

INSECT RECORDS FROM THE CONNEMARA (CO. GALWAY) AND MAYO (CO. MAYO) NATIONAL PARKS, WESTERN IRELAND

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Summary

Records of 304 insect species are provided for the Connemara National Park (Co. Galway, Ireland). Records of 131 insect species are provided for the Mayo National Park (Co. Mayo, Ireland). The two lists are briefly discussed. Comparison between them is confined to consideration of the Sciomyzidae and Syrphidae (Diptera), for which databased information is available. It is suggested that fewer species are recorded from the Mayo Park because of both the narrower range of habitats present and the area's recent management history. Scarcity of water bodies in both Parks is highlighted as a probable reason for the absence of many sciomyzid and syrphid species whose presence would be predicted in the habitats surveyed.

Introduction

The Connemara and Mayo National Parks are both low altitude areas covered largely by blanket bog that has been modified to various extents by human activity. Both are located in the west of Ireland and both are now being managed to maintain and enhance their floral, faunal and archaeological interest, while at the same time presenting these heritage elements to visitors. The Mayo National Park was established more recently (1998) than the Connemara National Park (1980), so its biota have had less time in which to respond to management aimed at their conservation.

Every species record from a site is a basic biogeographical datum potentially of use in various ways. In the case of a National Park, or other protected area, knowledge of the resource

to be managed is vital to the land manager and compilation of lists of the organisms present on a site is a necessary first step in that direction. But species lists are not, of themselves, interpretable. The scientific names of the species listed here for the Connemara and Mayo National Parks are just that, names. In a biogeographic context such issues as whether a list signals noticeable extensions to the known range of species, or occurrence of rarely recorded species, may be regarded as of interest. But knowing which species have such biogeographic interest can only help a land manager to orient management toward their protection if ecological data on the relevant species are also accessible.

There are scattered records of insects published for the areas now within these two National Parks, but little systematic survey data are available. To gather information on those components of the insect fauna susceptible to collection by interception traps, Malaise trap surveys were carried out in both Parks. The Connemara Park was surveyed in 1994, the Mayo Park in 1997. The present text lists some of the insects found. It does not represent a comprehensive listing of all the insects collected - the taxonomic groups covered reflect the taxonomic expertise of the author, rather than the range of material available. In the case of the Sciomyzidae and Syrphidae (Diptera), computerised autecological data are employed to identify habitats and parts of habitats that have the poorest representation of species, in comparison with the fauna expected to occur. Some consideration is then given to whether appropriate management might be expected to lead to improved representation of species.

Methods

Malaise traps were installed in pairs at various low-altitude locations within the Parks, chosen to reflect the range of habitats represented in them and to provide easy access for trap servicing. The trap locations were decided in discussion with Park personnel and the traps were installed with their long axis oriented N/S wherever possible, the south end of each trap (with its collecting bottle) being its highest point. Approximately 70% ethanol was used as

preservative in the Malaise trap sample bottles, which were replaced at approximately fortnightly intervals. In the Connemara Park, the trapping programme started 1 May and finished 7 September. In the Mayo Park trapping was from 1 June to 20 August. The habitat types observed where each Malaise trap was installed were also recorded, using the habitat categories defined in the StN database.

On removal from the Malaise traps sample bottles were capped, labelled, and stored to await sorting. Sorting was carried out in the laboratory, only those insects representative of certain taxonomic groups being sorted out and transferred to tubes containing 70% alcohol, to await determination. The rest of the collected material was retained in the sample bottles. Species belonging to the taxonomic groups selected for determination were sorted into tubes, with the exception of *Medetera* and *Thrypticus* species (Dolichopodidae: Diptera) and *Euura* and allied genera (Tenthredinidae: Hymenoptera), most of the species of which were judged too difficult to determine reliably.

Following determination, the sorted material was re-united with its parent sample, but in a small, capped, plastic tub containing 70% alcohol, that was inserted into the Malaise trap sample bottle. In this way, the determined material could be relocated, if necessary, without the need to resort the samples. The National Museum of Ireland has agreed to store the Malaise trap samples as reference data sets for the Parks.

In comparing the fauna of the two Parks, the Macrohabitats, Microhabitats and Range and Status files of the Syrph the Net (StN) database have been used (Speight *et al.*, 2003a, b; Speight and Castella, 2003). Since this database only covers European Syrphidae (Diptera) and equivalent databases are not available for other taxonomic groups, comparisons of habitat occupancy between the two Parks are thus largely confined to their syrphid faunas, although a limited investigation of the sciomyzids has also been carried out, based on databased Macrohabitat information.

Using the StN database, a first step is to associate the recorded species with the habitats

observed. This is achieved by using the Macrohabitat association data coded into the database, to produce a list of the recorded species predicted to occur with each of the habitats observed. These lists can then be compared with the lists of the species expected to occur in those habitats, basing prediction on the species available within various species pools of different geographical extent. In this instance the species in the county fauna (Co. Galway in the case of the Connemara Park, Co. Mayo in the case of the Mayo Park) expected to occur in each Park have been predicted, as have the Irish species in general and the species of the northern section of the Atlantic zone of Europe (Atlantic parts of Europe from Germany south to the River Loire). This comparison suggests whether the observed fauna of each habitat is well represented or under-represented. The fauna of a given habitat is taken to be well represented on a site if 75% or more of its expected species are observed on that site. Similarly, a fauna can be regarded as reasonably-represented if 50% or more of its expected species are present. Choice of the 75% and 50% levels is arbitrary, but provides for a standardised basis for comparison and evaluation of faunas.

A second step is to examine microhabitat occupancy levels in the habitats present, to establish whether apparently "under-performing" habitat components can be identified, through under-representation of their associated fauna. In this instance, micro-habitat occupancy levels have been examined for all habitats found in the vicinity of the sampling stations (i.e. Malaise trap emplacements), but with the habitats categorised into three broad groups: open ground, wetland and forest plus scrub. Since there are more than 80 microhabitat categories coded into the syrphid database, presentation of microhabitat occupancy levels for the Parks is confined to those micro-habitats that appear to be under-performing. In each case, a micro-habitat in a given habitat (or group of habitats) is taken to be potentially under-performing if its observed fauna represents less than 50% of the expected Galway species.

