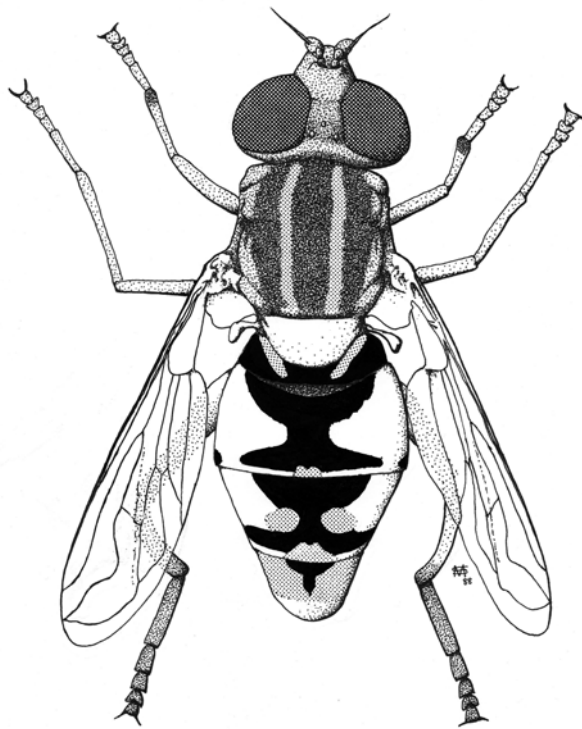


Database of Irish Syrphidae (Diptera)



Irish Wildlife Manual No. 36



Comhshaol, Oidhreachta agus Rialtas Áitiúil
Environment, Heritage and Local Government



Database of Irish Syrphidae (Diptera)

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PART 1: INTRODUCTION TO SYRPHIDAE AND THE DATABASE

1.1 What are syrphids?

The insect shown in Figure 1 is a hoverfly, or syrphid, that is known from Donegal to Cork and from Mayo to Dublin. When it is sitting on a flower it might easily be regarded as some sort of wasp, and a reluctance to try to catch it and look at it more closely would be understandable. So what makes it a fly, and a hoverfly in particular?



Figure 1: *Syrphus torvus*

The Syrphidae are one family of true flies, or Diptera. The Diptera are equivalent to other groups like the Coleoptera (the beetles), or the Odonata (the dragonflies). One of the most important distinguishing features of the Diptera is indicated in their name: di-ptera, or two wings, referring to the fact that the adults of these insects have only one pair of membranous wings, which can be seen in the photo. In Diptera the second pair of wings normally found in insects has become modified into a pair of gyroscopic balancing organs, known as the halteres. These small, stalked structures, with an enlarged, bulbous tip, are located just posterior to the normal wings, but are difficult to see in a photo. A second distinguishing feature of many Diptera, including syrphids, is that the mouthparts are much modified, the mandibles having been lost and, in their place, there is a mop-like structure through which these insects sop up much of their food. That mop-like structure can be seen in the photo, though not very clearly. But all Diptera are not the same in the character of their mouthparts, another frequent type being the sclerotised, syringe-like process found in mosquitoes or horse-flies.

There are approximately 850 species of Syrphidae known in Europe (Speight *et al*, 2008), 180 of them occurring in Ireland. Most exhibit one characteristic of their wings that is convenient in

helping to distinguish syrphids from other flies, namely a false vein, or *vena spuria* – see Figure 2, that is located towards the centre of the wing and lies more-or-less parallel to the wing's long axis.

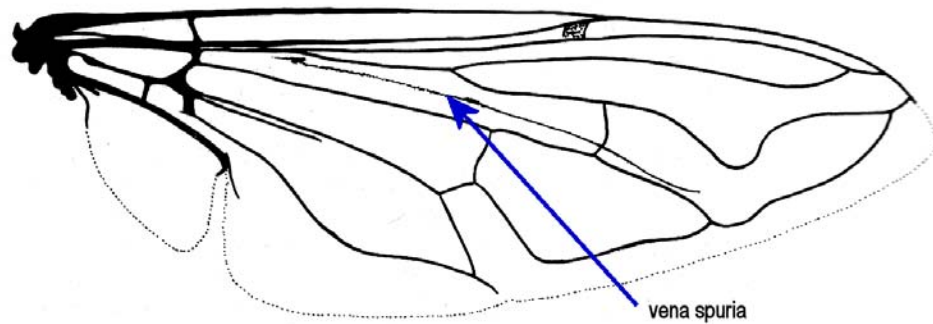


Figure 2: Diagram of the wing of the syrphid *Eristalis*, indicating the location of the false wing vein, or *vena spuria*

A second helpful feature is the plumule, which looks like a small, downy feather, located on the side of the thorax, ventral to the wing-base, and just anterior to the haltere. This curious little chemo-sensory structure is not well-studied, but is almost unique to Syrphidae. It is shown in Figure 3.

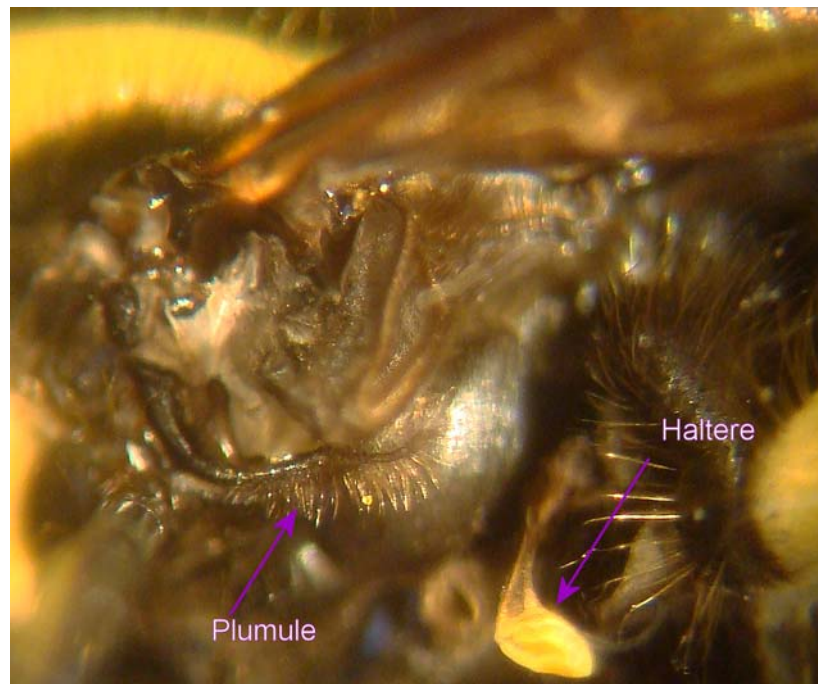


Figure 3: Wing-base area of the side of the thorax in *Xanthogramma*, showing plumule and haltere

Many syrphids have a general resemblance to bees or wasps and some are such good mimics that they are difficult to distinguish from their models. This is true of one of the most frequent and widely distributed of Irish syrphid species, *Eristalis tenax* (Figure 4), which closely resembles the honey-bee. *E.tenax* spends much of its time sitting on flowers, gaining additional protection from being exactly where one might expect to find honey-bees. Among other Irish species *Chrysotoxum cautum* (Figure 5) is a very convincing mimic of social wasps (*Vespula*) and *Volucella bombylans*

(Figure 6) similarly resembles bumble bees (*Bombus*). There are also mimics of solitary wasps and bees. *Doros profuges*, for instance (Figure 7), looks like eumenid wasps. But there are many Irish syrphids, like *Baccha* and *Brachyopa* species, which do not seem to mimic anything, while others seem only vaguely wasp or bee like, such as *Syrphus ribesi* and many *Cheilosia* species.



Figure 4: *Eristalis tenax*



Figure 5: *Chrysotoxum cautum*



Figure 6: *Volucella bombylans*



Figure 7: *Doros profuges*

Adult syrphids feed on nectar and pollen. They derive their nectar mostly from plants with yellow or white flowers, because their relatively-short mouthparts do not allow them to exploit flowers with deeply located nectar sources – normally indicated by pink, red and blue flowers. Male syrphids feed predominantly on nectar, but the females also feed extensively on pollen, which provides them with the protein source they require for egg maturation. Plants with anaemophilous flowers, like pine trees, poppies, plantains and grasses are frequently used as pollen sources by syrphids. One group of syrphids obtains pollen almost without visiting flowers at all, specialising in mopping up pollen that has accumulated on the foliage of trees, shrubs and bushes.

The developmental stages of syrphids are radically different in appearance from the adult insect. Syrphid eggs hatch to produce soft-bodied larvae, many of which have a characteristically “fly maggot” appearance. However, many different modes of development are found among syrphid genera and the larvae are correspondingly various. The larvae of *Microdon* (that develop in ants’ nests where they eat the ants’ larvae) look so unlike the usual fly maggot that they were first described as a genus of slug, and it was more than 50 years before it was realised that these “slugs”

actually turned into flies once they completed their development. Indeed, *Microdon* is in many ways so different from other syrphids that it can justifiably be consigned to a separate family, the Microdontidae, a course followed here. Another syrphid larval form is the “rat-tailed maggot”, an aquatic form whose tail is actually a periscopic respiratory tube, through which the larvae maintain their air supply in often de-oxygenated water. There are also larval types in which the body surface carries, laterally and or dorsally, a complicated arrangement of sclerotised spike-like, or frond-like outgrowths, converting them into quite fearsome-looking little monsters. Many syrphid larvae are quite colourful. But others are unicolourous pale brown and more-or-less cylindrical, with few obvious distinguishing features.

Among syrphids there are genera whose larvae are predatory (see Figure 8), others whose larvae feed in plant tissues and many others with microphagous/saprophagous larvae. Those that are predatory feed mostly on plant bugs like greenfly, white fly and psyllids.



Figure 8: Predatory (aphid-feeding) syrphid larva (*Syrphus* sp.)

Most of the plant feeders mine leaves, stalks or root bases and bulbs of non-woody plants, though there are a few that specialise in using the fruiting bodies of large basidiomycete fungi. The saprophagous larvae use a wide range of decaying plant materials, feeding in part on microscopic organisms and partly on the decaying material itself. Many of these larvae are sub-aquatic or aquatic, the subaquatic forms living in wet mud rich in plant debris, or in cow dung, or decaying vegetation in seasonally-flooded hollows in grassland or woodland, or compost heaps, others using sap-runs on tree trunks, or humid, decaying wood etc.

The aquatic larvae (see Figure 9) occur in decaying stems of water plants like *Typha*, or floating mats of plants like *Glyceria*, bottom muds rich in organic debris, water butts, water-filled tree holes and even in shallow pools containing decaying seaweed, in the splash-zone of rocky beaches.

The larval stage of syrphids is followed by a resting stage, the puparium, which is equivalent to the chrysalis or pupa of moths or beetles. Essentially, during this resting phase the insect's tissues are dismantled and reconstructed, so that when it hatches from the puparium it does so as the fully-formed, adult fly.



Figure 9: Aquatic syrphid larva (*Eristalis* sp)

1.2 Why use syrphids?

There are many different sorts of insects and other invertebrate animals and they differ widely from one another in their suitability for use as tools in biodiversity studies. Some of them, for instance the parasitic wasps (Ichneumonidae etc) are very difficult to identify, not only because the existing literature is in many different journals and various languages, so that it is difficult to use, but also because these insects have not been much studied and it is all-too-easy to find species that cannot be identified at all, because they have never been described. By themselves, these identification problems make these parasitic wasps almost impossible to use as tools in biodiversity studies. By contrast, the literature on syrphid identification is now reasonably accessible and most species can be identified with confidence, even if there are still some species that cause problems. A few syrphids new to science are still described each year from Europe, but they are mostly from south-eastern parts of the continent. In a large country like France (that has the greatest surface area after European Russia and the Ukraine) a few species are added to the national list in most years, but these additions are usually species that are already known elsewhere, rather than species new to science. In Ireland, rather less than one syrphid species per year is added to the national list, on average. The Irish syrphid list is now sufficiently reliable to make it possible to use syrphids as tools in biodiversity studies in Ireland.

A second important issue is whether there is sufficient information about a species group for it to be used as a tool. For instance, solitary bees (Halictidae, Apidae, etc) may be attractive and obvious insects, but not enough is known about their ecology for many of them to be useful. It takes a significant amount of time and effort to bring together the relevant information about a particular group of species, so to do this for a group of insects like the solitary bees would be largely unproductive. In comparison, sufficient habitat, microhabitat and traits information is available for more than 95% of the Irish syrphid species to make it worthwhile to code that information into a database.

Another way in which the various sorts of invertebrate differ from one another in their degree of usefulness in biodiversity studies is the range of ecosystem conditions for which they can provide information. Dragonflies (Odonata), for example, can be reliably identified and quite a lot of useful

information is available about them. But they provide little information about parts of the ecosystem other than the water bodies they inhabit during development. Similarly, ground beetles (Carabidae), although much used in certain types of ecological study, provide information only about the ground layer and, to some extent, about herb-layer vegetation. Because the various species inhabit different parts of the ecosystem, syrphids can provide information about all habitat strata, from grass-root zone to the canopy of dominant forest trees. They also occur in a wide range of habitat types, there being species characteristic of nearly all of the non-marine habitats that occur in Ireland, except large or deep water bodies (i.e. aquatic habitats of lakes and rivers), cliffs and caves. A final, unusual syrphid attribute worthy of mention is that, among the larvae of this one family of flies, all three trophic groups are represented, there being plant-feeding species, predatory species and saprophagous species.

Then there are logistic criteria. Biodiversity studies almost inevitably involve collection of samples from the field so, logistically, it is of concern whether a standardised sampling technique exists for an insect group that might be used in biodiversity management studies. Equally, the amount of time that must be spent in field campaigns is significant. Organisms that can be sampled quickly and reliably are clearly preferable to organisms that cannot. For instance, there are no reliable trapping methods for many old-forest beetles, so they have to be searched for by specialists, using a variety of techniques that are demanding of time and effort and quite difficult to standardise. This makes these beetles very difficult to use as tools, even though they can provide valuable information on site quality. By contrast, syrphids can be collected in a standardised way using Malaise traps (see Figure 10), and although trap installation is best carried out with the active participation of specialists, specialists are not required for collection of the sample bottles from the traps during a field survey. Further, the large catchment area of an individual Malaise trap ensures that the material it collects provides information about more than the immediate vicinity of the trap, making Malaise traps suitable for landscape-scale investigations. The sample bottles collected from Malaise traps can also be used for storage of samples and all that has to be done to extract the syrphids from them is to sort the samples under a microscope, the extracted specimens then being immediately available for identification.



Figure 10: Malaise trap, installed on a woodland track

Finally, there is one advantage to using syrphids that makes them almost unique among European terrestrial invertebrates – information needed for the interpretation of species lists has already been databased and is available to those who wish to use it for analytical procedures, in the form of the StN database, from which the Database of Irish Syrphidae is derived.

1.3 How do you use syrphids in management of biodiversity?

There is more than one concept of biodiversity, but it is generally accepted that the unit of biodiversity is the species. Measured in terms of numbers of species, invertebrate animals comprise approximately 75% of Europe's biodiversity.

1.3.1 Assessing the performance of the biodiversity maintenance function of a habitat

Maintenance of biodiversity can be regarded as a function of habitats. The performance of the biodiversity maintenance function in a particular habitat can be assessed and then, through management, modified. Assessment of the performance of the biodiversity maintenance function of a site can be achieved by comparison between the *expected* biodiversity of the combination of habitats present on that site and their *observed* biodiversity. The spreadsheets provided here are designed to engender lists of the syrphid species expected to occur on a site, for comparison with lists of the species observed there. It is an example of use of the "expert system" approach in biodiversity maintenance: an expert system may be defined as "a computer programme into which has been incorporated the knowledge of experts on a particular subject so that non-experts can use it for making decisions, evaluations or inferences".

1.3.2 The habitat concept employed in the Database of Irish Syrphidae

The habitat categories used in the Database of Irish Syrphidae are, where possible, the same as those used in the EU's "CORINE" habitat classification system and in the more comprehensive "EUNIS" system derived from CORINE, and are defined as in CORINE. They thus also correspond with habitat categories named in the Habitats Directive and its associated Manual. However, in the database these habitat categories are referred to as "macrohabitats", to distinguish them from the "microhabitat" categories also coded into the database. When specialists talk about the "habitat" of some species of insect they are frequently referring to its "microhabitat", in the sense that the latter term is applied in this database. Here, the term "microhabitat" is applied to a structural feature of a macrohabitat, with which the developmental stages of syrphids are associated. The larvae of each syrphid species are associated with one or more microhabitat, the different species occupying different parts of the same macrohabitat, just as different people occupy different parts of the same tenement block. On an overmature tree, for instance, the larvae of some syrphid species will be found among the foliage, the larvae of others will occur in rotting tree roots, larvae of another set of species will be found in trunk rot-holes (see Figure 11) and yet another set will occur in sap-runs.



Figure 11: Humid cavity in trunk of living tree: home to the larvae of syrphids found almost only in this very particular microhabitat

Rotting branches, broken from the tree and lying on the ground, provide the microhabitat for the larvae of further species. In the same way, herb-layer vegetation, the litter zone, shrubs and understorey trees each have their own distinctive complement of syrphid species, as do the various aquatic and sub-aquatic microhabitats.

1.3.3 Coding species/habitat association data

At both macrohabitat and microhabitat levels invertebrate species can exhibit considerable habitat fidelity so, if the particular types of macrohabitat and microhabitat with which a species is associated can be identified, they can be coded into a database. Habitat fidelity is well manifested among syrphids, allowing both macrohabitat and microhabitat associations of the species to be coded into the database. Coding is based on information from both published and unpublished sources. Unpublished sources, i.e. the information carried around in the heads of European syrphidologists, but which they've had neither time nor opportunity to publish, has proven very important. Indeed, without the extensive personal knowledge contributed by syrphid workers in various parts of Europe, from Norway to Spain and Ireland to Serbia, coding of the database files would not have been possible.

Macrohabitat and microhabitat data are coded into the database using a simplified "fuzzy-coding" system, as in Figure 12, which shows a piece of the Macrohabitats spreadsheet relating to the macrohabitat category "humid *Fagus* forest". Species may occur in association with more than one such category of macrohabitat, in which case they are coded accordingly. Inevitably, different people will have their own perceptions of what constitutes a habitat like "humid *Fagus* forest" and to maximise conformity of interpretation every category used in the database is provided with a written definition.

SPECIES:	MACROHABITAT: Humid <i>Fagus</i> forest			
	(general)	overmature	mature	saplings
<i>Sphegina atrolutea</i>	1	1	1	
<i>Sphegina clavata</i>	2	2	2	
<i>Sphegina clunipes</i>	2	2	2	
<i>Sphegina cornifera</i>				
<i>Sphegina elegans</i>	3	3	2	
<i>Sphegina latifrons</i>	1	1	1	
<i>Sphegina limbipennis</i>	3	2		
<i>Sphegina montana</i>	2	2		
<i>Sphegina platychira</i>				
<i>Sphegina sibirica</i>				
<i>Sphegina spheginea</i>	1	1	1	
<i>Sphegina sublatifrons</i>				
<i>Sphegina varifacies</i>	2	2	2	
<i>Sphegina verecunda</i>	3	2	1	

Figure 12: Extract from the Macrohabitats spreadsheet, showing fuzzy coding. Species coded either "2" or "3" for the macrohabitat category "humid *Fagus* forest" are species that would be predicted to occur in association with this habitat. Species coded "1" would be expected to occur in this habitat only under particular (specified) conditions and species showing a blank cell are not known to have any association with this habitat type. The coding "3" is used to denote a very high degree of association – the "favourite" habitat for a particular species.

1.3.4 Producing lists of the species expected to occur on a site

To engender a list of the syrphid species expected to occur on a site, using the database, you first need to survey the site to establish which habitats are present. When you know which habitats are present, the Macrohabitats file can be used to show which syrphid species are associated with those habitats. But only a part of the Irish fauna can be expected to occur on a site, wherever that site is located, due to limitations imposed by regional climate, geology, latitude etc. So a second important requirement is the syrphid species list for the region in which the site is located. A regional syrphid list is an expression of the maximum syrphid biodiversity that can be expected to occur anywhere within that region. In the case of Ireland, the counties are well-defined geographical and administrative units of an appropriate scale to function as regions in this context, and the species list for each county is coded into the Range, Status and Distribution spreadsheet. The longest species list for an Irish county is that for Co.Wicklow, with 143 species, closely followed by the list for Co.Cork, with 135 species.

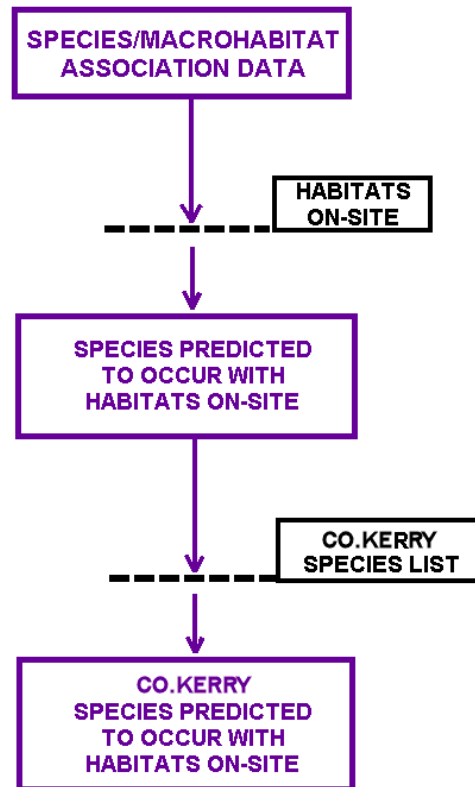


Figure 13: Diagrammatic representation of the process of generating a list of the species predicted to occur on a site in Co.Kerry. The on-site habitats are used to filter out species in the database known only from other habitats and the Co.Kerry species list is then used to filter-out species not known from Co.Kerry.

Using the species/habitat association data for a particular macrohabitat, together with a regional syrphid list, it is then possible to produce a list of the syrphid species expected to occur in that habitat, in that region. This process is shown diagrammatically in Figure 13. This exercise can be carried out for all of the habitats observed on a site, so that a list of the species expected to occur on that site can be engendered.

1.3.5 Comparing lists of expected and observed species

From a comparison between the list of species expected to occur on a site and the list of the species observed there you can establish what percentage of the expected species is present, both for the site in general and for each habitat represented. Comparing these percentages one with another indicates for which habitat the biodiversity maintenance function is being performed best and for which it is being performed worst, on that site. This procedure is shown diagrammatically in Figure 14. Given that it is most unusual for any site below 2000m not to have been influenced by human activity, entirely natural, i.e. complete faunas, cannot usually be expected and it is very rare for 100% of the expected species to be observed on a site. For instance, in any forest from which trees are harvested, however well the forest is managed, trees are very rarely allowed to grow old and die of old age. The consequence is a general lack of old trees and a corresponding lack of the syrphids associated with old trees, so that 100% of the fauna expected for a forested site is hardly ever observed.

Management of biodiversity implies an intention to not only maintain existing biodiversity but also to carry out remedial measures where there are indications that biodiversity is not adequately maintained under existing conditions. In the present context, that would mean seeking ways to improve management of habitats shown, by use of the database, to be performing the biodiversity maintenance function least well (i.e. the habitats showing the lowest representation of expected species) on a given site.

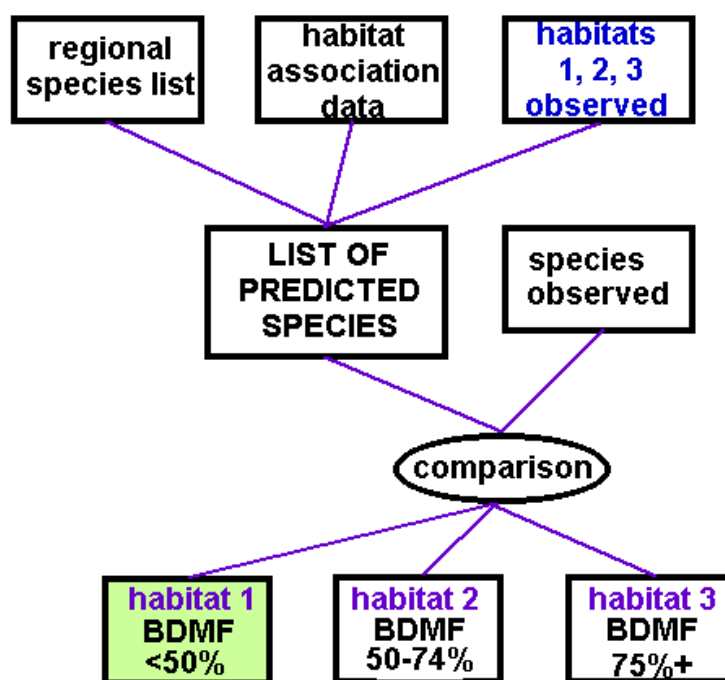


Figure 14: Diagrammatic representation of the use of the predicted and observed lists of species for a site, in identification of habitats under-performing in respect of the biodiversity maintenance function (BDMF). Comparison between the predicted and observed lists of species for a habitat demonstrates the percentage of the expected species found. Representation of 50% or more of the expected species is taken as reasonable. A habitat for which less than 50% of the expected species are observed is taken to be under-performing and requiring further investigation.

Once a macrohabitat has been identified as “underperforming”, in respect of its biodiversity maintenance function, it is worthwhile to investigate whether the underperformance is apparently general or due to disfunction in some particular part of that macrohabitat. This can be achieved by looking more closely at the expected and observed lists for that macrohabitat, using the species/microhabitat association data coded into the database.

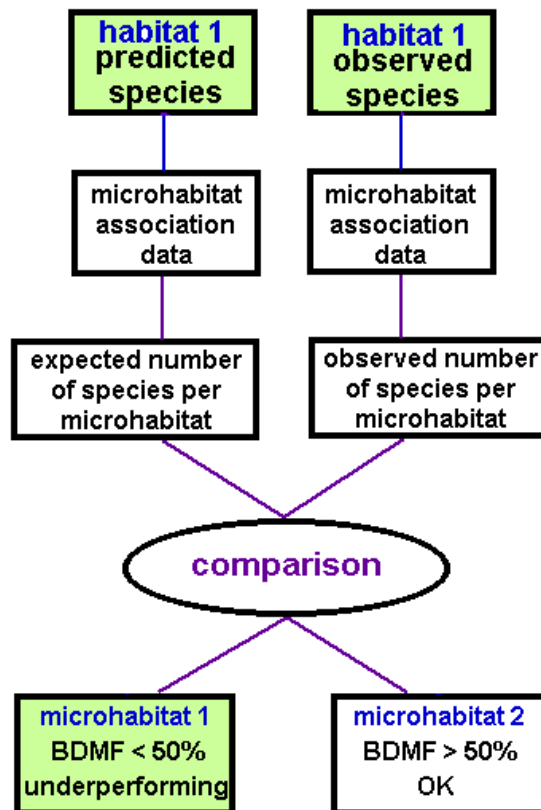


Figure 15: Diagrammatic representation of the use of predicted and observed species lists for a habitat, here called "habitat 1", in identification of microhabitats under-performing in respect of the biodiversity maintenance function.

The lists of expected and observed species for an underperforming macrohabitat can be used at microhabitat level by comparing the representation of expected species in each microhabitat i.e. by establishing what percentage is observed on-site of the species expected for each microhabitat within that macrohabitat. From this comparison underperforming microhabitats can frequently be identified. This procedure is shown diagrammatically in Figure 15. Since the microhabitats are themselves structural features of the macrohabitat, identification of a particular microhabitat as underperforming is also identification of some particular structural feature that is underperforming. It is then possible to consider how existing management impacts upon this structural feature and whether or no that management can be modified to enhance biodiversity. In forests for instance, old-tree microhabitats are frequently identified as underperforming, due to the lack of old trees, demonstrating a requirement to let a greater proportion of the tree crop grow old and die in situ, in order to enhance biodiversity.

1.4 What else can you do with the database?

In addition to macrohabitat and microhabitat data, range and status information and biological traits data are coded into the database. So the database can be used at various geographic scales: site, region, nation or even at European level and the various files of coded information can be used either independently or in combination, all depending upon the type of question to be addressed. If you want to know how many syrphids with rot-hole living larvae are known from Ireland, the database can tell you. If you want to know which of the marsh-associated species known from Ireland also occur in Spain the database can tell you. If you want to know what proportion of the Irish syrphid fauna with larvae that live in temporary ponds occurs in the Atlantic, Continental and Mediterranean zones of Europe, you can do so using the database. If you wanted to find out how many Irish syrphids with one generation per year, predatory larvae living on herbaceous plants and adults known to feed on pollen-only flowers occur in oak forest, as compared with beech forest, in different parts of Europe, you could do so using the database. So the database is potentially a very flexible tool, open to a wide range of applications in biodiversity and biogeographical studies.

The Database of Irish Syrphidae is derived from the StN database (for most recent issue see Speight *et al*, 2008), versions of which have been in the public domain since 1997. Publications resulting from use of the StN database are in consequence increasingly numerous and can be employed to show the type of issue that this sort of database can address. Using very general macrohabitat categories (forest, open ground), the species/habitat association data in the StN database have been used to show that the forest-syrphid fauna of a piece of a large forest is significantly more diverse than is the forest-syrphid fauna of an isolated forest of the same size - a matter of some importance in considering the effects of forest fragmentation on maintenance of biodiversity. That study involved more than 70 forests in SW France (Ouin *et al*, 2006). Once again employing macrohabitat data, but this time at the level of individual macrohabitat categories, using the database it has been demonstrated that in conifer plantations – at least in Ireland where there are no indigenous conifer species – most of the syrphid biodiversity present is dependent upon open areas (tracksides and patches where the conifers are not growing) and wetland occurring within the plantations (Gittings *et al*, 2006), with obvious management implications if biodiversity is to be maintained. More ecological management certainly can benefit forest syrphid faunas according to Reemer (2005), who used macrohabitat and microhabitat data together to investigate increased frequency and diversity of saproxylic forest syrphids in the Netherlands, concluding that changes in forest management there had benefited most of the species, the exception being a sub-group of the species associated with old, living trees, whose larvae were probably dependent upon the presence of other saproxylic insects. Another study, in the Swiss Jura, that used macrohabitat and microhabitat data from the StN database, also showed that traditional forest management (i.e. removal of individual trees, rather than clear-felling) can benefit saproxylic syrphids associated with dead wood (e.g. stumps), but does not favour the species associated with old, living trees (Goeldlin *et al*, 2003). In this instance, the findings were instrumental in initiating a change in forest management, that involved establishing enclaves within the forests where trees remained unharvested, so that they could grow old and die in situ. The importance of old, living trees to maintenance of forest syrphid biodiversity was shown by Speight and Good (2003) to be greatest in

the Mediterranean zone and least in Northern Europe, in a comparison between biogeographical zones using macrohabitat, microhabitat and range data from the StN database.

Species/habitat association data can be used to gain an overview of changes in biodiversity that would result from changes in habitat representation on a site, for example as a consequence of changes in site management. This approach was used in a study in Co.Cork, by Speight *et al* (2002), Speight (2001) and Speight and Good (2001a), to demonstrate that conversion of a family farm with a mixed economy based on production of cattle, hay, silage and cereal crops, into other types of farm, would result in loss of various syrphids occurring there now, all dependent upon which habitats were lost during the conversion process. The extreme scenario of conversion of the farm into an expanse of ground devoted only to crop production would result in loss of more than 90% of its existing syrphid fauna. This loss would be caused by conversion of existing habitats into croplands. Using a similar approach, based on which habitats “should” be present in a given landscape, it is possible to identify which species “should” be present also. This led Speight (2004a) to conclude that the lack of a component of the blanket-bog syrphid fauna from two National Parks investigated in western Ireland was due to a lack there of pools and streams, precipitating a management recommendation that introduction of man-made pools would help to provide for part of the missing fauna.

The faunistic consequences of habitat loss and gain can be translated to national level, with a knowledge of the habitats present in a country and which syrphid species are associated with those habitats. This approach was used by Speight (2004b) to investigate when Ireland’s existing syrphid fauna had arrived in the island, based on the knowledge of postglacial habitat representation in Ireland derived from the work of Pleistocene palaeoecologists and archaeologists. It was possible to conclude that the present syrphid fauna of the island could have been in place some 5000 years ago, but that the history of conifer-associated syrphids in Ireland was complicated by loss of indigenous conifers 1000 years ago, and the subsequent introduction of a miscellany of conifers from various geographical origins, for commercial forestry purposes, during the last 150 years – some conifer-associated syrphids are now re-establishing themselves in Ireland, having apparently been absent in the recent past. Using the StN database this way also showed that it is not really credible to attempt to explain the virtual absence of old-forest syrphids from Ireland as a consequence of their failure to arrive in the island during the postglacial, but that their absence is almost certainly due to extinction, brought about by the almost complete elimination of indigenous forest from the island by the beginning of the 20th century.

Species/habitat association data coded into the StN database have been employed in a different way by Burgio and Sommaggio (2006), to demonstrate that a Malaise trap catch of syrphids could be used as a measure of landscape complexity and permeability, through the habitat-associations of the non-predicted species (i.e. species not associated with the habitats in which the trap is located) caught by a trap – the higher the diversity of habitat-associations represented, the greater the degree of landscape complexity and permeability in the vicinity of the trap. Species not associated with the habitats surrounding the Malaise trap that collected them have also been used (Speight, 1997) to indicate which habitats might most usefully be introduced to a Killarney National Park (Co.Kerry) site under consideration for habitat restoration, by using the habitat-

associations of the collected species to show which habitats could be colonised by species reaching the site but unable to live there at the moment.

At the scale of European biogeographic zones, microhabitat data from the StN database have been used (Speight and Good, 2003) to show that syrphid species with larvae associated with ancient, living trees make up a far higher proportion of the old-forest syrphid fauna in Mediterranean Europe than further north, with the smallest proportion of these species being found in the boreal forests. This helps to explain why dead wood is regarded as of far greater importance to maintenance of old forest faunas in Northern Europe than are old, living trees. Equally, it shows that old, living trees are of far greater significance in maintaining the old-forest fauna of Mediterranean countries than is dead wood.

PART 2: MANAGING BIODIVERSITY IN THE IRISH COUNTRYSIDE

2.1 Introduction

Using the database in conjunction with the Irish National list of Syrphidae it is possible to identify the habitats that support the highest proportions of Irish syrphid biodiversity and combinations of habitats that might most easily support the full range of Irish syrphid species. Using County lists of species it is similarly possible to identify the habitats whose species are under-represented in a given county, in comparison with nationally. Such exercises help to identify priorities in biodiversity maintenance and so contribute to the process of developing a framework for action. But what action can be taken and how useful that action might be are also heavily dependent upon the types of use being made of land in the Irish countryside.

The two forms of land use predominating in the Irish countryside are animal farming and plantation forestry, with farming occupying 60% of the land surface (4.3 million ha of 6.9 million ha). Whatever part of Ireland's biodiversity cannot be maintained in farmland would have to be maintained in the much smaller hectares of land consigned to other uses, among which the only sites where biodiversity maintenance might reasonably be expected to become the primary form of land use would be those protected for wildlife conservation, that together occupy no more than 1% of the land surface of the nation (Hickey, 1997). The potential role of the farmed landscape in biodiversity maintenance is thus of considerable significance in Ireland. The same is true elsewhere in Europe. As Le Roux *et al* (2008) say, agriculture is "the most important human factor controlling biodiversity in western Europe". Use of the database to explore the contribution of farmland to biodiversity maintenance, and how that contribution might be enhanced, becomes the main focus of this section of text.

2.2 The role of species lists

The Convention on Biological Diversity defines biological diversity as including "diversity within species, between species and of ecosystems". The 'species' is thus a key element in biodiversity maintenance and species conservation a core objective of the Convention. This is recognised in the National Biodiversity Action Plan for Ireland (Department of Arts, Heritage, Gaeltacht and the Islands, 2002). The present text is focused on the biodiversity unit the species, and on biodiversity maintenance (and enhancement), through ensuring the survival in Ireland of the maximum diversity of the species known to occur there. In this context National species lists are pivotal to biodiversity maintenance.

2.2.1 The Role of the National List

A reliable National species list provides a precisely defined and finite objective for biodiversity maintenance measures i.e. to maintain the species on the list. In this way biodiversity maintenance ceases to be a vague concept with ill-defined objectives and the issue of practical measures

required for its achievement can be addressed. This is as true for any taxonomic group of organisms as it is for Syrphidae, the taxonomic group that provides the vehicle on which this text rides.

2.2.1.1 The list of Syrphidae known from Ireland

A list of the Syrphidae known to occur in Ireland has been available since the middle of the last century and has been periodically updated since then (see section 4.1.1 of the present text), the most recent update being incorporated into this account. There are now 183 syrphid species that have been recorded from Ireland during the last 100 years. Among them, three may be extinct in Ireland, not having been seen for more than 75 years (see below). Speight (2004b) has shown that the existing Irish syrphid fauna is a subset of the syrphid species occurring in the island of Great Britain, concluding that it is unrealistic to expect additions to the Irish syrphid fauna from among species not present in Great Britain, however widespread they may be in adjacent parts of continental Europe. In the event of a requirement to anticipate which syrphid species might be added to the Irish list this somewhat simplifies the prediction procedure, though it has to be recognised that the presence in Ireland, of a species previously unknown there, can be discovered before the presence of the same species is recognised in Great Britain. Syrphid species have been added to the British list at an average rate of one per year, over the past 50 years (Speight, 1988, 2000b). The rate of addition of species to the Irish syrphid list has been the same (Speight, 2004b). If the database is used to compare the ecological characteristics of the species known from Ireland in 1953 with those added to the Irish list in the period 1954-2007, it becomes apparent that 70-80% of the species associated with each major group of habitats were known to be present in 1953, with the exception of species associated with conifer forests. In the case of species associated strictly with conifer forests (as opposed to species that may inhabit either deciduous or coniferous forest) only 52% of the 21 species now recorded from Ireland were known from Ireland in 1953. Looking more closely at the conifer forest species added to the Irish list since 1953 shows that among the seven species associated only with coniferous trees (rather than with herbs or shrubs in open areas in conifer forests) there are no records of five of them from Ireland prior to the 1970s. All of these five species are associated with the foliage of conifers (that being where their predatory larvae occur, feeding on aphids). In terms of predicting changes likely to occur in the Irish syrphid list this suggests that, while all sections of the fauna might be expected to slowly accrete more species, due to improvements in taxonomy, or increases in collecting effort in poorly-known parts of the country (see Speight, 2004b), in the short term conifer forest-associated species could well increase in number more rapidly in Ireland, the extra species being arboreal aphid predators colonising Ireland from the island of Great Britain – at least to the extent that additional species are available to colonise from Great Britain. There are five such species not yet known from Ireland:

- *Dasysyrphus friuliensis* (van der Goot), 1960
- *Didea intermedia* Loew, 1854
- *Eupeodes nielsenii* (Dusek & Laska), 1976
- *Heringia pubescens* (Delucchi & Pschorn-Walcher), 1955
- *Melangyna ericarum* (Collin), 1946

Addition of some, or all, of these five species to the Irish list might be expected in the short term.

Overall, then, the present Irish syrphid list can be expected to change at the rate of approximately 0.5% per annum (i.e. one species per annum), with aphid predators inhabiting conifer foliage initially making up a higher than average proportion of species added to the list. If there is some massive increase in the availability of some other habitat, equivalent to the installation of conifer plantations in previously open countryside that has occurred during the last 100 years, an equivalent response from the syrphid fauna might be expected. But, in the absence of such an occurrence, it can be assumed that the syrphid species known from Ireland today are effectively the syrphid biodiversity resource that is available and thus the syrphid biodiversity resource upon which man's activities will impinge. It follows that it is appropriate to use the existing species list as a basis for identifying biodiversity maintenance issues. With the database, the state of the entire Irish syrphid fauna can be assessed in various ways, for instance in terms of which habitats support the highest proportions of the existing Irish syrphid biodiversity, which combinations of habitats would provide for all of the Irish species and which habitats support the highest concentrations of the least frequent species.

2.2.1.2 The potential contribution of different habitats to maintenance of Irish syrphid biodiversity

From a knowledge of which habitats occur in Ireland and the syrphid species that are associated with each of them, it is possible to gain some understanding of the potential contribution of each habitat to maintenance of Irish syrphid biodiversity.

It has been argued by Speight (2004b) that the array of habitats natural to Ireland today was in place by 5000 years ago, since when both the extent and diversity of these habitats has been progressively eroded by man's activities in the island. From 5000BP onwards man-made plagioclimax habitats also began to accumulate in the Irish landscape, and more recently have been joined by a series of man-made nothic habitats (i.e. habitats with non-indigenous components derived from various different geographical origins). The full array of habitats known to have been present in Ireland between 5000BP and now (though not necessarily at the same time, or throughout that period) have been listed (see Speight, 2004b), using habitat categories covered by the database and defined in the Macrohabitats Glossary (see Appendix 3). They can be listed with or without the supplementary habitats that are normally found embedded within them as they occur in the landscape. Here they are listed together with these supplementary habitats. That is not to say that, for example, every Irish oak forest would be expected to contain rivers, brooks, springs, flushes, pools, temporary pools, rock outcrops and tall-herb open areas! It is more that these supplementary habitats add species to the list that could not be expected from oak forest in its narrow botanical definition, and are normal components of the landscape that would be expected within Irish oak forest somewhere. The same additional species would not necessarily occur with these supplementary habitats in a different macrohabitat.

2.2.1.2.1 Habitats natural to Ireland

- moraine and scree

- *Betula* forest, with supplementary habitats river edge, brook edge, springs, flushes, pools, temporary pools, rock outcrops and tall-herb open areas
- *Betula/Pinus* swamp forest
- *Salix* swamp forest
- *Quercus/Ulmus* forest, with supplementary habitats river edge, brook edge, springs, flushes, pools, temporary pools, rock outcrops and tall-herb open areas
- acidophilous *Quercus* forest, with supplementary habitats river edge, brook edge, springs, flushes, pools, temporary pools, rock outcrops and tall-herb open areas
- *Fraxinus* forest, with supplementary habitats river edge, brook edge, springs, flushes, pools, temporary pools, rock outcrops and tall-herb open areas
- humid *Pinus sylvestris* forest, with supplementary habitats river edge, brook edge, springs, flushes, pools, temporary pools, rock outcrops and tall-herb open areas
- alluvial softwood and hardwood forest, with supplementary habitats river edge, brook edge, springs, flushes, pools, temporary pools and tall-herb open areas
- alluvial brook-floodplain forest, with supplementary habitats brook edge, springs, flushes, pools, temporary pools and tall-herb open areas
- *Alnus* forest, with supplementary habitats river edge, brook edge, springs, flushes, pools, temporary pools and tall-herb open areas
- tall herb communities
- fen, with supplementary habitats brook edge, springs, flushes and pools
- marsh, reed beds and sedge beds
- transition mire, with supplementary habitats brook edge, springs, flushes and pools
- raised bog, with supplementary habitats springs, flushes and pools
- coastal habitats including dune grassland with supplementary habitats brooks and flushes and dune slacks; lagoons; salt-marsh and salt-marsh meadow

2.2.1.2.2 Anthropogenic plaxioclimal habitats in Ireland

- Atlantic scrub
- lightly-grazed, unimproved, montane, acidophilous grassland grazed by sheep and/or cattle, with supplementary habitats brook edge, flushes, pools, temporary pools, rock outcrops and dung
- lightly-grazed, unimproved, montane, calcareous grassland grazed by sheep and/or cattle, with supplementary habitats brook edge, flushes, pools, temporary pools, rock outcrops and dung
- lightly-grazed, unimproved, humid, lowland, oligotrophic grassland grazed by sheep and/or cattle, with supplementary habitats brook edge, flushes, pools, temporary pools and dung

- lightly-grazed, lowland improved grassland, grazed by cattle/cows or sheep, with supplementary habitats river edge, brook edge, drainage ditches and pools
- heavily-grazed, lowland improved grassland, grazed by cattle/cows or sheep, with supplementary habitats river edge, brook edge, drainage ditches and pools
- lowland improved hay meadow
- intensive grassland
- setaside
- field margins with supplementary habitats brook edge, seasonal streams and ditches
- hedges
- field margin plus hedge with supplementary habitats brook edge, seasonal streams and ditches
- old field walls
- compost heaps
- farmyard manure heaps
- montane improved grassland
- lowland heath, with supplementary habitats river edge, brook edge, springs, flushes and pools
- moor, with supplementary habitats river edge, brook edge, springs, flushes and pools
- blanket bog, with supplementary habitats river edge, brook edge, springs, flushes and pools
- commercial *Fraxinus* plantations, with supplementary habitats river edge, brook edge, grassy open areas, tracksides and rock outcrops

2.2.1.2.3 Anthropogenic nothic habitats in Ireland

- commercial conifer plantations, with supplementary habitats rivers, brooks, grassy open areas, tracksides and rock outcrops
- crops
- orchards
- ornamental gardens
- urban/suburban parks

2.2.1.2.4 The potential contribution of habitats occurring in Ireland to maintenance of syrphid biodiversity in Ireland

Using the database, the number of Irish syrphid species associated with each of the habitats listed above (together with their supplementary habitats) is easily counted. This shows that the highest number of species (98) is associated with alluvial forest. To whatever extent alluvial forest was present in the Irish landscape 5000 years ago, it is today almost non-existent, and for that reason it would be unrealistic to expect that alluvial forest might play a dominant role in supporting Irish

syrphid biodiversity either now or in the immediate future. That so many of Ireland's syrphid species have an association with alluvial forest certainly highlights the interest of that habitat type and provides support for efforts to protect the residual patches of alluvial forest remaining. But, in practical terms, it would seem necessary to seek elsewhere for habitats that might ensure the survival, in Ireland, of Irish syrphid species. The same holds true for oak-elm forest, also now reduced to vestigial remnants. And humid pine forest seems to have been entirely lost from the Irish landscape some time during the last 1000 years, prior to introduction of conifer plantations by man. So these three habitat types are here excluded from the process of identifying the habitats that might be expected to contribute to maintenance of biodiversity in Ireland.

The database registers the second highest number of associated syrphid species (96) for oak (acidophilous *Quercus*) forest, a habitat type still represented in Ireland and attracting conservation measures under the provisions of the EU Habitats Directive. If the assumption is made that oak forest sites in Ireland could be expected to support the Irish species known to be associated with acidophilous oak forest, those species can, for the purposes of this exercise, be removed from further consideration and attention then be focused on the remaining Irish syrphid species. With the oak forest-associated species removed the next largest group of species (45) is associated with rich fen. That habitat type is another already targeted for conservation in Ireland and could reasonably be expected to play a role in maintaining the Irish species known to be associated with it. With the syrphids of both oak forest and rich fen species excluded the next largest group of species (13) is associated with *Abies/Larix/Picea* plantations. Theoretically then, it would seem possible to maintain 85% of the existing Irish syrphid biodiversity by appropriate management of a combination of oak forest, rich fen and conifer plantation sites. But what about the other 15% of the species and in which habitats are rare species concentrated? In order to provide for the remaining 15% of the species a combination of moor (7 associated species), fen carr (6 associated species), marsh and salt-marsh grassland (5 associated species), montane, calcareous, unimproved grassland (4 associated species), *Corylus* scrub (2 associated species), *Fraxinus* forest (1 associated species) and *Betula-Pinus* swamp forest (1 species) would have to be added to oak forest, rich fen and conifer plantations. This information is summarised in Table 1. The process leaves two species unaccounted for. The only definable Irish habitat that these two species (*Eupeodes goeldlini* and *Pipiza festiva*) are known to be associated with is alluvial forest. The single known Irish locality for *E.goeldlini*, albeit winter-flooded grassland scattered with thickets of *Salix*, does not fall readily into this category. The other species, *P.festiva*, was supposedly collected on the wooded shores of L. Neagh, in habitat approximating to alluvial forest.

Table 1: Minimum array of habitats theoretically required to support existing Irish syrphid biodiversity, plus the maximum number of species dependent upon each of those habitats, assuming availability of a sufficient resource of each listed habitat (and all of its supplementary habitats) to provide for its associated species

Habitat	No. Irish spp remaining	No. associated spp remaining
All habitats	182	
Acidophilous oak forest		96
Acidophilous oak forest spp removed	86	
Rich fen		45
Rich fen spp removed	41	
Abies/Larix/Picea plantations		13
Abies/Larix/Picea plantation spp removed	28	
Moorland		7
Moorland species removed	20	
Fen carr		6
Fen carr spp removed	14	
Marsh & salt-marsh grassland		5
Marsh & salt-marsh grassland spp removed	9	
Montane, unimproved grassland		4
Montane, unimproved grassland spp removed	5	
Corylus thickets		2
Corylus thicket spp removed	3	
Betula/Pinus swamp forest		1
Betula/Pinus swamp forest spp removed	2	
Fraxinus forest		1
Fraxinus forest spp removed	1	

The previous paragraph identifies what is probably the narrowest range of habitats required to maintain existing Irish syrphid biodiversity. It is noticeably a mix of habitats occurring naturally in Ireland, man-made plagioclimax habitats and man-made nothic habitats. In principle, at least, if sufficient areas of the naturally occurring habitats could be secured they should require little management. But the plagioclimax and nothic habitats are dependent upon management by man for their continued existence, in which case maintenance of the present-day syrphid biodiversity of Ireland would in part depend on pro-active management of those habitats.

If the approach is adopted, that protection of the full range of habitats occurring naturally in Ireland (as listed in section 2.2.2.1 above) should be the basis for maintenance of biodiversity in Ireland, it is worthwhile considering whether this approach would be likely to maintain existing Irish syrphid biodiversity. Counting the number of Irish syrphid species supported by all of the habitats listed in section 2.2.2.1 above, put together, gives a total of only 157 of the 182 Irish species, assuming that alluvial forest, oak-elm forest and humid pine forest have to be excluded because those three habitat types remain only as vestiges or have entirely disappeared. Essentially, then, maintenance of the existing Irish syrphid biodiversity is unlikely to be achieved solely by maintenance of habitats occurring naturally in Ireland and, whatever combination of habitats is targeted for biodiversity maintenance purposes, active management of a significant proportion of

them will be required. The only other way to maintain the existing Irish syrphid biodiversity using naturally occurring habitats would be to augment the range of naturally-occurring habitats by large-scale restoration of habitats that have been lost, like alluvial forest, an untried procedure that would itself involve much active management.

Given that many of Ireland's naturally-occurring habitats are today recognised as under threat themselves, it is also worthwhile considering what proportion of Ireland's syrphid biodiversity might be maintained by all of the plagioclimax and nothic habitats put together i.e. to establish what proportion of the existing biodiversity may not be dependent upon naturally-occurring habitats. Carrying out this procedure with the database demonstrates that 156 of Ireland's syrphid species might be expected to survive in the array of plagioclimax and nothic habitats (assuming their management does not change to adversely influence the species) listed in sections 2.2.2.2 and 2.2.2.3 above. Humid, unimproved, oligotrophic, lowland grassland (with its supplementary habitats) is the habitat contributing the largest number (62) of species. But it is recognised as a threatened habitat attracting conservation measures and is dependent upon a type of farmland management that is no longer financially viable. It was represented more widely prior to Ireland's entry into the EU, with EU-driven intensification of use of farmland during the latter part of the 20th century serving to all-but eradicate it. Just as it is unrealistic to suggest that remaining remnants of alluvial forest can play a major role in maintaining Irish syrphid biodiversity, so may it be unrealistic to suggest humid, lowland, unimproved, oligotrophic grassland could play such a role. The situation is made complicated by the potential for confusion between lowland grassland and low altitude, montane grassland in Ireland, the grasslands of western Ireland mostly falling into the latter category. Given the uncertain status of unimproved, lowland grassland in Ireland it would seem necessary to consider two scenarios, one in which humid, unimproved, lowland, oligotrophic grassland is included, the other in which it is excluded.

Assuming that humid, oligotrophic, lowland unimproved grassland is sufficiently well-represented in Ireland to support the syrphids associated with it those species can be excluded from further consideration. With that group of species removed, the plagioclimax/nothic habitat type that supports the next-most-numerous group of species (36) is *Abies/Larix/Picea* conifer plantations. With those species removed from consideration the next largest category (16 species) is thickets of Atlantic scrub. Montane, unimproved grassland comes next, with 9 species. The habitat hedge plus field margin (i.e. where hedge and field margin occur together, rather than separately) supports the next largest (6) group of species. This is followed by lowland, alluvial, unimproved grassland (3 species) and then *Fraxinus* plantations (2 species). Finally, there are 4 species each associated with different habitats: *Cheilosia semifasciata* with old field walls; *Heringia heringi* with orchards; *Platycheirus amplus* with moorland streams and *Sphaerophoria rueppellii* with crops (cabbage). What is noticeable about this habitat list is that, apart from humid, oligotrophic, lowland unimproved grassland, a habitat that is now under threat, habitats of the enclosed farm landscape (namely grassland, crops, hedges and field margins) play only a very minor role in it, their most significant contribution, of 6 species, coming from a farm infrastructural habitat, hedge plus field margin. This adds to the potential interest of re-running this procedure on the assumption that, in Ireland, humid, oligotrophic, lowland, unimproved grassland can no longer be relied upon to support the species associated with it because it is today such a scarce resource. The

issue becomes how many of the species associated with humid, oligotrophic, lowland, unimproved grassland can also be supported by other man-made plagioclimax/nothic habitats. Recounting with humid, oligotrophic, lowland, unimproved grassland excluded from the habitat array demonstrates that, in fact, no species should be lost in the event that this habitat disappeared from Ireland, i.e. all of the Irish species it supports are also supported by other plagioclimax and/or nothic habitats. In the absence of humid, oligotrophic, lowland, unimproved grassland the plagioclimax/nothic habitat that would support the largest number (60) of Irish syrphid species is the combination habitat hedge plus field margin (this assumes light hedge-management and permanent field margin). A third (20) of the species involved would also require the presence of the supplementary habitat stream edge. The next most important habitat would then be *Abies/Larix/Picea* plantations, with 27 species, followed by lowland, unimproved, alluvial grassland, with 24 species. Next comes Atlantic scrub (14 species), then montane, unimproved grassland (10 species), *Fraxinus* plantations (5 species), urban parks and moorland (each with 4 species), and finally a number of habitats each supporting single species (*Pinus* plantations; isolated trees of *Salix*; lowland, eutrophic/mesotrophic, unimproved grassland; crops; setaside; orchards; ornamental gardens; cutover bog).

The same procedure shows which species are apparently entirely dependent upon continued availability of existing naturally-occurring habitats in Ireland and which of those naturally-occurring habitats would be expected to support the greatest numbers of these species. Of the 27 species involved the largest number (15) is associated with acidophilous oak forest, again highlighting the significance of this habitat to maintenance of Irish syrphid biodiversity. *Salix* swamp forest follows, with 4 species. Then there are 3 species, *Anasimyia transfuga*, *Platycheirus immarginatus* and *Sphaerophoria loewi*, associated equally with reed beds/tall sedge beds and marsh, the latter two of which are also associated with salt-marsh, where a third otherwise unplaced species, *Eristalinus aeneus*, occurs. So, together these four species are associated with marsh/salt-marsh/reed and sedge beds. Finally there is a single species associated with *Fraxinus* forest (*Brachyopa scutellaris*). The two remaining species, *Eupeodes goeldlini* and *Pipiza festiva*, are associated with no known Irish habitats, other than alluvial forest.

2.2.1.2.5 The habitats of the rarer species

All of the Irish syrphid species are coded according to their perceived threat status in the Range and Status spreadsheet of the database, using very general threat categories. There are 50 species coded as being recognisably threatened to some extent in Ireland. Using the database the habitat associations of these 50 species can be examined. That shows the largest number of threatened species (26) to be associated with acidophilous oak forest, closely followed by alluvial forest (25 species) and *Quercus-Ulmus* forest (23 species). Perhaps not surprisingly, 20 of the threatened acidophilous *Quercus* forest species are shared with *Quercus-Ulmus* forest. A smaller proportion, 16 species, is shared with alluvial forest. The next most numerous group of threatened species (10) is that associated with *Abies/Larix/Picea* conifer plantations. Six of those 10 species are also associated with acidophilous *Quercus*. Whereas the total hectareage of oak forest + alluvial forest + oak-elm forest in Ireland is now minuscule, the total hectareage of mixed conifer plantations is now quite considerable, and the evident scarcity of conifer-associated syrphids in Ireland cannot easily be envisaged as due to a lack of availability of habitat. It is argued elsewhere in this account that

there are grounds for concluding that syrphids associated with conifers (but not also associated with deciduous trees) are recent arrivals in Ireland, most of them perhaps only having been present for 50 years or so. If, indeed, these species are still in the establishment phase of their existence in Ireland, it would help to explain the scarcity of the 4 conifer-only syrphids that would be classed as threatened in Ireland. Another potential explanation would be that conifer-plantation management in Ireland does not encourage any of the 10 threatened conifer-associated species. If both species establishment factors and plantation management are influencing conifer-associated syrphid species in Ireland the scarcity of these 10 species would be more understandable. There can be little doubt that plantation management is affecting the constitution of the syrphid fauna of Irish conifer plantations. The database shows that in Irish oak forest, while 58% of the syrphid species are associated with trees, only 37% are associated with tree foliage. By contrast, in Irish *Abies/Larix/Picea* plantations, where 68% of the species are associated with trees, fully 59% are associated with tree foliage, reflecting the lack of other arboreal microhabitats, for instance those associated with overmature trees.

2.2.2 The role of County lists

The National Biodiversity Plan (DAHGI, 2002) requires implementation not only at National level, but also at regional level, leading Local Authorities to produce County Biodiversity Plans that follow the objectives laid out in the National Plan. Section 1.3 of the present text points out that Counties make very appropriate regions, in the sense that the term region is applied in use of the database, and demonstrates how a regional list can be employed to engender the list of species predicted to occur on a site, for comparison with the list of species observed on that site. Examples of Irish County lists used in this way can also be found in Speight (2002a, 2004a).

Just as the National list provides a ceiling to the biodiversity maintenance requirement nationally by delimiting the biodiversity resource that is available nationally, so the County list provides a ceiling to the biodiversity maintenance requirement in a County, by delimiting the biodiversity resource that is available to that County. The County list also has a more certain role in biodiversity enhancement – it is more realistic to aim at enhancing the biodiversity of a county by management that would support species currently missing from that county but known elsewhere in Ireland, than it would be to aim for enhancement nationally by managing in a way that might provide for species lacking in Ireland but present in Britain.

The syrphid species known from each Irish County are listed, in tabular form, in the database “Range and Status” spreadsheet. Some Irish counties are clearly under-recorded, as can be seen from the map of county distribution of Irish syrphids provided in section 3.4.1.5.2 of this text. But those containing 100 or more species should provide a realistic reflection of the balance of larval microhabitat occupancy in the county. Taking as examples the lists for Clare, Kildare, Mayo and Sligo, which are all of more-or-less the same length, it can be shown that in all of these counties the most poorly represented component of the Irish syrphid fauna is that associated with tree-microhabitats: see Table 2. This under-representation includes not only the syrphids of old trees, but of trees of all ages (down to, and including, the microhabitat category “Tall shrubs/saplings” shown in the Table), and indicates that for enhancement of the syrphid biodiversity of these

counties an action that would be of general utility would be to increase the area of woodland. Comparing these lists with the longer lists for counties Cork and Kerry demonstrates that the great majority of the species represented in these two counties, but in none of the other four (22 species), is associated with trees (16 species). In other words, the greater length of the syrphid lists for Cork and Kerry may well be a direct reflection of the better representation of forest in the latter two counties than in Clare, Kildare, Mayo or Sligo. Whether increasing the area of conifer plantations would have an impact on this phenomenon is a moot point – it has already been observed that conifer plantations in Ireland remain largely unoccupied by the conifer-associated syrphids on the Irish list. Four of the 16 tree-associated syrphid species known in Cork and/or Kerry, but missing from the other 4 counties, are specifically associated with conifers. The rest are associated with deciduous forest.

Table 2: Representation of Irish syrphid species associated with various larval microhabitats in four different Irish counties. Percentages show the % representation of the Irish species associated with a particular microhabitat in a particular county.

	Clare		Kildare		Mayo		Sligo	
	no.spp	% spp	no.spp	% spp.	no.spp	% spp.	no.spp	% spp.
All species:	102	56%	104	57%	101	56%	104	57%
Terrestrial Larval Microhabitats								
• All living-tree microhabitats	34	44%	33	42%	32	41%	37	47%
• Foliage	22	42%	23	43%	25	47%	25	47%
• Overmature/senescent tree features	8	47%	7	41%	4	24%	9	53%
• Mature trees	19	42%	20	44%	19	42%	23	51%
• Understorey trees	15	36%	17	41%	18	43%	19	45%
• All timber microhabitats	4	40%	4	40%	3	30%	7	70%
• Stumps	3	33%	3	33%	2	22%	6	67%
• Rotting tree roots	6	46%	5	39%	4	31%	8	62%
• Tall shrubs/saplings	15	37%	17	42%	17	42%	17	42%
• Low shrubs	16	76%	16	76%	16	76%	16	76%
• On herb layer plants	32	65%	33	67%	33	67%	31	63%
• In herb-layer plants	15	54%	16	57%	13	46%	17	61%
• All ground surface debris microhabitats	19	100%	18	95%	19	100%	18	95%
• Dung	11	100%	11	100%	11	100%	11	100%
• Cow manure	5	100%	5	100%	5	100%	5	100%
• Compost	3	100%	3	100%	3	100%	3	100%
• Herb layer litter	7	100%	7	100%	7	100%	7	100%
• Nests of social insects	4	67%	4	67%	3	50%	2	33%
• Grass-root zone	15	94%	12	75%	13	81%	11	69%
• Bulbs/tubers	4	50%	6	75%	5	63%	7	88%
AQUATIC LARVAL MICROHABITATS								
• Emergent water plants	12	60%	16	80%	15	75%	13	65%
• Submerged water plants	3	75%	2	50%	3	75%	2	50%
• All submerged sediment/debris microhabitats	25	74%	26	77%	27	79%	25	74%
• mud/ooze	15	79%	16	84%	15	79%	15	78%
• non-woody plant debris	23	74%	24	77%	25	81%	23	74%
• All water-saturated ground microhabitats	25	76%	27	82%	27	82%	27	82%
• Wet mud/ooze	12	80%	13	87%	13	87%	13	87%
• Peat	12	92%	13	100%	12	93%	12	92%
• Sodden plant debris	24	77%	26	84%	26	84%	26	84%
• Sodden cow-dung	6	100%	6	100%	6	100%	6	100%

2.3 Biodiversity management and land use in the Irish countryside

In section 2.2 of the present text the paramount importance of particular naturally occurring habitats to maintenance of Irish syrphid biodiversity was pointed out. But it was also shown that the suite of plagioclimax and nothic habitats existing in Ireland could together provide support for most of the syrphid species known in Ireland. At the same time it was indicated that the habitats intrinsic to the enclosed farmland landscape of today's Ireland only figure at a rather low level, in arrays of habitats arranged hierarchically to indicate their potential contribution to maintenance of existing syrphid biodiversity. This implies that even though farmland does cover most of the land surface of Ireland, its biodiversity maintenance potential will be dependent less on what biodiversity management regime is in place in farmland proper (i.e. field surfaces plus field margins) than on which additional habitats are also present in the farmland, and whether the biodiversity supported by those additional habitats can be maintained. Since farms are units of economic production, upon which the farmer's livelihood depends, the maintenance within farmland of habitats that do not deliver a financial return to the farmer has to be recognised as a financial issue. This is especially so in the case of plagioclimax or nothic habitats that would require active management. In this context, the impact of "agroenvironmental" schemes, introduced by the EU as a mechanism to improve environmental quality in farmland in various ways, including the safeguarding of biodiversity, requires to be considered, since they provide payment to farmers for adopting an agreed programme of environmentally-friendly management measures. In Ireland these are known as "REPS schemes" and their impact on maintenance of biodiversity in farmland will be considered in section 2.5.

Inevitably, biodiversity maintenance priorities in farmland are influenced primarily not by national or regional (i.e. county-level) biodiversity maintenance objectives, but by sectoral biodiversity interests, that can perhaps best be expressed in terms of the "ecological services" potentially rendered by different organisms, the organisms that can be identified with provision of valuable services to farming having a higher priority for maintenance within the farmed landscape than those that cannot. Those organisms constitute what has come to be known as "agrobiodiversity". So, habitats in the farmland landscape that support concentrations of organisms providing ecological services to the farmer would be of greater agrobiodiversity maintenance value than other habitats. As stated in the report on Benefits and Costs of Biodiversity in Ireland (DEHLG, 2008) "It is beginning to be appreciated that intensive agriculture cannot be sustained in the long-run without consideration being given to the need to ensure the continuance of ecosystem services".

The relation between biodiversity and provision of ecological services within the farmed landscape is comprehensively reviewed by Le Roux *et al* (2008). Among ecological services recognised as operating not only in farmland but also in forestry, horticulture, orchards etc (see, for example, Constanza *et al*, 1997; Losey and Vaughan, 2006) are "pollination" and "pest control". It is in no way novel to suggest that syrphids are important both as pollinators and in pest control. The American name for syrphids is "flower flies", alluding to the characteristically flower-feeding habit of the adult flies. Virtually all adult syrphids visit flowers to feed, those that do not do so being in a small minority. Much of the earlier work on pollination sought to establish how syrphids perform as bees, i.e. how efficient syrphids are at carrying out pollination roles performed by bees, which

resulted in unsurprising conclusions that bees were better at being bees than hoverflies are! Only recently have attempts been made to identify what actual pollination services are provided by syrphids. It transpires that, while bees may effect pollination, syrphid flower visits augment seed quality and viability in crops, through multiple pollination effects (Frank and Volkmar, 2006; Jarlan *et al*, 1997). In the latitudes of a country like Ireland syrphids are more important as pollinators than further south in Europe, where the diversity of bee species is higher. A second effect of syrphid flower-visiting activities is to ensure the pollination of the flowers of plants that, because they are present as only a few individuals, do not get pollinated by bees, in mixed stands of flowering plants (Gibson *et al*, 2006). As to their role in pest control, the fact that syrphids of many species have larvae which are predatory on plant bugs like greenfly, white fly and psyllids has made them of immediate interest to those concerned with biological control. In cereal crops, syrphids with aphid-feeding larvae can control peak densities of aphid populations (Chambers and Adams, 1986; Tenhumberg and Poehling, 1995). It is thus of interest to consider such issues as which of the habitats, that may accompany production land (i.e. field surfaces used for grass or crop production) in the farmland landscape, can resupply syrphid species to the production land when necessary.

Within the farmed landscape the management unit is the individual farm, which thus equates with a nature reserve, or a commercial forest, or even a National Park, in terms of considering how its constituent habitats might best be managed to maintain or enhance biodiversity. However, field survey of the state of the biodiversity maintenance function of the habitats present on a site is not convenient to carry out on a farm. This is due to the constraints upon sampling imposed by necessary farm management activities. Equally, it would be both financially and logistically impractical to undertake such survey work for each farm for which a REPS scheme was being drawn up. In these circumstances use of the database would realistically be confined to employment of its predictive capabilities, using the regional (i.e. county) species list and the habitats present on the farm to derive a list of the species predicted to occur there and then using the database to identify the changes that could be expected in the farm fauna consequent upon changes in habitat representation and management practices introduced under the REPS scheme. Given the small likelihood that comprehensive lists of observed syrphid species would be compiled for a farm under these circumstances it is clearly desirable that data are available from at least one farm, to gain some perception of how closely prediction used in this way might co-incide with what can be observed on the ground. To this end a case study of a farm in Co.Cork has been conducted, to both compare its predicted syrphid fauna with its observed syrphid fauna and to establish which of the species observed there as adult insects, and predicted to live on the farm, can be shown to develop there. The data set derived from the case study farm has been used here to explore in more detail the potential of a farm to maintain syrphid biodiversity in the farmed landscape of Ireland. It is used to explore the utility of REPS measures, to see how their effectiveness as measures to maintain syrphid biodiversity within farmland might be increased and to examine the potential of certain habitat restoration/introduction measures for enhancement of biodiversity within farmland.

2.4 Case study of a farm

2.4.1 Introduction

The biodiversity maintenance characteristics of farmland were investigated over a five-year period, in a project carried out on a 41ha mixed farm located in Co.Cork. The farm is described in Good (2001), together with an overview of its use during the last 20 years and an account of what was known of its flora and fauna at the outset of the project. The first objectives of the project were to compile a list of the habitats present on the farm, so that a list of the syrphid species predicted to occur there could be engendered, and to survey its syrphid fauna, to provide a list of observed species for comparison with the list of predicted species. The habitat list was compiled by direct observation in 2000, using the habitat categories used in the database, and a syrphid survey was carried out in the same year, using Malaise traps. The results from these surveys are described in Speight (2001). The material has been reworked for purposes of the present account.

