fens [7210]. The site synopsis (NPWS, 2013) makes no reference to the fauna of the site and it is clear from our research that, prior to our survey, the fauna was essentially unknown.

Although the NPWS property is relatively small, it contains many of the distinctive features and habitats of the Burren including limestone pavement, calcareous grassland, scrub, fen and open water in an intricate and complex mosaic. Figure 4 and Figure 5 show two views across the site to illustrate the variation in the habitats. In addition to the Annex I habitat mentioned above, we identified the following habitats that are considered to be of significance to the invertebrate communities

- Scrub–grassland mosaic
- Hard water lakes with charophyte communities (Annex I habitat 3140)
- Freshwater marshes and swamp vegetation associated with lakes
- Mire habitats including calcareous fen and poor-fen communities with Bogbean *Menyanthes trifoliata,* Bog Myrtle *Myrica gale*, Heather *Calluna vulgaris* and Cross-leaved Heath *Erica tetralix*
- Calcareous grassland
- Wet grassland
- Species-rich hedgerows

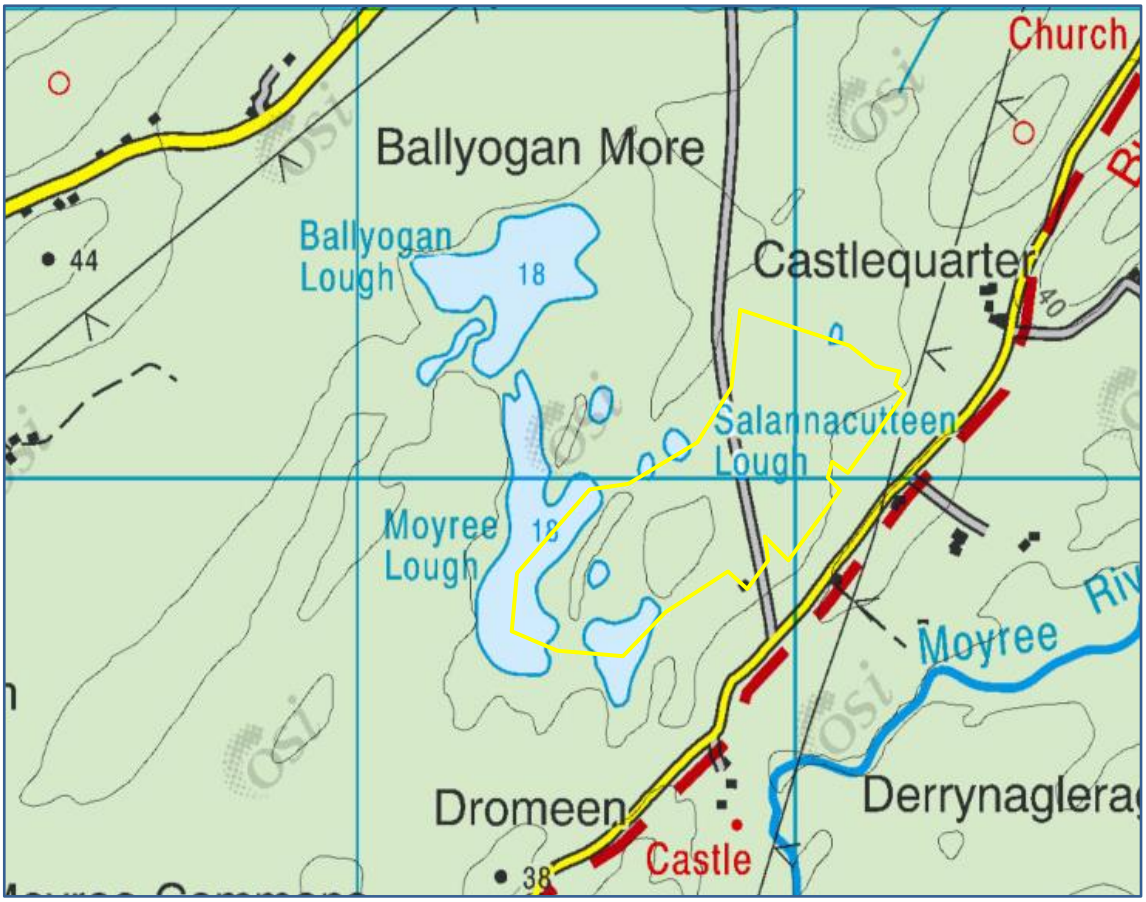

Figure 3 Map showing the study area at Ballyogan with the approximate boundary of the NPWS land holding shown in yellow.

Figure 4 View across *Cladium* fen margin at Ballyogan.

Figure 5 View across calcareous grassland to the marl lake at Ballyogan.

The current management arrangement consists of grazing by cattle across the site. There were no signs of other active management evident on site.

2 Methodology

2.1 Taxonomic groups sampled

The groups that were chosen for sampling reflected the requirements of the survey and the skills of the surveyors/taxonomists. The key groups specifically targeted and the primary taxonomists are listed in Table 1. Specific expertise on Diptera was brought in to support the project.

Table 1 List of key taxonomic target groups recorded and the primary taxonomist responsible for identifications

Taxonomic Group	Primary taxonomist
Arachnida, Araneae (Spiders)	Adam Mantell
Coleoptera (Beetles)	Roy Anderson, Brian Nelson
Diptera (Two-winged flies)	Peter Chandler
Hemiptera, Heteroptera (True bugs)	Brian Nelson
Hymenoptera, Aculeata (Bees & wasps)	Anna Hart
Mollusca (Snails & slugs)	Roy Anderson
Odonata (Damselflies & dragonflies)	All surveyors
Orthoptera (Grasshoppers & crickets)	All surveyors

The choice of taxonomic groups was based on invertebrate survey guidance produced by Natural England (Drake *et al.*, 2007). However, readily identifiable specimens of 'by-catch' across several other groups are included in this report. These include

- Arachnida, Opiliones (Harvestmen)
- Arachnida, Pseudoscorpiones (Pseudoscorpions)
- Diplopoda (Millipedes)
- Isopoda (Woodlice)
- Chilopoda (Centipedes)
- Hymenoptera, Formicidae (Ants).

2.2 Timing of visits and the weather

Timing of visits were based upon

- Weather conditions - fine, still, dry and warm but not hot conditions are ideal
- The need to collect specimens from passive traps in good time to prevent deterioration, and
- Seasonality of the target groups.

Visits for fieldwork and to set up and empty collecting equipment were conducted on the dates shown in Table 2. Approximately equal amounts of time were spent sampling at each of the two sites.

Table 2 Dates of visits and activities undertaken in 2018 and weather during the visit.

Date of visit	Activity and attendees	Weather
22 May	Brian Nelson and Adam Mantell site orientation day, a few records collected	Warm and dry
1–3 June	Adam Mantell and Roy Anderson Set up passive collecting equipment (Malaise, flight intercept and pitfall traps) Undertake hand searching in target habitats	Warm and dry
7 July	Adam Mantell only Single day to retrieve samples from passive traps and conduct limited hand searching	Hot and dry
10–12 August	Adam Mantell and Anna Hart Retrieve samples from passive traps Undertake hand searching in target habitats	Hot and dry
7–9 September	Adam Mantell, Anna Hart, Ryan Mitchell Retrieve samples from passive traps Undertake hand searching in target habitats	Cool and dry on 7th Cool and heavy rain on 8th Cool and showery on 9th

2018 was an unusual year in Ireland, notable for persistent hot and dry weather. The summer of 2018 was one of the driest and hottest on record for Co. Clare. Rainfall totals were extremely low between May and the end of August and, conversely, sunshine hours and temperatures were well above average (Met Éireann, 2018). The highest maximum temperature since 1946 was recorded at Shannon Airport, Co. Clare at 32°C.

The limestone pavements and calcareous grasslands with thin soils of the Burren are prone to be water-stressed during any prolonged dry periods. The exceptional weather in 2018 is likely to have affected the survey results. Previous experience of surveying Irish habitats in hot and dry conditions fit with our experience from the Burren in 2018. Invertebrates that are adapted to the comparatively cool, damp Irish climate become harder to find as conditions become hotter and drier during a drought. The impact of this event on the invertebrate fauna is difficult to evaluate with any certainty in the absence of a baseline against which to compare the survey results. The effects on the vegetation however were highly visible before the drought broke in August/September, with most ground layer vegetation dry and desiccated. Extensive die-back of leaves was noted on some tree species, particularly birch *Betula* species and Hazel (see Figure 6). It was also noticeable that some places with plants, such as Bogbean, that would normally be found in very wet or flooded areas were dry by the time of the July visit, suggesting that the water table had fallen further than normal.

Intuitively it seems likely that the populations of thermophilic species will have been favoured by the weather in 2018, and correspondingly those of species requiring cool, damp or humid habitats will have been depressed. This is supported by the fact that comparatively few linyphiid spiders, which in general have a requirement for high humidity, were captured during survey work. Two indicator species of warm, dry habitats, the Grayling *Hipparchia semele* and Dingy Skipper *Erynnis tages* butterflies, were present in good numbers however. Grayling were abundant at both sites, with a crudely estimated population of two adults flying per 250 m^2 in July at Slieve Carran, and it is considered that several thousand adults were present on the limestone pavement and grassland across the site.

One early attempt was made at quantifying the impact of the dry weather of 2018 on hoverflies in Britain by the Hoverfly Recording Scheme (Morris, 2019). Accepting there are difficulties in precisely establishing cause and effect, as is often the case with biological records, Morris (2019) argues that while the spring emergence was unaffected, a significant drop was seen in the summer hoverfly emergence.

This evidence is from British data, and not Ireland, but it agrees with our anecdotal experience during fieldwork for this project.

Careful siting of collecting equipment and fieldwork at both sites will have helped to mitigate the effect of drought on the findings to a degree. Pitfalls were deliberately located at Slieve Carran along a partially shaded spring line on the break in the scarp slope, and area which will have retained moisture longer into the year. Damper areas may have attracted invertebrates fleeing the drying ground and high temperatures (wet ground stays cooler for much longer than dry). Hand collecting also concentrated on damper micro-habitats, which proved much more productive than areas with parched, skeletal soils. Despite these measures, simple visual examinations of catches from passive traps indicated that samples from both the Malaise and pitfall traps fell in quantity and diversity through the course of the survey period as the dry, hot conditions persisted.

One notable exception to this trend which is worth mentioning is that the flight interception traps placed in woodland areas, attracted large numbers of calyptrate flies, mostly dung-feeding species, and significant numbers of silphid, carrion-feeding beetles. There are several possible reasons for this. We used propylene glycol as the preservative as under normal conditions it can be left for two to three months without significant deterioration of the specimens. It could be that the heat during the summer of 2018 accelerated decay, thus attracting dung and carrion feeding specialists in high numbers. Flies may have been more active in the heat and thus more likely to be caught in the flight interception traps positioned in the canopy as well as being attracted by chemical signals. The heat and low humidity on the limestone pavement and open grassy areas may also have driven some invertebrates into the wooded areas where temperatures are likely to be lower and humidity higher.

2.3 Installation and location of passive collecting equipment

Passive collecting equipment, which is installed and left *in situ* for extended periods, has pros and cons over hand searching including that

- It collects over a longer period meaning that the samples obtained are less affected by the weather so making the results more repeatable
- It can collect from habitats that are otherwise difficult to sample, *e.g.* the ground layer and tree canopy
- Labour costs in fieldwork are reduced but sorting of specimens can be time consuming
- It is indiscriminate in what it captures, although this is less of an issue on for a multi-taxa survey
- Passive traps are prone to human interference and damage from animals.

Pitfall traps, a Malaise trap and flight interception traps were set out at each site. These three trapping methods collect insects in different ways thereby sampling particular subsets of the fauna. Pitfall traps catch mainly ground-living species, Malaise traps and flight interception traps sample the aerial fauna. Malaise traps work on the principal that insects hit a barrier and then fly upwards to the apex of the trap. Here there is a hole leading to the collecting head. Malaise traps are especially useful for sampling Diptera and Hymenoptera. Flight interception traps work on the opposite principal in that flying insects, and especially beetles, drop to the ground when they hit a barrier. The collecting part of a flight interception trap is therefore placed at the base of the trap. The preservative used in the three types of passive trap was propylene glycol diluted 50:50 with water.

2.3.1 Pitfall Trapping

Pitfall traps were made from two standard disposable plastic cups inserted into each other to enable easier emptying and replacement. These were 8 cm wide by 9 cm deep. The traps were protected from

the weather using 15x15 cm plywood squares with an additional covering of chicken wire to prevent, as far as possible, the accidental by catch of vertebrates.

Two transect lines of five traps were placed at each site. Traps were separated by approximately 5 m. In most instances the traps required a shallow excavation which was carefully backfilled to be exactly level with the brim once the cups were inserted. Transects were deliberately not marked in order to avoid attracting attention. Transects were located to intersect areas thought by the surveyor most likely to be productive. At Ballyogan, one transect intersected calcareous grassland and crossed an area of quaking mire, and the second transect intersected the margin of the *Cladium* fen. At Slieve Carran, one transect was laid through a seepage line along the margin of the Hazel woodland. A second transect of specially adapted pitfalls was inserted into the clints in the limestone pavement. The latter set of traps consisted of a pitfall cup inserted into a hole of the correct diameter in a corrugated plastic sheet and carefully taped into place. These were pushed into the cracks deep in the limestone and formed a level surface to hold the cup and allow invertebrates to access the trap.

On installing each trap, about 3 cm of the preservative solution was placed in the cup and a splash of detergent added. The detergent reduces surface tension and helps trap smaller invertebrates which might otherwise climb out. Traps were set in June and emptied three times, with the final emptying in September. Disturbance of the pitfall traps was minimal except on the transect across the quaking bog at Ballyogan. A number of these traps had been removed and emptied by persons unknown during the two late summer trapping sessions.

2.3.2 Malaise traps

Malaise traps were set at both sites. These are large, obvious structures that tend to attract attention and, unless the site is remote, choosing where to site them is a balance between optimising catch and reducing the likelihood of interference from animals and humans. Optimal siting is usually along insect flight lines. This requires setting the trap perpendicular to a linear feature such as a hedgerow or woodland margin. At Slieve Carran the trap was located along the woodland margin at the edge of the limestone pavement out of the line of sight from the footpath that runs through the site (Figure 6).

Figure 6 Malaise trap in place at Slieve Carran on the edge of a patch of Hazel woodland. Note the browning of the leaves on some of the Hazel caused by the dry weather of early 2018.

At Ballyogan the siting choice was more difficult, and the Malaise trap was placed in an area of wet grassland with scrub. The trap at Ballyogan was trampled by cattle that were not present in July and destroyed by the time of the visit in August.

2.3.3 Flight interception traps (FITs)

These traps are a good way of sampling the otherwise inaccessible fauna in the tree canopy. Four FITs were deployed in this project, three at Slieve Carran and one at Ballyogan; a larger number were deployed at Slieve Carran because of the greater extent of wooded habitat. Each FIT was constructed from a plastic 2 l bottle bolted upside down to a square wooden plate fitted with a steel eyelet. The eyelet allows the trap to be hoisted into the tree canopy, and the wooden plate gives structural rigidity and protection from rain and leaves *etc*. The bottle had a window cut out of one side which allows the insects to enter the trap. The traps were charged with the preservative. Once set these traps can be left in place for several weeks. No problems were encountered with the FITs other than those linked to weather explained in Section 2.2.

2.4 Hand collecting

The active, hand-collecting sampling techniques used during this project are detailed below. These followed the Common Standards Monitoring methodology developed by the Joint Nature Conservation Committee in the UK for the assessment of invertebrate communities on sites of conservation importance (Drake *et al.*, 2007; JNCC, 2008). As well as providing a structured method for surveying important invertebrate assemblages, it also references fieldwork techniques to enable repeatability and consistency among surveys. There is no equivalent method developed for use in the Ireland.

2.4.1 Ground searching

This protocol is aimed at capturing ground-dwelling invertebrates and, as such, depends to a large extent upon the sampler's skills and experience. It specifically excludes treading and sieving techniques for water-logged ground which are described in Section 2.4.3. Ground searches should be spread out to more or less equally cover all likely areas at a site. Methods and places likely to yield results are

- Turning over and examining the undersides of rocks, stones and other objects on or embedded in the ground, particularly those in partially shaded places
- Levering or peeling off bark on dead wood
- Investigating fruiting bodies of epiphytic fungi
- Pulling up and shaking plant rosettes on otherwise bare ground
- Disturbing and excavating areas of bare soil, especially in coastal habitats
- Beating or sieving moss patches on hummocks or tussocks on otherwise flooded ground
- Lifting out and examining decaying leaves in fens and other wetlands, especially for adhering small snails
- Examining wet leaf litter by pulling out a sample with as little disturbance as possible from a drain, channel, hollow or other deep, undisturbed deposit. Examine by separating off one leaf at a time.

Tools and items of equipment

- Penknife or other blade
- White tray for sorting and a pooter for catching the insects
- Pots containing 70% alcohol (Industrial Methylated Spirits).

2.4.2 Sweep netting

Sweep nets are robust nets with bags made of canvas that is resistant to tearing when snagged. They are used for sampling invertebrates of the field layer. Sweep netting involves moving the net from side to side while walking forward at a moderate pace. This action knocks insects that are on the target vegetation into the net bag. The following are the general principles to observe when sweeping.

- Moving the net in broad, smooth arcs, backwards and forwards. Smooth, not jerky or erratic movements are best
- Holding the net at a slightly oblique angle if possible, i.e. not fully vertically aligned so that insects fall into the bag
- Moving forward into the wind is best but it is recommended to only sweep when winds are light. In breezy conditions the net will be difficult to operate effectively and the bag may be emptied by unexpected or unpredictable gusts
- Wet weather and damp early morning conditions should be avoided and use of a sweep net should be delayed until the vegetation is dry. In these conditions, the net bag will become wet and heavier and any insects caught will most likely also be damaged.
- Removing the target insects from the net using a pooter. This should be done regularly during sweeping so that the net does not become too full
- Transferring the catch to tubes of alcohol at the end of a session.

Tools and items of equipment

- Sweep net
- White tray for sorting and a pooter for catching the insects
- Pots containing 70% alcohol (Industrial Methylated Spirits).

2.4.3 Treading and sieving

These techniques are used in wetland habitats. Treading involves depressing the floating and overhanging mats of vegetation below the water so that any invertebrates are forced to the surface or into the area of open water that has been created. The target insects are then caught with a net or sieve by skimming the area of open water.

- Examine a possible transect carefully before starting, so that holes in the bog or other hazards can be detected and avoided
- Walk backwards from the starting point, trampling and depressing the vegetation below the water-table
- Poot insects collected directly from the net or from a tray
- Stop every few metres to examine the flooded vegetation and sweep before moving on
- Transfer animals to alcohol tubes after each transect.

Tools and items of equipment

- Waders
- Kitchen sieve or pond net
- White tray for sorting and a pooter for catching the insects
- Pots containing 70% alcohol (Industrial Methylated Spirits).

3 Results

This chapter gives a summary of the findings across the two sites. A full list of species encountered at each site is provided in Appendix 1. Full data associated with each of the species' records has been entered on the NPWS records database and is available on request. All species records have also been provided to the National Biodiversity Data Centre, Waterford for incorporation into their online data viewer. An account of each notable species is provided in Section 3.1 below. A more detailed analysis of the invertebrate communities using Pantheon software is given in chapter 4.

The combined total of 988 species were identified from the two sites with totals of, respectively, 646 from Ballyogan and 576 from Slieve Carran. Table 3 presents a summary of the number of species recorded at each site and across both sites by taxonomic group. Only taxa identified to species level are included in these totals. Perhaps one of the most striking results is the lack of overlap in the two lists. Just under a quarter of the species recorded were present on both sites.

Table 3 The number of species recorded at each site (and combined) by taxonomic group.

Taxonomic Group	Ballyogan	Slieve Carran	Both	Combined
Arachnida, Araneae (Spiders)	79	59	32	106
Arachnida, Opiliones (Harvestmen)	3	9	2	10
Arachnida, Pseudoscorpiones (False scorpions)	1	1	1	1
Arynchobdellida (Leeches)	1	0	0	1
Chilopoda (Centipedes)	0	2	0	2
Coleoptera (Beetles)	181	132	36	277
Crustacea, Isopoda (Woodlice & relatives)	5	6	3	8
Dermaptera (Earwigs)	1	0	0	1
Diplopoda (Millipedes)	4	7	4	7
Diptera (Two-winged flies)	203	180	90	293
Hemiptera (True bugs & relatives)	43	27	8	62
Hymenoptera, Aculeata (Bees, ants & wasps)	15	17	20	19
Lepidoptera (Butterflies & moths)	71	101	34	138
Mollusca (Snails & slugs)	23	29	7	45
Odonata (Damselflies & dragonflies)	13	2	2	13
Orthoptera (Grasshoppers & crickets)	5	4	3	6
TOTAL	648	576	234	990

3.1 Notable species accounts

The notable species listed below were selected based on the following criteria

- Rarity in Ireland – species were included if they had either a restricted geographical distribution (*i.e.* largely confined to the Burren region of Ireland) or a more widespread distribution but with reason to believe that populations are highly scattered
- Status on Irish Red Lists – species were included if categorised as Critically Endangered, Endangered, Vulnerable or Near Threatened (Nelson *et al.*, 2019)
- Where Irish Red Lists were not available, the equivalent British Red List was used as a proxy

- They have some form of British conservation designation and/or included on a UK Biodiversity Action Plan list. These are described and explained in JNCC (2019).

It should be noted that British conservation designations do not map directly across to Ireland. Climatic and geographical differences mean that, in many instances, invertebrates that are rare in Great Britain may be common in Ireland and vice versa. Where we believe this to be the case, we have not included the species within the notable species accounts. For this reason, several moths that are common in Ireland but are on UK Priority species lists have not been included. Species are listed alphabetically within group below. The species considered notable are also indicated in Appendix 1.

3.1.1 Arachnida, Araneae (spiders)

Spider accounts are based on publications and websites of Hänggi *et al.* (1995), Harvey *et al.* (2002), Nentwig *et al. (*2020), Roberts (1985, 1987), Spider and Harvestman Recording Scheme (2017) and van Helsdingen (1996).

***Allomengea scopigera* (Family Linyphiidae), Ballyogan**

This species is included as a new record for Co. Clare. It has been recorded from eight Irish counties with this one making nine. There was a single specimen taken in a pitfall trap at the edge of *Cladium* fen at Ballyogan. In Great Britain, the species has a northern and western bias to its distribution which seems to be broadly repeated in Ireland. It is found in the ground layer in a variety of damp habitat types.

***Asthenargus paganus* (Family Linyphiidae), Slieve Carran**

Asthenargus paganus has a Nationally Scarce designation in Great Britain. Its British distribution is widespread but scattered in England from the Severn to Yorkshire, with fewer records from Wales and Scotland. It is found in ground layer leaf litter, moss and detritus in a variety of different woodland types. Its European distribution appears skewed towards damper coniferous and deciduous woodland. A preference for damper, cooler woodland habitats may explain why it is more abundant in Ireland where it has been recorded from 19 Irish counties. On the basis of the available evidence, it does not seem to be especially rare in Ireland and is referenced here because of its British designation and potential for use in site monitoring (see Section 6).

***Attulus caricis* (Family Salticidae), Ballyogan**

Formerly known as *Sitticus caricis* and *Calositticus caricis*, this small jumping spider was reasonably frequent in the fen habitat at Ballyogan. It is found in lowland bogs and fens where it lives on the low vegetation including *Sphagnum* mosses. In Ireland, it has only been recorded from Co. Clare and Co. Westmeath. It is uncommon and very local generally in Europe and, in Great Britain, it is designated as Nationally Rare and a UK Biodiversity Action Plan priority species. There is evidence of significant and ongoing decline in Britain as sites have been lost largely through drainage of wetlands. Given the precipitous loss of wetland habitats in Ireland, the species is likely to have declined here as well. It is a possible candidate Red List species given its very restricted distribution and likely historic decline. Further searches of fens in this area may well reveal other undocumented colonies.

***Dolomedes fimbriatus* Raft Spider (Family Pisauridae), Ballyogan**

Like *Pirata piscatorius,* this is a very local species of still or slow-moving clean water in undisturbed habitats. The species is an indicator of high-quality wetland habitat. It is designated as Nationally Scarce in Great Britain, but is more widespread in Ireland. Surprisingly given the presence of many apparently suitable sites in the Burren, this is the first record from Co. Clare. Suitable habitat is patchily distributed across Ireland (there are records from 13 counties) and it can be very abundant where found, as was the case at Ballyogan (Figure 7).

Figure 7 Raft Spider *Dolomedes fimbriatus* from Ballyogan.