A more limited exercise has been carried out using the sciomyzids, or snail-killing flies, for which Macrohabitat association data have now been databased. Using the sciomyzid

Macrohabitat-association data with the list of habitats for the two Parks, lists of sciomyzids predicted to occur have been derived, based on the Irish and county species pools. The sciomyzids predicted to occur in association with water bodies (pools, streams, flushes) alone, within the Parks, have then been considered separately.

Results

The 353 species recorded are listed in Appendix 1. Of these, 304 are reported from the Connemara Park, but only 131 from the Mayo Park. It is possible to look more closely at these differences, firstly by considering the range of habitats observed and secondly by considering in more detail the species of syrphid associated with those habitats, using the StN database. There are 67 species of Syrphidae recorded here from the Connemara Park and 30 from the Mayo Park. Among the observed Connemara Park species, 60 would be predicted to occur there, on the basis of their known habitat associations, while 7 (i.e. 10% of the recorded species) would not. On the same basis, of the Mayo Park species, 2 (7%) would not be predicted to occur. These non-predicted species are as follows:-

Connemara National Park

Cheilosia longula, *Eristalis tenax*, *Eupeodes corollae*, *Portevinia maculata*, *Rhingia campestris*, *Scaeva pyrastris*, *Volucella pellucens*;

Mayo National Park

Eupeodes corollae, *Xanthandrus comtus*

The habitat categories recorded in the vicinity of the Malaise traps are listed in Appendix 2. From these lists it is clear that a wider range of habitats can be observed in the Connemara Park than in the Mayo Park. The numbers of syrphid species predicted for the two Parks, on the basis of the presence of these habitats, are shown in Tables 1 and 2. Tables 3 and 4 list microhabitats highlighted as potentially under-performing in biodiversity maintenance terms, again based on the syrphid data.

Tables 1 and 2 show that there is considerable variation between habitat categories, in the extent to which Park faunas are apparently "complete", when compared with the faunas for the same habitats in the larger geographic areas represented by county, Ireland and the northern section of the Atlantic zone. However, these Tables also show that the fauna of the Mayo Park habitats is consistently less diverse than might be expected, particularly in comparison with the fauna of the same habitats in Co. Mayo in general.

From Tables 3 and 4, it is noticeable that, in the Connemara Park, although microhabitat occupancy levels are at least reasonable, overall, there is a group of water-associated features, particularly in wetland habitats present (in this case blanket bog and cut-away blanket bog), that appear to be under-performing. In the Mayo Park (Table 4), by contrast, microhabitats in both open ground and wetland habitats are apparently generally under-performing, with most of the individual open ground microhabitats involved showing less than 25% of their expected fauna. In wetland habitats, under-performance by water-saturated sediments is highlighted.

Table 5 shows that the Mayo Park sciomyzid fauna is both predicted and observed to be less diverse than that of the Connemara Park. It also shows that, in both Parks, sciomyzids associated with water bodies make up half or more of the "missing" species, among those predicted to occur.

TABLE 1. Numbers of species of Syrphidae (Diptera) associated with Connemara Park habitats, in species pools derived from nested areas of differing geographical extent i.e. the species list for the Connemara Park is a subset of the species list for Galway, which is itself a subset of the Irish list, which is likewise a subset of the list for the northern part of the Atlantic zone of Europe.

Abbreviations used: IRL = the island of Ireland; N Atlantic = the northern section of the Atlantic zone of Europe (i.e. Atlantic parts of Germany, Denmark, Netherlands, Belgium and France south to the River Loire, plus Britain and Ireland).

Connemara National Park	No spp predicted for National Park based on different species pools			
Habitat category observed	N Atlant	IRL	Galway	Nat Park list
forest and scrub habitat categories				
<i>Betula</i> saplings	8	8	8	4
Humid <i>Fagus</i> forest, mature	39	27	22	15
<i>Ulex</i> thickets	4	4	4	3
<i>Alnus</i> swamp woodland (gen.)	18	18	18	11
<i>Salix</i> swamp woodland (gen.)	35	29	25	16
Scattered <i>Salix</i>	4	4	4	4
Plantations (<i>Abies/Larix/Picea</i> , <i>Pinus</i>) with trackside ditches	48	38	28	21
open ground habitat categories				
Humid, oligotrophic, unimproved				
<i>Molinia</i> grassland with brooks	31	31	29	23
Moorland with brooks/ivers	26	21	19	17
wetland habitat categories				
Blanket bog with brooks/ivers and pools	15	15	15	10
Cutaway bog with brooks/ivers and pools	34	33	30	17

TABLE 2. Numbers of species of Syrphidae (Diptera) associated with Mayo Park habitats, in species pools derived from nested areas of differing geographical extent (as in Table 1).

Abbreviations used: as in Table 1.

Mayo National Park	No spp predicted for National Park based on different species pools			
	N Atlant	IRL	Mayo	Nat Pk list
Habitat category observed				
forest and scrub habitat categories				
<i>Ulex</i> thickets	4	4	4	3
Scattered <i>Salix</i>	4	4	4	2
<i>Pinus</i> plantation with tracks	23	21	12	6
open ground habitat categories				
Humid, oligotrophic, unimproved grassland with temporary pools	55	51	44	15
wetland habitat categories				
Blanket bog with brooks/rivers	13	13	12	7
Cutaway bog with brooks/rivers and pools	34	33	29	14

TABLE 3. Numbers of species predicted and observed, and percent occupancy, for apparently under-performing microhabitats in Connemara Park habitats.

Connemara Park	Microhabitat occupancy level		
	predicted	observed	% occupancy
Forest microhabitats			
all	51	33	65
plant stems (hibernation)	3	1	33
Open ground microhabitats			
all	33	26	79
slow-moving water	4	1	25
Wetland microhabitats			
all	33	20	61
root-aphids (grass-root zone)	3	1	33
emergent aquatic plants	10	4	25
submerged, non-woody vegetable debris	11	5	46
oligotrophic water	15	6	40
eutrophic water	3	1	33
slow-moving water	5	2	40
standing water	16	7	44

TABLE 4. Numbers of syrphids predicted and observed, and percent occupancy, for apparently under-performing microhabitats in Mayo Park habitats.