2.4.2 The habitats present on the farm in 2000

The StN habitat categories observed on the farm in 2000 were as follows:

- Forest habitats
 - Atlantic thickets with flush
 - *Alnus* forest (general) with flush, temporary pool and brook
 - *Salix* swamp (general) (Speight and Good, 2001a: category not selected), with flush and temporary pool
 - scattered trees in open ground (tree lines of *Fagus* and *Acer pseudoplatanus*)
- Open ground habitats
 - lowland tall-herb communities with flush and seasonal brook
 - oligotrophic, humid, lowland unimproved grassland: nutrient-poor, humid, rush and mat-grass grassland
 - (Speight and Good, 2001a: unimproved, oligotrophic *Molinia* grassland) with flush and temporary pool/acid fen
 - lowland, improved grassland heavily grazed by cattle (Speight and Good, 2001a: improved grassland)
 - lowland, improved grassland hay
 - intensive grassland
- Culture habitats
 - hedges, with and without associated field margins, drainage ditch and/or canalised, seasonal brook

- old field walls (Speight and Good, 2001a: old walls)
- orchard
- farmyard organic waste
- horse-ducking pond
- farm buildings
- fallow land (set-aside)
- cereal crops (Speight and Good, 2001a: crops)

2.4.2.1 Production land habitats

Production land itself, i.e. the land directly involved in producing an income for the farmer, may occupy by far the greater part of the land surface of a farm – on the case-study farm c.88% of the total land area of the farm (see Good, 2001) – but does not encompass many different habitats. Of the habitats observed on the case study farm in 2000 the following comprise the production land:

- lowland, improved grassland heavily grazed by cattle
- lowland, improved grassland hay
- intensive grassland
- cereal crops

2.4.2.2 Infrastructural habitats

Some of the habitats present in a farmed landscape have been deliberately, or at least unavoidably, introduced as adjuncts to farming and can appropriately be categorised as infrastructural in character. In the case study farm the following habitats would fall into this group:

- scattered trees in open ground (tree lines of *Fagus* and *Acer pseudoplatanus*)
- hedges, with and without associated field margin, drainage ditch and/or canalised, seasonal brook
- old field walls
- orchard
- farmyard organic waste
- horse-ducking pond
- farm buildings
- fallow land (set-aside)

2.4.2.3 Disused land habitats

A third category of habitats within farmland is the disused land habitats, occupying land that either cannot be brought into use or is not currently economically/logistically possible to bring into use. On the case study farm the habitats falling into this category are:

- Atlantic thickets with flush, brook and temporary pools
- *Alnus* forest with flush and brook
- *Salix* swamp with flush and temporary pool
- oligotrophic, humid, lowland unimproved grassland; nutrient-poor, humid, rush and mat-grass grassland with flush and temporary pool
- lowland tall-herb communities with flush and seasonal brook.

Excluding from consideration its potential role in biodiversity maintenance, disused land is not required on a farm for farming purposes. It is, as identified by Good (2001), more a consequence of socio-cultural factors, tending to increase in area as a farmer approaches the end of his working life, only to be largely eradicated when management of the farm is taken over by the next generation. Infrastructural features can have a similar longevity, introduced to a farm to support the genre of farming carried out by one generation and removed when not required for the type of farming carried out by the next. This is clearly visible over much of Europe in respect of hedges introduced for livestock management, in that while hedges were generally employed until electric fencing became available they are now largely redundant, particularly where farms are converted entirely to crop production. Their differing functional significance to farming makes disused land, infrastructural land and production land useful categories into which to group their associated habitats, when considering biodiversity maintenance issues in the farmed landscape. These groupings are employed at various points in the following pages and, when the disused land habitats, infrastructural habitats or production land habitats are referred to as categories of habitat observed on the case study farm, the observed habitats are considered grouped as above.

2.4.3 The syrphid species recorded on the farm by Malaise trap survey in 2000

The species list derived from the 2000 Malaise trap survey is given in the Farm Data spreadsheet of the database. It is based on “saturation survey” i.e. use of far more Malaise traps than might normally be employed. In all, 27 Malaise traps were used. Their disposition on the farm is shown diagrammatically in the sketch map of the farm shown in Figure 16.

The syrphid list for Co.Cork is incorporated into the Range and Status spreadsheet of the database. Using it, together with the Macrohabitats spreadsheet and the habitats observed on the farm in 2000, a list of the syrphid species predicted to occur on the farm can be engendered, following the procedure illustrated in section 1.3.4 of this text. This list of predicted species can then be compared with the list of observed species derived from the 2000 Malaise trap survey, the basic procedure involved being described in section 1.3.5.

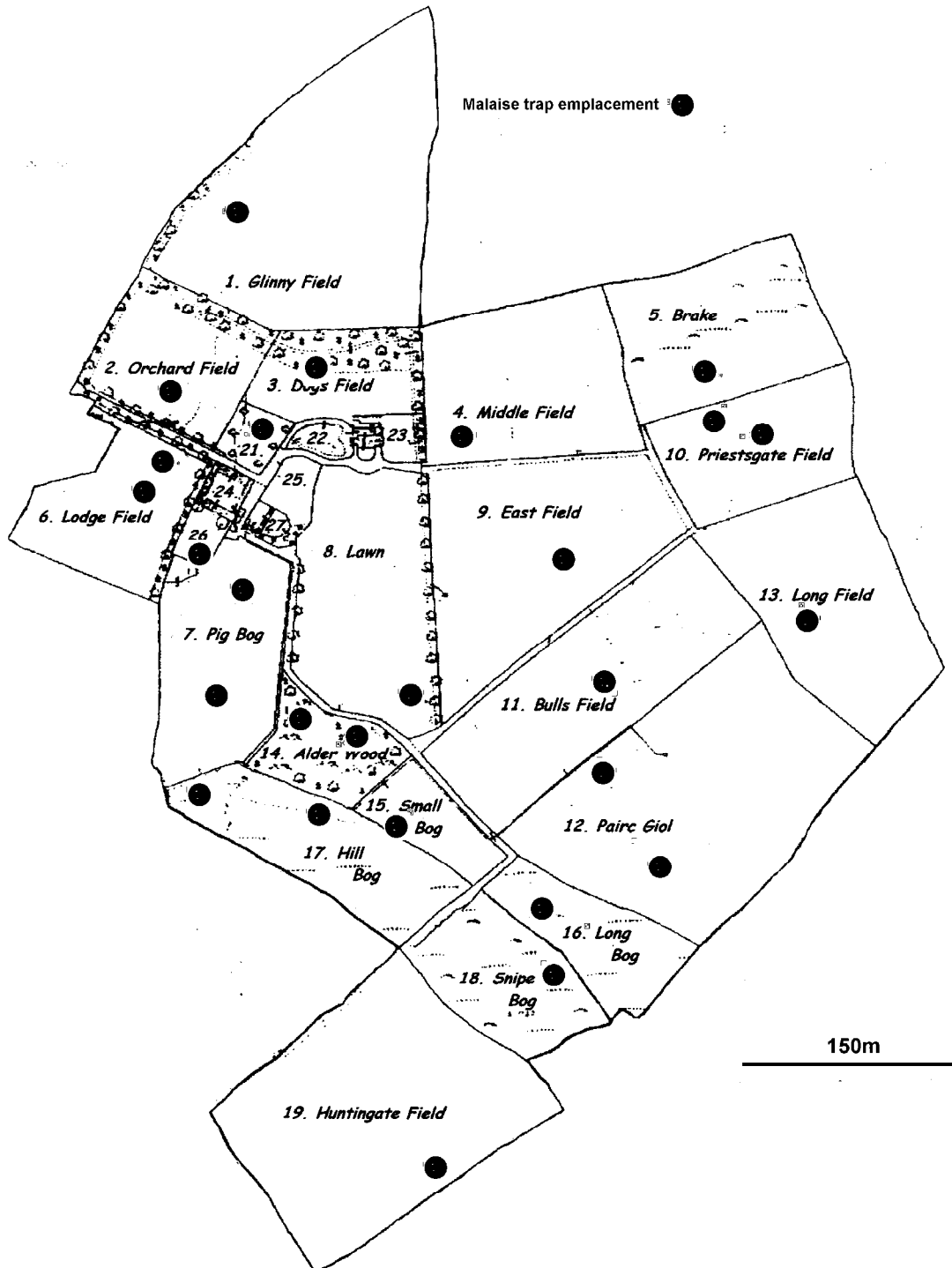


Figure 16: Sketch map of case-study farm, showing disposition of Malaise traps used in 2000 syrphid survey.

2.4.4 The state of the biodiversity maintenance function on the case study farm in 2000

There are 135 syrphid species listed for Co.Cork in the database 'Range and Status' spreadsheet. Of these, 67 were recorded from the farm by Malaise trap survey, in 2000. An additional 4 species were collected on the farm by hand net, in the period 1996-2000. Adding those 4 to the number of species collected by Malaise trap in 2000 gives a total of 71 syrphid species recorded for the farm then. That is 53% of the known syrphid fauna of Co.Cork. The number of Co.Cork syrphid species predicted to occur on the farm, based on the habitats observed on the farm in 2000, is 96. Five of the species collected by Malaise trap in 2000 were not predicted to occur on the farm: *Anasimyia lineata*, *Eristalis abusiva*, *Helophilus trivittatus*, *Sphegina elegans* and *Xylota sylvarum*. So, overall, the percentage of Co. Cork species predicted to occur on the farm that was observed on the farm 1996-2000 was 69%. And looking at the species list for the farm in another way, 94% of the 71 syrphid species recorded from the farm 1996-2000 were predicted to occur there, based on the habitats present.

Representation on the farm, of the species predicted to occur with each individual habitat observed there, is shown in Table 3, based on the 2000 species list for the farm. It will be noted that the representation of predicted species per habitat is greater than the representation of predicted species on the farm as a whole. This is due to a greater amount of habitat-sharing among the predicted and observed species than among the predicted but not observed species. Among the former the average number of habitats on the farm, with which each species would be predicted to occur, is 4; among the latter it is 2, i.e. the missing species show a greater degree of habitat specialisation that the observed species (at least within the range of habitats offered by the farm).

Table 3: Co. Cork syrphid species both observed to occur on the farm in 2000 and predicted to occur on the farm in 2000 based on the habitats observed on the farm in 2000.

Habitat category	No.assoc. spp. obs. on farm in 2000	As % of species predicted for hab.
Atlantic thickets (+ flush)	19	76
Salix swamp (+flush+temporary pool)	29	71
Alnus forest (+ flush+brook+temporary pool)	19	86
Scattered deciduous trees in open ground	5	71
Unimproved, humid, oligotrophic lowland grassland (+ flush+temporary pool)	34	74
Lowland tall-herb communities (+ flush+seasonal brook)	23	82
Lowland improved grassland, heavily grazed by cattle	11	92
Lowland improved grassland hay	12	92
Intensive grassland	4	100
Hedge plus field margin (+ ditch+canalised seasonal brook)	46	90
Old field walls	1	100
Orchard	16	80
Ornamental garden	18	86
Farmyard organic waste	6	100
Cereal crops	11	100
Setaside	10	91

The table demonstrates that, for most of the habitats represented on the farm, in 2000 the syrphid biodiversity maintenance function was in good condition on the farm i.e. 75% or more of the species predicted for each habitat were observed. The underlying assumption made is that the species collected on the farm as adults have developed on the farm as larvae. But, if the species collected as adults on the farm did not develop on the farm as larvae they must have come from somewhere else. Speight and Good (2001b) showed that, within a radius of 1km round the farm, the same habitat array occurs as is found on the case study farm, with the addition of only a *Picea* plantation, freshwater marsh and acid fen. Returning to the species listed for the farm in 2000 but not predicted to occur with habitats represented on the farm then, one of them (*Xylota sylvarum*) would be predicted to occur in mature spruce plantation, but the others would not. Three of them (*Anasimyia lineata*, *Eristalis abusiva* and *Helophilus trivittatus*) would be predicted to occur in freshwater marsh and/or acid fen. The fifth species (*Sphegina elegans*) would not be predicted to occur with any of the habitats either on the farm or in its vicinity. An additional species, *Platycheirus scambus*, not seen on the farm since 1994, is another fen and marsh species that would not be predicted to occur in any of the habitats observed on the farm in 2000. Essentially, then, if syrphid species collected as adults on the farm developed as larvae in the vicinity of the farm, rather than on the farm itself, the habitats involved are by and large the same as the habitats observed on the farm, with possibly some additional species from spruce plantation, marsh and acid fen. Using the database, the number of syrphid species predicted to occur in these three additional habitats, among the species observed on the farm, can also be established. The result is shown in Table 4, which demonstrates that there is a reasonable representation of species predicted to occur with these three habitats among the syrphids recorded from the farm. It would be perverse to suggest that these species are all derived from habitats in the farm's hinterland, rather than from habitats occurring on the farm, given that they are nearly all predicted to occur both in habitats present on the farm and in its surround. But this high degree of co-incidence in predicted habitat occupancy, between the syrphids observed on the farm and habitats both on the farm and in its surroundings, does re-enforce the hypothesis that the syrphids found in this farmland landscape are characteristically species with a wide ecological amplitude, the more specialist species i.e. the species that are more restricted to particular habitats, being the species that are absent, although their presence would be predicted based on the habitats observed.

Table 4: Co.Cork syrphid species observed to occur on the farm in 2000 and predicted to occur in habitats that are present in the vicinity of the farm.

Habitat category	No. assoc. spp. obs. on farm in 2000	As % of species predicted for habitat
Acid fen	23	70
<i>Picea</i> plantation	28	60
Marsh	23	69

In 2000 there were no strictly wetland habitat types represented on the farm, though some of the oligotrophic, humid, lowland, unimproved grassland was on the site of acid fen that had been present 20 years previously (Good, 2001), until subjected to partial drainage. Indeed the physical character of this part of the farm, known as Snipe Bog, was still highly suggestive of poor fen, although vegetation components necessary to classify the area as poor fen, in particular *Carex* species, were lacking. Given this ambivalence, the high incidence of wetland-associated syrphids

recorded as adults in the 2000 species list for the farm, the presence on that list of wetland species not predicted to occur in association with habitats present on the farm and the presence of acid fen in the farm's hinterland, it was decided to attempt to re-establish wetland habitats on the farm as part of the project, to find out what would be the impact of the presence of these additional habitats on the syrphid fauna. The wetlands introduced to the farm, and how they were installed, are described in Speight and Good (2005). The implications of this exercise in habitat restoration/enhancement to the issue of syrphid biodiversity management in farmland are considered in the following pages.

2.4.5 Species reared from habitats on the farm

The techniques used to study which species were completing their life cycles on the farm, and some of the results of that work, are described in Speight (2001), Speight and Good (2001a) and Speight (2004c). The device central to that work is the emergence trap. Two sizes of emergence trap were employed. They are illustrated here in Figures 17 and 18. In addition, searching for and rearing of developmental stages was carried out by hand, particularly in larval microhabitats where emergence traps could not be used e.g. tree foliage.



Figure 17: Small emergence traps. Each trap covers a ground-surface area of c.1sq.m. The small emergence traps can only be used efficiently where the ground vegetation is no more than 50cm high. Syrphids and other insects emerging within a trap are collected in alcohol, in the lower of the two bottles connected to the trap at its highest point. Connection is achieved by means of a tube running between the interior of the trap and the upper collection bottle. The tube is open at both ends, allowing insects to move from inside the trap into the collecting bottles. The lower collection bottle can be unscrewed from the upper bottle and removed, containing its sample of emerged insects.



Figure 18: Large emergence traps. Each trap covers a ground-surface area of c.4sq.m. Attachment of the collection bottles is the same as for the small emergence traps. The large traps are required where ground vegetation grows higher than 50cm.

Emergence trapping and searching for developmental stages by hand were carried out on various parts of the farm, during the period 2000-2004, with the intention of gathering data from the maximum range of habitats possible, by the end of the exercise. Much of this activity was carried out subsequent to 2000 and has not been reported on in any publication. Here, results from all years of this “ground-truthing” exercise are brought together. The results from habitats present on the farm in 2000, the year in which the syrphid survey of the farm was carried out, are first considered separately from the results obtained from the wetland habitats introduced to the farm after 2000. The species reared from the farm are listed on the ‘Farm, Data sheet of the Database of Irish Syrphidae spreadsheets.

2.4.5.1 Syrphids reared from habitats present on the farm in 2000

Using emergence traps and other techniques, 38 of the 66 syrphid species recorded as adults from the farm in 2000, and predicted to occur in association with habitats observed on the farm in 2000, were shown to develop in one or more of those habitats on the farm during the period 2000-2004. In addition, two of the species not predicted to occur in association with habitats observed on the farm were also shown to develop on the farm, in those habitats. Those two species (*Eristalis abusiva* and *Sphegina elegans*) were recorded on the farm as adults – none of the syrphid species shown to develop on the farm in association with habitats observed there in 2000 were species that had not been recorded as adults in 2000.

Considering at microhabitat level the representation of the reared species, as a percentage of the species observed on the farm as adults in 2000, produces the result shown in Table 5. In this table the farm is taken as a unit (i.e. with the results from all macrohabitats put together), showing which microhabitats exhibit the poorest representation of reared species overall, on the farm. It shows that, as a group, microhabitats associated with water/water-sodden ground show the lowest proportions of observed species (i.e. species observed as adults and predicted to occur in associated with habitats represented on the farm in 2000) reared.

Table 5: Microhabitat associations of syrphid species observed on the farm in 2000 and of the species reared from the case-study farm, shown as number of species associated with each microhabitat. The five observed species not predicted to occur in association with habitats represented on the farm are excluded (see text).

	Species predicted for the farm in 2000		
	Observed as adults in 2000	Observed as adults & reared from farm habitats present in 2000	Reared species as % of species observed as adults
All microhabitats	66	38	58
Individual microhabitats			
• Trees	23	14	61
• Shrubs/bushes/saplings	18	10	56
• Upward climbing lianas	8	7	88
• Herb layer plants	30	19	63
• Timber	3	2	67
• Cow dung	6	5	83
• Cow manure	5	4	80
• Compost	3	3	100
• Forest litter	1	1	100
• Herb layer litter	7	6	86
• Root zone	20	13	65
• Water plants	5	2	40
• Submerged fine sediment	12	5	42
• Submerged coarse sediment	15	9	60
• Water-saturated mud/ooze	11	4	36
• Water-saturated peat	9	3	33
• Sodden plant debris	19	13	68
• Sodden cow-dung	6	2	33
• Oligotrophic water	16	7	44
• Mesotrophic water	20	11	55
• Eutrophic water	12	9	75
• Slow moving water	10	4	40
• Standing water	17	11	65

2.4.5.2 Syrphids reared from habitats introduced to the farm 2001-2003

The habitats introduced to the farm during the period 2001-3, for purposes of restoring wetland on the farm can be listed as follows:

- marsh, seasonal pool in marsh, permanent pool in marsh, stream in marsh
- tall sedge beds, reed beds (of *Typha*)
- pond margin plus stream, in humid, unimproved, lowland grassland

Adding these habitats to the habitat list for 2000 produces a list of the habitats present on the farm in 2005. Various syrphid species were added to the species list for the farm during the period 2001-2005 (inclusive), from both general collecting activity and a repeat Malaise trap survey carried out in 2005. Adding those species to the species list for the farm in 2000 gives a list of species observed on the farm 2000-2005. This expanded species list is shown on the Farm Data sheet of the Database of Irish Syrphidae spreadsheets. Using the 2005 habitats list for the farm with the 2000-2005 syrphid list for the farm, a list of the observed species predicted to occur on the farm in 2005 can be engendered with the database. Comparing that list with the list of species proven to develop on the farm, in all habitats observed on the farm (i.e. including the wetland habitats introduced to the farm) grouped together, the level of microhabitat occupancy on the farm can again be established, for all microhabitats. Table 6 shows the results derived from carrying out this exercise, for all of the microhabitats included in Table 5. Comparing the content of these two Tables demonstrates that the poor representation of syrphids associated with aquatic/subaquatic microhabitats, so obvious in Table 5, has disappeared in Table 6.

The syrphids reared from the habitats introduced to the farm in the period 2001-3, but not from habitats present on the farm in 2000, are as follows:

Anasimyia contracta Claussen & Torp, 1980

Chrysogaster coemiteriorum (L.), 1758

Eristalis horticola (De Geer), 1776

Eristalis intricaria (L.), 1758

Eristalis nemorum (L.), 1758

Helophilus hybridus Loew, 1846

Lejogaster metallina (Fabricius), 1781

Melanogaster hirtella (Loew), 1843

Orthonevra nobilis (Fallen), 1817

Platycheirus occultus Goeldlin, Maibach & Speight, 1990

All of these species are associated with wetland habitats, and all but one of them have aquatic /subaquatic developmental stages. With the exception of *Anasimyia contracta* and *Chrysogaster coemiteriorum*, all of these species were recorded as adults on the farm in 2000 and predicted to occur in association with habitats present on the farm in 2000. So the habitats introduced to/restored on the farm resulted in breeding of 8 species on the farm that were predicted to do so, but that could not be proven to develop there, in the habitats present in 2000. It is possible that some of those 8 species were breeding on the farm in habitats present there in 2000, but very localised and in small numbers, rendering the species effectively inaccessible to the programme of

hunting for developmental stages and emergence trapping that was carried out in those habitats. But whether the introduced/restored habitats provided microhabitats that enabled these species to establish populations developing on the farm or to augment existing populations developing on the farm, they certainly achieved one or the other result.

So use of the database first identified wetland restoration/introduction as a worthwhile undertaking, on the farm, given the observed syrphid fauna of the farm in 2000 and the habitats present then. It then showed that the syrphids whose development on the farm could be proven, in habitats present in 2000, were most poorly represented in aquatic/subaquatic microhabitats and finally showed that the wetland habitats introduced to the farm corrected this imbalance.

Table 6: The percentage of the observed syrphid species associated with various microhabitats that was reared from the case-study farm

	Cork spp predicted for farm in 2005		
	Observed as adults in 2000-5	Observed as adults & reared from farm	Reared spp as % of spp observed as adults 2000-5
All microhabitats	79	49	62
Individual microhabitats			
Trees	26	15	58
Shrubs/bushes/saplings	21	11	52
Upward climbing lianas	8	7	88
Herb layer plants	36	20	56
Timber	3	2	67
Cow dung	6	6	100
Cow manure	5	4	80
Compost	3	3	100
Forest litter	1	1	100
Herb layer litter	7	6	86
Root zone	24	13	54
Water plants	8	5	63
Submerged fine sediment	15	12	80
Submerged coarse sediment	20	15	75
Water-saturated mud/ooze	12	11	92
Water-saturated peat	10	8	80
Sodden plant debris	21	19	90
Sodden cow-dung	6	5	83
Oligotrophic water	22	16	73
Mesotrophic water	25	18	72
Eutrophic water	15	10	67
Slow moving water	11	10	91
Standing water	22	18	82

2.4.6 The state of the biodiversity maintenance function on the case study farm in 2005

A second Malaise trap survey of the syrphid fauna of the farm was carried out in 2005. The results from that survey, plus the results of collecting by hand net, plus the results derived from emergence trapping and hunting for developmental stages in the period 2001-3, together provide a list of the syrphid species recorded from the farm for the period 2001-5. Attributes of this species list, pertaining to the state of the biodiversity maintenance function of the farm, can be compared with similar attributes of the species list from the farm for the period 1996-2000. All but 4 of the 71 species recorded 1996-2000 were also recorded in the period 2001-5, suggesting a considerable degree of stability in the syrphid fauna of this farmed landscape. The major difference between the two lists lies in the 14 species recorded 2001-5, but not in 1996-2000. Eight of those are wetland species, that would be predicted to occur in association with the wetland habitats introduced to the farm 2001-3. The others are as many of them forest species as open ground species.

Table 7: Co.Cork syrphid species both observed to occur on the farm in 2005 and predicted to occur on the farm in 2005 based on the habitats observed on the farm in 2005. Percentages showing an increase in comparison with 2000 are shown in bold.

Habitats present in 2000 and 2005	No. assoc. spp.obs. on farm 2001-2005	As % of species predicted for habitat
• Atlantic thickets (+ flush)	14	74
• Salix swamp (+flush+temporary pool)	19	73
• Alnus forest (+ flush,+brook+temporary pool)	17	81
• Scattered deciduous trees in open ground	5	71
• Unimproved, humid, oligotrophic lowland grassland (+ flush, temporary pool)	35	78
• Lowland tall-herb communities (+ flush, seasonal brook)	29	91
• Lowland improved grassland, heavily grazed by cattle	12	100
• Lowland improved grassland, hay	13	100
• Intensive grassland	4	100
• Hedge plus field margin (+ ditch, canalised seasonal brook)	46	90
• Old field walls	1	100
• Orchard	16	80
• Ornamental garden	19	91
• Farmyard organic waste	6	100
• Cereal crops	10	91
• Setaside	10	91
Habitats introduced 2001-2003		
• Marsh (+ pool)	23	74
• Reed bed (+ pool)	19	73
• Tall sedge bed (+ pool + seasonal pool)	30	77
• Humid, oligotrophic, unimproved, lowland grassland (+brook, permanent pool)	45	75

Table 7 shows the percentage of species predicted to occur in 2005 that were recorded from the farm in 2001-5, for each of the habitats present on the farm in 2005. Comparison between the contents of Table 7 and Table 3 shows no major differences between them, though in 2005 a small increment in the percentage of predicted species observed is apparent for six of the habitats present both in 2000 and 2005, three of those 6 being habitats directly influenced by enhancement of the wetland habitats on the farm. In addition, marsh, with 69% of its predicted species recorded 1996-2000, although not present on the farm then, is represented by 74% of its predicted fauna in the 2001-5 list having been introduced to the farm in 2002-3. In general, the habitats introduced to the farm in the period between 2000 and 2005 show a percentage representation of their associated fauna that is on a par with the representation of species associated with the other habitats, with marsh showing the smallest (71%) percent representation of predicted species.

So there are indications that introduction of wetland habitats to the farm during 2001-3 have had an impact on the farm's syrphid fauna, but this impact is not expressed as a dramatic increase in wetland syrphid species recorded from the farm, that would parallel the observed impact on the farm's dragonfly fauna (Speight and Good, 2005). Is there a basis for expecting that introduction of wetland habitats would result in noticeable changes in the constitution of the list of syrphids recorded from the farm? On the contrary, if the 2000 species list for the farm is a more-or-less complete inventory of the syrphid biodiversity of the farm and the surrounding farmed landscape in which the farm is embedded, little change might be expected in the species recorded from the farm following introduction of the wetlands, because the species that might be attracted to live in those wetland habitats on the farm should already be on the species list for the farm in 2000, having been collected there as adults. The impact that might reasonably be expected on the farm's syrphid fauna would not so much be an increment in the wetland syrphids collected there as adults as an increment in the diversity of wetland species recorded as adults in 2000 *that are found to develop* on the farm. As demonstrated in section 2.4.5.2 above, 10 wetland syrphid species were found to develop in the wetlands introduced to the farm, but apparently not in habitats present on the farm in 2000, and eight of those species were recorded from the farm as adults, on the 2000 species list. The additional two species (*Anasimyia contracta*, *Chrysogaster coemiteriorum*) were not recorded on the 2000 list and presumably arrived on the farm from the surrounding landscape. Both of them would be predicted to occur in the wetland habitats introduced to the farm 2001-2003 and in habitats known to be present within 1km of the farm. The same is true of the only other wetland syrphid (*Parhelophilus versicolor*) present on the 2005 list for the farm, but not on the 2000 list. This species was not proven to develop on the farm during course of this study, but it would be unreasonable to assume that, in the continued presence of the introduced marsh with *Typha* stands, this syrphid would fail to complete its life cycle there.

Both the 2000 and 2005 syrphid lists for the farm included a few species not predicted to live on the farm. Two of the species involved (*Sphagina elegans* and *Xylota sylvarum*) are present on both lists and one of these, *Sphagina elegans*, was proven to develop on the farm. The fact that the database did not predict the occurrence of *S.elegans* on the farm could be interpreted as indicating a need to re-examine the habitat-association coding for this species. But it can also be interpreted as highlighting the presence of an unusual combination of circumstances on the farm that is not open to prediction by the database. Adults of *S.elegans* were collected on the farm during Malaise trap

surveys in both 2000 and 2005. Development of *S.elegans* on the farm was demonstrated by collection of adults of this species in emergence traps installed in the bottom of a ditch channelling an almost-permanent brooklet (i.e. a shallow, spring-fed brook that remained running throughout the year, except in unusually dry summers). This ditch was along the edge of a hay field and totally beneath the canopy of a close-spaced line of planted beech trees (*Fagus*), all now nearly 200 years old. The branches of these beeches swept low to the ground above the ditch and shed both twigs and leaves into the ditch, creating a shaded, humid, microenvironment in the ditch and a facsimile of the microhabitat conditions that would be found in a flush on the floor of a humid beech forest, as shown diagrammatically in Figure 19. *S.elegans* is a species characteristic of humid beech forest and acidophilous oak forest. Beech forest does not occur naturally in Ireland and acidophilous oak forest does not occur either on the farm or within 1km of it in the surrounding landscape. So, in this instance, an unusual combination of farm infrastructural features, introduced to the landscape by man, enabled survival on the farm of a species that may well have disappeared from the surrounding landscape.

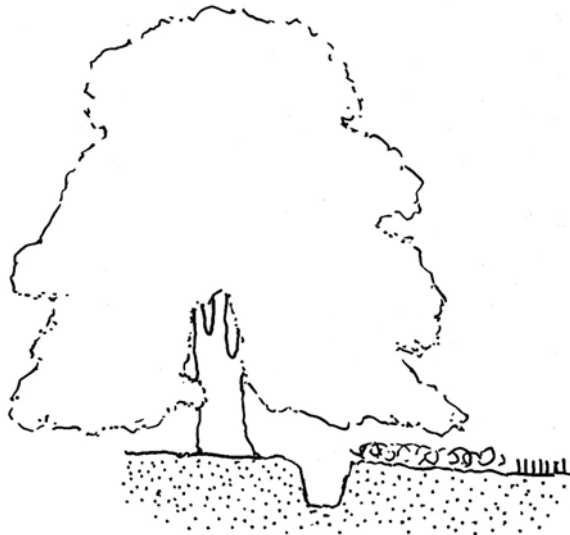


Figure 19: Diagrammatic representation of mature beech + ditch combination that supported development of the syrphid *Sphegina elegans* on the farm (see text).

The other non-predicted syrphid species recorded from the farm by the 2005 Malaise trap survey (*Dasysyrphus venustus* (Meigen), *Ferdinandea cuprea* (Scopoli), *Pipiza luteitarsis* Zetterstedt, *Xylota sylvarum* (L.)) are all of them also species that would be predicted to occur in association with both humid *Fagus* forest and acidophilous *Quercus* forest, and it is tempting to suggest that on the farm they may well have been supported by the old beeches that provided for *S.elegans*. However, since development on the farm was not proven for any of these species their status there is moot. *D.venustus* and *X.sylvarum* can also occur in association with conifer plantations and that habitat type was present within 1km of the farm. What is certainly clear is that, if the biodiversity maintenance potential of the farm had been assessed solely by use of the database in conjunction with habitat survey, the capacity of the farm to support *S. elegans* would not have been detected and the presence of *Dasysyrphus venustus*, *Ferdinandea cuprea*, *Pipiza luteitarsis* and *Xylota sylvarum* within that farmed landscape would not have been predicted. Putting these non-predicted species

into context, the 2001-2005 species list for the case-study farm included 81 species, 5 of which were not predicted to occur, amounting to 6% of the total list. It is only to be expected that on-site survey of the syrphid fauna would provide a more precise picture of the biodiversity maintenance potential of a site than a list of predicted species engendered from the habitats observed there, particularly when man-made nothic habitat (beech is an “alien” tree in Ireland) is present, because of the novel combinations of disparate ecological elements that can then be found together. But, from a practical point of view, it also requires to be pointed out that 94% of the 2001-2005 observed syrphid fauna of the farm was predicted by the database.

The syrphid list for the farm for 2001-2005 totalled 81 species, all but five of which would be predicted to occur on the farm, in association with habitats present there. So more than 50% of the 135 syrphid species known from Co.Cork were both recorded from the farm and predicted to occur on the farm, during this period. The percentage of Co.Cork species proven to develop on the farm during this period was somewhat smaller – 38%, but still represents a sizeable fraction of the Co.Cork syrphid fauna. It has already been commented that the habitats within 1km of the farm are effectively the same as those on the farm itself, and that the syrphid species collected on the farm reflect this conformity. Even if it has not been proven that *all* of the syrphid species collected on the farm and predicted to occur there do develop there, a good basis exists for arguing that they do develop within the farmed landscape surrounding the case study farm, if not actually within the farm itself. The conclusion that this farmed landscape can, as represented on the case study farm, maintain a proportion of the regional syrphid biodiversity that is potentially significant, not only to sustainable agriculture, but also in the wider context of national and regional biodiversity maintenance objectives, is almost inescapable. The previous pages show that this conclusion could be derived from use of the predictive capabilities of the database alone, unsupported by site survey data providing lists of observed syrphid species for the farm, but that the survey results reinforce the predictions made. It remains to consider how this level of biodiversity might be maintained within the farmed landscape, as exemplified by the case study farm.

2.4.7 The role of production land habitats, infrastructural habitats and disused land habitats in maintaining syrphid biodiversity on the farm

In section 2.4.2 of this account the habitats present on the farm were grouped into three categories, production land habitats, infrastructural habitats and disused land habitats. When biodiversity of agroecosystems is considered it is production land habitats that are the target of attention, with infrastructural habitats coming into consideration largely in terms of the support they can provide for maintenance of biodiversity in production land habitats (New, 2005). By contrast, disused land habitats on a farm are generally perceived as external to concerns about maintenance of the biodiversity of agroecosystems, and almost entirely ignored in studies of the production land habitats that are at the core of biodiversity manipulation within agroecosystems. Here the potential role of these three categories of habitat is considered in the context of maintenance of biodiversity on the farm as a land management unit. The wetland habitats introduced to the farm in 2001-3 (listed in section 2.4.5.2 above) are taken to be part of the disused land category.

Putting together all of the syrphids recorded from the farm in the period 1996-2005 produces a list of 85 species. Using the database, the habitats that these species would be predicted to occupy on the farm can be identified. With those habitats grouped into production land habitats, infrastructural habitats and disused land habitats it is similarly possible to predict which of the syrphid species recorded from the farm would be expected to occupy the habitats in each of these three categories. This exercise shows that 18 of the syrphid species recorded from the farm would be expected to occur there in association with production land habitats, 54 with infrastructural habitats and 73 with disused land habitats. The results derived from the emergence traps and other rearing methods provide information on which species develop on the farm, and in which habitats. Of the 18 species predicted to occur in production land habitats, 16 were reared from production land habitats. Of the 54 predicted for infrastructural habitats 28 were reared from infrastructural habitats and of the 73 predicted for disused land habitats 34 were reared from disused land habitats. In addition, one species, *Sphagina elegans*, was reared from an infrastructural habitat although not predicted to occur on the farm. Expressed as percentages, these figures are shown in Figure 20. In both the predicted scenario and what was found by rearing species the production land habitats support the smallest group of species, the infrastructural habitats occupy an intermediate position and the greatest proportion of the species is associated with disused land habitats.

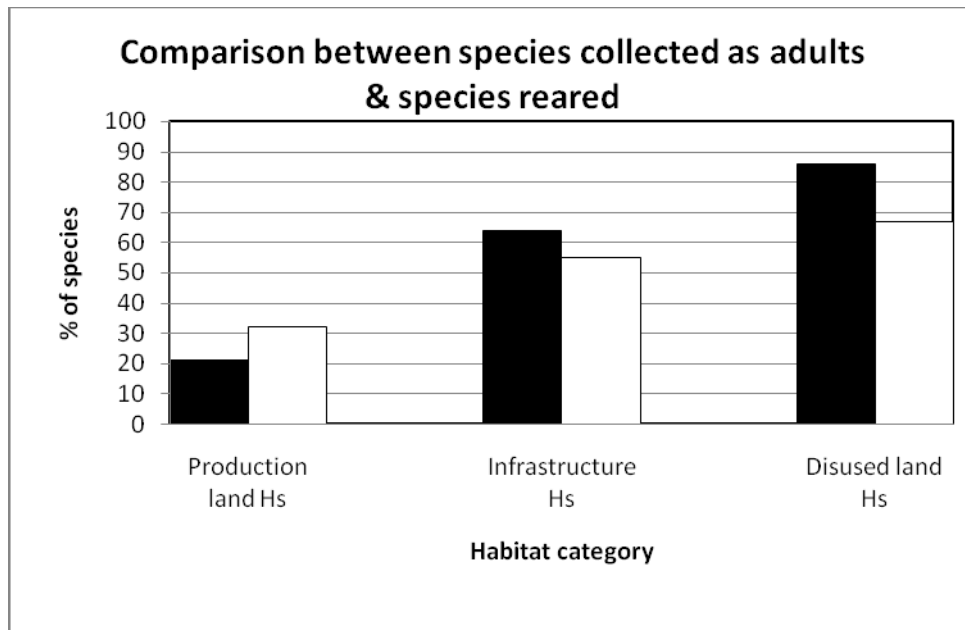


Figure 20: Comparison between representation of syrphid species collected as adults and species reared, in production land habitats (PH), infrastructural habitats (IH) and disused land habitats (DH) on the case study farm. The adult data (black) are shown as percentages of the total number of collected species *predicted* to occur with the habitats in each of the three categories, the reared species (white) are shown as percentages of the total number of reared species actually reared from habitats in each of the three categories.

2.4.7.1 The role of production land habitats

All 18 of the Co.Cork species predicted to occur with production land habitats present on the case-study farm were recorded from the farm as adults and 15 of those species were reared from

production land habitats on the farm. All but one of the 18 species would also be predicted to occur in association with infrastructural and/or disused land habitats present on the farm, so the unique contribution of the production land habitats to maintenance of the recorded syrphid biodiversity of the farm is predicted to be one species, among the 85 syrphid species listed for the farm. That one species is *Rhingia campestris*, whose larvae feed in cow dung. As predicted, it was reared from the cattle-grazed fields of the farm but not from elsewhere on the farm.

The 3 production land species observed on the farm as adults but not proven to develop in production land habitats on the farm (*Eupeodes luniger*, *Scaeva pyrastris*, *Sphaerophoria scripta*) are all of them highly migratory. None of these three species were proven to develop in any habitats on the farm. Two of them (*Scaeva pyrastris*, *Sphaerophoria scripta*) may not be resident in Ireland (see Species Accounts section of this text). If climatic change enables these two species to survive throughout the year in Ireland their role in production land habitats would be expected to increase here. *Sphaerophoria scripta*, in particular, can occur in considerable numbers in cropland habitats elsewhere. On the case study farm, only one male and one female of this species were recorded during the entire duration of the study. There seems no obvious reason why the third species, *Eupeodes luniger*, might not develop on the farm or in the surrounding farmed landscape.

Much has been written on the potential value of infrastructural habitats on farms as reservoirs of species potentially beneficial to production land habitats, the implication being that production land habitats “need” an injection of biodiversity from elsewhere in order to function efficiently. If one takes syrphids as potentially beneficial organisms, due to their capacity to play a role in pollination and in aphid predation, their maintenance within the agroecosystem, as represented by production land habitats, is of agrobiodiversity interest. In Ireland, for instance, 62% of the syrphid species characteristic of production land habitats have larvae that are aphid predators. Of the species in this group recorded from the case study farm 78% have aphidophagous larvae.

If the management regimes operating within production land habitats are taken into consideration it becomes immediately obvious why maintenance of agrobiodiversity in production land habitats can be heavily dependent upon availability of other habitats within their immediate vicinity. In croplands, ploughing is integral to management. Ploughing inverts the surface layers of the soil and, in so doing, renders the ground bare of vegetation. Together, these two processes represent virtual annihilation of the developmental stages of the syrphids inhabiting the field that is ploughed. Any syrphids that inhabit a crop grown on a ploughed field must thus originate elsewhere i.e. from populations surviving in some habitat adjacent to the ploughed land. Translating this reality to landscape scale, in regions where arable farming predominates in the landscape (both in Ireland and elsewhere) syrphids are effectively eliminated from most of the countryside every ploughing season. The same is true of areas where intensive grassland used for silage production predominates. The consequence can be seen in the characteristics of syrphids characteristic of croplands and intensive grassland; most of them are highly mobile, polyvoltine species with a short life history. Using the database to compare the frequency of these traits in Irish syrphid species predicted to occur in various production land habitats produces the result shown in Table 8. The same figures are shown for syrphids recorded from the farm, in Table 9.

Table 8: The proportion of the Irish syrphid fauna of various production land habitats exhibiting particular conditions of selected traits, expressed as a percentage of the number of species characteristic of each habitat.

G = grassland. Habitat category definitions as in the Glossary of Macrohabitat categories (Appendix 3).

Attribute/Habitat	Intensive G	Crops	Heavily-grazed, improved, lowland G	Lowland improved G hay	Unimproved lowland G
Migratory status					
• non-migrant	50	47	67	69	79
• migrant	50	65	33	39	25
No generations/year					
• one	0	34	33	15	54
• two or more	100	77	56	85	32
Duration of development					
• less than 2 months	100	82	56	62	38

Table 9: The proportion of the observed syrphid fauna of the farm predicted to occur with the production land habitats recorded on the farm exhibiting particular conditions of selected traits, expressed as a percentage of the number of observed species predicted for each habitat. G = grassland. Habitat category definitions as in the Glossary of Macrohabitat categories (Appendix 3).

Trait/Habitat	All production land habitats on farm	Intensive G	Cereal crops	Heavily-grazed, improved, lowland G	Lowland improved G, hay
Migratory status					
• non-migrant	69	50	46	63	69
• migrant	39	50	64	38	39
No generations/year					
• one	22	0	0	25	15
• two or more	89	100	100	75	85
Duration of development					
• less than 2 months	61	100	100	63	62

The only univoltine Irish syrphid species that are supposedly inhabitants of croplands, *Epistrophe eligans* and *Pipiza austriaca*, are coded in the database for crops on the basis that their larvae have been found in crops, not because they have been proven to complete their life cycle there. Larvae of *E.eligans* have been found feeding on aphids in cereal crops and larvae of *P.austriaca* likewise in the foliage of the potato plant, *Solanum tuberosum*. These crops are harvested before these syrphids could complete their development. The fields are then normally ploughed before replanting so that any larvae of these syrphids that have reached maturity and are attempting to overwinter would be eliminated. So it is extremely unlikely that either of these syrphid species can complete its development in these crops, and it would be more realistic to regard croplands as a drain on the population of both species. The potential of croplands to act as population sinks has serious implications to attempts to maintain biodiversity in agroecosystems, since it would be unusual for production land habitats to occupy less than 90% of the land surface of a farm, implying that up to

90% of the reproductive capacity of a species could be wasted in crops where it cannot complete its life cycle, only 10% then being available for maintenance of the species in infrastructural or disused land habitats on the farm.

Intensive grassland, used for silage production and then heavily grazed, or for production of multiple silage crops, acts as a population sink as do other forms of cropland. Indeed, in silage grassland this phenomenon probably reaches its extreme, because not only is the ground subject to periodic ploughing but the silage crop is baled and removed immediately on harvesting, taking with it into the silage bales any syrphid larvae living in it. In this respect there is a contrast between silage production and hay production - the hay crop is left in situ to dry after being cut, providing some opportunity for syrphid larvae to crawl away before it is baled and taken from the field.

The capacity of production land habitats to act as population sinks is not confined to croplands and intensive grassland. In grassland subject to heavy grazing by livestock the sward of the general field surface is grazed down to a height of 2-5cm, except for unpalatable herbs and, in the case of grazing by cows or horses, patches of vegetation in the immediate surround of their dung. Tall, unpalatable herbs and the vegetation of dung patches are thus the only places in heavily-grazed grassland where aphid-feeding syrphid larvae requiring taller herbaceous vegetation for their development can be found. But the management regime for such grasslands normally includes topping, as a mechanism for preventing seeding of unpalatable plants and to encourage livestock to graze the otherwise unused grass surrounding dung. Topping cuts off all but the stalk bases of all the taller ground vegetation during the growing season, at the same time removing the food supply for any aphid-feeding syrphid larvae living on these taller plants. An instance of this effect was noticed on the case-study farm: in July larvae of *Pipiza noctiluca* were found feeding on aphids in the developing inflorescence of thistles (*Cirsium*), in intensive grassland on the farm, and on blackthorn (*Prunus spinosa*) foliage in the adjacent hedge. Two weeks later this grassland was topped and the thistles were all cut. At that time, *P. noctiluca* larvae that had been collected in July, from the thistles and hedge, for rearing, were only part grown and did not reach maturity until later in the year.

The limitations alluded to above render croplands inimical to maintenance of syrphid biodiversity in agroecosystems and largely dependent upon presence of other habitats to supply syrphids for those periods of time that the crops might benefit from their presence. Not only is there virtually no "resident" syrphid biodiversity in land used for production of annual crops or intensive grassland, but the temporary syrphid biodiversity occurring there as larvae, during the periods when the land becomes inhabitable, is also for most species essentially a lost population, eradicated by crop management practices before it can reach maturity.

The habitat strata used by the larvae of the Irish species predicted to occur in various production land habitats are shown in Table 10. The same data are shown for the species recorded from the farm, as predicted to occur in the production land habitats present on the farm, in Table 11. If the species found in production land habitats have to be maintained by populations from other habitats in their surround then the syrphids characteristic of crops seem to require primarily an adjacent habitat with shrubs or tall herbs, and in this respect differ from the syrphids of the other production land habitats. In the situation of the case-study farm, where four different types of

production land habitat were present on the one farm, most production land syrphids lost from one of them could potentially be resupplied by syrphids from another, to judge from the degree of overlap exhibited in the syrphid faunas of these habitats, as shown in Table 12. In the situation where the production land on a farm was devoted entirely to crop production that possibility would not exist and the farm infrastructural habitat, hedges, potentially most easily able to resupply crop syrphids following their loss through management (e.g. ploughing), would also probably be absent. The presence of field margins, that might resupply many of the same species, could not be guaranteed either. In those circumstances resupply of syrphids to the crops could be largely dependent upon immigration of species from the landscape surrounding the farm. But the landscape surrounding the farm could also be cropland.

Table 10: Habitat strata used by larvae of Irish syrphids characteristic of various production land habitats, expressed as the percentage of the total number of Irish species predicted to occur in association with each habitat that is associated with each stratum. G = grassland.

Habitat stratum\Habitat	Intensive G	Crops	Heavily-grazed, improved, lowland G	Lightly-grazed, improved, lowland G	Unimproved, lowland G
Grass-root zone	75	29	33	29	23
on low-growing plants	100	59	56	41	25
on tall strong herbs	75	77	44	41	30
in herb-layer plants	0	0	44	41	18
Shrubs/bushes	25	65	33	24	14

Table 11: Habitat strata used by larvae of syrphids recorded from the farm and predicted to occur in association with production land habitats observed on the farm, expressed as the percentage of the total number of species associated with a habitat associated with each stratum. G = grassland

Habitat stratum\Habitat	All production land habitats	Intensive G	Cereal crops	Heavily- grazed, improved, lowland G	Lowland improved G, hay
Grass-root zone	33	75	36	38	62
on low-growing plants	50	100	73	63	54
on tall strong herbs	56	75	82	50	54
in herb-layer plants	17	0	0	25	23
Shrubs/bushes	39	25	64	38	31

Table 12: Syrphid species recorded from the farm 1996-2005 predicted to occur with production land habitats observed on the farm, showing how many production land habitats are shared by each species

Production land Species/Habitat	Habitats on farm predicted for species recorded on farm				No. of shared habitats
	Cereals	Intensive G	Lowland improved G heavily grazed by cattle	Lowland improved G, hay	
<i>Cheilosia albitarsis</i>			1	1	2
<i>Cheilosia pagana</i>				1	1
<i>Cheilosia vernalis</i>			1	1	2
<i>Chrysotoxum bicinctum</i>				1	1
<i>Episyrphus balteatus</i>	1		1	1	3
<i>Eupeodes corollae</i>	1		1	1	3
<i>Eupeodes luniger</i>	1				1
<i>Melanostoma mellinum</i>	1	1	1	1	4
<i>Melanostoma scalare</i>	1			1	2
<i>Platycheirus albimanus</i>	1	1	1	1	4
<i>Platycheirus clypeatus</i>	1	1	1	1	4
<i>Platycheirus rosarum</i>			1		1
<i>Platycheirus scutatus</i>	1				1
<i>Rhingia campestris</i>			1		1
<i>Scaeva pyrastris</i>	1				1
<i>Sphaerophoria interrupta</i>				1	1
<i>Sphaerophoria scripta</i>	1	1		1	3
<i>Syrphus ribesii</i>	1			1	2

The proportion of associated species that can feed on pollen-only flowers and nectar-bearing flowers is shown for various production land habitats in Table 13. It is presumably no coincidence that, as adults, the small number of syrphids characteristic of intensive grassland would all be able feed on the flowers of grasses, as well as on nectar-bearing flowers – this trait would enable the adult flies to more easily find food sources within the grassland, minimising their dependency on adjacent habitats. Approximately half of the species of other production land habitats would seem to require nectar-bearing flowers as adults, a dependence unlikely to be serviced by crops or heavily-grazed grassland, especially at certain times of the year. The flight period of the species has a bearing on this issue.

Table 13: Food sources of adults of Irish hoverflies characteristic of various production land habitats, expressed as the percentage of the total number of Irish species predicted to occur in association with each habitat that uses nectar-bearing flowers or pollen-only flowers.

Food sources (adults)/Habitat	Intensive G	Crops	Heavily-grazed, improved, lowland G	Improved, lowland G, hay	Unimproved, lowland G
Nectar-bearing flowers	100	94	100	100	95
Pollen-only flowers	100	59	56	54	54

For various production land habitats the proportion of the associated syrphid species in flight in Ireland, in the months from April to October, are shown in Table 14, using information coded into the database. Table 14 shows that, in all of these habitats, most of the associated syrphid species would be expected to be found in flight (as one generation succeeds another) from the beginning of

May to the end of September. Ssymank (2002) shows that there is movement of adult syrphids between adjacent habitats in the farmed landscape, following the fluctuating availability of floral resources manifest by the different fields that is caused by season and management. But he also shows that the various species do not all cross-habitat boundaries to the same extent, some showing a marked “reluctance” to do so. Equivalent data on floristic resources are not available for the case study farm, but even casual observation shows that there, as in almost any farmed landscape, there is a scarcity of plants in flower in production land habitats at certain times during the growing season. Given that the adults of most of the production land syrphid species require floral resources to be available from the beginning of May to the end of September, if their presence in the production land habitats is to be maintained, lack of floral resources in some field at a particular time e.g. due to crop harvesting, could only be expected to result in any adult syrphids present flying elsewhere and reduce the incentive for adult syrphids in adjacent fields to fly into that field. Thus harvesting a silage crop would not only remove syrphid larvae along with the crop, but also reduce likelihood of recolonisation of the species, due to removal of any flowers present that would otherwise supply ovipositing female syrphids with a food supply.

Table 14: Percentage of the syrphid fauna of different production land habitats that is in flight at different points in the period April to October, shown in two-week periods. G = grassland

	Intensive G	Crops	Heavily-grazed, improved, lowland G	Lightly-grazed, improved, lowland G	Unimproved, lowland G
April 1st.half	50	53	67	47	32
April 2nd.half	75	59	89	65	46
May 1st.half	100	77	100	88	71
May 2nd.half	100	77	100	88	88
June 1st.half	75	71	78	82	88
June 2nd.half	75	82	89	88	88
July 1st.half	100	88	78	88	88
July 2nd.half	100	88	89	94	88
August 1st.half	100	94	78	88	82
August 2nd.half	100	88	78	88	80
September 1st.half	100	77	78	88	75
September 2nd.half	75	59	78	77	59
October 1st.half	50	41	33	29	27
October 2nd.half	25	24	22	12	14

Overall, it has to be concluded that the syrphid biodiversity of some production land habitats is not self-maintaining and never could be so – for these habitats annual resupply of syrphids from adjacent habitats is essential. The rest of the production land habitats may have a quasi-permanent fauna of a small number of syrphid species, which may be permanent within the farm as a whole if a range of different production land habitats are available on the farm to resupply each other. But most production habitats act as a net drain on the populations of the syrphid species that attempt to inhabit them, because farm management procedures result in decimation of developmental stages before completion of the life cycle. Scarcity of floristic resources to provide food for the adult flies throughout the period beginning May to end of September will also act to inhibit recolonisation of production land habitats. The instability of the syrphid fauna of production land

habitats ensures that production land makes virtually no unique contribution to the syrphid biodiversity of the farmed landscape, its fauna being characterised by highly mobile, polyvoltine species “borrowed” from other habitats.

2.4.7.2 The role of farm infrastructural habitats

Of the 58 Co.Cork species predicted to occur in association with farm infrastructural habitats present on the case-study farm, 51 were recorded from the farm as adults during the period 2000-2005. The database shows that only 15 of these 51 species would be predicted to occur in production land habitats present on the farm, so if one takes production land habitats as the target of agrobiodiversity maintenance measures, most of the observed syrphid species predicted to occur with infrastructural habitats on the farm would seem to have no direct role in agrobiodiversity maintenance, since they are not predicted to occur with production land habitats found there. However, if one regards the case study farm as a part of the farmed landscape and adopts the principle that any farm in that landscape is potentially contributing to maintenance of agrobiodiversity at regional, or even national levels, then an additional 17 of the infrastructural habitat species recorded from the case study farm require consideration in the context of maintenance of agrobiodiversity, since they would be predicted to occur in association with production land habitats that occur elsewhere in Ireland. On that basis, two thirds of the species recorded from the case study farm and predicted to occur in association with the infrastructural habitats found there are potentially relevant to agrobiodiversity maintenance issues.

There are 3 syrphid species recorded from the farm predicted to occur in association with infrastructural habitats found on the farm, but not with either Irish production land habitats or any of the disused land habitats present on the farm. These three species, *Cheilosia semifasciata*, *Meligramma cincta* and *Volucella pellucens*, would thus seem to be dependent upon infrastructural habitats for their continued presence on the farm and as such show that the infrastructural habitats can make a unique contribution to maintenance of syrphid biodiversity in the farmed landscape. *C.semifasciata* is one of the species proven to complete its development on the farm. It's larvae are internal feeders in the tissues of *Umbilicus* and *Sedum* and occurs on the farm in association with the old field walls, where *Umbilicus* is abundant. Its natural habitats in Ireland are cliffs and scree, neither of which occurs in the immediate vicinity of the case-study farm, and the continued presence of this syrphid in the landscape in which the case-study farm is located is almost certainly dependent upon the continued presence of old field walls. The aphid-feeding larvae of the second species, *Meligramma cincta*, have been found on beech (*Fagus*), and would be predicted for the lines of mature/overmature beech trees that trace some of the field boundaries on the case-study farm. But developmental stages of this syrphid were not found on the farm. The same is true of the developmental stages of third species, *V.pellucens*, whose larvae are scavengers in the nests of wasps (*Vespula* spp). *V.pellucens* would be predicted to occur on the farm in association with field margins.

Given that 15 of the 18 species associated with production habitats occurring on the farm would be predicted to also occur in association with infrastructural habitats there, and most (9) of those 15 species were proven to develop in infrastructural habitats on the farm, the premise that

infrastructural habitats represent an agrobiodiversity biodiversity reservoir that can resupply species to production land when necessary gains support from the farm's syrphid fauna. Of the six production land habitat species not proven to develop in infrastructural habitats, but predicted to do so, four were not proven to develop on the farm at all. The situation of three of the latter group of species, *Eupeodes luniger*, *Scaeva pyrastris* and *Sphaerophoria scripta*, is discussed in previous pages (section 2.4.7.1). Adults of the last of these four species, *Sphaerophoria interrupta*, were observed persistently in certain locations on the farm and almost certainly maintained populations in field margins there, although not proven to do so. The lack of breeding records for this species is more likely due to inadequacies in the emergence trapping programme than to its failure to breed on the farm. The two other production land syrphids predicted to develop in infrastructural habitats on the farm but not proven to do so, *Eupeodes corollae* and *Platycheirus scutatus*, would be expected to develop in field margins and hedges, respectively.

The number of Co. Cork syrphid species predicted to occur in each of the infrastructural habitats present on the farm is shown in Table 15, together with the equivalent figures for the syrphids recorded from the farm 2000-2005. The farm infrastructural habitat predicted to support the most species is the composite habitat category field margin plus hedge, ditch and seasonal/permanent brook. Because these components do occur together along some field boundaries on the case-study farm it is convenient to present them as though they are always found together on the farm. But this is not the case and ditches or ditched streams, in particular, are present along only a few of the field boundaries. Dissecting this composite habitat category into its combinations of habitats present on the farm shows the potential contribution made by each of them to maintenance of syrphid biodiversity on the farm. That exercise is carried out in Table 16, which shows that there is little overlap between the species that are predicted to occupy a hedge and those that would similarly occupy a field margin, so that when these two components occur together the number of species supported is potentially more-or-less doubled. Addition of a ditch to the complex, intermittently carrying surface run-off water, further increases the predicted fauna by approximately 30% and, if the ditch also contains a seasonal brook (fed by spring water) the potential fauna increases further. At this point the combined habitat would be predicted to support 46 of the syrphid species recorded from the farm as adults, i.e. more than half of the recorded syrphid fauna of the farm. But the entire surface area of infrastructural habitats on the case-study farm is estimated to be 5ha (Speight, 2000), including farm buildings, farm yard, orchard and old field walls. The surface area of hedge plus field margin (with or without associated ditches and seasonal brooks) is thus little more than 2.5ha, and by no means a homogenous entity, including stretches with and without ditches, with and without ditched brooks. This means that half of the farm's existing syrphid fauna would be largely dependent upon heterogenous habitat occupying no more than 6% of the farm's surface area, in the circumstance that no disused land habitats were present on the farm.

Table 15: Syrphid species predicted to occur in association with the infrastructural habitats observed on the farm, shown for the species recorded from Co.Cork and for the species recorded from the case-study farm

Farm infrastructural habitat	No.predicted species		% Co.Cork species on farm
	Co.Cork	Farm	
Scattered deciduous trees in open	7	5	71
Hedge + field margin, ditch & brook	46	44	96
Old field walls	1	1	100
Orchard	20	18	90
Farmyard organic waste	6	6	100
Setaside	11	11	100
All infrastructural habitats on farm	58	51	90

Table 16: The field boundary habitat “Hedge + field margin + ditch + seasonal brook”, showing the potential contribution made by the various combinations of the components of this composite habitat found on the farm to maintenance of the syrphid biodiversity in Co.Cork and the case-study farm. d = ditch; h = hedge; sb = seasonal brook

Field boundary habitat	No.predicted spp.	
	Co.Cork species	Farm species
Field margin	18	18
Hedge	18	18
Field margin + h	35	33
Field margin + h + d	45	43
Field margin + h + d + sb	48	46

The definition of the term “field margin” applied here is given in section 3.2.2 of this text, in the database ‘Content and Glossary’. But there is no standardised use of this term in the literature. In many instances it is possible to divine that an author is referring to as “field margin” a strip of land along a field boundary that has only been taken out of cultivation within the last 2-3 years. Such a “field margin” is essentially a strip of unmanaged set-aside and would not be included in the field margin category recognised in the present text. Many authors who refer to “field margins” provide no definition of the term. In the case of Fossit (2000), field margins are not recognised as a habitat category at all. New’s (2005) definition of field margins is dysfunctional, in that he includes hedges within his definition, so that the separate nature of field margins, as defined here, and hedges, is obscured. He also applies the term “field margin” to the phenomenon here identified as “field boundary”. In the sense in which the term field boundary is applied in the present text it is the line dividing one field from one another (or from land used for some other form of land use), and as such does not extend laterally from that line. There is as much confusion in relation to “ditches”. In Fossit (2000) it is stated that, to be included in the habitat category “drainage ditch” a ditch “should either contain water (flowing or stagnant) or be wet enough to support wetland vegetation. Dry ditches that lack wetland plants are not included”. The intermittently flowing drainage ditches that are at the core of the definition of ditches applied here would thus not be recognised as ditches in Fossit (2000). Similarly, the functional differences between ditches containing permanently-flowing canalised brooks and seasonal, canalised brooks are obscured by that definition. With these various components of the hedge/field margin complex open to significantly different interpretations it is difficult to gain from the literature a coherent picture of their functional

significance, in respect of biodiversity maintenance. Using the Database of Irish Syrphidae certain aspects of syrphid biodiversity maintenance by hedges/field margins become clearer, using these habitat categories as defined there. But a more general adoption of one particular definition for “hedge”, and another for “field margin”, remains desirable.

An alternative to defining a series of sub-categories of hedge and field margin would be to take general hedge and field-margin categories, such as those defined in the Database of Irish Syrphidae, and use them in conjunction with predictions of the degree of impact of individual farm management practices upon the species of these habitats, in order to predict their fauna under different conditions. Taking a “hedge + field margin + ditched seasonal brook” as an example, and applying various different management scenarios to this habitat complex, the database Farm Management Practices spreadsheet could be used to suggest which of the species predicted to be associated with this habitat complex, among the syrphids recorded as adults from the farm, would be eradicated from this habitat complex under each management regimes. For instance, the expectation would be that 22 of the farm’s species could be eradicated from this habitat complex and a further 9 could have their populations seriously reduced, if severe hedge cutting during the growing season, two field margin cuttings and ditch management were all carried out in the same year. In the circumstance that all hedges, field margins and ditches on a farm were subjected to severe management as detailed above in the same year, those 22 species might be lost from the farm entirely. Those 22 species include four for which infrastructural habitats would be expected to act as a reservoir for resupply of populations to production land habitats. By contrast, with light hedge cutting out of the growing season, one field margin cut and no ditch management the habitat complex would be expected to lose no species and the population of only one species might be severely reduced. Hedges, field margins and ditches are managed, even if management activities are not carried out in these habitats each year. Frequency, severity and timing of management operations requires to be taken into consideration in predicting the species complement supported by these habitats and could evidently dictate their capacity to provide a “permanent” reservoir of those species on a farm. On the case study farm no severe hedge management was carried out during course of the study and field margins were not cut every year, and, when cut, were cut only once a year. Ditch management was only carried out on one ditch during the study, to re-route a canalised stream through the wetlands introduced to the farm. The predictions of which species recorded from the farm would be expected to occupy the habitat complex “hedge + field margin + ditch with canalised seasonal brook/brook” are based on that management regime.

When the habitat strata used by the syrphids observed from the farm and predicted to occur in infrastructural habitats are examined, a difference is apparent, between production land species and infrastructural habitat species. The data for the infrastructural species are shown in Table 17, for the production land species in Table 11. Whereas the larvae of production land species associated with the grass-root zone and herb-layer are characteristic of more than one habitat stratum, so that high percentages of the total fauna are recorded for each of these strata, the species of infrastructural habitats are not, indicating a greater degree of micro-habitat specialisation – in the event of population loss by the species inhabiting one habitat stratum of an infrastructural habitat those species would be less open to resupply from other infrastructural habitat strata.

Another difference is apparent in the proportion of infrastructural habitat species that are univoltine, as shown in Table 18. The corresponding information for the species of Production land habitats is shown in Table 9. As compared with the production land fauna, the proportion of univoltine species in the infrastructural habitat fauna is doubled, reflecting both the greater stability of the infrastructural habitats and the lower frequency of management operations there.

Table 17: The percentage of observed species predicted to occur in infrastructural habitats on the farm associated with various habitat strata

Habitat stratum	% of species of all infrastructural habitats on farm
Grass-root zone	14
on low-growing plants	23
on tall strong herbs	35
in herb-layer plants	9
Shrubs/bushes	40

Table 18: The proportion of the observed syrphid fauna of the farm predicted to occur with the infrastructural habitats recorded on the farm exhibiting particular conditions of selected traits, expressed as a percentage of the number of observed species predicted to occur in the infrastructural habitats. Habitat category definitions as in the Glossary of Macrohabitat categories (Appendix 3).

Trait	% of species of all infrastructural habitats on farm
Migratory status	
• non-migrant	69
• migrant	35
No generations/year	
• one	46
• two or more	65
Duration of development	
• less than 2 months	40

The database shows that the infrastructural habitats on the farm might well be able to resupply species to the production land habitats when required, but that their capacity to support those species could be adversely affected by severe forms of management of the infrastructural habitats. Indeed, severe forms of management could eradicate from the farm most of the species that might otherwise be expected to occupy the infrastructural habitats, much reducing their capacity to act as a reservoir for resupply of production land habitats. Further, the hectareage of the infrastructural habitat complex identified as responsible for maintaining by far the greater part of the syrphid biodiversity of the infrastructural habitats – field margin + hedge + ditch + seasonal brook/brook – is represented by only a very small proportion of the farm’s land surface (c 6%) and is heterogenous in nature, so that its associated species cannot be expected to all of them occur

throughout the area occupied by hedge and/or field margin. In these circumstances maintenance of the syrphid fauna of the infrastructural habitats may itself be dependent upon resupply from the disused land habitats on the farm – assuming the species occupying the infrastructural habitats are also supported by the disused land habitats present. Given that disused land habitats were present on the case study farm the data from the farm cannot be used to easily establish which infrastructural species might be present in the absence of those disused land habitats.

Many of the syrphids recorded from the farm and predicted to occur there in association with the infrastructural habitats present are not species that would be predicted to occur in association with production land habitats i.e. the infrastructural habitats have a potential biodiversity maintenance role that goes beyond support for agrobiodiversity and so relates also to regional/national biodiversity maintenance issues.

2.4.7.3 The role of disused land habitats

Of the 93 Co.Cork species predicted to occur in association with disused land habitats present on the case-study farm, 67 were recorded from the farm as adults, during the period 2000-2005. They include all but one (*Rhingia campestris*) of the production land species, so the disused land habitats would be predicted to support more of those species than the infrastructural habitats and could be expected to act as a reservoir for resupply of those species to the production land, if necessary. They also include all but three of the recorded species predicted to occur in association with infrastructural habitats observed on the farm and overall would be expected to support more of the farm's recorded species than the infrastructural habitats. This suggests that the disused land habitats could play a somewhat greater biodiversity maintenance role than the infrastructural habitats, both in respect of agrobiodiversity and regional/national biodiversity.

There are 21 syrphid species recorded from the farm in the period 2000-2005 that would be predicted to occur in association with disused land habitats present on the farm but not with any of the production land habitats or infrastructural habitats present on the farm. Of those, 18 would be predicted to occur in association with wetland habitats present, underlining the potential role of disused land habitats, on this farm at least, in maintaining biodiversity of wetland species in the farmed landscape. The same conclusion was drawn in respect of a different group of Diptera, the Sciomyzidae, or snail-killing flies, from investigation of them on the case-study farm. The sciomyzids are predominantly wetland insects and loss of the disused-land habitats from the farm would be predicted to reduce its sciomyzid fauna by more than 50% (Speight, 2004c). The general species list of insects recorded from the farm during this study also reflects the significance of the disused habitats in maintain biodiversity on the farm. Most of them (see Appendix 1) are either forest or wetland species that would not be expected to survive in the standard farmland landscape of green fields and hedges.

Table 19 shows that the disused land habitat predicted to provide support for the largest number of the production land habitat species observed on the farm is the disused, humid, lowland, oligotrophic, unimproved grassland. The presence of brook, flush and pool in the grassland would not be predicted to augment its performance in this respect. Lowland tall herb communities are

similarly shown to be the next most important disused land contributor to agrobiodiversity support. When the more general situation is examined, namely which disused land habitats on the farm have the potential to act as a reservoir for species observed on the farm that are associated with any Irish production land habitat, rather than just with the production land habitats present on the farm, the same pattern emerges: of the disused land habitats present on the farm the unimproved grassland and tall herb communities would provide the most agrobiodiversity support. Conversely, the disused land habitat on the farm that would be predicted to support the greatest number of the farm's syrphid species not associated with production land habitats is sedge beds, closely followed by *Salix* swamp, as shown in Table 20. So the disused land habitats on the farm predicted to be most useful in agrobiodiversity maintenance are different from the disused land habitats on the farm predicted to be most useful in maintenance of species that are not predicted to occur in production land habitats i.e. species that are not likely to be targets of agrobiodiversity maintenance measures.

Table 19: The number of observed production land habitats species predicted to occur in association with each disused land habitat present on the farm and with all production land habitats present in Ireland

Disused land habitat	Production land species	
	Observed on farm	Ireland
Atlantic thicket+flush	6	12
Alnus forest+flushes+brook+temporary pool	3	10
Salix swamp+flush+temporary pool	4	10
Lowland tall herbs+flush+brook	12	23
Humid lowland, oligotrophic, unimproved G+brook+flush+pool	15	32
Marsh+pool	4	17
Reed bed+pool	5	14
Tall sedge bed+pool+seasonal pool	9	22

Table 20: Number of syrphid species observed on the farm predicted to occur with each disused land habitat on the farm, excluding species predicted to occur with Irish production land habitats.

Disused land habitat	Non-production land species on farm
Atlantic thicket+flush	4
Alnus forest+flush+brook+temporary pool	8
Salix swamp+flush+temporary pool	9
Lowland tall herbs+flush+brook	7
Humid lowland, oligotrophic, unimproved G+brook+flush+pool	4
Marsh+pool	6
Reed bed+pool	6
Tall sedge bed+pool+seasonal pool	10

The increased prominence of wetland syrphids in the fauna of the disused land habitats is reflected in the proportion of species associated with different microhabitats. Comparing the species (observed on the farm) of production land habitats (i.e. predicted to occur in association with the production land habitats present on the farm) with those of infrastructural habitats and disused land habitats shows that while the proportion of species with larvae in aquatic/subaquatic microhabitats is negligible in the production land habitats it is largest in the disused land habitats, as indicated in Table 21. Considering the species traits also examined for production land species and infrastructural species, the species of the disused land habitats on the farm can be seen to include the smallest proportions of both migrant species and species with the shortest development times and the highest proportion of univoltine species (see Table 22), reflecting the minimal degree of perturbation of disused land habitats, as compared with habitats in the other two categories.

Table 21: Percentage of species associated with various microhabitats, in the syrphid faunas of production land habitats, farm infrastructural habitats and disused land habitats on the case-study farm.