***Erigonella ignobilis* (Family Linyphiidae), Ballyogan**

Two specimens of this very small spider were taken at Ballyogan in pitfall traps. One specimen came from the mire and the other from the edge of *Cladium* fen. There are records from 10 Irish counties and it is Nationally Scarce in Great Britain. The spider is found in wetland habitats and is considered an indicator of good quality site.

***Euryopis flavomaculata* (Family Theridiidae), Slieve Carran**

Euryopis flavomaculata has a very patchy distribution in Ireland with widely scattered records from 10 counties. It has Nationally Scarce designation in Great Britain but considered to have been in long-term decline due to habitat loss, a situation which is likely to be replicated in Ireland. This species lives on the ground in damp condition where it feeds on ants. At Slieve Carran, a single specimen was taken in a pitfall trap set along a seepage line at the edge of scrubby grassland.

***Evansia merens* (Family Linyphiidae), Slieve Carran**

This money spider is another ant-feeding (myrmecophilous) species. It has Nationally Scarce status in Great Britain and is uncommon across Europe. There are records from six Irish counties – Co. Kerry, Co. Cork, Co. Waterford, Co. Clare, Co. Dublin and Co. Longford. This largely southern distribution in Ireland is in marked contrast to the British range which is northern and western. This perhaps reflects climatic differences between the two islands. *Evansia merens* lives within ant nests so it is associated with stable, undisturbed habitats with strong populations of ants.

***Hypomma fulvum* (Family Linyphiidae), Ballyogan**

This spider is the rarest of the *Hypomma* genus found in Ireland and is a habitat specialist species with a close affinity with beds of Common Reed *Phragmites australis* and Great Fen-sedge *Cladium mariscus*. It has Nationally Scarce designation in Great Britain, where it is largely confined to East Anglia and the extreme south-east of England. It is perhaps more widespread in Ireland, as is *Cladium mariscus*, with records from 12 counties. This is, however, the first record for Co. Clare. Like *Attulus caricis* this species is likely to have undergone a significant decline throughout the 20th century due to loss of lowland wetland habitats, and may also be a candidate for Red Listing.

***Lasaeola tristis* (Family Theridiidae), Ballyogan & Slieve Carran**

This spider was formerly in the genus *Dipoena.* It feeds on ants, which it traps in a simple web. *Lasaeola tristis* has previous Irish records from only Co. Cork and Co. Kerry, so this is significant new county record for Co. Clare. It has Nationally Scarce status in Great Britain and a very southern distribution. The warm micro-climate associated with the limestone pavement is likely to be critical in enabling this species to survive this far north on the west coast of Ireland. It may be a candidate Red List species given its very restricted distribution.

***Liocranoeca striata* (Family Liocranidae), Slieve Carran**

Liocranoeca striata has been recorded from just four Irish counties, Co. Clare, Co. Cork, Co. Kerry and Co. Mayo. In Great Britain it has a Nationally Scarce designation and a southern, often coastal distribution. It has a strong affinity for wetland condition within a wide variety of habitats from saltmarsh to woodland. The specimen from Slieve Carran was taken in a pitfall trap along seepage line at the margin of the Hazel woodland and scrubby grassland.

***Mecynargus morulus* (Family Linyphiidae), Ballyogan**

A single specimen of this species was found by turning stones on the limestone pavement at Ballyogan. This is an unusual record as the species has a strong affinity for montane habitats where it can be found under stones and among mosses. It has been recorded from 12 Irish counties, and this is a first record for Co. Clare. It has a Nationally Scarce status in Great Britain. A question remains as to its status in the Burren and whether this individual comes from a permanent population or it was a stray (spiders can disperse over long distances by ballooning). The bare limestone pavement would seem to replicate the habitat structure found in upland areas even if it is at low altitude, so this would seem a likely explanation. More recording for this species is, however, needed to answer this question.

***Micrommata virescens* (Family Sparassidae), Slieve Carran**

This distinctive, bright, green spider is rare in Ireland having records from just three counties, Co. Clare, Co. Kerry and Co. Galway. In Great Britain it is widespread but mainly southern, a distribution likely to be mirrored in Ireland, and it has Nationally Scarce status. A single specimen was taken in the woodland margin Malaise trap at Slieve Carran. Shrubby vegetation and low branches in damp woodlands are the main habitat used in Great Britain, although in Europe it appears to inhabit a greater range of habitat types including xerothermic ones.

***Pirata piscatorius* (Family Lycosidae), Ballyogan**

This is a first county record for Co. Clare, which is perhaps surprising given the abundance of habitat that is likely to be available in the area. It lives in wetlands around areas of open water. It has been recorded in 10 Irish counties and most locations are from large and least modified wetlands. Given the loss of wetland habitats this is another species that is likely to have undergone a significant decline in the 20th century and may merit Red Listing on that basis. It has Nationally Scarce status in Great Britain.

***Pirata tenuitarsis* (Family Lycosidae), Ballyogan**

Pirata tenuitarsis is morphologically very similar to the much commoner *P. piraticus* and the two species may occur together. This species was added to the Irish list in 1993 from Pollardstown Fen, Co. Kildare and, later records have come from Co. Mayo and Co. Westmeath and in, 2015, Co. Down. This record is the first from Co. Clare. *Pirata tenuitarsis* is likely to be overlook in Ireland but it is undoubtedly considerably rarer than *P. piraticus*. It is most frequently found in acid habitats, living on the ground and on low vegetation around areas of with standing water. There are also records from neutral or calcareous fen habitats like at Ballyogan. Despite the uncertainty over its distribution, it is a good indicator of high-quality mire habitats (lowland bogs and fens). It has a Nationally Scarce status in Great Britain.

***Piratula latitans* (Family Lycosidae), Ballyogan & Slieve Carran**

This ground-living, wolf spider was formerly classified in the genus *Pirata*. Four specimens of this species were encountered during the study, three from Ballyogan and one from Slieve Carran. It was found in a variety of settings across the two sites (*Cladium* fen, calcareous grassland, wet seepages). There are previous records from only seven Irish counties. It is widespread but local in Britain, favours fen and marsh habitats and is less associated with acid sites than its relatives.

***Zelotes apricorum* (Family Gnaphosidae), Slieve Carran**

There are previous records of this ground spider from just three Irish counties. It is a thermophilic species of rocky or stony places including beach shingle, quarries, dry heath and, as here, limestone pavement. It appears to be significantly less common in Ireland than Britain which is likely to be due to its favoured warm and dry habitats being much less frequent.

3.1.2 Coleoptera (beetles)

There are over 2,200 beetle species recorded from Ireland. Recording levels vary across the families but are good for some such as ground beetles and water beetles. Accounts for the notable species draw on Anderson (1997, 2006), Cox (2007), Foster *et al*., (2009, 2016), Hyman (1994), Roy *et al.* (2011) and Telfer (2016) as well as the personal expertise and experience of the authors and species experts.

***Altica longicollis* (Family Chrysomelidae), Ballyogan**

Probably confused with other species by earlier authors but seems to be widespread if local in Ireland. Recent records include Scragh Bog, Co. Westmeath but this appears the first for Co. Clare This is a leaf-beetle and associated with Heather *Calluna vulgaris*. The beetle has a Nationally Scarce designation in Great Britain.

***Bagous lutosus* (Family Curculionidae), Ballyogan**

This aquatic weevil was found in Ireland for the first time in 2005. Records have come from turloughs and midland fens, including a site in the eastern Burren fringes in Co. Galway. This is the first record from Co. Clare. It was assessed as Data Deficient on the Irish Red List of water beetles and as Endangered on the British Red List although this the latter was pre 1994. It is rare in many European countries. One of this beetle's foodplants is considered to be Fen Pondweed *Potamogeton coloratus.*

***Colon viennense* (Family Leiodidae), Slieve Carran**

This species has recent records from only two vice-counties and is categorised as Insufficiently known in Great Britain. A single specimen was sieved from leaf litter in Hazel scrub on Slieve Carran, 10 August which is just the second Irish record, the previous one being from Killarney, Co. Kerry. Beetles in the family Leiodidae are generally fungal feeders.

***Hippodamia tredecemguttata* 13-spot Ladybird (Family Coccinellidae), Ballyogan**

This ladybird has been found at several sites in central Ireland and is not the extreme rarity it once was considered. This is most likely due to increased recording effort and a greater understanding of its natural history and ecology, but may also reflect a genuine increase. The species was considered very rare in Great Britain or, perhaps even extinct, but several populations have been discovered in recent years. An adult was swept from the mire at Ballyogan in October. Most Irish records have been from wetlands. This association with wetlands is not apparent on continental Europe.

***Ilyobates propinquus* (Family Staphylinidae), Slieve Carran**

New to Ireland. The genus to which this species belongs, *Ilyobates*, is exceptionally rare in Ireland and appears to have declined sharply in recent decades. *Ilyobates nigricollis,* heretofore the only Irish species, was recorded widely (11 sites) in the 19th and early 20th centuries. Post–1970 the only records for *Ilyobates nigricollis* are from Pollardstown Fen, Co. Kildare and the dune heath at Murlough National Nature Reserve, Co. Down. In this context, the capture of a single female of *Ilyobates propinquus* by pitfall at Slieve Carran, 7 July, seems significant. The ecology of both species is obscure. *Ilyobates nigricollis* is provisional Red Data Book (RDBK) in Britain and *I. propinquus* Notable B but the latter species has only one-third of the number of records of *nigricollis* and is more closely restricted to south-east Britain.

***Laccornis oblongus* (Family Dytiscidae), Ballyogan**

This is a species of calcareous fens and is classified as Near Threatened on the Irish and British Red Lists. The British sites in which it occurs are relict wetlands, whereas in Ireland it is found also in tussocky, often degraded, fens. A single specimen was caught in a Malaise trap at Ballyogan Loughs on 7 July 2018. This is of note as the species was found not to fly in experiments, though it is assumed at least some individuals are capable of flight.

***Philonthus corvinus* (Family Staphylinidae), Ballyogan**

This species occurs widely in fen habitats in Ireland whereas in Great Britain it is rare and recorded mainly from poor fen and *Sphagnum* bog. A total of six specimens was found, one by pitfall trap and the rest by sieving moss at the margins of a marl lake at Ballyogan on 11 and 12 August.

***Philonthus furcifer* (Family Staphylinidae), Ballyogan**

Though widespread in Ireland this species is absent from Britain which is the main reason for its inclusion in the present section. It has been recorded in most parts of Ireland, but principally in wetland sites in the north-east and south-west. There are now some forty records overall. A single specimen was taken by pitfall trap at Ballyogan Loughs on 7 July.

***Pterostichus aterrimus* (Family Carabidae), Ballyogan**

Habitat data suggest that this is an extremely hygrophilous species, confined to particular kinds of wet humic soils in eutrophic or mesotrophic fens. There are no records for raised or blanket (ombrotrophic) bogs, except where peat-cutting has brought about the regeneration of fen conditions. It is categorised as Critically Endangered in Great Britain and may even be extinct. In Ireland, most of records are from surveys of fens in Co. Fermanagh, Co. Armagh and Co. Down. There are scattered records across a wider area, but the species is extremely local and rather rare.

***Staphylinus dimidiaticornis* (Family Staphylinidae), Slieve Carran**

Formerly present in fenny lake margins of northern counties, but it has not been recorded from there for over 30 years. There are, however, a number of recent records for southern counties. Regarded as local in Britain. Its congener *S. erythropterus* remains widespread in Ireland especially in transition mires and other wetland habitats in the midlands and north. A single specimen of *S. dimidiaticornis* was identified in pitfall catches at Slieve Carran among numerous *S. erythropterus*.

***Stenus fornicatus* (Family Staphylinidae), Ballyogan**

Distinctly rare and southern in Britain and in Ireland it is a very local beetle of high-quality fen habitats and recorded infrequently.

***Tachyusa umbratica* (Family Staphylinidae), Ballyogan**

Recorded from a very few scattered localities in Britain. Known in Ireland mainly from the sandy shorelines of Lough Neagh where it is not uncommon. Also recorded from a sandy stream bank at Colebrooke Park, Co. Fermanagh. The habitat in which it was found at Ballyogan is surprising in this context – it was found by sieving moss in a *Cladium* fen. This is a new county record for Co. Clare.

3.1.3 Crustacea, Isopoda (woodlice & relatives)

***Philoscia affinis* (Family Philosciidae), Ballyogan and Slieve Carran**

Philoscia affinis is a segregate of the well-known Striped Woodlouse *Philoscia muscorum* and has been known in central and southern Europe since the early 20th century. Information on the species in Britain and Ireland is published in Segers *et al.* (2018), Anderson (2019) and Gregory (2020). The presence of this species in Great Britain was first confirmed in south-east England in summer 2017 and it has been clearly been over-looked. Recording has shown that it occurs widely and as far north as western Scotland. Similarly, it has been overlooked in Ireland and has been found in at least eight sites in a variety of habitats including mires, heaths and woodland. The specimens collected in pitfall traps are the first for the Burren.

3.1.4 Diptera (two-winged flies)

The Diptera is the most species-rich order of Irish insects with over 3,300 species on the Irish list. Nevertheless many families are poorly recorded and distributions little understood. Accounts for the notable species draw on personal expertise and experience of the authors and species experts, and in particular Peter Chandler, and the atlases, reviews, keys and identification manuals of the British Diptera including Belshaw (1993), Falk (1991), Falk (2005), Falk *et al.* (2016) and Falk & Pont (2017). Species accounts of the Irish hoverflies are provided on the All-Ireland Pollinator Plan website (Speight, 2017).

***Boletina bidenticulata* (Family Mycetophilidae), Slieve Carran**

New to Ireland. One male was identified at Slieve Carran from the Malaise trap sample emptied on 7 July. The species is widespread in Britain, with most records from woodland in the south and south-west. Little is known about the biology of this fly, but other species of the genus have been reared from rotten wood or in association with mosses and liverworts.

***Cheilosia ahenea* (Family Syrphidae), Ballyogan & Slieve Carran**

Red Listed as Vulnerable in Great Britain. This species was found at rest on stones on limestone pavement at Ballyogan on both 22 May and 2 June, and at Slieve Carran on 5 May using a sweep net on sparse vegetation on limestone pavement. In Ireland it is known from the Burren and areas of machair and limestone grassland in the west, from Co. Clare to Co. Donegal. There is just a single British record from sand dunes on Islay in the Inner Hebrides. The plant used by the larvae is still not known but this species is easily eradicated from natural grassland sites.

***Diogma glabrata* (Family Cylindrotomidae), Slieve Carran**

Diogma glabrata has a Notable designation in Britain. One male was identified from one of the samples from a flight interception trap at Slieve Carran. It is widespread in Britain, though restricted by its preferred habitat of mosses in limestone woodland. It has been recorded elsewhere in Ireland from sites in Co. Armagh, Co. Waterford and Co. Wicklow.

***Fannia aequilineata* (Family Fanniidae), Ballyogan**

Two males were identified from samples from the flight interception trap at Ballyogan, one in the sample emptied on 11 August, and one in the sample emptied on 7 September. There have been scattered records across Ireland in Co. Antrim, Co. Clare, Co. Cork and Co. Derry. Recent records are from old woodland sites and it is described as a species of ancient woodland in Britain, where it may be found in a variety of micro-habitats including rotten wood, fungi, bird's nests and small mammal burrows. Females are attracted to sap runs especially caused by Goat Moth *Cossus cossus*. It has a provisional Nationally Scarce designation in Great Britain.

***Helina abdominalis* (Family Muscidae), Ballyogan**

One female was identified in the sample emptied on 11 August from the flight interception trap at Ballyogan. *Helina abdominalis* has a provisional Nationally Scarce designation in Great Britain. The few Irish records are from old woodland sites in Co. Down and Co. Fermanagh so this is a first record from Co. Clare. In Britain it is locally common in damp woodland, recorded sparsely throughout England and in south Wales. The biology of *H. abdominalis* is unknown but related species have predatory larvae living in moss and wet soil.

***Homoneura tesquae* (Family Lauxaniidae), Ballyogan**

One female was caught by the Malaise trap at Ballyogan and found in the sample emptied on 7 July. *Homoneura tesquae* was recorded new to Ireland in 2002 from sites in Co. Laois and Co. Wexford. It is widespread in southern England and Wales. It has a provisional Nationally Scarce designation in Britain. Lauxaniid flies are saprophagous, the larvae feeding on decaying plants. Species are most commonly associated with wet and shaded habitats.

***Hydrotaea velutina* (Family Muscidae), Slieve Carran**

New to Ireland. One male was found in the sample emptied on 7 July from the flight interception trap placed near the Malaise trap at Slieve Carran. *Hydrotaea velutina* is categorised as provisionally Vulnerable in Great Britain. It is a rare species with all records near the west coast of England and Wales. The larvae live in cow- or horse dung, where they are predaceous on other dipterous larvae. The species occurs in grassland adjacent to broad-leaved woodland and it is thought to require high summer temperatures. Females visit large mammals such as cows and humans to feed on sweat.

***Limonia trivittata* (Family Limoniidae), Slieve Carran**

A male and female were identified in the Slieve Carran Malaise trap sample emptied on 7 July and a female in the sample emptied from the same trap on 10 August. This is a species of limestone woodland and there may be an association with Butterbur *Petasites hybridus*. It currently has a Notable designation in Great Britain but with records from more than 100 post 1990 hectads, it no longer justifies this status. There are records from seven counties in Ireland.

***Macronychia polyodon* (Family Sarcophagidae), Slieve Carran**

One male was identified from a sample that was emptied on 10 August from the flight interception trap placed the old church at Slieve Carran. The species was first recorded in Ireland from a specimen reared from a puparium found at Golden Grove, Co. Offaly. It is widespread in Great Britain but with relatively few recent records and it has a provisional Nationally Scarce designation.

***Mallochohelea munda* (Family Ceratopogonidae), Ballyogan**

New to Ireland. One female was identified in the Malaise trap sample at Ballyogan emptied on 7 July. It is a little recorded species, with records from wetlands in eastern England. Larvae of this genus develop in standing water. Adults are predators of other small flying insects.

***Manota unifurcata* (Family Mycetophilidae), Slieve Carran**

New to Ireland. One female was identified from a flight interception trap sample from Slieve Carran. It is designated as Nationally Scarce in Great Britain but it is perhaps spreading there. Prior to 2011 it had a scattered distribution in southern England and South Wales but it has since been recorded at a dozen additional sites further north in both England and Wales. Larvae have been found in decayed birch wood bearing unidentified greyish white fungal growth and it has been reared from rotten wood bearing a myxomycete.

***Microdon mutabilis* (Family Syrphidae), Ballyogan & Slieve Carran**

Microdon mutabilis is an obligate ant-associate and the larvae can be found by turning stones covering ant nests. The larvae are thought to be predators of the ant larvae and eggs. It is uncommon in Ireland but with many records from the Burren which appears to be a major stronghold of the species.

***Molophilus lackschewitzianus* (Family Limoniidae), Slieve Carran**

One male was identified from a flight interception trap sample from Slieve Carran. The species is local but widespread in Great Britain in calcareous woodland. The only published Irish record is one from Glencar, Co. Leitrim.

***Mycetophila gibbula* (Family Mycetophilidae), Slieve Carran**

New to Ireland. One male was identified from a flight interception trap sample at Slieve Carran emptied on 10 August and a female was caught in the same trap in the sample emptied on 8 September. This is a widespread and fairly common species throughout Great Britain. The biology of this species is unknown. *Mycetophila gibbula* belongs to the *M. vittipes* group, which includes *M. vittipes* itself that develops in myxomycetes and *M. abiecta* which has been reared from a moss-covered willow trunk in Finland.

***Mydaea anicula* (Family Muscidae), Ballyogan & Slieve Carran**

Females of this species were identified from both sites in samples from flight interception traps. *Mydaea anicula* is widely distributed and has a provisional Nationally Scarce designation in Great Britain. Previous Irish records come from Belfast and the shore of Lough Derg in Co. Clare. The biology of this species is unknown, but other members of the genus having predaceous larvae in either dung or fungi.

***Nemorilla floralis* (Family Tachinidae), Ballyogan**

One specimen was collected from species-rich grassland at Ballyogan on 7 September. This is widespread and common parasitic fly in England and Wales. However, the Tachinidae are poorly recorded in Ireland (just 66 of the 267 British species have been previously recorded in Ireland), and it is not unusual for species common in Britain to be absent. *Nemorilla floralis* is a parasitoid of caterpillars, mainly of the micro-lepidoptera, that feed on herbaceous plants especially thistles *Cirsium* spp. and nettles *Urtica* spp.

***Palpomyia quadrispinosa* (Family Ceratopogonidae), Ballyogan**

New to Ireland. One female was found in the Malaise trap sample at Ballyogan emptied on 7 July. The species is widespread in Great Britain. The family is however poorly recorded. Larvae of this genus develop in standing water and adults are predators of other small flying insects.

***Paragus constrictus* (Family Syrphidae), Ballyogan**

This small hoverfly was swept from limestone pavement at Ballyogan on 7 and 9 September (four specimens on each occasion). The species is absent from Great Britain and in Ireland it is only known from limestone pavement in the Burren. The species has been confused with *Paragus tibialis*.

***Pegomya meridiana* (Family Anthomyiidae), Ballyogan**

New to Ireland. One male was obtained in the Malaise trap sample from Ballyogan emptied on 7 July. It is widespread in Great Britain, with most records from southern England and Wales. The larvae develop in the seed capsules of species of St. John's wort *Hypericum* spp.

***Pherbellia rozkosnyi* (Family Sciomyzidae), Slieve Carran**

One male was identified from one of the flight interception traps Slieve Carran. The species was added to the Irish list in 2007 from Riverstick, Co. Cork. It is a little-known species first recorded in Great Britain from Devon and with specimens subsequently from Suffolk and Durham.

***Phyllomyza rubricornis* (Family Milichiidae), Ballyogan & Slieve Carran**

New to Ireland. A male was caught by the flight interception trap at Ballyogan and many specimens were identified from the samples from the flight interception traps that operated at Slieve Carran. This species is widely distributed in England and Wales, with records from woodland and dunes. There is a relatively low level of recording of this family in Ireland and only the commonest species of this genus (which has eight British species), *P. securicornis* has previously been recorded in Ireland. The biology is unknown. Other species of this genus are associated with ant nests and that may be the case with this species too.

***Potamia littoralis* (Family Muscidae), Ballyogan**

New to Ireland. One male was identified from a sample from the flight interception trap operated at Ballyogan and emptied on 11 August. The species is widespread and locally common in England and Wales. Adults occur on tree trunks. Larvae are predators living under bark and in bird and mammal nests, with records also from dung and stinkhorn fungus *Phallus* spp.

***Protocalliphora azurea* (Family Calliphoridae), Ballyogan**

New to Ireland. One specimen was recorded at Ballyogan on 2 June, taken by sweeping in species-rich grassland. It is widespread throughout Great Britain, so perhaps surprising that it has not been recorded in Ireland previously. The larvae live in bird nests where they feed on the blood of the nestlings.

***Sarcophaga discifera* (Family Sarcophagidae), Slieve Carran**

A male was found in a pitfall trap emptied on 7 July at Slieve Carran. This species is not found in Britain and in Ireland is almost entirely confined to the Burren. As it is widespread in Western Europe, there is no obvious reason why it should be so restricted in the British Isles. The larvae are parasitoids of snails.

***Sceptonia flavipuncta* (Family Mycetophilidae), Ballyogan**

New to Ireland. One female was identified from a flight interception trap operated at Ballyogan and emptied on 11 August. This species has a Nationally Scarce designation in Great Britain although it is widespread in the south of England and south of Wales, and there has been a recent increase in records. Adults occur on tree foliage and they have been reared from the terrestrial agaric *Rhodocybe gemina*.

***Speolepta leptogaster* (Family Mycetophilidae), Slieve Carran**

One male was found in the Malaise trap sample from Slieve Carran. This species is a common inhabitant of caves but is only occasionally found by sweeping or trapping and mainly in woodland. It is likely that the larval habitat is in crevices in limestone pavement. There are a number of records from the Burren during a 1991 survey of the Burren grikes. The only other Irish records are from Killarney district, Co. Kerry.

***Stilpon nubilus* (Family Hybotidae), Ballyogan**

Two males were caught in a pitfall trap emptied on 7 September from the bog at Ballyogan. This is a tiny short-winged species that lives among sedge tussocks. This confirms this species on the Irish list. Earlier records are uncertain as the species has been confused with another longer-winged species later described as *Stilpon subnubilus*. Both species have been listed as Irish due to this confusion and for the same reason no designation was applied to either species in Britain.