Mayo Pk	Microhabitat occupancy level		
	predicted	observed	% occupancy
Forest microhabitats			
all	15	8	53
understorey trees	12	5	42
shrubs and bushes	13	6	46
Open ground microhabitats			
all	42	14	33
low shrubs	3	1	33
herb layer plants (in)	5	0	0
submerged sediment (inc all subcats)	18	4	22
water-saturated mud	11	1	9
water-saturated peat	11	2	18
oligotrophic water	15	4	27
mesotrophic water	17	4	24
eutrophic water	9	3	33
slow-moving water	8	1	13
standing water	19	4	21
Wetland microhabitats			
all	31	15	48
root aphids, grass-root zone	3	1	33
submerged sediment (inc all subcats)	12	4	33
water-saturated mud	6	1	17
water-saturated peat	7	2	29
oligotrophic water	14	5	36
mesotrophic water	7	3	43
slow-moving water	4	1	25
standing water	15	5	33

TABLE 5. Numbers of sciomyzid species predicted and observed, shown for all habitats and for water bodies (pools, streams, flushes) alone, in the Connemara and Mayo National Parks.

	Number of sciomyzid species		
	Irish spp	Galway spp	Observed
Connemara Nat. Pk			
Predicted for all Pk habitats	26	20	11
Predicted for Pk.water bodies	12	7	1
Mayo Nat. Pk.			
Predicted for all Pk habitats	20	15	5
Predicted for Pk.water bodies	7	6	1

Discussion

None of the species listed here are included on any list of organisms requiring protection at the international level. Most of the listed species belong to the insect Order Diptera and there are no species of Diptera named in the Habitats Directive, for example, as requiring protection at European level. Whatever their biogeographic status these organisms are, then, "second-class", in that National Agencies are under no direct obligation to protect them under the provisions of international legislation, other than through the more vague requirements of the Biodiversity Convention. This can mean that such species also become *de facto* second class organisms, since land managers, faced with meeting daunting and exacting management objectives defined by existing legislation, have little time and resources available for such "faceless" species. Further, merely knowing that a species has some particular biogeographical interest does not, in itself, help a land manager to protect that species. Yet, some of the species listed here, for these two National Parks, could be recognised as extremely localised in Ireland and others might be of international interest. Some of them were recorded for the first time in Ireland during this survey work, and have been published as such (see, for example, Speight, 1995, 1996). But there is little utility attached to highlighting the occurrence of the rare or probably threatened species, if insufficient can be said of them to provide a basis for their

protection. To provide such supporting data is, in any case, beyond the scope of the present text. The alternative is to attempt to gain an overview of the list, by considering its constituent species together. Unfortunately, this is not possible either, in any comprehensive fashion, since to carry out such an operation objectively requires the information on the species to be first databased in some way, so that they can all be subject to the same forms of scrutiny, and databased information is not available for the vast majority of the listed species. Only for the Sciomyzidae and Syrphidae can this sort of exercise be conducted at present. So consideration of biodiversity issues in this text is largely dependent upon an examination of the species belonging to these two fly families, and as such is confined to consideration of probably only 1% of the fauna of the Parks.

Some of the syrphids recorded from the Parks are not predicted to occur there, and have for that reason been excluded from consideration. Four of those species (*Eristalis tenax* (L.), *Eupeodes corollae* (Fabricius), *Scaeva pyrastris* (L.), *Xanthandrus comtus* (Harris)) are acknowledged migrants and their presence on the Park lists could well be due to their movement through the Parks from elsewhere. Another of them, *Rhingia campestris* Meigen, has larvae that develop in cow dung and is one of the most frequent and omnipresent syrphid species in the Irish landscape. Its occurrence in the Connemara Park is thus explicable in terms of its presence in farmland in the immediate vicinity of the Park. However, the two remaining, unpredicted species, *Cheilosia longula* (Zetterstedt) and *Portevinia maculata* (Fallén) may well be resident in the Connemara Park. *C. longula* would be predicted to occur in association with mature and overmature *Betula* woodland, though not with *Betula* swamp-woodland. The larvae of *P. maculata* feed in the corms of *Allium ursinum* L., a plant occurring in some abundance within the planted *Fagus* woodland within the Connemara Park, where this syrphid was observed. This fly would be expected in the vicinity of streams in acidophilous *Quercus* woodland, and its presence probably tells us something of the nature of the Connemara site

prior to installation of the beech trees there.

The greater range and number of habitats observed in the Connemara Park might be taken as adequate to explain the greater number of species recorded there than in the Mayo Park, during course of these surveys. But more detailed examination of species representation within those habitats, conducted via the StN database, suggests otherwise. In the absence of equivalent evaluation of other taxonomic groups it cannot be stated that findings derived from syrphids are "typical" for all invertebrate taxa. But, as the only analytical data available for invertebrates in this case, the results derived from interrogating the StN database deserve some attention. Essentially, the syrphid data show that the expected fauna of the habitats present in the Mayo Park is generally more poorly represented than is the fauna of the Connemara Park habitats. Further, this disparity is maximal in open ground habitats (in this area unimproved, oligotrophic, humid grassland). It might be expected that the Malaise traps in the Connemara Park would collect more species than those in the Mayo Park because they were in place for a longer period of time. But this would not explain the particular lack of grassland species. It is no secret that the area of the Mayo Park has long been subject to unregulated grazing by both cattle and sheep, a situation the Park management personnel are now making strenuous efforts to change. By contrast, grazing levels have been progressively brought under control in the Connemara Park, over the years since its establishment, such that they are now generally at sustainable levels more consistent with the National Park's conservation objectives. The difference here is that in the Connemara Park a much longer time has been available within which to tackle this problem. Could the poor fauna of the Mayo Park grassland be simply a reflection of chronic overgrazing? The total absence there of syrphids feeding on the tissues of herbaceous plants would suggest that the answer, at least in part, is yes. But can over-grazing explain the poor showing of aquatic and sub-aquatic syrphids associated with water bodies in either grassland or wetland, within the Mayo Park fauna? This may have more to do with how

you define blanket bog than with over-grazing. Botanical definitions of blanket bog (like the CORINE definition used in the StN database) incorporate no explicit mention of pools, streams, springs or flushes. Such features in this way become "optional extras" and, while much of the Mayo Park may be classified as blanket bog, permanent pools, springs and flushes were almost entirely absent from the parts of the Park surveyed. The same is true of the Connemara Park and the absence of such features has to be considered as a potentially significant contributory factor, in determining the limitations of the Park fauna. The predominance of species associated with water bodies, among the sciomyzids predicted to occur in both Parks, but unrecorded there, strengthens this interpretation.