Habitat stratum	% of species associated with habitat group on farm		
	Production land habitats	Infrastructural habitats	Disused land habitats
grass-root zone	33	14	13
on low-growing plants	50	23	11
on tall strong herbs	56	35	30
in herb-layer plants	17	9	13
shrubs/bushes	39	40	28
water plants	0	4	12
submerged sediment	0	19	31
water-saturated ground	5	21	28

Table 22: Percentage of observed production land, infrastructural and disused-land habitat syrphids exhibiting selected traits

Trait	% of species of all production land habitats on farm	% of species of all infrastructural habitats on farm	% of species of all disused land habitats on farm
Migratory status			
• non-migrant	69	69	79
• migrant	39	35	25
No generations/year			
• one	22	46	52
• two or more	89	65	72
Duration of development			
• less than 2 months	61	40	36

Land that has fallen into disuse on a farm is, almost by definition, land that is not subject to management. It is thus more open to processes of ecological succession. In considering the potential role of disused land habitats in maintenance of biodiversity on a farm it thus becomes

necessary to consider the impact of successional processes on those habitats and on the species inhabiting them. On the case-study farm various successional processes are visible. Lack of grazing or cutting of the unimproved grassland is leading to/has led to the herb layer becoming a dense sward of tall ground vegetation/very tussocky grassland. This, in turn has been/is being progressively invaded by thickets of Atlantic scrub (*Rubus*, *Ulex*, *Prunus spinosa*) and saplings of *Alnus*, *Betula* and *Salix*. Essentially the open ground is converting to deciduous woodland. The wetland habitats introduced to the farm are not immune to this process and in 2005 already evidenced small *Salix* saplings. There is no basis for concluding these successional changes will halt, in an absence of management intervention. So here the potential impact on the farm's existing syrphid biodiversity, of replacement of the open habitats in the disused areas of the farm by various forest types, is examined. This issue was identified and addressed by Speight and Good (2001a), in respect of invasion of the unimproved grassland on the farm by *Alnus* woodland. Their conclusion was that this would result in a net decrease in the syrphid biodiversity supported by the farm.

The invading forest types considered here are those already developing on, or present on, disused land on the farm, together with the supplementary habitats that are present on currently open areas of the disused land, namely:

- Atlantic scrub (+ flush + brook + pool + temporary pool)
- *Alnus* forest scrub & mature (+ flush + brook + pool + temporary pool)
- *Salix* swamp forest scrub & mature (+ flush + brook + pool + temporary pool)

Assuming that the land disused under the current management of the farm were to remain disused for the probable tenure of the present owner/manager i.e. until at least 2020, on the erstwhile open areas the developing forest types could reach a mature (i.e. closed canopy) condition. In this scenario, where the open areas of disused land habitat (marsh; reed bed; tall edge bed; lowland tall herb communities; humid, oligotrophic, unimproved, lowland grassland) are replaced by closed canopy woodland, the database indicates that 15 of the syrphid species observed on the farm and predicted to develop there in the habitats present in 2005, would be expected to disappear from the farm (at least as resident species). Of those 15 species 12 would be lost from the wetland habitats introduced to the farm in 2001-3, two more would be lost from the unimproved grassland and one would be lost from tall herb communities. Further, these habitat changes would not be expected to result in any compensatory additions to the syrphid species inhabiting the farm. So, essentially, it would be expected that the biodiversity gains achieved through introduction of wetland habitats to the farm would be negated without proactive management aimed at maintaining the open (i.e. treeless) character of those wetlands.

The habitats represented in the disused land sector of the case study farm comprise only part of the range of Irish habitats that could be present, and the species supported by disused land habitats within different farmed landscapes would vary according to which Irish habitats were present. That being so, the role of disused land within farms, in maintaining biodiversity in the farmed landscape, could be equally variable. However, the data from the case-study farm do show that disused land habitats can be at least as effective as farm infrastructural habitats, in maintaining agrobiodiversity, while at the same time playing a role in maintenance of regional/national

biodiversity – indeed, most of the syrphid biodiversity of the disused land habitats on the case-study farm would be of regional/national biodiversity interest, rather than of agrobiodiversity interest. The data from the farm also show that augmenting the range of habitats represented in the disused sector of a farm – in this case partly by consigning additional land to the disused sector and partly by altering the habitat character of land already in the disused sector – can have a positive impact on the overall biodiversity maintenance potential of the farm, but that such habitat introduction/restoration measures can carry with them a need to maintain the introduced/restored habitats, once they are in place, due to processes of natural ecological succession that can otherwise negate the biodiversity gains made.

2.5 Agri-environmental measures

Driven by the requirement to comply with regulations introduced by the EU, a series of measures designed to make farming more “eco-friendly” are now in place. In the countryside in general these are administered via the Rural Environment Protection Scheme of the Department of Agriculture, Fisheries and Food (DAFF), otherwise known as “REPS”, and in prospective Natura 2000 sites (and other designated areas) they may take the form of either REPS schemes or National Parks and Wildlife Service “Farm Plans”. Both REPS and Farm Plans operate at the level of the individual farm, by means of a contract agreed with the farmer. REPS and Farm Plans are considered separately here.

The current version of REPS is REPS4, which came into operation in 2007. According to Finn *et al* (2004), earlier versions of REPS consisted of “11 compulsory measures”. REPS4 also comprises 11 measures. In the Terms and Conditions of REPS4 (DAFF, 2007b) it is stated that participants in the scheme shall undertake these measures “as appropriate”. No explanation is provided to indicate under what circumstances a measure would be deemed inappropriate. The assumption made here is that the type of farming carried out on a farm dictates which measures are “appropriate” to that farm. Thus measures relating to tillage would not be appropriate on a farm where crops are not grown and measures relating to grazing practices would not be appropriate on farms where livestock are absent. This interpretation of the application of measures “as appropriate” does not provide a clear course of action in all cases, however.

2.5.1 REPS4 measures

The current REPS measures are detailed in DAFF document “Farmers Handbook for REPS 4” (DAFF, 2007a). They may be listed as follows:

1. Nutrient management plan, to “protect the quality of our waters by avoiding pollution from Agriculture”
2. Grassland and soil management plan, to “promote a sustainable grassland and soil management plan that protects habitats and minimises poaching, overgrazing and soil erosion”

3. Protect and maintain watercourses, waterbodies and wells, to “maintain or improve water quality and to allow natural streamside vegetation to develop”
4. Retain wildlife habitats to “retain habitats and to ensure that farming practices on these areas are carried out in a manner beneficial to flora, fauna and conservation generally”
5. Maintain farm and field boundaries, to “conserve, maintain and enhance boundary fences, roadside fences, stone walls and hedgerows in the interest of stock control, animal health, wildlife and the scenic appearance of the area”
6. Restricted use of pesticides and fertilisers, to “protect water resources and habitats for flora and fauna”
7. Establish biodiversity buffer strips surrounding features of historical and archaeological interest, to “contribute to the conservation of these sites”
8. Maintain and improve visual appearance of farm and farmyard to “harmonise the visual impact of the farmyard and the farm with the surrounding countryside”
9. Tillage crop production to “encourage tillage farming practices and production methods that reflect the increasing concern for landscape conservation, the protection of the soil and related environmental issues”
10. Training in environmental friendly farming practices to “provide REPS farmers with information on the environmental benefits arising from REPS, clarification of all the relevant requirements included in the agri-environment specifications and the knowledge and skills necessary to follow their REPS Plan successfully”
11. Maintaining farm and environmental records to “record management information and work done throughout each year of their REPS plan”

An un-numbered additional measure details the requirements made of farmers whose land lies wholly or partly within priority sites: Natura 2000 sites (currently known as SACs); Special Protection Areas (SPAs); Areas designated under the Water Framework Directive; National Heritages Areas (NHAs) and/or Commonage sites.

There are also supplementary REPS4 measures relating to corncrakes, traditional apple orchards, rare livestock breeds, riparian zones, cereal strips for graminivorous birds, low-input spring cereals, minimum tillage, traditional sustainable grazing, incorporation of clover into grassland swards, mixed grazing and traditional farm buildings.

Measures 8, 10 and 11 have no direct impact on habitats and there is no obvious way in which they would affect biodiversity in the farmland landscape, beyond the named vertebrates targeted by measure 8. However, biodiversity maintenance is an explicit or implicit objective of the rest of these measures, so their potential impact, both individually and together, on the biodiversity maintenance function of the array of habitats present in the farmed landscape, requires examination. The potential of these measures to achieve biodiversity maintenance within farmland is explored here, using the database and information from the case-study farm. Given time, the REPS4 nutrient management measure could affect most habitats on a farm, but within the five-year period of operation of the scheme might be expected only to impact on the trophic status of smaller water bodies fed by surface water. Which syrphid species might be affected would depend upon which habitats those water bodies were embedded in, but, as a generality, the cleaner the water the more aquatic syrphid species might be expected, simply because the number of Irish species

inhabiting oligotrophic water as larvae is greater than the number inhabiting eutrophic water. Using information coded into the database, this is shown in Figure 21.

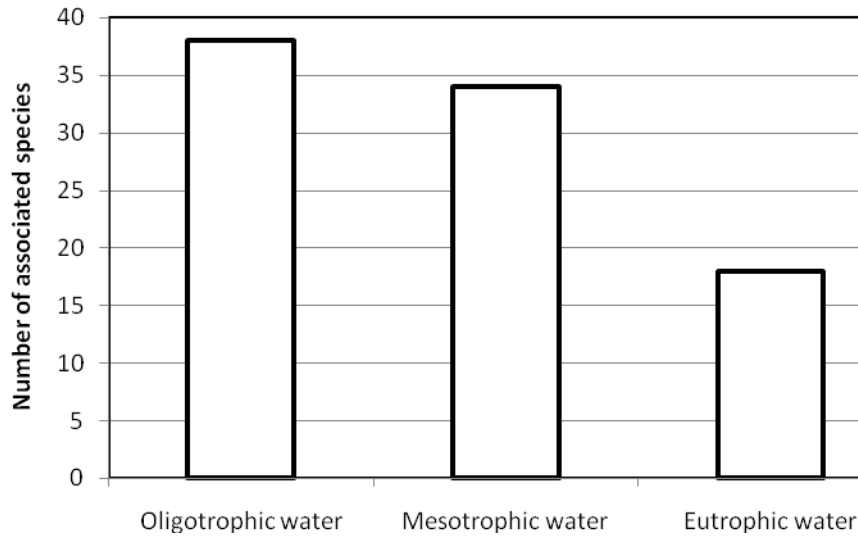


Figure 21: The number of Irish syrphid species with larvae inhabiting oligotrophic, mesotrophic and eutrophic waters.

With the exception of measure 4, the REPS measures with an explicit biodiversity maintenance component to them are focussed on production land habitats and or farm infrastructural habitats, in the sense that these terms are applied here (see section 2.4.2, above). They thus cannot be expected to play any direct role in maintenance of species that do not inhabit production land habitats or infrastructural habitats. So the primary interest of these measures lies in whether they can maintain, within production land habitats and/or infrastructural habitats, the species that can occur in those habitats.

2.5.1.1 REPS4 grassland and soil management measure

The universally applicable components of this measure would enable species characteristic of the various types of production habitat grassland to inhabit those grasslands, without either increasing their capacity to support biodiversity or preventing potential loss of biodiversity caused by tillage. It is, in other words, aimed at preventing destructive levels of livestock use of grassland that could lead to damage to soil, soil erosion etc. This measure is thus generally neutral, in respect of how it would impact on prediction of the syrphids expected to occur in grazed grassland, using the database, because coding of the habitat categories used in the database is based on “good” examples of each habitat type, whether the habitat involved is intensive grassland or alluvial forest. So the syrphid species coded for intensive grassland, for instance, are coded on the assumption that the grassland is neither poached nor exhibiting erosion etc. However, since one requirement of this measure is that “both overgrazing and undergrazing” should be avoided, it is unlikely to engender lightly-grazed grassland categories.

This measure includes the proviso that, on a farm with more than 5ha of grassland, one of a series of supplementary measures may be required of the farmer. These supplementary measures include

options to create a specified amount of “new habitat” (type unspecified), hedges, cereal strips for graminivorous birds or woodland. In instances where one of these options is taken up its impact would depend on which habitats are already present on the farm and in the immediate vicinity of the farm. The option to establish “new habitat” has the greatest potential to augment biodiversity, all dependent upon the type of “new habitat” introduced to the farm. Experience on the case – study farm (see section 2.4.7.3, above) shows that introduction of wetland/freshwater habitat can be achieved rapidly and can achieve a demonstrable impact on biodiversity within a five-year period – five years being the length of time for which a REPS contract is in place. However, REPS 4 does not provide any clarification of what is meant by “new habitat” and provides no information on how wetland might be introduced to a farm, or what form an introduced wetland might take, in order to maximise its utility as a biodiversity support feature. Establishment of lightly-managed hedges on a previously hedgeless farm would be expected to increase the syrphid biodiversity of that farm, assuming hedges and or woodland are available on adjacent farms to supply hedge-associated syrphid species to the new hedges. By contrast, establishment of cereal strips is unlikely to augment the biodiversity of a farm, since the species inhabiting cereal strips are common to grasslands or crops and thus presumably present already and the management stipulated for the cereal strips includes no requirement to refrain from annual ploughing of the cereal strips. The potential impact on biodiversity of establishing small areas of trees on a farm is considered elsewhere in this text (Section 2.5.1.7).

Certain of the options that may be taken up under this measure could have a direct impact on habitat availability on a farm and hence on biodiversity maintenance. The first of these requires at least 0.4ha of grassland to be maintained as “traditional hay meadow”. The second option requires at least 0.4ha to be managed as “species-rich grassland”. If “traditional hay meadow” is present on a farm this option should ensure its survival for another 5 years, together with its associated fauna. The same is true of “species-rich grassland”.

2.5.1.2 REPS4 measure to protect and maintain watercourses, water bodies and wells

This measure requires the fencing-off of watercourses and “lake shores” (but not the margins of smaller, standing water bodies) from access by livestock, and prohibits pesticide application within 1.5m of watercourses and water bodies. As such, it has limited impact on habitat availability and, in terms of the database, provides for a management regime that is assumed to be in place in predicting the species associated with water margins. In some instances, fencing of water margins could result in a growth of waterside tall-herb communities previously absent from a farm and a consequent increment to the species inhabiting the farm due to the development of those tall-herb communities, assuming that nearby populations of those species were available from which to colonise the farm. The same result might be achieved by the requirement, under this measure, to leave one side of a watercourse uncleaned, during watercourse maintenance. But development of tall-herb communities would not be an inevitable consequence of either fencing-off water margins or leaving one side of watercourses uncleaned and it is beyond the scope of the present text to predict under which circumstances such changes would occur. However, the database could be used to predict what increment to a farm’s syrphid fauna would be anticipated in the event that

such changes did occur. Where tall-herb communities do not develop these fenced-off water margins nonetheless represent *de facto* new field margins. However, this measure does not stipulate how these fenced-off margins should be managed, beyond the requirement that they should not be subject to application of pesticides or fertilisers. On a farm where field margins were previously absent, these fenced-off water margins could act as reservoirs for new field margin species not maintained in the other habitats present.

There are optional, additional components to this measure, to fence off a wider watercourse margin of 2.5m and to plant a fenced-off, 5m wide water margin with trees such as *Alnus*, *Salix* etc. Both of these options could result in development of riparian tall-herb communities where they were previously absent and planting a strip of *Alnus* and or *Salix* along a watercourse would introduce a *de facto* riparian gallery scrub-woodland. The database shows that, during the five years of operation of a REPS scheme, such gallery scrub might be expected to provide support for some of the species associated with infrastructural habitats (e.g. hedges) present on a farm. It is uncertain whether, in the uncertain future following the termination of the scheme, such gallery scrub would remain in place to develop into mature trees.

2.5.1.3 REPS4 measure to maintain farm and field boundaries

This measure requires that existing hedges be retained and advocates hedge maintenance be carried out during the winter (i.e. outside growing season), but does not stipulate either the frequency or severity of hedge maintenance regimes. Neither does it prohibit management of all hedges on a farm in the same year. A separate element of this measure requires an uncultivated margin, of at least 1.5m width, round every field. There is also a requirement under this measure to install new lengths of hedge by planting, where (DAFF, 2007c) “the extent of these features on the farm is less than 100 metres of hedgerow or 50 metres of stonewall per hectare”. Under those circumstances “the planner must specify that the farmer plant hedgerows (minimum of 10 metres per hectare up to a maximum of 400 metres) or tree species (minimum of 3 trees, 1000mm – 1200mm height, per hectare up to a maximum of 120 trees) on field boundaries or other locations on the farm.”

Taking the observed syrphid fauna of the case-study farm, and the scenario that the habitat range on the farm was reduced to cropland plus hedge and field margin – a not-uncommon combination in parts of the farmland landscape of Ireland – 34 of the observed species would be expected to survive if the hedges were lightly managed and the cropland was not all ploughed in any one year. However, the database would predict that if all hedges on a farm were subject to severe management in the same year, accompanied by ploughing of all cropland in that year, the observed syrphid fauna of the case-study farm could be reduced to seven species. In the case that light hedge-cutting was carried out, rather than severe hedge cutting, the syrphid fauna should be less reduced, the database indicating a reduction to 16 species. Nonetheless, a decrease in the fauna of more than 50% would be involved. The requirement under this measure to leave an uncultivated margin of at least 1.5m width around each field is taken into account in this assessment. Ecologically-sound hedge management regimes are recommended in the provisions for this measure, but are not mandatory. The figures given above suggest that the management of

hedges is critical in determining their capacity for biodiversity maintenance, so it is to be hoped that the REPS4 management recommendations are adhered to, since this measure could otherwise result in loss of biodiversity from the farmed landscape.

2.5.1.4 REPS4 measure on use of pesticides and fertilisers

This measure prohibits the application of pesticides and fertilisers on field margins, field hedges and the margins of running and standing water in grassland and cropland. It also seeks to prevent contamination of these habitats by pesticide or fertiliser applied nearby. The elements of this measure together reflect a level of good farming practice that is assumed in coding the species/habitat associations for these habitats in the database, i.e. where this sort of code of conduct is not in operation fewer species would be expected to occur than the database would currently predict. For instance, taking the example used in discussing the REPS 4 measure on farm and field boundaries, if pesticides were used on field margins in the case-study farm, during the same year that all field surfaces were ploughed and all hedges were subject to light management, the database indicates that the farm's syrphid fauna could be reduced to 12 species (rather than the 16 that would be expected to remain in the absence of such pesticide use).

2.5.1.5 REPS4 measure to establish "biodiversity" buffer strips surrounding features of historical and archaeological interest

This measure requires establishment of a 5m wide uncultivated strip round features of historical and archaeological interest and a 20 metre wide strip from which animals are excluded round such features in grassland. However, it does not stipulate how these buffer zones should or should not be managed, or restrict pesticide use on them. In an absence of management, these buffer strips could eventually become wooded, if retained beyond the five years of a REPS scheme. At the other extreme they could be subject to mechanical cutting and pesticide application each year, followed by re-integration into production after five years. This means there is no certain biodiversity gain to the farmed landscape resulting from this measure.

2.5.1.6 REPS4 measure on tillage crop production

The requirement under this measure to leave uncultivated field margins round every field and along every watercourse running through a field, would have the same biodiversity implications as other REPS 4 measures that make the same requirements. The greater mandatory width of uncultivated field margins established under this measure might be expected to have a quantitative effect, but whether it would have qualitative effects is less clear. Of potentially greater significance, in that context, is the lack, under this measure, of any stipulations concerning management of the field margins installed under it. Wide field margins subject to pesticide application and cutting every year could play a more restricted role in biodiversity maintenance than narrower field margins excluded from pesticide application and cut less frequently.

There are five different options that can be taken up under this measure. The first, Green Cover Establishment, requires a cover crop to be sown in cereal or oilseed rape fields, after crop harvesting and without ploughing, this cover crop then remaining in place through the winter until 14 January. The objective is to “use up nutrients that are left in the soil after a cereal or oilseed crop is harvested”. The fate of the cover crop after 14 January is not stipulated. If it were required to leave the cover crop in place throughout the winter and into the spring (i.e. until at least the end of April) this option could provide for successful overwintering of organisms that developed in a cereal or oilseed rape crop and remained there in the litter layer after harvesting – such as the aphid-feeding larvae of various syrphids. However, this option requires that the cover crop remains in place only until the middle of the winter. There is no prohibition on tillage of the cover crop area during the rest of the winter, a course of action that would destroy overwintering populations of organisms in the litter layer. In those circumstances it is doubtful this option would have any positive impact on biodiversity maintenance.

A second option under this measure relates to management of setaside. However, since setaside is no longer supported by the EU it has to be assumed that this option is no longer operated.

A third option under this measure relates to increasing to 3m the width of field margins round tillage crops, except along water courses, where, under this option, it is required that margins be 4.5m wide. Under this option a management regime for these expanded field margins is specified. Firstly, these field margins must either be left unsown, or sown with a recommended grass seed mix that will produce “rough grass” margins, or sown with cereals at 50% of normal sowing density. In the first year of their existence it is required that they be mown at least three times, within the period mid-July to end September, to a height of not less than 5cm, though the cereal-sown margins are exempt from this requirement. Pesticide or fertiliser application and use for “supplementary feeding sites, drinking troughs and storage areas for big baled silage” is prohibited on all types of field margin established under this option, for the five years that the scheme endures. No additional management is specified for the unsown margins after the first year of a REPS4 scheme. By contrast, it is specified that the “rough grass” margins are not subject to annual cutting, to grazing or to “ploughing, cultivation, re-seeding, rolling or chain harrowing”, throughout the five years of a scheme. Of the cereal-planted margins it is stated that they “may be harvested with the crop”.

The “field margins” established via the various options available under this measure are rather different from one another and highlight the need for a definition of field margins that incorporates functional, as well as physical/structural elements. The unsown “field margin” established under this measure is not functionally different from setaside, and of hardly greater permanence. The cereal-sown “field margins” are harvested and there is no prohibition on them being subject to “ploughing, cultivation, re-seeding, rolling or chain harrowing”, so they differ from normal crops only in that they are not subject to pesticide or fertiliser application, or to use as locations for “supplementary feeding sites, drinking troughs and storage areas for big baled silage”. This reduces the biodiversity support function of both the unsown and cereal-sown “field margins” to that of seasonal refuges for cropland species susceptible to fertiliser or pesticide application. This contrasts strongly with the rough-grass “field margins” where, critically, “ploughing, cultivation, re-seeding, rolling or chain harrowing” are prohibited for the five years of the scheme, in this way

providing overwintering sites for species in the litter-layer, including organisms that require an entire year for completion of their life cycle. The requirement to reseed these rough-grass margins with an approved grass-seed mix is, in essence, a form of ecological restoration, leading to the establishment of grassed field margins more rapidly than this might occur naturally. Due to their accelerated establishment phase, the rough-grass margins established under option 3 of the REPS4 tillage crop measure effectively fall into the 5-15 year-old field margin category recognised in the database. The database indicates that 13 of the syrphid species observed on the case-study farm could be maintained by such rough-grass margins, 11 of those species being syrphids occurring in croplands. This is a greater number of species than would be expected to survive in the croplands in an absence of field margins.

2.5.1.7 REPS4 measure on retention of wildlife habitats

This measure makes retention of habitats present on a farm mandatory, listing the following as habitats requiring retention:

- callows
- upland grassland
- lowland dry grassland
- lowland wet grassland
- turloughs and other seasonally flooded areas
- coastal grasslands
- sand dunes: foreshore and sea shore
- machairs
- raised bog
- cut-over bog
- blanket bog or moors
- fens
- lakes, ponds and their margins
- rivers, streams, watercourses and their margins
- marshes and swamps
- woodlands and groves of trees
- scrubland
- field boundaries/margins, hedgerows and stone walls (subject to conditions set out in Measure 5)
- old buildings inhabited by protected species such as barn owls and bats
- eskers and disused quarries and such workings that have become habitats
- commonages and habitats designated as SPAs, SACs, NHAs.

The grasslands referred to in this context are defined as “swards with less than 25% of ryegrass, timothy, white clover either individually or a combination”. Definitions are not provided of the individual grassland types listed, or for any of the other listed habitats. Neither is there any clear statement that any particular source of habitat definitions requires to be followed, in recognising the habitats represented on a farm. However, some guidance on habitat recognition is provided in the specifications for REPS Planners relating to this measure (DAFF, 2007c), where it is suggested that planners will find “A Guide to Habitats in Ireland written by Dr. Julie Fossitt, published by the Heritage Council, useful in identifying various habitats under this Measure.”

There is no guidance provided on how large an area of habitat of a given type is required for it to be regarded as a functional unit, or how small a surface area of a habitat can be and yet require retention. Such issues as what are the differences between a woodland and a grove of trees, and how few trees constitute a grove, or whether a spring-fed wet flush of a few square metres constitutes a fen, a watercourse margin, a marsh or a swamp, or a feature too small to require retention, are thus not addressed. Fossitt (2000) does not deal with such issues. Further, the habitat classification system employed by Fossitt (2000) could be interpreted as indicating that springs are not habitats requiring retention under this REPS4 measure, since the aquatic habitats listed as requiring retention under the measure are lakes, ponds, rivers, streams and watercourses, and springs are not included in any of these categories in Fossitt (2000), where they comprise a separate habitat category. The status of tree lines is also unclear, in respect of this measure. Do tree lines require retention? Lines of mature trees, fringing farm tracks and other field boundaries are not woodlands, or groves, or scrub, or hedges and seem thus to represent uncategorised and unrecognised habitat. Tree lines are not mentioned in Fossitt (2000).

In the opening paragraph presenting this measure it is stated (DAFF, 2007a) that “some habitats have developed naturally during the 10,000 years since the last ice age and are irreplaceable, while other habitats have developed as a result of centuries of traditional farming practice and are dependent upon the continuation of that management”. In DAFF (2007c) it is also said, in the Planner specifications for this measure, that “management and conservation practices required to maintain each habitat must be clearly stated”. The implication of these statements is that various of the habitats requiring retention under this measure also require specific forms of management. Management practices that are not permitted are listed In DAFF (2007a), as follows:

On habitats you must not do any of the following things:

- Afforestation
- Land improvement works including drainage
- Ploughing and re-seeding
- Interference with the free-flow of waters to “swallow holes” in turloughs
- Removal of sand and gravel from foreshore and seashore
- Commercial turf cutting on unexploited bog: areas included for payment cannot be exploited during the period of the REPS undertakings
- Burning of growing vegetation on land between March 1st and August 31st

However, which of the habitats requiring retention are dependent upon some form of pro-active management, or what that management should be, is not stipulated. In reality, if the objective is to prevent further erosion of the biodiversity they support, some form of pro-active management would normally be required for almost all of the habitats listed. Whether that management would best be some form of “traditional farming practice” is unclear, particularly since no form of “traditional management practice” relevant to this measure is identified. Changes that have occurred in farming in Ireland during the last 100 years have been many and various (CSO, 1997; Mitchell, 1986) and scattered throughout the century, and it is not obvious what constitutes a “traditional farming practice”. However, whatever definition is applied, it is clear that “traditional farming practices” are no longer in operation on the vast majority of Irish farms. The only additional information provided on pro-active habitat management under this REPS4 measure is the statement that “your planner will tell you in your plan if there is anything else you should do to retain the special qualities of the habitat, on top of what you will find in this Handbook under the other Measures (including the agreed conditions for the conservation of designated NHA sites). For example, changes in fertiliser usage, stocking levels, protective fencing, grazing restrictions and restrictions on the location of supplementary feeding points must be set out in your plan”. So there is no stipulation that pro-active management has to be carried out in any specific habitat type listed as requiring retention. In particular, the provisions of this measure make no reference to initiating, or re-establishing, pro-active management on land that has fallen out of use and is not currently actively managed, but is currently supporting habitat requiring retention. A recurring example of this phenomenon would be grassland/wetland habitats once subject to light grazing that have fallen into disuse and not been grazed for a number of years. To successfully retain such habitats would normally require proactive management to prevent scrub encroachment and re-establish a light-grazing regime.

There are four options available under this measure: to create new habitat; to plant broad-leaved trees; to maintain 2.5m wide field margins along all field boundaries; to establish “farm woodland”. Excepting prohibitions, the only management stipulated for the farm area consigned to “new habitat” is that it should be fenced off. Essentially, this is establishment of unplanted setaside habitat, or unplanted, new field margin habitat, under another name and not necessarily along field boundaries. As such its biodiversity support potential can be predicted using the database, by treating the “new habitat” as setaside or new field margin, or a combination of these two habitats. Considered in this way, it can be shown that the “new habitat” created under this option cannot be expected to augment the syrphid biodiversity of a farm, but could provide a refuge for some of the species inhabiting crops or grassland, at times when those grassland and crop areas are subjected to ploughing, pesticide application etc.

Option 4B – broad-leaved tree planting: the option to plant “broad-leaved trees” involves planting individual trees here and there on the farm, at least 25% of them to be planted away from field boundaries. During the 5 years’ duration of a REPS scheme the isolated tree saplings planted under this option are unlikely to have any impact on biodiversity support on a farm, unless they result in the presence of foliage feeders not there previously. And, since the maintenance of the planted trees cannot be guaranteed beyond the end of the scheme, *let alone* to a point where the trees reach maturity, there is no justification for assuming that biodiversity on the farm will

be augmented by species that would be dependent upon the planted trees remaining in situ for more than 5 years.

Option 4C – nature corridors: this option requires maintenance of 2.5m wide field margins along all field boundaries. It carries no stipulations with it, beyond certain prohibitions (including reseeding) and the requirement to “maintain grass field margins”. It is apparently assumed that, once field margins are in place along every field boundary, they will function as “nature corridors”, which “are used by wildlife for transportation and protection”. Essentially, then, implementation of this option would result in establishment of unplanted new field margin habitat, or setaside habitat (where a field margin was installed on ploughed ground). Its biodiversity support implications would be the same as those of the creation of “new habitat” option, offered under this measure. It is not stated what sort of wildlife corridor function these field margins would be expected to perform. As a generality, land assigned to a wildlife corridor function has to be managed to facilitate the movement of particular target organisms through the landscape (Good, 1998) – labelling field margins “nature corridors” does not, of itself, increase landscape permeability and certainly would not increase the opportunities for all components of the terrestrial Irish flora and fauna to move along those field margins. A network of unplanted new field margins, established throughout a farm under this option, might be expected to increase opportunities for grassland organisms to spread from one part of that farm to another, if, until then, barriers had been in place that obstructed their movement. However, it would only be by happenstance that they could perform such a function at landscape level, since a REPS plan is drawn up for an individual farm, without reference to management of surrounding farms. There would be no guarantee that a field margin “corridor” traversing one farm would be continued beyond that farm’s boundaries. In other words there is no basis for assuming that establishment of a network of field margins within the boundaries of a farm would result in augmentation of the biodiversity of either that farm or surrounding farms.

Option 4D – farm woodland establishment: this option requires the planting of trees in plots each of a minimum surface area of 0.1ha, to cover a minimum of 1000sq.m and it is required that these plots be fenced to exclude livestock. It is stipulated that indigenous trees must be used under this option. In DAFF (2007c) it is stated “The most suitable tree species must be chosen from Appendix 5, Tables 2 & 3 and including whitethorn, blackthorn, hazel, holly, willow, crab apple, guelder rose, elder and other suitable under-storey species”. The Tables referred to list the following trees: *Alnus* spp., *Betula* spp., *Fraxinus excelsior*, *Pinus sylvestris*, *Prunus avium*, *Quercus pedunculata*, *Quercus petraea*, *Salix* spp., *Sorbus aria*, *Sorbus aucuparia*.

As no associated forest ground flora is planted to accompany the tree saplings these farm forestry plots are effectively small tree plantations, rather than any form of young forest. The establishment phase of these small tree plantations would last for the duration of a REPS scheme, so in habitat terms they comprise a combination of new field margin-type habitat plus tree saplings.

The database shows that new field margin-type habitat plus planted saplings would be predicted to provide a reservoir for 11 (i.e. 55%) of the production-land syrphid species (production land habitats sensu section 2.4.2.1, but including all Irish cropland species, rather than just the species of

cereal crops) known in Ireland. These 11 species would presumably already be supported by new field margin habitat established under other REPS4 measures, so it is unlikely they would augment the farm's syrphid biodiversity. The tree saplings would be predicted to support additional species, all dependent upon which trees were planted and whether they were planted together with the understorey trees that normally accompany them in Irish forests. Assuming that the trees are accompanied by appropriate understorey trees, the number of Irish non-production land syrphid species predicted to be supported by them during the establishment phase is shown in Table 23. The table shows that on a farm where hedges and woodland are absent, the presence of establishment-phase farm-forestry plantations could augment the farm's syrphid biodiversity. The table also shows that, in general, *Fraxinus* and *Quercus* would be expected to support the largest numbers of these additional species. However, the database further demonstrates that these additional species are mostly associated with hedges. So, on a farm where lightly-managed hedges are already in place, the role of establishment-phase farm-forestry plantations would likely be more one of support for hedge-associated species that are already present on the farm, rather than one of biodiversity augmentation.

Table 23: Number of Irish non-production land syrphid species predicted to be supported by establishment-phase saplings in farm-forest plantations of various tree species

Tree used in plantation	Non-production land syrphid species	
	all	Hedge species
<i>Alnus</i>	1	0
<i>Betula</i>	2	1
<i>Fraxinus</i>	5	4
<i>Pinus sylvestris</i>	3	2
<i>Quercus</i>	7	5
<i>Salix</i>	5	3

Subjecting the observed syrphid fauna of the case study farm to the same analysis shows (Table 24) that nearly all of the additional species predicted to occur with establishment-phase farm forestry plantations would also be associated with hedges, so that only if either *Fraxinus* or *Quercus* were planted would establishment-phase farm-forestry plantations provide support for more syrphid species than the farm's hedges supply already.

Table 24: Number of non-production land syrphid species observed on the case-study farm that are predicted to be supported by establishment-phase saplings in farm-forest plantations of various tree species.

Tree	Non-production land syrphid species	
	all	Hedge species
<i>Alnus</i>	0	0
<i>Betula</i>	2	2
<i>Fraxinus</i>	5	4
<i>Quercus</i>	4	4
<i>Pinus sylvestris</i>	4	4
<i>Salix</i>	5	4

What will be the fate of farm-forestry plantations once a 5-year REPS contract has come to its end?

In the REPS4 scheme provisions there is no stipulation concerning continuation of these plantations beyond the end of the scheme. From the above paragraphs it seems clear that there would be negligible benefit to biodiversity maintenance on a farm, gained from the presence of establishment-phase farm-forestry plantations, beyond what would be expected from new field margins and hedges. Even if there is no certainty that these plantations will persist until the planted trees reach maturity it would seem worthwhile to investigate what their biodiversity maintenance potential might be, under circumstances that do permit their survival.

Planted at the required spacing (in DAFF 2007a it is stated that “trees should be planted at a minimum stocking density of 3,300 plant/ha (2.0m x 1.5m).”) farm-forestry plantations would be expected to become closed-canopy by the time the trees mature, shading out any grassy, open areas between the trees that developed during the establishment phase. Assuming they would, indeed, develop closed canopy conditions, any biodiversity support provided by farm-forestry plantations would then be dependent upon the trees themselves, there being no longer any guarantee of additional biodiversity support capacity provided by grassy open areas within the plantations.

The database indicates (Table 25) that farm-forest plantations would be predicted to provide less biodiversity support for production-land syrphids when mature than during their establishment phase, with the exception of *Quercus* plantations. Indeed, when the species associated with grassy areas are taken into account, the establishment-phase plantations would be expected to provide greater overall biodiversity support than the mature plantations, except in the case of *Pinus sylvestris* and *Quercus* plantations. Mature plantations would be expected to provide support for more hedge-associated syrphid species than is provided by establishment-phase plantations.

Table 25: Number of Irish syrphid species predicted to be supported by mature farm-forestry plantations of various tree species

Tree	Mature tree syrphid species		
	all	prod.land.spp	hedge species
<i>Alnus</i>	8	4	5
<i>Betula</i>	9	5	5
<i>Fraxinus</i>	7	3	4
<i>Pinus sylvestris</i>	20	7	7
<i>Quercus</i>	25	12	11
<i>Salix</i>	13	5	6

On a hedgeless farm that had participated in the REPS4 scheme, syrphid species supported by mature farm-forestry plantations but not found in either production land habitats or new field margins could all be additional to the farm’s biodiversity. The numbers of Irish species involved, as indicated by the database, are shown in Table 26, based on the assumption that all of the Irish species that could colonise these plantations are available somewhere within the landscape surrounding the farm. Under these circumstances it would seem that plantations of *Pinus sylvestris*, *Quercus* and *Salix* have the greatest potential to augment the syrphid biodiversity of a farm in this way. But data from the case-study farm show that all of the species that might colonise such plantations are not necessarily available, and alternative habitats for others can already be

present: some of the potential colonisers are not known from Co.Cork; of those known from Co.Cork some have not been recorded from the farm during the survey work carried out there; there is only one mature-tree syrphid species, *Xylota sylvarum*, that has been recorded from the case-study farm but which is not known to occur in association with any habitat already represented there. *X.sylvarum* would be predicted to occur in mature farm forestry plantations of *Quercus* or *Pinus sylvestris*. These data are summarised in Table 27.

Table 26: Numbers of Irish syrphid species predicted to be supported by mature farm-forestry plantations of various tree species, excluding syrphids occurring also in production land habitats or new field margin habitats.

Tree used in plantn.	No.mature tree syrphid species
<i>Alnus</i>	4
<i>Betula</i>	5
<i>Fraxinus</i>	7
<i>Pinus sylvestris</i>	13
<i>Quercus</i>	18
<i>Salix</i>	11

Table 27: Irish syrphid species predicted to be supported by mature farm-forestry plantations of various trees, excluding syrphids associated with habitats already present on the case-study farm.

Tree used in plantation	No.mature tree syrphid species		
	IRL	Co.Cork	farm
<i>Alnus</i>	2	2	0
<i>Betula</i>	5	3	0
<i>Fraxinus</i>	2	0	0
<i>Pinus sylvestris</i>	12	5	1
<i>Quercus</i>	13	7	1
<i>Salix</i>	7	5	0

The case-study farm has both hedges and patches of mature trees already in place on the farm and Table 27 shows that, under such circumstances, it would be predicted that almost no biodiversity increment would be achieved there by installation of farm-forestry plantations, that survived until the trees matured. So, where farm-forestry tree plantations established under REPS4 schemes do survive sufficiently long for the trees to reach maturity they may augment biodiversity on farms where hedges and tree patches are otherwise absent, but play a negligible role in augmenting biodiversity on a farm where hedges and patches of trees are already present. They could nonetheless be expected to play a role in *maintenance* of biodiversity on any farm where they were established, particularly in relation to species associated with hedges.

2.5.1.8 REPS4 measure on priority sites

The measure applying to land on a farm that falls within an NHA, SAC, SPA or a site designated under the Water Framework Directive, and also applying to Commonages, carries with it a range of stipulations, some of which relate to prevention of forms of usage that might cause habitat deterioration and others that detail required habitat management. Required livestock management regimes are detailed for all habitats in the Burren, and for "blanket bogs, heaths and upland

grasslands". "Upland grassland" is not a habitat category recognised by the Habitats Directive or mentioned in Fossitt (2000). Neither is it defined in DAFF (2007a). Given that grassland types found down to sea level in the West of Ireland could be found at 1000m and upwards, in central Europe, it is also unclear what is meant by "upland" in this context. However, for drawing up elements of a REPS4 farm plan under this measure the Farm Planner is required to consult with an environmentalist/ecologist, whose role is to advise on management of all land occupied by/used by habitats and species targeted on priority sites, including those for which no specific management regime is prescribed in the REPS4 documentation. It has to be assumed that all of the relevant habitats and species on a farm are known to the environmentalist/ecologist, that their whereabouts is clear and that the environmentalist/ecologist can stipulate appropriate management regimes for all of them, assumptions that may be over-optimistic.

Given that it targets only those parts of farms that fall within designated priority sites, this measure relates to only a minority of farms and a minor part of the hectareage under farming. Nonetheless, it targets habitats recognised internationally as requiring protection, the greater part of the national resource of some of them being within the boundaries of farms. That being so, REPS4 schemes within the general farmed landscape outside priority sites cannot provide an alternative to effective management of the priority sites, in terms of biodiversity maintenance at national level. In this context, the fact that there are REPS4 prescribed management regimes for some of the habitats requiring protection in priority sites, but not for others (e.g. wetland habitats other than blanket bog) suggests that REPS4 may be less effective in safeguarding the biodiversity of some of these habitats than others. The significant role of wetland habitats, particularly fen, in maintaining Irish syrphid biodiversity, was demonstrated by use of the database in section 2.2.1.2.4 of this text.

2.5.2 REPS4 consequences for biodiversity maintenance

In order to participate in REPS4 a farmer must apply all REPS4 measures that are appropriate to his/her farm and adopt a minimum of two of the options available under these measures. Various combinations of measures and options are possible, with a range of potential implications to biodiversity maintenance. No statistics are available on how many farms are participating on the basis of each possible combination of measures and options. However, one mandatory element, the requirement to establish field margins, is repeated explicitly again and again under different measures and the establishment of field-margin -type habitat is also implicit to others, e.g. fencing off of waterways and establishment of farm-forestry plantations. It is reasonable to conclude that all farms in the REPS4 scheme will at least have either new field margins (as distinct from permanent field margins) installed as part of the scheme, or field margins already in place. The database shows that the biodiversity maintenance implication of this is that these field margins can act as reservoirs for organisms of production land habitats, potentially resupplying those organisms to fields from which they have been eradicated by tillage or pesticide application. This is of significance from an agrobiodiversity standpoint and relates to provision of ecological services. But field margins per se can support only a small proportion of the species that can be found in farmed landscapes (see section 2.5.1.6), so their role is minor from the standpoint of maintenance of general biodiversity. On the case-study farm the production-land habitats and (permanent) field

margins together accounted for only 20 of the 81 syrphid species observed on the farm and predicted to develop there, i.e. 25% of the species. The only other non-production-land habitat that is universally targeted by REPS4 measures is hedges, and REPS4 should result in a certain minimal length of hedge/ha on all farms participating in the scheme. Whether, under REPS4 provisions, hedges will be managed to maximise their biodiversity maintenance capacity is less certain (see section 2.5.1.3). On the case-study farm, production land habitats plus field margins plus hedges would together account for 29 of the observed species (i.e. 36%), which is still noticeably less than half of the species found on the farm and predicted to live there. The potential role of hedges in maintaining or increasing landscape permeability does not seem to have been taken into account by REPS4, since no reference is made to prioritising installation of new hedges that would either link with existing ones or with hedges of adjacent farms. By contrast it is assumed (see option 4c, under section 2.5.1.7) that field margins do have an ecological corridor function, though the desirability of considering this issue at landscape scale (rather than farm scale) is not alluded to or accommodated. Indeed, landscape permeability across farm boundaries cannot be effectively addressed by a scheme like REPS4, that considers farms individually, rather than together as landscape components. If the REPS4 scheme results in augmentation of the biodiversity of a particular farm this would be more by coincidence than design (e.g. by opting for establishing farm forestry plantations of oak, rather than some other tree, on a farm that happens to be adjacent to oak forest), since it would be a consequence of organisms being available to colonise that farm from the surrounding landscape, and there is no requirement of either the farmer or the REPS Planner to take into consideration the surrounding landscape when drawing up a REPS4 plan for a farm.

There is no certainty that a farm would, as a consequence of participating in REPS4, include within its area any habitats additional to production land habitats plus field margins plus hedges. The option to create habitat (option 4a, under measure 4) requires only fencing off of land previously in production, an action unlikely to lead to an increase in the range of habitats present. It would thus be unrealistic to assume that the REPS4 scheme will result in a general *increase* in the biodiversity of the Irish farmed landscape, since it includes no measure that would generally increase the range of habitats present, or maximise landscape permeability such that new habitat could be colonised from outside the farm. Its impact is more likely to be manifest in maintenance of the biodiversity that is already present on a farm, particularly agrobiodiversity, since the field margins and hedges made omnipresent under this scheme can act as reservoirs for organisms able to maintain only temporary populations in production land, due to management practices like tillage and pesticide application. But whether this can achieve a general impact on the biodiversity of farmed land in Ireland is moot, given that less than half of Irish farms are apparently within the REPS4 scheme. The REPS4 measure requiring retention of various types of non-agricultural habitat on a farm (see list of habitats requiring retention, given in section 2.5.1.7 above) can only function on farms where at least one of those habitats is represented. In the absence of statistics detailing numbers of farms on which this measure has been applied, and how many of those farms retained each of the listed habitats, it is not possible to gauge whether this measure will have any general effect on biodiversity maintenance in the Irish farmed landscape. Suffice it to say that the fate of most of the biodiversity still persisting in the farmed landscape is probably dependent upon application of this measure, because of the numbers of species dependent upon the types of habitat targeted for

retention. This would be borne out by the data from the case-study farm, where the “disused land” habitat grouping (see text section 2.4.2.3), which corresponds with the retained habitat grouping applied in REPS4, was recognised as responsible for maintaining more than 50% of the syrphid species observed on the farm. The lack of clarity in detailing how retained habitat requires to be managed under this REPS4 measure can only reduce its effectiveness. In particular, the absence of a clear requirement for proactive management of open habitat types prone to scrub-invasion (e.g. grassland habitat types targeted for retention) can only be expected to lead to habitat loss and associated biodiversity loss. On the case-study farm, failure to actively manage the disused grasslands was predicted (Speight and Good, 2001a) to lead to loss from the farm of 13 syrphid species (i.e. more than 15% of the farm’s syrphid fauna). The need for proactive management to maintain habitat quality is recognised in the REPS4 measure on priority sites, under which prescribed, proactive management regimes are mandatory for some of the habitats involved. Why are there no prescribed, proactive management regimes for habitats requiring retention on farms not in priority sites? The need for habitat management is not reduced because the habitat concerned is outside a priority site. It is difficult to conclude otherwise than that the REPS4 scheme will not prevent continued loss of biodiversity in the Irish farmed landscape because much of that biodiversity is dependent upon retained habitat and it makes no clear requirement for proactive management of retained habitat.

A noticeable weakness of REPS4 is its treatment of wetland habitats. The only REPS4 habitat category that wetland on a farm could fall into is habitat requiring retention. Some wetland types are listed under the REPS4 habitat retention measure, but spring-fed flushes (and the springs themselves) seem to have been inadvertently excluded (see section 2.5.1.7) and the habitat retention measure makes no reference to management of wetlands, beyond certain prohibitions as to their use. Further, the new habitat creation option makes no provision for creation of either wetland or standing freshwater habitat. Experiences on the case-study farm (see section 2.4.6 and Speight and Good, 2005) demonstrate that creation of wetland and standing freshwater habitat on a farm can have an immediate impact on biodiversity, transforming the status of a significant number of species from “visitors” to “residents” – a transformation that apparently affected more than 10% of the farm’s syrphid species. There is currently no measure, option or supplementary measure in the REPS scheme that provides for creation of wetland/freshwater habitat on farms. Neither does REPS4 refer to the wetlands that have been introduced to Irish farmland for farm waste-water-treatment purposes (see Harrington and Ryder, 2002; Harrington *et al.*, 2007). Such wetlands, referred to as ICWs (Integrated, constructed wetlands) would not fall into the category of habitat requiring retention, but might be expected to form part of the REPS4 nutrient management plan measure. ICWs introduce distinctive assemblages of wetland organisms to the Irish farmland landscape (Becerra Jurado *et al.*, 2008) and so can play a significant role in both maintaining and augmenting biodiversity on a farm. In this instance, the organisms involved represent both an extension to agrobiodiversity (since many of them are performing an ecological service for farming, through their water-treatment action) and, at least where wetland was otherwise absent, an extension to the general biodiversity of farmland. Becerra Jurado *et al.* (2008) did not include Syrphidae in their study. However emergence trapping carried out on 3 of the ICWs they sampled, during the period beginning May/end August 2002, collected the syrphid species shown in Table 28 (Speight, *in litt.*). With the exception of *Episyrphus balteatus*, *Eupeodes corollae*, *Neoscia*

podagrica, *Platycheirus clypeatus* and *Syrphus vitripennis*, the syrphids listed in Table 28 are wetland species that would not be predicted to occur in production land habitats, or in the standard farmland landscape of green fields and hedges. Indeed, these emergence trap results show that the syrphid biodiversity of a farm where only production land habitats plus field margins are present could be almost doubled by installation of an ICW on the farm. Some of the syrphids listed, in particular *Eristalinus sepulchralis*, are known to have the capacity to process livestock waste, building up extremely dense populations in the process (Rojo *et al*, 2007). But among the others are species that would not be directly involved in water treatment, indicating that ICWs can also add to the general biodiversity maintenance capacity of farmland.

Table 28: Syrphid species collected by emergence traps installed on 3 ICWs in the Anne Valley, Co. Waterford, May/August, 2002, showing the number of specimens of each species collected.

Species	No.specimens
<i>Anasimyia lineata</i>	1
<i>Episyrphus balteatus</i>	5
<i>Eristalinus sepulchralis</i>	59
<i>Eristalis abusiva</i>	2
<i>Eristalis arbustorum</i>	1
<i>Eristalis intricaria</i>	1
<i>Eristalis pertinax</i>	4
<i>Eupeodes corollae</i>	5
<i>Helophilus hybridus</i>	77
<i>Helophilus pendulus</i>	35
<i>Neoascia geniculata</i>	11
<i>Neoascia meticulosa</i>	10
<i>Neoascia podagrica</i>	23
<i>Neoascia tenur</i>	48
<i>Platycheirus clypeatus</i>	22
<i>Platycheirus occultus</i>	11
<i>Platycheirus perpallidus</i>	14
<i>Platycheirus scambus</i>	1
<i>Syrphus vitripennis</i>	1

2.5.3 National Parks and Wildlife Service Farm Plan scheme

The National Parks and Wildlife Service (NPWS) Farm Plan scheme (see NPWS, 2005) applies over the same range of sites as the REPS4 Priority Sites measure (see section 2.5.1.8 above). On such sites the NPWS Farm Plan Scheme may be opted for as an alternative to REPS4, but cannot be applied on the same land as a REPS4 scheme. There is no legal requirement for a farmer to participate in either scheme. A major difference between REPS4 and the NPWS Farm Plan Scheme is that, in the former, all of the land on a farm must be subject to the provisions of the scheme. In the latter, only land where targeted habitats or species are present is subject to the scheme, the rest of the land on a farm not being addressed by the scheme. The plan compilation methodology and management requirements for land falling within the NPWS Farm Plan Scheme are the same as stipulated for the REPS4 priority sites measure. In relation to both schemes, the lack of precise information on

what management has been stipulated for particular habitats under each scheme, and on how many farms, makes it difficult to predict what their biodiversity maintenance benefits on priority sites are likely to be. For instance, the proportion of the land surface of these priority sites covered by farms taking part in these schemes remains unknown.

Whatever is achieved, in relation to biodiversity maintenance, on land subject to a NPWS Farm Plan Scheme, the NPWS Farm Plan plays no role in maintaining biodiversity elsewhere on a farm. It has already been pointed out (section 2.5.2) that REPS4 could only co-incidentally be effective in maintaining or improving landscape permeability, because it has no provisions for considering, or establishing, inter-farm habitat links. The same is true of the NPWS Farm Plan Scheme, but more so, since it not only has no provisions to establish, or maintain, inter-farm habitat links, but also deals only with parts of farms. The NPWS scheme is, then, unlikely to deal with issues of maintenance or enhancement of habitat connectivity within farms, as well as between farms. Neither does the NPWS Farm Plan Scheme carry with it any specific provision requiring the creation of new habitat, even as an option, as contained in REPS4. This has the consequence that potentially significant limitations to the quality of habitats targeted on priority sites cannot easily be addressed. One example would be creation of habitat to link isolated habitat patches. Another would be addition of standing-water bodies within wetland lacking them. For instance, the database indicates that 8% more Irish syrphid species would be expected to inhabit fen with pools, than fen without pools.

2.5.4 Dept of Agriculture and Food FEPS Scheme

The FEPS Scheme (Forest Environment Protection Scheme) provides financial incentives to farmers participating in REPS4 to plant a minimum of 8ha of trees on their farms (5ha on farms of less than 30ha), with the stipulation that the land to be planted is not habitat requiring to be retained under the REPS4 scheme. There is no mention of the NPWS Farm Plan Scheme in FEPS documentation and vice versa. So it is presumed here that participation in the FEPS Scheme is not open to farmers who have opted to participate in the NPWS Farm Plan Scheme.

According to the "Guidance Notes" document (an anonymous and apparently unpublished text downloadable from the Forest Service website) both deciduous trees and conifers are approved for planting under FEPS and may be planted in various combinations. The Guidance Notes document goes on to state that "Acceptable tree species are listed in Table 7 of Chapter 9 of the Forestry Schemes Manual (2003)". However, the latter document is apparently not in the public domain and thus could not be consulted for purposes of the present text. The FEPS documentation stipulates that 18-20% of every plantation established under FEPS should be designated as "Area for Biodiversity Enhancement" (ABE). An ABE is defined as comprising "open spaces, retained habitat and widely spaced native trees". A list of the habitats/types of ground cover/land surface features, that can be regarded as contributing to the required 18-20% of designated ABE, is provided. It is repeated here in Table 29. The establishment phase of this scheme runs for 5 years, but premia continue to be paid in support of FEPS plantations that remain in place after those five years, for up to 20 years.

Management of FEPS plantations can include one application of fertiliser (not to be aerially applied) and use of approved systemic herbicides for “weed control”. There are no other stipulations concerning the management of FEPS plantations. In particular, there are no stipulations concerning the management of habitat (e.g. hedges, open areas) or created habitat (i.e. ponds) comprising the ABE component of FEPS plantations.

Table 29: Land surface features that can (“YES”), or cannot (“NO”), be included as part of the mandatory 18-20% of every FEPS plantation designated as “area for biodiversity enhancement” (ABE) under the FEPS scheme. Asterisked categories are included or excluded on an individual case basis, dependent upon assessment of their potential for biodiversity enhancement.

Areas ABE Grant Premium	ABE
Open space for landscape and biodiversity	Yes
Hedgerows	Yes
Scrub	Yes
Buffer zones along aquatic zones	Yes
Archaeological sites and their exclusion zones	Yes
Created lakes/reservoirs	Yes
Former REPS habitats	Yes
Public road setback areas	Yes
Railway setback strip	Yes
Ridelines and drains	Yes
Internal roads and turning bay setback areas	Yes
Unplantable areas	*
Shallow, rocky soils	*
Rock and scree	*
Aquatic zones (area occupied by lake/ river)	*
Plantation forest. (Conifer High Forest and Broadleaf High Forest)	No
Non forest group of trees, copse, scrub	Yes
Dwelling house/associated building setback area	Yes
Rights of way held by third party	No
Areas with turbary or grazing rights held by a third party	No
Major water mains	*
Power line corridors	*
Gas line	*
Public road	No

Certain of the limitations of the REPS4 habitat retention measure tree-planting option, alluded to in previous paragraphs (see under section 2.5.1.7), do not apply to the FEPS scheme. Firstly, the FEPS scheme makes the habitats requiring retention (i.e. not to be planted by trees) much clearer, by using the habitat categories defined in Fossitt (2000), and referring to them by means of the habitat codes employed by Fossitt (2000). There is, for instance, no ambiguity in respect of the status of springs, which under FEPS clearly comprise a habitat category to be retained. Secondly, financial support for the management stipulated is provided under FEPS for 20 years, rather than ceasing after 5 years, so there is greater likelihood that plantations established under FEPS would survive to reach maturity, than their REPS4 counterparts. Use of the database to predict the biodiversity

maintenance implications of introducing plantations of trees to farms are considered under section 2.5.1.7 of this text.

There is a series of 19 optional measures accompanying the main FEPS measure, and participating farmers are required to adopt a minimum of six of these. The first of them refers explicitly to creation of ponds as a habitat creation option. The second refers to provision of “deadwood for invertebrate populations”. The third option is to “create wildlife corridors between habitats”. Granted that many of the FEPS optional measures have no direct habitat impact, and it would not be difficult for a farmer to take up six optional measures that would exclude these first three, it cannot be said that FEPS will result in introduction of a significant quantity of ponds, deadwood resources or “wildlife corridors” to the Irish farmed landscape in general. However, it is nonetheless true that FEPS does include explicit provision for pond creation as part of the scheme, at least as an option, in this way addressing, in part, one of the lacunae identified above (section 2.5.2) in respect of REPS4. What is the likely impact of implementation of these 3 options, on the biodiversity maintenance potential of a farm?

The impact on farmland biodiversity, of introducing a pond and associated wetland to a farm are considered here in section 2.4.6. But, as an integral part of the process of installing the pond introduced to the case-study farm, an overland flow wetland was synchronously established on the inflow stream (see Speight and Good, 2005), so that the water entering the pond was largely cleaned of eutrophication pollutants originating in the surrounding landscape. The FEPS pond creation option makes no reference to either water source or managing water inflow quality. Neither does it define a minimum surface area for ponds established under the scheme, or suggest what might usefully be done with spoil excavated in making the pond basin. It does require that trees are not planted within 5m of the margin of a created pond. But no stipulation is made as to how the 5m wide open area surrounding a created pond should be managed. It might be suggested that this lack of guidance could result in production of a range of pond types, that might together be expected to support more biodiversity than a set of uniform ponds produced by a more controlled construction and maintenance regime. But it could conversely be argued that a minimalist interpretation of the requirements of this option amount to little more than digging a hole, letting it fill with water and then abandoning it to fate – to potentially become stagnant, anaerobic and overshadowed by uncontrolled scrub invasion of its margins. Certainly, a pond created within a FEPS plantation, as part of the requisite ABE component, might be expected to reach that condition by the time FEPS financial support for the plantation ceased, 20 years later. The material presented in section 2.4.6 of this text shows that pond creation can have a significant impact on biodiversity maintenance within a farmed landscape. And ponds created under the FEPS scheme could have a similar impact during the first years of their existence. Lack of clear management requirements makes their subsequent biodiversity maintenance role uncertain.

Some consideration of the potentially limited utility of labelling landscape components as “wildlife corridors” has been given in section 2.5.1.7. Suffice it to say that without being designed and located specifically to benefit particular organisms, land designated as “wildlife corridor” may achieve little to increase landscape permeability. The FEPS option alludes to organisms that may benefit from establishment of corridors of certain types and so carries with it a degree of functionality missing from its REPS4 equivalent. Hedges and “open space” strips are both alluded

to as types of FEPS corridor. But no stipulations are made as to how these corridors should be managed in the FEPS scheme, either to maintain their integrity or to maximise their “corridor” potential.

The FEPS “deadwood” provision option has no parallel in REPS4 and requires consideration in its own right. The “Guidance Notes” document on FEPS (an unaccredited, apparently unpublished text downloadable from within the Coillte website) points out that the “measure will only apply to a limited number of sites i.e. sites with existing deadwood or where the creation of deadwood is appropriate”. It goes on to recommend locations and conditions appropriate for retaining dead wood, stating that “most deadwood dependant species are unable to utilise dead timber in dry, open conditions in full sunlight, such timber sometimes becomes heat sterilised. Most timber falling in the open should be moved into moister, shadier conditions”. Retaining dead wood under such conditions would increase the likelihood that it could be colonised by deadwood Diptera species. The guidance text also advises that another situation to locate “fallen deadwood is beside old veteran/specimen trees, which are a source of future deadwood. This ensures a continuity of deadwood”. It is not pointed out that “veteran/specimen trees”, and tree stumps, can be themselves a more valuable resource for the maintenance of deadwood invertebrates than is timber. This can be demonstrated using the database, as shown in Figure 22.

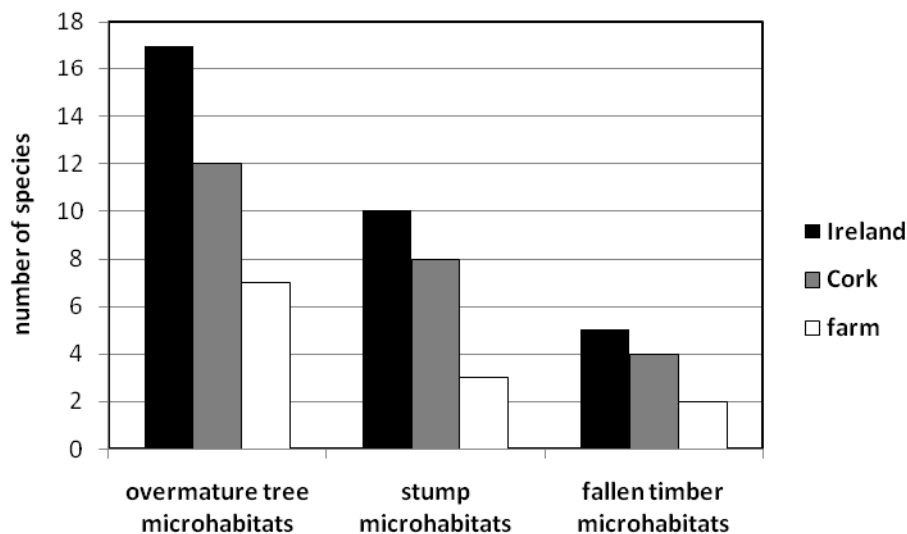


Figure 22: Numbers of syrphid species with larvae that use overmature (living) tree microhabitats (trunk cavities, rot-holes, insect workings, sap runs/lesions); stump microhabitats or fallen timber microhabitats, in Ireland, Cork and on the case-study farm

Essentially, most of the species whose larvae can develop in timber can also develop in tree stumps, but there are additional species that develop in tree stumps. Similarly, most of the saproxylic species that develop in tree stumps can develop in old, living trees, where there are yet more species that develop in rotting wood microhabitats that don’t occur in either stumps or fallen timber. The FEPS deadwood conservation option could thus usefully perform a greater role in biodiversity maintenance by explicitly requiring the retention of old, living trees and tree stumps on farms, as well as repositories of fallen timber.

Given that most of the habitats regarded as appropriate for designation as ABE are plagioclimax in character, the absence of any requirement for proactive management of ABE habitats under FEPS could prove a limitation to its effectiveness, as a tool for either biodiversity maintenance or biodiversity enhancement within farmland, particularly in respect of open-ground ABE habitat. The extent to which the planted trees themselves perform a significant role in biodiversity maintenance would depend more upon whether, within the landscape surrounding the farm, there is a source of organisms that can colonise the trees growing in the plantation. The requirement made under FEPS to plant a small part (i.e. 10%, or approximately 0.16ha) of the ABE of each plantation with combinations of different native trees, understorey trees and flowering shrubs, may increase the likelihood of both colonisation and population maintenance by insects like syrphids, when FEPS plantations are compared with their REPS equivalents, for which no such planting requirements are made. For instance, the presence of flowering trees and shrubs would help to ensure food sources are available for the adult insects, especially early in the year when alternative food sources are scarce in a farmed landscape.

In the context that the FEPS scheme is expected to operate in conjunction with the REPS4 scheme, on farms already participating in REPS, it is apposite to consider what biodiversity maintenance benefit may be derived from FEPS that would be additional to what might be expected from REPS4. Since there is no specific management required of the ABE component of FEPS plantations, to ensure its contained habitats maintain the character and quality they exhibit at the outset of the FEPS scheme, their contribution to biodiversity maintenance cannot be relied upon. It would be more realistic to assume the ABE component of a plantation would become an extension of the scrub cover already provided by the FEPS plantation. In that case a net decrease in the biodiversity maintenance potential of the FEPS plantation would be predicted. However, FEPS plantations have the capacity to augment biodiversity beyond what might be achieved in REPS4 because, under REPS4, establishment of plantations of trees is only an option, not a requirement, whereas it is mandatory in FEPS. Further, the FEPS plantations are supported for 20 years, rather than the 5 years that a REPS4 scheme runs, the extra years permitting the trees and shrubs of the FEPS plantation to approach maturity. On a REPS4 farm where the only other habitats present are the field surfaces, field margins and hedges, a 20-year-old FEPS plantation could be the only manifestation of mature-tree habitat types. As indicated in section 2.5.1.7 above, prediction of what actual biodiversity increment might be expected from introducing plantations of trees to a farm under those circumstances is dependent upon both the types of tree planted and a knowledge of what organisms are available in the landscape surrounding the farm, to colonise the plantation as it develops. And if woodland is already present on the farm, biodiversity augmentation derived from introducing plantations of trees could be minimal, or non-existent, whether those plantations are FEPS plantations or otherwise. However, where woodland is already present, a FEPS plantation could nonetheless play a significant role in maintenance of the biodiversity of tree and shrub-associated organisms on a farm, through providing continuity in tree cover. So FEPS plantations may, or may not, augment the biodiversity maintenance potential of a farm beyond what could be achieved under REPS4, but will certainly provide biodiversity maintenance support, for organisms inhabiting hedges, scrub and woodland on farms. As with REPS4, some of the non-mandatory measures available under FEPS could provide greater biodiversity augmentation than the mandatory measures, and would complement REPS measures rather than duplicating them.

But “the devil is in the detail”, in the case of FEPS the vagueness or absence of management requirements for ABEs set up under the scheme and for other non-planted habitat created under the scheme, which can only reduce the effectiveness of FEPS as a vehicle for maintaining biodiversity in the farmed landscape.

2.6 The Dept of Agriculture and Food Native Woodland Scheme

The Native Woodland Scheme (NWS) operated by the Forest Service of the Department of Agriculture and Food enables landowners to establish and/or maintain areas of native tree species on their property. It provides finance for management of existing woodland “where **two-thirds or more** of the existing overstorey stocking comprises native species” (Forest Service, 2008) and for establishing new plantations of native tree species “on open sites that have not been under forest cover in recent times.” The NWS thus represents an additional mechanism whereby plantations of trees can become established within the farmed landscape. The primary measure of the NWS is a requirement to either maintain and appropriately manage existing areas of native woodland, or to establish new plantations of native trees (and shrubs). So participating landowners are obliged to opt for one or the other of these actions.

In establishing new plantations it is recommended that “initial stocking should typically comprise 85% overstorey species and 15% understorey and minor species”. Species acceptable for planting under NWS are listed in the Native Woodland Scheme Manual (Forest Service, 2008). That listing is repeated here:

Overstorey species

Alder, *Alnus glutinosa*

Silver birch, *Betula pendula*

Downy birch, *Betula pubescens*

Ash, *Fraxinus excelsior*

Sessile oak, *Quercus petraea*

Pedunculate oak, *Quercus robur*

Scots pine, *Pinus sylvestris*

Understorey and minor species

Hazel, *Corylus avellana*

Hawthorn, *Crataegus monogyna*

Spindle-tree, *Euonymus europaeus*

Holly, *Ilex aquifolium*

Crab apple, *Malus sylvestris*

Aspen, *Populus tremula*

Wild cherry, *Prunus avium*

Blackthorn, sloe, *Prunus spinosa*

Eared willow, *Salix aurita*

Goat willow, *Salix caprea*

Rusty willow, *Salix cinerea* subspp. *oleifolia*

Elder, *Sambucus nigra*

Rowan, *Sorbus aucuparia*

Yew, *Taxus baccata*

Guellder rose, *Viburnum opulus*

A plantation established under NWS is required to be at least 0.1ha in surface area and, as under the FEPS, 20% of the NWS area requires to be designated as an 'area for biodiversity enhancement' (ABE). The habitats/features regarded as acceptable for inclusion in an NWS ABE are the same as for ABEs designated under FEPS (see section 2.5.4 of the present text). Drainage works are generally prohibited in NWS plantations, including during preparation for planting. Herbicide application within NWS plantations is regarded as desirable during the establishment phase of a plantation, using prescribed chemicals and by means of a knapsack sprayer, with the herbicide applied only within a metre radius of each planted sapling. In respect of harvesting the trees the Manual (Forest Service, 2008) states that "all woodlands under the NWS must be managed into the future using close-to-nature silviculture, based on single tree / group felling". It is required that non-native tree species be removed from NWS plantations, with the exception of overmature trees, retention of which is made optional: "due to their biodiversity, cultural and landscape value, non-native veteran trees can be retained indefinitely". The NWS lacks the habitat creation option included in FEPS, and the FEPS deadwood retention option. Like REPS4 and FEPS It lacks any option to establish woodland ground flora to accompany the planted trees. Also, like FEPS, it lacks any specific proactive management stipulations relating to maintenance of ABE habitats. However, it does follow the development of the plantations established under NWS, and of the existing woodlands participating in NWS, for a prolonged number of years, ensuring that their existence is safeguarded through that period. Plantations established under NWS can be expected to be subject to the provisions of the scheme until they reach maturity. In its provisions for establishment of new plantations NWS is thus little different from FEPS, in its capacity to maintain biodiversity, and perhaps less proactive in augmenting biodiversity, given that it lacks a habitat creation option. But the size of plantation aimed for by FEPS – 8ha for farms of more than 40ha – is rather lower than the plantation size for which provisions are made in NWS, which caters for establishment of plantations up to and over 40ha in extent. In such large plantations the requirement for a 20% ABE component would be expected to lead to inclusion of a greater range of habitats than in smaller plantations, and hence to a greater biodiversity support capability.