3.1.5 Hemiptera (true bugs and relatives)

Species accounts for the Hemiptera are based on publications of O'Connor *et al*. (2013), Savage (1989), Southwood & Leston (1959) and Szita *et al.* (2015), as well as the personal knowledge of authors and species experts, and reliable websites.

***Arctorthezia cataphracta* Alpine Ensign Scale (Family Ortheziidae), Ballyogan**

A single adult specimen of this ensign scale was taken in a suction sample from the calcareous heath at Ballyogan. These insects live in moist habitats and feed on plant roots and fungi. Ensign scales are considered one of the most primitive types of insects. This species is associated with many low growing herbaceous plants, mosses and trees. Perhaps significantly this includes *Dryas octopetala.* Like *Dryas*, the distribution of *Arctorthezia cataphracta* extends to the high Arctic. *Arctorthezia cataphracta* is listed from eight Irish counties and this is the first record from Co. Clare.

***Calocoris roseomaculatus* (Family Miridae), Ballyogan & Slieve Carran**

Calocoris roseomaculatus is a very attractively-marked mirid bug associated with dry flower-rich grassland. The species occurs throughout Ireland but it is very local and it is perhaps only in the Burren that it can be considered common. It is likely to have declined with losses of semi-natural grassland. The adults feed on species of composites, and are often seen on flowers of Ox-eye Daisy *Leucanthemum vulgare,* for example, but the larvae are associated with leguminous species such as Bird's-foot Trefoil *Lotus corniculatus*. The species was frequent at both sites.

***Drymus pilicornis* (Family Lygaeidae), Ballyogan & Slieve Carran**

Drymus pilicornis is a rare species found mainly on mossy calcareous grassland where it lives amongst mosses and low vegetation. Lygaeid bugs are generally seed-eating insects. In Ireland, *D. pilicornis* is confined to the Burren with just three previous records. It has a Nationally Scarce designation in Britain where it is locally found across southern England and Wales.

***Glaenocorisa propinqua* (Family Corixidae), Ballyogan**

This aquatic species is singled out as notable not because of its rarity, as it is reasonably widespread in Ireland, but because it is a glacial relict species normally found in deep upland lakes rather than in lowland lakes. Given that only a single specimen was taken and the fact that most corixids have strong flight capability, it is possible that this specimen came from elsewhere, but this needs to be investigated.

***Hesperocorixa moesta* (Family Corixidae), Ballyogan**

This is one of the rarest Irish corixids and its status and ecology is unclear. It occurs in less acid sites than the similar *Hesperocorixa castanea,* which was also recorded from Ballyogan. The small number of Irish records of *H. moesta* have been from a diversity of sites including artificial ponds, flooded quarries and a natural lake. This is the second record from Co. Clare, the previous being in 1960.

***Scolopostethus puberulus* (Family Lygaeidae), Ballyogan**

Scolopostethus puberulus is a fen specialist and most records have been made with a pond net. Previous Irish records are mainly from the inter-drumlin fens across the southern counties of Ulster. There is a single historic record from Curracloe in Co. Wexford dating to 1937. This record from Ballyogan is the

first from Co. Clare and represents a significant range extension in Ireland for this scarce species. The specimen came from a typical situation in saturated mosses in the *Cladium* fen.

***Zicrona caerulea* Blue Shieldbug (Family Pentatomidae), Ballyogan**

Zicrona caerulea is widespread throughout Britain but is much less frequent in Ireland where it is associated with the margins of good quality fen habitats. It is predatory on various leaf beetles (Family Chrysomelidae), notably the flea beetles (*Altica* species).

3.1.6 Hymenoptera, Aculeata (bees, ants & wasps)

The species accounts below are derived from reliable online sources and Fitzpatrick *et al.* (2006).

***Bombus lapidarius* Red-tailed Bumblebee (Family Apidae), Ballyogan & Slieve Carran**

This is Red Listed as Near Threatened in Ireland due to a decline in its population and range. This is a species of dry, open habitats which constructs its nests in the ground, especially under stones.

***Bombus muscorum* Moss Carder Bumblebee (Family Apidae), Ballyogan & Slieve Carran**

Red Listed as Near Threatened in Ireland based on a significant decline due to habitat loss. Similar declines are occurring across Great Britain and much of Europe. This is a species of high quality habitats. It is often found on quite wet sites but also on dunes and calcareous grasslands.

***Bombus sylvarum* Shrill Carder Bumblebee (Family Apidae), Ballyogan & Slieve Carran**

Formerly a common species of extensive flower-rich grasslands, now much declined in both Britain and Ireland. It was assessed as Vulnerable on the Irish Red List. While the Burren populations remain reasonably strong, the species appears to be still declining across the rest of its Irish range.

***Chrysis vanlithi* (Family Chrysididae), Slieve Carran**

Chrysis vanlithi is the correct name for this species which was previously called *C. rutiliventris*. It is a cuckoo species, the females laying eggs in the nest of a solitary wasp in genus *Ancistrocerus*. These wasps construct nests with a covering of mud, well-camouflaged on surface of a rock. Species of *Chrysis* are not well-recorded in Ireland, and uncertainty over their identification and the statuses of the species has not aided their study. Specimens of *vanlithi* are known from Co. Armagh, Co. Clare and Co. Down. The likely host species *A. oviventris* and *A. scoticus* are widespread in Ireland though largely coastal.

3.1.7 Lepidoptera (butterflies & moths)

Whilst the Lepidoptera was not a specific target group for the project, several records of notable species were nonetheless made. The data set includes species records provided by Mel Bellingham and Huw John who were coincidentally moth trapping at Slieve Carran in June 2018. We are grateful to them for providing their data and for permission to include it in this study. Comments on moth distribution and flight period are based on the maps and phenological charts shown on the MothsIreland website (www.mothsireland.com; map version of 10 December 2015) and Randle *et al.* (2019) which had a cut-off date of 31 December 2016. Ecological and other information on the moths comes from Waring & Townsend (2017) and Sterling & Parsons (2012). Information on the ecology, distribution and trends of the butterflies of Britain and Ireland is from Asher *et al*., 2001, Fox *et al.* (2010), Harding (2008), Nash *et al.* (2012) and Thomas & Lewington (2014). The Irish Red List assessment for butterflies is in Regan *et al.* (2010b) and the macro-moths in Allen *et al.* (2016). There has not been a Red List assessment of the Irish micro-moth species.

***Agrotis puta* Shuttle-shaped Dart (Family Noctuidae), Slieve Carran**

This species is common in southern Britain and increasing and spreading in the north of England and Scotland. It is very rare in Ireland and the records have been considered migrants, perhaps the fore-runners of colonisation given the increasing trend in Britain. This is the first record from Co. Clare and it seems most likely that this western specimen was a migrant. There remains, however, a small possibility, as with several other Lepidoptera, that there is an outlying isolated population of this species in the Burren. Further records would be needed to confirm this.

***Anania funebris* White-spotted Sable Moth (Family Crambidae), Slieve Carran**

Anania funebris is day-flying micro-moth with a restricted western and south-western distribution in Ireland. It is mainly known from the Burren and limestone areas of Co. Galway. The larva feeds on the leaves and flowers of Goldenrod *Solidago virgaurea*. *Anania funebris* is considered to be declining in Great Britain.

***Argynnis aglaja* Dark-green Fritillary (Family Nymphalidae), Ballyogan & Slieve Carran**

This large butterfly is found in coastal heath and dunes. Inland sites are much less common and many have been lost so it was assessed as Vulnerable on the Irish butterfly Red List.

***Boloria euphrosyne* Pearl-bordered Fritillary (Family Nymphalidae), Ballyogan & Slieve Carran**

Pearl-bordered Fritillary is a spring-flying butterfly of woodland clearings and woodland edge. It requires abundant Common Dog-violet *Viola riviniana* and a warm, dry micro-climate. In Ireland, it is restricted to the Burren in Co. Clare and adjacent areas of south Co. Galway. The species has undergone a significant decline in Great Britain and may also have declined in parts of the western Burren. It is Endangered on the Irish butterfly Red List. Maintaining a suitable scrub/grassland mosaic and appropriate sward height by grazing are crucial to the future survival of this species.

***Calamia tridens* Burren Green (Family Noctuidae), Ballyogan**

The Burren Green is a Burren-speciality: the Burren is the only place in Britain and Ireland in which it is found. Its foodplant is Blue-moor Grass *Sesleria caerulea*. The moth was only discovered in Ireland in 1950, which is surprising given its relative abundance and striking appearance. It was assessed as Least Concern on the Irish larger moth Red List.

***Coenonympha pamphilus* Small Heath (Family Nymphalidae), Ballyogan & Slieve Carran**

Small Heath is a widespread grassland butterfly that is most abundant in well-drained habitats that have a short and sparse sward with fine grasses. Agricultural intensification and loss of low nutrient grassland has meant that, while the species is still widespread, its abundance has reduced significantly across Britain and Ireland. Because of this reduction in abundance, the assessment was Near Threatened on the Irish butterfly Red List.

***Cupido minimus* Small Blue (Family Lycaenidae), Ballyogan & Slieve Carran**

The Small Blue has a scattered distribution on dry habitats with sparse vegetation that support good populations of its only foodplant, Kidney Vetch *Anthyllis vulneraria*. In Ireland, its distribution is very local, mainly coastal with a few inland populations. Suitable habitat is early successional and contains a mix of areas with a short sward and shelter provided by patches of taller vegetation and scrub. The future of the species in the Burren seems more secure than perhaps it is at many other of its Irish locations. The grazing regime at both sites should continue to provide suitable habitat in the long term. Red listed as Endangered in Ireland.

***Epirrhoe tristata* Small Argent and Sable (Family Geometridae), Ballyogan & Slieve Carran**

Small Argent and Sable is largely restricted to the Burren and Wicklow Mountains. It is found in heath and grassland habitat with its foodplant Heath Bedstraw *Galium saxatile.* Decline in its range and a reduction in the number of known sites mean it was assessed as Vulnerable on the Irish Red List.

***Eriogaster lanestris* Small Eggar (Family Lasiocampidae), Slieve Carran**

The Burren and south Co. Galway are important areas for the conservation of Small Eggar in Ireland. It is much more local elsewhere, though some large populations exist such as at Magilligan in Co. Derry/Londonderry. The adult moths appear in late winter and early spring (February/March) and do not feed and they also are rarely seen at light. The females lay batches of eggs on Blackthorn *Prunus spinosa* and Hawthorn *Crataegus monogyna* and the caterpillars live within a dense silken tent that they spin over the outer branches of the foodplant (Figure 8). This web can be conspicuous in mid-summer but care must be taken not to confuse it with other species that spin similar silken structures. As the adults are relatively immobile, habitat fragmentation can rapidly cause local extinctions. The species is easily lost from sites by excessive flailing of hedgerows and removal of scubby margins. Small Eggar was assessed as Near Threatened on the Irish larger moth Red List. A single larval web was found at Slieve Carran during this survey (Figure 8).

Figure 8 Larval tent of Small Eggar *Eriogaster lanestris* on Blackthorn at Slieve Carran.

***Erynnis tages* Dingy Skipper (Family Hesperiidae), Ballyogan & Slieve Carran**

The Dingy Skipper is Near Threatened on the Irish butterfly Red List. The species requires a sparse sward on an open sunny habitat and the presence of the foodplant Bird's-foot Trefoil *Lotus corniculatus*. Colonies can be found on calcareous grassland, sand dunes, abandoned quarries and cutaway bogs. The bulk of the Irish population is centred on the Burren and surrounding districts, but other significant populations are found in Co. Mayo, Co. Sligo and Co. Fermanagh. Like many habitat specialists, the species is declining through loss of habitat.

***Euphydryas aurinia* Marsh Fritillary (Family Nymphalidae), Ballyogan**

Marsh Fritillary was once widespread across Great Britain and Ireland but has undergone a significant decline in range across both islands. Consequently it was assessed as Near Threatened on the Irish butterfly Red List. It is also listed on Annex II of the Habitats Directive and the butterfly is a Qualifying Interest for the East Burren Complex SAC, of which Slieve Carran is a part. Adult butterflies were seen over-flying Ballyogan Lough in June, and breeding was confirmed when several larval webs were found in September. This is the first record of the species from this property and Ballyogan Lough SAC. More records are needed to determine whether there is a viable population at Ballyogan or whether it is part of a metapopulation in the wider wetland complex. Appropriate management of the habitat is needed to bring as much as possible into good condition including grazing and scrub control.

***Hipparchia semele* Grayling (Family Nymphalidae), Ballyogan & Slieve Carran**

The Grayling is a thermophilic butterfly that is found especially in sparsely vegetated areas such as the limestone pavement areas on both sites. 2018 would appear to have been an exceptional year in the Burren for the species. High summer temperatures coincided with the adult flight period and several thousands of adults were estimated to be present across Slieve Carran in July with smaller numbers at Ballyogan. The Grayling's range is mainly coastal and upland in Ireland. There are decreasing numbers of inland, lowland colonies, which is one reason it was Red Listed as Near Threatened in Ireland. The trends in its habitats are largely negative and this is considered to have caused a long-term decline. Nevertheless, the Burren population remains strong and it is named as a distinct subspecies *clarensis*.

***Lasiommata megera* Wall Brown (Family Nymphalidae), Slieve Carran**

Wall Brown was formerly a common species in much of Ireland but due to significant declines in range it is Endangered on the Irish butterfly Red List. It has somewhat similar habitat requirements to the Small Heath and Grayling, all preferring short sparse grassland with bare patches for basking. Many inland populations have been lost in recent decades through habitat loss due to enrichment and it has disappeared entirely from Northern Ireland. The Burren remains a stronghold for the species.

***Leptidea sinapis* Wood White (Family Pieridae) Ballyogan & Slieve Carran**

There are two species of *Leptidea* in Ireland, *sinapis* and *juvernica*, that are indistinguishable from each other in the field and identification requires dissection. The two are, however, ecologically distinct, as well as having separate ranges: *Leptidea sinapis* is confined to the limestone pavement and calcareous grassland in the Burren and Lough Corrib karst, whereas *L. juvernica* is found throughout the rest of Ireland. A male from Ballyogan was dissected and found to be the expected species *sinapis*. This is a Near Threatened species in Ireland. Earlier work on specimens from Slieve Carran showed that the species present is *sinapis.*

***Merrifieldia leucodactyla* Thyme Plume (Family Pterophoridae), Slieve Carran**

Thyme Plume is a rare, day-flying micro-moth in Ireland dependant on Wild Thyme *Thymus polytrichus* as a foodplant. It is known from the Burren and the Corrib/Mask area of Co. Galway and Co. Mayo. The moth is more widespread in Great Britain, occupying mainly coastal sites. Given the historic and ongoing loss of old semi-natural grassland supporting significant areas of Wild Thyme, it is highly likely to merit inclusion on a Red List. Habitat loss is one factor that is driving decline, but changes in climate may also be leading to a failed second brood which appears to be adversely affecting the viability of this species. Continuation of low-intensity cattle grazing, and avoidance of intensification are key to the long-term prospects of the species.

***Paratalanta pandalis* Bordered Pearl (Family Crambidae), Slieve Carran**

Bordered Pearl is another micro-moth with the bulk of its Irish population confined to the Burren and south Co. Galway region. The foodplants include Goldenrod *Solidago virgaurea*, Wood Sage *Teucrium*

scorodonia and Wild Marjoram *Origanum vulgare*. It is likely to require the warm micro-climate that exists around with outcrops of stone. It has a Nationally Rare designation in Great Britain.

***Photedes captiuncula* Least Minor (Family Noctuidae), Ballyogan**

Least Minor is essentially restricted in Ireland to the Burren and the population is named as subspecies *tincta*. The species is also restricted to limestone pavement areas in Britain. The foodplants are Glaucous Sedge *Carex flacca* and Blue Moor-grass *Sesleria caerulea.* Although it has a restricted range, the species was assessed as Least Concern in the moth Red List as there is no evidence of any decline.

***Phytometra viridiaria* Small Purple-barred (Family Noctuidae), Ballyogan**

This small noctuid is a day-flying inhabitant of unimproved grassland, heaths and sand dunes. The species has always been very local in Ireland and is increasingly restricted to areas like the Burren. It was assessed as Near Threatened on the Irish Red List. The larvae feed on species of milkwort *Polygala.*

***Platyptilia tesseradactyla* Irish Plume (Family Pterophoridae), Slieve Carran**

This micro-moth species is one of the small number of invertebrates that are found in Ireland but not Great Britain. Several were seen flying over short, species-rich calcareous grassland at Slieve Carran. Irish Plume is found in short, calcareous grassland in the Burren and in Co. Fermanagh and Co. Tyrone in N. Ireland. The foodplant is Mountain Everlasting *Antennaria dioica*. The moth is widespread across northern Europe but is considered very sensitive to habitat loss due to agricultural improvement and may merit Red-listing in Ireland for that reason.

***Pyrausta sanguinalis* Scarce Crimson and Gold (Family Crambidae), Slieve Carran**

Scarce Crimson and Gold (Figure 9) is a small but very attractive day-flying micro-moth that feeds on *Thymus* species and flies for a narrow window of approximately two weeks in June. This species has contracted dramatically in range due to habitat loss. The species is now extinct in Great Britain and is likely to merit Red Listing in Ireland. The range in Ireland is very local, and it is essentially confined to the Burren and north coast of Co. Londonderry.

Figure 9 *Pyrausta sanguinalis* Scarce Crimson and Gold on Kidney Vetch *Anthyllis vulneraria.*

***Setina irrorella* Dew Moth (Family Arctiidae), Ballyogan & Slieve Carran**

Dew Moth is a species of rocky coasts and rocky grassland with a very disjunct and probably declining distribution in Britain and Ireland. In Ireland, it is essentially confined to the limestone regions in the Burren, around Lough Corrib and on the Aran Islands. The Burren undoubtedly holds a significant proportion of the Irish population of this species. The larvae feed on lichens on bare rocks. Males fly by day.

***Thecla betulae* Brown Hairstreak (Family Lycaenidae), Ballyogan**

A single specimen of Brown Hairstreak was recorded at Ballyogan in September 2018 and several adults were seen in August 2020 in a suitable area of Blackthorn *Prunus spinosa* scrub. The caterpillar feeds only on Blackthorn, the females selecting the outer growth of the plant, where one-year old wood emerges from two-year old wood, to lay a single egg at the base of a thorn. The eggs are laid in late summer and they remain on the plant over the winter so can easily be found with diligent searching of Blackthorn bushes. Because of the position of the eggs, it is essential that Blackthorn is not cleared, flailed or otherwise managed so as to remove the new growth. Although the species is relatively restricted in range in Ireland, the assessment was of Least Concern on the Irish butterfly Red List as there was no evidence of a decline. The Burren and south Co. Galway area is the stronghold for this species in Ireland and holds most of the population.

***Zygaena purpuralis* Transparent Burnet (Family Zygaenidae), Ballyogan & Slieve Carran**

Transparent Burnet is a day-flying moth restricted within Ireland to the western limestone region from north Co. Limerick to south Co. Mayo. The Irish population of the species is considered an endemic subspecies *sabulosa* and the species is common in the Burren on the calcareous grassland and pavement containing its foodplant Wild Thyme *Thymus polytrichus*. The peak of the adult flight period is in June. The British populations are classified as different subspecies and only the western Scotland one – *caledonensis* – is extant.

3.1.8 Mollusca (snails & slugs)

The species accounts for the Mollusca are based on the expert knowledge of Roy Anderson, information in the Red List by Byrne *et al.* (2009) and reliable websites especially Anderson (2016).

***Acanthinula aculeata* Prickly Snail (Family Valloniidae), Slieve Carran**

This species has shown a large decline especially in the south and east of its range. It is found in woodland edge and hedgerows, generally in dry sites. Assessed as Near Threatened on the Irish Red List.

***Balea perversa* (Family Clausiliidae), Slieve Carran**

The widespread European wall snail *Balea perversa* is now known to comprise two closely allied species, *Balea perversa sensu stricto* and *Balea sarsii* (= *Balea heydeni*). The former occurs across Europe and has been the subject of most descriptions in the literature. The latter is smaller and lacks the parietal tooth typical of most populations of *perversa*. Most of the material so far examined in Irish collections is referable to *sarsii,* and *perversa* is seen as very local and fairly rare in Ireland. It is primarily a rupestral, calcicole species found on limestone rocks and walls whereas *sarsii* is less associated with alkaline rocks and more with trees *i.e.* on less base-rich substrates. *Balea perversa* is recorded principally from walls finished with old-fashioned lime mortar or on natural limestone rocks. At Slieve Carran a small colony was found under limestone slabs at St Colman's Church. It is assessed as Vulnerable on the Irish Red List. *Balea sarsii* was common in the Hazel scrub at both Slieve Carran and Ballyogan.

***Helicella itala* (Family Hygromiidae), Ballyogan & Slieve Carran**

This is assessed as Vulnerable on the Irish Red List due to a large decline in inland populations. It is stable on the coast and probably in the Burren. It is a species of warm, dry, open habitats and can easily be lost by improvement and abandonment of grazing.

***Leiostyla anglica* English Chrysalis Snail (Family Lauriidae), Slieve Carran**

This snail is a near-endemic of Britain and Ireland. It is typically found in shaded habitats but also occurs in open situations along the west coast, presumably as it needs areas of high humidity. Individuals live on the ground amongst leaf litter and debris. Although it remains widespread, the species is assessed as Vulnerable on the Irish Red List. In the Burren, it is one species that would benefit from the shaded conditions in scrub.

***Musculium lacustre* Lake Orb Mussel (Family Sphaeriidae), Ballyogan**

This freshwater bivalve is found in temporary wetlands and seasonally flooded sites. It is lost when sites become permanent but it can tolerate poor water quality. The Red List assessment is Vulnerable because the species has declined as wetlands have been drained and modified.

***Vertigo antivertigo* Marsh Whorl Snail (Family Vertiginidae), Slieve Carran**

This is a wetland species found in fens and wet grasslands across Ireland but is declining with loss of habitat. It was assessed as Vulnerable on the Irish Red List.

***Vertigo pygmaea* Common Whorl Snail (Family Vertiginidae), Slieve Carran**

Occurs in calcareous and coastal grasslands. Significant losses have occurred in inland populations and this lead to an assessment of Near Threatened on the Irish Red List.

***Vertigo substriata* Striated Whorl Snail (Family Vertiginidae), Slieve Carran**

Vertigo substriata is found in transition mires and also wet woodland. It was assessed as Near Threatened on the Irish Red List and is declining through loss of wetland habitat, especially across the south and east of Ireland.

3.1.9 Odonata (damselflies & dragonflies)

The account below draws on the expertise and personal knowledge of the authors and experts, Cham *et al*. (2014) and Nelson *et al.* (2011).

***Coenagrion lunulatum* Irish Damselfly (Family Coenagrionidae), Ballyogan**

Coenagrion lunulatum is unique amongst the Irish Odonata in being absent from Great Britain. It is widespread but local in Ireland, occurring in a wide band from Co. Down and Co. Antrim to Co. Clare. Most colonies are found in small lakes and fens. It was discovered in Ireland in 1981, and in the Burren region in 2011. The record at Ballyogan is the most southerly discovered so far in Ireland and its status at the site needs to be assessed. *Coenagrion lunulatum* was assessed as Vulnerable on the Irish Red List.

3.1.10 Orthoptera (grasshoppers & crickets)

The account below draws on the expertise and personal knowledge of the authors and experts, Marshall & Haes (1988), Speight (1999) and Sutton *et al.* (2017).

***Pholidoptera griseoaptera* Dark Bush Cricket (Family Tettigoniidae), Slieve Carran**

This species was first reported from the Burren area in 1998 at Slieve Carran and described as abundant in an area of Hazel woodland. It had previously been recorded from a very few sites in Co. Waterford

and Co. Cork. Two specimens were swept from a hedgerow adjacent to a larger block of high canopy woodland on 10 August 2018. This is a widespread and common species in the southern third of Britain, but like all the Tettigoniidae in Ireland, very localised and usually rare though possibly under-recorded.

3.2 Comments on notable species

The notable species encountered during the survey include a significant number of species which are either rare in Ireland or are highly restricted to the limestone habitats associated with the Burren and south Galway districts. A number of species were also notable by virtue of their presence in Ireland but not in Great Britain.

Table 4 shows the number of notable species found at the two sites by taxonomic group. Most groups are broadly comparable. Slieve Carran shows a greater number of notable Lepidoptera. This is partly attributable to the incorporation of light trapping data into the Slieve Carran data set, thus a greater range of species was sampled, but also to the fact that several day-flying grassland Lepidoptera species were encountered at Slieve Carran but not Ballyogan *i.e.* Scarce Crimson and Gold *Pyrausta sanguinalis*, Thyme Plume *Merrifieldia leucodactyla*, Irish Plume *Platyptilia tesseradactyla* and White-spotted Sable *Anania funebris*.