If the present constitution of the Connemara Park syrphid fauna reflects the response of the Park grasslands to establishment of acceptable grazing levels there, a noticeable increase in representation of grassland species might be expected within the Mayo Park over the next period of years. But better representation of the expected species associated with water bodies in either Park would seem more dependent upon the creation of man-made pool systems, which would surely induce some response from the fauna. The general absence of low-altitude springs and flushes could not easily be addressed in this way and faunal elements associated only with such features would seem likely to remain poorly represented.

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APPENDIX 1. Miscellaneous insect records from the Connemara and Mayo National Parks.

Species	National Park		
	Connemara	Mayo	
	L75	F80 Srahaduggau n	F9403 Glenamun g
COLEOPTERA			
CANTHARIDAE			
<i>Cantharis nigra</i> (DeGeer, 1774)		1	
CARABIDAE			
<i>Bembidion atrocoeruleum</i> Stephens, 1828	1		
<i>Bradycellus harpalinus</i> (Audinet-Serville, 1821)	1	1	
<i>Calathus fuscipes</i> (Goeze, 1777)		1	
<i>Dromius linearis</i> (Olivier, 1795)	1		
<i>Dromius meridionalis</i> Dejean, 1825	1	1	
<i>Leistus terminatus</i> (Hellwig, 1793)	1		
<i>Loricera pilicornis</i> (Fabricius, 1775)	1		
<i>Nebria salina</i> Fairmaire & Laboulbene, 1854	1		
<i>Notiophilus biguttatus</i> (Fabricius, 1779)	1		
<i>Pterostichus niger</i> (Schaller, 1783)			1
<i>Trechus rubens</i> (Fabricius, 1792)	1		
CERAMBYCIDAE			
<i>Rhagium bifasciatum</i> Fabricius, 1775	1		1
<i>Rhagium mordax</i> (DeGeer, 1775)	1		
CHRYSOMELIDAE			
<i>Galerucella tenella</i> (L., 1761)	1		
<i>Phratora laticollis</i> (Suffrian, 1851)	1		
<i>Phratora vulgatissima</i> (L., 1758)		1	
<i>Plateumaris discolor</i> (Panzer, 1795)	1	1	
CICINDELLIDAE			
<i>Cicindela campestris</i> L., 1758			1
COCCINELLIDAE			
<i>Adalia 2-punctata</i> (L., 1758)	1		
<i>Adalia 10-punctata</i> (L., 1758)	1	1	
<i>Anatis ocellata</i> (L., 1758)		1	

Calvia 14-guttata (L., 1758)	1		
Coccinella 7-punctata L., 1758	1		
Halzia 16-guttata (L., 1758)	1		
CURCULIONIDAE			
Hylobius abietis (L., 1758)			1
Mesites tardii (Curtis, 1825)	1		
Otiorrhynchus sulcatus (Fabricius, 1775)	1		
DASCILLIDAE			
Dascillus cervinus (L., 1758)	1		
ELATERIDAE			
Actenicerus sjaelandicus (Muller, 1764)	1	1	
Aplotarsus incanus (Gyllenhal, 1827)	1	1	1
Athous haemorrhoidalis (Fabricius, 1801)	1	1	1
Ctenicera cuprea (Fabricius, 1775)	1	1	
Dalopius marginatus (L., 1758)	1	1	
Hemicrepidius hirtus (Herbst, 1784)	1		
LEIODIDAE			
Anisotoma humeralis (Fabricius, 1792)	1		
SALPINGIDAE			
Salpingus planirostris (Fabricius, 1787)	1		
Salpingus ruficollis (L., 1761)	1		
SCARABAEIDAE			
Serica brunnea (L., 1758)	1		
SILPHIDAE			
Necrodes littoralis (L., 1758)	1		
Nicrophorus humator (Gleditsch, 1767)	1		
Phosphuga atrata L., 1758	1		
DERMAPTERA			
FORFICULIDAE			
Forficula auricularia L., 1758	1		
DIPTERA			
CLUSIIDAE			
Clusia flava (Meigen, 1830)	1		
Clusiodes albimanus (Meigen, 1830)	1		
Clusiodes caledonicus (Collin, 1912)		1	
Clusiodes gentilis (Collin, 1912)	1		
Clusiodes verticalis (Collin, 1912)	1		
COELOPIDAE			