A major difference between FEPS and NWS lies probably in the latter's provisions for pro-active management of existing areas of native woodland, that have no counterpart in FEPS. The management requirement under NWS, to remove non-native species of tree (and shrub) from a woodland included in the scheme, and to replace them by native species could have positive biodiversity maintenance implications. This is especially so where the removed species are from a different biogeographical zone of Europe (e.g. *Prunus laurocerasus*, *Rhododendron ponticum*) or a different biogeographic region (e.g. *Eucalyptus* spp). Removal of non-native European trees like

sycamore (*Acer pseudoplatanus*) and beech (*Fagus sylvatica*) may be botanically correct but is more neutral faunistically, given that the Irish fauna has evolved in company with such trees, even if they did not reach Ireland naturally during the postglacial. For instance, the database shows that 64% (36) of the tree-associated acidophilous oak-forest syrphids occurring in Ireland would also be predicted to occur in association with humid beech forest. This suggests that the facsimile beech forest found in some places in Ireland, even if not native, might support most of the Irish oak-associated syrphids. It follows that removal of mature beech from a woodland and replacing them with seedling oak could even result in a net reduction in the biodiversity of oak-associated syrphids present, in circumstances where the beech were the only mature trees in the woodland. Also, fewer of the tree-associated oak forest syrphid species known from Ireland are associated with ash (*Fraxinus*) forest than with beech (*Fagus*) forest, so it could be suggested that, to best maintain the syrphid fauna of a mixed woodland of oak, ash and beech it would be preferable to remove the ash trees than to remove the beech!

The potential biodiversity maintenance implications of establishing patches of trees within an otherwise treeless farmed landscape have been considered in previous sections of this text. The fact that, under NWS, only native tree species are involved, and that small quantities of native shrubs are planted to accompany them, should ensure maximal use of NWS plantations by whatever elements of the Irish tree-associated fauna are available locally to colonise them. The scale of the role that the various different Irish forest types might make to biodiversity maintenance nationally is considered here in section 2.2.1.2.4. Granted that plantations established under NWS represent truncated ecosystems (i.e. with no forest ground flora or forest-associated fauna brought in as part of the establishment process) located on sites where forest organisms have essentially (i.e. for a number of years) until then been absent. But the relative contributions that can be made by “green field” plantations of different native trees species, to maintenance of the Irish syrphid fauna, can probably still be inferred from use of the database as in section 2.2.1.2.4.

The fact that the NWS makes a special point of encouraging establishment of plantations along river margins carried with it an implicit landscape permeability element for forest-associated species, since rivers represent barriers to movement for many organisms, forcing them to either congregate at, or move along, the river edge. Movement along river margins would, in principle, be rendered easier for forest organisms if some form of tree cover were present there. There is no explicit ecological corridor component to the NWS provisions.

PART 3: DATABASE CONTENT AND GLOSSARY OF TERMS

3.1 Introduction

The Database of Irish Syrphidae comprises a set of spreadsheets and associated text files covering all of the known Irish and British syrphid species (including both Microdontidae and Syrphidae). Species accounts are also provided for the Irish species. With the exception of *Pipiza fenestrata* (Mg.) and *P. lugubris* (Fab.), the recorded British species are covered by all of the spreadsheets because the Irish syrphid fauna shows evidence currently of undergoing change in response to fluctuations in habitat availability and is demonstrably a subset of the British fauna (Speight, 2004), upon which any increment to the Irish fauna is thus largely dependent. It is hoped that by including the British species the database can accommodate gain or loss of species that would be expected under existing conditions. The two *Pipiza* taxa mentioned above are listed in the spreadsheets but remain uncoded other than in the “Range, status and distribution” spreadsheet, because doubt over their identity renders coding of their attributes impractical.

In the following pages the categories used in the spreadsheets are defined and the system used for coding those categories of information into the spreadsheets is explained.

3.2 The Macrohabitat categories

3.2.1 Macrohabitat category coding

The ‘Macrohabitats’ spreadsheets provide, in coded form, data on the macrohabitat preferences of the species of Syrphidae covered by the database. The coding system used is as follows:

- 3 = maximally preferred macrohabitat, the presence of the species would be expected in this macrohabitat/predicted for this macrohabitat
- 2 = preferred macrohabitat, the presence of the species would be predicted for this macrohabitat
- 1 = the species can occur in this macrohabitat under certain circumstances (e.g. if an appropriate supplementary habitat is also present), but would not generally be predicted for this macrohabitat (e.g. in the absence of any appropriate supplementary habitat)
- blank** = the species does not occur in this macrohabitat.

3.2.2 Macrohabitat category definitions

Each macrohabitat category recognised is treated in a separate spreadsheet column and defined in the Glossary of Macrohabitat categories (Appendix 3). It is important to consult the glossary in order to understand the precise interpretation to be put upon the terms used. In cases where a macrohabitat category recognised here co-incides with a “habitat” category used in the CORINE “habitat” classification system, the relevant CORINE code for that macrohabitat category is given in the Glossary, with its definition. An attempt has been made to maximise the use of CORINE

“habitats” in the ‘Macrohabitats’ spreadsheets, but the CORINE system did not prove as generally applicable as had been hoped - see Speight *et al* (1997). The CORINE categories are only comprehensive for western and central Europe, but through the EUNIS system the CORINE approach to “habitat” characterisation has now been extended to cover the entire continent. Rodwell *et al* (2002) list the categories of the pan-European system, but do not define them, and there still seems to be no accessible source of the EUNIS category definitions. For this reason, the CORINE definitions remain in use here.

The names used for a small number of Macrohabitat categories are the same as are used for certain Microsite Feature categories. In these cases, the coding of species depends on the definition of the category provided in the corresponding file Glossary and the function of the category in that file. For instance, “dung” appears as a supplementary habitat category in the Macrohabitats spreadsheets and as a ground-surface debris category in the Microsite Features spreadsheet. Dung-associated species are coded “1” in that category in the Macrohabitats spreadsheets, but may receive scores of “2” or “3” in the corresponding category in the Microsite Features spreadsheet. **Thus, although these categories may have the same names in different spreadsheets, their content is not interchangeable.**

To aid in certain analytical processes, each Macrohabitat category has been given a code number, which appears at the head of each column, beneath the name of the category. To help familiarise the user with the organisation of the ‘Macrohabitats’ spreadsheet, a Summary Table of Macrohabitat categories, showing the order in which they appear in the spreadsheet, their hierarchical relationships and their respective code numbers, is given below.

3.2.3 Use of the supplementary habitat categories

1. The habitat categories in the ‘Macrohabitats’ spreadsheets are subdivided into broad, general groupings, Forest Macrohabitats, Open Ground Macrohabitats, Culture Macrohabitats, Wetland Macrohabitats and Brackish Macrohabitats. Preceding each of these general groupings (except Brackish Macrohabitats) a set of supplementary habitat categories is given to use with them. The supplementary habitat categories have been set up to refine the prediction procedure, once it was recognised that over-prediction of species was occurring if, for instance, species associated with streams occurring in heathland were coded simply under the categories “streams” and “heathland”, rather than in some way which accommodated their requirement for the presence of both habitat categories.
2. Species which occur in association with a given Macrohabitat category (e.g. “heathland”) only when a particular supplementary habitat (e.g. “stream”) is also present are now coded with a “1” in the respective Macrohabitat column and with a “1” in the relevant supplementary habitat column, so that their presence would not be predicted on a site where only one of these two habitat components occurred.
3. The basic list of species predicted to occur in association with a particular category of Macrohabitat is given by the species coded either “2” or “3” in the relevant Macrohabitat column. So the basic list of species predicted for lowland heathland can be derived directly from the

“lowland heath” column. However, that basic list will not now include species associated with the occurrence of a supplementary habitat and Macrohabitat together, such as the edge of a stream in heathland. In order to augment the species predicted for a site to include the species associated with such habitat combinations it is necessary to follow a simple procedure. This procedure is illustrated here for a site on which the combination “stream in lowland heathland” occurs:

- a) copy the “lowland heath” column to a new file,
- b) copy the open ground supplementary habitat column “brook/river edge in open” to the new file,
- c) replace the codings “2” and “3” in the “lowland heath” column by blanks (so that the only level of species-association remaining coded is level “1”)
- d) in a separate column of the new file, sum the coding for each species in the “lowland heath” column with its corresponding coding in the “brook/river edge in open” column, so that codes for the combination “brook/river edge in lowland heath” are produced.

5. Once this is done, some species will show a coding of “2” in the column for the combination “brook/river edge in lowland heath”, enabling these species to be predicted for the site. In situations where a number of supplementary habitats occur in conjunction with a Macrohabitat, a single column, containing all of the supplementary predicted species, can be derived by using the “max” function to show the maximum level of coding obtained for each species from the Macrohabitat/ supplementary habitat combinations represented. In the same way, this column of supplementary predicted species can then be combined with the column containing the basic list of species predicted for “lowland heath”, to give an overall predicted list.

6. The same procedure should be followed for each Macrohabitat category that is accompanied by supplementary habitat categories on a site.

3.2.4 Use of the Macrohabitat categories in on-site habitat survey

An integral feature of the prediction procedure for a site fauna is information about the habitats occurring on the target site. On-site habitat survey requires the following adjuncts:

- a) a printed-out copy of the “Summary table of habitat categories used in the Macrohabitats Table”, which forms part of the present text file (Appendix 2).
- b) a printed-out copy of the “GLOSSARY OF MACROHABITAT CATEGORIES”, which also forms part of the present text file (Appendix 3)
- c) printed-out copies of the “Habitat survey form”, a copy of which is provided in Appendix 4.

3.2.5 The Freshwater Macrohabitat categories

Freshwater habitat categories have become supplementary in the ‘Macrohabitats’ spreadsheets. In order to provide general freshwater categories, in which, for instance, all of the species associated

with “permanent pool edge” may be coded into one category, a separate spreadsheet of Freshwater Macrohabitat categories has been provided. This Table is NOT for use in predicting site faunas, but may be used in other applications of the database files. A summary table showing the categories used in the ‘Freshwater Macrohabitats’ spreadsheet is provided here, following the summary table of Macrohabitat categories (Appendix 2).

3.3 The Microhabitat categories

3.3.1 Coding of Microhabitat categories

The microhabitat data are coded into the ‘Microhabitats’ spreadsheet under a series of “microsite feature” categories (Appendix 5). The term microsite feature is used here to denote physical features of the environment, discernable by human eye, which can be used as proxies for the microhabitats of syrphid larvae or puparia. No one of these features can be regarded as precisely identical with the true microhabitat of a species, because to define the microhabitat of an organism it is necessary to refer to not only physical features but also the conditions under which these features are used by the species (e.g. temperature and humidity parameters), and, frequently, to more than one physical feature.

The coding system used in the ‘Microhabitats’ spreadsheet is as follows:

3 = maximally preferred microsite feature,

2 = preferred microsite feature,

1 = the species can occur with this microsite feature under certain circumstances but would not generally be predicted to occur with this feature

blank = the species does not occur with this microsite feature.

Each microsite feature is defined, in alphabetic order, in the ‘Microsite Features Glossary’ in Appendix 6. It is important to consult the glossary in order to understand the precise interpretation to be put upon the terms used.

The coded data are derived from both published and unpublished sources. In Syrphidae, intra-generic similarities between larval life styles of the species make possible a certain amount of extrapolation, from what is known of the microhabitat preferences of some species, to the microhabitat preferences of others that are less well known. Using best professional opinion, this extrapolation process, taken together with what is known of the macrohabitat preferences and habits of the adult insects of such less well-known species, has been employed to code microsite feature categories for their larvae/puparia. The data coded into the ‘Microsite Features’ spreadsheet is thus an amalgam of established fact and deduction. References to published data on larval microhabitats are given in Speight (2008a).

3.3.2 Microsite feature definitions

Each microsite feature category recognised is treated in a separate spreadsheet column and defined in the Glossary of Microsite Feature categories. It is important to consult the glossary in order to understand the precise interpretation to be put upon the terms used.

Three of the microsite features referred to are not physical features of the environment, but attributes of physical features. These are water trophic status, water movement and soil drainage, which are included here for convenience. Species are only coded for water trophic status or water movement if their larvae are aquatic/sub-aquatic. Species are only coded for soil drainage if their larvae are associated with the soil.

3.4 The Range, Status and Distribution categories

3.4.1 Coding of Range & Status categories

The 'Range and Status' spreadsheet is subdivided into a number of sections. The data coding system used is not the same in all the sections. A summary of the spreadsheet categories can be found in Appendix 7, with a glossary in Appendix 8.

3.4.1.1 Nomenclature and taxonomy

This section deals with nomenclature and taxonomy, the first column providing a nomenclaturally complete checklist of Irish and British Syrphidae and Microdontidae (*Microdon* is included in the spreadsheets because it is treated by various authors as a genus of Syrphidae, but in the Species Accounts in Part 3 it is treated as a representative of a separate family, the Microdontidae). This section also gives a rough guide to the taxonomic status of each species. In the "taxonomic status" column fuzzy coding is used as follows:

- 4 = concept of species apparently stable; species identifiable in at least one sex, using generally reliable, European-level keys
- 3 = concept of species apparently stable but species either not adequately differentiated in generally reliable keys and/or not incorporated into generally reliable, European-level keys
- 2 = concept of species instable, due to existence of inadequately differentiated segregates (e.g. the situation of *Cheilosia vernalis* within the *vernalis* complex) or other taxonomic complications
- 1 = status of taxon as a valid species doubtful, but the case for relegation of the name to synonymy has either not yet been investigated or formally made.

A taxon categorised as "status doubtful" (i.e. coded "1"), in the Taxonomic Status category is not coded for other attributes in the 'Range and Status' spreadsheet except for indicating (where known), under "European States and other entities", the part of Europe from which the type material of that taxon originates.

The expression "European-level key", as employed above, is used to refer to identification keys that purport to cover all, or nearly all, the known European species of a genus, in contradistinction to keys with restricted geographical coverage, like those that deal only with the species known from a particular country or part of Europe.

3.4.1.2 Occurrence of species in different parts of Europe and elsewhere

This section of the 'Range and Status' spreadsheet deals with the range of each species in Europe and elsewhere, using general Biogeographic Region categories for parts of the world other than Europe.

For coding the Range categories a simple presence/absence system is used, as follows:

1 = species present

blank = species absent.

The following major works have been used in coding range information from outside Europe:

- Afrotropical Region: Dirickx (1998)
- Australasian/Oceanian Regions: Thompson and Vockeroth (1989)
- Nearctic Region: Vockeroth (1992), Wirth *et al* (1965)
- Neotropical Region: Thompson *et al* (1976)
- Oriental Region: Knutson *et al* (1975)
- Palaearctic Region: Peck (1988)

Range within Europe is coded using the "regions" recognised by the EU. The occurrence of Irish and British species in other European States and geopolitical entities (e.g. islands, geographically definable parts of States) is also coded. Sources of published information on the species occurring in individual European States are detailed in Speight *et al*, 2008). Norway is here regarded as part of the Northern Region of Europe in general, Liechtenstein and Switzerland as largely part of the Alpine region of Europe in general (none of these States are members of the EU). An overview of the area of Europe covered by the database, for Northern, Atlantic and Continental regions of Europe is provided in Figures 23-25. The Alpine region of Europe covered by the database is shown in solid black in each of these figures. The regions are only approximately delineated in Figures 23-25 and should not be taken as portraying accurately the precise location of boundaries between them.

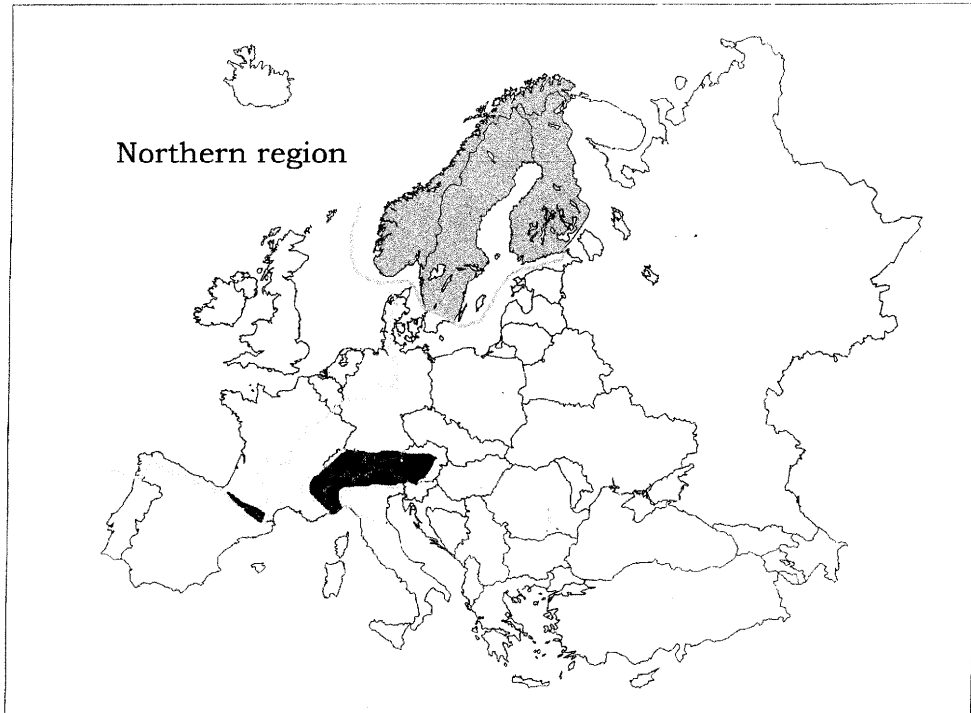


Figure 23: Approximate area of the northern region of Europe (stippled) covered by the database files.

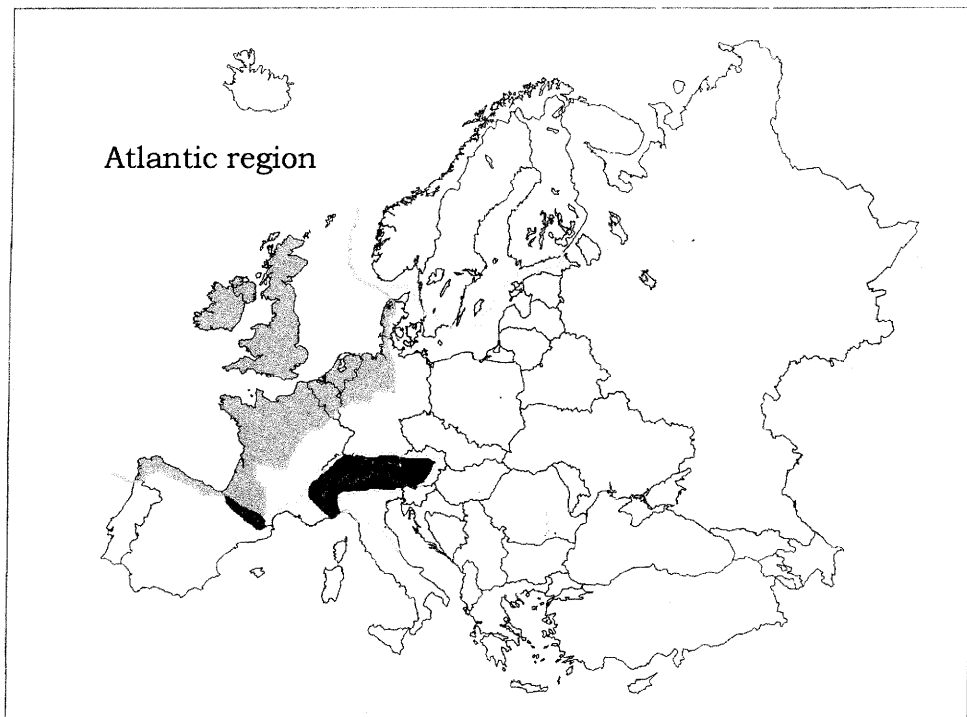


Figure 24: Approximate area of the Atlantic region of Europe (stippled) covered by the database files.

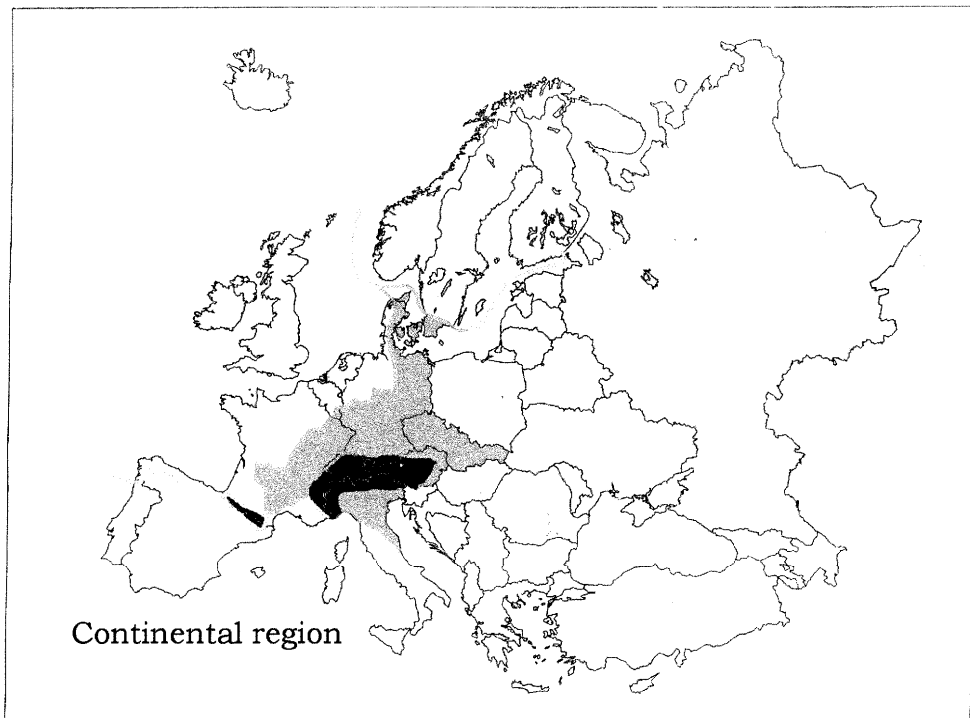


Figure 25: Approximate area of the continental region of Europe (stippled) covered by the database files

3.4.1.3 European endemism

This section of the spreadsheet categorises the species according to the degree of European endemism they each exhibit. In coding the Degree of Endemism categories a simple system is employed, the species consigned to a particular category being coded "1" and the species not consigned to that category indicated as a blank. A species endemic to Europe is coded "1" for the category "European (general)" and "1" for "European endemic". If the species is a localised endemic, it will also be coded "1" for the category "localised endemic".

3.4.1.4 Status

This section of the 'Range & Status' spreadsheet deals with the conservation status of the species, expressed as the degree to which each species is estimated to be under threat of extinction in biogeographical zones of Europe and individual Atlantic seaboard countries.

In the Degree of Threat categories, the fuzzy coding system used in the other spreadsheets is employed, as follows:

3 = maximal association

2 = moderate association

1 = minor association

blank = the species is not associated with this category.

The fuzzy coding system is particularly useful here, because the precise status of species within these parts of Europe is frequently unclear, not least since the different authors who have consigned species to status categories in their own areas have not used the same systems or criteria in categorising the species. Typically, a species whose status is clear in one of the parts of Europe covered by the Table will receive a coding of '3' in the relevant column. In cases where a species appears to be a border-line case it is given a coding of '2' in each of the categories to which it may be consigned. In cases where, on balance, it seems most justified to consign a species to a particular category, but there are some grounds for considering it might be consigned to a different category, it is coded '2' and '1' for these categories, respectively. Use of IUCN status categories has been deliberately avoided here, it being concluded that, at this point in time, a simpler system with more flexibility matches better the heterogenous nature of existing syrphid data, while still enabling a usable categorisation of the species.

3.4.1.5 Distribution in Ireland

The final section of the 'Range and Status' spreadsheet deals with distribution in Ireland. The distribution data are presented in two ways in the spreadsheet, as 50km Universal Transverse Mercator (UTM) grid square records and as Irish County records. For coding these two categories a simple presence/absence system is used, as follows:

1 = species present

blank = species absent.

3.4.1.5.1 Irish 50Km UTM square distribution data

Published Irish ordnance maps use the Irish National Grid, so distribution records have been gathered using Irish National Grid references, which have then been transformed to 50km, UTM grid square references, for use. This transformation has been accomplished using the computer programme by Rasmont *et al* (1986). Each 50km UTM grid square has its own, unique, reference code. These 50km squares, together with their reference codes, are shown in Figure 26. An overview of the 50km UTM records data coded into the 'Range and Status' spreadsheet is shown in Figure 27. Spot maps, showing distribution plotted on the UTM grid using 50km squares, are also provided for each Irish syrphid species in the Species Accounts section of this text.

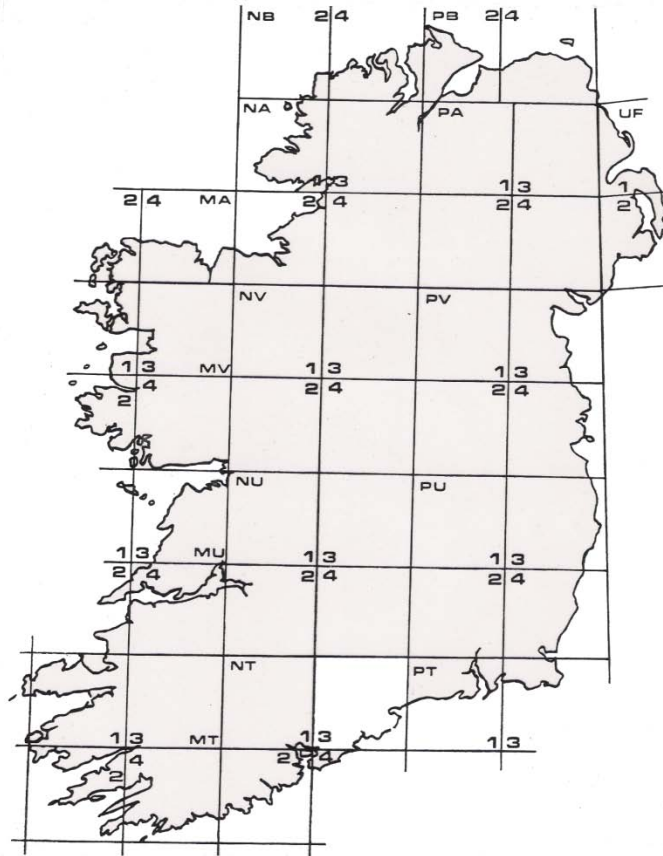


Figure 26: Map of Ireland showing 50km UTM grid squares and their codes.

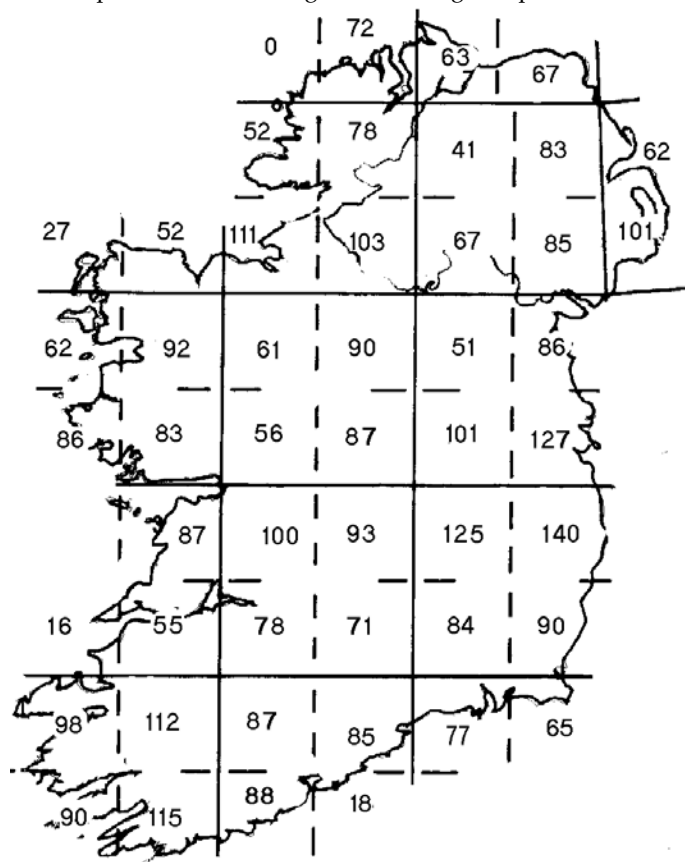


Figure 27: Map of Ireland showing number of syrphid species known from each 50km UTM grid square

3.4.1.5.2 Irish counties distribution data

The Irish counties are shown in Figure 28, which also serves to provide an overview of the distribution data coded into the Irish Counties section of the 'Range and Status' spreadsheet.

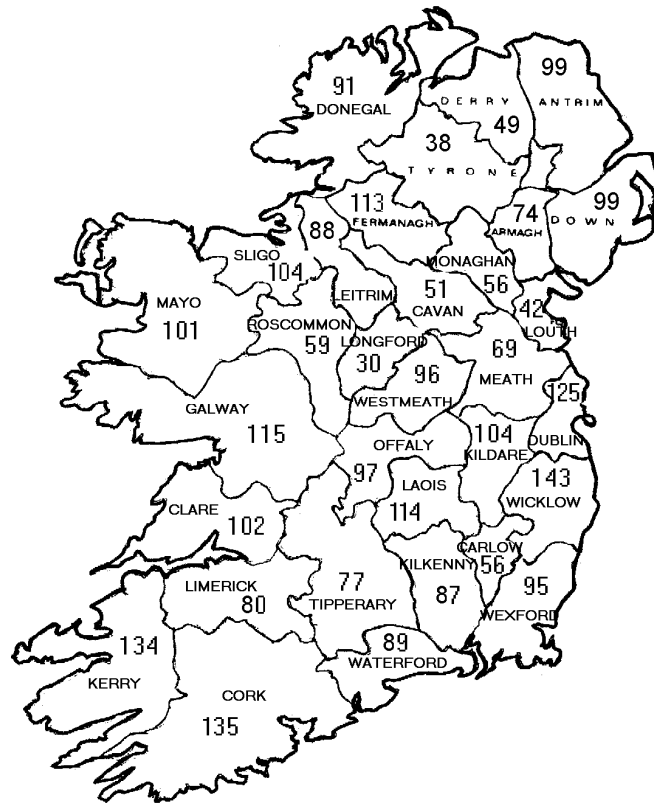


Figure 28: Map of Ireland showing the Irish counties and the number of syrphid species known from each county

3.5 The Trait categories

3.5.1 Coding of Trait categories

The 'Traits' spreadsheet provides, in coded form, data on selected traits of the species (summarised in Appendix 9). Some of the trait variables refer to larval traits, others to traits of the adult insect. Each trait category is defined in alphabetic order in the Traits Glossary in Appendix 10. It is important to consult the Glossary in order to understand the precise interpretation employed for each of the categories used in the spreadsheet. The fuzzy coding system has been applied in the Traits spreadsheet as follows:

3 = maximum association

2 = moderate association

1 = minor association

blank = no association

Some of the traits included in the table could have been coded simply using '1' for presence and blank for absence. In these cases, for example "food type (larvae)", the categories are coded '3' or blank for each species. This ensures that throughout the spreadsheet the numbers used in coding may be treated in the same way.

Where possible, extrapolation from knowledge existing for well-known species in a genus has been used to code traits for less well-known species in the same genus, using best professional judgement. In cases where it is deemed that such an approach is not justified, species are coded in the "unknown" category for the trait concerned.

3.6 The farm management operation categories

3.6.1 Introduction

One objective of the syrphid database is to provide a predictive tool for use in site management. By comparing between the expected and observed faunas of a site, attributes of missing species can be recognised and used to help in identifying site features which may be damaged or missing. Larval microhabitat requirements are of particular significance in this process, under-representation of the species associated with a particular microhabitat potentially indicating that microhabitat has been damaged or is in some other way under-performing.

When site management operations are conducted on a scale that entire macrohabitats are affected the overall result is that one type of macrohabitat is replaced by another. When management is aimed at modification of an existing macrohabitat, rather than its replacement, its impact is, *de facto*, on some part, or parts, of the macrohabitat rather than on all of its components. Experience in use of the syrphid database (Speight, 2000b) has demonstrated that there are clear links between microhabitat occupancy levels and site management operations - essentially, site management operations impinge at the level of larval microhabitat. It follows that knowledge of which larval microhabitats are affected by a particular management operation, and what changes are caused in these microhabitats by that management operation, could have considerable implications to prediction of the syrphid fauna of a site where that management operation is in use.

The two forms of land use that have the most extensive and intensive impact on the rural landscape of Europe are farming and forestry. Of these two, farming is usually the more important, in that farming *sensu lato* predominates over the greater part of the land surface of nearly every European State. To understand how farm management operations impinge upon syrphid microhabitats, and thence on syrphid faunas, is thus, arguably, an important step towards interpretation of man-induced change in the syrphid faunas of Europe's countryside, as observed today.

Farming is by no means a single, well-defined phenomenon and embraces a wide range of plant and animal husbandry techniques. The 'Farm Management Operations Impact' spreadsheet of the syrphid database represents an attempt to code the impacts on syrphids of the land management operations intrinsic to the dominant livestock sector of Irish farming. This sector is dairy, beef and sheep farming (including associated feed crop production) in a regulated landscape i.e. where the

livestock are confined to fields rather than allowed to roam unconstrained through forest and moorland etc. Compilation of this file has proceeded via a number of stages:

1. Identification of the farm management operations intrinsic to animal farming. A summary table of the management operation categories used in the spreadsheet is provided in Appendix 11.
2. Definition of these management operations, in terms of the parts of the ecosystem they affect (by reference to the categories used in the Microsite Features file of the database) and the types of impact they make on those parts of the ecosystem (see Glossary of Farm Management Operation Categories Appendix 12).
3. Tabulation of the seasonality and frequency per annum of occurrence of these management operations (Appendix 13).
4. Tabulation of the parts of the ecosystem impinged upon by each farm management operation, using the same categories as in the Microsite Features file (Appendix 5).
5. Codification of the impact of each farm management operation upon each species, using, in conjunction, the products of stages 2-4 above and the data coded into the Microsite features file for each species.

Codification of the impact of these management operations on syrphid species has been carried out using a series of assumptions and is unashamedly an exercise in the use of logic and judgement – there is little published that relates directly to impact of individual farming operations on particular syrphid species (with the exception of some work on effects of insecticide applications, which form part of animal farming operations in production of fodder crops). **The resulting spreadsheet is, in consequence, to a significant extent an experimental tool and this requires to be taken into consideration in its use.**

Assumptions made in coding the impacts of management operations upon the species may be listed as follows:

1. Coding relates to the larvae of a species developing on a site, or parts of a site, actually exposed to the management operation. In coding for impact over the course of a year, the potential occurrence of a species on adjacent land not subject to the management operation is taken into consideration i.e. it is assumed that the species is available to recolonise the land affected by the management operation.
2. In coding for impact over the course of a year, coding relates to impact over the twelve months following from when the management operation is carried out, not just to the season or time of year in which the management operation is carried out. Essentially, what is being coded for a species is the capacity of the land to support it during that 12 month period. No attempt is made to estimate impact of a management operation on the syrphid populations of subsequent years. Coding for effects of nutrient enrichment and liming represent exceptions to this general rule: the impact of these management operations becomes apparent in the year following treatment and coding thus also relates to the year following treatment.
3. Coding does not take into account *the degree of probability* of a particular management operation being carried out in a given macrohabitat with which a species may be associated. What is

coded is the perceived impact in the eventuality that a particular management operation **IS** carried out there. Thus, although ploughing of montane grassland might be considered a rare occurrence, the impact of ploughing on species occurring in montane grassland is coded for the circumstance that ploughing is carried out in this macrohabitat.

4. In cases where the larvae of a species may develop in more than one microhabitat of a group of microhabitats which occur together, and these microhabitats are not equally affected by a management operation whose impact is being coded, it is assumed that the species will survive in the less affected microhabitat(s) and the impact is coded at the level estimated as appropriate for the least affected microhabitat. For instance, the larvae of an aphidophagous species living on both tall herbs and low-growing plants may be affected more severely in a moderate grazing regime when on tall herbs than on low-growing plants. In this case the degree of impact coded would be that for the larvae living on the low-growing plants.

The simplified fuzzy coding system employed in other spreadsheets of the syrphid database has again been adopted here. In the other spreadsheets in the database it is the degree of *positive* association between the species and the category that is coded. But in the Farm Management Operations Impacts spreadsheet it is the degree of *negative* interaction between the species and the management operation category that is coded. The coding system has been used as follows:

- **3** = maximum impact of the specified management operation upon the species, predicted to lead to eradication of the species from the area subjected to that management operation
- **2** = moderate impact of the specified management operation upon the species, predicted to lead to loss of most of the population of the species from the area subjected to that management operation, but not to its eradication
- **1** = minor impact of the specified management operation upon the species, predicted to lead to loss of some part of the population of the species from the area subjected to that management operation, but not to loss of either most or all of its population
- **blank** = no discernable impact of the management operation upon the species, in the area subjected to that management operation.

Farm management operations are more often than not carried out in combination. For instance, a field that is to be cut for silage would typically have earlier been ploughed, fertilised and reseeded with appropriate grass species, though this is not necessarily apparent from simply looking at the field when it is covered in grass. And just looking at it covered in grass does not tell you whether it is to be grazed, cut for hay, or cut for silage. In order to predict the syrphid fauna of such a field using the database spreadsheet, it is necessary to know at least what management operations it has been subject to within the past twelve months - data most easily obtained from the farmer or land manager. Effects of some farm management operations, for example ploughing, would appear to have a much longer term impact than one year. But these longer-term impacts are not addressed here.

Clearly, there is potentially considerable difference between the impact on the syrphid fauna of carrying out farm management operations on a piece of land for the first time and carrying out those same operations on a piece of land that has been subject to them repeatedly in previous

years. In the latter instance, most of the species adversely impacted by that management regime will have been eradicated in previous years, leaving only the syrphids that are able to withstand it, so repeating the same management regime again would be unlikely to cause much change in the fauna. In its present format, the spreadsheet should help to predict the potential consequence of introducing particular management operations, whether alone or in combination, to a site for the first time. It should also help to predict the present fauna of already managed land - assuming an accurate record is available of the management operations that have been carried out there.

PART 4: SPECIES ACCOUNTS FOR IRISH SYRPHIDAE AND MICRODONTIDAE

4.1 Introduction

The Species Accounts presented below have been compiled to provide a summary of data on the species of Syrphidae and Microdontidae known from Ireland, to accompany the spreadsheets. They refer specifically to information relating to Ireland. More general information on both the Irish and British species is provided in Speight (2008a).

4.1.1 The species of Syrphidae and Microdontidae known from Ireland

In the 20th century, the first comprehensive listing of the species of Syrphidae (including Microdontidae) occurring in Ireland was that of Coe (1953), incorporated into keys for the identification of the species. Coe's (1953) publication provides a reliable starting point for compilation of an Irish species list. It was followed nearly 25 years later by the annotated list of Speight *et al* (1975), that was accompanied by distribution records drawn both from examination of the available museum material and from field data gathered by the authors. In the years between 1975 and 2000, various species have been added to the list and it was updated by Speight (1978d) and Speight (1985a). A further update was provided by Chandler (1998). Since 1997, the list has been updated annually in the StN database and the nomenclature used here follows the most recent StN issue (Speight *et al*, 2008).

Ashe *et al* (1998) refer to the following species as occurring in Ireland:

Eristalis rupium Fabricius

Neoascia interrupta (Meigen)

Orthonevra brevicornis Loew

The only known records of *E.rupium* and *O.brevicornis* prior to 1985 proved to be erroneous (Speight, 1985a) and there are no more recent records of the occurrence of either of these species in Ireland. There are no known records of *N.interrupta* from Ireland. Based on the available information, these three species must thus be regarded as having been included on the Irish list in error by Ashe *et al* (1998) and are not regarded as part of the Irish fauna in the present review. The situation of *Cheilosia fraterna* (Meigen) in Ireland is more ambiguous. It is not regarded as an Irish species in the present text, but a species account is included for it, detailing recent references to its occurrence in Ireland and explaining why these are discounted.

Coe (1953) recognised 135 hoverfly species (Syrphidae plus Microdontidae) as occurring in Ireland. Today, 183 hoverfly species are known from the island. Species for which no Irish reference material is known to exist are excluded from this total (and from this text in general). The 33% increase in the number of species involved since 1953 is in line with developments in knowledge of the syrphid faunas of other parts of the Atlantic zone of Europe. There are recognised taxonomic problems still existing in certain genera occurring in Ireland. *Dasysyrphus* and *Melanostoma* are cases in point. There also remain difficulties in separation of the females in the genera *Heringia*,

Pipizella and *Sphaerophoria*, though if one considers only the known Irish fauna these difficulties impinge here only in respect of *Sphaerophoria*.

4.1.2 The spot maps accompanying the species accounts

The species accounts presented here are accompanied by spot maps providing a visual interpretation of the 50km, UTM distribution data, given in tabular form in the 'Range and Status' spreadsheet.

In the spot maps, only one symbol is used to denote occurrence of a species, a solid black circle. No attempt has been made to indicate records derived from pre-1950 using some other symbol, because the number of pre-1950 records is so small that comparison between pre-1950 and post-1950 distribution data would be largely meaningless. In the small number of cases where a species is only known from Ireland prior to 1950 this is referred to in the species account for that species. Nearly all available pre-1950 records have been published in Speight *et al* (1975) - very few additional early records have come to light subsequently.

4.1.3 Subheadings used in the species accounts

The information in the species accounts is partitioned under a series of subheadings, as follows:

4.1.3.1 History

Reference is given to the publication in which the species was added to the Irish list, if postdating Coe (1953), which is taken as the starting point for reliable recording of syrphids in Ireland. The species noted by Coe (1953) as occurring in Ireland are indicated. Nomenclatural events affecting the published record of the species in Ireland are also alluded to, if they have occurred since Coe (1953), and attention has not already been drawn to them in subsequent literature on the Irish syrphid fauna. In some instances this involves confirmation that Irish material has been rechecked, where redefinition of species has occurred. Exceptionally (i.e. in the case of *Cheilosia fraterna*) a species doubtfully recorded from Ireland is removed from the list, on the basis that there is no reference material available to confirm presence.

4.1.3.2 Ecology

Habitat associations of the species in Ireland and elsewhere are compared, and any differences are highlighted. Most species are explicitly categorised into one or other of two broad categories, anthropophilic or anthropophobic, according to whether they are supported or threatened by current land use practises occurring in Ireland.

4.1.3.3 Range, distribution and status

Species exhibiting regional or relictual distribution patterns in Ireland are highlighted and those requiring consideration for inclusion on lists of protected species are indicated.

4.1.3.4 Irish reference specimens

This lists the location of at least one determined Irish voucher specimen of the species. All species represented by Irish specimens in the collections of the National Museum of Ireland and the Ulster Museum are indicated. Only when species are not represented by Irish specimens in the collections of either of those institutions are other locations referred to. Abbreviations used are as follows:

BM = British Museum, Natural History (London)

NMI = National Museum of Ireland (Dublin)

SI = Smithsonian Institution (Washington)

UM = Ulster Museum (Belfast)

4.2 Species Accounts: *Microdontidae*

Genus *MICRODON*

Microdon analis (Macquart), 1842



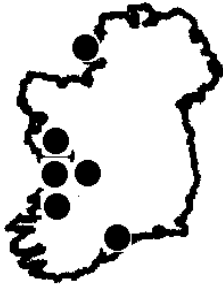
History: added to Irish list under the name *M.eggeri* Mik, by Breen (1977), on the basis of puparia from nests of "*Lasius niger*". Until publication of the key by Doczkal & Schmid (1999), there has been potential for confusion between *M.analis* and *M.miki*. Subsequent re-examination of all available Irish material has confirmed the presence in Ireland of *M.analis*, but *M.miki* has not been found here so far. More recently (Schmid, 2004) has shown that two cryptic species have been confused under the name *M.analis*. One of these, *M.major* Andries, is associated with *Formica* species, the other (*M.analis*) with *Lasius*. There is at present no reason to suppose *M.major* occurs in Ireland since all bred material of Irish "*M.analis*" is derived from nests of *Lasius*.

Ecology: so far, this species has been found in Ireland only in association with inhabited nests of a black *Lasius* species, probably *L.platythorax* (only recently separated from *L.niger*) in open areas of low altitude *Molinia* heath, within or edging deciduous woodland. The ant nests concerned were in fallen, rotting trunks of *Betula* and *Pinus*, with the bark still more or less intact; in rotting fence posts of *Pinus* and *Quercus*, from which the bark had not been removed and, on one occasion, in a large moss hummock. The distribution of *Lasius platythorax* in Ireland is currently unknown, so it is not possible to gauge whether availability of appropriate ant hosts per se is limiting the range of *M.analis* here. It is more likely that absence of fallen, rotting timber in otherwise appropriate localities is preventing colonisation.

Range, distribution and status: today this species occupies a very restricted range in SW Ireland and is known from few records (see distribution map). Distribution of this species elsewhere (it is known, for instance from the Scottish highlands to the south coast of England, in Britain) suggests no good reason other than habitat loss for its present restricted range in Ireland. Taken in context with the rest of the Irish hoverfly fauna of deciduous forest, *M.analis* should be regarded as a relict forest insect, which was almost certainly widely distributed in Ireland (including in areas of pine forest) until forest clearance caused its disappearance from most of the island. Now it has to be regarded as threatened and would be a candidate for inclusion in any list of invertebrates requiring protection throughout the island.

Irish reference specimens: in the collections of NMI.

Microdon mutabilis (L.), 1758



History: given as occurring in Ireland in Coe (1953), but since then Schönrogge *et al* (2002) have shown that two cryptic species have been confused under the name *M.mutabilis*. They confirmed the presence of *M.mutabilis* in Ireland, and Speight (2002b) added the other cryptic taxon, *M.myrmicae*, to the Irish list.

Ecology: larvae and/or puparia of *M.mutabilis* have been found in nests of the ants *Formica lemani* in Ireland, where this species occurs under large stones on well-drained ground. *F.lemanii* is widespread in Ireland but is not present in large numbers where land is used for hay or silage, and where a regime of alternation between grazing and mowing is in operation *M.mutabilis* does not occur. For the same reasons, *M.mutabilis* does not occur where land is periodically ploughed. In consequence, the fly is rarely found away from unimproved, permanent pasture. The karst limestone formations of parts of W Ireland still provide extensive tracts of appropriate habitat and in low-lying, sheltered parts of this limestone pasturage *M.mutabilis* reaches what are probably now its highest population densities in western Europe. In these circumstances, the ant nests are usually under large, loose pieces of limestone, lying on the ground surface and partly embedded in the thin soil.

Range, distribution and status: the dependence of this species upon large, undisturbed ant colonies on well-drained sites in open country almost inevitably dictates its present distribution in Ireland, whatever the limits to its previous distribution may have been. The solitary record from a scrap of old grassland in Donegal, and the isolated record from the south of the island suggest that the species could have been widespread before progressive eradication of unimproved grassland occurred. But even if once widespread it is unlikely to have been very frequent, due to its apparent

sensitivity to the trampling action of cattle on the mound nests constructed by ants under conditions of poor land-surface drainage. The astonishing abundance of this species in the Burren gives an indication of how successful it could be under more traditional regimes of animal farming. Today, in most of Europe, it would seem hardly credible that the orchid *Ophrys fuciflora* would have evolved a flower specifically to attract male *Microdon* (especially *M.mutabilis*) to attempt false-mating, so that the orchid's pollinia could be attached to the fly and then transported to another flower - the fly is now so localised in its occurrence it can perform this pollination role but rarely. Only in a few places, like the Burren, can the probable previous abundance of *M.mutabilis* in Europe be appreciated. But even in the Burren this insect is susceptible to man's activities - removal of loose limestone rock, whether for use in ornamental gardens or bulldozed out of the way to expose soil, is inimical to the survival of both the fly and its ant hosts. *M.mutabilis* is scarce, but probably not threatened, in much of western Europe, but apparently more under threat in central Europe. It reaches the southern edge of Scandinavia but only becomes frequent in southern Europe, where dry, stony grassland still provides appropriate habitat. Because of its abundance in the limestone karst region *M.mutabilis* cannot be regarded as under threat in Ireland, but it can be expected to disappear from all but protected sites elsewhere, if current pressures on land are maintained.

Irish reference specimens: in the collections of NMI and UM.

Microdon myrmicae Schönrogge *et al*, 2002



History: added to the Irish list by Speight (2002b); presence in Ireland confirmed by Speight (2003).

Ecology: this wetland species occurs in association with fen and the margins of raised bog and cutover bog (including blanket bog) in Ireland. It has been found most abundantly on a site (All Saints bog) where indigenous bog woodland of *Betula* is present on an ancient fen now in transition to raised bog. *M.myrmicae* occurs at that site in nests of the ant *Myrmica scabrinodis*, in huge, ancient tussocks of moss mixed with *Eriophorum* and *Vaccinium oxycoccus*.

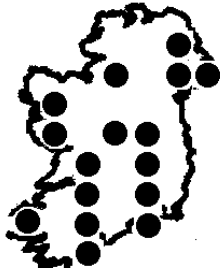
Range, distribution and status: it can be presumed that records of "*Microdon mutabilis*" from wetland sites in Ireland refer to this species (see Speight, 2002a), but such records are few and scattered (see accompanying distribution map). This species has to be regarded as a candidate for inclusion in any list of invertebrates requiring protection throughout the island.

Irish reference specimens: in the collections of NMI.

4.3 Species Accounts: *Syrphidae*

Genus *ANASIMYIA*

Anasimyia contracta Claussen & Torp, 1980



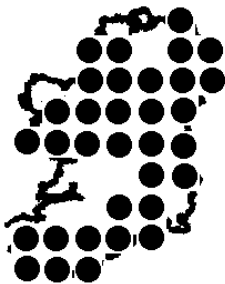
History: added to Irish list by Speight (1981a). Additional Irish records have been published by Anderson (1988) and Nelson (1988). This species was confused with *A.transfuga*(L.) until its description in 1980. Earlier records of *A.transfuga* in Ireland (e.g. in Speight *et al*, 1975) comprise a mixture of *A.contracta* and *A.transfuga* records, and cannot be relied upon.

Ecology: In Ireland this species has been found in association with various sorts of standing water wetlands, but a feature common to nearly all the sites involved is the presence of *Typha*. It has also been reared from larvae collected in Ireland, from under the water-surface, between the stem-sheathing leaf bases of dead *Typha* in a pond. Freshwater coastal lagoons, fen edging large lakes or small ponds and both limestone lakes and ponds in cut-over valley bog are included. *A.contracta* has also been found along large, water-filled drainage ditches and can occur in Ireland in association with constructed wetlands, introduced to farmland for treatment of livestock waste. The Irish records are from the period May/August, with the peak in July, suggesting that here there may be but one generation per year, in contrast to the situation over most of Europe.

Range, distribution and status: this species is widely, but sparsely distributed in Ireland. It is neither common nor threatened here. Elsewhere among the Atlantic seaboard countries of Europe it is more frequent. *A.contracta* is an endemic European species that occurs primarily in the Atlantic zone, becoming much more localised in central and southern Europe.

Irish reference specimens: in the collections of NMI and UM.

Anasimyia lineata (Fabricius), 1787



History: given as occurring in Ireland in Coe (1953).

Ecology: although this insect occurs in Ireland in a greater range of wetland types than the other *Anasimyia* species it is not frequent here in bogs, other than where ground water influence is apparent, such as along streams, or along the edge of valley bogs or in cutover bog. To this extent, the statements in Speight *et al* (1975) and Speight and Lucas (1992) that *A.lineata* occurs on "bogs" could be misleading. Characteristically, in Ireland *A.lineata* is a species of fen and marsh, but also extends into poorly-drained farmland, where it makes use of permanently wet ditches and ponds. It can apparently survive higher levels of eutrophication than the other *Anasimyia* species. Stubbs and Falk (1983) suggest that in Great Britain *A.lineata* "is characteristic of pools of mesotrophic or eutrophic character on sandy soils". This may reflect more the relative scarcity of peaty wetlands in Britain than a difference in the ecology of *A.lineata* in Ireland and Great Britain i.e. where peaty wetlands are absent in W Europe, *A.lineata* will be largely confined to wetlands on mineral soils. *A.lineata* does not occur away from situations where either slow-running or standing water occurs and so is not a component of the syrphid fauna of the standard Irish farmland landscape, of green fields plus hedges. However, it can occur in Ireland in association with (and has been bred from) constructed wetlands, introduced to farmland for treatment of livestock waste. Neither does it occur in suburban gardens or in closed canopy situations within woodland or conifer plantation.

Range, distribution and status: *A.lineata* is more generally distributed in Ireland than other *Anasimyia* species, and not threatened. The species is not infrequent in much of the rest of Europe's Atlantic seaboard, from southern Norway to northern France.

Irish reference specimens: in the collections of NMI and UM.

Anasimyia lunulata (Meigen), 1822



History: given as occurring in Ireland in Coe (1953), but at that point in time *A.lunulata* was confused with *A.interpuncta* (Harris). The presence of *A.lunulata* in Ireland was confirmed by Speight (1981a). *A.interpuncta* has not so far been recorded from Ireland but its presence here would not be unexpected.

Ecology: In Ireland *A.lunulata* is to be found in blanket bog (where it occurs in association with extensive flush systems), round the periphery of valley bogs and in pools and drainage ditches on cut-over bogs where the ground-water is once again influencing their biological character. It is also to be found in large numbers on transition mires, epitomised by Scraw Bog (Westmeath), and poor fen. Lake-margin communities, in which *Scirpus* predominates, may also support *A.lunulata* and on the Shannon floodplain the species occurs in spring-fed drainage ditches still subject to annual winter flooding. It is thus a strongly anthropophobic species and can only be expected to decrease

in frequency as processes of general land surface drainage, eutrophication of surface water and peat exploitation continue.

Range, distribution and status: *A.lunulata* is recorded from most parts of Ireland and available information suggests that the species may be more frequent here than elsewhere in Europe. But even so it cannot be regarded as common in Ireland and, though not as yet threatened, it could move into the threatened category soon, given the rate at which appropriate habitat is being lost. This syrphid is endemic to Europe.

Irish reference specimens: in the collections of NMI and UM.

Anasimyia transfuga (L.), 1758



History: given as occurring in Ireland in Coe (1953), but at that point in time this species was confused with *A.contracta*. The presence of *A.transfuga* in Ireland was confirmed by Speight (1981a). Earlier records of *A.transfuga* in Ireland (e.g. in Speight *et al*, 1975) comprise a mixture of *A.contracta* and *A.transfuga* records, and cannot be relied upon. Since 1981, additional Irish records have been published by Anderson (1988) and Nelson (1988).

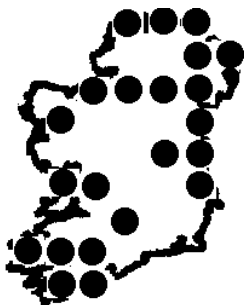
Ecology: unlike its close relative *A.contracta*, *A.transfuga* exhibits no clear association with *Typha*. The available records are from shallow standing water with marginal vegetation of *Phragmites* or *Scirpus*, on both unmodified (lake edge) and modified (ornamental pond, standing water ditch edging valley bog and pool in cutover bog) sites. Due to confusion with *A.contracta*, information pertaining to "*A.transfuga*" published from prior to 1980 has to be discarded, including that in Speight *et al* (1975).

Range, distribution and status: there are few Irish records of this species and it is probably less frequent in Ireland than in any other country of the Atlantic seaboard of Europe, from Denmark to northern France (inclusive). Why this is so is unclear. Suffice it to say that, to err on the side of caution, *A.transfuga* should probably be regarded as threatened in Ireland.

Irish reference specimens: in the collections of NMI and UM.

Genus ARCTOPHILA

Arctophila superbiens (Muller), 1776



History: given as occurring in Ireland in Coe (1953), under the name *A.fulva*.

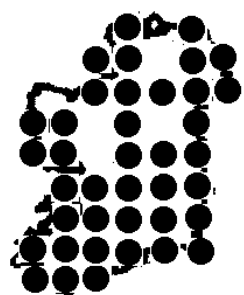
Ecology: In Ireland, most adequately documented records of this fly are from the vicinity of streams, springs and wet flushes in deciduous woodland of *Fraxinus/Quercus*, or in fen carr of *Salix/Alnus*, but a few are from predominantly open situations. The more or less open country records are from poorly-drained oligotrophic pasture invaded by *Salix* scrub. *A.superbiens* is not an insect of bogs, or even transition mires. It does not occur in association with conifer plantations, nor does it occur in the standard farmed landscape of green fields and hedges, or in suburban gardens or parks.

Range, distribution and status: most Irish records of *A.superbiens* are from western or northern parts of the island. But this is not a predominantly northern European insect - it reaches only halfway up the length of Norway (Nielsen, 1999), and occurs in both the Alps and the Pyrenees. It is, however, a characteristically Atlantic zone species and becomes very localised in central Europe. It is also endemic to Europe. It is not threatened in Ireland, but because it is susceptible to general land surface drainage and coniferisation of woodland it can only decrease in frequency if current trends in intensification of land use continue.

Irish reference specimens: in the collections of NMI and UM.

Genus BACCHA

Baccha elongata (Fabricius), 1775



History: given as occurring in Ireland in Coe (1953).

Ecology: *B.elongata* occurs in Ireland in most types of deciduous woodland, with the exception of birch woods, for which there are few records. It does not seem to occur in conifer plantations in

Ireland, except where deciduous scrub is also present (e.g., along forest roads), suggesting that under these circumstances it is dependent not on the crop trees but on the deciduous scrub. This species is to a significant extent anthropophilic, occurring in the standard Irish farmland landscape of green fields and hedges and in mature suburban gardens.

Range, distribution and status: *B.elongata* is both frequent and widely distributed over most of Europe, including Ireland. Surprisingly enough, it is, however, apparently endemic to Europe.

Irish reference specimens: in the collections of NMI and UM.

Genus *BRACHYOPA*

Brachyopa insensilis Collin, 1939



History: added to the Irish list by Chandler (1982).

Ecology: In Ireland, it is probable that the continued survival of this species is largely dependent upon introduced, European deciduous trees, notably sycamore (*Acer pseudoplatanus*). Sap-runs and tree holes in which sap-runs are present represent a preferred site for larval development of *B.insensilis* in continental Europe. The potential indigenous Irish tree hosts, oak and elm, are now so scarce in Ireland as overmature trees that overmature sycamore is more frequent and more generally distributed. In this context it is unfortunate that it can be fashionable to remove sycamore from protected sites on the grounds that this tree is not native - it often provides the only remaining refuge for indigenous old forest insects like *B.insensilis*. Presence of woodland microclimate seems to be of significance for this insect, since it is not recorded from isolated trees in hedge or pasture. This is an extremely anthropophobic insect in Ireland, not found in the standard Irish farmland landscape of green fields plus hedges, or in conifer plantations, or in suburban gardens.

Range, distribution and status: this insect is normally found only in the immediate vicinity of the site in which larval development has occurred, which reduces the probability of its discovery. The arboreal habit and short flight season of the adult insect also reduce the susceptibility of this species to collection. Together, these factors combine to suggest *B.insensilis* is likely to be under-recorded, in comparison with most other syrphids, that needs to be born in mind in considering the status of the species in Ireland. At present, there are but three known records of *B.insensilis* here, from widely separate locations, and, even if allowances are made for the difficulties of finding this insect, its distribution in Ireland has to be regarded as relictual in character. There is no simple basis on which to judge whether the number of records of *B.insensilis* would be

significantly increased from some comprehensive attempt at rearing syrphids from tree rot-hole material in Ireland. The limited amount of rearing work that has been undertaken is responsible for the sole record from eastern Ireland, but only resulted in that one record. Suffice it to say that, even if the number of Irish *B.insensilis* records quadrupled as a consequence of such a study, the species would still remain extremely infrequent in Ireland and threatened by habitat loss, due to the lack of interest in conservation of overmature sycamores in Ireland and the extreme scarcity of alternative, indigenous tree hosts for its larvae.

Irish reference specimens: in the collections of NMI.

Brachyopa scutellaris Robineau-Desvoidy, 1844



History: given as occurring in Ireland in Coe (1953). This species appeared in earlier literature under the name *bicolor* (Fall.) and the unsubstantiated record of *B.bicolor* from Ireland, referred to by Coe (1953), is taken to refer to a record of *B.scutellaris*. *B.bicolor* (Fall.) is a distinct species, most reliably identified by the key in Thompson (1980). It occurs in the island of Great Britain, where it appears to be associated primarily with ancient beech (*Fagus*). There remain no confirmed records of *B.bicolor* from Ireland.

Ecology: *B.scutellaris* usually occurs in Ireland in association with overmature ash (*Fraxinus*) and sycamore (*Acer pseudoplatanus*). The introduced sycamore provides an alternative tree host where ash is lacking and is also used when ash is present. Overmature elm (*Ulmus*) were used where available until they were entirely eliminated by Dutch elm disease. This insect seems to require a woodland micro-climate for its survival, since it does not seem to occur on isolated trees, or in hedgerows, though it may, on occasion, be found in association with tree lines of overmature trees. It thus has to be regarded as strongly anthropophobic in Ireland.

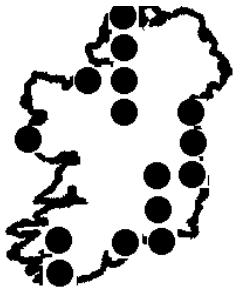
Range, distribution and status: given that the only large, indigenous trees occurring in most of the Irish countryside are ash (*Fraxinus*) and that *B.scutellaris* larvae are associated primarily with this tree, it might be expected that *B.scutellaris* would also be a frequent species in Ireland. However, although *B.scutellaris* is widely distributed in the western half of the island it is confined to woodland locations, there being no records from hedgerow trees or small copses, and although it is not currently threatened, this species cannot be regarded as common. Adults of *B.scutellaris* are much easier to locate than those of *B.insensilis*, in that they characteristically fly around the trunks of host trees within 2 metres of the ground. *B.scutellaris* is widely distributed in western Europe, but, just as *Fraxinus excelsior* becomes more localised away from the Atlantic zone of the continent, so does *B.scutellaris*. It does not seem to occur north of Denmark and is largely confined to riparian

gallery forests where ash occurs, or to areas with sycamore, in central Europe. This syrphid is apparently endemic to Europe.

Irish reference specimens: in the collections of NMI and UM.

Genus *BRACHYPALPOIDES*

Brachypalpoides lentus (Meigen), 1822



History: given as occurring in Ireland in Coe (1953).

Ecology: In Ireland, this insect is primarily associated with mature/overmature oak (*Quercus*) woodland, but will utilise old beech (*Fagus*) when this is available and has been reared in Ireland from wet, fungus-riddled wood at the trunk-base of an old, living beech. The scarcity of oak woodland in Ireland today makes mature/ overmature beech a significant contributor to the survival of *B.lentus*. Oak is absent from some Irish localities from which *B.lentus* has been recorded, but there is no indication that ash (*Fraxinus*) or birch (*Betula*) provide alternative larval habitat - sycamore (*Acer pseudoplatanus*) or wych elm (*Ulmus glabra*) may be involved. Although in continental Europe this species occurs in mature/overmature *Abies/Picea* forest it has not been found in British or Irish conifer plantations. This is presumably due to a lack of appropriate larval habitat, occasioned by plantation management practices employed and the lack of sufficiently mature trees. *B.lentus* has to be regarded as an anthropophobic insect in Ireland. It does not occur in the standard farmland landscape of green fields and hedges any more than in conifer plantations. Neither is it to be found in suburban gardens.

Range, distribution and status: *B.lentus* is an infrequent species in Ireland, though there are scattered records from most parts of the island. Its larval microhabitat requirement for overmature, living trees ensures that it is very unlikely to become more frequent here in either short or medium term. Indeed, unless the "Native Woodlands" scheme brings to a halt the coniferisation of remaining enclaves of unprotected deciduous woodland *B.lentus* is likely to further decrease in Ireland. However, one of the "native" trees approved for planting under the Native Woodlands scheme is *Pinus sylvestris*, so the scheme may cause further coniferisation. *B.lentus* is widely distributed and not infrequent in Europe in general, except in the north. Its range extends beyond Europe, into Asia Minor.

Irish reference specimens: in the collections of NMI and UM.

Genus *BRACHYPALPUS*

Brachypalpus laphriformis (Fallen), 1816



History: given as occurring in Ireland in Coe (1953). Erroneously removed from the Irish list by Speight (1980a) on grounds of supposed extinction, and subsequently reinstated by Speight (1985a).

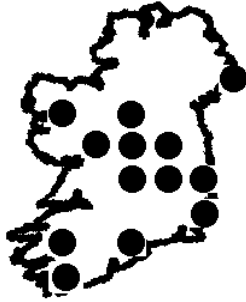
Ecology: this hoverfly is characteristically a species of overmature oak and beech forest, in Europe. The only Irish locality from which *B.laphriformis* has been recorded in the last 50 years is a fringe of deciduous woodland, including a few overmature beech and sycamore, edging young conifer plantation near Laragh (Wicklow). Earlier this century it was recorded from an old oak (*Quercus*) woodland locality in the same county, since converted to conifer plantation. It would seem likely that this insect was originally associated with oak forest in Ireland. Lack of records from other Wicklow oak woods is a testament to the absence of natural age structure in the tree populations there, and, in particular, to the almost total lack of overmature trees. Even acknowledging the early flight period of this species and the infrequency with which it may be found at flowers, given that it has been actively searched for in a significant proportion of the few localities supporting potentially appropriate larval habitat and in knowledge of its habits, there should by now be more Irish records of *B.laphriformis* were it present in anything more than a very few localities.

Range, distribution and status: there are only two Irish records of *B.laphriformis*, one of them dating from the first half of the 20th century and the more recent record is from an unprotected site subject to management for forestry. So, there is every justification for regarding this insect as endangered here. It would be a high priority for inclusion in lists of species threatened in Ireland. Although it is widely distributed in Europe in general, and probably the most frequently met with *Brachypalpus* species in Europe, this insect is recognised as either threatened or decreasing in some parts of continental Europe, as well as in Ireland. It is apparently endemic to Europe.

Irish reference specimens: in the collections of NMI.

Genus *CHALCOSYRPHUS*

Chalcosyrphus nemorum (Fabricius), 1805



History: added to the Irish list by Speight *et al* (1975). Anderson (1985) published an additional record based on a sighting in 1984. But at that time the presence of *X.abiens* Mg. in Ireland was not known and frequently specimens of these two species cannot be reliably distinguished in the field. Similarly, it can be difficult to distinguish *C.nemorum* and *X.jakutorum* in the field. Records of *C.nemorum* based on sightings not backed by microscopic examination are thus unreliable.

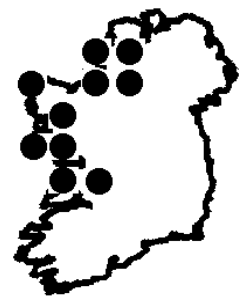
Ecology: in Ireland, this fly is closely associated with stands of small willow (*Salix*) species that include fallen and rotting trunks and branches, along the banks of lakes, streams and rivers, which is also typical habitat for *C.nemorum* elsewhere in Europe. The secretive habits of the adult fly render it easily overlooked and it may be somewhat under-recorded in consequence. But it is very susceptible to capture by Malaise traps, which can be relied upon to demonstrate the species' presence where it occurs.

Range, distribution and status: the distribution of *C.nemorum* in Ireland is centred on the midlands, with few records from elsewhere. Where it does occur the species is by no means abundant, most records being of few individuals occurring within very circumscribed areas. There is no basis for categorising *C.nemorum* as threatened in Ireland. This species is unusual among saproxylic syrphids, in that it has an extremely large world range, being found throughout Eurasia from the Atlantic to the Pacific and also from coast to coast in N America.

Irish reference specimens: in the collections of NMI and UM.

Genus *CHEILOSIA*

Cheilosia ahenea von Roser, 1840



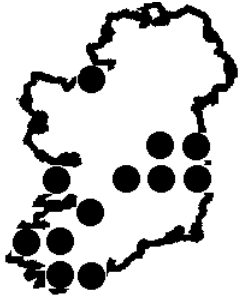
History: added to the Irish list by Speight (1978b) as *C.laskai*. The synonymy of this species was subsequently established by Speight and Claussen (1987). Additional Irish records have been published by Nelson (1988).

Ecology: This species occurs in Ireland in low-lying parts of the karst limestone areas, where it is found mostly in open, sparsely-vegetated, unimproved permanent pasture on limestone pavement. It occurs also on the landward side of the calcium-rich machair dune systems on the west coast, again in low-lying, unimproved, permanent pasture. The only other situation in which *C.ahenea* has been found in Ireland is in association with outcropping limestone on the grazed shores of L.Conn (Mayo). Potential plant hosts are discussed by Speight and Claussen (1987), but plants actually used as a food supply by the larvae remain unknown. The apparent linkage between calcareous sites and this syrphid in Ireland might well be due to the availability of only one appropriate foodplant here, since no such linkage is evident in the central Europe, where *C.ahenea* can also be found in non-calcareous, unimproved, montane grassland. In the Alps it occurs from the montane zone up into subalpine grassland. The link with unimproved, permanent pasture seems strong for this species everywhere and its plant hosts must be presumed susceptible to eradication by reseeding and fertilisation of grassland, and to practices of alternation of pasturage with crop production (and hence to cultivation of the soil).

Range, distribution and status: known in Ireland only from limestone pavement and machair systems from Co.Clare to Co.Donegal. Where found, this species is often abundant, especially in low-lying parts of the Burren which have not been subject to "improvement", i.e. bulldozing of loose surface rock into heaps and reseeding of the exposed soil, or fertilisation. It does seem extremely sensitive to grassland improvement and is also absent from machairs that have been subject to overgrazing. These are presumably indirect effects, mediated by adverse impacts upon its larval host plant. *C.ahenea* has recently (Parker, 2001) been found in a calcareous dune system on an island (Islay) off the coast of western Scotland, and subsequently in a few other sites in Britain. It is not known in the low countries and Scandinavia. The closest known continental records are from c.1000m in the Vosges mountains in north-east France. It can be hypothesised that *C.ahenea* is a survivor of early post-glacial colonisation of Ireland by cool-climate species, a process which ceased with further climatic amelioration. It is not currently under threat here, but is liable to remain dependent for its survival on protection of its habitat from agricultural improvement, or any other use of land which involved application of fertiliser or vegetation change (including introduction of such facilities as golf courses).