The disparity in notable Coleoptera and Hemiptera between the two sites appears to be due to the recording of wetland species at Ballyogan especially open water species. The molluscan fauna at Slieve Carran is richer than at Ballyogan and many of the notable species were associated with the woodland.

Table 4 Numbers of notable species recorded at each site by taxonomic group. See Appendix 1 for the full list of notable species and their occurrence in each site.

Taxonomic Group	Overall	Ballyogan	Slieve Carran
Arachnida, Araneae (spiders)	16	10	8
Coleoptera (beetles)	12	9	3
Crustacea, Isopoda (woodlice & relatives)	1	1	1
Diptera (two-winged flies)	27	16	15
Hemiptera (true bugs & relatives)	7	6	2
Hymenoptera, Aculeata (bees, ants & wasps)	4	3	4
Lepidoptera (butterflies and moths)	23	14	17
Mollusca (snails & slugs)	8	2	7
Odonata (damselflies & dragonflies)	1	1	0
Orthoptera (grasshoppers & crickets)	1	0	1
TOTAL	100	62	58

At a habitat level, most of the notable species were recorded from the grassland, scrub and wet habitat components. This emphasises the importance of these open areas and the threat posed by scrub invasion into the grassland and limestone pavement. Fewer notable species were associated with woodland. The reasons for this are unclear but it could be linked to the historic cycles of scrub and woodland removal that have taken place in the Burren (Cabot & Goodwillie, 2018). Stenotopic woodland species may have been lost in these clearance phases and then been unable to recolonize as woodland regrew. In general, woodland species are quite sedentary with poor dispersal powers. The woodland at Slieve Carran, including the field layer under the closed canopy of the Hazel wood, is comparatively poor in plant species which will restrict the number of species of phytophagous invertebrates.

There were a number of notable myrmecophilous (ant-dependant) insect species recorded in the survey including the hoverflies *Microdon mutabilis, Pipizella viduata* and the spiders *Dipoena tristis* and *Evansia merens.* The fly *Phyllomyza rubricornis* is also likely have an ant association although this is not proven. The presence of these myrmecophiles appears a notable feature of the grassland and limestone pavement in the Burren. During fieldwork, ants were generally noted as abundant in the open habitats and they must play a very significant role in the ecology of the Burren habitats.

4 Pantheon analysis

Pantheon is an invertebrate analytical tool developed by Natural England and the Centre for Ecology & Hydrology (Webb *et al.*, 2018) to assist invertebrate nature conservation in England. Pantheon was launched in April 2018 and supersedes the previous ISIS analysis tools. Lists of invertebrates from individual sites can be uploaded into Pantheon. The software then analyses the species lists, and assigns them to a hierarchical structure of biotopes, habitats, resources and traits down to specific assemblage types. The programme will produce quality scores for sites but this was not used in this analysis as they are only applicable to England.

Whilst data sets for sites outside of England can be analysed using Pantheon there are important limitations that must be understood, and caution is needed when interpreting the outputs. The range and abundance of many species are strikingly different between England and Ireland. Many species that are common and widespread in England and so appear to be habitat generalists, have much more restricted distributions in Ireland because of climate and soil conditions. As a corollary wetland species can be more general in Ireland than in England and found in habitats that in England would appear sub-optimal. Ireland, generally speaking has just over 50% of the species on the British invertebrate lists, depending on the taxonomic group (Regan *et al.*, 2010a). The differences between the insect faunas of Ireland and England can largely be explained by

- Climatic differences (Ireland is wetter and milder in winter and significantly cooler in summer)
- A paucity of dry, well-drained habitats
- Some species did not reach Ireland after the end of the last ice age
- Less biological recording in Ireland means that distributions are less well understood and there are undoubtedly many species still awaiting discovery, especially in the less frequently-recorded groups, and
- Fewer plant species in Ireland compared to Britain restricts not only the number of phytophagous invertebrate species that live on a single plant or a restricted group of plants, but also any other species (*e.g.* parasitoids with a single host) that have a close dependence upon a single phytophagous species absent from Ireland.

Our analysis using Pantheon has been restricted to the Biotope and Habitat outputs from the programme. Biotopes are the top-level divisions of the species into broad ecological groups. The habitat is the second-level of the Pantheon hierarchy. Species may be classified in more than one Biotope and Habitat. We did not include the assemblage quality outputs from Pantheon as there is uncertainty over the applicability of the Great Britain conservation designations in Ireland.

4.1 Discussion of Pantheon results

Appendix 1 shows the Biotope and Habitat associations for each species found in the survey as interpreted by the Pantheon data tables. Table 5 provides a summary of the numbers of species associated with each of the biotopes and Table 6 shows the corresponding numbers of species associated with the habitat categories. It should be noted that a significant proportion of the species in the Pantheon data base have not been associated with any biotope or habitat. These are shown as unclassified in Tables 5 and 6. Pantheon's data tables are based on English data and the programme is recognised as having limited application outside England. This qualification applies especially to the quality scores outputs, which are not referred to here, but also to some extent with the data tables. Species habitat associations may be different in Ireland compared to England and the availability of habitats in both countries also differs. For example, many species that occur inland in England are coastal in Ireland and certain habitats that are common in Ireland are not so in England. There are also some species of invertebrate that are present in Ireland but not in Great Britain and are not included in the Pantheon

data tables. Examples include the flesh fly *Sarcophaga discifera*, the moth *Platyptilia tesseradactyla*, the damselfly *Coenagrion lunulatum* and the hoverfly *Paragus constrictus*. We have been assigned these species to what we consider is the appropriate Biotope and Habitat category so that they could be included in our analysis.

Table 5 Number of invertebrate species categorised in one of the four Pantheon biotopes or are unclassified. The percentage figures given exclude the unclassified species. Species may be categorised in more than one biotope.

Biotope	No of species Ballyogan	% of total	No of species Slieve Carran	% of total
Wetland	242	43%	62	13%
Open Habitats	217	39%	281	58%
Tree-associated	99	18%	139	28%
Coastal	2	<1%	3	<1%
Unclassified	103	–	109	–

Table 6 Number of invertebrate species categorised in one of the four Pantheon habitat categories or are unclassified. The percentage figures given exclude the unclassified species. Species may be categorised in more than one habitat category.

Habitat	No of species Ballyogan	% of total	No of species Slieve Carran	% of total
Arboreal	24	4%	32%	7
Coastal habitats	2	<1%	3%	1
Decaying wood	16	3%	23%	5
Lake	12	2%	1%	<1
Marshland	103	17%	19%	4
Peatland	127	21%	28%	6
Running water	18	3%	14%	3
Shaded woodland floor	68	12%	89%	18
Short sward and bare ground	27	5%	32%	7
Tall sward and scrub	173	29%	224%	46
Upland	9	2%	6%	1
Wet woodland	13	2%	14%	3
Unclassified	127	–	137	–

Broadly the results of the Pantheon analysis reflect what might be intuitively expected from the habitats at the two sites. The greatest number of species recorded at Ballyogan are wetland species (43%), whereas over half the species at Slieve Carran recorded are associated with open habitats. The open habitat at Ballyogan is also a significant element of its fauna but wetland species are relatively scarce at

Slieve Carran. The woodland fauna at Slieve Carran accounts for just over a quarter of the species list but this is perhaps less significant than the extent of the habitat would suggest. The wetland species at Ballyogan are split roughly equally between species of peatland and marshland. The latter species are those found in wet sites on mineral soils. This we interpret as showing the natural complexity of the wet habitats at Ballyogan with conditions ranging over a short distance from acid and ombrotrophic to base-rich and influenced by groundwater. The elevated numbers of wetland species at Ballyogan were balanced at Slieve Carran by significantly higher numbers of species associated with tall sward and scrub, and secondly by higher numbers of species associated with decaying wood and arboreal niches.

The small number of species that Pantheon assigned to lake habitats is somewhat surprising but may be related to the differences between England and Ireland. Lowland lakes are much more common in Ireland. Additionally the lake at Ballyogan is an example of a marl lake, which have highly calcareous, clear and low-nutrient water and which are virtually unrepresented in England. Lakes therefore are perhaps not elevated to an important and distinct habitat for invertebrates in England, whereas they clearly are here.

The vegetation of the lake at Ballyogan is unusual in being dominated by charophytes and having few higher plants. (Figures 11 and 12). It would appear the low nutrient status of these lakes does affects the number of insects and invertebrates present. As a surveyor, one was struck by the difficulty in extracting even small numbers of specimens from this habitat. The exception to this were comparatively large numbers of the water spiders *Argyroneta aquatica*. The presence of these water spiders (which are Irelands' only truly aquatic spider) in good numbers suggests there must be a significant food source, perhaps from insects blown into the lake then trapped on the surface. Pantheon, however, does not associate *Argyroneta aquatica* to the lake habitat.

The Pantheon output includes some mis-association of species with habitats not present on either site. This has arisen as some species are associated in the Pantheon data tables with more than one biotope or habitat. Two examples are *Zygaena purpuralis* and *Chrysis vanlithi* which are linked to both inland and coastal habitats. Some false associations arise due to the differences between Ireland and England and this is exemplified best by *Gammarus duebeni.* In Ireland this is a common species in many types of freshwater (Hynes, 1954) whereas in England it is restricted to brackish habitats and it is only coded to brackish habitat in the Pantheon data table. These examples demonstrates some of the issues in interpreting Pantheon outputs for Ireland and supports our decision to limit the interpretation to just the habitat information.

Figure 10 The lake edge at Ballyogan showing bleached charophytes and the soft marl deposits. Note also the sparse littoral vegetation.

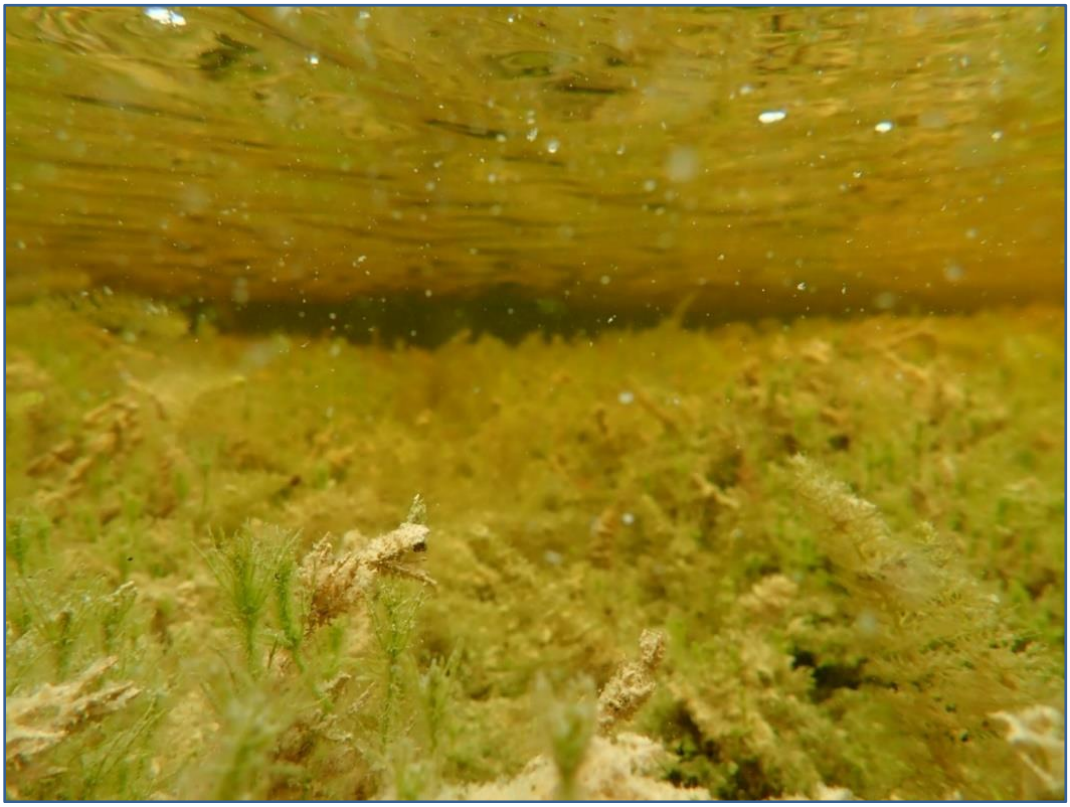

Figure 11 Underwater view of the charophytes in the lake at Ballyogan.

5 Site management for invertebrates

Both sites possess remarkable invertebrate assemblages in an Irish context which are a product of three factors

- The mosaics of vegetation types and variation in physical structure of the sites, including surface outcrops of limestone
- The long history of traditional management, and
- Their siting within a landscape of similar habitats of high conservation quality.

The diversity of invertebrates and the number of notable species found across both sites enable us to conclude that both are in favourable conservation condition. In terms of future management of the sites, there are some considerations that apply to both sites and some that are applicable to just one. We have also identified a number of management measures that are specific to a single species.

5.1 Grazing regime

It is hard to overstate the importance of optimising grazing regimes for grassland sites. Grazing is a balance between grazing pressure, seasonality, species of grazer and whether intensive or extensive. Changing any of these can have profound impacts on the vegetation and also the invertebrate assemblages. Under-grazing results in a dense thatch of dead vegetation that reduces plant species diversity and may present a fire hazard. Over-grazing can also negatively affect species diversity and damage the micro-habitats (*e.g.* tussocks) that some species require. Summer intensive grazing can completely remove floral resources that many insect species require but winter grazing runs the risk of removing over wintering sites in the form of tussocks. However it may create areas of bare ground that are needed by heat-loving and ground-nesting species.

5.1.1 Slieve Carran

We understand that Slieve Carran is grazed under the historical practice of winterage, a system that has been important in the development of the unique flora and fauna of the Burren region. Under the winterage system, cattle are taken to pasture in October and then removed in the spring. Winterage allows unfettered flowering and setting seed of plants during the summer. It also ensures that grasses and other plants are grazed back in the winter, preventing the development of a thatch of dead grass that would smother less competitive plant species.

Management by farmers or land managers and grazing by feral goat herds will help limit the encroachment of scrub. Goats will preferentially browse woody plants and during our visit we observed feral goats grazing Slieve Carran. Whilst goat numbers may need to be managed in the long-term, summer grazing by goats is likely to be beneficial to the invertebrate assemblages. In addition to the benefits of grazing, goat dung will support coprophilous species. The dung of goats is likely an important resource in the summer at a time when cattle (and therefore fresh dung supplies) are absent.

We believe that the grazing regime at Slieve Carran is well managed and is suitable for the species-rich grassland. If not already done, we recommend that the site management plan should include the best available information about the nature of the historic and current grazing regimes. Generally speaking, replicating historic management practices that enabled the communities to develop in the first place will help maintain the site in favourable condition. This should include grazing periods, types and numbers of stock and density in livestock units per hectare (Eurostat, 2019) so that this information is not lost in the future.

5.1.2 Ballyogan

Cattle were present during the summer survey period, and the site appears to receive light summer grazing. We believe the current grazing regime is suitable for maintaining the invertebrate conservation interest of the site. There would be value in recording any information on current and historic grazing regimes in the site management plan as for Slieve Carran.

5.2 Scrub management

Scrub is an important component of the Burren landscape. For an invertebrate surveyor, woodland and scrub margins places are highly productive features for recording species. The high degree of structural diversity, and the provision of shelter, food and breeding sites supports many invertebrate species. It seems likely that the scrub, which is usually dominated by Hazel in the Burren, has been through cycles of expansion followed by removal and control by farmers over the last few hundred years (Cabot & Goodwillie, 2018). However, if not controlled, scrub will quickly cover extensive areas of land, reducing diversity and greatly damaging the prospects for wildlife. It should be emphasised that scrub control will depend on the constituent species and the possible impact on rare invertebrates needs to be considered before implementing control. Mortimer *et al.* (2000) and Kirby (2001) review the value of scrub to invertebrates and give advice on its management.

During the time of our visit there was no evidence of scrub control at Ballyogan, but evidence of manual scrub cutting in several locations at Slieve Carran, see Figure 12 for an example.

Figure 12 Cut Hazel scrub lying along a wall at Slieve Carran.

Scrub control will be an important aspect of management of both sites. If not already in place, we recommend the following

- Using high resolution aerial and satellite imagery to map the extent and spread of scrub through time and using that information to evolve plans for managing scrub over time. Drones are a

cost-effective method of obtaining detailed imagery on a regular basis if suitable imagery is unavailable from other sources.

- Setting limits on the extent of scrub. Extensive blocks of closed canopy scrub will reduce the populations of grassland and open habitat invertebrate species and should not be allowed to encroach further into the site. These species are a higher conservation priority. Many invertebrate species use the edges that exist between scrub and grassland so patches and belts of scrub in a mosaic with the grassland and limestone pavement should be encouraged to retain some structural diversity to the habitat and provide heat and shelter.

5.3 Invasive species

Problematic native and non-native invasive species are not presently a major issue at either site with the exception of Hazel. There are just four points to mention

- Sporadic plants of *Cotoneaster* species were encountered on the limestone pavement at both sites. While there are currently few established plants we advise early intervention to remove these as there is abundant evidence of the problems *Cotoneaster* can cause, particularly in limestone habitats with skeletal soils (Boer, 2014; Booy *et al.*, 2015; Doidge *et al.*, 2019). Early eradication is important to limit dispersal of the seed by birds.
- We also draw attention to extensive stands of dense bracken along the northern boundary of the site at Ballyogan. This should be monitored for incursion into the site as it has the potential to rapidly cover significant areas of grassland. It will tend to preferentially invade drier areas.
- Ballyogan contains an area of conifer plantation. While the plantation itself is generally in poor condition with many dead and dying trees, we would recommend the complete removal of all the conifers. Young coniferous saplings are also apparent and these should be removed as soon as possible.
- In the long term we recommend that the extent of birch (*Betula* species) and willow (*Salix* species) at Ballyogan is kept under review. Action may be needed if these spread too much and reduce the area of fen habitat.

Finally, in addition to these issues it would be advisable to walk the sites once a year to look for any other problems with invasive species, especially Red Valerian *Centranthus ruber* as control at an early stage will be much cheaper and far more likely to succeed.

5.4 Fly-tipping at Ballyogan

We noted a couple of instances of fly-tipping at Ballyogan. Small quantities of builder's rubble, domestic refuse and, more worryingly, garden waste had been tipped along the roadside (Figure 13). Garden waste has the potential to introduce undesirable plant and animal species into the site. Removal of tipped material may help to discourage this becoming a more significant problem and signage could be considered.

Figure 13 Garden waste fly-tipped at Ballyogan.

5.5 Actions for individual species

We have identified the following three species that merit some specific actions. Two, the Small Eggar and Brown Hairstreak, are dependent on careful management of Blackthorn, and the third is the EU Habitats Directive Annex II listed species, Marsh Fritillary.

5.5.1 Small Eggar at Slieve Carran

A single larval tent of Small Eggar *Eriogaster lanestris* was found at Slieve Carran during this survey. A brief account of the species was given in Section 3.1.7. In order to understand its status at Slieve Carran better, and the possible impact of scrub management, we recommend that larval web counts are undertaken annually in July to determine its distribution across the site. Its biology is complicated by two factors. First, it requires a sunlight threshold to be met in spring to trigger emergence of the adult from the cocoon. The numbers of adults emerging (and hence larval webs) thus fluctuates significantly from one year to the next. Second, females are effectively flightless which places limits on the dispersal powers of the moth to find suitable new areas of habitat. Essentially, dispersal is dictated by the distance any larvae move at final instar, when they migrate away from the communal larval web to find a place to pupate.

As well as recording the location, it would be advisable to record the height of scrub in which any webs are found into either tall scrub (in excess of 1.3 m tall) or low scrub (that less than 1.3 m tall). At Magilligan in Northern Ireland, where this species has been best studied in Ireland, most larval webs are found on low-growing scrub, and management options are different for tall *versus* low scrub. If, after a few years of surveys it is found that the moth is restricted to small areas, then care should be taken when managing Blackthorn during scrub cutting. It is important to ensure that enough foodplant remains in the areas where larval webs have been found due to the limited dispersal. We believe it is most likely that the moth is inhabiting the margins of the woodland as shown in Figure 14. This area

should form the core of the survey, but other areas could be included depending on resource availability.

Figure 14 The area at Slieve Carran considered most likely to hold Small Eggar *Eriogaster lanestris*.

5.5.2 Brown Hairstreak at Ballyogan

Like the Small Eggar, the Brown Hairstreak *Thecla betulae* utilises Blackthorn as its foodplant. Females lay their eggs at the junction of the second year and current year growth on the shrub, which is one of the main reasons the Brown Hairstreak has declined, as this growth is most impacted by hedge cutting (Thomas & Lewington, 2014). As Blackthorn is patchy in its occurrence at Ballyogan, often in old hedgelines, it may be sensitive to scrub clearance. In order to locate the whereabouts of the species on the site, we recommend using the UK Butterfly Monitoring Scheme egg-count methodology (UKBMS, 2019). Once the whereabouts of the key populations are known, then management practices can be adapted. Whilst we did not find Brown Hairstreak at Slieve Carran during this survey, there is a high probability it could also be present in the area identified in Figure 14. This area should be surveyed for adults and/or eggs to establish presence or absence.

5.5.3 Marsh Fritillary at Ballyogan

Marsh Fritillary *Euphydryas aurinia* is listed in Annex II of the EU Habitats Directive. This species is most easily surveyed by autumn surveys of larval webs, which are done at the same time as a standard habitat assessment (NBDC, 2019). The butterfly is known to utilise smaller sites in some years but not all, and it would be advisable to ascertain if Ballyogan holds a permanent or transient population. It would also be helpful to identify areas of optimal habitat so that any management issues around grazing or scrub-clearance can be identified and built into the management plan. The larval webs that were found during this survey were in sunny areas of damp grassland sheltered by banks of scrub with significant areas of Devil's-bit Scabious *Succisa pratensis* present. From aerial imagery available online, it appears that similar habitat exists in the surrounding area. We recommend these areas are surveyed to identify the extent of the metapopulation at Ballyogan and beyond.

6 Recommendations for future monitoring

In the absence of any Ireland-specific methodology, we have used Drake *et al.*, (2007) as the basis for the monitoring recommendations for each site and also had regard to the principles of Common Standards Monitoring Guidance developed in the UK (JNCC, 2008). Whilst these were developed for use in Great Britain, they have been used in Northern Ireland and the principles we consider are generally applicable in Ireland.

This approach requires invertebrate assemblages to be identified for each site and a number of invertebrates that are characteristic of that assemblage to be monitored on a seven-year cycle. Rare species and those that are highly characteristic of the habitat generally make the best indicator species for assessing site condition, but this needs to be balanced with some pragmatism. Selecting species across multiple or comparatively obscure taxonomic groups can unnecessarily complicate matters and species that are present at very low densities, where there is a significant element of chance in finding them, may make poor targets. In describing the selected assemblages and target species for each site as shown in Appendices 2 and 3 we have taken these factors into account. We have also provided brief notes on how, when and where to survey for them. Species that are known to have large natural inter-annual fluctuations in abundance also may not make good targets.

We have used the Pantheon software to assign invertebrates to habitat assemblages. Our recommendations for monitoring focus on species of wetland and open grassland and scrub habitat. These habitats hold the invertebrate communities with the greatest number of notable species at, respectively, Ballyogan and Slieve Carran, so are most important from a conservation perspective. Whilst some notable species were recorded from the woodland habitats, especially Diptera, there are fewer of them and they often do not make good target species. That is because very few specimens were found which gives lower chances of finding them again as part of a structured repeatable sampling programme.

7 Discussion and summary

The invertebrates we identified reflect the diverse and contrasting nature of the sites and the unique biogeographical features of the Burren region. In total, almost 1,000 insect and invertebrate species were identified in the survey and this included 12 species new to Ireland and 100 species that are notable in an Irish context. This total we consider is quite remarkable and significantly higher than any other study with a similar scope and scale undertaken by the authors. Particularly pleasing were the following discoveries and records

- The hoverflies *Cheilosia ahenea*, *Paragus constrictus* and *Pipizella viduata*
- The flesh-fly *Sarcophaga discifera*
- The beetles *Bagous lutosus*, *Philonthus furcifer*, *Ilyobates propinquus* and *Pterostichus aterimus*
- A new site for the Irish Damselfly *Coenagrion lunulatum*
- Six species of Red Listed and threatened butterflies including the Annex II Marsh Fritillary *Euphydryas aurinia*
- And many notable moth species.

Of the 12 species recorded for the first time in Ireland, 11 were Diptera and a single Staphylinid beetle. The bias towards new Irish records of Diptera is no great surprise; this group is large and less well recorded in general than some other taxonomic groups. Many of the new records are in the more taxonomically difficult families and genera reflecting the expert knowledge and experience of our taxonomist, Peter Chandler. It is likely that these are mostly native Irish species that have been overlooked, rather than recent arrivals.