Coelopa frigida (Fabricius, 1805)		1	
CONOPIDAE			
Myopa buccata (L., 1758)	1		
DOLICHOPODIDAE			
Anepsiomyia flaviventris (Meigen, 1824)	1		1
Argyra diaphana (Fabricius, 1775)	1		
Argyra elongata (Zetterstedt, 1843)	1	1	
Argyra leucocephala (Meigen, 1824)	1		
Argyra perplexa Becker, 1918	1		
Campsicnemus alpinus (Haliday, 1833)			1
Campsicnemus compeditus Loew, 1857	1	1	
Campsicnemus curvipes (Fallen, 1823)	1		
Campsicnemus loripes (Haliday, 1832)	1	1	1
Campsicnemus scambus (Fallen, 1823)	1		1
Chrysotus gramineus (Fallen, 1823)	1	1	
Dolichopus atratus Meigen, 1824	1	1	
Dolichopus atripes Meigen, 1824			1
Dolichopus discifer Stannius, 1831			1
Dolichopus lepidus Staeger, 1842	1	1	
Dolichopus nigricornis Meigen, 1824	1	1	
Dolichopus pennatus Meigen, 1824	1		
Dolichopus phaeopus Haliday in Walker, 1851	1		
Dolichopus plumipes (Scopoli, 1763)	1	1	
Dolichopus popularis Wiedemann, 1817	1		
Dolichopus rupestris Haliday, 1833		1	
Dolichopus simplex Meigen, 1824	1	1	
Dolichopus unguatus (L., 1758)	1		
Dolichopus urbanus Meigen, 1824	1	1	1
Dolichopus vitripennis Meigen, 1824	1	1	
Dolichopus wahlbergi Zetterstedt, 1843		1	
Hercostomus aerosus (Fallen, 1823)	1		
Hercostomus cupreus (Fallen, 1823)	1	1	
Hercostomus germanus (Wiedemann, 1817)	1		
Hercostomus nigripennis (Fallen, 1823)	1		1
Hydrophorus nebulosus Fallen, 1823	1	1	1
Hypophyllus discipes (Germar, 1817)	1		
Hypophyllus obscurellus (Fallen, 1823)	1		
Liancalus virens (Scopoli, 1763)	1		

Rhaphium crassipes (Meigen, 1824)	1		
Rhaphium fasciatum Meigen, 1824	1		
Rhaphium fascipes (Meigen, 1824)			1
Rhaphium longicorne (Fallen, 1823)	1	1	1
Rhaphium macrocerum Meigen, 1824	1		
Rhaphium riparium (Meigen, 1824)	1	1	
Rhaphium zetterstedti (Parent), 1925	1		
Sciapus platypterus (Fabricius, 1805)	1		
Sympycnus cirrhipes (Haliday in Walker, 1851)	1	1	1
Sympycnus pulicarius (Fallen, 1823)	1	1	
Syntormon pallipes (Fabricius, 1794)	1	1	
Syntormon tarsatus (Fallen, 1823)	1		
Syntormon zelleri (Loew, 1850)	1		
DROSOPHILIDAE			
Drosophila phalerata Meigen, 1830	1		
Drosophila transversa Fallen, 1823	1		
Stegana similis Lastovka & Maca, 1982	1		
DRYOMYZIDAE			
Neuroctena anilis (Fallen), 1820	1	1	
HELCOMYZIDAE			
Heterocheila buccata (Fallen, 1820)	1		
Malacomyia sciomyzina (Haliday, 1833)		1	
HELEOMYZIDAE			
Heleomyza serrata (L., 1758)		1	
Heteromyza rotundicornis (Zetterstedt, 1846)	1		
Scoliocentra confusa (Wahlgren, 1918)	1		
Scoliocentra dupliciseta (Strobl, 1894)	1		
Scoliocentra villosa (Meigen, 1830)	1		
Suillia atricornis (Meigen, 1830)	1		
Suillia bicolor (Zetterstedt, 1838)	1	1	
Suillia humilis (Meigen, 1830)	1		
Suillia mikii (Pokorny, 1886)	1		
Suillia notata (Meigen, 1830)	1		
Suillia parva (Loew, 1862)	1		
Suillia variegata (Loew, 1862)	1	1	
Tephrochlamys rufiventris (Meigen, 1830)		1	
HIPPOBOSCIDAE			
Ornithomya chloropus (Bergroth, 1901)	1	1	

LAUXANIIDAE				
<i>Lyciella decipiens</i> (Loew, 1847)	1			
<i>Lyciella pallidiventrtris</i> (Fallen, 1820)	1			
<i>Lyciella platycephala</i> (Loew, 1847)	1			
<i>Lyciella stylata</i> Papp, 1978	1			
<i>Lyciella subfasciata</i> (Zetterstedt, 1838)	1			
<i>Lyciella vittata</i> (Walker, 1849)	1			
<i>Minettia lupulina</i> (Fabricius, 1787)	1			
<i>Peplomyza litura</i> (Meigen, 1826)	1			
<i>Sapromyza albiceps</i> Fallen, 1820	1			
<i>Sapromyza sordida</i> Haliday, 1833	1			
<i>Sapromyza zetterstedti</i> Hendel, 1908	1	1		1
<i>Tricholauxania praeusta</i> (Fallen, 1820)	1			
LONCHAEIDAE				
<i>Lonchaea patens</i> Collin, 1953	1			
MICROPEZIDAE				
<i>Calobata petronella</i> (L., 1761)	1			
<i>Compsobata cibaria</i> (L., 1761)	1			
ORYGMATIDAE				
<i>Orygma luctuosa</i> Meigen, 1830	1			
OPETIIDAE				
<i>Opetia nigra</i> Meigen, 1830	1			
OPOMYZIDAE				
<i>Geomyza balachowskyi</i> Mesnil, 1934	1			
<i>Geomyza majuscula</i> (Loew, 1864)	1			
<i>Geomyza tripunctata</i> Fallen, 1823	1			
<i>Opomyza germinationis</i> (L., 1758)	1	1		
<i>Opomyza petrei</i> Mesnil, 1934	1			
OTITIDAE				
<i>Herina frondescentiae</i> (L., 1758)	1	1		
PALLOPTERIDAE				
<i>Palloptera muliebris</i> (Harris, 1780)	1			
<i>Palloptera 5-maculata</i> (Macquart, 1835)	1			
<i>Palloptera scutellata</i> (Macquart, 1835)	1			
<i>Palloptera umbellatarum</i> (Fabricius, 1775)	1			
<i>Palloptera ustulata</i> Fallen, 1820	1			
PIOPHILIDAE				
<i>Liopiophila varipes</i> (Meigen, 1830)	1			