Irish reference specimens: in the collections of NMI and UM.

Cheilosia albipila (Meigen), 1838



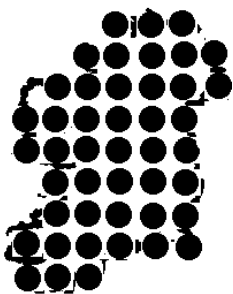
History: given as occurring in Ireland in Coe (1953).

Ecology: nearly all Irish records of this insect are from some sort of woodland, or woodland edge, either close to water or in poorly-drained situations. There are virtually no Irish records from pasturage. Rotheray (1991) notes that in comparison with the larvae of other *Cheilosia* species he reared from *C.palustre* in Scottish pastures he found very few *C.albipila* larvae. These facts suggest some other *Cirsium* species may well be the preferred host for *C.albipila*, at least in Ireland and Scotland. From the situations in which the adult fly occurs this could be *C.dissectum*. Alternatively, *C.albipila* may exploit *C.palustre* only when the plant is under conditions of physiological stress, such as when it is in a sub-optimal environment. Certainly, until the larval biology of this insect is better known, why it is apparently absent from situations in which its supposed foodplant is most abundant is likely to remain a mystery.

Range, distribution and status: almost all Irish records of this insect are from the southern half of the island. Climate may play a role here, since in Scandinavia *C.albipila* only reaches the southern tip of Norway (Nielsen, 1999). This syrphid is certainly infrequent in Ireland, but cannot be regarded as threatened here. It is a reasonably frequent species in Atlantic parts of Europe in general, but becomes much more localised in central Europe and is not recorded from the Mediterranean zone. However, its range does extend eastwards from Europe far into Siberia, making it one of the more wide-ranging of the plant-feeding syrphids found in Ireland.

Irish reference specimens: in the collections of NMI and UM.

Cheilosia albitarsis (Meigen), 1822 sensu Doczkal, 2000



History: given as occurring in Ireland in Coe (1953).

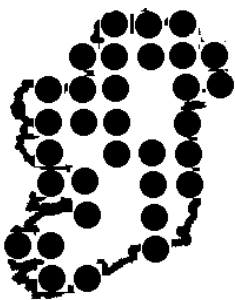
Ecology: In Ireland, *C.albitarsis* is abundant in poorly-drained pasture, where its foodplant also abounds. It is a characteristic species of the standard Irish farmland landscape of green fields plus

hedges, where the fields are used for pasturage. But it does not persist in cropland. It may be found also along tracks and in clearings in deciduous woods and conifer plantations. Rotheray (1991) unfortunately does not note what *Ranunculus* species acted as host for the *C.albitarsis* larvae he reared, but from the range of situations in which *C.albitarsis* occurs it would be very likely that this hoverfly can exploit more than one *Ranunculus* species. Even so, *C.albitarsis* is not a suburban insect, despite the frequency of some *Ranunculus* species in gardens and urban waste ground and either a poorly-drained ground surface or a woodland micro-climate seem necessary for its success. *C.albitarsis* is strongly anthropophilic in Ireland, and likely to remain so for as long as fields are used for livestock grazing here.

Range, distribution and status: in Ireland, *C.albitarsis* is the most frequent and generally distributed of the plant feeding syrphid species and has to be categorised as common. It ranges widely over Europe in general, though becoming localised in the Mediterranean zone. It occurs across the Palaearctic Region to the Pacific and is the only European *Cheilosia* species to supposedly occur also in N America. The closely related *C.ranunculi* does not seem to occur in Ireland and, until and unless its presence is demonstrated, Irish females of *C.albitarsis/ranunculi* can be assumed to belong to *C.albitarsis*.

Irish reference specimens: in the collections of NMI and UM.

Cheilosia antiqua (Meigen), 1822



History: given as occurring in Ireland in Coe (1953).

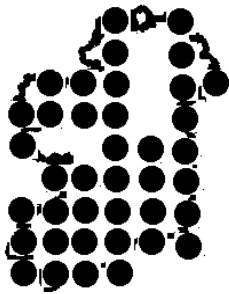
Ecology: the range of situations in which this fly occurs in Ireland is entirely consistent with its larval food requirements, its plant hosts being various species of *Primula*. It is noticeable that although *C.antiqua* is frequent to beyond 1000m in calcareous parts of the Alps, where *Primula* species are also found, this hoverfly does not occur away from low altitudes in Ireland, *Primula* generally being very scarce away from the lowlands in Ireland. Rotheray (1991) does not record which *Primula* species he reared *C.antiqua* from in Scotland, but in Ireland *P.veris* and *P.vulgaris* are very probably both used, accounting for the occurrence of *C.antiqua* in both deciduous woods and permanent pasture here. Improvement of grassland is no more favourable to *C.antiqua* than to *Primula* species and this hoverfly is now much less frequent in grassland in Ireland than previously. Indeed, it is now unusual to find *C.antiqua* in the standard farmland landscape of green fields and hedges.

Range, distribution and status: although widely distributed, *C.antiqua* is becoming progressively confined to deciduous woodland situations in Ireland, away from the unimproved limestone

pavement grasslands protected in the Burren. It is by no means threatened here, but certainly decreasing. It is widely distributed in most of the Atlantic zone of Europe, but more localised in central Europe, where it is mostly a montane insect. *C.antiqua* is endemic to Europe.

Irish reference specimens: in the collections of NMI and UM.

Cheilosia bergenstammi Becker, 1894



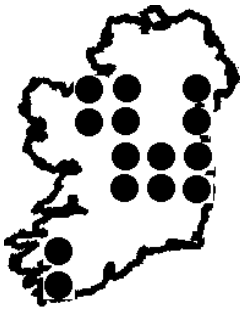
History: given as occurring in Ireland in Coe (1953).

Ecology: the general distribution of this insect in Ireland and its occurrence in a range of open-country situations here, can reasonably be regarded as a reflection of the predominance of domestic stock in the island's farming regimes. If there is significant change in animal husbandry practices, which resulted, for instance, in animals being kept most of the time indoors and fed mechanically cut grass etc., *C.bergenstammi* might be expected to become much scarcer, since its larval host plant, *Senecio*, would not be so favoured by such a system. The extent to which larvae of *C.bergenstammi* can utilise species other than *S.jacobaea* as hosts is unknown, but use of other *Senecio* species would seem quite likely. At present, *C.bergenstammi* can be regarded as a predominantly anthropophilic species in Ireland, occurring in the standard farmland landscape of green fields and hedges.

Range, distribution and status: herbicidal control of ragwort (*Senecio jacobaea*), now a common farming practice, removes the most abundant food source for the larvae of *C.bergenstammi* and, although this syrphid is still generally distributed in Ireland, it is largely absent from intensively used grassland. The trend towards general intensification of use of farmland in Ireland may now be decreasing, but while it persists an accompanying decrease in the frequency of occurrence of *C.bergenstammi* can only be expected. This species remains widely distributed in Atlantic parts of Europe, but in central Europe is mostly a species of montane/alpine grassland. This syrphid appears to be endemic to Europe.

Irish reference specimens: in the collections of NMI and UM.

Cheilosia chrysocoma (Meigen), 1822



History: given as occurring in Ireland in Coe (1953).

Ecology: in continental Europe this species is characteristic of alluvial softwood forest, with *Salix alba* and *S.viminalis* - a biotope almost entirely missing in Ireland. Irish localities for *C.chrysocoma* are nonetheless mostly scrub *Salix* woodland in swampy situations beside standing or running water. It is tempting to suggest the larval foodplant may be some large umbellifer or composite occurring in such situations, but until the larval host plant is identified it will remain difficult to characterise the habitat needs of this species more precisely. *C.chrysocoma* does not occur in the standard farmland landscape of green fields and hedges, or in conifer plantations, suburban gardens or parks. It is thus a strongly anthropophobic insect in today's Ireland.

Range, distribution and status: *C.chrysocoma* is an infrequent species in Ireland, but not as yet threatened. This species is not compatible with general land surface drainage, so current trends in intensification of use of farmland can be expected to lead to its decrease. It occurs widely but infrequently over much of Europe and into Siberia.

Irish reference specimens: in the collections of NMI and UM.

Cheilosia fraterna (Meigen), 1830

History: added to the Irish list by Speight *et al* (1975). The single specimen mentioned in Speight *et al* (1975) cannot be re-located and the Irish specimen subsequently recorded in Nash and Speight (1976) has proved to be misidentified. There have been no further records of *C.fraterna* from Ireland.

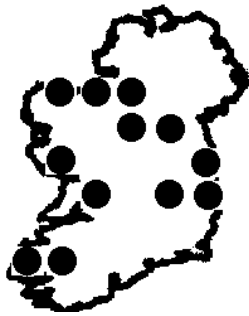
Ecology: *C.fraterna* is characteristically encountered alongside rivers and streams, in unimproved grassland or open areas in deciduous forest. It has been reared in Scotland from *Cirsium palustre*, a host plant widely distributed and common in Ireland and the adult feeds from flowers equally generally available. Indeed, there seems no obvious ecological explanation for the apparent absence of *C.fraterna* from Ireland. That, together with the few existing doubtful Irish records, makes the situation of this species something of a mystery in Ireland. If it were present, the expectation would be for records to be reasonably frequent and widely scattered through the island. Its wide distribution in continental Europe, together with the fact that it is known from the Scottish Highlands to the south coast of England in Great Britain, demonstrate that this hoverfly has a wide ecological tolerance. It is not a species known to migrate, but the narrow strait of sea

water between Scotland and Northern Ireland, in particular, should not represent an insuperable obstacle to colonisation of Ireland by this fly.

Range, distribution and status: the status of *C.fraterna* as an Irish insect must be regarded as doubtful and requiring confirmation. Until and unless the presence of this species in Ireland can be verified there is no adequate basis for including it on the Irish list.

Irish reference specimens: none known.

Cheilosia grossa (Fallen), 1817



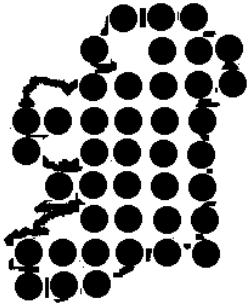
History: given as occurring in Ireland in Coe (1953).

Ecology: the distribution and frequency of *C.grossa* do not reflect the ubiquity and abundance in Ireland of the known larval host plants. Whatever ecological factors determine the success of *C.grossa*, superficially at least it would seem very unlikely that availability of larval food supply - various thistles, notably *Carduus* and *Cirsium* spp.- is one of them. However, most plants have defences against being consumed and it remains possible that *C.grossa* is unable to use more than a small proportion of the population of apparent appropriate plant hosts because of their physiological condition - i.e. perhaps *C.grossa* requires plants in poor condition if its larvae are to gain access. The potential of *C.grossa* to act as an agent of biological control of thistles has been investigated (Rizza *et al*, 1988), but this does not seem to have led to any explanation for the disparity between the distribution and numbers of *C.grossa* and of its potential plant hosts. In Ireland, the adults of *C.grossa* are most frequently encountered in woodland or scrub-invaded pasture situations, where the larval host plants may not be particularly obvious and it is possible that availability of early-blooming flowers required by the adults is to some extent dictating where this hoverfly can maintain populations.

Range, distribution and status: *C.grossa* is sparsely, but widely, recorded in Ireland. It is not threatened in Ireland, and unlikely to become threatened while thistles are omnipresent in the countryside. It is widely distributed in continental Europe, though records are few, and extends beyond Europe into Siberia and south east as far as northern India. This species is probably to some extent under-recorded everywhere, due to its early flight season.

Irish reference specimens: in the collections of NMI and UM.

Cheilosia illustrata (Harris), 1776



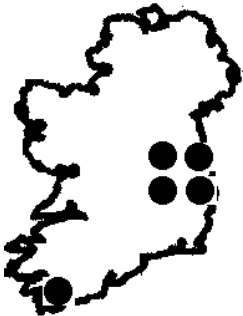
History: given as occurring in Ireland in Coe (1953).

Ecology: There are no obvious differences between the general ecology of this species in Ireland and elsewhere. Its frequency in Ireland reflects that of one of its known plant hosts, *Heracleum*. Open areas and tracksides in humid deciduous forest up to the altitude of natural *Picea* forests would be typical for this species in Europe. It can also occur in the standard farmland landscape of green fields and hedges, not infrequently persisting along field margins or road verges, making it to a significant extent an anthropophilic species.

Range, distribution and status: in Ireland, this is one of the most generally distributed and common *Cheilosia* species. It is also very frequent in adjacent parts of the continent and occurs widely in Europe in general. However, it is endemic to Europe.

Irish reference specimens: in the collections of NMI and UM.

Cheilosia impressa Loew, 1840



History: given as occurring in Ireland in Coe (1953).

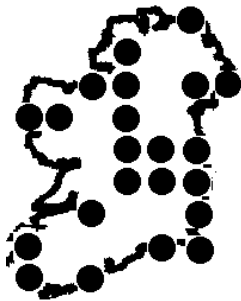
Ecology: as is the case with a number of other *Cheilosia* species, *C.impressa* occurs in rather different biotopes. In Ireland it is to be found in fen in parts of the midlands, and in the south-west it turns up in deciduous woodland. Its other haunt in Atlantic parts of Europe is chalk grassland, in which it may be found in southern England, while in the Alps it occurs up to the level of subalpine grassland. The explanation for the unlikely combination of environmental preferences exhibited by *C.impressa* is almost certainly to be found in the host plants used by the larvae. But this will remain conjecture until the host plants are better known. At present, its only definite foodplant is *Arctium*, which certainly doesn't occur in all of the habitats where *C.impressa* is found.

In Ireland, *C. impressa* appears to be only partially divoltine. Further south, in parts of the Atlantic zone and in central Europe the second generation is more pronounced.

Range, distribution and status: most Irish records are from a relatively small area in the east of the island, but within that relatively small area the species is frequently encountered and cannot be regarded as under threat in Ireland. It occurs in large numbers at Pollardstown fen (Kildare). In continental Europe it is both widespread and frequent over much of the continent, though it does not reach further north than the southern edge of Scandinavia. Eastwards it is found through Eurasia to the Pacific, making it one of the most widely ranging *Cheilosia* species occurring in Ireland.

Irish reference specimens: in the collections of NMI and UM.

Cheilosia latifrons (Zetterstedt), 1843



History: given as occurring in Ireland in Coe (1953), under the name *C. intonsa*. The two segregates into which this taxon is subdivided by British authors could both be recognised among Irish material. However, the lack of consistent morphological differences between these segregates renders them of doubtful taxonomic significance, and they are not employed here. If genetics work could be carried out on the *latifrons* complex, perhaps the number of taxa involved would become clearer.

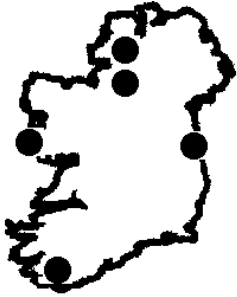
Ecology: In Ireland, as elsewhere in Atlantic parts of Europe, this insect occurs in a number of rather different situations, but is far from ubiquitous. Its ecological amplitude would certainly imply that *C. latifrons* could be a polyphyletic entity. Irish localities from which *C. latifrons* has been recorded are mostly unimproved, poorly-drained pasture, whether edging midland bogs or in coastal dune systems or on the karst limestone. Discovery of the larval host plant(s) would be very helpful in understanding the ecology of this species – there is some evidence to suggest that one plant host may be *Leontodon autumnalis*, though this association is yet to be confirmed. The use of *Plantago* and *Luzula* flowers by the adults could also have some bearing on the distribution of *C. latifrons*, if the female is to any extent dependent upon the pollen of these plants as a protein source for egg maturation. These plants are not generally visited by other *Cheilosia* species. *C. latifrons* does not persist in improved or intensively-used grassland, and so is absent from the standard farmland landscape of green fields and hedges. It is a largely anthropophobic species, absent not only from improved grassland, but also from conifer plantations, gardens and parks.

Range, distribution and status: in all probability, *C. latifrons* was much more frequent in Ireland prior to the phase of grassland improvement, which has all-but eradicated the primary habitat for

C.latoifrons over considerable areas. However, data are inadequate to either prove or disprove this hypothesis. Today, *C.latifrons* occurs in most parts of the island, but is by no means frequent. It would not be regarded as under threat either in Ireland or elsewhere. It occurs widely in Europe, its range extending eastwards into Asiatic parts of Siberia.

Irish reference specimens: in the collections of NMI and UM.

Cheilosia longula (Zetterstedt), 1838



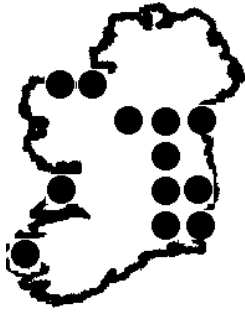
History: given as occurring in Ireland in Coe (1953).

Ecology: *C.longula* is associated primarily with fungi of coniferous forests. The paucity of Irish records may be indicative of the youth of Irish conifer plantations and their lack of continuity with the original indigenous *Pinus sylvestris* forests, which has led to virtual absence of associated large basidiomycetes. Records from elsewhere suggest *C.longula* may also use fungi of ericaceous shrubs as larval food, and survival of *C.longula* in Ireland may have been dependent upon this food source. The character of Irish localities from which the species is recorded would lend support to this view - certainly there is little indication of its occurrence in association with stands of conifers in Ireland.

Range, distribution and status: while they are nearly all from western parts of the island, the Irish records of this species are also very few and widely scattered, from Donegal to Cork, presenting a distribution pattern which suggests that *C.longula* should be regarded as a relictual species in Ireland and categorised as threatened here. *C.longula* seems to be markedly less frequent in Ireland than anywhere else along the whole of Europe's Atlantic seaboard from northern Scandinavia to northern France. This is a syrphid with a very extensive range, occurring as it does from the Atlantic through Europe and most of Siberia almost to the Pacific.

Irish reference specimens: in the collections of NMI.

Cheilosia nebulosa Verrall, 1871



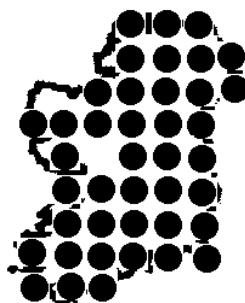
History: given as occurring in Ireland in Coe (1953).

Ecology: the sort of poorly-drained *Salix* woodland and poorly-drained, scrub-invaded, unimproved pasture frequented by this species in Ireland is extremely scarce over most of western Europe, where *C.nebulosa* is correspondingly scarce. In central Europe it is primarily a montane to sub-alpine species. Whatever the larval host plant may be it is evidently not able to survive modern farming practice, to judge from the total absence of *C.nebulosa* from all forms of improved farmland. Similarly, *C.nebulosa* is absent from managed woodland and conifer plantations, except in a few cases where attempts at site drainage have failed. It has to be regarded as a markedly anthropophobic syrphid in Ireland.

Range, distribution and status: it is difficult to envisage "environmentally-friendly" farm or forestry practices which might lead to increase in the frequency of this insect. In Ireland, it would seem to be a species condemned to suffer progressive contraction in range and abundance until it occurs almost only in protected sites of one sort or another. The scattered records indicate that this species has occurred over most of the island, though the main block of records is centred on eastern parts of the midlands. *C.nebulosa* may not as yet be endangered here, but could, with justification, be classified as vulnerable in Ireland, due to the progressive land drainage still occurring as part of intensification of farming activities, peat exploitation and expansion of forestry.

Irish reference specimens: in the collections of NMI and UM.

Cheilosia pagana (Meigen), 1822



History: given as occurring in Ireland in Coe (1953).

Ecology: this is a species of unimproved, humid grassland and open areas in various sorts of deciduous forest. There are no obvious differences between the general ecology of this species in

Ireland and elsewhere. Use of such a widespread and common umbel as *Anthriscus* as a larval foodplant makes *C.pagana* an almost ubiquitous countryside hedgerow insect here. Further, emergence trap results strongly suggest *C.pagana* also uses both *Heracleum* and *Angelica* as larval host-plants. Use of these plants as larval food would be consistent with the widespread occurrence of *C.pagana* in the standard farmland landscape of green fields and hedges. Altogether, *C.pagana* can be regarded as a significantly anthropophilic insect.

Range, distribution and status: in Ireland *C.pagana* is one of the most common and widely distributed of hoverfly species with plant-feeding larvae. It is also widely distributed and very frequent over much of Europe, from northern Scandinavia almost to the Mediterranean and ranges widely beyond Europe in Siberia, almost reaching the Pacific.

Irish reference specimens: in the collections of NMI and UM.

Cheilosia psilophthalma Becker, 1894



History: added to the Irish list by Speight (1978c), under the name *praecox* (Zetterstedt). The known Irish material of *C.praecox* was reviewed by Speight (1996b), resulting in withdrawal of *praecox* from the Irish list and recognition of all Irish specimens as belonging to *C.psilophthalma*.

Ecology: until recently, this species has been totally confused with *C.urbana* (Meigen) in literature. As yet, insufficient is known of *C.psilophthalma* for difference between its ecology in Ireland and elsewhere to have become apparent. To some extent, the paucity of Irish records must reflect the species' early flight period, but its apparent association with unimproved, reasonably well-drained, oligotrophic, low altitude grassland and scrub also requires to be taken into consideration in considering its status, given the scarcity of this habitat in Ireland. The larvae are known to develop in the aerial parts of *Hieracium pilosella* and *H.caespitosum*. It remains an enigmatic species, not least because all Irish records are based on single specimens. It is a pronouncedly anthropophobic insect in Ireland, entirely absent from the standard farmland landscape of green fields and hedges, from conifer plantations and from suburban gardens and parks.

Range, distribution and status: the few Irish records of *C.psilophthalma* are from the southern half of the island. It has to be regarded as threatened here and would be a candidate for inclusion in any national list of Irish insects requiring protection. Elsewhere in the Atlantic zone of Europe it was until recently only known from the Netherlands, but a few scattered localities are also now known for the species in Britain. In central Europe this species becomes more frequent in the Alps, along the tree line in unimproved alpine grassland. It appears to be endemic to Europe.

Irish reference specimens: in the collections of NMI.

Cheilosia pubera (Zetterstedt), 1838



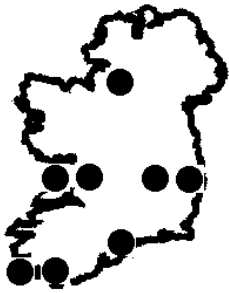
History: added to the Irish list by Speight *et al* (1975). Nash and Speight (1976) cite further records of *C.pubera* from the locality given in Speight *et al* (1975).

Ecology: in the Alps this is primarily a species occurring close to water in open areas within *Picea* forest from 700m to 1000m, though records range from 400m to 2000m. Records from alpine pasture at higher altitudes are often due to confusion with the closely similar *C.grisella*. In the West of Ireland the altitudinal range from sea level to 400m appears to be roughly equivalent, faunistically, to the 700-1000m range in the Alps, but *Picea* is not native to Ireland and any indigenous forest which was present has been almost completely eradicated, and has entirely vanished from above 250m. Under these circumstances, it is perhaps surprising *C.pubera* has survived in Ireland at all. The record from totally treeless montane slopes in Sligo, rather than being regarded as an anomaly, could be interpreted as an indication that *C.pubera* has persisted here in its montane environment despite forest loss, since the species can occur in similar open situations elsewhere. Its occurrence in thick fen carr by L.Neagh, at Masserene, has no parallels in central Europe, but does mirror lowland records from Britain. These rather curious habitat details would presumably become more comprehensible were the larval food plant(s) to become more certainly known – one of them is supposedly *Caltha*, but nothing definitive has been published to confirm this.

Range, distribution and status: occurrence of this species in Ireland would be expected to be restricted to the north and west, with perhaps additional records from mountainous country elsewhere in the island, given what is known of its general ecology. It's primary association with forested biotopes would render it scarce in Ireland at all altitudes today, due to loss of forest cover during the historic period and the widespread and intensive overgrazing by sheep, to which all montane environments have been subject in Ireland recently, would ensure that montane populations of this hoverfly occurring away from forest are now also under extreme threat. The fact that *C.pubera* has been recorded from only two Irish stations so far is thus very probably a reasonable reflection of its status in Ireland. Also, the factors most likely to have led to the scarcity of this species here are still operating, so it should be regarded as threatened in Ireland and as an appropriate candidate for inclusion on lists of species requiring protection in the island.

Irish reference specimens: in the collections of UM.

Cheilosia scutellata (Fallen), 1817



History: given as occurring in Ireland in Coe (1953).

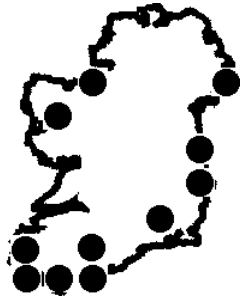
Ecology: *C. scutellata* is primarily a forest insect, occurring with a wide range of humid forest types, both deciduous and coniferous and there is no indication that the ecology of this species in Ireland differs from what is observed elsewhere. The scattered records are from mature deciduous or mixed woods at low altitude.

Range, distribution and status: in the Atlantic zone of Europe, this is a common and very widespread species, normally found almost anywhere there is woodland of deciduous trees or pine. However, *C. scutellata* does not seem to have any clear association with birch or ash woods, or with *Picea*, which may account for, at least in part, the paucity of Irish records, though it does not entirely explain the lack of records from conifer plantations in Ireland. It is not known which large basidiomycetes are used by *C. scutellata* larvae (the larvae mine the tissues of the fungal fruiting bodies) in Ireland, but the general scarcity of the fruiting bodies of these fungi in Irish woods is all too apparent to anyone who embarks on autumnal fungus forays! Elsewhere in Europe, this insect is usually found in large numbers at localities it frequents. In Ireland, it is unusual to encounter more than one or two specimens. This presumably reflects the lack of old deciduous woods here, it being in ancient woodland that large basidiomycetes are most in evidence. The extensive tracts of conifer plantation introduced to the Irish landscape during the present century include significant quantities of *Pinus* but *C. scutellata* does not seem to frequent them. Even though in many cases these introduced conifers are located on sites where the indigenous deciduous woodland was felled to make way for them, *C. scutellata* remains unrecorded there. Presumably the fungus flora of the original woods has largely been eradicated along with the trees on which the fungi were dependent. Similarly, present-day conifer plantation management, aimed at producing a rapid turnover of forest product and based on clear-felling of large patches of trees at harvesting, does not lend itself to a build-up of basidiomycete populations. Essentially then, *C. scutellata* can reasonably be viewed as a casualty of forest stripping in Ireland, whose status cannot be expected to improve along with increase in the hectareage of plantations of introduced conifers here. Conversely, although by no means common, it is not recorded so infrequently as to yet be regarded as under direct threat. But there is no basis for concluding that the present situation is stable. If, as seems to be the case, *C. scutellata* does not inhabit *Betula* or *Fraxinus* woods and will be unable to utilise plantations of introduced conifers at least until they have been in situ for some hundreds of years, then the resource base upon which it is dependent in Ireland is oak woodland, planted beech woods and old pine plantations, all of which continue to dwindle. If this analysis of the interplay of factors affecting *C. scutellata* is largely correct, then it can be expected that this insect

will become increasingly scarce and progressively dependent for its survival upon protected sites containing oak woods. It should probably be regarded as vulnerable here.

Irish reference specimens: in the collections of NMI and UM.

Cheilosia semifasciata Becker, 1894



History: added to the Irish list by Speight *et al* (1975).

Ecology: in continental Europe this species occurs in at least three very different habitats: humid oak/hornbeam forest, subalpine grassland and old walls/cliffs. And it also reaches very high population densities along the edges of the cycle tracks in the leafy suburbs of towns and cities in central Germany! In its suburban existence, *C.semifasciata* makes use of *Sedum* as a larval foodplant, a plant which it also inhabits in the subalpine zone. On old walls and cliffs it uses *Sedum* or *Umbilicus*. Its plant host in deciduous forest is uncertain. Wherever this species is found in Ireland, close inspection of the site nearly always reveals the presence of either *Sedum* or *Umbilicus* in the immediate vicinity of the adult flies. The rare exceptions involve the fly occurring with large stands of *Allium ursinum*. The use of *Umbilicus* as a larval foodplant is well-established, but no clear association has been demonstrated with *Allium*. Another continental European *Cheilosia* species, *C.fasciata*, is a leaf miner of *Allium ursinum*, so there is some possibility that *C.semifasciata* might, on occasion, exploit the same plant. However, no direct observations of this exploitation have yet been obtained. If *C.semifasciata* larvae were using *A.ursinum*, evidence of leaf/stem mining would be expected. The most widely distributed habitat for *Umbilicus* in Ireland is old stone walls and *C.semifasciata* may be found in association with the plant in such situations, though the plant host is clearly more frequent than the fly. Where *Umbilicus* occurs on cliffs and scree slopes the fly may also be found, but normally only in sheltered spots.

Range, distribution and status: the Irish records for this species are scattered round the island at low altitude and usually not far from the coast - though none are from coastal sites. The species is not frequent, but neither can it be regarded as under threat here. It is endemic to Europe, but not to any one part of the continent, occurring widely but not frequently.

Irish reference specimens: in the collections of NMI.

Cheilosia uviformis Becker, 1894



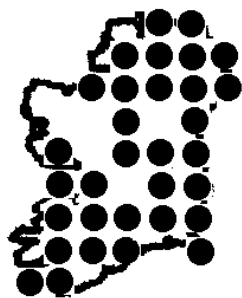
History: added to Irish list by Speight (1986b), as *C. argentifrons*.

Ecology: there are but two sites from which *C. uviformis* has been recorded in Ireland, but it has been found repeatedly at one of them (Ballynafid lake, Co. Westmeath). That site is very wet *Salix* carr, interrupted by small glades covered in *Molinia*, patches of scraw and pools, along the edge of a lake. The second Irish site has similar fascies, except in that there is no scraw, the *Salix* woodland there edging a lake with noticeably fluctuating water level. In Britain the species is also associated with the wooded shores of lakes with noticeably fluctuating water levels. In addition, in continental Europe the species is known from alluvial hardwood forest.

Range, distribution and status: *C. uviformis* has to be regarded as threatened - and probably endangered - in Ireland and is a candidate species for inclusion on national lists of insects requiring protection. Although it is recorded from Britain, Denmark, the Netherlands and Belgium, it is regarded as under threat in all of these parts of Europe's Atlantic seaboard. It is not known in Atlantic parts of France. In central Europe, this insect becomes more frequent in humid forest at moderate altitude in the prealps. It is endemic to Europe, but occurs over a wide band from Denmark to Belgium through mountainous parts of central Europe to mountain ranges in the former Yugoslavia.

Irish reference specimens: in the collections of NMI.

Cheilosia variabilis (Panzer), 1798



History: given as occurring in Ireland in Coe (1953).

Ecology: the pattern of occurrence of this species in Ireland co-incides with what might be expected from elsewhere - *C. variabilis* occurs in deciduous woodland here, and the adults are encountered along the edges of tracks and clearings, on marginal vegetation. The known food plant of the larvae of this species, *Scrophularia nodosa*, is by no means a prominent component of

the flora of all sites at which *C.variabilis* occurs and it seems likely that this hoverfly also uses other plant hosts, as yet unknown. However, *C.variabilis* occurs neither in the standard farmland landscape of green fields plus hedges, nor in conifer plantations, suburban gardens or parks. It has thus to be regarded as an anthropophobic insect in Ireland and is probably the most frequent species consigned to this category.

Range, distribution and status: in Ireland, this is one of the most frequent and widely distributed of *Cheilosia* species, and has to be categorised as common. It is widely distributed and frequent in much of Europe and extends beyond Europe into Asiatic parts of Siberia.

Irish reference specimens: in the collections of NMI and UM.

Cheilosia velutina Loew, 1840



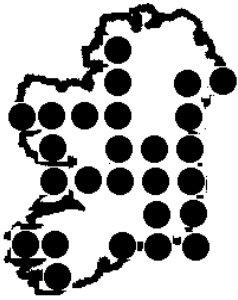
History: given as occurring in Ireland in Coe (1953).

Ecology: There are insufficient Irish records of this species for its habitats in the island to be readily defined. The record from Ballyteige, in Wexford, would accord reasonably well continental records from well-drained, unimproved pasture, usually on sandy soil. The other Irish record is from *Betula* scrub at the edge of drained valley bog exploited for peat extraction and is most unusual.

Range, distribution and status: there are but two records of *C.velutina* from Ireland during the 20th century, both from the southern half of the island, and the species has to be regarded as endangered here. It would be a candidate for inclusion in any national list of insects requiring protection. In other parts of western and central Europe, this species varies from infrequent to threatened, but it is widely distributed and its range extends through Eurasia from the Atlantic to the Pacific.

Irish reference specimens: in the collections of NMI.

Cheilosia vernalis (Fallen), 1817



History: given as occurring in Ireland in Coe (1953).

Ecology: This species occurs in a number of different ecosystem types in Ireland, as elsewhere in Europe. It also exhibits a wider range of phenotypic variation than is characteristic for related species, giving rise to speculation that it may be a mixture of two or more species. However, repeated attempts at subdividing *C. vernalis* have so far been unsuccessful, and on the basis of available information it would seem that, in Ireland at least, only one species is involved. Here, it occurs in coastal dune systems, unimproved grassland and in grassy open areas in deciduous woodland. It occurs on both well-drained sites and under conditions of poor site drainage, though it is not usually found in the karst limestone grassland of the Burren, for instance. It is one species characteristic of winter-flooded *Molinia* grassland, at sheltered locations. There it may be met with very early in the year and these early specimens are usually rather large, pale-haired and with pale antennae - seemingly very different from the standard summer brood individuals.

Range, distribution and status: as at present defined, *C. vernalis* is widely distributed and not uncommon in Ireland. But if it is demonstrated that the variability of this species masks the existence of more than one valid taxon, the status of *C. vernalis* in Ireland would require re-assessment. This is another *Cheilosia* species that is very generally distributed both in Europe and in Asiatic parts of the Palaearctic region.

Irish reference specimens: in the collections of NMI and UM.

Cheilosia vicina (Zetterstedt), 1849



History: added to the Irish list by Speight (1986a), under the name *C. nasutula*.

Ecology: *C. vicina* is a species of open areas in the upper levels of montane zone forests and higher altitudes, up into unimproved, calcareous and non-calcareous, subalpine grassland. Larval

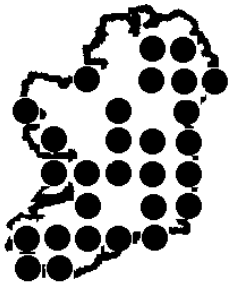
development is believed to occur in *Alchemilla*. It is difficult to see why there should be so few Irish records of this species, unless the almost universal overgrazing of potential habitat in Ireland is responsible. *C.vicina* is widespread and frequent in Scotland.

Range, distribution and status: there is only one known locality for *C.vicina* in Ireland, on the flanks of the calcareous massif of Ben Bulbin, and the species has to be regarded as endangered here. It would be a candidate for inclusion in any national list of insects requiring protection in Ireland.

Irish reference specimens: in the collections of NMI.

Genus *CHRYSOGASTER*

Chrysogaster coemiteriorum (L.), 1758



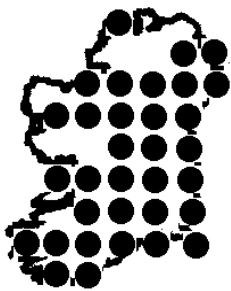
History: given as occurring in Ireland in Coe (1953).

Ecology: In Ireland this is a low-altitude species associated particularly with fens and the lagg edge of raised bogs, the small fens developing between the lagg edge and adjacent esker ridges being especially characteristic locations for it. *C.coemiteriorum* does not seem adversely affected by traditional peat-cutting along the lagg edge, which is almost universal round Irish raised bogs, but drainage, with concomitant “improvement” by reseeded and fertilisation of the surrounding grassland, leads to its disappearance. The species occurs also along rivers, both where there is a fenny margin and where patchy, poorly-drained, scrub deciduous woodland borders the water.

Range, distribution and status: scattered records from most parts of the island, but most frequent in the Midlands. This species is greatly affected by land-drainage schemes, which have resulted in significant and progressive loss of habitat, to such an extent that this syrphid has to be regarded as vulnerable in Ireland, given that this drainage process has not yet ceased. *C.coemiteriorum* is in a similar situation in Belgium, France, Germany and the Netherlands, though it cannot be regarded as threatened at European level. Although it reaches the southern edge of Scandinavia it appears to meet climatic limitations to its range there, and remains unrecorded from the extensive Scandinavian mire systems.

Irish reference specimens: in the collections of NMI and UM.

Chrysogaster solstitialis (Fallen), 1817



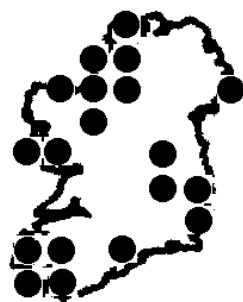
History: given as occurring in Ireland in Coe (1953).

Ecology: essentially an insect of stream-side *Quercus* woods and fen in Ireland, *C.solstitialis* may also be found here beside lowland rivers and streams in more open conditions, where a certain amount of *Salix* scrub lines the banks and the hinterland is poorly-drained. It does not occur in association with the more acid conditions of bog. It is very much a species of riparian gallery forest, especially along streams. Where a strip of deciduous woodland vegetation has been left along streams, it may also occur in conifer plantations, but is not otherwise found with conifers. It is not a constituent of the syrphid fauna of the standard Irish farmland landscape, of green fields and hedges. Neither does it occur in suburban gardens or parks.

Range, distribution and status: generally distributed and frequent in Ireland and most other parts of Europe's Atlantic seaboard, *C.solstitialis* is the most often met with European *Chrysogaster* species. Even so, it does not extend northwards further than the southern edge of Scandinavia and becomes very localised in central Europe. It is more frequent in mountainous parts of southern Europe, extending eastwards to the Caucasus and round the Mediterranean into north Africa.

Irish reference specimens: in the collections of NMI and UM.

Chrysogaster virescens Loew, 1854



History: given as occurring in Ireland in Coe (1953).

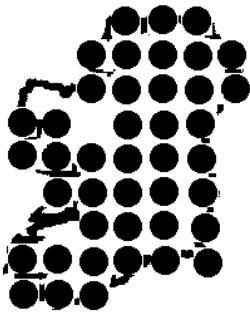
Ecology: this is a deciduous forest species, associated with streams and flushes in woodland. Most Irish records of this insect are from alongside streams flowing through poorly-drained, scrub-invaded pasture. Other records are from beside streams in *Quercus* woods, or from scrub and pasture beside lakes. *C.virescens* is a rather enigmatic species in that only isolated specimens are usually met with.

Range, distribution and status: *C.virescens* is not infrequent in Ireland, especially in the west. It is endemic to Europe and probably has a more restricted world range than any other syrphid known in Ireland – it is archetypally a species of Atlantic parts of Europe, hardly recorded away from the Atlantic zone.

Irish reference specimens: in the collections of NMI and UM.

Genus *CHRYSOTOXUM*

Chrysotoxum bicinctum (L.), 1758



History: given as occurring in Ireland in Coe (1953).

Ecology: In Ireland, *C.bicinctum* occurs in a very wide range of lowland situations, including dune grassland, limestone karst grassland, poorly-drained *Molinia* grassland, the edge of raised bogs, fen, open areas in *Quercus* woods and conifer plantations and beside streams or lakes in improved pasture. Even the latter example involves at least a narrow strip of more-or-less undisturbed soil, but this range of habitats is otherwise quite heterogenous and encompasses mineral and organic soils, both well-drained and poorly-drained. It is only generally absent from higher altitudes, closed-canopy conifer plantations, the general surface of bogs and improved grassland, croplands and the urban environment. It can persist locally in the standard Irish farmland landscape of green fields and hedges, where there are old-established field margins.

Range, distribution and status: *C.bicinctum* is common and generally distributed in Ireland and ranges through most of Europe into Siberia and south round the Mediterranean into North Africa.

Irish reference specimens: in the collections of NMI and UM.

Chrysotoxum cautum (Harris), 1776



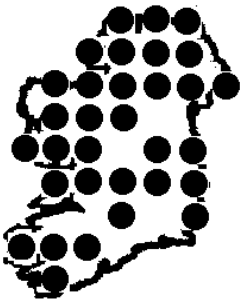
History: added to the Irish list by Speight and Nash (1993), on the basis of a solitary specimen collected in 1919. If *C.cautum* is not rediscovered in Ireland, inclusion of this species on the Irish list may require reconsideration.

Ecology: the single Irish specimen was apparently obtained from an area of estate parkland. It is characteristically a species of open, grassy areas in forest, both deciduous and coniferous, and unimproved, humid, but well-drained, grassland.

Range, distribution and status: this large and distinctive species would seem to either be extinct in Ireland, or to have been recorded here in error. But in case it does persist in the island it should be included in any listing of insects requiring protection at national level. *C.cautum* reaches its northern limit in Europe at the southern tip of Norway. Further south it becomes frequent and widely distributed in Atlantic and central parts of Europe, extending beyond Europe southwards into Turkey and eastwards to Mongolia.

Irish reference specimens: in the collections of UM.

Chrysotoxum fasciatum (Muller), 1764 (*arcuatum* sensu auct Brit)



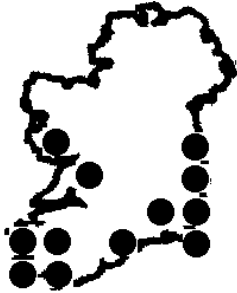
History: given as occurring in Ireland in Coe (1953), under the name *C.arcuatum*.

Ecology: in Ireland this syrphid occurs in clearings and along tracksides in deciduous woodland and conifer plantations, and is as frequently encountered along streams in moorland, or along margins of bog and fen. However, it is mostly found at rather lower altitudes, up to 800 ft., although in the Alps it occurs up to the levels of subalpine grassland. Essentially, *C.fasciatum* is here a species of unmanaged margins of waterways and wetlands. It does not normally occur here in association with karst limestone areas. Its sparse occurrence in conifer plantations in Ireland is in contrast to its frequency in humid conifer forests in continental Europe, and is presumably dictated by management and husbandry conditions current in Irish commercial forestry, which result in considerable disturbance of soil surface layers, shaded stream margins, comprehensive land-surface drainage and a general lack of ground vegetation. This species does not persist in the standard Irish farmland landscape of green fields and hedges. Neither does it occur in gardens or parks. It has thus to be regarded as primarily an anthropophobic syrphid in Ireland.

Range, distribution and status: *C.fasciatum* is not uncommon in Ireland and is recorded from most parts of the island, becoming noticeably more frequent in its northern half. This would be in keeping with its European distribution - further south than the Ardennes, this insect is almost confined to mountainous country. But it has an extensive range outside Europe, in Asia, reaching the Pacific and Japan.

Irish reference specimens: in the collections of NMI and UM.

Chrysotoxum festivum (L.), 1758



History: given as occurring in Ireland in Coe (1953).

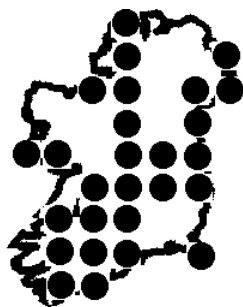
Ecology: in Ireland *C.festivum* occurs almost exclusively on sites with undisturbed, well-drained, mineral soils. In consequence, apart from a few records from open areas in deciduous woods, it is known only from the limestone karst grasslands and coastal dune systems. "Improvement" of grassland, entailing as it does reseeded, cultivation and fertiliser use, is clearly inimical to this insect's survival, presumably due to the adverse effects of these practices upon ant populations and the grass-root aphid colonies they maintain. It has to be regarded as an anthropophobic insect in Ireland.

Range, distribution and status: *C.festivum* is known in Ireland only from low altitude sites in the southern half of the island, mostly near the coast. While there are a number of 20th century records, few of them are recent and the progressive habitat loss during the last 25 years, especially in dune grassland, can only have caused diminution in *C.festivum* populations. This insect seems to have become threatened quite rapidly and would now require consideration for inclusion on national lists of insects requiring protection in Ireland. Elsewhere in Europe, particularly central and southern Europe, *C.festivum* is generally distributed and frequent. Its range extends well beyond Europe, in Asia and North Africa.

Irish reference specimens: in the collections of NMI and UM.

Genus *CRIORHINA*

Criorhina berberina (Fabricius), 1805



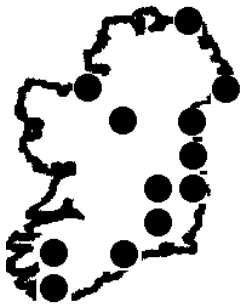
History: given as occurring in Ireland in Coe (1953).

Ecology: *C.berberina* is primarily an inhabitant of remaining areas of oak woodland in Ireland, but occurs also away from oak, in more artificial mixed woodland of conifers, sycamore and beech. *C.berberina* does not seem to occur in association with birch in Ireland, or with conifer plantations. But in Scotland Rotheray (1991) has found this species in association with birch and, in continental Europe, it is found in various sorts of conifer forest, for instance being frequent in humid mixed forest of beech and fir or spruce. It there occurs up to altitudes where only conifer forests are found and clearly uses overmature conifers as much as overmature deciduous trees. This species is as able to use overmature beech and sycamore as it is oak and its survival in parts of Ireland at present is probably dependent upon the remains of estate woodland containing such trees, rather than on any indigenous tree species. The fact that larvae of *C.berberina* occur, in particular, in association with rotting tree roots should make it possible for them to occur in stumps remaining in conifer plantations, even if the trees there are normally cut before they would develop other microhabitats suitable for *C.berberina*. However, the practice of chemically-treating conifer stumps, to inhibit development of the weevil *Hylobius abietis*, also inhibits decomposition of the stumps by other saproxylic invertebrates.

Range, distribution and status: both in Ireland and elsewhere in western Europe, *C.berberina* is the most frequently encountered and most widely distributed *Criorhina* species, except in the forests of northern Europe, where it is scarce. It occurs over most of Ireland and is not uncommon here. This species is endemic to Europe.

Irish reference specimens: in the collections of NMI and UM.

Criorhina floccosa (Meigen), 1822



History: given as occurring in Ireland in Coe (1953).

Ecology: the only indigenous Irish trees with which *C.floccosa* is known to be associated are oak and elm, but on the continent it occurs also with beech and Irish records would suggest that beech is as important as oak in maintaining this insect here – it is doubtful that elm plays a significant role, especially following the recent devastation of *Ulmus* species in Ireland by disease. *C.floccosa* has also been reared in Ireland from a trunk cavity in sycamore, and it is likely that this tree, too, plays a significant role in the survival of *C.floccosa* in Ireland. Unlike *C.berberina*, *C.floccosa* does not occur in conifer forest and is not known to have any association with any coniferous tree species.

Range, distribution and status: in Ireland, records of *C.floccosa* are few but widely scattered, from one end of the island to the other, making this syrphid relictually distributed here. Most recent

records are from protected sites and the species cannot be regarded as much threatened, though it perhaps should be categorised as vulnerable. *C.floccosa* occurs widely in western and central Europe, but is regarded as threatened in the Atlantic seaboard countries except for France. It is also regarded as threatened in Germany and Switzerland. *C.floccosa* is endemic to Europe.

Irish reference specimens: in the collections of NMI and UM.

Criorhina ranunculi (Panzer), 1804



History: added to the Irish list by Nash and Speight (1976).

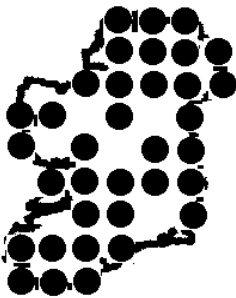
Ecology: although known to be associated with other trees indigenous to Ireland, *C.ranunculi* is demonstrably associated with overmature birch here, and if this hoverfly does use other trees in Ireland, this is not apparent. However, existing records are from localities where birch occurs within mature woodland, intermixed with other trees, not from stands of birch occurring in isolation.

Range, distribution and status: there are but four Irish records of this insect and it has to be regarded as threatened here. *C.ranunculi* would be a candidate for inclusion of any Irish list of insects requiring protection. It is also regarded as threatened in other parts of Europe's Atlantic seaboard, and in both Germany and Switzerland. *C.ranunculi* is endemic to Europe.

Irish reference specimens: in the collections of UM.

Genus *DASYSRPHUS*

Dasysyrphus albostrigatus (Fallen), 1817



History: given as occurring in Ireland in Coe (1953).

Ecology: in Ireland, *D.albostratus* may be found in suburban gardens and parks, along tall hedges and around open areas in conifer plantations as much as in more natural surroundings. Although in general associated with forested situations, this species frequents areas of young woodland and scrub as well as more mature forest. It thus occurs in Ireland with the *Corylus* scrub of the limestone karst areas, as well as in association with oak woods. It has to be regarded as a largely anthropophilic species here.

Range, distribution and status: *D.albostratus* is generally distributed and common in Ireland, though since this species is a known migrant it cannot be assumed that all Irish records relate to resident populations. It occurs widely throughout the Palaearctic Region and is frequent over most of Europe.

Irish reference specimens: in the collections of NMI and UM.

Dasysyrphus hilaris (Zetterstedt), 1843



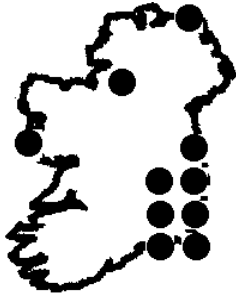
History: added to the Irish list by Speight (2000a). Inclusion of *D.hilaris* as an Irish species is based on unpublished identification keys provided by Doczkal (pers.comm.), which provide a sound basis for separation of this species from others with which it has until now been confused. Previous uncertainty over the correct identity of *D.hilaris* has led to omission of this species from the Irish list.

Ecology: the few Irish records of *D.hilaris* are from not very successful pine plantations on partially-drained bog, that have more than the usual quantity of *Betula* growing among the conifers, which does not accord well with what is known of the habitat associations of this species in continental Europe.

Range, distribution and status: perhaps habitat for this species has not been available in Ireland until forestry activities expanded to include attempts to establish pine plantations on poorly-drained sites? The paucity of Irish records may be partly because the species is only recently established here. However, conifer plantations including pines are now scattered through the length and breadth of the island, so scarcity of pine *per se* is unlikely to restrict the distribution of *D. hilaris* here. Indeed, there is more evidence for an association of *D.hilaris* with deciduous trees than with conifers. As elsewhere in Europe, in Ireland the status of this species is uncertain.

Irish reference specimens: in the collections of UM.

Dasysyrphus pinastri (DeGeer), 1776 sensu Doczkal (1996)



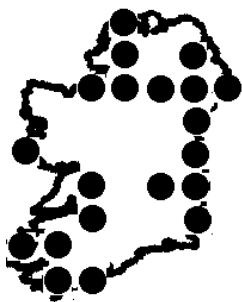
History: given as occurring in Ireland in Coe (1953), under the name *lunulatus* (Meigen).

Ecology: the confused nomenclatural history of this taxon makes it necessary to refer to the interpretation of it that is followed here, before any remarks can be made concerning its ecology. The interpretation used here is that of Doczkal (1996). *D. pinastri* is essentially a species of humid conifer forests, though at the northern end of its range it may be found in association with birch. In Ireland, there is no indication of an association with birch, and the species is found with conifer plantations. Unless it can be demonstrated that *D. pinastri* can be reared on aphids found associated with birch in Ireland it has to be assumed that it is a recent colonist, which has established itself since conifers were introduced here for forestry purposes.

Range, distribution and status: there are few Irish records of this species, widely scattered except in the south-east, where it would seem to be well-established. Given that *D. pinastri* may be a recent arrival in Ireland and habitat appropriate to it seems to be increasingly available here, it is not realistic to categorise the species as threatened on the basis of the small number of records. A pragmatic solution is to regard its status here as indeterminate at present.

Irish reference specimens: in the collections of NMI and UM.

Dasysyrphus tricinctus (Fallen), 1817



History: given as occurring in Ireland in Coe (1953).

Ecology: this is an enigmatic species, in that the adults are rarely encountered other than as isolated individuals. In mature woodland this might be attributed to them flying more at canopy level than within reach of an observer, but in scrub the species also occurs only as isolated specimens. Birch (including scrub) and oak woodland and conifer plantation are the main habitats with which the species has been found in Ireland, and this would be consistent with its habitats in continental Europe.

Range, distribution and status: for whatever reason, there are few records of this species from central and western parts of the island. Nonetheless, *D.tricinctus* is known from Donegal to Kerry and Galway to Wexford, and is not infrequent. Certainly, it is not a threatened insect in Ireland at present. Neither is it regarded as threatened elsewhere in Europe. *D.tricinctus* has an extensive range both in Europe and in Asiatic parts of the Palaearctic region.

Irish reference specimens: in the collections of NMI and UM.

Dasysyrphus venustus (Meigen), 1822

History: given as occurring in Ireland in Coe (1953). Concepts of this species, as enshrined in existing literature, are an amalgam of three or more taxa that occur in Ireland, and which await both redefinition and description. The necessary revisionary work is underway (Doczkal, pers.comm.) but as yet unpublished.

Ecology: despite current nomenclatural confusion, it can be said that *D.venustus* is a forest species in Ireland, occurring here in both deciduous woodland and conifer plantation as it does in continental Europe.

Range, distribution and status: the confusion surrounding correct identity of this species makes its status in Ireland very uncertain at present and mapping of its distribution cannot be carried out until this confusion is resolved and the identity of all available Irish material then rechecked.

Irish reference specimens: in the collections of NMI and UM.

Genus *DIDEA*

Didea alneti (Fallen), 1817



History: given as occurring in Ireland in Coe (1953).

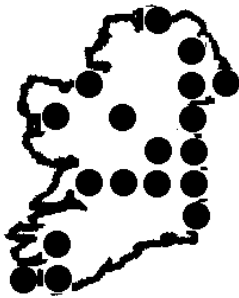
Ecology: the sole Irish specimen known of this species, collected by Stelfox, carries no habitat information on its data labels. The general character of the locality from which that specimen is derived (Clara, Co.Wicklow), together with what is known of the ecology of the species elsewhere, suggests it is likely to have come from riverside conifer plantation. There is no obvious reason why it would have disappeared from there, or why it would not occur elsewhere in similar situations in Ireland (see also under *Melangyna compositarum*). However, the species seems to have been declining in western Europe in general during the present century (in Britain it is nearly

extinct now). On the continent, this species occurs in association with conifers, especially *Abies*, but it does not seem to have been able to colonise Irish conifer plantations.

Range, distribution and status: the only Irish record dates from more than 50 years ago and *D. alneti* has to be regarded as probably extinct in Ireland. In case it persists here, it should be included on any listing of insect species requiring protection in Ireland.

Irish reference specimens: in the collections of SI.

Didea fasciata Macquart, 1843



History: given as occurring in Ireland in Coe (1953).

Ecology: *D. fasciata* is an inhabitant of both deciduous and coniferous forests. While still found in deciduous woodland situations in Ireland, this species has now managed to colonise conifer plantations here to a significant extent. What is surprising is that the third European *Didea* species, *D. intermedia* Loew, remains unrecorded from Ireland, associated as it is with humid pine forests up to the level of the tree line in continental Europe. *D. intermedia* can be expected to colonise pine plantations in Ireland sooner or later, and care should be taken in determination of *Didea* specimens derived from Irish conifer plantations in case *D. intermedia* is among them.

Range, distribution and status: *D. fasciata* is widely distributed in Ireland, though not common. The same may be said of it in most of Europe. It occurs outside Europe through Asiatic parts of the Palearctic region to the Pacific and also extensively in the Nearctic region.

Irish reference specimens: in the collections of NMI and UM.

Genus *DOROS*

Doros profuges (Harris), 1780



History: added to the Irish list by Speight *et al* (1975), under the name *conopseus* (L.).

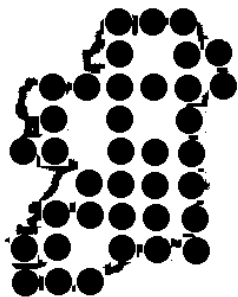
Ecology: until very recently the two males collected from flowers in the vicinity of Carran (Co.Clare), more than 35 years ago, remained the only known Irish material of this large and enigmatic hoverfly. The environs of Carran make it reasonably clear that it must have occurred there either in ash woodland/ unimproved drumlin grassland or hazel scrub/limestone pavement grassland. Either of these situations would be compatible with what is known of the ecology of *D. profuges* elsewhere. Very recently, Tom Gittings has rediscovered this species in Ireland (T.Gittings, pers.comm.), recording it by Malaise from three sites in Co. Clare. One of these sites is in the Burren. The other two sites are on the edge of the Burren, in south-east Co. Clare, and both have areas of hazel scrubwood nearby. However, *D.profulges* is not a species of improved grassland and does not occur in the habitats present in the typical farmland landscape of green fields and hedges. Neither would it be present in conifer plantations, gardens or parks.

Range, distribution and status: Carran is almost centrally located in the Burren and similar habitat occurs repeatedly there, in the surrounding thousands of hectares. Its occurrence in the farmed landscape of south-east Co. Clare shows that *D.profulges* can persist in landscapes where the semi-natural habitat is significantly fragmented. *Doros* could occur elsewhere in and around the Burren yet remain unrecorded. It has a short flight period and is notoriously erratic in its appearances. Discovery of a large, flightless bush cricket in the Burren for the first time, as recently as 1997 (Speight, 1999a) indicates the scale of this problem – if such an insect could occur in the Burren unknown till now, *D.profulges* could well be more widely distributed there than is currently recognised. The recent records suggest that Malaise trapping is an effective, if laborious, method of detecting this species. But until and unless more records of *D.profulges* accumulate, to show it really is more frequent and widely distributed than appears at present, it should be included in any national listing of insects requiring protection.

Irish reference specimens: in the collections of BM.

Genus *EPISTROPHE*

Epistrophe eligans (Harris), 1776



History: given as occurring in Ireland in Coe (1953).

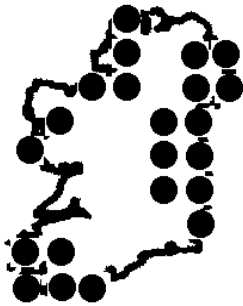
Ecology: this syrphid is essentially an insect of deciduous forests and in Ireland is found in all types of indigenous woodland, including wet woodland (*Alnus/Salix*) and scrub (e.g. *Corylus*). Although there are instances of its occurrence in conifer plantations these are few, and are more likely to relate to the presence of deciduous scrub e.g. *Betula* or *Salix* species with the conifer crop, than to the presence of the conifers themselves. *E.eligans* is frequent in mature suburban gardens

where ornamental shrubs and small trees are to be found and also in association with mature hedges in farmland. It is thus to a significant extent anthropophilic in Ireland.

Range, distribution and status: *E.eligans* is common and generally distributed in Ireland. It is also widely distributed and common in continental Europe, from the southern edge of Scandinavia to the Mediterranean. It is, however, almost confined to Europe, not known beyond Turkey and the Caucasus.

Irish reference specimens: in the collections of NMI and UM.

Epistrophe grossulariae (Meigen), 1822



History: given as occurring in Ireland in Coe (1953).

Ecology: in Ireland this species seems to be found primarily in association with humid, tall herb communities rather than in more open grassland with tall herbs like thistles, or in open areas in woodland - situations in which it can occur in continental Europe. It does not occur in the standard Irish farmland landscape of green fields plus hedges, or in conifer plantations, or in suburban gardens and parks. The general land surface drainage, which accompanies current trends in intensification of use of farmland, can only have caused diminution in the frequency of this insect.

Range, distribution and status: although *E.grossulariae* has been recorded from many parts of the island, the species has not been seen frequently, particularly recently. It is possible that this species is undergoing a rapid decline in Ireland, but the available data are inadequate to demonstrate this. *E.grossulariae* could not be regarded as under threat here at present, but its status probably requires re-assessment in the short term.

Irish reference specimens: in the collections of NMI and UM.

Epistrophe nitidicollis (Meigen), 1822



History: added to the Irish list by Speight (1975). Nash (1997) lists the species for Northern Ireland, but the specimen on which the record is based cannot be traced. The great degree of similarity between *E.nitidicollis* and *E.melanostoma* (Zetterstedt) could lead to the latter being overlooked, should it occur in Ireland. Speight (1988) forecast that once the distinctions between these two species were clearly presented in literature easily accessible to British entomologists, the presence of *E.melanostoma* in Great Britain would quickly be confirmed. The first British records of *E.melanostoma* were published in 1990 (Beuk, 1990), based on specimens collected in 1988 and 1989, from localities in southern England. Whether *E.melanostoma* has been present in Britain for many years or has established itself there only recently cannot be decided. However, if no specimens of *E.melanostoma* collected Britain earlier than 1988 come to light, it would be reasonable to conclude that *E.melanostoma* has only reached Britain recently. In that eventuality it becomes more likely that *E.melanostoma* would establish itself in Ireland at some point in the future.

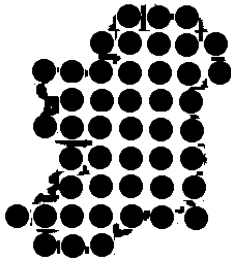
Ecology: the few Irish records of this species are mostly from acidophilous oak woodland, and tracks in or along the edge of conifer plantations, both of these situations falling within the known habitat range of the species in continental Europe. But there are also Irish records from wet *Salix* woodland sites (T.Gittings, pers.comm.). *E.nitidicollis* occurs in alluvial softwood forest in continental Europe and in the past this may well have been a habitat for the species in Ireland. The identity of specimens from *Salix* woodland requires to be carefully checked in case the extremely similar *E.olgae* Mutin is present. The range of the latter species is as yet poorly known. It is present in Scandinavia and France, but has not been recorded from Britain.

Range, distribution and status: In Ireland, *E.nitidicollis* is behaving like a relict population that has become adapted to some very specific situation in order to survive, now unable (due to loss of genetic variability?) to colonise potentially appropriate, but different, habitat that has become available, since there is now an abundance of conifer plantations scattered round the island but almost no records of *E.nitidicollis* from them. It is a moot point whether this species should be regarded as under threat in Ireland. Its populations appear to be small, localised, far between and arguably susceptible to loss. So perhaps *E.nitidicollis* should be included in any national listing of insects requiring protection, simply to err on the side of caution.

Irish reference specimens: in the collections of NMI.

Genus *EPISYRPHUS*

Episyrphus balteatus (de Geer), 1776



History: given as occurring in Ireland in Coe (1953).

Ecology: this remarkable species is found as frequently in ecosystem conditions highly modified by human activities as elsewhere. It has a short generation time and can build up large populations by completing at least one generation in crops, like cereals, before they get harvested. It can also take advantage of setaside land. These attributes have led to its recognition as a useful supplementary biological control agent of greenfly in various crop situations. It definitely overwinters in Ireland as an adult, as in other parts of its range, and is one of the earliest species seen on the wing - typically in February. The extent to which populations of this insect in Ireland are maintained via the overwintering adults is uncertain, because they can be augmented by migrant swarms which arrive over the sea, and not necessarily across the narrowest piece of water (Speight, 1996a). However, there is no evidence for arrival of these migrants before July/August, and *E. balteatus* is normally both frequent and generally distributed in Ireland by that time of the year. Recently, evidence has accumulated to suggest *E. balteatus* may also be capable of overwintering as a larva, though the extent to which populations can be maintained in this way in Atlantic parts of Europe is unclear.

Range, distribution and status: common and widespread in Ireland, as elsewhere in most of Europe. Although known throughout the Palaearctic Region (except in the extreme north) and in both the Oriental and Australasian Regions, this species does not seem to have been found in the Nearctic.

Irish reference specimens: in the collections of NMI and UM.

Genus *ERIOZONA*

Eriozona syrphoides (Fallen), 1817



History: added to the Irish list by Speight (1998).

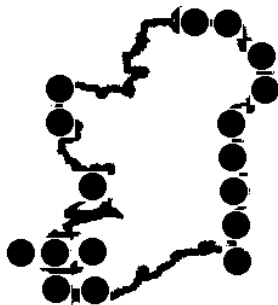
Ecology: *E.syrphoides* is dependent upon aphids associated with conifer plantations in Ireland. It is a striking looking species, and unlikely to have been long overlooked prior to its first recorded occurrence (Speight, 1998). It occurs with a narrower range of conifers than *E.erratica*, being primarily an *Abies/Picea* insect. But the planting of *Picea* species is widespread in commercial forestry plantations here, and, as these plantations mature, it might be expected that *E.syrphoides* would become more frequent. The fact that it is recorded from both counties Cork and Dublin indicates it must have already reached widely scattered localities in the island.

Range, distribution and status: given that *E.syrphoides* may well have arrived in Ireland only recently, the few Irish records cannot be regarded as indicating that the species is under threat in Ireland. From the fact that *E.syrphoides* is known from two such widely separated parts of Ireland it can be concluded that it has successfully established itself here. *E.syrphoides* occurs widely, and not infrequently, in central Europe and its range extends beyond Europe through Asiatic parts of the Palaearctic region to the Pacific. However, *E.syrphoides* does not seem to occur in the Nearctic.

Irish reference specimens: in the collections of NMI.

Genus ERISTALINUS

Eristalinus aeneus (Scopoli), 1763



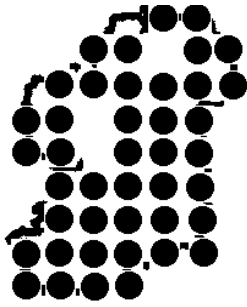
History: given as occurring in Ireland in Coe (1953).

Ecology: this insect is at the north edge of its range in Ireland and occurs here only in coastal situations. It may be found along either rocky or sandy shores, but rarely more than a few metres from the high tide line. This contrasts considerably with its occurrence further south in Europe, where it is to be found far from the coast, in particular along the margins of major rivers.

Range, distribution and status: this species is frequent along most parts of the coast in Ireland and is not threatened here. It occurs widely in central and southern Europe and is one of the most cosmopolitan of all syrphid species, found more or less throughout the world (except for in the Neotropical), in suitable habitats.

Irish reference specimens: in the collections of NMI and UM.

Eristalinus sepulchralis (L.), 1758



History: given as occurring in Ireland in Coe (1953).

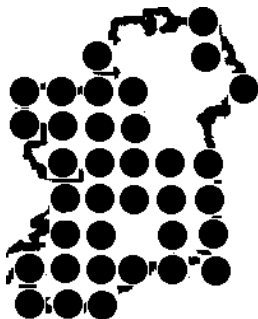
Ecology: this syrphid is primarily an anthropophilic species in Ireland, associated with animal farming. Areas of poached, bare mud enriched with animal faeces or the vicinity of farmyard manure heaps are the situations frequented by the adults. It can occur in Ireland in association with (and has been bred from) constructed wetlands, introduced to farmland for treatment of livestock waste. *E.sepulchralis* seems to have become less frequent recently, which may be due to changes in farming practices associated with animal waste storage and disposal – the farmyard manure heaps of yesteryear have all but disappeared from the countryside due to progressive enforcement of EU regulations. The same phenomenon is apparent in some of the other syrphids whose larvae feed in cow manure. *E.sepulchralis* can occur in Ireland away from sites frequented by livestock, for instance in rich fen and eutrophic wetland.

Range, distribution and status: *E.sepulchralis* is common and widely distributed in Ireland, even if somewhat less frequent than previously. It is also common and widely distributed in much of Europe and ranges beyond Europe through Asiatic parts of the Palaearctic and into the Oriental region.

Irish reference specimens: in the collections of NMI and UM.

Genus ERISTALIS

Eristalis abusiva Collin, 1931



History: given as occurring in Ireland in Coe (1953).

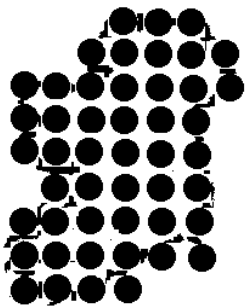
Ecology: in Ireland, this species occurs in a wide range of situations, from dune slacks and marsh to fen and streambanks in blanket bog and in oligotrophic, seasonally flooded grassland. Unlike some other *Eristalis* species, *E.abusiva* has no known association with animal dung or eutrophic

conditions and is not, generally, an anthropophilic species. However, it can occur in Ireland in association with (and has been bred from) the cleaner lagoons (i.e. towards the end of the lagoon series) in constructed wetlands, introduced to farmland for treatment of livestock waste. It does not occur in the standard farmland landscape of green fields and hedges, or in suburban gardens and parks. It can be found at almost any altitude and can be abundant where found. Indeed, in Ireland this insect probably reaches its maximum frequency in western Europe, except for parts of Scandinavia.

Range, distribution and status: *E.abusiva* is frequent and widely distributed in Ireland, except in the north of the island. Elsewhere, it is primarily a species of northern and Atlantic parts of Europe, occurring frequently from northern Norway southwards to the Netherlands, but becoming extremely localised in central Europe, where it is absent from the Alps. It is not found in the Mediterranean zone. Nonetheless, from northern Europe its range extends eastwards to the Pacific.

Irish reference specimens: in the collections of NMI and UM.

Eristalis arbustorum (L.), 1758



History: given as occurring in Ireland in Coe (1953).

Ecology: the close association of this species with cow manure as a larval microhabitat has made it one of the most abundant syrphids in farmland in Ireland. However, this situation has changed noticeably during the last ten years and although today *E.arbustorum* is still frequent in wetland situations where its larvae do not depend upon animal dung, its frequency in farmland has diminished considerably. But it can occur in Ireland in association with (and has been bred from) constructed wetlands, introduced to farmland for treatment of livestock waste and if they become a generally-distributed feature of the Irish farmland landscape *E.arbustorum* can be expected to again become abundant here.