We targeted the following major groups for consistent survey effort on both sites: bees, spiders, beetles, two-winged flies, true bugs, snails, dragonflies and damselflies, and grasshoppers and crickets. We also identified significant elements of other groups caught in traps or taken by field sampling, including harvestmen, pseudoscorpions, millipedes, woodlice, centipedes, other Hymenoptera and day-flying moths and butterflies. All the main habitats at both sites were covered by survey effort using a combination of field recording, collection of species for later identification and the use of passive traps.

The Pantheon analysis showed that both sites hold exceptional invertebrate assemblages and both sites protect excellent examples of typical Burren habitats. A greater number of species was found at Ballyogan (648 species) than at Slieve Carran (576 species). The reason for this is due to the balance of habitats at the two sites. Ballyogan is a much wetter site and contains a range of wetland habitats including unmodified fen, cut-over fen with numerous pools and a marl lake that are not present at Slieve Carran. The wetland at Ballyogan exists in an intimate mosaic with limestone pavement, calcareous grassland and several types of scrub. Ballyogan is also part of an extensive wetland complex, within which the areas of limestone pavement are small 'islands'. Slieve Carran is significantly larger and is mainly composed of limestone pavement with areas of closed-canopy Hazel woodland, Hazel scrub and grassland. Wetland habitat is restricted to modest areas of spring-fed flush and seepage and the site contains no areas of standing water. The landscape surrounding Slieve Carran is essentially the same as exists in the reserve. These gross differences are reflected in the species list. Though the site was significantly smaller, the species total from Ballyogan was higher than Slieve Carran because of the greater habitat diversity on this site.

We encountered a number of myrmecophilous (ant-dependant) species that are rare in an Irish context, including the hoverflies *Microdon mutabilis* and *Pipizella viduata*, and the spiders *Dipoena tristis* and *Evansia merens*. Whilst not a certainty, the fly *Phyllomyza rubricornis* is also likely to have an ant association. The biology of this species is obscure, but the other members of the genus are known myrmecophiles. The caterpillars of the Small Blue butterfly are tended by ants on the continent although this relationship is less clear in Ireland. The presence of a number of rare myrmecophiles at higher

trophic levels is a notable feature of the grassland and limestone pavement assemblage. Through visual examination during fieldwork, ants were found to be abundant across in these dry, open habitats this habitat. Ants must play a significant ecological role in the cycling of nutrients, altering the physical structure of the habitat through their nest building and changing species composition by predation, in addition to supporting these highly specialised species that are predatory or commensal on the ants themselves.

The survey revealed that while the grassland, limestone pavement and wetland features of the sites (the latter only at Ballyogan) are of very high quality in an Irish context, the assemblages associated with the woodland canopy and the shaded woodland floor habitats are of lesser significance. Whilst it is normal to find lower diversity in these habitats as a matter of course, very few notable species were recorded in these niches at either site. There are two possible explanations.

1. The plant species diversity in the closed-canopy Hazel woodland is low and the lack of light means that the field layer is also poorly developed. Phytophagous invertebrates are often restricted to a single plant or a small group of plants, and low plant diversity will provide correspondingly lower invertebrate diversity. This impacts all trophic levels, as predation of invertebrates by other invertebrates is similarly species-specific in some instances.
2. The other reason could be that these habitats are known to have been subject to cycles of heavy disturbance, as agricultural practices led to removal and re-expansion of woodland over recent centuries (Cabot, 2018). Whilst disturbance is often a helpful factor in maintaining woodland biodiversity (Kirby, 1992), the scale of historic woodland loss in this area may have been such that many of the often sedentary species characteristic of old woodlands were lost.

Finding *Coengrion lunulatum* at Ballyogan is part of a pattern of recent records of this species from the Burren region. The species was first found in the Burren in 2004 at Lough Skeardeen which is situated approximately 5 km to the north of Ballyogan. It has since been found near Ardrahan, approximately 20km to the north-east. It seems unlikely that a population of Irish Damselfly has remained hidden for so long in this part of Ireland. We suggest that an environmental factor has triggered an expansion of range, although quite what factors are involved remains unclear. There is significant potential for revealing new populations in similar small lakes that are found in this part Co. Clare.

The summer of 2018 was notable for high temperatures and an extended period of drought. Whilst it is difficult to quantify objectively, the weather during the survey period is likely to have skewed the results to a degree. We expect some thermophilic species to have benefitted from this unusual weather *e.g.* Grayling butterfly, but overall it is likely to have reduced the variety and abundance of species encountered. Additionally, the start date of the fieldwork in June meant that spring-active species will have been missed. The spring period is important for some species of Araneae, Coleoptera and Diptera but less critical for other groups. Our survey will not have captured the full extent of the invertebrate assemblages on the two sites, but with 648 species at Ballyogan, 576 at Slieve Carran and 990 in total, we feel this is a reasonable total on which to base this assessment.

Both sites have an appropriate grazing regime, which is crucial to maintaining the invertebrate communities. There were few obvious problems with invasive species, just the occasional shrub of *Cotoneaster* species was noted. A watching brief is required in order to manage any problematic species early whilst control costs are minimised. Continuation of historic grazing patterns is recommended as far as is practicable.

We make recommendations for future invertebrate assemblage condition monitoring and recommend a protocol (Appendix 2 and 3). Rare species and those that are characteristic of the habitat generally make the best indicator species for assessing site condition, but this needs to be balanced with some pragmatism. Selecting species across multiple or comparatively obscure taxonomic groups can unnecessarily complicate matters and species that are present at very low densities, such that there is a significant element of chance in finding them, also make poor targets. We have also provided brief notes on how, when and where to survey for them.

We have recommended separate monitoring programmes for three important species that may be vulnerable to management practices, and data collected should be used to help inform management plans. Two species (Small Eggar *Eriogaster lanestris* and Brown Hairstreak *Thecla betulae*) are especially sensitive to the removal and inappropriate trimming of Blackthorn which removes egg-laying and caterpillar feeding sites. For the third, Marsh Fritillary *Euphydryas aurinia*, collecting data on distribution will assist with managing grazing and to understand if the Ballyogan site supports a temporary meta-population or a more permanent one. It is worth mentioning that all three are attractive species of Lepidoptera and lend themselves to volunteer/community input in monitoring their status.

The single biggest challenge for site managers in maintaining the exceptional invertebrate communities at both sites is natural successional change, particularly scrub invasion and expansion of the woodland leading to a loss of the open grassland and limestone pavement habitats. We recommend setting limits on the extent and type of scrub. We noted that scrub control is taking place in several locations at Slieve Carran, so the importance of this work is clearly already well understood. Aerial imagery is a useful tool in monitoring scrub expansion and where best to focus effort.

Our views on the importance of scrub control are supported by the findings of the survey. At both sites, most of the notable species were associated with either the grassland and scrub mosaic or wetland habitats. The communities associated with the closed canopy woodland were comparatively much less interesting. The reason for that is not entirely clear but it may be related to historic phases of woodland clearance when woodland communities may have been lost, and possibly the comparatively low diversity of plant species; the woodland is dominated by Hazel with occasional Ash *Fraxinus excelsior* and Blackthorn trees with willow in wetter areas. We recommend that scrub is not permitted to form extensive areas with a closed canopy, but narrow belts of scrub with plenty of 'edge' are very important for the invertebrate communities here. Woodland and scrub margins not only provide shelter but also increase the diversity of physical habitat structure and diversity of plants which is vital for many invertebrates.

Given the exceptional invertebrate assemblages and the number of notable species records we conclude from this study that both sites are currently in favourable conservation status.

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Appendix 1 Species lists

This provides the full species lists from the study. Species are listed by taxonomic group. The occurrence of the species at each site is given, column headed 'B' is Ballyogan' 'SC' is Slieve Carran. Species defined as notable (see Section 3.1 and 3.2) are shown in the Notable column (headed 'Not.') with the species recorded as new to Ireland during this survey are indicated by **ns** after the + symbol.

The abbreviations used in Column 1 for the higher taxonomy are as follows

Aran.	Arachnida, Araneae (Spiders)
Opil.	Arachnida, Opiliones (Harvestmen)
Pseud.	Arachnida, Pseudoscorpiones (False Scorpions)
Arynch.	Arynchobdellida (Leeches)
Chilo.	Chilopoda (Centipedes)
Coleo.	Coleoptera (Beetles)
Crust.	Crustacea, Isopoda (Woodlice & relatives)
Derm.	Dermaptera (Earwigs)
Diplo.	Diplopoda (Millipedes)
Dipt.	Diptera (Two-winged flies)
Hemi.	Hemiptera (True Bugs & relatives)
Hym.	Hymenoptera (Bees, ants & wasps)
Lep.	Lepidoptera (Butterflies and moths)
Moll.	Mollusca (Snails & slugs)
Odo.	Odonata (Damselflies & dragonflies)
Orth.	Orthoptera (Grasshoppers & crickets)

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Aran.	*Agelena labyrinthica*	+	+		Open habitats	Tall sward and scrub
Aran.	*Agelenatea redii*		+		Open habitats	Unclassified
Aran.	*Agraecina striata*	+			Wetland	Peatland
Aran.	*Agyneta ramosa*		+		Tree-associated	Shaded woodland floor
Aran.	*Allomengea scopigera*	+		+	Wetland	Peatland
Aran.	*Alopecosa pulverulenta*	+	+		Open habitats	Tall sward and scrub; Upland
Aran.	*Anelosimus vittatus*		+		Tree-associated	Arboreal
Aran.	*Antistea elegans*	+			Wetland	Peatland
Aran.	*Anyphaena accentuata*		+		Tree-associated	Arboreal
Aran.	*Aphileta misera*	+			Wetland	Peatland
Aran.	*Araneus diadematus*	+			Unclassified	Unclassified
Aran.	*Araneus quadratus*	+	+		Unclassified	Unclassified
Aran.	*Araniella cucurbitina*		+		Tree-associated	Arboreal
Aran.	*Araniella opisthographa*		+		Tree-associated	Arboreal
Aran.	*Arctosa leopardus*	+			Wetland	Peatland
Aran.	*Argyroneta aquatica*	+			Wetland	Peatland
Aran.	*Asthenargus paganus*		+	+	Tree-associated	Shaded woodland floor
Aran.	*Attulus caricis*	+		+	Wetland	Peatland
Aran.	*Baryphyma trifrons*		+		Wetland	Peatland
Aran.	*Bathyphantes gracilis*	+			Unclassified	Unclassified
Aran.	*Bathyphantes parvulus*	+			Open habitats	Tall sward and scrub
Aran.	*Bathyphantes setiger*	+			Wetland	Peatland
Aran.	*Centromerita bicolor*	+			Open habitats	Tall sward and scrub
Aran.	*Clubiona comta*		+		Tree-associated	Arboreal
Aran.	*Clubiona neglecta*	+			Open habitats	Short sward and bare ground
Aran.	*Clubiona pallidula*		+		Tree-associated	Arboreal
Aran.	*Clubiona phragmitis*	+			Wetland	Peatland
Aran.	*Clubiona reclusa*	+	+		Wetland	Peatland
Aran.	*Clubiona stagnatilis*	+			Wetland	Peatland
Aran.	*Clubiona terrestris*		+		Unclassified	Unclassified
Aran.	*Dictyna arundinacea*		+		Open habitats	Tall sward and scrub
Aran.	*Dicymbium tibiale*		+		Unclassified	Unclassified
Aran.	*Diplocephalus latifrons*	+			Tree-associated	Shaded woodland floor
Aran.	*Dolomedes fimbriatus*	+		+	Wetland	Peatland
Aran.	*Drassodes cupreus*		+		Open habitats	Tall sward and scrub
Aran.	*Enoplognatha ovata*	+			Open habitats	Tall sward and scrub
Aran.	*Episinus angulatus*	+			Open habitats	Tall sward and scrub
Aran.	*Erigone atra*	+			Unclassified	Unclassified
Aran.	*Erigone dentipalpis*	+	+		Unclassified	Unclassified
Aran.	*Erigonella ignobilis*	+		+	Wetland	Peatland
Aran.	*Euryopis flavomaculata*		+	+	Open habitats	Tall sward and scrub
Aran.	*Evansia merens*		+	+	Open habitats	Unclassified
Aran.	*Gibbaranea gibbosa*		+		Tree-associated	Arboreal
Aran.	*Gnathonarium dentatum*	+			Wetland	Peatland
Aran.	*Gonatium rubens*	+			Open habitats	Tall sward and scrub; Upland
Aran.	*Gongylidiellum vivum*	+			Open habitats	Tall sward and scrub
Aran.	*Heliophanus cupreus*	+	+		Open habitats	Tall sward and scrub
Aran.	*Heliophanus flavipes*	+			Open habitats	Tall sward and scrub
Aran.	*Hypomma bituberculatum*	+			Wetland; Coastal	Marshland; Brackish pools and ditches
Aran.	*Hypomma fulvum*	+		+	Wetland	Peatland
Aran.	*Larinioides cornutus*	+	+		Wetland	Peatland

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Aran.	*Lasaeola tristis*	+	+	+	Open habitats	Unclassified
Aran.	*Linyphia triangularis*	+	+		Unclassified	Unclassified
Aran.	*Liocranoeca striata*	+	+	+	Wetland	Peatland
Aran.	*Mecynargus morulus*	+		+	Open habitats	Tall sward and scrub; Upland
Aran.	*Meioneta saxatilis*	+			Unclassified	Unclassified
Aran.	*Metellina mengei*		+		Unclassified	Unclassified
Aran.	*Metellina merianae*		+		Tree-associated	Decaying wood
Aran.	*Metellina segmentata*	+	+		Unclassified	Unclassified
Aran.	*Micaria pulicaria*	+			Open habitats	Short sward and bare ground
Aran.	*Micrargus herbigradus*		+		Tree-associated	Shaded woodland floor
Aran.	*Microlinyphia pusilla*	+	+		Open habitats	Tall sward and scrub
Aran.	*Micrommata virescens*		+	+	Open habitats	Tall sward and scrub
Aran.	*Misumena vatia*	+			Open habitats	Tall sward and scrub
Aran.	*Monocephalus castaneipes*		+		Tree-associated	Arboreal; Decaying wood
Aran.	*Monocephalus fuscipes*		+		Tree-associated	Shaded woodland floor
Aran.	*Neon reticulatus*	+	+		Tree-associated	Shaded woodland floor
Aran.	*Nesticus cellulanus*	+	+		Unclassified	Unclassified
Aran.	*Oedothorax fuscus*	+			Unclassified	Unclassified
Aran.	*Ozyptila atomaria*	+	+		Open habitats	Tall sward and scrub
Aran.	*Ozyptila trux*	+	+		Open habitats	Tall sward and scrub
Aran.	*Pachygnatha clercki*	+	+		Wetland	Peatland
Aran.	*Pachygnatha degeeri*	+	+		Unclassified	Unclassified
Aran.	*Pardosa amentata*	+			Wetland	Peatland
Aran.	*Pardosa nigriceps*	+	+		Open habitats	Tall sward and scrub
Aran.	*Pardosa prativaga*	+			Open habitats	Tall sward and scrub
Aran.	*Pardosa pullata*	+	+		Open habitats	Tall sward and scrub
Aran.	*Philodromus cespitum*	+			Tree-associated	Arboreal
Aran.	*Pirata hygrophilus*	+			Wetland	Peatland
Aran.	*Pirata piraticus*	+			Wetland	Peatland
Aran.	*Pirata piscatorius*	+		+	Wetland	Peatland
Aran.	*Pirata tenuitarsis*	+		+	Wetland	Peatland
Aran.	*Piratula latitans*	+	+	+	Wetland	Peatland
Aran.	*Pisaura mirabilis*	+	+		Open habitats	Tall sward and scrub
Aran.	*Pocadicnemis pumila*	+	+		Open habitats	Tall sward and scrub; Upland
Aran.	*Poeciloneta variegata*	+			Open habitats	Tall sward and scrub; Upland
Aran.	*Robertus lividus*	+	+		Unclassified	Unclassified
Aran.	*Segestria senoculata*	+	+		Open habitats	Short sward and bare ground
Aran.	*Silometopus elegans*	+			Wetland	Peatland
Aran.	*Taranucnus setosus*	+			Wetland	Peatland
Aran.	*Tenuiphantes mengei*	+	+		Open habitats	Tall sward and scrub; Upland
Aran.	*Tenuiphantes tenuis*	+			Open habitats	Tall sward and scrub
Aran.	*Tetragnatha extensa*	+	+		Wetland	Peatland
Aran.	*Textrix denticulata*	+	+		Open habitats	Tall sward and scrub
Aran.	*Theridion varians*	+			Tree-associated	Arboreal
Aran.	*Tibellus oblongus*	+			Open habitats	Tall sward and scrub
Aran.	*Tiso vagans*		+		Open habitats	Tall sward and scrub
Aran.	*Trochosa spinipalpis*	+			Wetland	Peatland
Aran.	*Walckenaeria antica*	+			Unclassified	Unclassified

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Aran.	*Walckenaeria atrotibialis*		+		Unclassified	Unclassified
Aran.	*Walckenaeria vigilax*	+	+		Open habitats	Tall sward and scrub
Aran.	*Xysticus cristatus*	+	+		Unclassified	Unclassified
Aran.	*Xysticus erraticus*		+		Open habitats	Tall sward and scrub
Aran.	*Zelotes apricorum*		+	+	Open habitats	Short sward and bare ground
Aran.	*Zelotes latreillei*	+	+		Open habitats	Tall sward and scrub
Aran.	*Zora spinimana*	+	+		Open habitats	Tall sward and scrub
Opil.	*Dicranopalpus ramosus*		+		Tree-associated	Arboreal
Opil.	*Leiobunum rotundum*	+	+		Tree-associated	Arboreal
Opil.	*Megabunus diadema*		+		Tree-associated	Shaded woodland floor
Opil.	*Mitopus morio*		+		Unclassified	Unclassified
Opil.	*Nemastoma bimaculatum*	+	+		Tree-associated	Shaded woodland floor
Opil.	*Oligolophus hanseni*		+		Tree-associated	Arboreal
Opil.	*Oligolophus tridens*		+		Tree-associated	Shaded woodland floor
Opil.	*Paroligolophus agrestis*		+		Unclassified	Unclassified
Opil.	*Phalangium opilio*		+		Unclassified	Unclassified
Opil.	*Platybunus triangularis*	+			Tree-associated	Shaded woodland floor
Pseud.	*Chthonius ischnocheles*	+	+		Unclassified	Unclassified
Arynch.	*Haemopis sanguisuga*	+			Unclassified	Unclassified
Chilo.	*Lithobius borealis*		+		Open habitats	Unclassified
Chilo.	*Lithobius variegatus*		+		Tree-associated	Shaded woodland floor
Coleo.	*Abax parallelepipedus*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Acalles misellus*		+		Tree-associated	Decaying wood
Coleo.	*Adrastus pallens*	+			Open habitats	Tall sward and scrub
Coleo.	*Agabus affinis*	+			Wetland	Peatland
Coleo.	*Agabus bipustulatus*	+	+		Wetland	Marshland
Coleo.	*Agabus nebulosus*	+	+		Wetland	Marshland
Coleo.	*Agabus sturmii*	+			Wetland	Marshland
Coleo.	*Agonum thoreyi*	+			Wetland	Peatland
Coleo.	*Agriotes obscurus*		+		Open habitats	Tall sward and scrub
Coleo.	*Aleochara funebris*	+			Open habitats	Tall sward and scrub
Coleo.	*Aleochara sparsa*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Altica longicollis*	+		+	Open habitats	Unclassified
Coleo.	*Altica lythri*	+			Open habitats	Tall sward and scrub
Coleo.	*Altica oleracea*	+			Open habitats	Short sward and bare ground
Coleo.	*Amara lunicollis*		+		Open habitats	Tall sward and scrub
Coleo.	*Amischa analis*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Anacaena globulus*	+	+		Wetland	Marshland
Coleo.	*Anacaena limbata*	+			Wetland	Marshland
Coleo.	*Anacaena lutescens*	+			Wetland	Peatland
Coleo.	*Anaspis rufilabris*		+		Tree-associated	Decaying wood
Coleo.	*Anotylus rugosus*	+			Wetland	Marshland
Coleo.	*Aplotarsus incanus*		+		Open habitats	Tall sward and scrub
Coleo.	*Archarius salicivorus*	+	+		Tree-associated	Arboreal
Coleo.	*Atholus duodecimstriatus*		+		Open habitats	Tall sward and scrub
Coleo.	*Athous haemorrhoidalis*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Badister bullatus*		+		Open habitats	Tall sward and scrub
Coleo.	*Badister sodalis*		+		Tree-associated	Shaded woodland floor
Coleo.	*Bagous lutosus*	+		+	Wetland	Running water
Coleo.	*Bembidion mannerheimii*		+		Open habitats; Tree-associated; Wetland	Peatland; Shaded woodland floor; Wet woodland
Coleo.	*Bolitobius cingulatus*		+		Tree-associated	Shaded woodland floor
Coleo.	*Brachypterus glaber*		+		Open habitats	Tall sward and scrub

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Coleo.	*Brachypterus urticae*	+			Open habitats	Tall sward and scrub
Coleo.	*Bryaxis bulbifer*	+			Tree-associated; Wetland	Shaded woodland floor; Wet woodland; Marshland
Coleo.	*Byrrhus fasciatus*	+			Open habitats	Unclassified
Coleo.	*Callicerus obscurus*	+			Open habitats	Tall sward and scrub
Coleo.	*Cantharis cryptica*		+		Open habitats	Tall sward and scrub
Coleo.	*Cantharis figurata*		+		Open habitats	Tall sward and scrub
Coleo.	*Cantharis thoracica*		+		Open habitats	Tall sward and scrub
Coleo.	*Carabus granulatus*	+	+		Wetland	Marshland
Coleo.	*Carabus problematicus*		+		Open habitats	Unclassified
Coleo.	*Carpelimus corticinus*	+			Wetland	Marshland
Coleo.	*Carpelimus fuliginosus*	+			Wetland	Marshland
Coleo.	*Carpelimus similis*	+			Wetland	Running water
Coleo.	*Cassida flaveola*	+			Open habitats	Tall sward and scrub
Coleo.	*Catops fuliginosus*		+		Unclassified	Unclassified
Coleo.	*Cercyon ustulatus*	+			Wetland	Marshland
Coleo.	*Cetonia aurata*	+			Open habitats	Tall sward and scrub
Coleo.	*Chaetarthria simillima*	+			Wetland	Peatland
Coleo.	*Chaetocnema concinna*		+		Open habitats	Tall sward and scrub
Coleo.	*Chilocorus bipustulatus*	+			Open habitats	Tall sward and scrub
Coleo.	*Chrysolina staphylaea*		+		Open habitats	Tall sward and scrub
Coleo.	*Chrysolina varians*		+		Open habitats	Short sward and bare ground
Coleo.	*Coccidula rufa*	+	+		Wetland	Peatland
Coleo.	*Coccinella septempunctata*	+	+		Unclassified	Unclassified
Coleo.	*Coelostoma orbiculare*	+			Wetland	Peatland
Coleo.	*Colon viennense*		+	+	Unclassified	Unclassified
Coleo.	*Colymbetes fuscus*	+			Wetland	Marshland
Coleo.	*Crataraea suturalis*		+		Tree-associated	Decaying wood
Coleo.	*Crepidodera aurea*	+			Tree-associated	Arboreal
Coleo.	*Cryptophagus pilosus*	+			Unclassified	Unclassified
Coleo.	*Ctenicera cuprea*		+		Open habitats	Unclassified
Coleo.	*Cychramus luteus*		+		Open habitats	Tall sward and scrub
Coleo.	*Cychrus caraboides*		+		Open habitats	Tall sward and scrub
Coleo.	*Cyphon hilaris*	+			Wetland	Peatland
Coleo.	*Cyphon laevipennis*	+			Wetland	Peatland
Coleo.	*Cyphon ochraceus*	+			Wetland	Marshland
Coleo.	*Cyphon padi*	+			Wetland	Peatland
Coleo.	*Cyphon variabilis*	+			Wetland	Marshland
Coleo.	*Cytilus sericeus*	+			Unclassified	Unclassified
Coleo.	*Dascillus cervinus*		+		Open habitats	Tall sward and scrub
Coleo.	*Donacia versicolorea*	+			Wetland	Lake; Marshland
Coleo.	*Dropephylla vilis*	+			Tree-associated	Decaying wood
Coleo.	*Drusilla canaliculata*	+			Open habitats	Tall sward and scrub
Coleo.	*Dryops luridus*	+			Wetland	Lake; Marshland
Coleo.	*Elaphrus cupreus*		+		Tree-associated; Wetland	Shaded woodland floor; Wet woodland; Marshland
Coleo.	*Enochrus coarctatus*	+			Wetland	Peatland
Coleo.	*Enochrus ochropterus*	+			Wetland	Peatland
Coleo.	*Enochrus testaceus*	+			Wetland	Marshland
Coleo.	*Epuraea biguttata*		+		Tree-associated	Decaying wood
Coleo.	*Erichsonius cinerascens*	+			Wetland	Peatland
Coleo.	*Euaesthetus ruficapillus*	+			Wetland	Peatland
Coleo.	*Eutrichapion ervi*		+		Open habitats	Tall sward and scrub