PIPUNCULIDAE			
Dorylomorpha maculata (Walker, 1834)	1		
PSILIDAE			
Loxocera albiseta (Schränk, 1803)	1		
Loxocera aristata (Panzer, 1801)	1		1
Psila atra (Meigen, 1826)	1		
PTYCHOPTERIDAE			
Ptychoptera albimana (Fabricius, 1787)	1		
RHAGIONIDAE			
Chrysopilus auratus (Fabricius, 1805)	1		
Rhagio lineola Fabricius, 1794	1	1	
Rhagio scolopaceus (L., 1758)	1	1	
SCATHOPHAGIDAE			
Ceratinostoma ostiorum (Haliday in Curtis, 1832)		1	
Cordilura albipes (Fallen, 1819)	1		
Cordilura pubera (L., 1758)	1		
Delina nigrita (Fallen, 1819)	1		
Gymnomera tarsea (Fallen, 1819)	1	1	
Leptopa filiformis Zetterstedt, 1838	1		
Nanna fasciata (Meigen, 1826)	1		
Nanna multisetosum (Hackman, 1956)	1		
Norellia spinimana (Fallen, 1819)	1	1	
Parallelomma vittata (Meigen, 1826)	1		
Pogonota barbata (Zetterstedt, 1838)	1		
Scathophaga furcata (Say, 1823)	1	1	
Scathophaga stercoraria (L., 1758)	1	1	
Scathophaga suilla (Fabricius, 1794)	1	1	
SCIOMYZIDAE			
Hydromya dorsalis (Fabricius, 1775)	1		
Ilione albiseta (Scopoli, 1763)		1	
Limnia paludicola Elberg, 1965	1	1	
Pherbellia dubia (Fallen, 1820)	1		
Pherbellia scutellaris (von Roser, 1840)	1		
Pherbellia ventralis (Fallen, 1820)	1		
Pteromicra angustipennis (Staeger, 1845)	1		1
Pteromicra pectorosa (Hendel, 1902)	1		
Renocera pallida (Fallen, 1820)	1		
Tetanocera elata (Fabricius, 1781)			1

Tetanocera ferruginea Fallen, 1820	1		
Tetanocera fuscinervis (Zetterstedt, 1838)	1		
Tetanocera hyalipennis von Roser, 1840	1		
Trypetoptera punctulata (Scopoli, 1763)			1
STRATIOMYIIDAE			
Beris chalybata (Forster, 1771)	1		
Beris fuscipes Meigen, 1820	1		1
Beris geniculata Curtis, 1830	1		
Beris vallata (Forster, 1771)	1	1	1
Microchrysa flavicornis (Meigen, 1822)	1	1	
Sargus flavipes Meigen, 1822	1		
Sargus iridatus (Scopoli, 1763)	1		
SYRPHIDAE			
Anasimyia lineata (Fabricius, 1787)		1	
Anasimyia lunulata (Meigen, 1822)		1	
Baccha elongata (Fabricius, 1775)	1		
Brachypalpoides lentus (Meigen, 1822)	1		
Cheilosia albitarsis (Meigen, 1822)	1		
Cheilosia illustrata (Harris, 1780)	1		
Cheilosia longula (Zetterstedt, 1838)	1		
Chrysotoxum bicinctum (L., 1758)	1	1	
Criorhina berberina (Fabricius, 1805)	1		
Epistrophe eligans (Harris, 1780)	1		
Episyrphus balteatus (DeGeer, 1776)	1	1	1
Eristalis arbustorum (L., 1758)	1		
Eristalis interrupta (Poda, 1761)	1		
Eristalis intricaria (L., 1758)	1	1	
Eristalis lineata (Harris, 1776)	1		
Eristalis pertinax (Scopoli, 1763)	1		
Eristalis tenax (L., 1758)	1		
Eupeodes bucculatus (Rondani, 1857)	1		
Eupeodes corollae (Fabricius, 1794)	1	1	
Ferdinanda cuprea (Scopoli, 1763)	1		
Helophilus pendulus (L., 1758)	1	1	1
Leucozona lucorum (L., 1758)	1		
Melangyna arctica (Zetterstedt, 1838)	1		
Melangyna lasiophthalma (Zetterstedt, 1843)	1	1	1
Melanogaster hirtella (Loew, 1843)	1		

<i>Melanostoma mellinum</i> (L., 1758)	1	1	1
<i>Melanostoma scalare</i> (Fabricius, 1794)	1	1	1
<i>Meliscaeva auricollis</i> (Meigen, 1822)	1	1	
<i>Meliscaeva cinctella</i> (Zetterstedt, 1843)	1	1	1
<i>Microdon myrmicae</i> Schonrogge <i>et al.</i> , 2002	1		
<i>Neoascia geniculata</i> (Meigen, 1822)	1		
<i>Neoascia podagrica</i> (Fabricius, 1775)	1		1
<i>Neoascia tenur</i> (Harris, 1780)	1	1	
<i>Parasyrphus malinellus</i> (Collin, 1952)	1		
<i>Pipizella viduata</i> (L., 1758)	1		
<i>Platycheirus albimanus</i> (Fabricius, 1781)	1	1	1
<i>Platycheirus amplus</i> Curran, 1927	1		
<i>Platycheirus angustatus</i> (Zetterstedt, 1843)	1	1	1
<i>Platycheirus clypeatus</i> (Meigen, 1822)	1	1	1
<i>Platycheirus granditarsus</i> (Forster, 1771)	1		
<i>Platycheirus manicatus</i> (Meigen, 1822)	1		
<i>Platycheirus nielseni</i> Vockeroth, 1990	1	1	1
<i>Platycheirus occultus</i> Goeldlin, Maibach & Speight, 1990	1	1	
<i>Platycheirus peltatus</i> (Meigen, 1822)	1		
<i>Platycheirus podogratus</i> (Zetterstedt, 1838)	1		
<i>Platycheirus ramsarensis</i> Goeldlin, Maibach & Speight, 1990	1	1	1
<i>Platycheirus rosarum</i> (Fabricius, 1787)	1		
<i>Platycheirus scutatus</i> (Meigen, 1822)	1	1	1
<i>Portevinia maculata</i> (Fallen, 1817)	1		
<i>Rhingia campestris</i> Meigen, 1822	1		
<i>Riponnensia splendens</i> (Meigen, 1822)	1		
<i>Scaeva pyrastris</i> (L., 1758)	1		
<i>Sericomyia lappona</i> (L., 1758)	1		1
<i>Sericomyia silentis</i> (Harris, 1776)	1	1	1
<i>Sphaerophoria fatarum</i> Goeldlin, 1989	1	1	
<i>Sphaerophoria interrupta</i> (Fabricius, 1805)	1		
<i>Sphaerophoria philantha</i> (Meigen, 1822)	1		1
<i>Sphegina clunipes</i> (Fallen, 1816)	1		
<i>Sphegina elegans</i> Schummel, 1843	1		
<i>Syrirta pipiens</i> (L., 1758)	1		
<i>Syrphus ribesii</i> (L., 1758)	1		