Range, distribution and status: *E.arbustorum* remains widely distributed in Ireland, though it is no longer abundant here. It also remains widely distributed in Europe and its considerable world range, together with its capacity to use other media than cow dung as larval food, should ensure its survival, whatever may be the effects upon it of Ivermectins.

Irish reference specimens: in the collections of NMI and UM.

Eristalis cryptarum (Fabricius), 1794



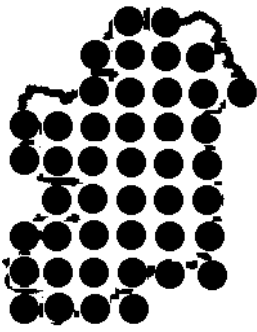
History: given as occurring in Ireland in Coe (1953).

Ecology: no habitat information is provided on the data labels of any of the Irish specimens available in collections. But the general character of the landscape in the vicinity of the localities from which those specimens were derived gives no obvious indication that *E.cryptarum* required habitat conditions in Ireland that were markedly different from those it uses elsewhere. All that can be said in this context is that it seems to have been associated with small, clear, ground-water water bodies like flushes and streams - susceptible to both drainage and pollution.

Range, distribution and status: *E.cryptarum* has not been recorded in Ireland for more than 50 years, despite the increase in attention received by syrphids here over the last 25 years, and has to be regarded as extinct. But, in case it survives as yet undetected, it should be included in any listing of insects requiring protection at national level. Ireland is well within the range of this species and it would be unrealistic to postulate that its disappearance here is due primarily to any regional change in climatic conditions. A combination of climatic change and habitat destruction may have been involved, but the universal and all-pervasive effects of land drainage operations, which have been such a pronounced feature in the Irish landscape over the last 50 years, coupled with the progressive eutrophication of remaining small water bodies and ground-water, caused by the animal farming sector, could arguably have resulted in the demise of this insect without the involvement of any other factors to accelerate the process. The disappearance of this insect from Ireland parallels what has been observed elsewhere, in lowland parts of western Europe, and *E.cryptarum* is now virtually extinct in the land south from Scandinavia to the Pyrenees (except for parts of the Massif Central in France, where it is not infrequent in high altitude wetlands) and east of mountainous parts of central Europe. It is also apparently extremely localised in the Alps.

Irish reference specimens: in the collections of NMI.

Eristalis horticola (DeGeer), 1776



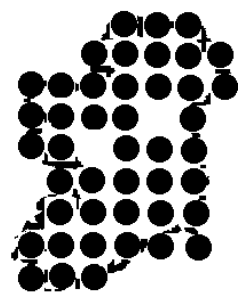
History: given as occurring in Ireland in Coe (1953).

Ecology: this is a species of brooksides in humid forest and scrub, both deciduous and coniferous, plus fen. The ecology of this species seems to be the same in Ireland as elsewhere. Lack of natural conifer forest in Ireland may be responsible for its lower frequency at higher altitudes here and the acidified, over-shadowed streams characteristic of commercial conifer plantations do not provide a replacement - where *E.horticola* occurs in these plantations the streams or pools are in the open or fringed by deciduous trees. It does not occur in the standard farmland landscape of green fields plus hedges, unless streams or other water bodies are present, or in suburban gardens and parks.

Range, distribution and status: widely distributed and frequent in Ireland and much of the Atlantic seaboard of western Europe, *E.horticola* is essentially an Atlantic zone insect, becoming localised in central Europe where it is only frequent in the uplands, and confined to mountainous country in southern Europe.

Irish reference specimens: in the collections of NMI and UM.

Eristalis intricaria (L.), 1758



History: given as occurring in Ireland in Coe (1953).

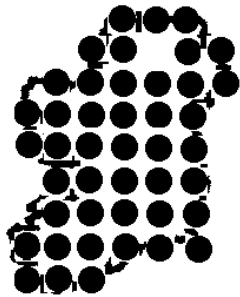
Ecology: this *Eristalis* species is particularly frequent in Ireland. It is among the earliest syrphids to appear in the spring and has a succession of generations through into the autumn. Humid grassland that is even slightly flooded for part of the year and is used for grazing of cows seems especially suited to the needs of *E.intricarius*, and under those conditions its larvae may develop in water-logged cow-dung. But this species demonstrates no general dependency on cow dung, being generally absent from the standard farmland landscape of green fields plus hedges, and occurring in many locations from which livestock are absent. However, it can occur in Ireland in

association with (and has been bred from) constructed wetlands, introduced to farmland for treatment of livestock waste. In more natural conditions, it occurs abundantly in fen and can be found also at the lagg edge of cut-over valley bog, where pools influenced by ground water are present.

Range, distribution and status: although widely distributed and frequent in Ireland and in other parts of Europe's Atlantic seaboard countries northwards from northern France (inclusive), *E.intricaria* becomes progressively localised as one travels further south or into central Europe. It is, however, frequent in northern Europe, where its range extends eastwards into Asiatic parts of Siberia.

Irish reference specimens: in the collections of NMI and UM.

Eristalis nemorum (L.), 1758



History: given as occurring in Ireland in Coe (1953).

Ecology: in Ireland, this species occupies the same habitats as elsewhere in Atlantic parts of Europe. *E.nemorum* is particularly associated with the shallow, slow-moving, oligotrophic/mesotrophic water of permanently water-filled drainage ditches and wetlands. It is also an alluvial floodplain species, occurring in temporary pools in alluvial forest caused by flooding, where there is an abundance of decaying vegetable matter. It has been reared from cow-dung in the laboratory, but it is doubtful whether it can complete development in dung away from water-logged conditions.

Range, distribution and status: *E.nemorum* is widely distributed and common, both in Ireland and other parts of the Atlantic zone of Europe. Further south, and in central Europe, it becomes a more montane species. It has an extensive range beyond Europe, through most of the Palaearctic and in the Nearctic.

Irish reference specimens: in the collections of NMI and UM.

Eristalis pertinax (Scopoli), 1763



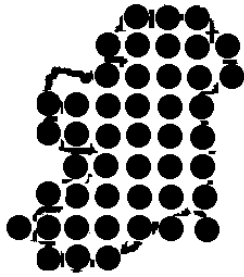
History: given as occurring in Ireland in Coe (1953). The 19th century Irish record of "*E.similis*", mentioned in Speight *et al* (1975) presumably refers to *E.pertinax*, though this cannot be confirmed. The name *similis* (Fall.) is now recognised as the correct name for the species known until recently as *E.pratorum* Meigen. *E.similis* is difficult to segregate from *E.pertinax* (Speight, 1988), and (under the name *E.pratorum*) has recently been found in Britain (Falk, 1990), though there are as yet few records there, albeit scattered from the Scottish highlands to the south coast of England. *E.similis* could occur in Ireland and this requires to be borne in mind when determining Irish specimens which appear to be *E.pertinax*.

Ecology: the combination of a humid climate and extensive animal farming suit this species well and *E.pertinax* is well-nigh ubiquitous in Ireland, occurring in both natural and man-made habitats. It can occur in association with (and has been bred from) constructed wetlands, introduced to farmland for treatment of livestock waste. It is also frequent in wetland habitats in Ireland where livestock are not present. It is found on the wing here from February to November, without a break, and presumably manages an uninterrupted succession of generations throughout this period. It appears at the same time as do those species which hibernate as adults (in Ireland, *Episyrphus balteatus* and *Eristalis tenax*), but there is no evidence for adult hibernation in this species. Elsewhere in Europe it is very widely distributed and frequent in the Atlantic and continental zones, but does not occur above the tree-line in the Alps. Further south in Europe it becomes progressively restricted to the vicinity of forest streams.

Range, distribution and status: common and widely distributed in Ireland. This species is recognised as undertaking long distance movements in large numbers, in parts of continental Europe, but this behaviour has not been noted here. It remains unknown whether Irish populations of this species are augmented each year by immigration from elsewhere. Despite its frequency in most of Europe, *E.pertinax* becomes confined to mountain ranges in southern Europe, where it is difficult to find other than in association with either wetlands or streams within forest.

Irish reference specimens: in the collections of NMI and UM.

Eristalis tenax (L.), 1758



History: given as occurring in Ireland in Coe (1953).

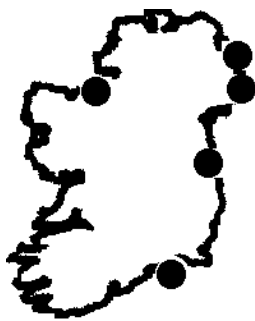
Ecology: in Ireland, *E.tenax* is more frequent in man-modified habitat than under more natural conditions. The predominance of animal-farming in the Irish landscape provides a plentiful supply of larval microhabitat, in cow dung, manure heaps, the seepages of various sorts of organic waste from farming activities (especially silage clamps) that find their way into ditches etc. *E.tenax* is equally at home in a suburban environment, where accumulations of water-sodden organic waste can be found. It does not seem to have been so markedly affected as some other cow-manure-associated species, by factors that have recently caused diminution in their frequency.

Range, distribution and status: common and generally distributed in Ireland and most of Europe. This species is known to exhibit long distance movements in large numbers, but it is unknown whether there is an annual immigration of *E.tenax* to Ireland from other parts of Europe. This insect is well-nigh cosmopolitan.

Irish reference specimens: in the collections of NMI and UM.

Genus EUMERUS

Eumerus funeralis Meigen, 1822



History: added to the Irish list by Speight (1979). Additional Irish records are published by Anderson (1987) and Nelson (1988), all under the name *tuberculatus* Rondani.

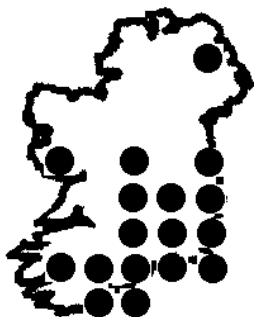
Ecology: in Ireland, this species has been only found in suburban gardens or land used by horticulturalists for production of ornamental bulbiferous plants. It has almost certainly been transported to Ireland with bulbs and apparently continues to be dependent upon human activities for its survival here. Its natural habitat, of dry grassland supporting wild bulbiferous plants, is

hardly available in Ireland. Gardens with abundant daffodils, tulips and crocuses are the most likely places to encounter *E.funeralis* in Ireland.

Range, distribution and status: its occurrence in the vicinity of both Belfast and Dublin suggests this species could be found in almost any large urban area in Ireland. The few records may well be more a reflection of the lack of collecting activity for syrphids in Irish suburban gardens, than anything else. Speight (1985a) suggested that *E. funeralis* is probably not a resident species here, but its persistent occurrence in gardens round Dublin argues against this interpretation and, even if it never establishes itself in any natural habitat in Ireland, it would seem that it is now a resident insect of Dublin's suburbia. *E.funeralis* probably originated in Mediterranean parts of the Palaearctic Region, but has been inadvertently introduced by man to many different parts of the world and is now well-nigh cosmopolitan.

Irish reference specimens: in the collections of NMI and UM.

Eumerus strigatus (Fallen), 1817



History: given as occurring in Ireland in Coe (1953).

Ecology: if *E.strigatus* is an indigenous species, in that it first arrived in Ireland during the postglacial unaided by man's activities, its natural habitat here may well be coastal grassland, given that existing records away from coastal grassland are nearly all from habitats introduced to Ireland by man's activities and dependent upon man's activities for their continued existence. However, *E.strigatus* is one of a small number of European *Eumerus* species (*E.amoenus* Lw, *E.funeralis* Mg.and *E.sogdianus* Stack. would be other examples) that have been able to make use of part of the heterogenous assemblage of bulb, corm and tuber-making plants distributed round Europe by human activity, for use as either vegetables or ornamental garden plants. *E.strigatus* has certainly been introduced to parts of the world well outside its natural range with such plants and will almost certainly have reached Ireland in this way, whether or no an indigenous population of the species was here already. One definite consequence is that *E.strigatus* can be found today in Ireland in a variety of situations in addition to coastal grassland, including, on occasion, farmland and artificial habitat like suburban gardens. Various of the introduced plants that could act as hosts for *E.strigatus* larvae establish themselves, at least temporarily, along hedge margins, in rubbish dumps etc., providing a probable explanation for the appearance of *E.strigatus* in unexpected situations. It is quite possible that *E.strigatus* can also use one or another of the various wild umbellifers (Apiaceae) occurring in Ireland as a larval food plant, one candidate being pignut (*Conopodium*). But there is little constancy to the occurrence of *E.strigatus* in semi-natural/natural

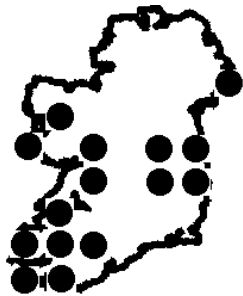
habitats away from coastal grassland in Ireland. It would seem possible that the consistent occurrence of *E.strigatus* in association with coastal grasslands in the south east of the island is due to the suitability of soils there for growing potatoes (one alternative food for *E.strigatus* is rotting potato tubers). The available data would seem more indicative of a recent, man-made introduction of *E.strigatus* to Ireland than of natural occurrence of the species in the island.

Range, distribution and status: largely confined to the southern half of the island, and with most records from the south-east. Where it occurs, *E.strigatus* is often present in dense, populous colonies. It is by no means a threatened insect in Ireland, and can be expected to expand and consolidate its range here. It is frequent over most of Europe south of Scandinavia and, through human transport, is becoming cosmopolitan.

Irish reference specimens: in the collections of NMI and UM.

Genus *EUPEODES*

Eupeodes bucculatus (Rondani), 1857



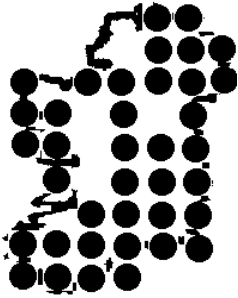
History: given as occurring in Ireland in Coe (1953), under the name *latilunulatus* (Collin). The recent segregation of *E.duseki*, Mazánek, Láska & Bicik and *E.goeldlini* Mazánek, Láska & Bicik from *E.bucculatus* (Mazánek *et al*, 1999) has necessitated re-examination of Irish material of *E.bucculatus* to establish its identity, a process greatly facilitated by the keys provided by Haarto and Kerppola (2007). This has confirmed the presence in Ireland of both *E.bucculatus* and *E.goeldlini*.

Ecology: in Ireland, *E.bucculatus* is associated with wetland/freshwater habitats, occurring essentially with *Salix* scrub along streams and round pools in various situations - fen, bog, deciduous woodland and conifer plantation. The species may well be under-recorded because the first generation adults are on the wing very early in the year (mid-April to mid-May) and the second generation is rather late (mid-August to mid-September). Certainly, given the habitat preferences it exhibits, and the fact that it is well within its climatic range anywhere in Ireland, *E.bucculatus* might be expected to be more frequent here than available information would indicate it to be.

Range, distribution and status: *E.bucculatus* is not a frequent species in Ireland, but neither can it be regarded as under threat. It is also widely, but sparsely, distributed from northern Scandinavia south to mountainous parts of southern Europe. This species appears to be endemic to Europe and is not known from eastern parts of the continent.

Irish reference specimens: in the collections of NMI and UM.

Eupeodes corollae (Fabricius), 1794



History: given as occurring in Ireland in Coe (1953).

Ecology: this is an open-ground species, well-known for exhibiting long range dispersal by the adults. Although it may be found in the summer in various different open country habitats in Ireland and almost anywhere in the island, the early spring generation of adults is much more localised, hardly occurring away from low altitude situations near the coast. These early specimens are found in such places as suburban gardens. Doubtless, the Irish populations of *E.corollae* are augmented in many years by migrants that reach the island by flying over the sea. Evidence for occurrence of such migrations is fragmentary but, for instance, it is not a rare event to find a few specimens flying round the deck of cross-channel car ferries in summer, staying with the boat for much (if not all) of the crossing - but there is no evidence that such migrants are responsible for the early spring records of this species in Ireland. Neither is there any evidence that the larvae of *E.corollae* can go into suspended animation during the winter. How, or if, *E.corollae* manages to survive the winter in Ireland as a puparium is not a question open to easy investigation, but does represent an intriguing enigma. Further south in Europe, where it is clear *E.corollae* does overwinter successfully, the species is almost continuously brooded, adults appearing on winter-flowering shrubs like *Viburnum timus* on suitable days even in January. In much of central/southern Europe, *E.corollae* is an intensely anthropophilic species, building up immense populations in farmland, particularly on leguminous crops and weeds. These numerous populations are not seen in Ireland, presumably because the farming system would be less likely to engender them. But the species is markedly anthropophilic here as well, occurring as frequently in extensively man-modified, open-ground habitats as elsewhere, including the standard farmed landscape of green fields and hedges.

Range, distribution and status: widely distributed, but not common in Ireland. More frequent, and more generally distributed, further south in Europe.

Irish reference specimens: in the collections of NMI and UM.

Eupeodes goeldlini Mazanek, Laska & Bicik, 1999



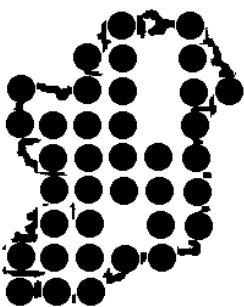
History: added to the Irish list by Speight *et al* (2007).

Ecology: in Europe in general the habitat preferences of this species are not very precisely known. It is associated with open areas in humid deciduous forest where small *Salix* species are present and is also known from alluvial softwood forest. It's only known Irish locality is a drained valley bog where a mosaic of *Salix* and *Betula* scrub have invaded, interspersed with *Molinia* grassland and with wetter patches carrying *Juncus* and a few small pools carrying *Typha*. This area is immediately adjacent to a closed-canopy plantation of introduced *Pinus* sp.

Range, distribution and status: the Irish site is at the edge of a drained Midlands valley bog currently exploited for commercial peat extraction and is not obviously different from other scrub-invaded, part-drained valley bogs. There is thus no obvious reason why, in Ireland, *E.goeldlini* should be confined to this location. On the other hand, it has not been found on other such sites in Ireland and in continental Europe it appears to be a localised species that is nowhere frequent. On a precautionary basis it perhaps should be treated as threatened in Ireland until and unless records accumulate to demonstrate this is an inappropriate designation.

Irish reference specimens: in the collections of NMI.

Eupeodes latifasciatus (Macquart), 1829



History: given as occurring in Ireland in Coe (1953).

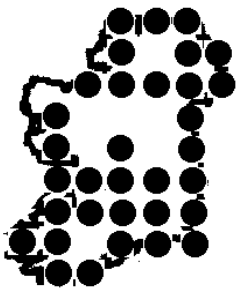
Ecology: *E.latifasciatus* is, *par excellence*, an insect of waterside and humid open ground habitats wherever it occurs in Europe - though in the Mediterranean region it is also associated with wooded stream margins. Climatic conditions prevalent in Ireland render many locations suitable for the species and it is probably more readily found here than almost anywhere else. It occurs in the full range of freshwater wetland habitats represented in Ireland, including blanket bog,

although its occurrence in blanket bog is restricted to streamsides and the more mineral-rich flushes. In farmland, it may occur in the immediate vicinity of water-filled ditches, as well as in humid grassland. In contrast with the more anthropophilic species *E.corollae* and *E.luniger*, *E.latifasciatus* is not an insect characteristic of suburban gardens or croplands.

Range, distribution and status: *E.latifasciatus* is widely distributed in Ireland and frequent - it is more frequently met with here than is *E.corollae*, which is the converse of the situation found elsewhere in Europe where both species occur.

Irish reference specimens: in the collections of NMI and UM.

Eupeodes luniger (Meigen), 1822



History: given as occurring in Ireland in Coe (1953).

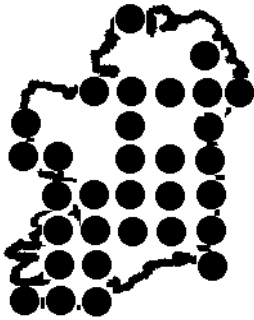
Ecology: as for *E.corollae*, the spring records of *E.luniger* in Ireland are localised in coastal, low-altitude situations, but later in the year the species can be found more generally distributed. *E.luniger* is also a noticeably anthropophilic species, crops, orchards and suburban gardens being strongholds of this insect. In the suburban landscape it can be found almost throughout the year – it can be found on the wing there as late as the end of November. Dune grassland, and coastal habitats in general, are also typical for *E.luniger* in Ireland. It also occurs in open areas in deciduous woodland, and can be found in similar situations within conifer plantations. The capacity of this insect to exploit crop aphids as a larval food source does not seem to result in large populations of it in Ireland - the infrequency of records may well reflect the absence of a reservoir of population derived from arable farming, which would be present in many other parts of Europe.

Range, distribution and status: the extent to which *E.luniger* populations in Ireland are augmented each year by immigration from elsewhere is unknown. At present, the species is quite widespread, though not common, and there are no indications that it is decreasing here. It is widespread in continental Europe, from northern Norway to the Mediterranean, but is most common in southern parts of the continent.

Irish reference specimens: in the collections of NMI and UM.

Genus *FERDINANDEA*

Ferdinandea cuprea (Scopoli), 1763



History: given as occurring in Ireland in Coe (1953).

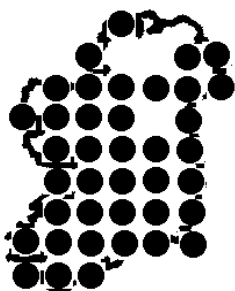
Ecology: in Ireland, as elsewhere, this is predominantly a species of deciduous woodland (*Quercus*, *Fraxinus* and *Betula*), but with some records away from the immediate vicinity of woods. Given the range of situations in which the larvae are now known to develop, it would be reasonable to conclude that, on occasion, this species can develop in rotting parts of large herbaceous plants, as well as in sap runs on the trunks of trees, potentially accounting for records away from woodland. However, this species can only be regarded as marginally anthropophilic, at most: there is a general lack of records of *F.cuprea* from farmland, suburban gardens or parks and this species does not occur in association with conifers. Any records from conifer plantations are presumably due to an admixture of deciduous trees surviving with the conifer crop.

Range, distribution and status: for a deciduous woodland species supposedly associated primarily with mature/overmature trees, *F.cuprea* is surprisingly well distributed in Ireland, and not infrequent. However, this may be in part due to its apparent ability to survive away from woodland on occasion. This syrphid occurs over most of Europe from southern parts of Scandinavia southwards and can be abundant where it is found. It does become more localised in southern Europe however, where it is largely restricted to more humid situations within forest.

Irish reference specimens: in the collections of NMI and UM.

Genus *HELOPHILUS*

Helophilus hybridus Loew, 1846



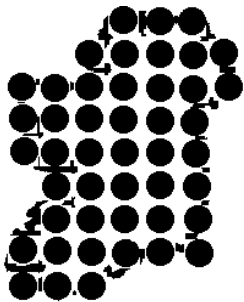
History: given as occurring in Ireland in Coe (1953).

Ecology: occurs in a wide range of situations in Ireland, but normally very close to some form of water body that is not eutrophic. Temporary pools, such as may occur in dune slacks or seasonally-flooded grassland, are frequented by this species, along with river banks, brook edges permanent pools and water-filled ditches. With drainage and eutrophication of surface-water bodies *H.hybridus* becomes scarcer and the species is now less frequent in farmland than previously. However, it can occur in abundance in Ireland in association with (and has been bred from) temporarily-flooded *Glyceria maxima* beds in constructed wetlands, introduced to farmland for treatment of livestock waste.

Range, distribution and status: very widely distributed in Ireland, and more frequent here than in most other parts of Europe. This species also has an extensive range outside Europe.

Irish reference specimens: in the collections of NMI and UM.

Helophilus pendulus (L.), 1758



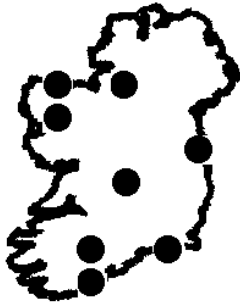
History: given as occurring in Ireland in Coe (1953).

Ecology: this syrphid is markedly anthropophilic, occurring in garden ponds, rain-water barrels, silage seepage, wet ditches etc. and various more natural situations in which water-sodden vegetable matter accumulates, including shallow, temporarily water-filled depressions on the surface of bog. In Ireland, *H.pendulus* is almost ubiquitous, and omnipresent in farmland. It can occur in Ireland in association with (and has been bred from) constructed wetlands, introduced to farmland for treatment of livestock waste.

Range, distribution and status: *H.pendulus* is abundant and well-nigh ubiquitous in Ireland and over most of Europe, except in the Mediterranean zone, where it becomes more localised, occurring in humid forest and wetland.

Irish reference specimens: in the collections of NMI and UM.

Helophilus trivittatus (Fabricius), 1805



History: unverifiable reports of the occurrence of this species in Ireland early in the last century are mentioned by Speight *et al* (1975), but no specimen became available to confirm the presence of *H.trivittatus* in Ireland until 1991 (Speight & Nash, 1993). The latter authors also refer to unconfirmed sightings of the species in Ireland in the 1980s.

Ecology: an enigmatic species in Ireland, giving no indication of undertaking the long distance dispersal movements here that seem to characterise it in central/southern Europe - it may occur on the continent in almost any habitat and up to above 2000m altitude, in situations in which it would be almost impossible for it to develop. Here it is a low altitude wetland species, but with no clear indications of the range of situations it can exploit. Until very recently, in Ireland *H.trivittatus* has been found only in lightly managed systems, like the ditched, seasonally-flooded grasslands along the river Shannon. There are recent records from roadsides in blanket bog, but they relate to adults found feeding at flowers and give no indication of where in the vicinity the species might be developing. Blanket bog itself is not a habitat of this species and it might be hypothesised that in such surroundings *H.trivittatus* may be using roadside drainage ditches receiving run-off from fields of improved grassland, that also occur in the vicinity. A novel habitat, so far almost entirely restricted to a few locations in the south-east (Waterford), is the chain of shallow pools comprising a constructed wetland used for treatment of organic waste from farms. These constructed wetlands have only been introduced to the Irish landscape since 1995, but can provide an alternative habitat for *H.trivittatus*, which has been found in considerable numbers in association with pools toward the lower (outflow) end of the chain.

Range, distribution and status: the situation of this species in Ireland has been reviewed by Speight and Nelson (2000). Essentially, its presence in Ireland was only verified recently, but it now appears to be spreading rapidly.

Irish reference specimens: in the collections of NMI and UM.

Genus *HERINGIA*

Heringia heringi (Zetterstedt), 1843



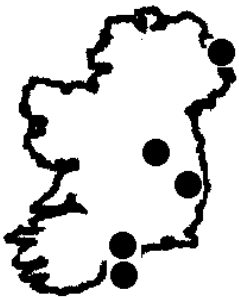
History: given as occurring in Ireland in Coe (1953), but based on a specimen with no locality data. The presence of this species in Ireland was confirmed by Speight (1980b).

Ecology: The few Irish records of this species are all from deciduous woodland with a well-developed understorey of shrubs. It would be expected to occur in the fruit-growing region of the south-east, but as yet has not been found there. *H.heringi* is not an insect of wet deciduous woodland e.g. *Alnus* or *Salix* and has not been found in either *Betula* forest or coniferous forest, so it is largely restricted in Ireland to remnant areas of oak forest.

Range, distribution and status: there are only three Irish records of this species, and it probably should be regarded as a candidate for inclusion on any list of insects requiring protection at national level. Were it not for the fact that the existing records are all from sites that are to some extent protected, this species would have to be regarded as endangered in Ireland.

Irish reference specimens: in the collections of NMI and UM.

Heringia vitripennis (Meigen), 1822



History: as *Neocnemodon vitripennis* this hoverfly was added to the Irish list by Speight (1986a), on the basis of a male specimen. *H.latitarsis* had previously been added to the Irish list on the basis of females (as *Cnemodon latitarsis*, in Speight *et al*, 1975), at a time when it was believed that females of *H.latitarsis* could be distinguished from females of other *Heringia* species, using Coe's (1953) keys. But it has since become apparent that the features used by Coe (1953) for distinguishing the female of *H.latitarsis* are unreliable. Further, NO existing key satisfactorily distinguishes the females of *H.latitarsis* from females of *H.vitripennis* and, as yet, no morphological features can be found which do achieve separation of the females of these two species. There are still no males of *H.latitarsis* known from Ireland, so the status of *H.latitarsis* as an Irish species has to be regarded as

doubtful - it is quite conceivable that the females recorded from Ireland as *H.latitarsis* belong in fact to *H.vitripennis*. Indeed, until and unless a male of *H.latitarsis* is found in Ireland, it seems reasonable to treat Irish females of *H.latitarsis/vitripennis* as belonging to *H.vitripennis*, a practise which has been followed here.

Ecology: the sparse information available about this insect in Ireland suggests it is here associated with oak woodland and fruit trees. The lack of any indication of the presence of *H.vitripennis* in conifer plantations in Ireland so far is unexpected, given that elsewhere it has been reared from plant bugs on *Abies*.

Range, distribution and status: this insect would be a candidate for inclusion on any list of insects requiring protection in Ireland, unless it can be demonstrated that it does occur here in conifer plantations. At present, it is not known from any protected site.

Irish reference specimens: in the collections of UM.

Genus *LAPPOSYRPHUS*

Lapposyrphus lapponicus (Zetterstedt), 1838



History: added to the Irish list by Gittings (2006).

Ecology: in continental Europe this species is frequent in forests from the Mediterranean to subarctic parts of Scandinavia. It is found in deciduous forest of beech and coniferous forests of spruce and fir, and, at the northern end of its range, in montane birch forest. It also occurs abundantly on the continent in conifer plantations. The sole Irish record is from a conifer plantation.

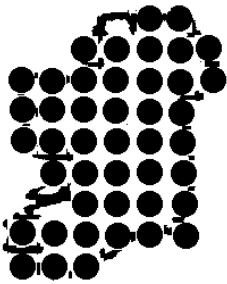
Range, distribution and status: at present known only from one specimen collected from a plantation of *Picea sitchensis* in Co.Kerry in 2003. It's occurrence in a conifer plantation in Ireland would be in character with its occurrence elsewhere in Europe. If this species were generally distributed in conifer plantations in Ireland it should have been found previously and should certainly have been reported more than once during the massive sampling programme conducted in conifer plantations by Tom Gittings, during course of the BIOFOREST project that gave rise to the only known Irish record of *L.lapponicus*. However, only the one specimen was found and it has to be concluded that, despite the availability of many apparently suitable areas of conifers, the species is extremely localised in Ireland. It is tempting to conjecture that this syrphid has only recently arrived in Ireland and is as yet not well-established here. How it arrived in Ireland would then be of some interest, since the species is all but extinct in Britain. The adults are well known for

long distance movements, and it would seem as likely that it has reached Ireland from Iberia as that the remnant British population has given rise to its arrival in Ireland. If it is a recent arrival in Ireland one might expect Irish records of it to become more frequent. But at present it would have to be regarded as a candidate for inclusion on any list of threatened Irish Syrphidae.

Irish reference specimens: in the collections of NMI.

Genus *LEJOGASTER*

Lejogaster metallina (Fabricius), 1776



History: given as occurring in Ireland in Coe (1953).

Ecology: the predominance of cattle farming in many parts makes this an anthropophilic species in Ireland, because *L.metallina* is characteristic of unimproved and improved humid grassland, with slow-flowing, canalised brooks in open ditches and shallow, temporary pools and seepages, where its aquatic larvae can develop. It is associated with floating plants like *Glyceria fluitans* and can tolerate a certain amount of eutrophication. With increased intensification of use of farmland poorly-drained grassland has diminished in frequency, but *L.metallina* remains one of the most generally-distributed wetland syrphids in Ireland. It is not a species of either bog or conifer plantation, but is found here along brooks and around pools in both fen and deciduous woodland, including wet woodland of *Alnus* and *Salix*.

Range, distribution and status: *L.metallina* is very widespread in Ireland and still frequent, if perhaps less common than in the recent past. It is also widespread in Atlantic parts of Europe, being common from Denmark south to northern France, but becomes much more localised in central Europe.

Irish reference specimens: in the collections of NMI and UM.

Lejogaster tarsata (Megerle in Meigen), 1822



History: added to the Irish list by Speight (1978c).

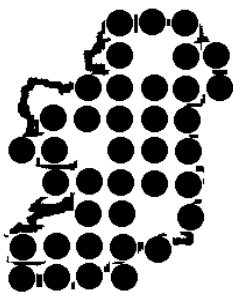
Ecology: being associated with spring-fed pools and small brooklets, *L.tarsata* might be expected to be frequent in Ireland. However, it is not found in association with water bodies with cattle-trampled margins, or water eutrophicated by cattle droppings, which would exclude it from the vast majority of otherwise potential locations. The few Irish records are all from wetland situations where livestock are either excluded or exert minimal influence. That most records are from the south-east of the island is probably no co-incidence, because *L.tarsata* does not extend far into northern Europe - in Norway, for instance, there is but one record from the southern edge of the country - and may be climatically on the edge of its range here.

Range, distribution and status: there are few Irish records of this species, most of them from the south-east. Recent records are all from sites which are provided with some degree of protection, but are so few that *L.tarsata* has to be categorised as vulnerable in Ireland, if not as endangered. The situation of this species in other parts of Europe is varied. While it would justifiably be regarded as threatened in Germany and Switzerland, it does not appear to be so elsewhere.

Irish reference specimens: in the collections of NMI and UM.

Genus *LEUCOZONA*

Leucozona glauca (L.), 1758



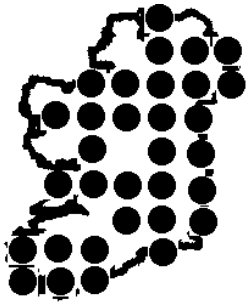
History: given as occurring in Ireland in Coe (1953).

Ecology: characteristically an insect of oak woodland in Ireland, where it occurs with tall herb communities along tracksides, lake shores and river banks, or open areas along streams. *L.glaucius* can also be found in comparable situations in ash woods. Occurring in these situations, *L.glaucius* exhibits a similar range of habitat preferences as elsewhere in Atlantic parts of Europe. It is not a species of the standard Irish farmland landscape of green fields and hedges and neither does it occur in association with conifer plantations, parks or suburban gardens.

Range, distribution and status: this insect is widely distributed in Ireland and not threatened here. It also ranges widely through continental Europe, except the Mediterranean zone, and does not seem to be regarded as under threat in any part of the continent.

Irish reference specimens: in the collections of NMI and UM.

Leucozona laternaria (Mueller), 1776



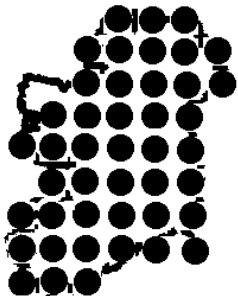
History: given as occurring in Ireland in Coe (1953).

Ecology: *L.laternarius* is frequently found in Ireland with *L.glaucius*, but occurs also in more open situations, away from woodland, though standing or running water are almost invariably close by. This is characteristically a "tall herb communities" syrphid of the edges of water bodies in Ireland and is more frequent here than in many other parts of western Europe - presumably favoured by the humid Irish climate.

Range, distribution and status: *L.laternarius* is frequent in occurrence in Ireland and known to occur over most of the island. It is more frequent in Atlantic parts of Europe than in central or southern Europe, and is absent from the Mediterranean zone, Portugal and Spain.

Irish reference specimens: in the collections of NMI and UM.

Leucozona lucorum (L.), 1758



History: given as occurring in Ireland in Coe (1953).

Ecology: in Ireland, this is characteristically a species of hedgerows and tracksides and open areas within oak woodland and hazel scrub. It is not a garden hoverfly and can only be expected in conifer plantations where there is a fringe of deciduous shrubs etc along tracks. Similarly, it does not occur in wetlands, dune systems or improved grassland. It has an unusually long flight period here, with females occurring throughout the summer to as late as September. This hoverfly is to a significant extent an anthropophilic species in Ireland at present. But its situation could deteriorate markedly, if intensification of use of farmland were to cause loss of hedges and unused field margins on a significant scale. One unusual feature exhibited by *L.lucorum* in Ireland is a partial second generation in August/September, particularly in the south-east of the island. This syrphid seems to be strictly univoltine elsewhere in Europe.

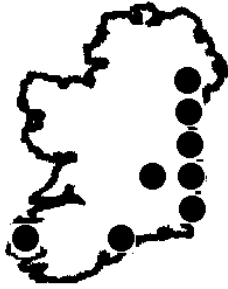
Range, distribution and status: this Holarctic species is frequent and generally distributed in Ireland. It is also frequent over most of western and central Europe, from northern Norway

southwards to central France. But further south it becomes increasingly confined to mountain ranges and is not known from the Mediterranean zone. The closely related *L.inopinata* does not seem to occur in Ireland.

Irish reference specimens: in the collections of NMI and UM.

Genus MEGASYRPHUS

Megasyrphus erraticus (L), 1758



History: added to the Irish list by Speight (1976c), where it appears as *Megasyrphus annulipes*. A subsequent Irish record is published by Anderson (1987).

Ecology: *M.erraticus* is dependent upon aphids inhabiting coniferous trees and is found in Ireland in association with conifer plantations established for commercial forestry purposes. Its arrival in Ireland almost certainly postdates establishment of these plantations - it is a large, distinctive species not especially difficult to observe, collect or determine, and its absence from collections made in Ireland prior to the last quarter of the 20th century is difficult to explain otherwise. However, that is not to say that the first recorded occurrence in Ireland, in Wexford (Speight, 1976c), should be taken as demonstrating when and where it arrived in the island. In all probability it had been established here for some time prior to that. This species would seem to be highly anthropophilic in Ireland.

Range, distribution and status: there may be few Irish records of this species but, given the high probability of its recent arrival in the island, it would be more reasonable to interpret the existing records as indicative of the extent to which the species has expanded its range here so far, than in any other way. On that basis, *M.erraticus* seems to now be well-established in Ireland, in the east and south of the island and its range expansion can be expected to continue. However, extensive survey of the syrphids of conifer plantations during 2001-5 did not demonstrate the presence of this species in either the centre or West of the island (T.Gittings, pers.comm.). It is widely distributed and frequent in conifer forest in Europe and elsewhere in the Palaearctic region and also widely distributed in the Nearctic.

Irish reference specimens: in the collections of NMI and UM.

Genus MELANGYNA

Melangyna arctica (Zetterstedt), 1838



History: given as occurring in Ireland in Coe (1953).

Ecology: as in continental Europe, *M. arctica* occurs in Ireland in association with both wet deciduous woodland (*Alnus/Salix*) and with conifers - in this case with commercial conifer plantations. *M. arctica* also occurs here in birch scrub on bogs. But it is unclear whether the larvae can develop feeding on aphids on *Betula*, or if other tree species in the vicinity are supporting it e.g. *Salix*. Certainly, *M. arctica* must develop with the aphids occurring on a wider range of tree genera than *Alnus* (the only genus from which it has been reared so far), including various genera of conifers.

Range, distribution and status: *M. arctica* seems to be rather localised in Ireland, with most records from the north-west of the island, the south-west and Wicklow/Kildare. Nonetheless, it is by no means threatened here and its repeated occurrence in conifer plantations suggests it is unlikely to become threatened in the immediate future. This is a Holarctic species, frequent in northern Europe and mountainous parts of central Europe and occurring through much of Siberia to the Pacific.

Irish reference specimens: in the collections of NMI and UM.

Melangyna compositarum (Verrall), 1873



History: added to the Irish list by Speight *et al* (1975).

Ecology: there is no habitat information associated with the sole Irish record of this species. Habitat data from elsewhere in Europe, where it is associated with conifers in montane situations,

occurring from the *Picea* zone up to the tree line in *Larix* forest, provide no clue as to why *M.compositarum* would not be found frequently in Ireland now, given that it definitely occurred here earlier this century. Perhaps it depends upon *Larix* or *Pinus sylvestris*-associated aphids which are missing from Ireland? Certainly, the aphid fauna of *P.sylvestris* in Ireland is depauperate and probably accounts for the absence from Ireland of pine syrphids like *Didea intermedia* Loew and *Eupeodes nielsenii* (Dusek & Laska). But if *M.compositarum* has not been recorded for more than 50 years in Ireland for this reason, why was it present in the 1930s? Curiously, a second pine-associated syrphid with aphidophagous larvae, *Didea alneti*, exhibits a similar history in Ireland.

Range, distribution and status: only one record of *M.compositarum* is known from Ireland, dating from more than 50 years ago, and it is reasonable to presume the species is extinct here. In case it persists, *M.compositarum* should be included in any listing of insects requiring protection at national level in Ireland. It is not regarded as threatened elsewhere in Europe, apart from in Belgium.

Irish reference specimens: in the collections of NMI.

Melangyna lasiophthalma (Zetterstedt), 1843



History: given as occurring in Ireland in Coe (1953).

Ecology: *M.lasiophthalma* occurs in Ireland in association with most types of scrub woodland and conifer plantations, plus oak forest, wet forest of *Alnus* and *Salix*, field hedges of *Crataegus/Prunus spinosa* and suburban gardens. It is thus a markedly anthropophilic species in the Irish landscape of today. In continental Europe it is found in acidophilous *Quercus* forest, humid beech forest and humid conifer forests.

Range, distribution and status: *M.lasiophthalma* is a widely distributed and frequent, early spring species in Ireland. In Europe, it ranges widely through northern parts and mountainous areas further south. It is a Holarctic insect, present in much of Canada and in mountainous parts of the USA.

Irish reference specimens: in the collections of NMI and UM.

Melangyna quadrimaculata (Verrall), 1873



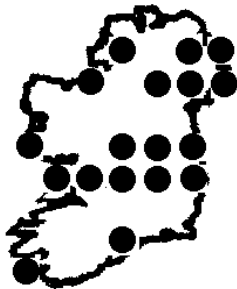
History: given as occurring in Ireland in Coe (1953).

Ecology: this species has only been found in Ireland in association with relict patches of mature oak forest. It is not recorded from conifer plantations. It is one of the earliest syrphids on the wing, but not early enough to use *Corylus* flowers, which it apparently uses in central Europe. In Ireland, *M. quadrimaculata* uses flowers of *Salix* species as a food source.

Range, distribution and status: *M. quadrimaculata* exhibits a relict distribution pattern in Ireland and can very reasonably be categorised as threatened here. It would be a candidate for inclusion on any listing of insects requiring protection at national level. This species would also be regarded as threatened in some other parts of Europe. But the situation is not consistent. It would not be considered as threatened in Britain, but is regarded as threatened in Switzerland, for instance.

Irish reference specimens: in the collections of NMI and UM.

Melangyna umbellatarum (Fabricius), 1794



History: given as occurring in Ireland in Coe (1953).

Ecology: in Ireland this species occurs in association with wet woodland and scrub of *Salix*, at the edge of raised bog and fen or along streams with some scrub of *Salix*. Essentially it is usually found where tall wetland umbellifers occur, on which its aphid-feeding larvae are known to develop. In continental Europe it may be found in much less humid conditions and presumably uses there a wider range of aphids.

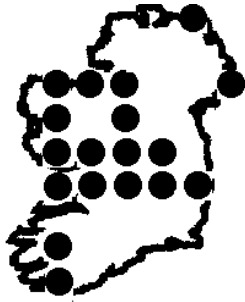
Range, distribution and status: although most Irish records of this species are from the midlands, there are scattered records from most parts of the island except for the south-east. *M. umbellatarum* is not a frequent species here, but neither does it appear to be threatened. The same could be said

of this insect over much of its European range. It also ranges widely beyond Europe, across Siberia to the Pacific.

Irish reference specimens: in the collections of NMI and UM.

Genus *MELANOGASTER*

Melanogaster aerosa (Loew), 1843



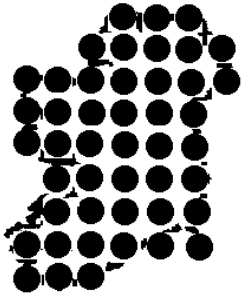
History: given as occurring in Ireland in Coe (1953), as *Chrysogaster macquarti* Loew. Following revision of this species complex by Maibach *et al* (1994), re-examination of Irish material demonstrates that it is *M.aerosa*, rather than the closely-related *M.parumplicata*, that occurs here.

Ecology: as elsewhere, *M.aerosa* is a strictly wetland insect in Ireland. It occurs in both fen and bog, in association with oligotrophic water bodies, usually pools or small streams. It is characteristic of poor fen and transition mire, can also occur in rich fen and in raised bog is primarily found with pools around the edge of the bog. In blanket bog it may be found with mineral-rich flushes and pools and along streams. It does not occur in bog pools *per se*. The closely-similar *M.parumplicata* would be expected to occur in Ireland, but has not been found here yet. Its ecology is somewhat different, and although *M.parumplicata* can occur in wetland (aapamire and calcareous fen) it is also associated with unpolluted ground-water springs in grassland and woodland. General land-surface drainage and grassland improvement, which have characterised intensification of use of farmland in Ireland over the past 25 years, are inimical to the survival of *M.aerosa*, as is eutrophication of surface water. It is an anthropophobic insect both in Ireland and elsewhere.

Range, distribution and status: the Irish distribution of this insect is centred on the midlands and the west of the island. Away from protected sites, *M.aerosa* is becoming difficult to find and, although it could not yet be classified as threatened in Ireland, if present rates of loss of habitat continue it can only be expected that this species will become threatened here within the next decades. Given its habitat associations, *M.aerosa* is unlikely to have been very frequent over most of Europe since before the post-glacial climatic optimum and, certainly, it is regarded as threatened in most of western Europe today. Since this syrphid appears to be endemic to Europe, and has a restricted range within Europe, the fact that it is regarded as threatened in most of western Europe has more significance than would be the case in many other species. Indeed, *M.aerosa* is probably more frequent in Ireland now than it is anywhere else in Europe, so any significant decrease in its frequency in Ireland has potential implications to the status of this species in general.

Irish reference specimens: in the collections of NMI and UM.

Melanogaster hirtella (Loew), 1843



History: given as occurring in Ireland in Coe (1953).

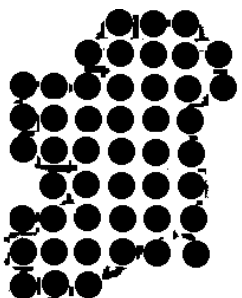
Ecology: *M.hirtella* occurs in a wide range of fen/wet grassland situations in Ireland, though drainage and surface-water eutrophication are now probably responsible for a diminution in its frequency. It is found where there are streamlets or flushes, pools or ponds, its larvae living in water-edge mud or fen peat. In bog this species is replaced by *M.aerosa*. Its close similarity to both that species and others necessitates careful checking of the identity of putative specimens of *M.hirtella* collected in Ireland.

Range, distribution and status: until recently, *M.hirtella* has been very frequent and widely-distributed in Ireland. It is still generally distributed here, but intensification of use of farmland, involving drainage of wet grassland, leads to disappearance of this insect, except where there are canalised streams which may continue to provide larval microhabitat. Nonetheless, *M.hirtella* is probably as frequent in Ireland as it is anywhere else in its range. Its "headquarters" are essentially the Atlantic seaboard of Europe from northern Germany south to Brittany, plus the offshore islands of Britain and Ireland. Unlike many wetland syrphids, this is not a species which is abundant in lowland wetlands of Scandinavia. In fact, it is not known there further north than Denmark.

Irish reference specimens: in the collections of NMI and UM.

Genus *MELANOSTOMA*

Melanostoma mellinum (L), 1758



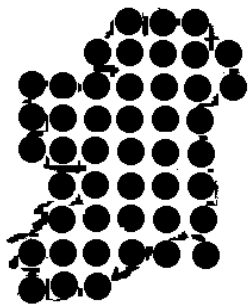
History: given as occurring in Ireland in Coe (1953).

Ecology: *M.mellinum* is a polyform species, the different forms varying in frequency with the habitat in which the species is found. Whether these forms are simply ecotypes or have greater taxonomic significance is unclear - they are certainly not all equally distinct. In Ireland, the two predominant forms are one which occurs in moorland/bog situations and the other which occurs generally in grassland. Both are frequent and can occur together. *M.mellinum* ranges over a wide variety of open country habitats here, including improved grassland, which is typical of the species over much of Europe. Its capacity to survive in improved grassland makes *M.mellinum* a characteristic species of the standard farmland landscape of green fields and hedges and it has to be regarded as extremely anthropophilic in Ireland. However, it is not an insect of suburban gardens or parks, and in conifer plantations would be confined to vegetated tracksides.

Range, distribution and status: this Holarctic species is widely distributed and common over most of Europe, including Ireland.

Irish reference specimens: in the collections of NMI and UM.

Melanostoma scalare (Fabricius), 1794



History: given as occurring in Ireland in Coe (1953).

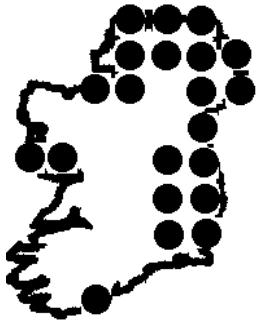
Ecology: although primarily an insect of humid forest, *M.scalare* is in Ireland as much an open country insect, due to the extremely Atlantic climate. It is of frequent occurrence along field margins and hedges, in the standard farmland landscape, and can occur entirely away from any woodland influence in humid, unimproved grassland and along streams in moorland. It is also found in fen, although not in bog or transition mire and does not occur in brackish habitats like salt marsh, or in coastal dunes. It occurs in association with most types of deciduous woodland found in Ireland, including scrub, and is to be found in suburban gardens and parks. In conifer plantations it is absent except where deciduous woodland intrusions occur or well-vegetated track margins are present. Despite that, it can be classified as a strongly anthropophilic insect in Ireland.

Range, distribution and status: *M.scalare* is common and generally distributed in Ireland. It also ranges widely through the Palaearctic, from the Atlantic to the Pacific. It is not, however, known from N America. In Europe, it is found from northern Norway to the Mediterranean, but becomes localised to more humid situations in southern parts of the continent.

Irish reference specimens: in the collections of NMI and UM.

Genus MELIGRAMMA

Meligramma cincta (Fallen), 1817



History: given as occurring in Ireland in Coe (1953).

Ecology: *M.cincta* is associated primarily with remaining areas of oak forest in Ireland, but can be found in suburban parks and gardens where scattered, mature oak, sycamore or beech trees are present. It is not a species of conifer plantations (unless stands of deciduous trees are present), hedges or *Betula/Salix* scrub and in continental Europe is frequently found in association with humid beech forest. Its larvae have been found on beech, lime, oak and sycamore.

Range, distribution and status: Irish records of *M.cincta* are concentrated in the north and east of the island. This is not a frequent species here, but neither can it be regarded as threatened. There is no obvious reason why it is apparently distributed mostly in northern and eastern Ireland. *M.cincta* extends beyond Europe only as far as Asia Minor. Within Europe it ranges widely, being most frequent in central parts of the continent and mountainous parts of southern Europe.

Irish reference specimens: in the collections of NMI and UM.

Meligramma guttata (Fallen), 1817



History: added to the Irish list by Speight *et al* (1975).

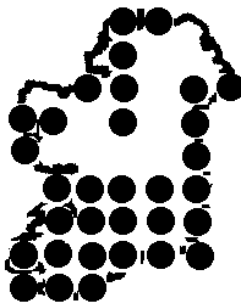
Ecology: riparian gallery forest of *Fraxinus* and hedges in farmland with mature *Fraxinus* seem to be the focus of this enigmatic species in Ireland. Seeing that elsewhere the larvae have been collected from aphid colonies on *Acer pseudoplatanus* it might be expected that *M.guttata* would exhibit some association with sycamore here, but this is not the case. This is another syrphid with arboreal aphidophagous larvae on deciduous trees and it shows no capacity to colonise conifer plantations.

Range, distribution and status: the few Irish records of this species are from the east of the island and not from protected sites. It would realistically be categorised as vulnerable in Ireland and as a candidate for inclusion on any listing of species requiring protection at national level. *M.guttata* is a Holarctic syrphid, with an extensive range in both Eurasia and N America, but although it is widely distributed in Europe, it is generally infrequent and in some parts regarded as threatened. In southern Europe it is confined to mountainous country and is not known in the Mediterranean zone.

Irish reference specimens: in the collections of NMI.

Genus *MELISCAEVA*

Meliscaeva auricollis (Meigen), 1822



History: given as occurring in Ireland in Coe (1953).

Ecology: occurs in association with both oak forest and *Betula/Salix* scrub in Ireland, but is by no means characteristic of either. The wide range of situations in which its larvae can occur (tree foliage, shrubs and tall herbs) and the fact that it can use both aphids and psyllids as larval food, provide this syrphid with potential to exploit a variety of habitats. *M.auricollis* is to a significant extent an anthropophilic species here, found more frequently in suburban gardens and conifer plantations, than in more natural situations. However, in Ireland *M.auricollis* is not characteristically a constituent of farmland hedge faunas.

Range, distribution and status: until recently, the available distribution records for this syrphid in Ireland were scattered round the periphery of the island, few records originating further than 20km from the coast. It is well-established that the adults of *M.auricollis* undertake long distance movements, though not on the scale of the classic "migrators" among European syrphids, like *Episyrphus balteatus*, and it would be typical for such movements to occur along the coast. There is no reason to suppose that such movements would be confined to immigrant specimens arriving in Ireland from elsewhere. They could equally easily be undertaken by elements of the resident Irish population of the species. Latterly, *M.auricollis* has been recorded from conifer plantations in much of the southern half of the island and it can only be concluded that it is now established in these plantations and expanding its range through them quite rapidly. Considering this species' capacity for long distance movement together with the reality that it has probably been on the edge of its climatic range here - it reached northwards in western Europe only to the southern tip of Norway as recently as 10 years ago (Nielsen, 1999) - suggests that the existing Irish distribution pattern may in part be a consequence of recent changes in climatic conditions. In the previous version of these

species accounts (Speight, 2000a) it was suggested that *M.auricollis* would be an appropriate candidate for monitoring, in any attempt to use insects in climatic warming studies in Ireland, since it would be expected that this species would establish more permanent populations over much of the island as climatic amelioration occurred, leading rapidly to it becoming generally distributed here, due to the general availability of appropriate habitat.

Irish reference specimens: in the collections of NMI and UM.

Meliscaeva cinctella (Zetterstedt), 1843



History: given as occurring in Ireland in Coe (1953).

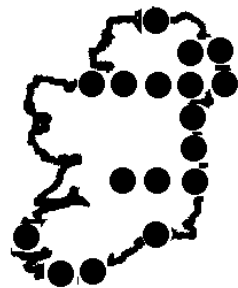
Ecology: found in association with most types of deciduous forest and woodland occurring in Ireland and with conifer plantations. *M.cinctella* is often found in the vicinity of *Ulex* thickets and it seems likely that its larvae may use aphids on this shrub as food, though this has not been demonstrated. In continental Europe, this species is more frequently found with conifers than it is in Ireland.

Range, distribution and status: *M.cinctella* is generally distributed and common in Ireland, as it is over much of Europe, from central parts of Scandinavia almost to the Mediterranean. This is a Holarctic species, ranging widely in both the Palaearctic and Nearctic regions.

Irish reference specimens: in the collections of NMI and UM.

Genus *MERODON*

Merodon equestris (Fabricius), 1794



History: given as occurring in Ireland in Coe (1953).

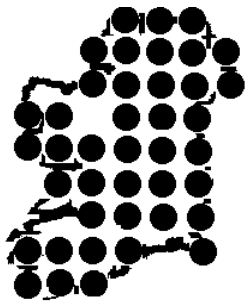
Ecology: this species is almost entirely anthropophilic in Ireland, and still occurs most frequently within urban/suburban areas. The form of the species present in Ireland is that normally found in open areas within humid deciduous forest in the Atlantic zone of Europe. Other forms occur further south and at higher altitudes. *M.equestris* may now have established itself in wild plant hosts, or at least in populations of garden plants (e.g. various *Allium* and *Narcissus* species) that have established themselves away from gardens in Ireland, but the general lack of appropriate bulbiferous indigenous plants would seem to ensure that this syrphid will remain largely dependent upon gardens and horticultural establishments for its survival here.

Range, distribution and status: this species has evidently reached most parts of the island now, even if remains somewhat localised. It is not a threatened insect in Ireland and is widely distributed and frequent in much of Europe, except in the north, where it reaches only the southern edge of Scandinavia. *M.equestris* is effectively becoming cosmopolitan, under man's influence.

Irish reference specimens: in the collections of NMI and UM.

Genus *MYATHROPA*

Myathropa florea (L.), 1758



History: given as occurring in Ireland in Coe (1953).

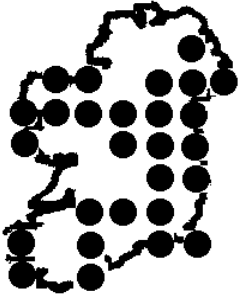
Ecology: although primarily a forest insect, with its aquatic larvae living in wet tree holes (in particular in temporary, water-filled hollows in tree forks, or other external situations), *M.florea* may also frequently be found away from woodland in Ireland, for instance in fen or humid, seasonally-flooded grassland. The range of microhabitats used by the larvae of this insect is probably inadequately known and it seems likely that it may, on occasion, be able to use garden compost heaps and, on farms, other accumulations of wet vegetable matter like manure, or even silage, from the circumstances under which it can be found.

Range, distribution and status: *M.florea* is generally distributed and common in Ireland, as it is over most of Europe from central Scandinavia southwards almost to the Mediterranean. It also ranges widely outside Europe, through Asiatic parts of the Palaearctic.

Irish reference specimens: in the collections of NMI and UM.

Genus *NEOASCIA*

Neoascia geniculata (Meigen), 1822



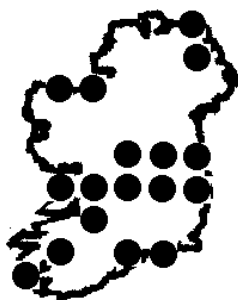
History: given as occurring in Ireland in Coe (1953).

Ecology: in Ireland, as elsewhere, *N.geniculata* is almost exclusively an oligotrophic wetland insect. Here it is associated primarily with fen conditions, including poor/acid fen. Northern European mires are probably more the habitat of *N.geniculata*. This insect seems distinctly anthropophobic - it does not normally occur within the farmed landscape, in suburbia or in association with forestry.

Range, distribution and status: there are few recent records of this species, which appears to be declining in Ireland, presumably as a consequence of habitat loss. It is not, as yet, sufficiently localised that it warrants categorisation as threatened. But it probably should be regarded as vulnerable. Although it ranges widely through northern Europe into Siberia, further south it becomes scarce, and is almost unknown south of the Ardennes. It is extremely infrequent in central Europe, including the Alps.

Irish reference specimens: in the collections of NMI and UM.

Neoascia meticulosa (Scopoli), 1763



History: given as occurring in Ireland in Coe (1953).

Ecology: there is no noticeable difference between the ecology of this species in Ireland and elsewhere. It is absent from both bogs on the one hand and the vicinity of eutrophicated streams and pools on the other, occurring primarily in association with streamlets and pools in fen and marsh.

Range, distribution and status: Irish records of this species are well scattered round the island, but with a concentration in the midlands. *N.meticulosa* is not a threatened species in Ireland, but

neither is it very frequent here. It is frequent in Atlantic parts of Europe, but less so in central Europe and remains unrecorded in the Mediterranean zone.

Irish reference specimens: in the collections of NMI and UM.

Neoascia obliqua Coe, 1940



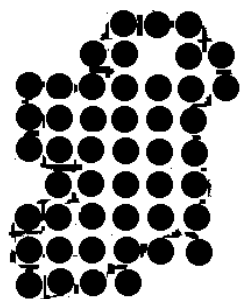
History: added to the Irish list by Anderson (1986).

Ecology: this is a species of waterside woodland, especially along brooks, where it may occur in association with quite dense tall herb vegetation at partially-shaded situations. There are too few Irish records to be certain that *N.obliqua* shows no ecological characteristics particular to Ireland, but the available data would suggest the species can be expected to act here as it does elsewhere. This is an insect whose habitat is adversely influenced by man's activities, not in any sense an anthropophilic insect.

Range, distribution and status: *N.obliqua* exhibits a relictual distribution pattern in Ireland and has to be regarded as an endangered species here, appropriate for inclusion on any listing of insects requiring protection throughout the island. It is also regarded as threatened in some other parts of the Atlantic seaboard, but this is not a general situation. *N.obliqua* is endemic to Europe and is primarily a central European species, which reaches only the southern edge of Scandinavia and is unknown in the Mediterranean zone.

Irish reference specimens: in the collections of UM.

Neoascia podagrica (Fabricius), 1775



History: given as occurring in Ireland in Coe (1953).

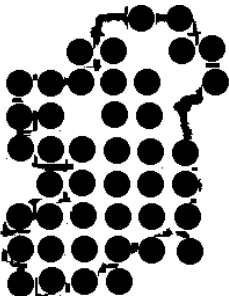
Ecology: although in wetland *N.podagrica* does occur away from human influence it is essentially an anthropophilic species in Ireland, frequent where there are garden compost heaps, wet field

ditches, farmyards etc. It can occur in Ireland in association with (and has been bred from) constructed wetlands, introduced to farmland for treatment of livestock waste. The largely cow-based farming economy of Ireland, coupled to the humid climate, suits this species well.

Range, distribution and status: *N.podagrica* is common and generally distributed in Ireland. It is also widely distributed and frequent in much of continental Europe, from central Scandinavia to the Mediterranean.

Irish reference specimens: in the collections of NMI and UM.

Neoscia tenur (Harris), 1780



History: given as occurring in Ireland in Coe (1953).

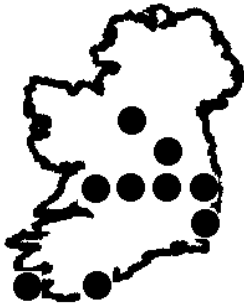
Ecology: in Ireland, this is a species of fen, marsh and humid, seasonally flooded grassland. But it is an insect associated with oligotrophic conditions and there are no data to suggest it may take advantage of the presence of cow dung as a larval microhabitat, or that it is in other ways supported by current animal farming practices, except in that it can occur in Ireland in association with (and has been bred from) constructed wetlands, introduced to farmland for treatment of livestock waste. Neither is this an insect which occurs in association with garden compost heaps or garden ponds. As general nutrient levels increase in farmland, with persistent use of fertilisers, this species can be expected to decrease.

Range, distribution and status: this species remains common and widely distributed in Ireland. It is frequent in Scandinavia, from northern Norway southwards and in Atlantic parts of Europe. It is markedly less frequent in the continental and Mediterranean zones of Europe.

Irish reference specimens: in the collections of NMI and UM.

Genus *ORTHONEVRA*

Orthonevra geniculata (Meigen), 1830



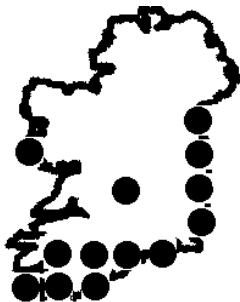
History: given as occurring in Ireland in Coe (1953).

Ecology: while it is true to say that this species occurs in association with cold, oligotrophic springs and small brooklets, often within fen, it does so primarily where the water spreads out to give a thin surface film, and is found also in association with more strictly helocren features. These features may be of only a few square metres in surface area, isolated within some other habitat, and adults of this species are rarely found away from them. Over much of the countryside, this type of habitat has been drained or consigned to a ditch and in all probability remaining Irish localities for *O. geniculata* reflect only part of its potential habitat range here.

Range, distribution and status: most of the few records (9 in all) are from the Midlands and south of the island, all of them from different 50km UTM squares. Recent records are mostly from protected wetland sites and the species may well be largely dependent upon such protection for its continued survival in Ireland. Although it cannot realistically be regarded as endangered here, it would reasonably be categorised as vulnerable. In most parts of Europe south of Scandinavia, and for which data are available it would also be classified as vulnerable, or at least decreasing. In central Europe it should perhaps be regarded as endangered.

Irish reference specimens: in the collections of NMI.

Orthonevra nobilis (Fallen), 1817



History: given as occurring in Ireland in Coe (1953).

Ecology: this syrphid occurs in association with springs and flushes in various situations in Ireland, but not where the water has become eutrophicated or the water-saturated ground has become enriched by organic waste like cow dung, or in conifer plantations. Neither does *O. nobilis*

seem to be associated with rich fen in Ireland. General land-drainage activities and canalisation or piping of springs, such as are often associated with farm improvement, do not favour *O.nobilis*. This is not an anthropophilic insect and it can only be speculated that it was much more frequent in Ireland previously than it is today.

Range, distribution and status: the Irish records of *O.nobilis* are nearly all from the south and east of the island, but they cover a range of altitudes from 175m in Wicklow to sea level in Wexford. This is not a frequent species in Ireland and can only be expected to decrease as land drainage continues. It is widely distributed elsewhere in Europe, though absent from much of Scandinavia, and does not seem to be regarded as under threat in any part of the continent from which it is known.

Irish reference specimens: in the collections of NMI.

Genus *PARAGUS*

Paragus constrictus Simic, 1986



History: attention was first drawn to the presence of this insect in Ireland by Speight (1978a), who at that time considered it to be a variant of *P.tibialis*. Speight & Chandler (1995) pointed out that all known Irish material of *P.tibialis* belonged in fact to *P.constrictus*.

Ecology: in Ireland, *P.constrictus* has only been found on thinly vegetated limestone pavement at low altitude and in a calcareous coastal dune system. Low-lying limestone pavement is evidently a most suitable habitat for this insect, since it occurs in the Burren in many different localities and may be frequent where found. A predominantly bare-rock ground surface seems to be significant to this species, since it is largely replaced by the much more generally-distributed *P.haemorrhous* where a complete cover of ground vegetation occurs.

Range, distribution and status: it seems that in Ireland *P.constrictus* is virtually confined to low altitude, limestone pavement areas. Although this means that it is known from only two 50km UTM grid squares it is frequent where it occurs and does not at present seem to be under significant threat. Like *Cheilosia ahenea*, with which it occurs in Ireland, *P.constrictus* gives every indication of being an early post-glacial relict species in Ireland, and, like *C.ahenea*, its closest-known continental stations to Ireland are in the vicinity of the Rhine. Neither of these two species, it should be noted, are known from the Pyrenees, or northern Spain or Portugal, though *P.constrictus* does occur in central Spain. Similarly, *P.constrictus* is unknown from Scandinavia. It is not yet known from Britain (though it would seem very likely to occur there). Localised as it is, its

continued presence in Ireland is heavily dependent upon protection of the Burren limestone pavements from significant change.

Irish reference specimens: in the collections of NMI and UM.

Paragus haemorrhous Meigen, 1822



History: added to the Irish list by Speight (1978a).

Ecology: in Ireland, this open-ground insect is largely confined to heath, heather-dominated areas of partially-drained raised bog, *Molinia* grassland and limestone pavement grassland. It does not occur in improved or intensive grassland and does not seem to occur along field or hedge margins. Neither has it been recorded from suburban gardens. It thus has to be regarded as a largely anthropophobic species here.

Range, distribution and status: Irish records of *P.haemorrhous* are scattered round much of the island, but it is not a frequent species here. Even so, it would not be justified to regard it as under threat in Ireland. This species has a vast world range and occurs over most of Europe, becoming more frequent towards the south, where it also occurs in association with certain crops.

Irish reference specimens: in the collections of NMI and UM.

Genus *PARASYRPHUS*

Parasyrphus annulatus (Zetterstedt), 1838



History: given as occurring in Ireland in Coe (1953).

Ecology: the few Irish records are from the vicinity of *Picea* plantations, but there is no obvious reason why a spruce-associated hoverfly should be so rarely recorded from spruce plantations in Ireland, if it occurs here in such situations at all. Possibly, the aphids upon which the larvae of *P.annulatus* feed are themselves scarce in Irish conifer plantations. Or, possibly, the species has

only recently arrived in Ireland and its spread is for some reason less rapid than that of some of the other conifer-associated species? Certainly, none of the other *Parasyrphus* species associated only (or almost entirely) with conifers, and now found in Ireland, are frequent here. Neither were any of them recorded from Ireland prior to the 1970s. But the presence of *P.annulatus* in Ireland was recognised in the 1950s (Coe, 1953). Since *P.annulatus* is known from taiga forest in northern Norway south to pine forest in the Alpes Maritimes of southern France, plus right across Siberia to the Pacific coast, it does not seem likely that climatic factors would restrict its occurrence in Ireland.

Range, distribution and status: considered simply on the basis of the small number (four) of records there are of this species from Ireland, it should be regarded as threatened here. The fact that apparently appropriate habitat is becoming increasingly available year by year, in the form of conifer plantations, should lead to increased frequency of *P.annulatus* in Ireland. However, there is no evidence that the species is responding in this way - unknown factors appear to be limiting its frequency in Ireland. One possibility which requires to be brought into consideration is that *P.annulatus* is not associated with conifers in Ireland, but with deciduous trees. A few conifer-associated beetles, notably the clerid *Thanasimus formicarius* (L.) and the lycid *Pyropterus nigroruber* (DeGeer), are presumed to have survived the prolonged absence of indigenous conifers in Ireland via a limited association with deciduous trees, which has left them apparently adapted to this situation and unable to take advantage of the recent re-appearance of conifers mediated by human activity. It is conceivable that some similar history is responsible for the curious situation of *P.annulatus* in Ireland. But if other conifer-associated syrphids (e.g. *Parasyrphus lineola*, *P.malinellus*) are arguably recent arrivals in Ireland, which have established themselves since conifer plantations were introduced to the landscape, why would *P.annulatus* be unable to do likewise? If *P.annulatus* were able to colonise Irish conifer plantations by immigration from elsewhere, any localised indigenous *P.annulatus* population associated with deciduous trees would be unlikely to figure prominently in distribution records, its presence being masked by records of immigrants to the conifers. The relative scarcity of Irish records of various conifer-associated hoverflies is alluded to a number of times in these species accounts, the most extreme examples being *Didea alneti* and *M.compositarum*. There is perhaps a general conclusion to be drawn from these data, namely that, although the conifer plantations scattered around the Irish countryside in ever-increasing quantity might appear to provide habitat for syrphids with larvae feeding on aphids in conifer foliage, so that the conifer foliage-associated syrphids in the Irish fauna should be reasonably frequent, if not increasing in frequency, this interpretation fails to take into account the significance of other factors which may limit occurrence of these insects. Returning to the case of *P.annulatus* in Ireland, there does not seem to be any obvious explanation for the scarcity of Irish records of this species. So, to err on the side of caution, the species should be included in any listing of insects requiring protection in the island. It has a wide range elsewhere in Europe, and is not generally regarded as threatened, though it would be categorised as under threat in the Netherlands.