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Coleo.	*Exapion ulicis*	+			Open habitats	Unclassified
Coleo.	*Fagniezia impressa*	+			Wetland	Peatland
Coleo.	*Gabrius breviventer*	+			Wetland	Peatland
Coleo.	*Galerucella lineola*	+			Wetland	Marshland
Coleo.	*Galerucella pusilla*	+			Open habitats	Tall sward and scrub
Coleo.	*Graptodytes granularis*	+			Wetland	Peatland
Coleo.	*Gymnusa brevicollis*	+			Wetland	Peatland
Coleo.	*Gyrinus minutus*	+			Wetland	Lake; Peatland
Coleo.	*Gyrinus substriatus*	+			Wetland	Marshland
Coleo.	*Haliplus fulvus*	+			Wetland	Lake; Marshland
Coleo.	*Haliplus lineatocollis*	+			Wetland	Running water
Coleo.	*Haliplus ruficollis*	+			Wetland	Marshland
Coleo.	*Haliplus sibiricus*	+			Wetland	Lake; Marshland
Coleo.	*Haploglossa nidicola*	+	+		Open habitats	Short sward and bare ground
Coleo.	*Harpalus latus*		+		Open habitats	Tall sward and scrub
Coleo.	*Helochares obscurus*	+			Wetland	Peatland
Coleo.	*Helophorus aequalis*	+			Wetland	Marshland
Coleo.	*Helophorus brevipalpis*	+			Wetland	Marshland
Coleo.	*Helophorus grandis*	+			Wetland	Marshland
Coleo.	*Helophorus obscurus*	+			Wetland	Marshland
Coleo.	*Hippodamia 13-punctata*	+		+	Open habitats	Tall sward and scrub
Coleo.	*Hydrobius fuscipes*	+			Wetland	Marshland
Coleo.	*Hydroporus angustatus*	+			Wetland	Marshland
Coleo.	*Hydroporus erythrocephalus*	+			Wetland	Marshland
Coleo.	*Hydroporus longulus*	+			Wetland	Running water
Coleo.	*Hydroporus memnonius*	+			Tree-associated; Wetland	Peatland; Shaded woodland floor; Wet woodland
Coleo.	*Hydroporus nigrita*	+			Wetland	Peatland
Coleo.	*Hydroporus obscurus*	+			Wetland	Peatland
Coleo.	*Hydroporus palustris*	+			Tree-associated; Wetland	Marshland; Shaded woodland floor; Wet woodland
Coleo.	*Hydroporus planus*	+			Wetland	Marshland
Coleo.	*Hydroporus pubescens*	+			Wetland	Marshland; Peatland
Coleo.	*Hydroporus tessellatus*	+			Wetland	Marshland
Coleo.	*Hydrothassa marginella*	+			Open habitats	Tall sward and scrub
Coleo.	*Hygrotus inaequalis*	+			Wetland	Marshland
Coleo.	*Hypera nigrirostris*		+		Open habitats	Tall sward and scrub
Coleo.	*Hypera rumicis*	+			Open habitats	Short sward and bare ground
Coleo.	*Hyphydrus ovatus*	+			Wetland	Marshland
Coleo.	*Ilybius ater*	+			Wetland	Lake; Marshland
Coleo.	*Ilybius fuliginosus*	+			Wetland	Marshland
Coleo.	*Ilybius guttiger*	+			Wetland	Peatland
Coleo.	*Ilybius montanus*	+			Wetland	Peatland
Coleo.	*Ilybius quadriguttatus*	+			Wetland	Peatland
Coleo.	*Ilyobates propinquus*		+	+ **ns**	Tree-associated; Wetland	Peatland; Shaded woodland floor; Wet woodland
Coleo.	*Ischnopoda umbratica*	+			Wetland	Running water
Coleo.	*Ischnopterapion loti*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Ischnopterapion modestum*		+		Open habitats	Tall sward and scrub
Coleo.	*Laccobius bipunctatus*	+			Wetland	Marshland

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Coleo.	*Laccobius colon*	+			Wetland	Lake: Marshland
Coleo.	*Laccobius minutus*	+	+		Wetland	Lake; Marshland
Coleo.	*Laccornis oblongus*	+		+	Wetland	Peatland
Coleo.	*Lathrobium geminum*		+		Open habitats	Tall sward and scrub
Coleo.	*Lathrobium terminatum*	+			Wetland	Peatland
Coleo.	*Lesteva sicula*	+			Wetland	Marshland
Coleo.	*Liophloeus tessulatus*	+			Open habitats	Tall sward and scrub
Coleo.	*Liopterus haemorrhoidalis*	+			Wetland	Peatland
Coleo.	*Lobrathrium multipunctum*	+			Wetland	Running water
Coleo.	*Lochmaea caprea*	+			Tree-associated	Arboreal
Coleo.	*Lochmaea suturalis*	+	+		Open habitats	Unclassified
Coleo.	*Longitarsus holsaticus*	+			Open habitats	Tall sward and scrub
Coleo.	*Longitarsus luridus*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Longitarsus melanocephalus*		+		Open habitats	Tall sward and scrub
Coleo.	*Longitarsus pratensis*		+		Open habitats	Tall sward and scrub
Coleo.	*Longitarsus reichei*		+		Open habitats	Short sward and bare ground
Coleo.	*Malthodes marginatus*		+		Tree-associated	Decaying wood
Coleo.	*Mecinus labilis*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Megasternum concinnum*		+		Open habitats	Tall sward and scrub
Coleo.	*Meligethes erythropus*		+		Unclassified	Unclassified
Coleo.	*Micrambe vini*	+			Unclassified	Unclassified
Coleo.	*Myllaena dubia*	+			Wetland	Peatland
Coleo.	*Myllaena kraatzi*	+			Wetland	Peatland
Coleo.	*Nebria salina*		+		Open habitats	Tall sward and scrub
Coleo.	*Neocrepidodera ferruginea*		+		Open habitats	Tall sward and scrub
Coleo.	*Neocrepidodera transversa*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Nicrophorus vespilloides*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Noterus clavicornis*	+			Wetland	Marshland
Coleo.	*Noterus crassicornis*	+			Wetland	Peatland
Coleo.	*Notiophilus aquaticus*		+		Open habitats	Unclassified
Coleo.	*Notiophilus biguttatus*		+		Open habitats	Tall sward and scrub
Coleo.	*Notiophilus palustris*		+		Open habitats	Tall sward and scrub
Coleo.	*Ochthebius minimus*	+			Wetland	Marshland
Coleo.	*Ochthephilum fracticorne*	+			Wetland	Peatland
Coleo.	*Ocypus olens*		+		Open habitats	Tall sward and scrub
Coleo.	*Ocyusa maura*	+			Wetland	Marshland
Coleo.	*Ocyusa picina*	+			Wetland	Peatland
Coleo.	*Odeles marginata*		+		Wetland	Running water
Coleo.	*Oomorphus concolor*	+			Tree-associated	Shaded woodland floor
Coleo.	*Othius angustus*		+		Open habitats	Unclassified
Coleo.	*Otiorhynchus rugifrons*		+		Open habitats	Short sward and bare ground
Coleo.	*Otiorhynchus sulcatus*		+		Unclassified	Unclassified
Coleo.	*Oulema melanopus*		+		Open habitats	Tall sward and scrub
Coleo.	*Oulema obscura*		+		Open habitats	Tall sward and scrub
Coleo.	*Paederus riparius*	+			Wetland	Peatland
Coleo.	*Paradromius linearis*	+			Open habitats	Tall sward and scrub
Coleo.	*Perapion curtirostre*	+			Open habitats	Tall sward and scrub
Coleo.	*Perapion hydrolapathi*		+		Open habitats	Tall sward and scrub
Coleo.	*Phaedon armoraciae*	+			Wetland	Marshland

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Coleo.	*Phalacrus substriatus*	+			Unclassified	Unclassified
Coleo.	*Philhygra elongatula*	+			Wetland	Marshland
Coleo.	*Philonthus addendus*	+			Open habitats	Tall sward and scrub
Coleo.	*Philonthus cognatus*		+		Open habitats	Tall sward and scrub
Coleo.	*Philonthus corvinus*	+		+	Wetland	Peatland
Coleo.	*Philonthus decorus*	+			Tree-associated	Shaded woodland floor
Coleo.	*Philonthus fumarius*	+			Wetland	Peatland
Coleo.	*Philonthus furcifer*	+		+	Wetland	Unclassified
Coleo.	*Philonthus laminatus*	+			Open habitats	Tall sward and scrub
Coleo.	*Philonthus marginatus*		+		Open habitats	Tall sward and scrub
Coleo.	*Philonthus nigrita*	+			Wetland	Peatland
Coleo.	*Philonthus splendens*	+			Open habitats	Tall sward and scrub
Coleo.	*Phyllobius argentatus*		+		Tree-associated	Arboreal
Coleo.	*Phyllobius pyri*		+		Tree-associated	Arboreal
Coleo.	*Phyllopertha horticola*		+		Open habitats	Unclassified
Coleo.	*Plateumaris sericea*	+			Wetland	Lake; Peatland
Coleo.	*Pocadius adustus*	+			Open habitats	Tall sward and scrub
Coleo.	*Podabrus alpinus*		+		tree-associated	Arboreal
Coleo.	*Poecilus versicolor*		+		Open habitats	Tall sward and scrub
Coleo.	*Polydrusus pilosus*		+		Tree-associated	Arboreal
Coleo.	*Polydrusus pterygomalis*		+		Tree-associated	Arboreal
Coleo.	*Porhydrus lineatus*	+			Wetland	Marshland
Coleo.	*Propylea 14-punctata*	+	+		Unclassified	Unclassified
Coleo.	*Protapion apricans*		+		Open habitats	Tall sward and scrub
Coleo.	*Protapion assimile*		+		Open habitats	Tall sward and scrub
Coleo.	*Protapion fulvipes*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Protapion nigritarse*	+			Open habitats	Tall sward and scrub
Coleo.	*Pselaphus heisei*		+		Wetland	Peatland
Coleo.	*Pterostichus aterrimus*	+		+	Wetland	Marshland
Coleo.	*Pterostichus diligens*	+	+		Wetland	Peatland
Coleo.	*Pterostichus madidus*		+		Open habitats	Tall sward and scrub
Coleo.	*Pterostichus melanarius*		+		Open habitats	Tall sward and scrub
Coleo.	*Pterostichus minor*	+			Wetland	Peatland
Coleo.	*Pterostichus niger*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Pterostichus nigrita*	+	+		Wetland	Marshland
Coleo.	*Pterostichus rhaeticus*	+			Open habitats	Unclassified
Coleo.	*Pterostichus strenuus*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Pterostichus vernalis*		+		Open habitats	Tall sward and scrub
Coleo.	*Quedius curtipennis*		+		Open habitats	Tall sward and scrub
Coleo.	*Quedius fuliginosus*	+	+		Wetland	Marshland
Coleo.	*Quedius maurorufus*		+		Wetland	Running water
Coleo.	*Quedius molochinus*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Quedius nitipennis*		+		Open habitats	Tall sward and scrub
Coleo.	*Quedius picipes*		+		Open habitats	Tall sward and scrub
Coleo.	*Quedius schatzmayri*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Rhagium bifasciatum*		+		Tree-associated	Decaying wood
Coleo.	*Rhagium mordax*		+		Tree-associated	Decaying wood
Coleo.	*Rhagonycha fulva*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Rhagonycha lignosa*		+		Tree-associated	Arboreal
Coleo.	*Rhagonycha limbata*		+		Open habitats	Tall sward and scrub
Coleo.	*Rhantus exsoletus*	+			Wetland	Lake; Peatland
Coleo.	*Rhyzobius litura*		+		Open habitats	Tall sward and scrub
Coleo.	*Rugilus erichsonii*	+			Wetland	Peatland
Coleo.	*Sciaphilus asperatus*		+		Open habitats	Tall sward and scrub
Coleo.	*Serica brunnea*		+		Open habitats	Tall sward and scrub

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Coleo.	*Silpha atrata*	+	+		Tree-associated	Shaded woodland floor; Wet woodland
Coleo.	*Silpha tristis*		+		Open habitats	Tall sward and scrub
Coleo.	*Sitona lineatus*		+		Open habitats	Tall sward and scrub
Coleo.	*Sitona lineellus*	+			Open habitats	Tall sward and scrub
Coleo.	*Sitona suturalis*		+		Open habitats	Tall sward and scrub
Coleo.	*Soronia grisea*		+		Tree-associated	Decaying wood
Coleo.	*Staphylinus dimidiaticornis*		+	+	Open habitats	Short sward and bare ground
Coleo.	*Staphylinus erythropterus*	+	+		Open habitats	Unclassified
Coleo.	*Stenus bimaculatus*		+		Tree-associated; Wetland	Marshland; Shaded woodland floor; Wet woodland
Coleo.	*Stenus boops*	+			Wetland	Marshland
Coleo.	*Stenus brunnipes*	+	+		Unclassified	Unclassified
Coleo.	*Stenus clavicornis*		+		Open habitats	Tall sward and scrub
Coleo.	*Stenus flavipes*		+		Tree-associated; Wetland	Shaded woodland floor; Wet woodland
Coleo.	*Stenus formicetorum*	+			Wetland	Peatland
Coleo.	*Stenus fornicatus*	+		+	Wetland	Marshland
Coleo.	*Stenus fulvicornis*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Stenus impressus*		+		Unclassified	Unclassified
Coleo.	*Stenus juno*	+			Wetland	Marshland
Coleo.	*Stenus latifrons*	+			Wetland	Peatland
Coleo.	*Stenus melanarius*	+			Wetland	Peatland
Coleo.	*Stenus nitidiusculus*	+			Wetland	Peatland
Coleo.	*Stenus ossium*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Stenus palustris*	+			Wetland	Peatland
Coleo.	*Strophosoma melanogrammum*		+		Tree-associated	Arboreal
Coleo.	*Suphrodytes dorsalis*	+			Wetland	Peatland
Coleo.	*Suphrodytes figuratus*	+			Wetland	Peatland
Coleo.	*Synuchus vivalis*		+		Open habitats	Tall sward and scrub
Coleo.	*Tachinus rufipes*		+		Open habitats	Tall sward and scrub
Coleo.	*Tachinus signatus*		+		Open habitats	Tall sward and scrub
Coleo.	*Tachyporus atriceps*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Tachyporus chrysomelinus*	+			Open habitats	Tall sward and scrub
Coleo.	*Tachyporus dispar*	+			Open habitats	Tall sward and scrub
Coleo.	*Tachyporus pusillus*		+		Open habitats	Tall sward and scrub
Coleo.	*Tachyporus transversalis*	+			Wetland	Peatland
Coleo.	*Tachyusa umbratica*	+		+		
Coleo	*Tetartopeus terminatus*	+				
Coleo.	*Thanatophilus rugosus*		+		Open habitats	Tall sward and scrub
Coleo.	*Thinonoma atra*	+			Wetland	Marshland
Coleo.	*Trechus obtusus*		+		Open habitats	Tall sward and scrub
Coleo.	*Trichosirocalus troglodytes*	+	+		Open habitats	Tall sward and scrub
Coleo.	*Tychius picirostris*		+		Open habitats	Tall sward and scrub
Coleo.	*Xantholinus linearis*	+			Open habitats	Tall sward and scrub
Coleo.	*Xantholinus longiventris*		+		Open habitats	Tall sward and scrub
Coleo.	*Zyras collaris*	+			Wetland	Marshland
Crust.	*Armadillidium vulgare*	+			Unclassified	Unclassified
Crust.	*Asellus aquaticus*	+			Wetland	Marshland

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Crust.	*Gammarus duebeni*		+		Coastal	Brackish pools and ditches; Saltmarsh
Crust.	*Oniscus asellus*	+	+		Unclassified	Unclassified
Crust.	*Philoscia affinis*	+	+	+	Unclassified	Unclassified
Crust.	*Philoscia muscorum*	+	+		Unclassified	Unclassified
Crust.	*Porcellio scaber*		+		Unclassified	Unclassified
Crust.	*Trichoniscus pusillus*		+		Unclassified	Unclassified
Derma.	*Forficula auricularia*	+			Unclassified	Unclassified
Diplo.	*Cylindroiulus britannicus*	+	+		Tree-associated	Decaying wood
Diplo.	*Cylindroiulus latestriatus*		+		Open habitats	Short sward and bare ground
Diplo.	*Cylindroiulus punctatus*	+	+		Tree-associated	Shaded woodland floor
Diplo.	*Glomeris marginata*		+		Tree-associated	Shaded woodland floor
Diplo.	*Ophyiulus pilosus*	+	+		Tree-associated	Shaded woodland floor
Diplo.	*Polydesmus inconstans*		+		Open habitats	Tall sward and scrub
Diplo.	*Tachypodoiulus niger*	+	+		Unclassified	Unclassified
Dipt.	*Actia pilipennis*	+			Unclassified	Unclassified
Dipt.	*Allopiophila vulgaris*		+		Unclassified	Unclassified
Dipt.	*Anasimyia lineata*	+			Wetland	Peatland
Dipt.	*Anthomyia liturata*	+			Unclassified	Unclassified
Dipt.	*Anthomyia procellaris*	+			Unclassified	Unclassified
Dipt.	*Azelia nebulosa*	+	+		Tree-associated	Peatland; Shaded woodland floor; Wet woodland
Dipt.	*Beris fuscipes*	+	+		Tree-associated; Wetland	Shaded woodland floor
Dipt.	*Bezzia circumdata*	+			Unclassified	Unclassified
Dipt.	*Bicellaria simplicipes*	+			Tree-associated	Shaded woodland floor
Dipt.	*Boletina bidenticulata*		+	+ **ns**	Tree-associated	Unclassified
Dipt.	*Botanophila striolata*	+			Unclassified	Unclassified
Dipt.	*Brachicoma devia*		+		Open habitats	Tall sward and scrub
Dipt.	*Bradysia nitidicollis*	+			Unclassified	Unclassified
Dipt.	*Calliphora vicina*	+	+		Unclassified	Unclassified
Dipt.	*Calliphora vomitoria*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Campsicnemus curvipes*	+			Wetland	Running water
Dipt.	*Campsicnemus loripes*	+	+		Tree-associated; Wetland	Peatland; Shaded woodland floor; Wet woodland
Dipt.	*Cerodontha denticornis*	+			Unclassified	Unclassified
Dipt.	*Chamaepsila rosae*	+			Open habitats	Unclassified
Dipt.	*Cheilosia ahenea*	+	+	+	Open habitats	Short sward and bare ground
Dipt.	*Cheilosia illustrata*	+			Open habitats	Tall sward and scrub
Dipt.	*Chloromyia formosa*	+			Open habitats	Tall sward and scrub
Dipt.	*Chrysopilus asiliformis*		+		Tree-associated	Shaded woodland floor
Dipt.	*Chrysopilus cristatus*	+	+		Tree-associated; Wetland	Peatland; Shaded woodland floor; Wet woodland
Dipt.	*Chrysops relictus*	+			Wetland	Peatland
Dipt.	*Chrysotus cilipes*	+			Wetland	Marshland; Peatland
Dipt.	*Chrysotus gramineus*	+	+		Wetland	Marshland; Running Water
Dipt.	*Clusiodes verticalis*		+		Tree-associated	Decaying wood
Dipt.	*Coboldia fuscipes*	+			Unclassified	Unclassified
Dipt.	*Coenosia mollicula*	+			Open habitats	Tall sward and scrub
Dipt.	*Coenosia pedella*	+			Unclassified	Unclassified
Dipt.	*Coenosia tigrina*	+			Open habitats; Tree associated	Tall sward and scrub; Shaded Woodland Floor
Dipt.	*Contarinia coryli*		+		Unclassified	Unclassified

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Dipt.	*Copromyza nigrina*		+		Unclassified	Unclassified
Dipt.	*Copromyza pedestris*		+		Unclassified	Unclassified
Dipt.	*Cordilura rufimana*	+			Wetland	Peatland
Dipt.	*Coremacera marginata*		+		Open habitats	Tall sward and scrub
Dipt.	*Crumomyia nitida*		+		Tree-associated	Shaded woodland floor
Dipt.	*Dexiosoma caninum*		+		Unclassified	Unclassified
Dipt.	*Dicraeus vagans*	+			Open habitats	Short sward and bare ground; Tall sward and scrub
Dipt.	*Dicranomyia autumnalis*		+		Wetland	Peatland
Dipt.	*Dicranomyia morio*	+			Wetland	Marshland; Running Water
Dipt.	*Dilophus febrilis*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Diogma glabrata*		+	+	Tree-associated	Shaded woodland floor
Dipt.	*Dolichopus atratus*	+			Wetland	Peatland
Dipt.	*Dolichopus popularis*	+	+		Unclassified	Unclassified
Dipt.	*Dolichopus subpennatus*	+			Wetland	Marshland
Dipt.	*Dolichopus trivialis*	+			Wetland	Marshland; Running Water
Dipt.	*Dolichopus ungulatus*	+			Wetland	Marshland
Dipt.	*Dolichopus urbanus*	+			Unclassified	Unclassified
Dipt.	*Drosophila obscura*	+			Unclassified	Unclassified
Dipt.	*Drosophila subobscura*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Drosophila tristis*		+		Unclassified	Unclassified
Dipt.	*Dryomyza anilis*	+	+		Unclassified	Unclassified
Dipt.	*Elachiptera diastema*	+			Open habitats	Tall sward and scrub
Dipt.	*Eloeophila maculata*	+			Tree-associated; Wetland	Running water; Shaded woodland floor; Wet woodland
Dipt.	*Empis aestiva*	+			Wetland	Unclassified
Dipt.	*Empis femorata*		+		Open habitats	Tall sward and scrub
Dipt.	*Empis lutea*		+		Open habitats; Tree associated	Shaded Woodland floor; Tall sward and scrub
Dipt.	*Empis stercorea*		+		Tree-associated	Shaded woodland floor
Dipt.	*Empis tessellata*		+		Open habitats	Tall sward and scrub
Dipt.	*Empis trigramma*		+		Open habitats	Tall sward and scrub
Dipt.	*Episyrphus balteatus*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Erioconopa diuturna*		+		Wetland	Running water
Dipt.	*Eristalis abusivus*	+			Wetland	Peatland
Dipt.	*Eristalis arbustorum*	+			Wetland	Peatland
Dipt.	*Eristalis horticola*	+	+		Wetland	Peatland
Dipt.	*Eristalis intricarius*		+		Wetland	Peatland
Dipt.	*Eristalis nemorum*	+			Wetland	Peatland
Dipt.	*Eristalis pertinax*	+	+		Wetland	Peatland
Dipt.	*Eristalis tenax*	+	+		Wetland	Peatland
Dipt.	*Eudasyphora cyanella*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Eumerus strigatus*		+		Open habitats	Tall sward and scrub
Dipt.	*Eupeodes corollae*	+			Open habitats	Tall sward and scrub
Dipt.	*Eupeodes latifasciatus*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Eupeodes luniger*	+			Open habitats	Short sward and bare ground; Tall sward and scrub
Dipt.	*Exorista larvarum*	+			Unclassified	Unclassified
Dipt.	*Fannia aequilineata*	+		+	Tree-associated	Decaying wood; Shaded woodland floor
Dipt.	*Fannia lustrator*		+		Tree-associated	Shaded woodland floor