Syrphus torvus Osten-Sacken, 1875	1	1	
Syrphus vitripennis Meigen, 1822	1		
Trichopsomyia flavitarsis (Meigen, 1822)	1	1	
Volucella bombylans (L., 1758)	1	1	1
Volucella pellucens (L., 1758)	1		
Xanthandrus comtus (Harris, 1780)		1	
Xylota jakutorum Bagatshanova, 1980	1		
Xylota segnis (L., 1758)	1	1	
Xylota sylvarum (L., 1758)	1		
TABANIDAE			
Chrysops relictus Meigen, 1820		1	
Haematopota crassicornis Wahlberg, 1848	1	1	1
Haematopota pluvialis (L., 1758)	1		1
Hybomitra montana (Meigen, 1820)	1	1	1
TEPHRITIDAE			
Xyphosia miliaria (Schrank, 1781)	1	1	
TIPULIDAE			
Dictenidea bimaculata (L., 1761)	1		
Tanyptera atrata (L., 1758)	1		
HEMIPTERA			
PENTATOMIDAE			
Pentatoma rufipes (L., 1758)	1		
HYMENOPTERA			
ARGIIDAE			
Arge gracilicornis (Klug, 1814)	1		
CIMBICIDAE			
Abia candens Konow, 1887	1		
CRABRONIDAE			
Crossocerus 4-maculatus (Fabricius, 1793)	1		
FORMICIDAE			
Myrmica rubra (L., 1758)	1		
Myrmica ruginodis Nylander, 1846	1		
Myrmica scabrinodis Nylander, 1846	1		
SPHECIDAE			
Mellinus arvensis (L., 1758)	1		1
TENTHREDINIDAE			
Aglaostigma aucupariae (Klug, 1817)	1		
Allantus calceatus (Klug, 1818)	1	1	

Ametastegia carpini (Hartig, 1837)	1		
Ametastegia equiseti (Fallen, 1808)	1		1
Ametastegia pallipes (Spinola, 1808)	1	1	
Aneugmenus temporalis (Thomson, 1871)	1		
Athalia cordata Lepeletier, 1823	1	1	
Athalia lugens (Klug, 1815)		1	
Cladius pectinicornis (Geoffroy, 1785)	1		
Claremontia confusa (Konow, 1886)	1		
Claremontia tenuicornis (Klug, 1816)	1		
Dolerus aeneus Hartig, 1837	1	1	1
Dolerus niger (L., 1767)	1	1	
Dolerus planatus, Hartig, 1837	1		
Empria excisa (Thomson, 1871)	1		
Empria klugii (Stephens, 1835)	1		
Empria tridens (Konow, 1885)	1		
Eutomostethus luteiventris (Klug, 1816)	1		
Euura mucronata (Hartig, 1840)	1		
Heptamelus ochroleucus (Stephens, 1835)	1		
Hoplocampa pectoralis Thomson, 1871		1	
Monophadnus pallescens (Gmelin in L., 1790)		1	
Monosoma pulveratum (Retzius in DeGeer, 1783)	1		
Nematus brevisvalvis Thomson, 1871	1		
Nematus flavescens Stephens, 1835	1		
Nematus frenalis Thomson, 1888	1		
Nematus melanaspis Hartig, 1840	1		
Nematus oligospilus Foerster, 1854	1		
Nematus viridis Stephens, 1835	1		
Nesoselandria morio (Fabricius, 1781)			1
Pachynematus clitellatus (Lepeletier, 1823)	1	1	1
Pachynematus extensicornis (Norton, 1861)	1		
Pachynematus kirbyi (Dahlbom, 1835)	1		
Pachynematus obductus (Hartig, 1837)	1		
Pachynematus vagus (Fabricius, 1781)	1		
Pachyprotasis rapae (L., 1767)	1		
Pristiphora atlantica, Lacourt, 1987	1		
Pristiphora aphantoneura (Foerster, 1854)	1		
Pristiphora cincta Newman, 1837		1	
Pristiphora pallidiventris (Fallen, 1808)	1	1	

Pristiphora punctifrons (Thomson, 1871)	1		
Rhogogaster viridis (L., 1758)	1		
Strombocerina delicatula (Fallen, 1808)	1		
Tenthredo atra L., 1758	1		
Tenthredo livida L., 1758	1		
Tenthredopsis coquebertii (Klug, 1817)	1	1	
Tenthredopsis nassata (L., 1767)	1	1	
NEUROPTERA			
CHRYSOPIDAE			
Chrysoperla carnea (Stephens, 1836)	1		
Cinctochrysa albolineata (Killington, 1935)	1		
Nineta flava (Scopoli, 1763)	1		
Nineta vittata (Wesmael, 1841)	1		
HEMEROBIIIDAE			
Hemerobius humulinus L., 1761	1		
Hemerobius lutescens Fabricius, 1793	1		
Hemerobius marginatus Stephens, 1836	1		
Hemerobius nitidulus Fabricius, 1777	1		
Hemerobius simulans Walker, 1853	1		
Hemerobius stigma Stephens, 1836	1		1
Micromus variegatus (Fabricius, 1793)	1		
Nesomicromus paganus (L., 1767)		1	
Wesmaelius betulinus Strom, 1788	1		
Wesmaelius subnebulosus (Stephens, 1836)	1		
SIALIDAE			
Sialis lutaria (L., 1758)		1	
ODONATA			
COENAGRIIDAE			
Pyrrhosoma nymphula (Sulzer, 1776)	1	1	
LESTIDAE			
Lestes sponsa (Hansemann, 1823)		1	
ORTHOPTERA			
ACRIDIDAE			
Myrmelleotettix maculatus (Thunberg, 1815)		1	
Omocestus viridulus (L., 1758)			1

APPENDIX 2. Habitats recorded at the Malaise trap installations.