Irish reference specimens: in the collections of NMI.

Parasyrphus lineolus (Zetterstedt), 1843



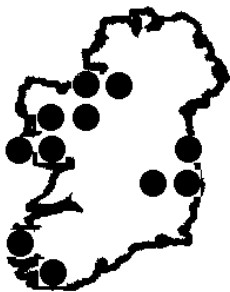
History: added to the Irish list by Speight (1974). Additional Irish records have been published by Anderson (1987).

Ecology: in Ireland, this conifer forest syrphid is confined to commercial conifer plantations. It is almost certainly a recent arrival in the island (Speight, 1974, 1985b), whose presence has been made possible by the extensive programme of conifer planting carried out in the latter half of the 20th century. It may thus be regarded as a highly anthropophilic species in Ireland.

Range, distribution and status: the scattered records of this species in Ireland suggest it is well-established here, even if not frequent. It is widely distributed and frequent in northern and central Europe and ranges far beyond Europe, through northern parts of the Palaerctic and in the Nearctic.

Irish reference specimens: in the collections of NMI and UM.

Parasyrphus malinellus (Collin), 1952



History: added to the Irish list by Speight *et al* (1975). Additional Irish records are published in Nash and Speight (1976) and Nelson (1988).

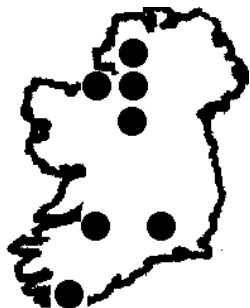
Ecology: this is another conifer forest syrphid. Its history in Ireland parallels that of *P.lineola*, though it seems to have spread more comprehensively into Irish conifer plantations than has *P.lineola*. It can be regarded as a recent arrival, dependent upon introduced conifers. As such, it is an anthropophilic species here.

Range, distribution and status: the situation of *P.malinellus* in Ireland is similar to that of *P.lineolus*, though it has been more frequently recorded than the latter species, especially in the west. *P.malinellus* is widely distributed in the Palaearctic, but apparently does not occur in the Nearctic. In Europe, it is not infrequent from southern parts of Scandinavia south to the Alps, where it may be abundant in *Abies* and *Picea* forests. Ball *et al* (2002) suggest that the *P.malinellus*

recognised in Britain seems a little different from *P.malinellus* in Ireland. Continental material of *P.malinellus* also seems to be somewhat heterogenous, and it is possible that more than one taxon is confused under this name.

Irish reference specimens: in the collections of NMI and UM.

Parasyrphus nigratarsis (Zetterstedt), 1843



History: added to the Irish list by Speight (1986a).

Ecology: an unusual feature of *P.nigratarsis* is that its larvae feed on those of leaf beetles (Chrysomelidae), rather than greenfly and their allies. But this larval diet does not provide any obvious explanation for the restriction of the species to cool climates and northerly latitudes. The general absence of *P.nigratarsis* from farmland, where large populations of some potentially-suitable chrysomelid larvae can occur (e.g. *Gastrophysa viridula* on *Rumex*), may well be due to farm management practices, though apparently *P.nigratarsis* larvae can, on occasion be found with *G.viridula* (Rotheray and Hewitt, 1999). Normal farming practice of topping grassland during the growing season, before seeding of plants like *Rumex* takes place, could be expected to ensure that any *P.nigratarsis* larvae present failed to complete their development, converting the fields into a population sink for species like *P.nigratarsis*. But dense populations of larval chrysomelids can also occur away from farmland in most parts of Ireland, for instance of *Phyllodecta* species on various *Salix* species. It can only be assumed that *P.nigratarsis* is not food-limited in Ireland, but that other factors come into play to restrict its occurrence here. A similar conclusion might be drawn in respect of its occurrence in continental Europe, where *P.nigratarsis* is equally restricted. The scattered Irish records of *P.nigratarsis* are from "cold" wet *Salix* woodland sites with a well-developed tall-herb ground flora, protected from the grazing activities of livestock – for instance along streams in conifer plantations.

Range, distribution and status: in continental Europe *P.nigratarsis* is known from southern Scandinavia to mountainous parts of northern Spain and through central Europe into European parts of Russia and on through Siberia to the Pacific. It is also known in N America. It is an infrequent species in Britain and in central Europe hardly met with other than in montane situations – it is most easily found in association with high altitude *Alnus viridis*/*Salix* scrub. This species is very localised in Ireland and, although found repeatedly in some of the sites from which it is known, has to be regarded as a suitable candidate for inclusion on any listing of insects requiring protection at national level.

Irish reference specimens: in the collections of NMI.

Parasyrphus punctulatus (Verrall), 1873



History: given as occurring in Ireland in Coe (1953).

Ecology: conifer plantations and oak woodlands are the situations in which *P.punctulatus* is most frequently encountered in Ireland. It may also occur in association with mature, deciduous scrub. *Betula* does not seem to support this species, but it does occur in *Alnus/Betula/Salix* scrub. Its occurrence with conifer plantations ensures a wide distribution here and it can be regarded as primarily an anthropophilic species in Ireland. In continental Europe it occurs in association with humid deciduous forests of oak and beech and with conifer forests up to the tree limit, in *Larix* forest.

Range, distribution and status: *P.punctulatus* is common and widely distributed in Ireland and in other Atlantic parts of Europe, from the southern edge of Scandinavia to northern France. Away from mountainous country it becomes less frequent in central and southern Europe and is not known from the Mediterranean zone, or from Spain and Portugal. It does, however, range widely beyond Europe, in Asiatic parts of the Palaearctic.

Irish reference specimens: in the collections of NMI and UM.

Parasyrphus vittiger (Zetterstedt), 1843



History: added to the Irish list by Nash (1975).

Ecology: the few Irish records of this species are from predominantly *Quercus* woodland situations and do not accord with what is known of *P.vittiger* in continental Europe. There, this syrphid is characteristic of conifer forests, though it does not seem to reach the altitudes of *Larix* forest. In Britain it is associated particularly with *Pinus sylvestris* woodland, and so reflects the continental situation. It is especially frequent in the indigenous Caledonian pine forest of Scotland. If precise

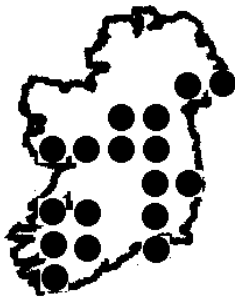
information were available on the aphid species used as larval food by *P.vittiger*, the reasons for its scarcity in Ireland might become clearer. But, for now, *P.vittiger* joins the ranks of the group of conifer associated syrphids which are unaccountably scarce in Ireland, despite the existence of an apparent abundance of potential habitat provided by commercial conifer plantations.

Range, distribution and status: *P.vittiger* is yet another conifer-associated syrphid that is very restricted in its Irish distribution, being in this case largely confined to a limited part of eastern Ireland. In this it contrasts with its situation in Britain, where it is widely distributed and frequent. In continental Europe it is also widely distributed and not infrequent from southern Scandinavia south to the Alps (inclusive) and in the Pyrenees. It is probably a candidate to be considered for inclusion on listings of insects requiring protection in Ireland.

Irish reference specimens: in the collections of NMI and UM.

Genus *PARHELOPHILUS*

Parhelophilus consimilis (Malm), 1863



History: given as occurring in Ireland in Coe (1953).

Ecology: in Ireland, this insect is characteristic of small pools in poor fen. *P.consimilis* also occurs where the secondary habitats created by abandoned peat-diggings round the edge of raised bogs include pools. Its occurrence on blanket bog is very limited, being confined to pools in poor-fen flushes or, on occasion, abandoned cut-over where pools fed by ground-water have produced a facsimile of fen conditions. A temporary habitat for this species was created by the immense ditches installed for drainage of large Midland bogs used for commercial peat extraction. *P.consimilis* does not occur in association with eutrophicated waters and can be expected to disappear as small standing-water bodies become enriched with fertiliser residues. General land-surface drainage can also eliminate the species, or consign it to an uncertain future confined to drainage ditches.

Range, distribution and status: apparently absent from the north west of the island, but otherwise well distributed in Ireland. On the basis of the number of available records, it is unrealistic to consign this species to any threat category. However, the factors which conspire currently to cause progressive reduction in the availability of habitat for *P.consimilis* show little sign of abating and it has to be anticipated that this species may soon require inclusion among those regarded as vulnerable in Ireland. Ireland is one of the few parts of western Europe where the status of

P.consimilis is not already that of a threatened species, at some level. It is also very scarce in central Europe and regarded as threatened in Switzerland.

Irish reference specimens: in the collections of NMI and UM.

Parhelophilus versicolor (Fabricius), 1794



History: given as occurring in Ireland in Coe (1953).

Ecology: *P.versicolor* can occur in water that is more nutrient-rich than can be tolerated by *P.consimilis* and can be expected wherever the larger species of bulrush (*T.latifolia*) is to be found in standing water, its larvae occurring just below the water surface on decaying *Typha* stems, beneath the outer stem-sheathing leaves. However, this hoverfly can occur in the absence of *Typha*, which is the case in many of its Irish localities. *P.versicolor* is an insect of water bodies in marsh and fen, rather than bog habitats, and can sometimes be found in farmland in Ireland, in association with permanent pools/ponds or permanently water-filled ditches. It can also occur in Ireland in association with constructed wetlands, introduced to farmland for treatment of livestock waste. It does not seem to be found in association with temporary water bodies, or with garden ponds. Its tolerance for eutrophication thus lies somewhere between that of *P.consimilis* (intolerant) and *Helophilus pendulus* (very tolerant).

Range, distribution and status: in Ireland, *P.versicolor* is infrequent, though widely distributed. However, it is not a threatened species here. It is also widely distributed in Europe, from the southern tip of Norway to the Mediterranean, and becomes more frequent towards southern parts of the continent.

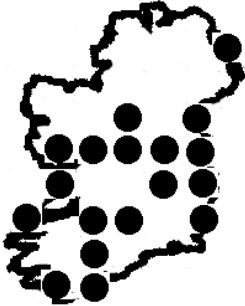
Irish reference specimens: in the collections of NMI and UM.

Genus *PIPIZA*

The European species of the genus *Pipiza* are badly in need of revision - arguably more so than the species of any other syrphid genus. At present species concepts in this genus are uncertain and a stable nomenclature cannot be established. Speight (2002a) provides a key to the Irish *Pipiza* species, more-or-less following Coe (1953) and Stubbs and Falk (1983) in the way in which the names *P.austriaca*, *P.bimaculata*, *P.luteitarsis* and *P.noctiluca* are applied. *P.festiva* is also included in the key, because of the existence of a specimen of this species supposedly of Irish provenance (see under *P.festiva*, below). *Pipiza fenestrata* (Mg) and *P.lugubris* (Fab.), that are not known in Ireland but

recognised as occurring in Britain, are not included in that key because of uncertainty over their identity and lack of reliable diagnostic features.

Pipiza austriaca Meigen, 1822



History: given as occurring in Ireland in Coe (1953).

Ecology: in Ireland as elsewhere *P.austriaca* is characteristic of the ecotone between forest and open ground and can occur in man-made facsimiles of this ecotone, like hedgerows with an associated field margin. However, it does not seem to occur in suburban gardens. Frequently, it is found in the vicinity of bramble (*Rubus fruticosus* agg.) thickets along tracks in deciduous woodland or conifer plantation. This is an insect that has probably diminished in frequency in consequence of hedgerow removal.

Range, distribution and status: there are no records of *P.austriaca* from the NW of Ireland, which would be consistent with its distribution elsewhere, e.g. its absence from most of Scotland (Ball and Morris, 2000) and from all but the extreme south of Norway (Nielsen, 1999). But records from the rest of the island are sufficiently frequent that this species cannot be regarded as under threat in Ireland.

Irish reference specimens: in the collections of NMI.

Pipiza bimaculata Meigen, 1822



History: given as occurring in Ireland in Coe (1953).

Ecology: in Ireland this species is known from woodland edge and tracksides of *Quercus* forest.

Range, distribution and status: the few verified Irish records of *P.bimaculata* are from counties Dublin and Wicklow. The fact that it has only one generation per year and an early flight period

mitigate against capture. But the species seems nonetheless scarce. It would seem appropriate that *P.bimaculata* be considered for inclusion on any list of threatened Irish species.

Irish reference specimens: in the collections of NMI.

Pipiza festiva Meigen, 1822



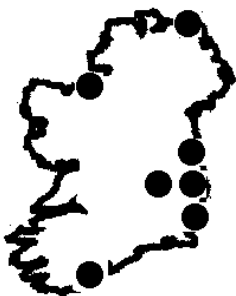
History: added to the Irish list by Speight (2002b), who discusses the doubtful provenance of the only known Irish specimen.

Ecology: *P.festiva* is primarily a species of alluvial forest, with a secondary habitat in fruit orchards. The Irish locality, woodland on the shores of L. Neagh, would be in some ways similar to alluvial forest.

Range, distribution and status: known Irish material is limited to one female specimen labelled as collected from Rea's Wd. (Co. Antrim). *P.festiva* is not known from Britain. In continental Europe, the species ranges from the Netherlands south to the Mediterranean zone and from Spain eastwards through central and southern Europe into Russia and on to the Pacific. In Belgium and the Netherlands it is regarded as decreasing and under some degree of threat, but not elsewhere. If the presence of *P.festiva* in Ireland is confirmed by discovery of more specimens it would be necessary to regard it as threatened here. But, until and unless more Irish material of this species is discovered the status of *P.festiva* as an Irish species will remain very doubtful (see Speight, 2002b).

Irish reference specimens: in the collections of the Ulster Museum, Belfast.

Pipiza luteitarsis Zetterstedt, 1843



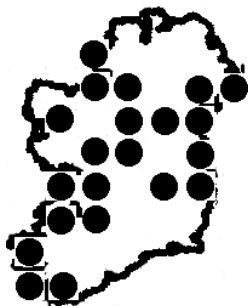
History: given as occurring in Ireland in Coe (1953). Subsequent to recognition of the presence of *P.accola* in western Europe (Wolff, 1998) the identity of available Irish *P.luteitarsis* material has been rechecked and it can be confirmed that it refers to *P.luteitarsis*, not *P.accola*.

Ecology: *P.luteitarsis* is characteristically a species of pathsides and edges of mature acidophilous oak forest in Ireland. Mature suburban gardens (i.e. with shrubs and deciduous trees) can on occasion provide a secondary habitat for this species, but there is no indication that *P.luteitarsis* occurs along hedgerows in farmland. Essentially, this is a deciduous forest insect which does not occur in either open ground or wetland habitats. Neither does it occur in association with conifer plantations.

Range, distribution and status: Irish records of *P.luteitarsis* are few, localised and concentrated mostly in one part of the east of the island. But there is no indication that the species is decreasing and it is recorded from protected sites, so at present there is not much justification for including it on lists of species requiring protection at national level. This species is not widely distributed in Europe, occurring from southern Norway south through mountainous country to central France and then eastwards through the Alps. But generally it is not regarded as under threat, apart from in Belgium.

Irish reference specimens: in the collections of NMI.

Pipiza noctiluca (L.), 1758



History: given as occurring in Ireland in Coe (1953). Due to the potential for confusion between the males of this species and *P.bimaculata*, identification of the females is more reliable.

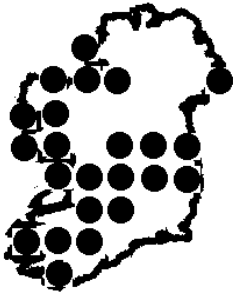
Ecology: *P.noctiluca* is very much a species that “skulks” along and within the fringes of tall-herb vegetation edging tracks or open areas in deciduous and coniferous woodland and in similar situations between wetlands and drier open ground. In this it resembles *P.austriaca*, but occurs also in wetter and more humid situations than *P.austriaca*. Additionally, *P.noctiluca* can occur in suburban gardens.

Range, distribution and status: *P.noctiluca* is the most frequently met with species of *Pipiza* occurring in Ireland and cannot be regarded as threatened here.

Irish reference specimens: in the collections of NMI.

Genus *PIPIZELLA*

Pipizella viduata (L.), 1758



History: given as occurring in Ireland in Coe (1953), wherein it appears under the name *P. varipes*. The presence of *P. viduata* in Ireland was confirmed by Speight (1978d). In earlier literature, *P. viduata* appeared under the name *P. virens* (Fab.). It is now recognised that *P. virens* is distinct from *P. viduata*. Andrews (1914) recorded *P. virens* from Kenmare (Co.Kerry), but he was presumably referring to specimens of what is today called *P. viduata*. There are no substantiated records of *P. virens* (Fab.) from Ireland. *P. virens* is predominantly an insect of well-drained deciduous woodland and might be expected in the south east of the island, if it were to occur here at all.

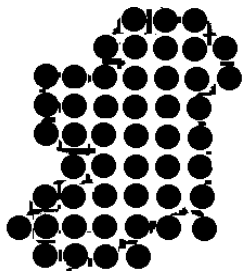
Ecology: in contrast to the situation over much of continental Europe, in Ireland *P. viduata* is not characteristically a woodland hoverfly. Nearly all Irish records of *P. viduata* are derived from one or another of three different situations. The first of these is open ground dominated by low-growing ericaceous shrubs, from boggy moorland through to raised bog, the second is limestone karst grasslands, the third is coastal dune grasslands. Ecological conditions in dune grassland and raised bog might reasonably be regarded as rather different, leading to speculation that perhaps more than one species is confused under the name *P. viduata* in Ireland. However, there is no evidence from the external morphology of the adults that this is the case. But given that a large number of extremely similar *Pipizella* species occur in Europe, many of which can only readily be distinguished by examination of the male terminalia, it remains prudent to check the identity of all male specimens taken in Ireland and to confine records to the male sex. *P. viduata* is not a species which survives in farmland comprising drained, reseeded grassland, fields and hedges. Neither does it occur in conifer plantations or suburban gardens. It thus has to be regarded as largely anthropophobic in the Ireland of today.

Range, distribution and status: *Pipizella viduata* is widely distributed and not infrequent in Ireland, except for in the north of the island, where it appears to be largely absent. In this, its distribution is similar to what is observed in central Scandinavia, where the species abruptly becomes very infrequent and then absent further north. Further south in Europe it is both widely distributed and frequent, only becoming more restricted (to mountainous parts) in the Mediterranean zone.

Irish reference specimens: in the collections of NMI and UM.

Genus *PLATYCHEIRUS*

Platycheirus albimanus (Fabricius), 1781



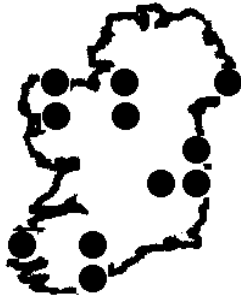
History: given as occurring in Ireland in Coe (1953).

Ecology: in Ireland, Britain and other parts of the Atlantic seaboard of Europe from Denmark to northern France, *P.albimanus* is an extremely anthropophilic species, occurring abundantly in various sorts of farmland, suburban gardens and parks. It is also found along tracks and in other open parts of conifer plantations. Under more natural conditions it occurs in open parts of oak forest and Atlantic scrub, including *Corylus* thickets. It is not characteristically a wetland species, though it may occur on the periphery of wetlands. Neither is it associated with either coastal dunes or saltmarsh. Within farmland, field margins and hedges provide *P.albimanus* with appropriate habitat. The productive surface area of fields can also be used by this species when ruderal herbs are frequent within crops for periods of two months or so within the growing season, or when aphid populations on the crops themselves are sufficiently abundant. But the alternation between bare, ploughed ground and vegetated ground within one year, recurring either annually or every 2-3 years, which characterises intensively-used farmland, has as a consequence that the open field cannot be relied upon to support *P.albimanus* throughout the year - without the farm infrastructure of hedges and unused corners of land the species can be expected to disappear there. The current trend of combining fields into larger units, in which process hedgerow removal is an integral part, destroys this infrastructure, and *P.albimanus* cannot be predicted to occur in the consequent "prairie farming" landscape. Replacement of the stock-containment function of hedges by electric-fencing also serves to reduce hedge utility and hence hedge maintenance - in these circumstances hedges are at best useful as windbreaks, and at worst little more than ornament, so a farmer has little reason to invest time and money in their maintenance. The farm-landscape structures inherited from the traditional animal-farming regimes ubiquitous in Ireland are ideal for *P.albimanus*. As the infrastructural elements of that landscape deteriorate and disappear, the frequency of occurrence of *P.albimanus* on farmland here can be expected to diminish.

Range, distribution and status: *P.albimanus* is probably the most abundant and generally distributed syrphid in Ireland at present. It is also common in much of Europe (except the south) and ranges widely through both the Palearctic and Nearctic regions.

Irish reference specimens: in the collections of NMI and UM.

Platycheirus ambiguus (Fallen), 1817



History: given as occurring in Ireland in Coe (1953).

Ecology: in Ireland, this syrphid is characteristic of areas of deciduous scrub of *Prunus/Crataegus* and mature hedgerows. It can be expected to occur also where *Ribes* is grown as a fruit crop. *P.ambiguus* does not occur in mature forest, wetlands or open ground and there are no records of it from *Corylus* scrub. Intensification of farm use, resulting in tighter control over scrub-invasion of grasslands and grubbing-up of hedges, removes the only available habitats for this species in much of the Irish landscape, so that current trends in farming can only be expected to result in a reduction in the frequency of occurrence of *P.ambiguus*. Conversion of deciduous scrub to conifer plantation would have a similar effect.

Range, distribution and status: records of *P.ambiguus* are scattered through most of the island, but are few and far between – a circumstance that may well be influenced by the early spring flight period of this insect. Nonetheless, there is no justification for regarding *P.ambiguus* as threatened in Ireland and, unless the current policy of providing financial incentives to farmers for maintenance of hedges in the farmed landscape fails, there is little reason to suppose that this species will become threatened in the immediate future.

Irish reference specimens: in the collections of NMI.

Platycheirus amplus Curran, 1927



History: added to the Irish list by Speight and Vockeroth (1988).

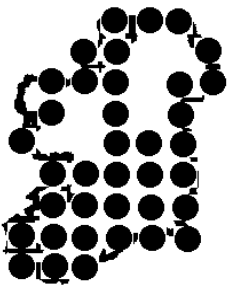
Ecology: recognition of the presence of this species in Europe recently has led in some instances to a rapid demonstration of its widespread occurrence, most evident in Norway (Nielsen, 1999), where it is now known to occur from the far north to the south coast. But re-examination of Irish material belonging to this species group has not had a similar effect - there are but four confirmed Irish records of *P.amplus*. This is essentially an insect of mires, occurring in areas with fluctuating

annual water levels, where the ground surface is almost constantly water-logged. Insufficient Irish records are available to characterise its habitat preferences here and it would seem that conditions are in some ways generally unsuitable for its occurrence. Two of the existing records are from wet, open, oligotrophic grassland/*Juncus* areas along small streams. It has not been refound in its original site of occurrence in Ireland (Pollardstown Fen, Kildare) and subsequent eutrophication of the part of the fen in which it was found may well have caused its disappearance there.

Range, distribution and status: there are few Irish records of this species. From what is known of it in general, it would seem realistic to regard *P.amplus* as a cold climate relict in Ireland, whose distribution here is now affected by restricted habitat availability due to both climatic factors and man's influence. It has to be categorised as threatened, and probably endangered, and should be included on any listing of insects recognised as requiring protection throughout the island. *P.amplus* is frequent in Scandinavia, but generally regarded as threatened further south in Europe. Its situation in Asiatic parts of the Palaearctic is unknown, but it is known to range widely in northern parts of the Nearctic.

Irish reference specimens: in the collections of NMI.

Platycheirus angustatus (Zetterstedt), 1843



History: given as occurring in Ireland in Coe (1953), but at that time this species was confused with *P.occultus*, *P.ramsarensis* and other related species. The presence of this species in Ireland was confirmed by Speight and Goeldlin (1990).

Ecology: *P.angustatus* is typically a species of wetland and humid, seasonally flooded grassland. It is frequent in fen, but in bogs is largely restricted to the edges of raised bog and more base-rich flushes and stream-sides in blanket bog. General land-surface drainage is inimical to the survival of this insect and it is absent from most farmland as a result. Neither is *P.angustatus* an inhabitant of deciduous woodland or conifer plantation, except where they enclose open areas of wet grassland/wetland. Similarly, the species is not normally found with hedgerows or gardens.

Range, distribution and status: *P.angustatus* is more-or-less generally distributed in Ireland and not infrequent. The same is true of this species in other parts of Europe's Atlantic seaboard from northern France northwards, in much of northern Europe and in appropriate habitats in the humid, montane zone of central Europe. Further south, the species is much more localised. It ranges far beyond Europe, through Siberia to the Pacific and also occurs widely in the Nearctic.

Irish reference specimens: in the collections of NMI and UM.

Platycheirus aurolateralis Stubbs, 2002



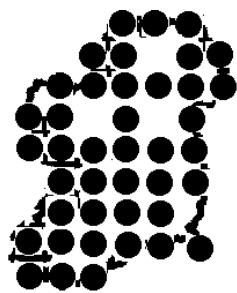
History: added to the Irish list by Speight *et al* (2004).

Ecology: so far, this species has only definitely been collected in Ireland from suburban gardens (Speight, 2005) and mature suburban parks. The adult fly exhibits some specialisation in its flower-visiting habits, seeming not to use such frequent, early spring flowers as *Salix* and *Taraxacum*. Whether this might limit the species to localities where appropriate early-flowering plants are present is unknown, but since one function of urban parks and gardens is to provide a display of herbaceous plants in flower from early spring to autumn it is conceivable that the presence of *P.aurolateralis* in these habitats is related to provision of adult food supply in early spring and autumn, when the species is on the wing. Elsewhere, *P.aurolateralis* seems to be particularly associated with deciduous scrub, having been found with both Atlantic scrub and subalpine scrub.

Range, distribution and status: only further investigation will establish whether this species is more widely distributed in Ireland than the recent records from Co Dublin suggest. Re-examination of Irish material in collections, subsequent to description of *P.aurolateralis*, has not brought to light any further material of the species.

Irish reference specimens: in the collections of NMI.

Platycheirus clypeatus (Meigen), 1822



History: given as occurring in Ireland in Coe (1953), but at that time this species was confused with various other, closely related species. The presence of *P.clypeatus* in Ireland was confirmed by Speight and Goeldlin (1990).

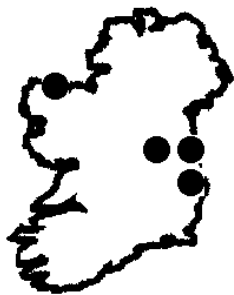
Ecology: in Ireland, *P.clypeatus* is frequent in fen vegetation, wherever it occurs. This syrphid can also be abundant in humid, unimproved grassland, and can persist where there is occasional use of fertiliser to improve the sward. But where grassland is subject to a regime of ploughing, re-seeding and fertilisation (i.e. in intensive grassland) *P.clypeatus* is normally absent. Other closely-related

wetland *Platycheirus* species normally occur together with *P.clypeatus*, but in drier sites *P.clypeatus* is the only species of this group to be found. Essentially, *P.clypeatus* may be found in humid grassland not subject to flooding, while the others are not. This is another species liable to suffer a diminution in frequency consequent upon intensification of farming activities and it is absent from much of the farmed landscape of green fields and hedges. For survival in these situations it is dependent upon farm infrastructural elements of undrained wet patches, margins of wet ditches and neglected corners of grassland.

Range, distribution and status: *P.clypeatus* is common and widely distributed in both Ireland and much of Europe, from northern Norway south to central France. Further south it becomes more localised. It ranges widely outside Europe in Asiatic parts of the Palaearctic and in the Nearctic.

Irish reference specimens: in the collections of NMI and UM.

Platycheirus discimanus Loew, 1871



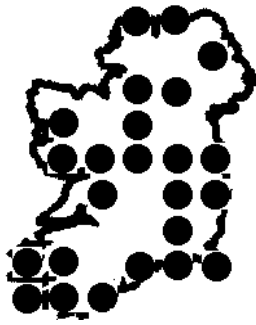
History: added to the Irish list by Speight *et al* (1975).

Ecology: this enigmatic species is in Ireland associated with open areas in humid deciduous woodland and *Prunus spinosa* scrub, but the few records allow little more than that to be said. However, despite its apparent association with *P.spinosa* scrub, it does not seem to occur in hedgerows and there are no records of this insect from the standard Irish farmland landscape of green fields plus hedges. Its early flight period almost inevitably leads to under-recording - a phenomenon not confined to Ireland. It can occur in great numbers at the tree line in the Alps (L.Verlinden, pers.comm.), but elsewhere is rarely encountered.

Range, distribution and status: the few Irish records of this species suggest it should be included in any listing of insects requiring protection in Ireland, but until there is better knowledge of its habitat requirements and biology, such a listing would be largely an empty gesture towards its conservation. The range of this species in Europe extends from the southern edge of Scandinavia south to the Alps, but it is nowhere recorded frequently. It ranges far beyond Europe, through Asiatic parts of the Palaearctic and in the Nearctic.

Irish reference specimens: in the collections of NMI.

Platycheirus fulvoiventris (Macquart), 1829



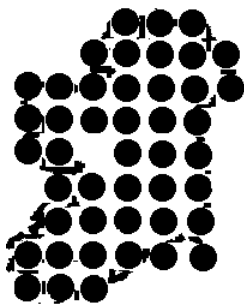
History: given as occurring in Ireland in Coe (1953).

Ecology: *P. fulvoventris* is a characteristic species of reed (*Phragmites*, *Phalaris*) beds and stands of other tall, water margin grasses (e.g. *Glyceria maxima*) in Ireland. It can be found in most situations where this type of vegetation occurs, but does not occur away from it. In consequence, this syrphid does not occur in farm landscapes of green fields and hedges, except where features like reed-lined drainage ditches are present. Similarly, it does not occur in conifer plantations, deciduous woodland or suburban gardens. It can reasonably be regarded as anthropophobic here and liable to diminish in frequency with drainage of wetlands.

Range, distribution and status: widely distributed but infrequent in Ireland, *P. fulvoventris* becomes more common in central (lowlands) and southern Europe. It reaches into northern Europe only as far as the southern edge of Scandinavia. Outside Europe, it ranges through Asiatic parts of the Palaearctic to the Pacific, but is unknown in the Nearctic.

Irish reference specimens: in the collections of NMI and UM.

Platycheirus granditarsus (Foerster), 1771



History: given as occurring in Ireland in Coe (1953).

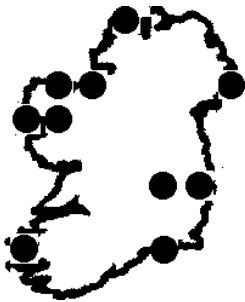
Ecology: this syrphid is characteristic of humid grassland subject to periodic flooding. Until recently, this secondary habitat has provided it with an extensive range within Ireland, away from its more natural wetland sites, in fen and marsh. However, general land-surface drainage has been carried out on a considerable scale during the last half of the 20th century and today *P. granditarsa* cannot today be regarded as an insect typical of the Irish farmland landscape. It does not normally occur in either croplands or the productive area of intensive grasslands, but in Ireland has been bred from setaside strips and from the taller vegetation patches that surround cow dung in humid grassland. In wetlands, it occurs primarily in fen and around the margin of raised bogs. It can also occur along the margin of running or standing water bodies, in association with stands of tall herb

vegetation. Where patches of humid, seasonally-flooded grassland persist it may be found in various situations, such as within conifer plantation.

Range, distribution and status: until recently, *P.granditarsus* has been an extremely frequent and widely-distributed species in Ireland, in marked contrast to its situation in continental Europe, where it is very localised, especially away from the Atlantic seaboard. Although remaining widely distributed in Ireland, it is now much more confined to the wetter, unused patches surviving within the farmland infrastructure, and to the margins of drainage ditches etc. Beyond Europe, *P.granditarsus* ranges through Asiatic parts of the Palaearctic to the Pacific and is very widely distributed in the Nearctic.

Irish reference specimens: in the collections of NMI and UM.

Platycheirus immarginatus (Zetterstedt), 1849



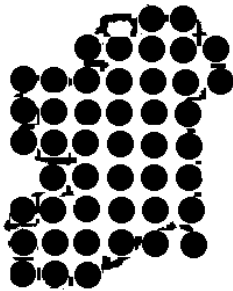
History: given as occurring in Ireland in Coe (1953), but at that time this insect was confused with *P.clypeatus*, *P.occultus*, *P.perpallidus*, *P.ramsarensis* and various other *Platycheirus* species. The presence of *P.immarginatus* in Ireland was confirmed by Speight and Goeldlin (1990).

Ecology: until recently, this species has been so totally confused with others, especially *P.perpallidus* and *P.ramsarensis*, that European distribution data and ecological information supposedly relating to *P.immarginatus* have to be treated with caution. But, wherever it occurs, *P.immarginatus* is essentially a wetland species. In Ireland it has been found almost at sea level in the west, in coastal freshwater marsh and in flush fen systems in bogs. In the midlands it occurs in fen and in the east it has been recorded at some altitude (750ft.) in the Wicklow mountains, with flushes on the periphery of transition mire/fen. In all cases, it is found with tall vegetation. But the records are few and scattered. This species shows every indication of having special requirements which are not easily identified from the character of the localities at which it is found. Brancquart (1999) identifies different types of life history strategy characterising generalists and specialists among syrphid species with aphidophagous larvae and it would seem very likely that *P.immarginatus* is one of those species adapted to exploiting some specific aphid (or other plant bug). This stratagem would restrict it to localities where its chosen prey occurs, because, although such a syrphid species is able to use a food source not available to other syrphids it becomes itself unable to exploit more generally-available, alternative prey. In Norway, where available information has been recently revised (Nielsen, 1999), the situation of *P.immarginatus* is similar to that pertaining in Ireland - it occurs from within the arctic circle to the south coast. In the north it occurs in mires in taiga and tundra and in the south at coastal sites. But all together there are confirmed records from only 4 50km UTM grid squares in the entire country.

Range, distribution and status: in western Ireland recorded from localities scattered from Donegal to Kerry, most of them coastal. There are also a few records from east coast localities and inland records from Kildare and Mayo. The apparent restriction of this species to isolated localities, albeit scattered the length and breadth of the island, gives a relictual distribution pattern to the occurrence of *P.immarginatus* in Ireland. In nearly all cases it is associated with small-scale landscape features susceptible to drainage, or even partial drainage, of the site. Considering these various strands of data together, *P.immarginatus* should probably be regarded as vulnerable in Ireland. It is an extremely infrequent species where it occurs elsewhere along Europe's Atlantic seaboard and is apparently absent from central, southern and eastern parts of the continent. It is a moot point whether the North-American *P.immarginatus* is indeed that species or some other, closely related taxon.

Irish reference specimens: in the collections of NMI and UM.

Platycheirus manicatus (Meigen), 1822



History: given as occurring in Ireland in Coe (1953).

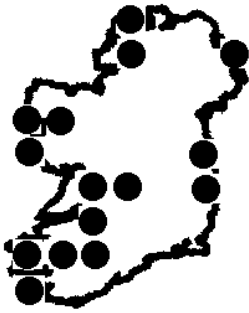
Ecology: In Ireland *P.manicatus* is characteristically a humid grassland insect, occurring both where the ground is subject to shallow flooding and where it is not subject to flooding. Unimproved, or marginally improved (i.e. subject to occasional fertiliser addition) grassland used for extensive grazing or for hay-making suit this insect well and it has been very frequent and widespread here. However, a switch to silage production provides less favourable circumstances for this insect, because silage harvesting involves an increased risk that its larvae will be harvested along with the vegetation and removed from the site with it (within the silage bales). This drain on *P.manicatus* populations, together with the general trend towards intensification of use of grassland, would be sufficient to explain the increasing scarcity of *P.manicatus*. This syrphid can no longer be regarded as characteristic of the farmland landscape of green fields and hedges, because of such changes in land use. Today it survives in farmland along wet ditches and in undrained, largely unused patches within the farm infrastructure. In more natural habitats, *P.manicatus* occurs around the periphery of fens or raised bogs, and along streams in blanket bog or moor etc. In continental Europe, *P.manicatus* is associated with humid, unimproved grassland up to and including subalpine altitudes.

Range, distribution and status: *P.manicatus* is generally distributed in Ireland, but in farmland the species is usually encountered today in small numbers, rather than as large populations. Away from the Atlantic seaboard, *P.manicatus* is primarily an insect of northern Europe, the Alps, the

Pyrenees and other mountainous parts of the continent. It also ranges widely through Siberia and reaches the Nearctic in Alaska.

Irish reference specimens: in the collections of NMI and UM.

Platycheirus nielseni Vockeroth, 1990



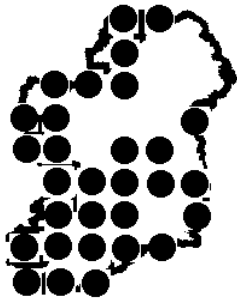
History: added to the Irish list by Vockeroth (1990).

Ecology: *P.nielseni* is essentially an upland and western species in Ireland, found where *Betula/Salix* scrub is present in oligotrophic *Molinia* grassland/moorland or partially-reclaimed blanket bog, especially along streams. It is not, however, a wetland insect per se. It is entirely absent from the farmed landscape of green fields and hedges, from suburban situations and from coastal habitats. It may be regarded as an anthropophobic species, able to use man-modified habitats to only a marginal extent, unless it is recognised that where it occurs today it is occupying largely secondary habitats engendered by long-term (i.e. hundreds of years) grazing activity, in what was probably *Pinus/Betula* forest previously. Realistically, *P.nielseni* is a species of boreal mixed forests and humid, montane conifer forests, which has survived in Ireland in an extensively deforested landscape. Today's conifer plantations do not seem to provide an alternative habitat for *P.nielseni*, except during the establishment phase, or where a plantation includes a significant proportion of open area, allowing invasion by *Betula* and *Salix*.

Range, distribution and status: most Irish *P.nielseni* records are from the west of the island, and the species appears to be absent from lowland areas further east. This species cannot be classed as threatened here, but neither is it frequent. It is primarily a northern European insect, which extends southwards through mountainous country as far as the Alps, where it is frequent in the *Abies/Picea* zone. It is a Holarctic syrphid, though little seems to be known of its occurrence in Asiatic parts of the Palaearctic.

Irish reference specimens: in the collections of NMI and UM.

Platycheirus occultus Goeldlin, Maibach and Speight, 1990



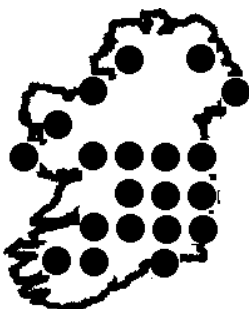
History: added to the Irish list by Goeldlin *et al* (1990). This species was previously confused with other *clypeatus*-group species in Ireland.

Ecology: *P.occultus* is a wetland insect, which occurs in Ireland from sea level to above 1000ft., among tall vegetation in fen, marsh and transition mire, seasonally-flooded grassland, dune slacks and around coastal lagoons. It can also be found in blanket bog, along stream and in association with base-rich flushes. It is not a component of forest, suburban or drained grassland habitats and is absent from the standard farm landscape of green fields plus hedges, but can be found in association with wet, open areas within conifer plantation.

Range, distribution and status: *P.occultus* is predominantly an insect of western parts of Ireland, where it may be common. It is also frequent in Britain and the Netherlands, but becomes very localised further south and also further north than the southern edge of Norway. It is also localised in the Alps and apparently reaches the southern edge of its range at 1500m in the northern Appenines. It appears to be endemic to Europe, reaching no further east than Liechtenstein, though this may be due to a lack of recent revisions of eastern European syrphid faunas.

Irish reference specimens: in the collections of NMI and UM.

Platycheirus peltatus (Meigen), 1822



History: given as occurring in Ireland in Coe (1953), but at that time this species was confused with other *Platycheirus* species. The presence of *P.peltatus* in Ireland was confirmed by Speight and Vockeroth (1988).

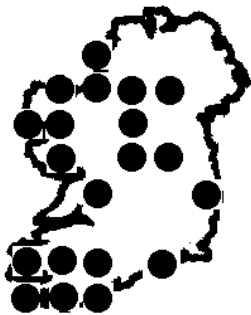
Ecology: humid, tall herb vegetation along rivers and streams and in seasonally-flooded grassland is the principal habitat for *P.peltatus* in Ireland. It also occurs in fen. General land surface

drainage, that accompanies intensification of farming, results in loss of habitat for this species and it is not found in improved or intensive grassland. Neither does it occur in conifer plantations (other than in humid, open areas not planted with trees, or plantations newly-established in erstwhile humid grassland, where the young trees have not yet grown to produce closed-canopy conditions) or suburban gardens, horticultural establishments or orchards. So in today's Ireland it has to be classed as a largely anthropophobic insect.

Range, distribution and status: until recently this insect seemed to be decreasing in frequency quite rapidly. Its apparent requirement for tall ground vegetation is not compatible with increased grazing intensities, which exacerbate the problems caused by drainage of humid grassland, by leaving a turf too short for *P.peltatus* in humid grassland where the species might otherwise still occur. However, there are recent records from field margins and young conifer plantations in parts of the island from which records were previously lacking. This species is not regarded as threatened elsewhere, and is frequent in Scandinavia. It occurs further south to central France and through the mountains of central/southern Europe to the Balkans. Its range in Asiatic parts of the Palaearctic is unclear and likely to remain so until more recent revisions of relevant regional faunas have been carried out.

Irish reference specimens: in the collections of NMI and UM.

Platycheirus perpallidus Verrall, 1901



History: given as occurring in Ireland in Coe (1953), but at that time this species was confused with various others in the genus *Platycheirus*. The presence of this species in Ireland was confirmed by Speight and Goeldlin (1990).

Ecology: in Ireland this insect occurs among tall, emergent vegetation, standing in the water at the edge of pools and lakes, or on scraw in fen, transition mire and flushes in blanket bog. It is a pronouncedly anthropophobic species, absent from the standard farming landscape of green fields plus hedges and from conifer plantations, parks and gardens. However, it can occur in abundance in Ireland in association with (and has been bred from) *Carex riparia* beds in constructed wetlands, introduced to farmland for treatment of livestock waste.

Range, distribution and status: most Irish records of this species are from the west and the midlands. It is not a frequent species here, but neither is it threatened at present. In most other parts of the Atlantic seaboard from which it is recorded, it is regarded as threatened. It is also regarded as threatened in parts of central Europe. *P.perpallidus* has a wide range in Europe, from

northern Norway to Spain. It occurs through northern Europe into Siberia and on to the Pacific and in N America. But nowhere in Europe does it appear to be a frequent species.

Irish reference specimens: in the collections of NMI and UM.

Platycheirus podagratus (Zetterstedt), 1838



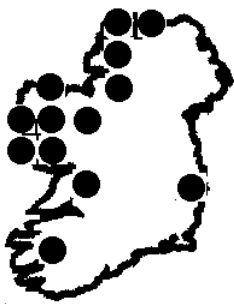
History: given as occurring in Ireland in Coe (1953), but at that time this insect was confused with other European *Platycheirus* species. The presence of this species in Ireland was confirmed by Speight and Goeldlin (1990).

Ecology: the few Irish records of this syrphid are from humid, unimproved grassland in the west. Two of them are from traditional hay meadows, which have now disappeared. The others are from grassland strips along streams/small rivers, within blanket bog. *P.podagratus* is particularly a species of small sedge beds in upland marshes, for instance along the shores of montane and subalpine lakes. Loss of unimproved hay meadows and overgrazing of its other habitats in Ireland by sheep, particularly severe during the last part of the 20th century, could easily have led to virtual eradication of this species.

Range, distribution and status: *P.podagratus* appears to have been largely confined to the northwest of the island. There are very few records of the species from Ireland during the last 50 years and it would validly be classed as endangered here. It is a candidate for inclusion on any listing of insects requiring protection throughout the island. Further north in Europe *P.podagratus* is frequent (to as far north as northern Norway). It is also frequent in the Alps and has a wide range beyond Europe, through Asiatic parts of the Palaearctic and in N America. It is, however, absent from the Atlantic zone of Europe further south than Denmark, except for in Britain and Ireland.

Irish reference specimens: in the collections of NMI.

Platycheirus ramsarensis Goeldlin, Maibach & Speight, 1990



History: added to the Irish list by Goeldlin *et al* (1990). This species was unrecognised prior to that date, having been confused with other closely similar members of the *clypeatus* group which also occur in Ireland. The type locality for *P.ramsarensis* is in Ireland and the species was named in honour of the Ramsar Convention which, in the year that this species was described, redefined its charter to cover all wetland organisms, having been concerned previously primarily with conservation of wetland birds.

Ecology: *P.ramsarensis* is a western and upland syrphid in Ireland. It occurs among tall marginal vegetation (e.g. *Juncus*) along streams in moor and blanket bog. It may also be found where tall ground vegetation occurs in base-rich flushes in blanket bog, with flushes in unimproved, upland grassland, in transition mires and in cutover blanket bog where pools with tall marginal vegetation have formed. It is more a species of mire than bog and in Scandinavia occurs into the far north in tundra. The combination of standard farmland (green fields plus hedges) and conifer plantations, that occupies most of the surface of Ireland today, does not provide any suitable habitat for *P.ramsarensis*. But the devastation visited upon the uplands in western Ireland, by overgrazing by sheep, which has been especially severe during the last decade, has probably had less effect upon *P.ramsarensis* than on the related *P.podagratus*, because *P.ramsarensis* is more associated with unpalatable *Juncus* than is *P.podagratus*.

Range, distribution and status: in Ireland, *P.ramsarensis* is almost confined to the western half of the island. It is not infrequent, but is nonetheless rather localised. This is essentially a northern European syrphid, occurring in western and upland parts of Britain and Ireland, but otherwise not yet known south of Scandinavia. It remains to be established whether the range of *P.ramsarensis* extends eastwards beyond Scandinavia, into Siberia, but this would seem likely. If not, then this species has a more restricted world range than most other syrphids known in Ireland.

Irish reference specimens: in the collections of NMI and UM.

Platycheirus rosarum (Fabricius), 1787



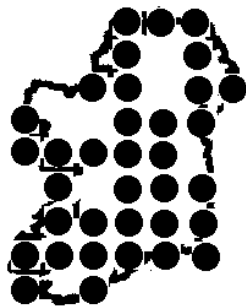
History: given as occurring in Ireland in Coe (1953).

Ecology: the habitat range occupied by *P.rosarum* in Ireland is very similar to that of *P.granditarsus*, and these two species may often be found together. Also, what can be said of the impact of intensification of farming activity on *P.granditarsus* applies to *P.rosarum* (see *P.granditarsus* species account). *P.rosarum* is more a species of the ecotone between deciduous woodland and wetland than is *P.granditarsus*, but both typically occur where tall herb vegetation is found in seasonally-flooded grassland.

Range, distribution and status: *P.rosarum* is generally distributed in Ireland, though largely absent from the standard farmland landscape of green fields and hedges. It has a wide range of Europe and onwards into Asiatic parts of the Palaearctic and occurs also in the Nearctic. Only in mountainous parts of central Europe is it anywhere regarded as threatened.

Irish reference specimens: in the collections of NMI and UM.

Platycheirus scambus (Staeger), 1843



History: given as occurring in Ireland in Coe (1953).

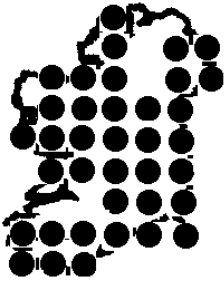
Ecology: *P.scambus* is a syrphid of tall, dense reed-bed type vegetation, and occurs in Ireland in all wetland types from saltmarsh (where it occurs with *Spartina* beds) and coastal lagoons to flushes in blanket bog. It can occur with tall herb vegetation like *Iris* beds, in addition to tall grasses and sedges, and may be found where tall marginal vegetation occurs along the edges of rivers, pools or lakes, away from strictly wetland situations. This is not a species of forest, conifer plantation or the standard farm landscape of green fields and hedges. Neither does it occur in suburban gardens.

Range, distribution and status: *P.scambus* is widely distributed and not threatened, in Ireland. It is frequent in northern Europe, but further south becomes confined to lakeside reed beds and

alluvial wetlands on the floodplains of major rivers. It ranges widely beyond Europe, through Asiatic parts of the Palaearctic and in the Nearctic.

Irish reference specimens: in the collections of NMI and UM.

Platycheirus scutatus (Meigen), 1822



History: given as occurring in Ireland in Coe (1953). Subsequent to the description of the closely-related *P. splendidus* (Rotheray, 1998) and *P. aurolateralis* (Stubbs, 2002), checking of Irish material shows that it is *P. scutatus* that is generally distributed in Ireland.

Ecology: in Ireland, *P. scutatus* is an insect of gardens, hedges, scrub and woodland edge. It is a markedly anthropophilic insect, able to survive in the standard farmland landscape of green fields and hedges, but hardly occurs there without the hedges. In general, *P. scutatus* is a species of deciduous forests, especially at the scrub and sapling stage of development. It can also be found in open areas within conifer plantation.

Range, distribution and status: *P. scutatus* is common and widely distributed in both Ireland and much of Europe, from central Scandinavia south to the Mediterranean. It is a Holarctic species, ranging through Asiatic parts of the Palaearctic to the Pacific and occurring over much of North America.

Irish reference specimens: in the collections of NMI and UM.

Platycheirus splendidus Rotheray, 1998



History: added to the Irish list by Speight *et al* (2004).

Ecology: at present, this *Platycheirus* species is known only from enclosed farmland, where it has been found in association with hedges (Speight *et al*, 2004) and in Dublin suburbia (Speight, 2005), where it was found in a recently-established (i.e. less than 20 years old) suburban garden. These

records suggest the species might be expected from the immediate vicinity of scrub woodland, but the lack of records from any natural/semi-natural habitat in Ireland, and the absence of the species from earlier collections, imply that it may have established itself in Ireland only recently. Its occurrence in scrub-invaded clearings in forest and with scrub formations up to 2000m, in central Europe, would also suggest it may be found with scrub woodland in Ireland.

Range, distribution and status: existing Irish records may provide no guide to the distribution of the species in Ireland, because of uncertainty over whether *P.splendidus* has been overlooked in Ireland in the past. However, there is no evidence that this has occurred, in the form of specimens in collections proving to be misdetermined when their identity has been rechecked. On the other hand there seems no reason why this species should be confined in Ireland to counties Dublin and Kildare. It's apparent capacity to occur both within the farmed landscape and in suburbia provides no basis for regarding it as a species threatened in Ireland, despite the few existing records.

Irish reference specimens: in the collections of NMI.

Platycheirus sticticus (Meigen), 1822



History: added to the Irish list by Speight *et al* (1975). Re-examination of available Irish material demonstrates that it belongs to *P.sticticus* and not to the closely similar *P.laskai* Nielsen described recently (Nielsen, 1999).

Ecology: there are insufficient Irish records of this insect to indicate whether its ecology differs here from elsewhere. Its occurrence at the edge of a conifer plantation would be consistent with what is known of *P.sticticus* in general, but this is an obscure species and rather imprecisely known.

Range, distribution and status: there is but one confirmed record of this insect in Ireland and it has to be regarded as threatened here. It is a candidate for listing as a species in need of protection throughout Ireland. Although it supposedly occurs through much of the Atlantic zone and in central Europe, it is rarely seen and generally regarded as under threat, or at least as decreasing. Its range extends beyond Europe through much of Siberia.

Irish reference specimens: in the collections of NMI.

Genus PORTEVINIA

Portevinia maculata (Fallen), 1817



History: added to the Irish list by Speight *et al* (1975), where it is treated as a species of *Cheilosia*.

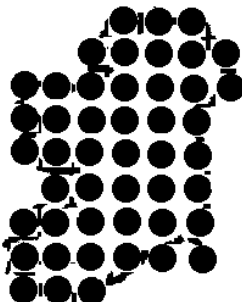
Ecology: within and along the edge of humid deciduous woodland harbouring large stands of *Allium ursinum* is the primary habitat of *P.maculata* in Ireland. In Ireland, *A.ursinum* may be found in what is today predominantly *Fagus* or *Acer pseudoplatanus* woodland, as easily as in *Quercus* woodland, although the former are non-native trees. *P.maculata* may also be found away from *A.ursinum* in Ireland, in association with the introduced *A.triquetrum*, where stands of this plant occur in humid, semi-shaded situations. So, to some extent, *P.maculata* must be regarded as an anthropophilic insect here.

Range, distribution and status: *P.maculata* is widely distributed and not uncommon in Ireland. It is also widely distributed elsewhere in Europe, but is apparently endemic to the continent. It is regarded as a threatened species in Belgium and the Netherlands, and is extremely localised in southern Norway, but in other parts of western Europe it is more frequent, though remaining rather localised. It is also rather localised in central Europe and is not known east of the Alps. Neither is it reported from the Mediterranean zone.

Irish reference specimens: in the collections of NMI and UM.

Genus RHINGIA

Rhingia campestris Meigen, 1822



History: given as occurring in Ireland in Coe (1953). There are suggestions (see Speight *et al*, 1975) that *R.rostrata* (L.) has been found in Ireland, but there are no substantiated records. The only Irish "*R.rostrata*" specimen that has been traced is in the Morley collection in the Ipswich Museum

(Suffolk, England). Through the good offices of the curator (H.Mendel) it has been possible to examine this specimen, which proved to belong to *R.campestris*.

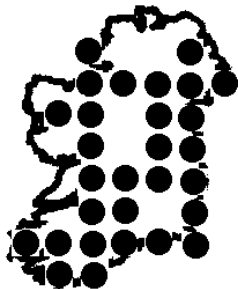
Ecology: with cattle and beef farming well-nigh ubiquitous in Ireland, so is *Rhingia campestris*, whose larvae feed in cow dung. Here, it is thus a classic example of an anthropophilic syrphid. The question of what *R.campestris* larvae can use as alternative foodstuffs has not been adequately addressed, but nutrient-rich, water-logged concentrations of decaying vegetable matter of some form other than cow-dung very probably can be used by this species, since it can occasionally occur in an apparent absence of cows, for instance in alluvial hardwood forest. However, alluvial hardwood forest is now absent from Ireland and it can reasonably be said that the continued survival of *R.campestris* here is almost entirely dependent upon current climatic conditions and the livestock management practices adopted in the beef and dairy industries. If livestock management practices were to change towards keeping the animals more-or-less permanently in pens, as has happened in some parts of Europe, *R.campestris* could be expected to disappear from the Irish countryside. Similarly, if climatic change were to result in long, dry summers in Ireland, this species would be expected to decrease in frequency and become restricted to wetter parts of the island. There is clear evidence for loss of populations of some dung-feeding insects caused by the blanket application of the systemic helminthicides generically known as Ivermectins. But there is an absence of published research data on the effects of these chemicals on *Rhingia campestris* and all that can be said at present is that, since Ivermectins were introduced, *R.campestris* populations do seem to have become more localised in time and space than previously, though, in Ireland at least, this syrphid remains both frequent and well distributed.

Range, distribution and status: *R.campestris* is common and generally distributed in Ireland and much of the Atlantic zone of Europe. It occurs widely through the Palaearctic region, from the Atlantic to the Pacific, but maintenance of large populations seems to be mainly dependent upon presence of cow-farming in which pasturing of the animals is practised during the growing season. In southern Europe the species becomes much more localised, occurring within forests grazed by livestock.

Irish reference specimens: in the collections of NMI and UM.

Genus *RIPONNENSIA*

Riponnensia splendens (Meigen), 1822



History: given as occurring in Ireland in Coe (1953).

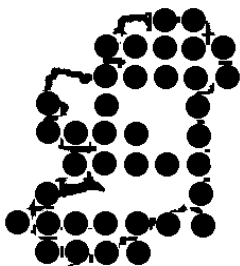
Ecology: where small, shaded, canalised streams run along field boundaries, accompanied by hedges, is as likely a situation in which to find *R.splendens* in Ireland as any other. Its other stronghold is along streams in deciduous woodland. The advent of the electric fence, which has reduced the traditional hedge to the status of at best a windbreak, is liable to have catastrophic effect upon this species within farmland, as hedges are no longer maintained or are removed. It can occur in association with springs or seepages, within woodland, but its apparent requirement for shallow water that is flowing, even if only slowly, means that it is not normally found with standing water-bodies. Similarly, it is not found where the water flow is intermittent and dries up entirely during part of the year.

Range, distribution and status: widely distributed and frequent in Ireland, Britain and northern France, *R.splendens* becomes scarce further south and in central Europe. It is also absent from northern Europe. So, although it ranges south into the Mediterranean zone and round the Mediterranean basin into the mountain ranges of north Africa, *R.splendens* is primarily an insect of parts of the Atlantic fringe of Europe. It is present in southern parts of the Atlantic zone, in mountainous parts of northern Spain, but whether it is frequent there is unclear.

Irish reference specimens: in the collections of NMI and UM.

Genus SCAEVA

Scaeva pyrastris (L.), 1758



History: given as occurring in Ireland in Coe (1953).

Ecology: it is uncertain whether or not this insect survives throughout the year in Ireland. Speight (1985a) argues that its occurrence here is probably as a migrant only, and there are still no data to suggest otherwise. If this interpretation is correct, the ecological requirements of *S.pyrastris* in Ireland are limited to the habitats it can use during the period mid-June to October. That would include various crops, orchards, suburban parks and gardens, as well as the general farmland landscape of green fields and hedges – *S.pyrastris* is a markedly anthropophilic hoverfly and its generation time can be as little as six weeks. It is unclear why this insect may not survive the year round in Ireland, but climatic factors must be suspected as limiting. In this regard it is perhaps apposite that, like another syrphid extremely frequent and widespread in continental Europe but also seemingly unable to maintain populations throughout the year in Ireland (*Sphaerophoria scripta*), *S.pyrastris* is unusual in that it is known to overwinter as a puparium (Kantyerina, 1979). Although it is a strongly migrant insect, the only records of *S.pyrastris* in Norway are from the southernmost part of the country (Nielsen, 1999), while the same author shows that the closely related (and resident in Ireland) *S.selenitica* occurs as far north as Lappland.

Range, distribution and status: recorded from most parts of the island, and in some years not infrequent during late summer. *S.pyrastris* ranges widely through the Palaearctic and Nearctic regions and beyond and is abundant in southern Europe.

Irish reference specimens: in the collections of NMI and UM.

Scaeva selenitica (Meigen), 1822



History: given as occurring in Ireland in Coe (1953).

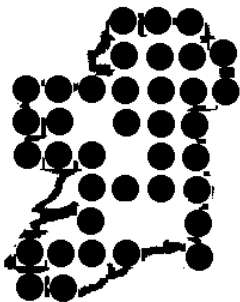
Ecology: in Ireland *S.selenitica* was until recently primarily a deciduous woodland syrphid, found with both oak forest and *Betula/Salix* scrub. But it was then found once in young Sitka spruce plantation in 2002 (Gittings *et al*, 2005) and subsequently found to be widespread in conifer plantations in southern parts of the island, from where it is evidently extending its range. It can also occur in association with mature suburban gardens around Dublin. This mix of habitat associations might be expected to ensure that this species will become both frequent and widely distributed in Ireland, assuming its range does continue to expand here. It is difficult to argue that the recent expansion of this species in Ireland may be associated with climatic warming, because *S.selenitica* has for a long time been known in northern Europe to as far north as Lapland – though whether it maintains year-round populations that far north is unclear. In Ireland, there is evidence that this species is resident (Speight, 1985a), in contrast to *S.pyrastris*.

Range, distribution and status: until recently Irish records of *S.selenitica* were clumped in two parts of the island, around Dublin and in the south-west, areas widely separated from each other. But it appears to be expanding its range currently, and is occurring more frequently, in conifer plantations that “fill the gap” between the south-west and Dublin. More survey would be required in the north-west of the island to establish how far it has now spread. It ranges widely through the Palaearctic, from northern Norway to North Africa and across Siberia to the Pacific and is common in parts of the Atlantic and continental zones of Europe.

Irish reference specimens: in the collections of NMI.

Genus SERICOMYIA

Sericomyia lappona (L.), 1758



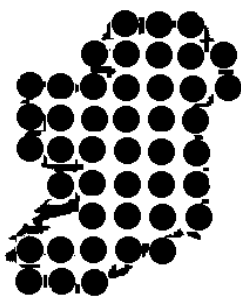
History: given as occurring in Ireland in Coe (1953).

Ecology: the habitat range of this species in Ireland is as elsewhere, except that extensive planting of conifers in areas which would naturally be humid deciduous forest allows *S.lappona* to sometimes be found in association with open areas along streams in conifer plantations here. General land surface drainage does not favour this insect and it is absent from the standard farmland landscape of green fields and hedges. Neither is it to be found in suburban gardens or coastal habitat types. It is thus largely an anthropophobic species. While it can occur in forested situations, it is most frequently met with in wetlands and moorland.

Range, distribution and status: *S.lappona* is widespread and frequent in Ireland. It ranges widely in northern Europe, but is more restricted to mountainous country further south. Outside Europe its range extends through Siberia to the Pacific.

Irish reference specimens: in the collections of NMI and UM.

Sericomyia silentis (Harris), 1776



History: given as occurring in Ireland in Coe (1953).

Ecology: *Sericomyia silentis* and *S.lappona* have rather similar habitat preferences, and may be found together, but *S.silentis* is more of a forest species, found in a greater variety of forested situations than *S.lappona*. Essentially, *S.silentis* is characteristic of the humid *Fagus/Picea* forest belt, whereas *S.lappona* becomes more frequent toward the upper levels of this zone, at locations where wetland conditions are more pronounced. Nonetheless, *S.silentis* is also very much a species of bog and fen in Ireland and occurs also in humid, seasonally-flooded, grassland (e.g. *Molinia* grasslands) and in open areas along streams in poorly-drained conifer plantations. This is not an insect of the

standard farmland landscape of green fields and hedges, though it may persist there in undrained patches of largely unimproved, wet grassland. *S.silentis* is not an insect of orchards, suburban gardens or urban parks. It is a generally anthropophobic syrphid which can only co-exist with man's use of the countryside in certain circumstances i.e. when that use is not intensive and does not involve comprehensive land drainage of its larval microhabitats.

Range, distribution and status: *S.silentis* is generally distributed in Ireland and usually frequent where it occurs. It is also widely distributed in northern and central Europe and in the Atlantic zone southwards to northern France. Further south it becomes more restricted to mountainous country, occurring down to 750m at the southern end of the Pyrenees and at c1500m in the Apennines. Outside Europe, it occurs through Siberia to the Pacific.

Irish reference specimens: in the collections of NMI and UM.

Genus *SPHAEROPHORIA*

Sphaerophoria batava Goeldlin, 1974



History: added to the Irish list as *S.taeniata* (Mg.), by Speight *et al* (1975). A further Irish record was published by Nash and Speight (1976). It was indicated by Speight (1985a) that all Irish material previously identified as *S.taeniata* belonged to *S.batava*, so that *S.taeniata* should be removed from the Irish list.

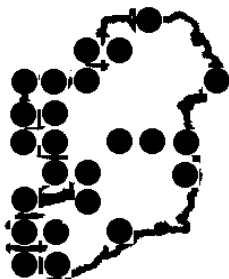
Ecology: the habitat associations of this species remain poorly defined, both in Ireland and elsewhere, a problem compounded by difficulties of identification which render some published information questionable. Suffice it to say that *S.batava* is an anthropophobic species that has been found in Ireland in open patches within various woodland situations. It seems to occur on generally well-drained sites, round the edges of small clearings where areas of feeble ground-water upwelling occur, sufficient to trigger a vegetation cover change but not sufficient to result in standing or running water at the ground surface. Another feature of its occurrence in Ireland is that it has not been found consistently at any one site. All Irish records are of single males from sites where the species has not been refound subsequently. This is consistent with patterns of occurrence of a number of other European *Sphaerophoria* species, namely a tendency to occur only temporarily on a site, with early seral stage/transitory tall-herb vegetation that is rapidly superseded by other denser, more perennial vegetation. However, *S.batava* is not necessarily a transitory species - in its one known locality in western Switzerland it occurs regularly and abundantly in small glades in an extensive, extremely dry *Pinus sylvestris* forest on an alluvial, sandy soil, where the water table is nonetheless close to the ground surface. In Britain it is "most

frequently found on heathland, or along open rides in conifer plantation" (Ball *et al*, 2002), and it is tempting to postulate that the natural home of *P.batava* in Ireland was the now lost pine forests. However, it shows no evidence of colonising tracks and open areas in conifer plantations in Ireland.

Range, distribution and status: there are very few Irish records of *S.batava* and it can justifiably be regarded as threatened here. It is a candidate for inclusion in any listing of Irish insects requiring protection throughout the island. Elsewhere in Europe, it is probably most frequent in other parts of the Atlantic zone and records, though sparse, are scattered from northern Norway to the Pyrenees and through much of the continent to the Balkans.

Irish reference specimens: in the collections of NMI.

Sphaerophoria fatarum Goeldlin, 1989



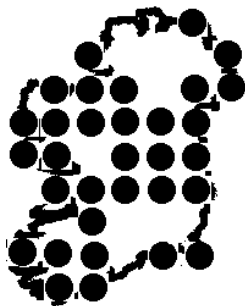
History: added to the Irish list by Speight (1973), as *S.abbreviata* (Zetterstedt). It was pointed out by Speight (1989) that all Irish records of *S.abbreviata* then known refer to *S.fatarum*, and that *S.abbreviata* should be removed from the Irish list. *S.fatarum* is primarily montane in Ireland, occurring particularly in moorland areas. Goeldlin (1989) notes that, in the Alps, the closely related species *S.bankowskae* Goeldlin and *S.laurae* Goeldlin occur at lower and higher altitudes, respectively, than *S.fatarum*. The occurrence of *S.bankowskae* in Great Britain has since been confirmed by Plant (1990) and its presence in Ireland would seem quite possible, so extreme care is needed in determination of Irish specimens of this species group.

Ecology: in Ireland, *S.fatarum* is a species of unimproved, oligotrophic grassland, limestone pavement grassland, moor and blanket bog. It is an open country species, not found in fen, deciduous woodland or conifer plantations, unless significant areas of wet, heathy grassland are present. Neither does it occur in the standard farm landscape of green fields and hedges, or in parks or gardens. It is thus pronouncedly anthropophobic. It frequently occurs in the company of *S.philantha* here, with which it shares many habitats. However, on the continent, *S.fatarum* occurs in calcareous, unimproved, montane/alpine grassland from which *S.philantha* is entirely absent. This disparity hints at the existence of some difference between Irish and continental *S.fatarum* populations, which could be due to this taxon being polyphyletic in Ireland. However, no consistent differences can be found to separate any element of the Irish material from the rest, though Goeldlin (1989) does allude to discrepancies between the appearance of the terminalia of some Irish specimens and the appearance of the terminalia of the type specimen of this species.

Range, distribution and status: *S.fatarum* is frequent in the west of Ireland and the Wicklow mountains, but apparently absent from most other parts of the island. Although there are scattered records from northern Norway southwards, this species seems only to be frequent in mountainous parts of the Atlantic zone and in the Alps. It is not, as yet, known from the Pyrenees, or into south-east Europe beyond Roumania.

Irish reference specimens: in the collections of NMI and UM.

Sphaerophoria interrupta (Fabricius), 1805



History: given as occurring in Ireland in Coe (1953), but at that time this insect was confused with various other European *Sphaerophoria* species. The presence of this syrphid in Ireland was confirmed by Speight *et al* (1975), where it appears under the name *S.menthastri*.

Ecology: in Ireland today, this insect occurs in humid, seasonally flooded grassland, limestone pavement grassland, dune grassland (where not exposed to heavy grazing), streamside grassland in moor and blanket bog, grassy open areas in deciduous woodland and in fen. It has all but disappeared from the standard farmland landscape of green fields and hedges, except where a strip of more-or-less unimproved grassland remains as field margin, and in this mirrors its disappearance from much of western Europe. It is very much a species of humid, unimproved grassland, in central Europe rarely seen now except in montane to subalpine situations – it can be found up to nearly 2000m in the Alps. Essentially, present-day grassland management practices of fertilisation, re-seeding and periodic cultivation make *S.interrupta* an extremely anthropophobic syrphid, a situation probably contrasting strongly with that of 50 years ago, when it would seem likely that traditional grassland management would have ensured that *S.interrupta* was well-nigh ubiquitous here. But, inevitably, the available distribution data are inadequate to substantiate this perception.

Range, distribution and status: *S.interrupta* remains frequent through most of central Ireland and cannot be regarded as under threat here. Its frequency is apparently diminishing rapidly in some parts of the Atlantic zone, but it not yet classed as threatened anywhere. It is widely distributed in Europe, from northern Norway to the Mediterranean, and extends beyond Europe into parts of Siberia.

Irish reference specimens: in the collections of NMI and UM.

Sphaerophoria loewi Zetterstedt, 1843



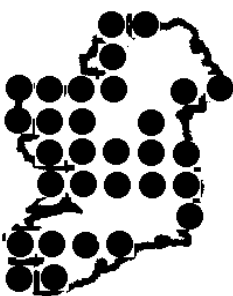
History: added to the Irish list by Speight (1982).