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Dipt.	*Fannia manicata*	+			Tree-associated	Decaying wood; Shaded woodland floor
Dipt.	*Fannia rondanii*	+			Tree-associated	Shaded woodland floor
Dipt.	*Fannia scalaris*	+			Tree-associated	Shaded woodland floor
Dipt.	*Ferdinandea cuprea*	+	+		Tree-associated	Decaying wood
Dipt.	*Gaurax fascipes*	+			Tree-associated	Decaying wood
Dipt.	*Geomyza hackmani*		+		Open habitats	Tall sward and scrub
Dipt.	*Geomyza tripunctata*	+			Open habitats; Tree associated	Shaded Woodland floor; Tall sward and scrub
Dipt.	*Graphomya maculata*	+			Open habitats; Tree associated	Decaying wood; Marshland; Peatland; Shaded woodland floor; Wet Woodland
Dipt.	*Haematobosca stimulans*	+			Unclassified	Unclassified
Dipt.	*Haematopota pluvialis*	+			Wetland	Peatland
Dipt.	*Hebecnema nigricolor*		+		Tree-associated	Shaded woodland floor
Dipt.	*Hebecnema umbratica*	+			Tree-associated	Shaded woodland floor
Dipt.	*Hebecnema vespertina*	+			Tree-associated	Shaded woodland floor
Dipt.	*Helina abdominalis*	+		+	Tree-associated	Decaying wood; Shaded woodland floor
Dipt.	*Helina confinis*		+		Tree-associated; Wetland	Running water; Shaded woodland floor; Wet woodland
Dipt.	*Helina depuncta*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Helina evecta*		+		Tree-associated	Shaded woodland floor
Dipt.	*Helina impuncta*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Helina reversio*		+		Tree-associated	Shaded woodland floor
Dipt.	*Helophilus hybridus*	+	+		Wetland	Peatland
Dipt.	*Helophilus pendulus*	+	+		Wetland	Peatland
Dipt.	*Herina frondescentiae*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Heteromyza commixta*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Heterostylodes nominabilis*	+			Unclassified	Unclassified
Dipt.	*Homoneura tesquae*	+		+	Tree-associated	Shaded woodland floor
Dipt.	*Hydrophoria lancifer*		+		Unclassified	Unclassified
Dipt.	*Hydrophoria ruralis*	+	+		Unclassified	Unclassified
Dipt.	*Hydrotaea diabolus*	+			Tree-associated	Shaded woodland floor
Dipt.	*Hydrotaea irritans*	+			Unclassified	Unclassified
Dipt.	*Hydrotaea militaris*		+		Unclassified	Unclassified
Dipt.	*Hydrotaea velutina*		+	+ **ns**	Tree-associated	Shaded woodland floor
Dipt.	*Hylemya nigrimana*	+	+		Unclassified	Unclassified
Dipt.	*Hylemya vagans*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Ilione lineata*	+			Wetland	Peatland
Dipt.	*Lasiomma seminitidum*	+	+		Unclassified	Unclassified
Dipt.	*Limnia paludicola*		+		Tree-associated	Shaded woodland floor
Dipt.	*Limnophora maculosa*	+			Wetland	Running water
Dipt.	*Limonia flavipes*		+		Tree-associated	Shaded woodland floor
Dipt.	*Limonia nubeculosa*		+		Tree-associated	Decaying wood; Shaded woodland floor
Dipt.	*Limonia trivittata*		+		Tree-associated; Wetland	Running water; Shaded woodland floor; Wet woodland
Dipt.	*Lonchaea chorea*	+			Tree-associated	Decaying wood
Dipt.	*Lonchaea tarsata*	+	+		Tree-associated	Decaying wood
Dipt.	*Lonchoptera lutea*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Lucilia caesar*	+	+		Unclassified	Unclassified

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Dipt.	*Macronychia polyodon*		+	+	Open habitats	Tall sward and scrub
Dipt.	*Mallochohelea munda*	+		+ **ns**	Wetland	Unclassified
Dipt.	*Manota unifurcata*		+	+ **ns**	Tree-associated	Unclassified
Dipt.	*Medetera muralis*	+			Tree-associated	Decaying wood
Dipt.	*Meiosimyza decempunctata*	+			Tree-associated	Shaded woodland floor
Dipt.	*Meiosimyza platycephala*		+		Tree-associated	Shaded woodland floor
Dipt.	*Meiosimyza rorida*		+		Tree-associated	Shaded woodland floor
Dipt.	*Melanogaster aerosa*	+			Wetland	Peatland
Dipt.	*Melanostoma mellinum*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Melanostoma scalare*	+			Open habitats	Tall sward and scrub
Dipt.	*Melinda viridicyanea*	+	+		Unclassified	Unclassified
Dipt.	*Merodon equestris*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Mesembrina meridiana*	+	+		Unclassified	Unclassified
Dipt.	*Microchrysa flavicornis*	+			Open habitats	Tall sward and scrub
Dipt.	*Microdon mutabilis*	+	+		Open habitats	Tall sward and scrub; Upland
Dipt.	*Minettia fasciata*	+			Open habitats	Unclassified
Dipt.	*Minettia inusta*	+			Tree-associated	Shaded woodland floor
Dipt.	*Molophilus lackschewitzianus*		+		Tree-associated	Running water; Shaded woodland floor; Wet woodland
Dipt.	*Molophilus occultus*	+			Tree-associated; Wetland	Peatland; Shaded woodland floor; Wet woodland
Dipt.	*Morellia simplex*	+			Unclassified	Unclassified
Dipt.	*Muscina levida*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Muscina prolapsa*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Myathropa florea*	+	+		Tree-associated	Decaying wood
Dipt.	*Mycetophila britannica*		+		Tree-associated	Shaded woodland floor
Dipt.	*Mycetophila curviseta*		+		Unclassified	Unclassified
Dipt.	*Mycetophila edwardsi*	+			Unclassified	Unclassified
Dipt.	*Mycetophila fungorum*		+		Tree-associated	Decaying wood; Shaded woodland floor
Dipt.	*Mycetophila gibbula*		+	+ **ns**	Unclassified	Unclassified
Dipt.	*Mycetophila perpallida*		+		Tree-associated	Shaded woodland floor
Dipt.	*Mycetophila pumila*		+		Tree-associated	Shaded woodland floor
Dipt.	*Mycetophila sordida*		+		Unclassified	Unclassified
Dipt.	*Mycetophila subsigillata*		+		Unclassified	Unclassified
Dipt.	*Mycetophila trinotata*		+		Tree-associated	Decaying wood
Dipt.	*Mycomya cinerascens*		+		Tree-associated	Shaded woodland floor
Dipt.	*Mycophaga testacea*		+		Unclassified	Unclassified
Dipt.	*Mydaea ancilla*	+	+		Unclassified	Unclassified
Dipt.	*Mydaea anicula*	+	+	+	Tree-associated	Shaded woodland floor
Dipt.	*Mydaea corni*	+	+		Unclassified	Unclassified
Dipt.	*Mydaea urbana*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Nemorilla floralis*	+			Unclassified	Unclassified
Dipt.	*Neoascia tenur*	+			Wetland	Peatland
Dipt.	*Neolimonia dumetorum*		+		Tree-associated	Decaying wood
Dipt.	*Neomyia cornicina*	+			Unclassified	Unclassified
Dipt.	*Neuroctena anilis*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Opetia nigra*	+			Tree-associated	Shaded woodland floor
Dipt.	*Opomyza germinationis*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Opomyza petrei*		+		Open habitats	Tall sward and scrub
Dipt.	*Orfelia nemoralis*	+	+		Unclassified	Unclassified
Dipt.	*Oscinella vindicata*	+			Open habitats	Tall sward and scrub

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Dipt.	*Palloptera modesta*	+	+		Open habitats	Unclassified
Dipt.	*Palpomyia brachialis*	+			Unclassified	Unclassified
Dipt.	*Palpomyia luteifemorata*	+			Unclassified	Unclassified
Dipt.	*Palpomyia quadrispinosa*	+		+ **ns**	Wetland	Unclassified
Dipt.	*Paradelia intersecta*	+			Unclassified	Unclassified
Dipt.	*Paragus constrictus*	+		+	Open habitats	Short sward and bare ground
Dipt.	*Pedicia rivosa*		+		Wetland	Unclassified
Dipt.	*Pegomya flavifrons*	+			Unclassified	Unclassified
Dipt.	*Pegomya meridiana*	+		+ **ns**	Unclassified	Unclassified
Dipt.	*Pegomya winthemi*	+	+		Unclassified	Unclassified
Dipt.	*Pegoplata infirma*	+			Unclassified	Unclassified
Dipt.	*Phaonia angelicae*		+		Unclassified	Unclassified
Dipt.	*Phaonia errans*	+	+		Unclassified	Unclassified
Dipt.	*Phaonia erronea*		+		Tree-associated	Shaded woodland floor
Dipt.	*Phaonia incana*	+			Unclassified	Unclassified
Dipt.	*Phaonia pallida*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Phaonia palpata*		+		Tree-associated	Shaded woodland floor
Dipt.	*Phaonia rufiventris*	+	+		Unclassified	Unclassified
Dipt.	*Phaonia subventa*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Phaonia tuguriorum*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Phaonia valida*		+		Unclassified	Unclassified
Dipt.	*Pherbellia cinerella*		+		Open habitats	Tall sward and scrub
Dipt.	*Pherbellia rozkosnyi*		+	+	Wetland	Unclassified
Dipt.	*Pherbellia scutellaris*		+		Tree-associated	Shaded woodland floor
Dipt.	*Pherbina coryleti*	+	+		Wetland	Marshland
Dipt.	*Phronia signata*		+		Unclassified	Unclassified
Dipt.	*Phylidorea ferruginea*	+			Wetland	Marshland; Peatland
Dipt.	*Phyllomyza rubricornis*	+	+	+ **ns**	Unclassified	Unclassified
Dipt.	*Phytosciara flavipes*	+			Unclassified	Unclassified
Dipt.	*Piezura pardalina*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Pipizella viduata*		+		Open habitats	Tall sward and scrub
Dipt.	*Pipunculus campestris*	+			Open habitats	Tall sward and scrub
Dipt.	*Pipunculus lenis*	+			Open habitats	Tall sward and scrub
Dipt.	*Platycheirus albimanus*	+	+		Unclassified	Unclassified
Dipt.	*Platycheirus angustatus*	+			Open habitats; Wetland	Tall sward and scrub
Dipt.	*Platycheirus granditarsus*	+			Wetland	Marshland; Peatland
Dipt.	*Platycheirus scutatus*		+		Open habitats	Tall sward and scrub
Dipt.	*Platypalpus pallidiventris*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Polietes lardarius*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Pollenia amentaria*	+	+		Wetland	Marshland
Dipt.	*Pollenia angustigena*		+		Unclassified	Unclassified
Dipt.	*Pollenia rudis*	+	+		Wetland	Marshland
Dipt.	*Potamia littoralis*	+		+ **ns**	Unclassified	Unclassified
Dipt.	*Protocalliphora azurea*	+		+ **ns**	Unclassified	Unclassified
Dipt.	*Pseudolyciella stylata*	+			Tree-associated	Shaded woodland floor
Dipt.	*Pteromicra angustipennis*		+		Wetland	Peatland
Dipt.	*Ptychoptera lacustris*		+		Tree-associated; Wetland	Running water; Shaded woodland floor; wet woodland
Dipt.	*Renocera pallida*	+			Tree-associated; Wetland	Peatland; Shaded woodland floor; Wet woodland
Dipt.	*Rhagio lineola*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Rhagio notatus*		+		Tree-associated	Shaded woodland floor

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Dipt.	*Rhagio scolopaceus*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Rhamphomyia variabilis*		+		Tree-associated	Shaded woodland floor
Dipt.	*Rhingia campestris*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Rhipidia maculata*	+	+		Tree-associated	Decaying wood; Shaded woodland floor
Dipt.	*Riponnensia splendens*	+	+		Wetland	Peatland
Dipt.	*Sapromyza sexpunctata*		+		Open habitats	Unclassified
Dipt.	*Sarcophaga carnaria*	+	+		Unclassified	Unclassified
Dipt.	*Sarcophaga discifera*		+		Unclassified	Unclassified
Dipt.	*Sarcophaga haemorrhoa*		+		Open habitats	Tall sward and scrub
Dipt.	*Sarcophaga nigriventris*	+			Open habitats	Unclassified
Dipt.	*Sarcophaga teretirostris*		+		Unclassified	Unclassified
Dipt.	*Sargus iridatus*		+		Tree-associated	Shaded woodland floor
Dipt.	*Scaeva pyrastri*		+		Open habitats	Tall sward and scrub
Dipt.	*Scathophaga furcata*	+	+		Open habitats; Wetland	Running water; Tall sward and scrub; Upland
Dipt.	*Scathophaga inquinata*	+	+		Open habitats; Wetland	Running water; Tall sward and scrub; Upland
Dipt.	*Scathophaga stercoraria*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Scathophaga spurca*	+	+		Open habitats; Wetland	Running water; Tall sward and scrub
Dipt.	*Sceptonia flavipuncta*	+		+ **ns**	Unclassified	Unclassified
Dipt.	*Schwenckfeldina carbonaria*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Sciapus platypterus*		+		Tree-associated	Shaded woodland floor
Dipt.	*Seioptera vibrans*	+			Tree-associated	Shaded woodland floor
Dipt.	*Sepedon sphegea*	+			Wetland	Marshland; Peatland
Dipt.	*Sepsis cynipsea*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Sepsis orthocnemis*	+			Open habitats	Tall sward and scrub
Dipt.	*Sepsis punctum*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Sericomyia lappona*	+			Unclassified	Unclassified
Dipt.	*Sericomyia silentis*	+	+		Wetland	Peatland
Dipt.	*Serromyia femorata*		+		Unclassified	Unclassified
Dipt.	*Sicus ferrugineus*	+	+		Open habitats	Short sward and bare ground
Dipt.	*Silba fumosa*	+	+		Unclassified	Unclassified
Dipt.	*Siphona geniculata*		+		Unclassified	Unclassified
Dipt.	*Speolepta leptogaster*		+	+	Unclassified	Unclassified
Dipt.	*Sphaerophoria interrupta*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Sphaerophoria scripta*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Stigmatomeria crassicornis*		+		Unclassified	Unclassified
Dipt.	*Stilobezzia lutacea*	+			Unclassified	Unclassified
Dipt.	*Stilpon nubilus*	+		+	Open habitats	Tall sward and scrub
Dipt.	*Suillia bicolor*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Suillia notata*		+		Tree-associated	Shaded woodland floor
Dipt.	*Suillia parva*		+		Unclassified	Unclassified
Dipt.	*Sylvicola cinctus*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Sylvicola punctatus*	+	+		Open habitats	Unclassified
Dipt.	*Sympycnus pulicarius*	+			Wetland	Marshland; Peatland
Dipt.	*Syritta pipiens*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Syrphus ribesii*	+			Unclassified	Unclassified
Dipt.	*Tachina grossa*	+			Unclassified	Unclassified
Dipt.	*Tachypeza nubila*	+	+		Tree-associated	Decaying wood
Dipt.	*Tephrochlamys flavipes*	+			Tree-associated	Shaded woodland floor

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Dipt.	*Tephrochlamys rufiventris*	+	+		Unclassified	Unclassified
Dipt.	*Tetanocera ferruginea*	+			Wetland	Peatland
Dipt.	*Tetanocera fuscinervis*	+			Wetland	Peatland
Dipt.	*Teuchophorus spinigerellus*	+			Tree-associated, Wetland	Peatland; Running water; Shaded woodland floor; Wet woodland
Dipt.	*Thaumatomyia notata*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Themira minor*	+			Wetland	Marshland; Peatland
Dipt.	*Thricops semicinereus*	+	+		Tree-associated	Shaded woodland floor
Dipt.	*Tipula lateralis*		+		Wetland	Running water
Dipt.	*Tipula maxima*		+		Tree-associated; Wetland	Running water; Shaded woodland floor; Wet woodland
Dipt.	*Tipula oleracea*	+	+		Wetland	Peatland
Dipt.	*Tipula paludosa*	+	+		Open habitats	Tall sward and scrub
Dipt.	*Tipula scripta*		+		Tree-associated	Shaded woodland floor
Dipt.	*Tipula unca*	+			Tree-associated; Wetland	Running water; Shaded woodland floor; Wet woodland
Dipt.	*Tipula variicornis*		+		Tree-associated	Shaded woodland floor
Dipt.	*Tricholauxania praeusta*		+		Tree-associated	Shaded woodland floor
Dipt.	*Trichopsomyia flavitarsis*	+			Wetland	Peatland
Dipt.	*Tricimba cincta*	+			Tree-associated	Decaying wood
Dipt.	*Trigonometopus frontalis*	+			Wetland	Marshland
Dipt.	*Tropidia scita*	+			Wetland	Peatland
Dipt.	*Trypetoptera punctulata*		+		Open habitats	Tall sward and scrub
Dipt.	*Xyphosia miliaria*	+			Open habitats	Short sward and bare ground
Dipt.	*Zaira cinerea*		+		Unclassified	Unclassified
Dipt.	*Zygomyia valida*		+		Unclassified	Unclassified
Hemi.	*Acalypta parvula*	+			Open habitats	Short sward and bare ground
Hemi.	*Adelphocoris lineolatus*		+		Open habitats	Tall sward and scrub
Hemi.	*Anthocoris nemoralis*	+			Tree-associated	Arboreal
Hemi.	*Anthocoris nemorum*		+		Unclassified	Unclassified
Hemi.	*Arctorthezia cataphracta*	+		+	Unclassified	Unclassified
Hemi.	*Berytinus minor*		+		Open habitats	Short sward and bare ground
Hemi.	*Calocoris roseomaculatus*	+	+	+	Open habitats	Short sward and bare ground
Hemi.	*Charagochilus gyllenhalii*		+		Open habitats	Short sward and bare ground
Hemi.	*Chartoscirta cincta*	+			Wetland	Marshland
Hemi.	*Cicadella viridis*	+			Wetland	Unclassified
Hemi.	*Closterotomus norwegicus*		+		Open habitats	Tall sward and scrub
Hemi.	*Compsidolon salicellum*	+			Tree-associated	Arboreal
Hemi.	*Coreus marginatus*		+		Open habitats	Tall sward and scrub
Hemi.	*Corixa dentipes*	+			Wetland	Marshland
Hemi.	*Cymatia bonsdorffii*	+			Wetland	Marshland
Hemi.	*Cymus glandicolor*	+			Wetland	Marshland
Hemi.	*Dolycoris baccarum*	+	+		Open habitats	Tall sward and scrub
Hemi.	*Drymus brunneus*	+			Tree-associated	Shaded woodland floor
Hemi.	*Drymus pilicornis*		+	+	Open habitats	Tall sward and scrub
Hemi.	*Eurygaster testudinaria*	+			Open habitats	Tall sward and scrub

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Hemi.	*Gerris lacustris*	+			Wetland	Marshland
Hemi.	*Gerris odontogaster*	+			Wetland	Marshland
Hemi.	*Glaenocorisa propinqua*	+		+	Wetland	Lake; Peatland
Hemi.	*Globiceps flavomaculatus*		+		Wetland	Marshland
Hemi.	*Hebrus ruficeps*	+			Wetland	Peatland
Hemi.	*Hesperocorixa castanea*	+			Wetland	Peatland
Hemi.	*Hesperocorixa linnaei*	+			Wetland	Marshland
Hemi.	*Hesperocorixa moesta*	+		+	Wetland	Marshland
Hemi.	*Heterotoma planicornis*	+			Open habitats	Tall sward and scrub
Hemi.	*Himacerus mirmicoides*		+		Open habitats	Tall sward and scrub
Hemi.	*Hydrometra stagnorum*	+	+		Wetland	Marshland
Hemi.	*Lygocoris pabulinus*		+		Open habitats	Tall sward and scrub
Hemi.	*Lygus wagneri*	+	+		Open habitats	Tall sward and scrub
Hemi.	*Malacocoris chlorizans*	+			Tree-associated	Arboreal
Hemi.	*Megamelodes 4-maculatus*	+			Wetland	Unclassified
Hemi.	*Nabis limbatus*		+		Open habitats	Tall sward and scrub
Hemi.	*Nabis flavomarginatus*		+		Open habitats	Tall sward and scrub
Hemi.	*Neophilaenus lineatus*	+			Open habitats	Tall sward and scrub
Hemi.	*Nepa cinerea*	+			Wetland	Marshland
Hemi.	*Notonecta glauca*	+			Wetland	Marshland
Hemi.	*Notonecta obliqua*	+			Wetland	Peatland
Hemi.	*Pachybrachius fracticollis*	+			Wetland	Peatland
Hemi.	*Palomena prasina*	+	+		Open habitats	Tall sward and scrub
Hemi.	*Paracorixa concinna*	+			Wetland	Marshland
Hemi.	*Phytocoris varipes*		+		Open habitats	Tall sward and scrub
Hemi.	*Phytocoris longipennis*		+		Tree-associated	Decaying wood
Hemi.	*Phytocoris tiliae*	+			Tree-associated	Arboreal
Hemi.	*Piezodorus lituratus*	+			Open habitats	Unclassified
Hemi.	*Pithanus maerkelii*	+	+		Open habitats	Tall sward and scrub
Hemi.	*Plagiognathus arbustorum*		+		Open habitats	Tall sward and scrub
Hemi.	*Plagiognathus chrysanthemi*		+		Open habitats	Short sward and bare ground
Hemi.	*Psallus haematodes*	+			Tree-associated	Arboreal
Hemi.	*Salda littoralis*		+		Wetland	Running water
Hemi.	*Scolopostethus puberulus*	+			Open habitats	Tall sward and scrub
Hemi.	*Sigara semistriata*	+			Wetland	Peatland
Hemi.	*Stenodema calcarata*	+	+		Open habitats	Tall sward and scrub
Hemi.	*Stenodema laevigata*		+		Open habitats	Tall sward and scrub
Hemi.	*Stygnocoris sabulosus*	+	+		Open habitats	Tall sward and scrub
Hemi.	*Tachycixius pilosus*	+			Unclassified	Unclassified
Hemi.	*Temnostethus gracilis*		+		Unclassified	Unclassified
Hemi.	*Velia caprai*	+			Wetland	Running water
Hemi.	*Zicrona caerulea*	+		+	Open habitats	Tall sward and scrub
Hym.	*Andrena haemorrhoa*		+		Open habitats	Short sward and bare ground
Hym.	*Apis mellifera*		+		Open habitats	Unclassified
Hym.	*Bombus lapidarius*	+	+	+	Open habitats	Tall sward and scrub
Hym.	*Bombus lucorum*	+	+		Open habitats	Tall sward and scrub
Hym.	*Bombus muscorum*	+	+	+	Open habitats	Tall sward and scrub
Hym.	*Bombus pascuorum*	+	+		Open habitats	Tall sward and scrub
Hym.	*Bombus pratorum*	+	+		Open habitats; Tree associated	Shaded Woodland floor; Tall sward and scrub
Hym.	*Bombus sylvarum*	+	+	+	Open habitats	Tall sward and scrub

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Hym.	*Bombus sylvestris*	+	+		Tree-associated	Shaded woodland floor
Hym.	*Bombus terrestris*	+	+		Open habitats	Tall sward and scrub
Hym.	*Chrysis vanlithi*		+	+	Coastal; Open habitats	Seacliff; Short sward and bare ground
Hym.	*Ectemnius continuus*	+	+		Tree-associated	Decaying wood
Hym.	*Formica lemani*	+			Open habitats	Tall sward and scrub
Hym.	*Halictus rubicundus*		+		Open habitats	Short sward and bare ground
Hym.	*Lasioglossum albipes*	+	+		Open habitats	Short sward and bare ground
Hym.	*Lasioglossum fratellum*	+	+		Open habitats	Short sward and bare ground
Hym.	*Leptothorax acevorum*	+			Open habitats	Short sward and bare ground
Hym.	*Myrmica rubra*	+			Open habitats	Tall sward and scrub
Hym.	*Myrmica ruginodis*	+	+		Tree-associated	Shaded woodland floor
Hym.	*Phanacis hypochoeridis*		+		Unclassified	Unclassified
Lep.	*Acronicta rumicis*	+	+		Unclassified	Unclassified
Lep.	*Aglais io*	+	+		Open habitats	Tall sward and scrub
Lep.	*Aglais urticae*	+			Open habitats	Tall sward and scrub
Lep.	*Agrotis exclamationis*		+		Open habitats	Tall sward and scrub
Lep.	*Agrotis puta*		+	+	Open habitats	Tall sward and scrub
Lep.	*Alcis repandata*		+		Unclassified	Unclassified
Lep.	*Aluccita hexadactyla*	+			Open habitats	Tall sward and scrub
Lep.	*Amphipyra pyramidea*	+	+		Tree-associated	Arboreal
Lep.	*Anania funebris*		+	+	Unclassified	Unclassified
Lep.	*Anania fuscalis*		+		Unclassified	Unclassified
Lep.	*Anthocharis cardamines*	+			Open habitats	Tall sward and scrub
Lep.	*Anthophila fabriciana*		+		Open habitats	Tall sward and scrub
Lep.	*Apamea crenata*		+		Open habitats	Tall sward and scrub
Lep.	*Apamea monoglypha*	+	+		Open habitats	Tall sward and scrub
Lep.	*Apamea remissa*		+		Open habitats	Tall sward and scrub
Lep.	*Apamea sordens*		+		Open habitats	Tall sward and scrub
Lep.	*Aphantopus hyperantus*	+	+		Open habitats	Tall sward and scrub
Lep.	*Aplocera plagiata*	+			Open habitats	Tall sward and scrub
Lep.	*Arctia caja*	+			Open habitats	Tall sward and scrub
Lep.	*Argynnis aglaja*	+	+	+	Open habitats	Tall sward and scrub
Lep.	*Argynnis paphia*		+		Open habitats	Tall sward and scrub
Lep.	*Autographa gamma*	+	+		Unclassified	Unclassified
Lep.	*Biston betularia*		+		Unclassified	Unclassified
Lep.	*Boloria euphrosyne*	+	+	+	Open habitats	Short sward and bare ground
Lep.	*Cabera exanthemata*	+			Tree-associated	Arboreal
Lep.	*Cabera pusaria*		+		Tree-associated	Arboreal
Lep.	*Calamia tridens*	+		+	Open habitats	Short sward and bare ground
Lep.	*Calliteara pudibunda*		+		Tree-associated	Arboreal
Lep.	*Callophrys rubi*	+			Open habitats	Tall sward and scrub
Lep.	*Ceramica pisi*		+		Unclassified	Unclassified
Lep.	*Charanyca trigrammica*		+		Open habitats	Tall sward and scrub
Lep.	*Chiasmia clathrata*	+	+		Open habitats	Tall sward and scrub
Lep.	*Chloroclysta siterata*	+	+		Tree-associated	Arboreal
Lep.	*Chrysoteuchia culmella*	+	+		Unclassified	Unclassified
Lep.	*Cochylimorpha straminea*		+		Open habitats	Tall sward and scrub