The habitat definitions used below are from Speight *et al.* (2003a), which follows, where possible, the CORINE system (Devillers *et al.*, 1991). Corresponding categories in Fossitt (2000), where these exist, are given in brackets following the definitions.

Connemara National Park

Forest and scrub habitat categories

Betula saplings: CORINE 41.B: BIRCH WOODS; Formations dominated by *Betula pendula*, *B. pubescens*, or their allies, on non-marshy terrain (WN1: oak/birch/holly woodland; WS2: immature woodland).

Humid *Fagus* forest, mature: CORINE 41.11, 41.12, 41.13, 41.15, except 41.122: Forests dominated by *Fagus sylvatica* (WD1: mixed broadleaved woodland).

Ulex thickets: CORINE 31.85: GORSE THICKETS; *Ulex europaeus* thickets of the Atlantic domain (WS1: scrub).

Alnus swamp woodland (gen.): CORINE 44.91: ALDER SWAMP WOODS; *Carici elongatae-Alnetum* (*Irido-Alnenion*); mesotrophic and meso-eutrophic *Alnus glutinosa* swamp woods of marshy depressions (WN6: wet willow-alder-ash woodland).

Salix swamp woodland (gen.): small-willow (*Salix* spp.) dominated wet woodlands of lake edges and seepages/springs on river or brook floodplains (WN5: riparian woodland; WN6: wet willow-ash-alder woodland)).

Scattered *Salix*: individual mature or overmature trees of *Salix* spp. isolated from one another, or occurring only in scattered clumps or lines, or as occasional outstanding trees in hedgerows (WD5: scattered trees and parkland).

Plantations (*Abies/Larix/Picea, Pinus*) with trackside ditches: CORINE 83.3111: EUROPEAN FIR, SPRUCE, LARCH PLANTATIONS; CORINE 83.3112: EUROPEAN PINE PLANTATIONS *plus* tracksides carrying a grassy herb layer vegetation which cannot survive under closed canopy conditions, with or without some shrub vegetation (e.g. *Rubus fruticosus, Prunus spinosus, Corylus*) and often with patches of bare ground *plus* intermittently-flooded, man-made drainage channels (WD4: conifer plantations).

Open ground habitat categories

Humid, oligotrophic, unimproved *Molinia* grassland with brooks: CORINE 51.2: nutrient-poor purple moorgrass (*Molinia caerulea*) grassland, developed on peat *plus* small, permanently running, freshwater bodies with a channel sufficiently narrow that the marginal bushes or herb layer vegetation can form a closed canopy above the water (both natural brooks and permanently flowing drainage ditches are included).

Moorland with brooks/rivers: wet heathland: CORINE 31.1, 31.211, 31.212, 31.45 *plus* small, permanently running, freshwater bodies with a channel sufficiently narrow that the marginal bushes or herb layer vegetation can form a closed canopy above the water (both natural brooks and permanently flowing drainage ditches are included) (HH3: wet heath/HH4: montane heath).

Wetland habitat categories

Blanket bog with brooks/rivers and pools: CORINE 52.1: lowland blanket bogs *plus* rivers and

small, permanently running, freshwater bodies with a channel sufficiently narrow that the marginal bushes or herb layer vegetation can form a closed canopy above the water (both natural brooks and permanently flowing drainage ditches are included) *plus* small, permanently-flooded, standing-water bodies (PB3: lowland blanket bog *plus* FW1: eroding/upland rivers).

Cutaway bog with brooks/rivers and pools: areas of blanket bog which have been exploited for peat-cutting in the past, leaving an uneven and lowered land surface incorporating pools, regenerating bog and (usually) patches of birch/willow (*Betula/Salix*) scrub *plus* rivers and small, permanently running, freshwater bodies with a channel sufficiently narrow that the marginal bushes or herb layer vegetation can form a closed canopy above the water (both natural brooks and permanently flowing drainage ditches are included) *plus* small, permanently-flooded, standing-water bodies.

Mayo National Park

Forest and scrub habitat categories

Ulex thickets: CORINE 31.85: GORSE THICKETS; *Ulex europaeus* thickets of the Atlantic domain (WS1: scrub).

Scattered *Salix*: individual mature or overmature trees of *Salix* spp, isolated from one another, or occurring only in scattered clumps or lines, or as occasional outstanding trees in hedgerows (WD5: scattered trees and parkland).

Pinus plantation with tracks: CORINE83.3112: EUROPEAN PINE PLANTATIONS *plus* tracksides carrying a grassy herb layer vegetation which cannot survive under closed canopy conditions, with or without some shrub vegetation (e.g. *Rubus fruticosus*, *Prunus spinosus*,

Corylus) and often with patches of bare ground (WD4: conifer plantations).

Open ground habitat categories

Humid, oligotrophic, unimproved grassland with temporary pools: CORINE 37.22, 37.32: humid/flooded, unimproved grassland: oligotrophic, seasonally-flooded, grassland with Cyperaceae and/or Juncaceae *plus* small, temporary water bodies of natural origin and their basins, flooded by river overflow, fluctuation in ground-water level, and/or rain or snow melt, considered both when containing water and when not (G54: wet grassland).

Wetland habitat categories

Blanket bog with brooks/rivers: CORINE 52.1: lowland blanket bogs *plus* rivers and small, permanently running, freshwater bodies with a channel sufficiently narrow that the marginal bushes or herb layer vegetation can form a closed canopy above the water (both natural brooks and permanently flowing drainage ditches are included).

Cutaway bog with brooks/rivers and pools: areas of blanket bog which have been exploited for peat-cutting in the past, leaving an uneven and lowered land surface incorporating pools, regenerating bog and (usually) patches of birch/willow (*Betula/Salix*) scrub *plus* rivers and small, permanently running, freshwater bodies with a channel sufficiently narrow that the marginal bushes or herb layer vegetation can form a closed canopy above the water (both natural brooks and permanently flowing drainage ditches are included) *plus* small, permanently-flooded, standing-water bodies.