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Lep.	*Coenonympha pamphilus*	+	+	+	Open habitats	Short sward and bare ground
Lep.	*Colocasia coryli*		+		Tree-associated	Arboreal
Lep.	*Colostygia pectinataria*		+		Open habitats	Tall sward and scrub
Lep.	*Cosmorhoe ocellata*	+	+		Open habitats	Tall sward and scrub
Lep.	*Crambus lathoniellus*		+		Unclassified	Unclassified
Lep.	*Crambus pascuella*		+		Unclassified	Unclassified
Lep.	*Crambus perlella*		+		Unclassified	Unclassified
Lep.	*Crocallis elinguaria*	+			Tree-associated	Arboreal
Lep.	*Cucullia umbratica*		+		Open habitats	Tall sward and scrub
Lep.	*Cupido minimus*		+	+	Open habitats	Tall sward and scrub
Lep.	*Deilephila porcellus*		+		Open habitats	Tall sward and scrub
Lep.	*Diarsia mendica*	+	+		Unclassified	Unclassified
Lep.	*Diarsia rubi*		+		Open habitats	Tall sward and scrub
Lep.	*Dysstroma truncata*		+		Open habitats	Unclassified
Lep.	*Eana penziana*		+		Open habitats	Tall sward and scrub
Lep.	*Eilema griseola*	+			Tree-associated	Arboreal
Lep.	*Electrophaes corylata*		+		Tree-associated	Arboreal
Lep.	*Ematurga atomaria*	+	+		Open habitats	Unclassified
Lep.	*Epiphyas postvittana*		+		Tree-associated	Arboreal
Lep.	*Epirrhoe alternata*	+	+		Open habitats	Tall sward and scrub
Lep.	*Epirrhoe galiata*	+			Open habitats	Tall sward and scrub
Lep.	*Epirrhoe tristata*	+	+	+	Open habitats	Unclassified
Lep.	*Eriogaster lanestris*		+	+	Open habitats	Unclassified
Lep.	*Erynnis tages*	+		+	Open habitats	Tall sward and scrub
Lep.	*Euclidia glyphica*	+	+		Open habitats	Tall sward and scrub
Lep.	*Euclidia mi*	+	+		Open habitats	Tall sward and scrub
Lep.	*Eudonia angustea*		+		Unclassified	Unclassified
Lep.	*Eulithis testacea*	+			Tree-associated	Arboreal
Lep.	*Euphydryas aurinia*	+		+	Open habitats	Tall sward and scrub
Lep.	*Eupithecia centaureata*		+		Open habitats	Short sward and bare ground
Lep.	*Eupithecia distinctaria*		+		Open habitats	Short sward and bare ground
Lep.	*Eupithecia pusillata*	+			Tree-associated	Arboreal
Lep.	*Eupithecia subumbrata*		+		Open habitats	Tall sward and scrub
Lep.	*Euthrix potatoria*	+			Open habitats	Tall sward and scrub
Lep.	*Gonepteryx rhamni*	+	+		Unclassified	Unclassified
Lep.	*Hada plebeja*		+		Open habitats	Tall sward and scrub
Lep.	*Hemaris tityus*	+			Open habitats	Tall sward and scrub
Lep.	*Hepialus humuli*		+		Open habitats	Tall sward and scrub
Lep.	*Hipparchia semele*	+	+	+	Open habitats	Short sward and bare ground
Lep.	*Hydriomena furcata*	+			Tree-associated	Arboreal
Lep.	*Idaea biselata*	+			Tree-associated	Shaded woodland floor
Lep.	*Inachis io*	+			Open habitats	Tall sward and scrub
Lep.	*Jodis lactearia*		+		Tree-associated	Arboreal
Lep.	*Korscheltellus fusconebulosa*		+		Open habitats	Tall sward and scrub
Lep.	*Lacanobia contigua*		+		Open habitats; Tree associated	Shaded Woodland floor; Tall sward and scrub
Lep.	*Lasiocampa quercus*	+			Unclassified	Unclassified
Lep.	*Lasiommata megera*		+	+	Open habitats	Short sward and bare ground
Lep.	*Leptidea sinapis*	+	+	+	Open habitats	Tall sward and scrub

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Lep.	*Lomaspilis marginata*	+			Tree-associated	Arboreal
Lep.	*Lycaena phlaeas*	+	+		Open habitats	Tall sward and scrub
Lep.	*Lycophotia porphyrea*		+		Open habitats	Unclassified
Lep.	*Macroglossum stellatarum*	+	+		Unclassified	Unclassified
Lep.	*Maniola jurtina*	+	+		Open habitats	Tall sward and scrub
Lep.	*Melanchra persicariae*		+		Unclassified	Unclassified
Lep.	*Merrifieldia leucodactyla*		+	+	Unclassified	Unclassified
Lep.	*Mesoleuca albicillata*		+		Tree-associated	Arboreal
Lep.	*Mirificarma mulinella*		+		Open habitats	Tall sward and scrub
Lep.	*Mythimma impura*	+			Open habitats	Tall sward and scrub
Lep.	*Noctua comes*	+			Unclassified	Unclassified
Lep.	*Noctua janthe*	+			Unclassified	Unclassified
Lep.	*Noctua pronuba*	+			Open habitats	Tall sward and scrub
Lep.	*Notodonta ziczac*	+			Tree-associated	Arboreal
Lep.	*Ochropleura plecta*		+		Open habitats	Tall sward and scrub
Lep.	*Oligia fasciuncula*		+		Open habitats	Tall sward and scrub
Lep.	*Oligia strigilis*		+		Open habitats	Tall sward and scrub
Lep.	*Opisthograptis luteolata*		+		Tree-associated	Arboreal
Lep.	*Pandemis cerasana*		+		Tree-associated	Arboreal
Lep.	*Pararge aegeria*	+	+		Open habitats	Tall sward and scrub
Lep.	*Paratalanta pandalis*		+	+	Unclassified	Unclassified
Lep.	*Perconia strigillaria*		+		Open habitats	Unclassified
Lep.	*Peribatodes rhomboidaria*	+			Tree-associated	Arboreal
Lep.	*Phalera bucephala*		+		Tree-associated	Arboreal
Lep.	*Phlogophora meticulosa*	+	+		Unclassified	Unclassified
Lep.	*Photedes captiuncula*	+		+	Open habitats	Tall sward and scrub
Lep.	*Phytometra viridaria*	+		+	Open habitats	Tall sward and scrub
Lep.	*Pieris brassicae*	+			Open habitats	Unclassified
Lep.	*Pieris napi*	+	+		Open habitats	Unclassified
Lep.	*Platyptilia tesseradactyla*		+	+	Open habitats	Unclassified
Lep.	*Polia nebulosa*		+		Unclassified	Unclassified
Lep.	*Polyommatus icarus*	+	+		Open habitats	Short sward and bare ground
Lep.	*Pseudopanthera macularia*		+		Open habitats	Tall sward and scrub
Lep.	*Pseudopterna pruinata*	+			Open habitats	Tall sward and scrub
Lep.	*Pyrausta purpuralis*	+	+		Open habitats	Short sward and bare ground
Lep.	*Pyrausta sanguinalis*		+	+	Open habitats	Short sward and bare ground
Lep.	*Rusina ferruginea*		+		Open habitats	Tall sward and scrub
Lep.	*Scoparia ambigualis*		+		Unclassified	Unclassified
Lep.	*Scoparia pyralella*		+		Unclassified	Unclassified
Lep.	*Scoparia subfusca*		+		Unclassified	Unclassified
Lep.	*Scotopteryx chenopodiata*	+			Open habitats	Tall sward and scrub
Lep.	*Selenia dentaria*	+			Tree-associated	Arboreal
Lep.	*Setina irrorella*	+	+	+	Open habitats	Short sward and bare ground
Lep.	*Spilosoma lubricipeda*		+		Open habitats	Tall sward and scrub
Lep.	*Spilosoma lutea*		+		Unclassified	Unclassified
Lep.	*Stenoptilia bipunctidactyla*		+		Open habitats	Tall sward and scrub
Lep.	*Stilbia anomala*	+			Open habitats	Unclassified
Lep.	*Tetheella fluctuosa*		+		Tree-associated	Arboreal

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Lep.	*Thecla betulae*	+		+	Tree-associated	Arboreal
Lep.	*Tyria jacobaeae*	+	+		Open habitats	Tall sward and scrub
Lep.	*Vanessa cardui*		+		Unclassified	Unclassified
Lep.	*Xanthorhoe ferrugata*	+	+		Open habitats	Tall sward and scrub
Lep.	*Xanthorhoe montanata*		+		Open habitats	Tall sward and scrub
Lep.	*Xestia baja*	+			Unclassified	Unclassified
Lep.	*Zygaena purpuralis*	+	+	+	Coastal; Open habitats	Seacliff; Short sward and bare ground
Moll.	*Acanthinula aculeata*		+	+	Tree-associated	Shaded woodland floor
Moll.	*Aegopinella nitidula*		+		Open habitats	Tall sward and scrub
Moll.	*Aegopinella pura*		+		Tree-associated	Shaded woodland floor
Moll.	*Arion ater*	+			Open habitats	Tall sward and scrub
Moll.	*Balea perversa*		+	+	Unclassified	Unclassified
Moll.	*Balea sarsii*	+	+		Unclassified	Unclassified
Moll.	*Bathyomphalus contortus*	+			Wetland	Marshland
Moll.	*Bithynia tentaculata*	+			Wetland	Marshland
Moll.	*Carychium tridentatum*		+		Open habitats	Tall sward and scrub
Moll.	*Cepaea hortensis*	+	+		Open habitats	Tall sward and scrub
Moll.	*Cepaea nemoralis*		+		Open habitats	Tall sward and scrub
Moll.	*Clausilia bidentata*		+		Open habitats	Tall sward and scrub
Moll.	*Cochlicopa lubrica*		+		Open habitats	Tall sward and scrub
Moll.	*Cochlicopa lubricella*		+		Open habitats	Short sward and bare ground
Moll.	*Columella aspera*		+		Open habitats	Unclassified
Moll.	*Cornu aspersum*		+		Open habitats	Tall sward and scrub
Moll.	*Deroceras reticulatum*		+		Open habitats	Tall sward and scrub
Moll.	*Discus rotundatus*	+	+		Open habitats	Tall sward and scrub
Moll.	*Euconulus alderi*		+		Wetland	Marshland
Moll.	*Galba truncatula*	+	+		Wetland	Marshland
Moll.	*Helicella itala*	+	+	+	Open habitats	Short sward and bare ground
Moll.	*Lauria cylindracea*		+		Open habitats	Tall sward and scrub
Moll.	*Leiostyla anglica*		+	+	Open habitats	Tall sward and scrub
Moll.	*Lymnaea fuscus*	+			Wetland	Marshland
Moll.	*Lymnaea stagnalis*	+			Wetland	Marshland
Moll.	*Musculium lacustre*	+		+	Unclassified	Unclassified
Moll.	*Nesovitrea hammonis*	+			Open habitats	Tall sward and scrub
Moll.	*Oxychilus alliarius*		+		Open habitats	Tall sward and scrub
Moll.	*Oxychilus cellarius*		+		Open habitats	Tall sward and scrub
Moll.	*Oxyloma elegans*	+			Wetland	Marshland
Moll.	*Pisidium nitidum*	+			Unclassified	Unclassified
Moll.	*Pisidium personatum*	+			Unclassified	Unclassified
Moll.	*Planorbis carinatus*	+			Wetland	Marshland
Moll.	*Planorbis planorbis*	+			Wetland	Lake; Peatland
Moll.	*Punctum pygmaeum*		+		Unclassified	Unclassified
Moll.	*Pyramidula pusilla*	+	+		Open habitats	Short sward and bare ground
Moll.	*Radix balthica*	+			Unclassified	Unclassified
Moll.	*Sphaerium corneum*	+			Unclassified	Unclassified
Moll.	*Trochulus hispidus*	+	+		Open habitats	Tall sward and scrub
Moll.	*Trochulus striolatus*		+		Open habitats	Tall sward and scrub
Moll.	*Valvata piscinalis*	+			Wetland	Marshland
Moll.	*Vertigo antivertigo*		+	+	Wetland	Peatland
Moll.	*Vertigo pygmaea*		+	+	Open habitats	Tall sward and scrub
Moll.	*Vertigo substriata*		+	+	Wetland	Marshland

Higher taxon	Species name	B	SC	Not.	Biotope(s)	Habitat(s)
Moll.	*Zonitoides nitidus*	+			Wetland	Marshland
Odo.	*Aeshna grandis*	+			Wetland	Marshland
Odo.	*Aeshna juncea*	+			Wetland	Peatland
Odo.	*Brachytron pratense*	+	+		Wetland	Peatland
Odo.	*Coenagrion lunulatum*	+		+	Wetland	Marshland
Odo.	*Coenagrion puella*	+			Wetland	Marshland
Odo.	*Coenagrion pulchellum*	+			Wetland	Marshland
Odo.	*Enallagma cyathigerum*	+			Wetland	Marshland
Odo.	*Ischnura elegans*	+			Wetland	Marshland
Odo.	*Lestes sponsa*	+			Wetland	Marshland
Odo.	*Libellula quadrimaculata*	+			Wetland	Marshland
Odo.	*Pyrrhosoma nymphula*	+			Wetland	Peatland
Odo.	*Sympetrum danae*	+			Wetland	Peatland
Odo.	*Sympetrum striolatum*	+	+		Wetland	Marshland
Orth.	*Chorthippus brunneus*	+	+		Open habitats	Tall sward and scrub
Orth.	*Myrmeleotettix maculatus*	+	+		Open habitats	Short sward and bare ground
Orth.	*Omocestus viridulus*	+	+		Open habitats	Tall sward and scrub
Orth.	*Pholidoptera griseoaptera*		+	+	Open habitats	Tall sward and scrub
Orth.	*Tetrix subulata*	+			Wetland	Peatland
Orth.	*Tetrix undulata*	+			Open habitats	Tall sward and scrub

Appendix 2 Monitoring target species Ballyogan

Species names have been grouped in the table by species assemblage. The blue shaded applied to some species is to indicate that not every species must be found during each monitoring exercise for the site to still be regarded as favourable. This is because of the unpredictability of finding a particular species within the group due to difficultly in detection.

Species assemblage	Habitats	Target species	Search method & notes
Mineral Marsh and open water assemblage	Lakes, pools and lake margins	Hairy Hawker *Brachytron pratense*	Field observation mid-May to early July. Must be found within one hour of searching.
Mineral Marsh and open water assemblage	Lakes, pools and lake margins	Irish Damselfly *Coenagrion lunulatum*	Field observation mid-May to late July. Must be found within two hours of searching
Mineral Marsh and open water assemblage	Lakes, pools and lake margins	*Dolomedes fimbriatus*	Netting along vegetated margins of lakes and cut-over fen pools. Adults present all year but can be identified as juveniles. Must be found within two hours of searching.
Mire assemblages	*Cladium* fen, cut-over fen, basin mire	*Laccornis oblongus*	Netting in fen habitats including cut-over pools. Present as adults all summer. Find within three hours of searching. Two of blue five must be found.
Mire assemblages	*Cladium* fen, cut-over fen, basin mire	*Pterostichus aterimus*	Sieving moss and litter from fen and fen margins. Find within three hours of searching. Two of blue five must be found.
Mire assemblages	*Cladium* fen, cut-over fen, basin mire	*Bagous lutosus*	Sweep netting vegetation in/around basin mire and fen June to August. Find within three hours of searching. Two of blue five must be found.
Mire assemblages	*Cladium* fen, cut-over fen, basin mire	*Hypomma fulvum*	Sieving moss and litter from fen and fen margins. Find within three hours of searching. Two of blue five must be found.
Mire assemblages	*Cladium* fen, cut-over fen, basin mire	*Philonthus corvinus*	Sieving moss and litter from fen and fen margins. Find within three hours of searching. Two of blue five must be found.
Mire assemblages	*Cladium* fen, cut-over fen, basin mire	*Attulus caricis*	Sweeping field layer and sieving moss and litter from fen and fen margins. Find within three hours of searching. Must be found.
Mire assemblages	*Cladium* fen, cut-over fen, basin mire	Water Spider *Argyroneta aquatica*	Easily identifiable as adult or sub-adult by the velvet-grey water-repellent abdomen. Adults present year-round but most abundant in summer. Find within three hours of searching. Must be found.

Species assemblage	Habitats	Target species	Search method & notes
Mire assemblages	*Cladium* fen, cut-over fen, basin mire	*Pirata tenuitarsis*	Sieving moss and litter from fen and fen margins. Find within three hours of searching. Must be found.
Mire assemblages	*Cladium* fen, cut-over fen, basin mire	*Scolopostethus puberulus*	Adults present late August into the winter. Sieving moss and litter from ground layer. Find within three hours of searching. Must be found.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	Dingy Skipper *Erynnis tages*	Field observation around limestone pavement and calcareous grassland. Most adults emerge between early May and the end of June. Must be found within one hour of searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	Pearl-bordered Fritillary *Boloria euphrosyne*	Field observation. Adults are on the wing between late May and mid-July in grassland sheltered by blocks of scrub or woodland margins. Must be found within one hour of searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	Transparent Burnet *Zygaena purpuralis*	Field observation on limestone pavement and calcareous grassland. Flight season is quite narrow and mostly confined to June. Must be found within one hour of searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	Marsh Fritillary *Euphydryas aurinia*	Autumn (September to mid-October) larval web counts and habitat assessment following standard methodology. See instructions on National Biodiversity Data Centre website
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	Grayling *Hipparchia semele*	Field observation across limestone pavement and surrounding areas of short calcareous grassland in July and August. Must be found within one hour of searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	*Calocoris roseomaculatus*	Sweeping flower-rich calcareous grassland. Adult season early July to end of August. Must be found within two hours of searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	Blue Shieldbug *Zicrona caerulea*	Beat willows and sedges around the margins of fen habitats; sweeping. Adults present from late summer into autumn but can be identified from nymphs. Must be found within two hours of searching
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	*Drymus pilicornis*	Sweeping and sieving moss on calcareous grassland. Adults present August through September. Must be found within two hours of searching.

Species assemblage	Habitats	Target species	Search method & notes
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	*Cheilosia ahenea*	Sweeping vegetation on limestone pavement. Adults peak in May but persist into June. Must be found within two hours of searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	*Microdon mutabilis*	This large hoverfly has a characteristic lazy flight over limestone pavement and adjacent short grassland and is identifiable to genus by eye. It is advisable however to take specimens to rule out the congener *M. myrmicae*. Flight season May to June. Must be found within two hours of searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	*Paragus constrictus*	Sweeping vegetation on limestone pavement. Adults present from late spring to early autumn. Must be found within two hours of searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	*Dipoena tristis*	Sweeping vegetation on limestone pavement. Adults present from late May to end of July. Must be found within two hours of searching.
Arboreal canopy assemblage	Tree canopy dwelling species	Brown Hairstreak *Thecla betulae*	Field observation along the edges of woodland and blocks of scrub containing *Prunus spinosa*. Adults fly between late July and September. Can also be surveyed in winter by egg counts. Must be found within one day searching.
Arboreal shaded woodland floor	Woodland floor under closed canopy	*Asthenargus paganus*	Sieving moss and leaf litter on woodland floor. Must be found within two hours searching.
Arboreal shaded woodland floor	Woodland floor under closed canopy	*Helina abdominalis*	Flight intercept traps, June to end of August.
Arboreal shaded woodland floor	Woodland floor under closed canopy	*Fannia aequilineata*	Flight intercept traps, June to end of August.

Appendix 3 Monitoring target species Slieve Carran

Species names have been grouped in the table by species assemblage. The blue shaded applied to some species is to indicate that not every species must be found during each monitoring exercise for the site to still be regarded as favourable. This is because of the unpredictability of finding a particular species within the group due to difficultly in detection.

JNCC Assemblage	Habitats	Target species	Search method & notes
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	Scarce Crimson and Gold *Pyrausta sanguinalis*	Field observation on limestone pavement and adjacent calcareous grassland in June. Must be found within two hours searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	Irish Plume *Platyptilia tesseradactyla*	Field observation on limestone pavement and adjacent calcareous grassland in late May and June. Must be found within two hours searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	Thyme Plume *Merrifieldia leucodactyla*	Field observation on limestone pavement and adjacent calcareous grassland in June. Must be found within two hours searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	Grayling *Hipparchia semele*	Field observation across limestone pavement and surrounding areas of short calcareous grassland in July and August. Must be found within two hours searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	Dingy Skipper *Erynnis tages*	Field observation around limestone pavement and calcareous grassland. Most adults emerge between early May and the end of June. Must be found within two hours searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	White-spotted Sable *Anania funebris*	Field observation and sweeping calcareous grassland. Flight period mid-May to mid-July. Must be found within three hours searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	*Calocoris roseomaculatus*	Sweeping flower-rich calcareous grassland. Adult season early July to end of August. Must be found within two hours searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	Dark Bush Cricket *Pholidoptera griseoaptera*	Sweeping woodland and scrub block margins between August and October. Must be found within four hours searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	*Micrommata virescens*	Beating or sweeping woodland, scrub margins and hedgerows including tall grass tussocks from June to August Must be found within three hours searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous	*Zelotes apricorum*	Pitfalls in limestone pavement or turning stones May to September.

JNCC Assemblage	Habitats	Target species	Search method & notes
	grassland and scrub/hedgerow margins		
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	*Dipoena tristis*	Sweeping vegetation on limestone pavement. Adults present from late May to end of July. Must be found within three hours searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	*Cheilosia ahenea*	Sweeping vegetation on limestone pavement. Adults peak in May but persist into June. Must be found within three hours searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	*Microdon mutabilis*	This large hoverfly has a characteristic lazy flight over limestone pavement and adjacent short grassland and is identifiable to genus by eye. It is advisable however to take specimens to rule out the congener *M. myrmicae*. Flight season May to June. Must be found within three hours searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	*Pipizella viduata*	Sweeping flower-rich limestone grassland from June to July. Must be found within three hours searching.
Grassland and scrub matrix assemblage	Wet grassland, limestone pavement, calcareous grassland and scrub/hedgerow margins	*Paragus constrictus*	Sweeping vegetation on limestone pavement. Adults present from late spring to early autumn. Must be found within three3 hours searching.
Arboreal canopy	Tree canopy species	Small Eggar *Eriogaster lanestris*	Best surveyed by looking for the very distinctive larval webs in June and July on *Prunus spinosa*. Must be found within a day's searching.
Arboreal shaded woodland floor	Woodland floor under closed canopy	*Diogma gabrata*	Flight intercept traps, June to end of August. One of green three must be found.
Arboreal shaded woodland floor	Woodland floor under closed canopy	*Molophilus lackschewitzianus*	Flight intercept traps, June to end of August. One of green three must be found.
Arboreal shaded woodland floor	Woodland floor under closed canopy	*Limonia trittivata*	Flight intercept traps, June to end of August. One of green three must be found.