Ecology: this species occurs within beds of emergent reeds and *Scirpus* and in Ireland its stronghold is probably coastal lagoons. But these have not been systematically surveyed for *S.loewi*. Inland records from lacustrine reedbeds are almost non-existent. This corresponds with the situation elsewhere in Europe - only in Denmark does this species appear to be to any extent frequent. *S.loewi* can be regarded as extremely anthropophobic.

Range, distribution and status: most of the few Irish records of *S.loewi* are from coastal lagoons and, although there may be additional lagoons where it occurs as yet unrecorded, the scarcity of this habitat ensures that any insect largely dependent upon it would itself be scarce. *S.loewi* has to be regarded as threatened in Ireland and as a species to include in any listing of insects requiring protection throughout the island. It would also be categorised as threatened in other parts of Europe from which it is recorded, with the exception of Denmark. However, there are widely scattered records of this species, from the southern coast of Norway to the Camargue (southern France) and its range does extend beyond Europe, into Asiatic parts of the Palaearctic as far as Mongolia.

Irish reference specimens: in the collections of NMI and UM.

Sphaerophoria philantha (Meigen), 1822



History: added to the Irish list by Speight (1973). Additional Irish records are published in Anderson (1988), Nelson (1988) and Speight *et al* (1975).

Ecology: in Ireland, *S.philantha* and *S.fatarum* almost invariably occur together, their habitat range overlapping substantially, though *S.fatarum* is more generally distributed in blanket bog

habitats than is *S.philantha*, and *S.philantha* can occur in poor fen. In continental Europe, where more distinctly calcareous, unimproved montane/alpine grasslands occur, *S.philantha* is absent.

Range, distribution and status: *S.philantha* is frequent in Ireland and occurs in most parts of the island, though it is more generally distributed over the midlands and in the west. It is frequent in other parts of the Atlantic zone also, and in northern Europe, but becomes more localised in the Alps.

Irish reference specimens: in the collections of NMI and UM.

Sphaerophoria rueppelli Wiedemann, 1830



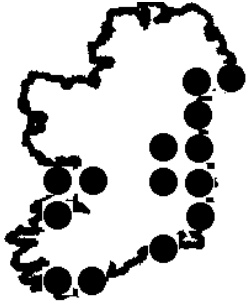
History: added to the Irish list by Speight (1976b), based on a solitary male collected from Bull Island, Co.Dublin.

Ecology: It was suggested by Speight (1976b, 1985a) that *S.rueppelli* is not a resident Irish insect, the only known Irish specimen being regarded as a migrant. Since then there have been no published records of this species in Ireland. However, recent intensive search of the Bull Island locality from which the record derives has resulted in location of a dense population of *S.rueppelli*, occurring at the junction between salt marsh and sand dune in this estuarine site. The adults occur within a band of *Juncus* and *Limonium* some 20 metres wide and 1 kilometre long, which they seem rarely to leave. Some other Irish localities where similar salt marsh conditions occur have been searched for the species, but this has not resulted in additional records. Nonetheless, it would seem likely that careful examination of this habitat during July could reveal the presence of *S.rueppelli* elsewhere in Ireland. In continental Europe this species is noticeably associated with ruderal communities and, in southern Europe, with various crops.

Range, distribution and status: *S.rueppelli* is known from only one locality in Ireland where it would seem to be resident, and has to be regarded as extremely vulnerable to extinction here. It should be included in any listing of insects requiring protection throughout the island. It is also very localised in northern Europe, where it reaches only the southern edge of Scandinavia. But further south it becomes more frequent and is frequent in early seral-stage habitats in southern Europe.

Irish reference specimens: in the collections of NMI.

Sphaerophoria scripta (L.), 1758



History: given as occurring in Ireland in Coe (1953).

Ecology: nearly all Irish records of this species are derived from coastal localities, usually dune systems, though a few are from unimproved/ improved grassland. This contrasts sharply with the situation over most of W Europe (including Great Britain and Denmark, where conditions are in many ways similar to those in Ireland), where *S.scripta* is one of the most frequent and widespread of hoverflies and occurs in nearly every sort of grassland and open ground, including suburban gardens. A second feature of the Irish records is that they are nearly all derived from the period July /August. Put together with the knowledge that *S.scripta* is a strongly migratory insect, these facts provide a strong basis for postulating that *S.scripta* may well be a non-resident species in Ireland, and that the Irish records are due to annual migration to the island, with subsequent establishment here of only temporary colonies. The few early records - one from Belfast, one from Dublin - may indicate that the species does overwinter in Ireland on occasion. In stark contrast to elsewhere in Europe, in Ireland *S.scripta* cannot be regarded as a primarily anthropophilic insect. It is difficult to believe that its failure to occur generally in the farmland landscape in Ireland is due to climatic conditions, since this hoverfly is abundant and widely distributed from the Mediterranean to northern Scandinavia. However, if climate is the controlling influence then the current phase of climatic amelioration should trigger an explosive spread of *S.scripta* in Ireland in the very near future and this species would seem an extremely appropriate target for climate warming studies here.

Range, distribution and status: the majority of Irish records of *S.scripta* are from close to, or on, the east coast. Perhaps this is indicative of limited, intermittent immigration of the species from Britain? Certainly, *S.scripta* is apparently entirely absent from Ireland in some years, though there seems no obvious reason why it should not establish itself here. The present uncertainty over whether it is resident effectively makes its conservation status indeterminate. Elsewhere in Europe it is widely distributed and common, becoming abundant in southern Europe, where it is an extremely anthropophilic insect.

Irish reference specimens: in the collections of NMI and UM.

Genus SPHEGINA

Sphegina clunipes (Fallen), 1816



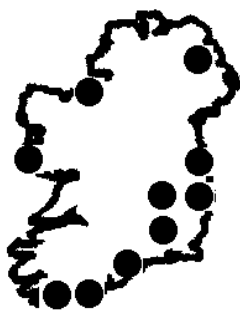
History: given as occurring in Ireland in Coe (1953).

Ecology: *Sphegina clunipes* is associated with both deciduous and coniferous forests in continental Europe and with deciduous forests and conifer plantations in Ireland. In Ireland it has been found in both mature conifer plantations and establishment-phase crops i.e. plantations in which closed canopy conditions have not yet developed. *S.clunipes* is generally absent from the standard farm landscape of green fields plus hedges and from gardens and parks, though on occasion it can occur with tree lines of overmature trees.

Range, distribution and status: *S.clunipes* is widely distributed and frequent in Ireland. It is probably the most frequently encountered species of the genus in most parts of Europe, and occurs in wooded situations from northern Norway to the Mediterranean. It also ranges widely in Asiatic parts of the Palaearctic.

Irish reference specimens: in the collections of NMI and UM.

Sphegina elegans Schummel, 1843



History: given as occurring in Ireland in Coe (1953), wherein it is referred to under the name *S.kimakowiczi* Strobl.

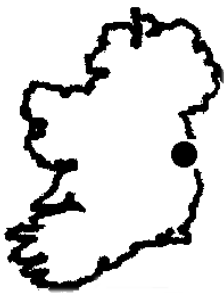
Ecology: although known from more-or-less the same range of deciduous forest habitat types as *S.clunipes*, *S.elegans* is markedly less frequently encountered, and the ecological reasons for this are obscure. *S.elegans* presumably has more specialised ecological requirements than *S.clunipes*, since the latter species occurs regularly in both deciduous and coniferous forests, whereas *S.elegans*

occurs only in deciduous forest. It is absent from conifer plantations, the farmland landscape of green fields and hedges, orchards and gardens.

Range, distribution and status: the majority of Irish records of this species are from the south and east of the island, though there are scattered records from elsewhere. *S.elegans* is not a frequently encountered insect in Ireland, but neither can it be regarded as threatened here. It is essentially endemic to Europe, but with a wide and scattered distribution in the continent, southwards from the southern tip of Scandinavia.

Irish reference specimens: in the collections of NMI and UM.

Sphagina sibirica Stackelberg, 1953



History: added to the Irish list by Speight (2008b).

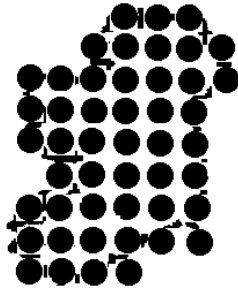
Ecology: in Ireland recorded from a plantation of mature *Picea* and *Pinus*, most of which had been brought down by gales during the previous two years, the cut off stumps and their attached root plates then being left where they fell (together with some of the trunks), creating a considerable resource of recently-dead timber. In continental Europe, *S.sibirica* is a species of mature spruce (*Picea*) forests and has spread rapidly through spruce plantations in western Europe during the latter part of the 20th century. Its arrival in Ireland was expected (Speight, 2004b). It's flight season in Ireland is unusual, being later than in adjacent parts of Europe. At the Irish locality specimens were seen on the wing from 13 July to 8 August.

Range, distribution and status: at present known only from one Co.Dublin locality, but this is almost certainly a species that has arrived in Ireland only recently that, given its habitat, can be expected to spread to other parts of the island quite rapidly, given the ubiquity of spruce in Irish commercial forestry plantations, and judging from its rate of expansion elsewhere in Europe.

Irish reference specimens: in the collections of NMI.

Genus SYRITTA

Syritta pipiens (L.), 1758



History: given as occurring in Ireland in Coe (1953).

Ecology: *Syritta pipiens* is an archetypally anthropophilic syrphid, occurring both in Ireland and elsewhere in association with garden compost heaps, cow dung and manure, seepages from silage clamps, rubbish dumps and other concentrations of decaying vegetable matter. Evolutionarily, its home is probably in alluvial forest and nutrient-rich wetlands and it may be found in Ireland in fen and marsh habitats today. But it is in the standard Irish farmland landscape of green fields and hedges that *S. pipiens* is effectively ubiquitous.

Range, distribution and status: in Ireland, *S. pipiens* is one of the most common and generally distributed syrphid species. It is also common in most of the rest of Europe, from northern Norway to the Mediterranean and occurs widely beyond Europe, in Asiatic parts of the Palaearctic region and beyond, in the Oriental, the Nearctic and the Neotropical regions.

Irish reference specimens: in the collections of NMI and UM.

Genus SYRPHUS

Syrphus rectus (Osten-Sacken), 1877



History: added to the Irish list by Speight (1999b). *S. rectus* was first recognised as a European species by Goeldlin (1996), based on material from central Europe, but it is still unclear whether, in Europe, this taxon is a separate species or a variety of *Syrphus vitripennis* Mg. There is a reasonable basis for accepting that, in N America, *S. rectus* is a distinct species, which occurs together with *S. vitripennis* (Vockeroth, 1992). It is treated here as a distinct species.

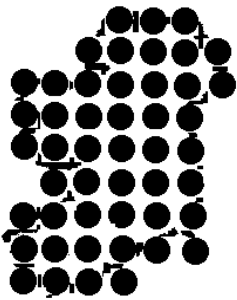
Ecology: improved pasture and unimproved grassland with thickets of deciduous scrub seem to characterise the habitat of this taxon, both in Ireland and elsewhere. But its uncertain identity

makes it difficult to say more than that. There are as yet no indications that its habitat range differs from that of *S.vitripennis*, the species with which *S.rectus* is so intimately confused in Europe.

Range, distribution and status: one Irish specimen referable to this taxon has been collected in Co.Donegal, another in Dublin and the third in Co.Cork, all of them from the end of August/beginning of September. Given its uncertain taxonomic status, the conservation status of this taxon in Ireland has to be regarded as indeterminate.

Irish reference specimens: in the collections of NMI.

Syrphus ribesii (L.), 1758



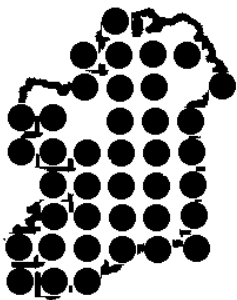
History: given as occurring in Ireland in Coe (1953).

Ecology: the original habitats of this species are probably deciduous forest margins and open areas within deciduous forest, but it is today a thoroughly anthropophilic species in Ireland, typical of the standard farmland landscape of green fields and hedges. It is also a frequent garden, park and orchard insect and can occur along vegetated track margins in conifer plantations. This is typical of its occurrence elsewhere in the Atlantic seaboard countries of Europe.

Range, distribution and status: *S.ribesii* is common and generally distributed both in Ireland and over most of Europe. It is a Holarctic species, ranging almost throughout the Palaearctic and Nearctic regions.

Irish reference specimens: in the collections of NMI and UM.

Syrphus torvus Osten-Sacken, 1875



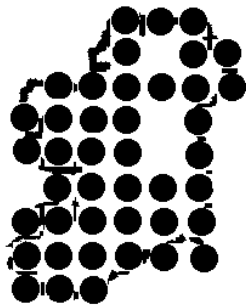
History: given as occurring in Ireland in Coe (1953).

Ecology: this primarily humid forest insect occurs in association with both deciduous woodland (including scrub woodland) and conifer plantation in Ireland. However, *S.torvus* is not an insect of the standard farmland landscape of green fields and hedges. Its frequency in conifer plantations makes it to a significant extent anthropophilic, a designation reinforced by its occurrence in mature gardens and suburban parks.

Range, distribution and status: *S.torvus* is common and widely distributed in Ireland, even if somewhat less frequently encountered than either *S.ribesii* or *S.vitripennis*. Elsewhere in Europe, it is frequent except in the south. Its range extends throughout the Palaearctic and into parts of the Oriental and it also occurs extensively in the Nearctic.

Irish reference specimens: in the collections of NMI and UM.

Syrphus vitripennis Meigen, 1822



History: given as occurring in Ireland in Coe (1953).

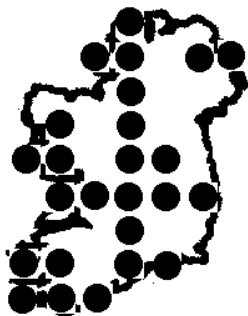
Ecology: today, *S.vitripennis* is a frequent insect of the standard Irish farmland landscape of green fields and hedges. It is also common in gardens, parks and conifer plantations. Although it is primarily an anthropophilic syrphid in Ireland, it occurs here in deciduous woodland and scrub as well. It is not, however, a wetland insect and is absent from bog and fen, except where patches of deciduous scrub (e.g. *Alnus*, *Betula*, *Salix*) are present. This habitat range would be typical for the species in Atlantic parts of Europe.

Range, distribution and status: in Ireland, as elsewhere in most of Europe, *S.vitripennis* is generally distributed and common. It is a Holarctic species, occurring widely in Asiatic parts of the Palaearctic and in the Nearctic.

Irish reference specimens: in the collections of NMI and UM.

Genus *TRICHOPSOMYIA*

Trichopsomyia flavitarse (Meigen), 1822



History: given as occurring in Ireland in Coe (1953).

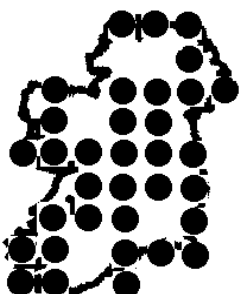
Ecology: In Ireland this species occurs in various wetland situations. In the east of the island it is not infrequent beside streams and in boggy moorland in mountainous country. In the Midlands it is frequent in poorly drained pasture with *Juncus*, around raised bogs and in fenland. In the west it may be found in all of these situations, plus wet hollows and *Schoenus* fen in the karst limestone grasslands and also in the landward parts of machair systems. It may be found in large numbers in the Burren. Its larvae are associated with *Juncus* and it is much less frequent in most parts of the Atlantic zone than in Ireland. This is not an insect of the standard farm landscape of green fields and hedges, or of conifer plantations.

Range, distribution and status: *T. flavitarse* is frequent in the west of Ireland, and in wetland/humid grassland in the midlands. This species is not threatened in Ireland, but neither is it generally distributed here. It is probably most frequent in the Atlantic zone of Europe, becoming very localised further north and in central Europe. It is not recorded from the Mediterranean zone. Its range extends through northern Europe into Siberia and thence eastwards across to the Pacific.

Irish reference specimens: in the collections of NMI and UM.

Genus *TROPIDIA*

Tropidia scita (Harris), 1776



History: given as occurring in Ireland in Coe (1953).

Ecology: In Ireland, *T. scita* occurs in marsh, fen and humid, unimproved grassland with springs and flushes or unmaintained drainage ditches. It occurs sometimes in an apparent absence of standing water, but is usually in the immediate vicinity of pools or other water bodies. It may also

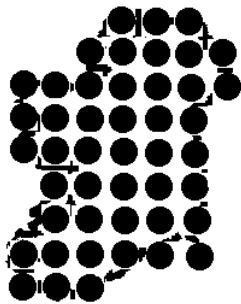
be found in coastal freshwater marsh situations, particularly in association with lagoons. *T.scita* is not a component of the syrphid fauna of the standard farmland landscape of green fields and hedges. Neither does it occur in conifer plantations, gardens or parks. It is thus largely an anthropophobic species, though it can sometimes be found in humid, unimproved grassland. The range of habitats occupied by *T.scita* in Ireland is wider than in many other parts of the Atlantic seaboard of Europe, where drainage and general water eutrophication have resulted in this species becoming very localised. With the general trend towards intensification of use of farmland in Ireland, *T.scita* can be expected to decrease in frequency here, too.

Range, distribution and status: *T.scita* is known from most parts of Ireland and is quite frequent here at present. Away from the Atlantic zone it becomes infrequent, being known only from the southern edge of northern Europe, absent from Mediterranean parts of the continent and very localised in central Europe. But in the Atlantic zone it occurs widely.

Irish reference specimens: in the collections of NMI and UM.

Genus *VOLUCELLA*

Volucella bombylans (L.), 1758



History: given as occurring in Ireland in Coe (1953).

Ecology: *V.bombylans* occurs in a wide range of habitats in Ireland, where the bumble bees (*Bombus*) that host its larvae are to be found. These include the Irish species *Bombus jonellus*, *B.lapidaries*, *B.muscorum*, *B.pascuorum*, *B.ruderarius*, *B.sylvarum* and *B.terrestris* (Barkemeyer, 1994). Some of these bumble bee species are now becoming threatened in Ireland as a consequence of intensification of farming activities, drainage of wetlands and coniferisation of erstwhile open areas, but others remain frequent. The latter group includes *B.pascuorum*, which can use field margins/hedgerows as nest sites and *V.bombylans* is frequent in farmland. It does not occur in gardens or suburban parks, however. *V.bombylans* is to a significant extent an anthropophilic syrphid in Ireland and this is likely to continue for as long as farming practices do not cause the disappearance of bumble bees from the Irish farmland landscape (bumble bees have already largely disappeared from farmland in parts of the Atlantic seaboard countries of Europe).

Range, distribution and status: *Volucella bombylans* is common and widely distributed in Ireland, as it is in much of western and central Europe. It occurs north to as far as northern Norway, and south almost to the Mediterranean. However, it is somewhat less frequent in southern Europe than elsewhere in the continent. It is a Holarctic syrphid, widely distributed in North America.

Irish reference specimens: in the collections of NMI and UM.

Volucella pellucens (L.), 1758



History: given as occurring in Ireland in Coe (1953).

Ecology: the association of *V.pellucens* with the common Irish wasps *Vespula germanica* and *V.vulgaris*, as hosts for its larvae, ensures that this syrphid is frequent here. However, *V.pellucens* does not seem to occur in the full range of situations occupied by its wasp hosts and is largely absent from the standard farmland landscape of green fields and hedges, and also from gardens and suburban parks. It is primarily a deciduous woodland insect (including scrub woodland of *Corylus* etc.) in Ireland. It is not recorded from conifer plantations, other than round their edges or, occasionally, along well-vegetated track margins. It can be regarded as to some extent anthropophilic here, but seems largely dependent upon presence of deciduous woodland or scrub.

Range, distribution and status: *V.pellucens* is common and generally distributed in Ireland and in much of the rest of Europe. It does not extend into northern Europe as far as *V.bombylans*, but is more frequent than that species in southern Europe. Beyond Europe, *V.pellucens* through Asiatic parts of the Palaearctic to the Pacific and into the Oriental region, but is not, apparently, known in N America.

Irish reference specimens: in the collections of NMI and UM.

Genus *XANTHANDRUS*

Xanthandrus comtus (Harris), 1776



History: given as occurring in Ireland in Coe (1953).

Ecology: Shaw & Rotheray (1990) suggest this species is not resident in the British Isles, but migrates here each year from the continent. *X.comtus* is not noted for strong migratory behaviour

in continental Europe, though the adult insect has on occasion been recorded as apparently engaging in long-distance movements. In continental Europe, the first generation of *X.comtus* is on the wing in May (and earlier in southern Europe) and were the species resident here records might be expected from then onwards. So, the fact that *X.comtus* has only regularly been recorded in Ireland from the extreme south-west, from July onwards, perhaps provides circumstantial evidence supporting Shaw & Rotheray (1990). It might seem that a recent record from the beginning of June, in north-west Co. Mayo, would not fit conveniently with this interpretation. But this specimen was caught within an extensive area of habitat with which the species is not associated, namely blanket bog. Only when engaged in long-distance movements would adult syrphids be expected to occur in habitats entirely unsuitable for development of their larvae (unless visiting flowers in a habitat adjacent one in which their larvae may develop - and the Mayo record was far removed from any obvious *X.comtus* habitat), so the Mayo record could be interpreted as being of a migrant specimen. However, there is also a recent record from young conifer plantation in Kilkenny, in May (Gittings *et al.* 2005), the species being subsequently recorded from the same locality in June. The Kilkenny locality provides stronger evidence for the existence of a localised resident population and maybe this insect does now maintain itself here? It would be useful to have more comprehensive seasonal occurrence data from localities where it has been found, in order to decide this issue. The only other Irish record away from the south-west is that of Nelson (1990), of a specimen from Fermanagh, collected at the end of July. There seems to be no reason why *X.comtus* should be unable to overwinter in Ireland, so if it is a non-resident species the explanation probably has to be sought elsewhere. For instance, although the larvae of this syrphid feed on a range of lepidopterous larvae it is possible that in Ireland caterpillar populations do not build up to sufficient density each year to support *X.comtus*. An equally simple explanation for the Irish distribution data would be that the species is indeed resident in Ireland and, like many other syrphid species at the northern edge of their range, has only one generation per year in Ireland, which is on the wing in June/July. This would certainly fit with the origin of most specimens recorded in Ireland, which are from mature oak woodland in either the Killarney valley or Glengarriff, not from anomalous habitats or locations. The Crom estate in Fermanagh, origin of the record published by Nelson (1990), is also mature oak woodland. In the absence of any serious attempt to resolve this issue the status of *X.comtus* as a resident species remains open to question. All that can be said of it is that, when found in Ireland, it has normally been in association with oak forest, which is in keeping with its ecology elsewhere. If it is a migrant, it has singularly failed to establish itself in the extensive conifer plantations now scattered around the Irish countryside, despite its equal association with conifer forests in continental Europe. If it is a migrant, there seems to be no explanation for the localisation of records in Killarney and Glengarriff, either. Some of the other migrant species, like *Scaeva pyrastris*, turn up all round the coast of Ireland, and inland as well. Viewed in this way, it could be argued that *X.comtus* exhibits characteristics of a relictual, indigenous population in Ireland, rarely moving beyond its remaining, very localised population centres.

Range, distribution and status: the few Irish records of *X.comtus* are from western and northern parts of the island. The species is very localised here and perhaps requires to be regarded as vulnerable to extinction. However, its population centre in the south-west has been known throughout the 20th century and the species can still be found there without difficulty. The fact

that it is open to question whether *X.comtus* is resident there complicates assessment of its conservation status, which might in consequence realistically be regarded as indeterminate. Elsewhere in Europe, *X.comtus* reaches north only as far as the southern edge of Scandinavia, but becomes frequent further south and in central Europe. It also occurs widely in Asiatic parts of the Palaearctic.

Irish reference specimens: in the collections of NMI and UM.

Genus *XANTHOGRAMMA*

Xanthogramma citrofasciatum (de Geer), 1776



History: given as occurring in Ireland in Coe (1953).

Ecology: the requirement of this species for unimproved grassland, where large, stable ant colonies can develop, is manifest in Ireland as elsewhere. Scattered records from earlier this century indicate that *X.citrofasciatum* may once have been widely distributed in low altitude grassland in Ireland, at least away from ground liable to flooding. However, it is now more-or-less confined to low-lying limestone pavement grasslands, and is by no means frequent even there. It occurs where there is a more complete grass cover than is characteristic of much of the limestone pavement, which may well be due to its dependence on root-aphids as a larval food source. Elsewhere, recent records are from the secondary habitat provided by the banks of the Grand and Royal canals.

Range, distribution and status: Irish records of this species form a band across central Ireland from Dublin south to Kilkenny in the east and Clare to Limerick in the west. But away from the limestone karst region *X.citrofasciatum* has all but vanished, along with its usual habitat of unimproved grassland. The fact that parts of the canal banks can provide a facsimile of conditions under which it might occur more naturally serves at least to show that the species was once more generally distributed in Ireland. But whether canal banks can be relied upon to provide for the long term survival of *X.citrofasciatum* is less certain. What is clear is that reversion of existing areas of improved/ intensively-used grassland to low-intensity permanent pasture where large, stable ant colonies can develop, is extremely unlikely, so that opportunities for *X.citrofasciatum* to recolonise lost territory will be virtually non-existent in the short to medium term. Within the limestone karst region, the future of *X.citrofasciatum* is arguably less certain than that of either *Cheilosia ahenea* or *Paragus constrictus*, both of which occur where there is a lower percentage of ground cover than appears necessary for *X.citrofasciatum*. The association of *X.citrofasciatum* with ground more completely covered in vegetation, essentially grassland, results in its habitat being

more susceptible to efforts at land improvement and thus eradication of *X.citrofasciatum*. If these various issues are considered together, in the context of how they influence the status of *X.citrofasciatum* in Ireland, it is difficult to conclude other than that it should be regarded as threatened here. Indeed, it might be expected that it will rapidly move into the endangered category. Elsewhere, *X.citrofasciatum* would currently be regarded as either decreasing or threatened over much of its European range, though it cannot be regarded as generally threatened at European level.

Irish reference specimens: in the collections of NMI and UM.

Genus *XYLOTA*

Xylota abiens Meigen, 1822



History: given as occurring in Ireland in Coe (1953), but subsequently removed from the Irish list by Speight (1981b), on grounds of potential confusion of this species with *X.jakutorum* by earlier authors and the lack of Irish reference material. Subsequently reinstated by Speight (1985a), based on recently collected specimens.

Ecology: the few Irish records of *X.abiens* are from areas of wet oak forest with overmature trees, and this is consistent with what is known of the ecology of the species elsewhere. This is a highly anthropophobic species in Ireland, associated, as it is, with overmature oak.

Range, distribution and status: *X.abiens* exhibits a relictual distribution pattern in Ireland and has to be regarded as endangered here. It is a candidate for inclusion in any listing of insects requiring protection throughout the island. It is not known in northern parts of Europe and is extremely scarce in the Mediterranean zone. There are parts of the Atlantic zone (like Britain) where it is not regarded as threatened, but it is nowhere frequent. It is also regarded as threatened in parts of central Europe.

Irish reference specimens: in the collections of NMI and UM.

Xylota florum (Fabricius), 1805



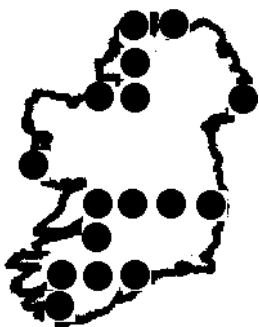
History: given as occurring in Ireland in Coe (1953), but at that time this species was confused with *X.jakutorum*. The presence of *X.florum* in Ireland was confirmed by Speight (1976a).

Ecology: two of the Irish records of *X.florum* are from riparian deciduous forest, in the one case *Quercus/Fraxinus*, in the other *Salix* spp. In this general habitat context, the ecology of *X.florum* in Ireland seems to be as elsewhere in Europe. It is a species associated particularly with alluvial hardwood forest and alluvial brook forest. The third Irish record (Gittings *et al*, 2005) is from a *Fraxinus* plantation remote from any stream or river margin and the fourth is from a suburban garden. However, whatever tree the larvae of this species are associated with in Ireland it is not *Populus nigra*, from which the species has probably been bred elsewhere - *Populus nigra* is not present at any of the Irish localities for *X.florum*. Neither is it an indigenous species of tree here. This syrphid has to be regarded as an extremely anthropophobic species in Ireland.

Range, distribution and status: *X.florum* has to be regarded as an endangered species here, and as a candidate for inclusion in any listing of insects requiring protection throughout Ireland. It does not seem to be so threatened elsewhere, and ranges from southern Scandinavia to central France and through central Europe into parts of Asiatic Russia.

Irish reference specimens: in the collections of NMI.

Xylota jakutorum Bagatshanova, 1980



History: added to the Irish list by Speight (1976a) under the name *coeruleiventris* Zetterstedt. Additional Irish records are published by Nash and Speight (1976).

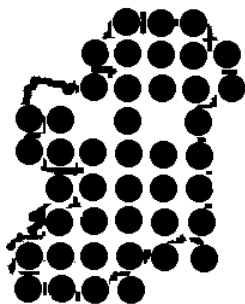
Ecology: *X.jakutorum* is characteristically an insect of mature/overmature coniferous forests, occurring with spruce, fir and pine. In Ireland this species is associated with mature conifer plantations, the larvae presumably occurring in the cut stumps of felled trees. Irish distribution

data for the fly reflect neither the distribution nor frequency of Irish conifer plantations, however. In part this may be due to the frequent practice of treating spruce stumps with urea, to reduce the numbers of the weevil *Hylobius abietis*, rendering the stumps as unusable by *X.jakutorum* as by other saproxylics. Even so, some stumps will almost inevitably escape treatment. The present distribution of *X.jakutorum* may well also reflect the history of spruce plantations in Ireland, in that most were planted within the last 50 years and are only now reaching maturity and being felled for the first time – until very recently larval microhabitat suitable for *X.jakutorum* (i.e. spruce stumps) would have been very much scarcer in conifer plantations than it is today. The great frequency of *X.jakutorum* encountered by Tom Gitings (pers.comm.), in mature spruce plantations during survey work 2001-5 suggests that rapid expansion of Irish *X.jakutorum* populations may now be underway. There are reports of *X.jakutorum* occurring in association with deciduous forest in some parts of Europe, and in Donegal (Glenveagh National Park) this syrphid is frequent in oak woodland distant from conifer plantations (though conifer plantations do remain within the park). Whether this species is able to develop in rotting oak wood is unknown, and certainly, over most of its known range it shows no association with *Quercus* species. In Scotland this insect is associated with humid *Pinus sylvestris* forest. Whether *X.jakutorum* represents some element of the otherwise extinct Irish *P.sylvestris* fauna that has somehow managed to survive until the advent of commercial forestry in Ireland is doubtful. This possibility was examined by Speight (1985b). Today it seems dependent upon conifer plantations for its survival here.

Range, distribution and status: existing Irish records are widely scattered, but predominantly in the western half of the island. The species is arguably undergoing a rapid expansion in Ireland at present and there is no basis for regarding it as threatened here. This species is frequent from central Scandinavia southwards to central Europe, but is largely confined to mountain ranges further south. It ranges beyond Europe into Asiatic parts of the Palaearctic.

Irish reference specimens: in the collections of NMI and UM.

Xylota segnis (L.), 1758



History: given as occurring in Ireland in Coe (1953).

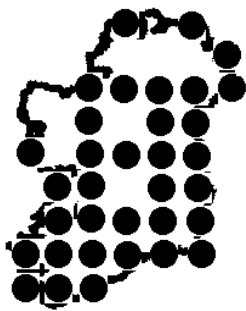
Ecology: the larvae of European *Xylota* species are inhabitants of rotting wood, and most of them are confined to this microhabitat. The larvae of *X.segnis* provide an exception, in that although they occur in rotting wood situations they can also occur in accumulations of other sorts of vegetable debris found away from woodland, in particular on farms. In consequence, *X.segnis* can be found in Ireland in association with hedges on farmland and in suburban gardens, as well as in

woodland. This species is also frequent in mature conifer plantations in Ireland and is as frequent in conifer forest as in deciduous forest in continental Europe. *X.segnis* is an anthropophilic species in Ireland, as much as elsewhere along Europe's Atlantic seaboard.

Range, distribution and status: *X.segnis* is common and generally distributed, both in Ireland and much of the rest of Europe. It ranges from northern Norway to the Mediterranean and beyond Europe through Asiatic parts of the Palaearctic to the Pacific. It is a Holarctic species, occurring also in eastern parts of N America.

Irish reference specimens: in the collections of NMI and UM.

Xylota sylvarum (L.), 1758



History: given as occurring in Ireland in Coe (1953).

Ecology: despite being found equally frequently in coniferous forest and deciduous forest in continental Europe, in Ireland *X.sylvarum* is very largely a deciduous forest species. It is generally scarce in conifer plantations in Ireland, a situation that does not seem to be changing as spruce plantations mature, in contrast to the situation of *X.jakutorum*. Occurring as it does, in both *Quercus* and *Salix/Alnus* woodland, means that *X.sylvarum* may be found in many deciduous woodland situations in Ireland and its association with rotting tree roots as larval microhabitat renders it less confined to sites with overmature trees than some other *Xylota* species. However, it does not seem to occur in association with either *Betula* or *Fraxinus*. Unlike *S.segnis*, *X.sylvarum* is not a species that can occur within the standard farmland landscape of green fields plus hedges. Neither is it a normal constituent of the fauna of gardens or suburban parks. So, in Ireland, *X.sylvarum* cannot be regarded as an anthropophilic species.

Range, distribution and status: widely distributed and common in Ireland, *X.sylvarum* ranges from the southern edge of Scandinavia to the Mediterranean in continental Europe and beyond Europe extensively into Asiatic parts of the Palaearctic. It is frequent in most parts of the Atlantic zone and in central Europe.

Irish reference specimens: in the collections of NMI and UM.

Xylota tarda Meigen, 1822



History: added to the Irish list by Speight *et al* (1979).

Ecology: the known association of *X.tarda* with overmature and dying *Populus tremula* would not favour this insect in Ireland, where stands of overmature aspen are vanishingly scarce. Aspen does occur in the immediate vicinity of the only known Irish site for *X.tarda*, hinting that this syrphid may well, indeed, use the rotting wood of this tree as larval microhabitat here. However, in continental Europe *X.tarda* can be found in an absence of aspen, in particular in oak forest, and its larvae have also been found in rotting wood of overmature beech, so it is possible that it can use other trees in Ireland as well, though the extreme scarcity of *X.tarda* here would suggest otherwise. In Scandinavia, where aspen is more abundant, so is *X.tarda*, and its range in Norway extends to the far north of the country, indicating that climatic considerations are unlikely to limit this syrphid in Ireland. *X.tarda* has to be regarded as an extremely anthropophobic insect in Ireland, unlikely to be found other than with its water-margin habitat.

Range, distribution and status: only one locality is known for *X.tarda* in Ireland and the species has to be regarded as endangered here. It should be included in any listing of insects requiring protection throughout the island. Its status varies from one part of the Atlantic zone to another, but it is apparently threatened in Germany and, in central Europe, it is regarded as threatened in Switzerland. It has a wide range beyond Europe, in Asiatic parts of the Palaeartic.

Irish reference specimens: in the collections of NMI.

BIBLIOGRAPHY & RELEVANT LITERATURE

- Anderson, R. (1985) *Chalcosyrphus nemorum* (Fabricius) in Quoile Wood, Co.Down. *Ir.Nat.J.*, 21: 463.
- Anderson, R. (1986) *Neoascia obliqua* Coe, a hoverfly (Diptera, Syrphidae) new to Ireland. *Ir.Nat.J.*, 22: 211.
- Anderson, R. (1987) Some local woodland hoverflies (Diptera: Syrphidae) including *Parasyrphus lineolus* (Zett.), from the Lagan Valley, Belfast. *Ir.Nat.J.*, 22:258.
- Anderson, R. (1988) An interesting faunal association including *Anasimyia transfuga* (L.) (Diptera: Syrphidae) at Aughnadarragh Lough, Co.Down. *Ir.Nat.J.*, 22: 452.
- Andrews, H.W. (1914) Notes on some Diptera taken in the south of Ireland. *Ir.Nat.*, 23: 136-143.
- Ashe, P., O'Connor, J.P. & Murray, D.A. (1998) A checklist of Irish aquatic insects. *Occ. Pub. Ir Biogeog.Soc.*, No 3: 1-80.
- Ball, S.G. & Morris, R.K.A. (2000) Provisional atlas of British hoverflies (Diptera, Syrphidae). 167pp. BRC/JNCC, Huntington.
- Ball, S.G., Stubbs, A.E., McClean, I.F.G., Morris, R.K.A., Falk, S.J. & Hawkins, R.D. (2002) *British Hoverflies: an illustrated identification guide, 2nd edition*, 469pp. British Entomological and Natural History Society.
- Barkemeyer, W. (1994) Untersuchung zum Vorkommen der Schwebfliegen in Niedersachsen und Bremen (Diptera: Syrphidae). *Naturschutz und Landschaftspflege in Niedersachsen*, 31: 1-514.
- Becerra Jurado, G., Maston, R., Harrington, R., Baars, J.-R. & Kelly-Quinn, M. (2008) Macroinvertebrate diversity in constructed ponds: community structure and driving environmental factors. *Verh. Internat. Verein. Limnol.*, 30: 489-492.
- Beuk, P.L.T. (1990) A hoverfly of the genus *Epistrophe* (Dipt., Syrphidae) new to Britain. *Entomologists mon.Mag.*, 126: 167-170.
- Branquart, E. (1999) Life history strategies of hoverflies with predacious larvae (Diptera: Syrphinae). Doctoral thesis, Faculté Universitaire des Sciences Agronomiques de Gembloux. 150pp.
- Breen, J.A.G. (1977) A note on the species of *Microdon* (Diptera, Syrphidae) in Ireland. *Ent.Gaz*, 28: 243-244.
- Burgio, G. & Sommaggio, D. (2003) Diptera Syrphidae caught by Malaise trap in Bologna province and new record of *Neoascia interrupta* in Italy. *Bulletin of Insectology*, 55: 43-47.
- CSO (1997) *Farming since the famine, Irish farm statistics 1847-1996*. 407pp. Stationary Office, Dublin.
- Chambers, R.J. & Adams, T.H.L. (1986) Quantification of the impact of hoverflies (Diptera: Syrphidae) on cereal aphids in winter wheat: an analysis of field populations. *Journal of Applied Ecology*, 23: 895-904.
- Chandler, P. J. (1982) Some Diptera of the Killarney area May 1981, including five species new to Ireland. *Ir.Nat.J.*, 20: 555-558.

- Chandler, P. J. (ed.) (1998) Syrphidae. In: *Checklist of insects of the British Isles (New Series), Pt.1, Diptera*, 104-114. Royal Entomological Society, London.
- Coe, R.L. (1953) Diptera: Syrphidae. *Handbks.ident.Br.insects*, 10(1): 1-98. R.Ent.Soc. London.
- Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Peruelo, J., Raskin, R.G., Sutton, P. & van der Belt, M. (1997) The value of the world's ecosystem services and natural capital. *Nature*, 386: 253-260.
- DAFF (2007a) Farmers Handbook for REPS 4. 79pp. DAFF, Johnstown Castle, Co Wexford.
- DAFF (2007b) Terms and conditions of the Rural Environment Protection Scheme (REPS) and Natura 2000 scheme introduced by the Minister for Agriculture and Food in implementation of Council Regulation (EC) No.1698/2005. Unpaginated. DAFF, Johnstown Castle, Co Wexford.
- DAFF (2007c) Specification for REPS Planners in the Preparation of REPS 4 Plans. 162pp.
- DAHGI (2002) *National Biodiversity Plan*. 49pp. Government of Ireland.
- Dirickx, H.G. (1998) Catalogue synonymique et géographique des Syrphidae (Diptera) de la Région Afrotropicale. *Instrumenta Biodiversitatis, II*, 187pp. Muséum d'histoire naturelle, Genève.
- Doczkal, D. (1996) Schwebfliegen aus Deutschland: Erstnachweise und wenig bekannte Arten (Diptera, Syrphidae). *Volucella*, 2: 36-62.
- Doczkal, D. & Schmid, U. (1999) Revision der mitteleuropäischen Arten der Gattung *Microdon* Meigen (Diptera, Syrphidae). *Volucella*, 4: 45-68.
- Falk, S.J. (1990) *Eristalis pratorum* (Meigen, 1822): a new British hoverfly. *Br.J.Ent Nat.Hist.*, 3: 139-141.
- DEHLG (2008) *The economic and social aspects of Biodiversity: Benefits and Costs of Biodiversity in Ireland*. 195pp. Department of Environment, Heritage and Local Government, Dublin.
- Finn, J.A., Kavanagh, B. & Flynn, M. (2004) *Identification of environmental variables for use in monitoring for the evaluation of the Rural Environment Protection Scheme (REPS)*. 93pp. Environmental Protection Agency, Johnstown Castle, Co.Wexford.
- Forest Service (2008) Native Woodland Scheme Manual. 92pp. Forest Service, Johnstown Castle Estate, Co.Wexford.
- Fossitt, J. (2000) *A Guide to Habitats in Ireland*. 120pp. The Heritage Council, Dublin.
- Frank, J. and Volkmar, W. (2006) *Episyrphus balteatus*: an example of pollination efficiency in hover flies. *91st Annual Meeting of the Ecological Society of America (ESA)*, Memphis, Tennessee.
- Gibson, R. H., Nelson, I.L., Hopkins G.W., Hamlett B.J. and Memmott, J. (2006) Pollinator webs, plant communities and the conservation of rare plants: arable weeds as a case study. *Journal of Applied Ecology* 43: 246-257.

- Gittings, T. (2006) *Lapposyrphus lapponicus* (Zetterstedt, 1838) a hoverfly (Diptera, Syrphidae) new to Ireland. *Ir.Nat.J.*, 28: 301.
- Gittings, T., Giller, P. & O'Halloran, J. (2005) Notable Irish hoverfly (Diptera: Syrphidae) records, 2001 and 2002. *Ir.Nat.J.*, 28: 132-133.
- Gittings, T., O'Halloran, J., Kelly, T. & Giller, P.S. (2006) The contribution of open spaces to the maintenance of hoverfly (Diptera, Syrphidae) biodiversity in Irish plantation forests. *Forest Ecology & Management*, 237: 290-300.
- Goeldlin, P. (1989) Sur plusieurs espèces de *Sphaerophoria* (Dipt.,Syrphidae) nouvelles ou méconnues des régions paléarctique et néarctique. *Bull.Soc.ent.Suisse*, 62: 41-66.
- Goeldlin, P. (1996) Sur plusieurs nouvelles espèces européennes de *Syrphus* (Diptera, Syrphidae) et clé des espèces paléarctiques du genre. *Bull.Soc.ent.Suisse*,69: 157-171.
- Goeldlin, P., Maibach, A. & Speight, M.C.D. (1990) Sur quelques especes de *Platycheirus* (Diptera, Syrphidae) nouvelles ou meconnues. *Dipterists Digest*, 5: 19-44.
- Goeldlin, P., Delarze, R., Castella, E. & Speight M.C.D. (2003) Ecological reference-state studies for forest reserve management in Montricher (Vaud, Jura, Switzerland). Insects as bioindicators. *Mém.Soc.vaud.Sc.nat*, 20: 159-267.
- Good, J.A. (1998) The potential role of ecological corridors for habitat conservation in Ireland: a review. *Irish Wildlife Conservation Manuals*, no.2: 76pp. Duchas, Dublin.
- Good, J.A. (2001) Farms as biogeographical units: 1. Habitat and faunal changes as influenced by farmer decision-making on a mixed farm in south Cork, Ireland. *Bull.Ir.biogeog.Soc.*, 25: 2220-247.
- Haarto, A. & Kerppola, S. (2007) Finnish hoverflies and some species in adjacent countries. Otavan Kirjapaino Oy, Keuruu. 647pp.
- Harrington, R. & Ryder, C. (2003) The use of integrated constructed wetlands (ICWs) in the management of farmyard runoff and waste water. In: *Water Resource Management, sustainable supply and demand*, 55-63. Proceedings of the National Hydrology Seminar, 2002.
- Harrington, R., Carroll, P., Carty, A.H., Keohane, J., & Ryder, C. (2007) Integrated Constructed Wetlands: concept, design, site evaluation and performance. *Int.J.Water*, 3: 243-256.
- Hickey, D. (1997) *Evaluation of Environmental Designations in Ireland*. 104pp. Heritage Council, Kilkenny.
- Jarlan, A., de Oliveira, D. & Gingras, J. (1997). Effects of *Eristalis tenax* (Diptera: Syrphidae) pollination on characteristics of greenhouse sweet pepper fruits. *Journal of Economic Entomology* 90: 1650-1654
- Kantyerina NF (1979) [Biological characteristics of syrphid flies (Diptera, Syrphidae) in the Orlovksi Region]. *Byull Nauchno-Tekhn Inf Vses Nauchno-Issled Instit zernobobovykh i Krupianykh Kul'tur* 24: 37-40. (In Russian)

- Knutson, L.V., Thompson, J.C. & Vockeroth, J.R. (1975) Family Syrphidae. In: Delfinado, M.D. & Hardy, D.E. (eds.) A Catalog of the Diptera of the Oriental Region, 2, Suborder Brachycera through Division Aschiza, Suborder Cyclorhapha, 307-374. University Press of Hawaii, Honolulu.
- Le Roux, X., Barbault, R., Baudry, J., Burel, F., Doussan, I., Garnier, E., Herzog, F., Lavorel, S., Lifran, R., Roger-Estrade, J., Sathou, J.-P. & Trommetter, M. (2008) *Agriculture et biodiversité : valoriser les synergies*. 116pp. Institut National de la Recherche Agronomique, Paris.
- Losey, J.E. & Vaughan, M. (2006) The economic value of ecological services provided by insects. *Bioscience*, 56: 311-323.
- Maibach, A., Goeldlin, P. & Speight, M.C.D. (1994) Limites génériques et caractéristiques taxonomiques de plusieurs genres de la Tribu des Chrysogasterini (Diptera: Syrphidae) 2. Statut taxonomique de plusieurs des espèces étudiées et analyse du complexe *Melanogaster macquarti* (Loew). *Ann.Soc.Entomol.Fr.* (N.S.), 30: 253-271.
- Mazánek, L., Láska, P. & Bicik, V. (1999) Two new Palaearctic species of *Eupeodes* similar to *E.bucculatus* (Diptera, Syrphidae). *Volucella*, 4: 1-9.
- Mitchell, F. (1986) *Shell Guide to Reading the Irish Landscape*. 228pp. Country House, Dublin.
- Nash, R. & Speight, M.C.D. (1976) Records of, and notes on, some rare Irish hoverflies (Dipt., Syrphidae), including a first Irish record of *Criorhina ranunculi*. *Ir.Nat.J.*, 18: 351-156.
- Nash, R. (1975) *Parasyrphus vittiger* (Zetterstedt) (Diptera: Syrphidae) confirmed as an Irish species. *Ir.Nat.J.*, 18: 229-230.
- Nash, R. (1997) Species inventory for Northern Ireland: Hoverflies (Diptera: Syrphidae). *Environment and Heritage Service, Research & Development Series*, No.97/8, 1-23.
- NPWS (2005) *Farm Plan Scheme for designated areas and commonages: specifications document*. 80pp. Dept of the Environment, Heritage and Local Government, Dublin.
- Nelson, B. (1988) Records of uncommon hoverflies (Diptera: Syrphidae) from Northern Ireland. *Ir.Nat.J.*, 22: 453.
- Nelson, B. (1990) *Xanthandrus comtus* (Harris) and *Xylota abiens* Meigen (Diptera: Syrphidae) in Co. Fermanagh. *Ir.Nat.J.*, 23: 221.
- New, T.R. (2005) *Invertebrate conservation and agricultural ecosystems*. 354pp. Cambridge University Press, UK.
- Nielsen, T.R. (1999) Check-list and distribution maps of Norwegian Hoverflies, with description of *Platycheirus laskai* nov.sp. (Diptera, Syrphidae). *NNA Fagrapport*, No.35: 1-99.
- Ouin, A., Sarthou, J.-P., Bouyjou, B., Deconchat, M., Lacombe, J.P. & Monteil, C. (2006) The species-area relationship in the hoverfly (Diptera, Syrphidae) communities of forest fragments in southern France. *Ecography* 29 (2): 183-190.

- Parker, M.J. (2001) *Cheilosia ahenea* von Roser (Diptera, Syrphidae) new to Great Britain. *Dipterists Digest (Second Series)*, 8: 24-26.
- Peck, L.V. (1988) Syrphidae. In: Soos, A. & Papp, L. (eds.) *Catalogue of Palaearctic Diptera*, 8: 11-230. Akad.Kiado, Budapest.
- Plant, C. W. (1990) *Sphaerophoria bankowskiae* Goeldlin, 1989 (Syrphidae) recorded in mainland Britain. *Dipterists Digest (first series)*, 3: 32-33.
- Rasmont, P., Speight, M.C.D. & Picton, B.E. (1986) A computer programme for conversion of the Irish Transverse Mercator Projection to the Universal Transverse Mercator Projection. *Ir.Nat.J.*, 22: 45-50.
- Reemer, M. (2005) Saprophytic hoverflies benefit by modern forest management (Diptera: Syrphidae). *Journal of Insect Conservation*. 9:49-59.
- Rizza, A., Campobasso, G., Dunn, P.H. & Stazi, M. (1988) *Cheilosia corydon* (Diptera: Syrphidae), a candidate for the biological control of musk thistle in North America. *Ann.Entomol.Soc.Am.*, 81(2): 225-232.
- Rodwell, J.S., Schaminée, J.H.J., Mucina, L., Pignatti, S., Dring, J. & Moss, D. (2002) The diversity of European vegetation. An overview of phytosociological alliances and their relationships to EUNIS habitats. 168pp. Report EC-LNV 2002/054. EC-LNV, Wageningen, NL.
- Royo, S., Pérez-Bañón, C. & Hurtado, P. (2007) Preliminary results on potential use of saprophagous eristalines (Diptera, Syrphidae) in the biodegradation of pig slurry. In: Laiho, J. & Ståhls-Mäkelä, G. (eds.) *Programme and Abstracts, 4th International Symposium on Syrphidae, Siikaranta, Finland*, 36. Yliopistopaino, Helsinki.
- Rotheray, G.E. (1991) Larval stages of 17 rare and poorly known British hoverflies (Diptera: Syrphidae). *J.Nat.Hist.*, 25: 945-969.
- Rotheray, G. E. (1998) *Platycheirus splendidus* sp.n. from Britain formerly confused with *Platycheirus scutatus* (Diptera: Syrphidae). *Ent.Gaz.*, 49: 271-276.
- Rotheray, G.E. & Hewitt, S.M. (1999) Northern records of *Parasyrphus nigratarsis* (Zetterstedt) (Syrphidae). *Dipterists Digest, second series*, 6: 106.
- Schmid, U. (2004) *Microdon rhenanus* and *Microdon eggeri* var. *major* (Diptera, Syrphidae) revisited. *Volucella*, 7: 111-124.
- Schönrogge, K., Barr, B., Wardlaw, J.C., Napper, E., Gardner, M.G., Breen, J., Elmes, G.W. & Thomas, J.A. (2002) When rare species become endangered: cryptic speciation in myrmecophilous hoverflies. *Biological J.Linn.Soc.*, 75: 291-300.
- Shaw, M.R. & Rotheray, G.E. (1990) *Xanthandrus comtus* (Harris) (Dipt., Syrphidae) reared. *Entomologists mon.Mag.*, 126: 258.
- Speight, M.C.D. (1973) British species of *Sphaerophoria* (Diptera, Syrphidae) confused with *S.menthastris* (L.), including a key to the males of the seven species of *Sphaerophoria* found in the British Isles. *Entomologist*, 106: 228-233.

- Speight, M.C.D. (1974) *Bombus lapponicus*, *Parasyrphus lineola* and *Phaonia exoleta*: insects new to Ireland. *Ir.Nat.J.*, 18: 123-124.
- Speight, M.C.D. (1975) *Conops vesicularis*, *Epistrophe nitidicollis* and *Ctenophora atrata*: insects new to Ireland. *Ir.Nat.J.*, 18: 191-192.
- Speight, M.C.D. (1976a) *Agonum livens*, *Asemum striatum* and *Xylota coeruleiventris*: insects new to Ireland. *Ir.Nat.J.*, 18: 274-275.
- Speight, M.C.D. (1976b) *Sphaerophoria rueppellii* (Dipt., Syrphidae) new to Ireland, with figures of its surstyli. *Ir.Nat.J.*, 18: 332-334.
- Speight, M.C.D. (1976c) *Badister meridionalis*, *Megasyrphus annulipes* and *Wesmaelius quadrifasciatus*: insects new to Ireland. *Ir.Nat.J.*, 18: 303-305.
- Speight, M.C.D. (1978a) The genus *Paragus* (Dipt., Syrphidae) in the British Isles, including a key to known and possible British species. *Ent.Rec.J.Var.*, 90: 100-107.
- Speight, M.C.D. (1978b) *Cheilosia laskai* sp.n. (Dipt. Syrphidae) from Western Ireland. *Ir.nat.J.*, 19: 217-222.
- Speight, M.C.D. (1978c) *Cheilosia praecox*, *Lejogaster splendida* and *Orthonevra brevicornis* (Diptera: Syrphidae) insects new to Ireland. *Ir.Nat.J.*, 19(8): 278-279.
- Speight, M.C.D. (1978d) A check list of Irish Syrphidae (Diptera). *Bull.Ir.biogeog. Soc.*, 2: 26-31.
- Speight, M.C.D. (1979) *Eumerus tuberculatus*, *Geomyza majuscula* and *Pteromicra leucopeza*: insects new to Ireland, including a key to British Isles *Eumerus* species. *Ir.Nat.J.*, 19: 397-399.
- Speight, M.C.D. (1980a) *Brachypalpus laphriformis* (Dipt., Syrphidae) in Ireland and its probable demise. *Ir.Nat.J.*, 20(2): 70-72.
- Speight, M.C.D. (1980b) *Chiloxanthus pilosus*, *Palloptera modesta* and *Pipizella heringi* confirmed as Irish species. *Ir.Nat.J.*, 20: 72-73.
- Speight, M.C.D. (1981a) The Irish *Anasimyia* species, including a key and first records of *A.contracta* (Diptera, Syrphidae). *Ir.Nat.J.*, 20(6): 229-234.
- Speight, M.C.D. (1981b) A key to the Xylotini (sensu Hippha) known in Great Britain and Ireland, plus *Xylota ignava* (Dipt., Syrphidae). *Ent.Rec.*, 93: 25-27.
- Speight, M.C.D. (1982) *Acrocera globulus*, *Limnia paludicola* and *Sphaerophoria loewi*: insects new to Ireland. *Ir.Nat.J.*, 20: 369-372.
- Speight, M.C.D. (1985a) Adjustments to the Irish hoverfly list (Dipt., Syrphidae). *Ir.Nat.J.*, 21(9): 385-391.
- Speight, M.C.D. (1985b) The extinction of indigenous *Pinus sylvestris* in Ireland: relevant faunal data. *Ir.Nat.J.*, 21: 449-453.
- Speight, M.C.D. (1986a) *Cheilosia nasutula*, *Neocnemodon vitripennis* and *Parasyrphus nigratarsis*: hoverflies (Diptera: Syrphidae) new to Ireland. *Ir.Nat.J.*, 22: 149-152.

- Speight, M.C.D. (1986b) *Cheilosia argentifrons* (Diptera: Syrphidae) new to Ireland; *Donacia cinerea* (Coleoptera: Chrysomelidae) and *Palloptera muliebris* (Diptera: Pallopteridae), presence in Ireland confirmed. *Ir.Nat.J.*, 22: 159-160.
- Speight, M.C.D. (1988) Syrphidae known from temperate Western Europe: potential additions to the fauna of Great Britain and Ireland and a provisional species list for N.France. *Dipterists Digest*, No.1: 2-35.
- Speight, M.C.D. (1989) *Sphaerophoria fatarum* in the British Isles (Syrphidae). *Dipterists Digest*, 2: 34.
- Speight, M.C.D. (1996a) A mass migration of *Episyrphus balteatus* and *Eupeodes corollae* arriving in the south-west and remarks on other migrant hoverflies (Diptera: Syrphidae) in Ireland. *Ir.Nat.J.*, 25: 182-183.
- Speight, M.C.D. (1996b) *Cheilosia psilophthalma* and *Odinia boletina*, insects new to Ireland and *Sapromyza sexpunctata* confirmed as an Irish species (Diptera: Syrphidae, Odiniidae and Lauxaniidae). *Ir.Nat.J.*, 25: 178-182.
- Speight, M.C.D. (1997) Invertebrate species lists as management tools: an example using databased information about Syrphidae (Diptera). Proc.Colloq. conservation, management and restoration of habitats for invertebrates: enhancing biological diversity. *Environmental Encounters Series*, No.33: 74-83. Council of Europe, Strasbourg.
- Speight, M.C.D. (1998) *Eriozona syrphoides* (Diptera: Syrphidae); an insect new to Ireland. *Ir.Nat.J.*, 26: 114-116.
- Speight, M.C.D. (1999a) Bush crickets and the Burren, with first records of *Pholidoptera griseoptera* (de Geer) (Orth.: Tettigoniidae). *Ent.Rec.*, 111: 139-141.
- Speight, M.C.D. (1999b) *Syrphus rectus* Osten Sacken and its potential implications to the recording of *Syrphus* species. *Dipterists Digest* 6: 85-91.
- Speight, M.C.D. (2000a) Irish Syrphidae (Diptera), Pt.1: species accounts and distribution maps. In: Speight, M.C.D., Castella, E., Obrdlik, P. and Ball, S. (eds.) *Syrph the Net, the database of European Syrphidae*, vol. 18, 215 pp., Syrph the Net publications, Dublin.
- Speight, M.C.D. (2000b) The syrphid fauna of western temperate Europe revisited (Diptera: Syrphidae). *Dipterists Digest*, 7: 89-99.
- Speight, M.C.D. (2001) Farms as biogeographical units: 2, the potential role of different parts of the case-study farm in maintaining its present fauna of Sciomyzidae and Syrphidae (Diptera). *Bull. Ir.Biogeog.Soc.*, 25: 248-278.
- Speight, M.C.D. (2002a) An annotated list of the Syrphidae (Diptera) of Pollardstown Fen, Co.Kildare, Ireland. *Bull.Ir.Biogeog.Soc.*, 26: 196-210.
- Speight, M.C.D. (2002b) Two controversial additions to the Irish insect list: *Microdon myrmicae* Schönrogge *et al* and *Pipiza festiva* Meigen (Diptera: Syrphidae) *Bull.Ir. Biogeog.Soc.*, 26: 143-153.
- Speight, M.C.D. (2003) *Microdon myrmicae* Schönrogge *et al* 2002 (Dipt.: Microdontidae): presence in Ireland confirmed. *Ent.Rec.*, 115: 155-157.

- Speight, M.C.D. (2004a) Insect records from the Connemara (Co.Galway) and Mayo (Co.Mayo) National Parks, Western Ireland. *Bull.Ir.biogeog.Soc.*, 28: 31-60.
- Speight, M.C.D. (2004b) Towards an understanding of the development and constitution of the Irish post-glacial syrphid fauna (Diptera: Syrphidae). *Volucella*, 7: 125-155.
- Speight, M.C.D. (2004c) Predicting impacts of changes in farm management on sciomyzids (Diptera, Sciomyzidae): a biodiversity case study from southern Ireland. *Dipterists Digest*, 11: 147-166.
- Speight, M.C.D. (2005) *Platycheirus aurolateralis*, *P.scutatus* and *P.splendidus* in a Co Dublin garden. *Bull.Ir.biogeog.Soc.*, 29: 258-261.
- Speight, M.C.D. (2007) Species accounts of European Syrphidae (Diptera) 2007. In: Speight, M.C.D., Castella, E., Sarthou, J.-P. and Monteil, C. (eds.) *Syrph the Net, the database of European Syrphidae*, vol. 55, 261 pp., Syrph the Net publications, Dublin.
- Speight, M.C.D. (2008a) Species accounts of European Syrphidae (Diptera) 2008. In: Speight, M.C.D., Castella, E., Sarthou, J.-P. and Monteil, C. (eds.) *Syrph the Net, the database of European Syrphidae*, vol. 55, 261 pp., Syrph the Net publications, Dublin.
- Speight, M.C.D. (2008b) On the arrival in Ireland of *Sphegina sibirica* Stackelberg, 1953 (Diptera: Syrphidae). *Bull.Ir.biogeog.Soc.*, 32: 90-96.
- Speight, M.C.D. & Chandler, P.J. (1995) *Paragus constrictus*, *Pteromicra pectorosa* and *Stegana similis*: insects new to Ireland and *Stegana coleoprata*, presence in Ireland confirmed (Diptera). *Ir.Nat.J.*, 25: 28-32.
- Speight, M.C.D. & Claussen, C. (1987) Redefinition of *Cheilosia ahenea* and *C.argentifrons* with records extending the known range of these species in Western Europe (Diptera, Syrphidae). *Annls.Soc.ent.Fr. (N.S.)*, 23(3): 299-308.
- Speight, M.C.D. & Goeldlin, P. (1990) Keys to distinguish *Platycheirus angustipes*, *P.europaeus*, *P.occultus* and *P.ramsarensis* (Dipt., Syrphidae) from other *clypeatus* group species known in Europe. *Dipterists Digest*, 5: 5-18.
- Speight, M.C.D. & Good, J.A. (2001b) Farms as biogeographical units: 4, concept and reality. *Bull. Ir.Biogeog.Soc.*, 25: 292-308.
- Speight, M.C.D. & Good, J.A. (2001a) Farms as biogeographical units: 3, the potential of natural/semi-natural habitats on a farm to maintain its syrphid fauna under various management regimes. *Bull. Ir.Biogeog.Soc.*, 25: 248-278.
- Speight, M.C.D. & Good, J.A. (2003) Development of eco-friendly forestry practices in Europe and the maintenance of saproxylic biodiversity. In: Mason, F., Nardi, G. & Tisato, M. (eds.) Proc. Internat.Symposium "Legno Morto: una chiave per la biodiversità", Mantova, May 2003, *Sherwood*, 95, Suppl.2, 73-77.
- Speight, M.C.D. & Good, J.A. (2005) Farms as biogeographical units 5: the response of Odonata to increased habitat availability on a farm in Co.Cork, Ireland. *Bull.Ir.biogeog.Soc.*, 29: 262-277.

- Speight, M.C.D. & Lucas, J.A.W. (1992) Liechtenstein Syrphidae (Diptera). *Ber.Bot.-Zool.Ges. Liechtenstein-Sargans-Werdenberg*, 19: 327-463.
- Speight, M.C.D. & Nash, R. (1993) *Chrysotoxum cautum*, *Ctenophora ornata*, *C.pectinicornis*, *Helophilus trivittatus* and *Mesembrina mystacea* (Diptera): insects new to Ireland.. *Ir.Nat.J.*, 24: 231-236.
- Speight, M.C.D. & Nelson, B. (2000) The changing status of *Helophilus trivittatus* in Ireland (Diptera: Syrphidae). *Bull.Ir.biogeog.Soc.*, 24: 171-174.
- Speight, M.C.D. & Vockeroth, J.R. (1988) *Platycheirus amplus*: an insect new to Ireland not previously recorded from Europe. (Dipt.: Syrphidae). *Ir.Nat.J.*, 22: 518-521.
- Speight, M.C.D., Brown, M.J.F. & Stout, J.C. (2004) *Platycheirus aurolateralis* and *P.splendidus* (Diptera: Syrphidae) new to Ireland and their separation from related species. *Ir.Nat.J.*, 27: 413-417.
- Speight, M.C.D., Castella, E., Obrdlik, P. & Schneider, E. (1997) Are CORINE habitats invertebrate habitats? In: Schreiber, H. (ed.) The importance of chorology to invertebrates, 193-200. *Proc.10th.Int. Colloq.EIS*, Saarbrücken.
- Speight, M.C.D., Castella, E., Sarthou, J.-P. & Monteil, C. (eds) (2008) Syrph the Net on CD, Issue 6. *The database of European Syrphidae*. ISSN 1649-1917. Syrph the Net Publications, Dublin.
- Speight, M.C.D., Chandler, P. & Nash, R. (1975) Irish Syrphidae (Diptera): notes on the species and an account of their known distribution. *Proc.R.Ir.Acad.*, 75B(1): 1-80.
- Speight, M.C.D. Good, J.A. & Castella, E. (2002) Predicting the changes in farm syrphid faunas that could be caused by changes in farm management regimes (Diptera: Syrphidae). *Volucella*, 6: 125-137.
- Speight, M.C.D., Sarthou, J.-P. & Levy, D.A. (2007) *Eupeodes goeldlini* (Diptera: Syrphidae) new to Britain, France and Ireland, with a key to separate it from related Atlantic zone species. *Entomologist's Rec. J. Var.*, 119: 213 – 219.
- Speight, M.C.D., Williams, M. de C. and Withers, P. (1979) *Pachygaster minutissima*, *Psacadina zernyi* and *Xylota tarda*: insects new to Ireland. *Ir.Nat.J.*, 19: 354-355.
- Ssymank, A. (2002) Patterns of habitat use by Syrphidae (Diptera) in the valley of the river Strom in north-east Brandenburg. *Volucella*, 6: 81-124.
- Stubbs, A.E. & Falk, S.J. (1983) *British hoverflies: an illustrated identification guide*. Br.Ent.Nat.Hist.Soc., London, 253pp.
- Stubbs, A.E. (2002) Advances in the understanding of the *Platycheirus scutatus* complex in Britain, including the addition of *Platycheirus aurolateralis* sp.nov.(Diptera, Syrphidae). *Dipterists Digest (second series)*, 9: 75-80.
- Tenhumberg, B. & Poehling, H-M. (1995) Syrphids as natural enemies of cereal aphids in Germany: Aspects of their biology and efficacy in different years and regions. *Agriculture, Ecosystems and Environment*, 52: 39-43.

- Thompson, F.C. & Vockeroth, J.R. (1989) Family Syrphidae. In: Evenhuis, N.L. (ed.) Catalog of the Diptera of the Australasian and Oceanian Regions, 437-458. Brill, Leiden.
- Thompson, F.C. (1980) The problem of old names as illustrated by *Brachyopa conica* Panzer", with a synopsis of Palearctic *Brachyopa* Meigen (Diptera: Syrphidae). *Ent. scand.*, 11: 209 - 216.
- Thompson, F.C., Vockeroth, J.R. & Sedman, Y.S. (1976) Family Syrphidae. A catalogue of the Diptera of the Americas south of the United States, 1-195. Museo e Zoologia, Universidade de Sao Paulo, Brazil.
- Vockeroth, J.R. (1990) Revision of the Nearctic species of *Platycheirus* (Diptera, Syrphidae). *Can.Ent.*, 122: 659-766.
- Vockeroth, J.R. (1992) The flower flies of the Subfamily Syrphinae of Canada, Alaska and Greenland (Diptera, Syrphidae). The insects and arachnids of Canada, Pt.18, 1-456. Agriculture, Canada.
- Wirth, W.W., Sedman, Y.S. & Weems, H.V. (1965) Family Syrphidae. In: Stone, A., Sabrosky, C.W., Wirth, W.W., Foote, R.H. & Coulson, J.R. (eds.) A catalog of the Diptera of America north of Mexico. 557-625. USDA, Washington.
- Wolff, D. (1998) Zur Schwebfliegenfauna des Berliner Raums (Diptera, Syrphidae). *Volucella*, 3: 87-131.

APPENDIX 1: MISCELLANEOUS INSECT RECORDS FROM THE CASE-STUDY FARM

The following insects were collected from the farm (located at W6658 (NT2), Co. Cork) during the period 1996-2006, by use of Malaise traps, emergences traps and hand net. The lists presented here for some of the families of Diptera are probably more-or-less complete for the farm, but the lists for other insect families are not – the species listed in those cases are simply species that were encountered during course of the study of the farm.

COLEOPTERA

Attelabidae

Rhynchites germanicus (Herbst), 1797

Carabidae

Agonum muelleri (Herbst), 1784

Amara aulica (Panzer), 1797

Amara ovata (Fabricius), 1792

Amara plebeja (Gyllenhal), 1810

Amara similata (Gyllenhal), 1810

Asaphidion curtum (Heyden), 1870

Bembidion aeneum Germar, 1824

Bembidion guttula (Fabricius), 1792

Bembidion mannerheimi Sahlberg, 1827

Bradycellus harpalinus (Audinet-Serville), 1821

Bradycellus sharpi Joy, 1912

Carabus granulatus L., 1758

Dromius linearis (Olivier), 1795

Dromius melanocephalus Dejean, 1825

Dromius meridionalis Dejean, 1825

Harpalus rufipes (DeGeer), 1774

Leistus terminatus (Hellwig), 1793

Loricera pilicornis (Fabricius), 1775

Nebria brevicollis (Fabricius), 1792

Notiophilus substriatus Waterhouse, 1833

Pterostichus cupreus (L.), 1758

Stenolophus mixtus (Herbst), 1784

Synuchus nivalis (Illiger), 1798

Trechus quadristriatus Schrank, 1781

Cerambycidae

Grammoptera ruficornis (Fabricius), 1781

Leiopus nebulosus (L.), 1758

Rhagium bifasciatum Fabricius, 1775

Chrysomelidae

Altica lythri Aube, 1843

Chrysolina banksi (Fabricius), 1775

Chrysolina staphylea (L.), 1758

Donacia vulgaris Zschach, 1788

Galerucella calmariensis (L.), 1767

Galerucella lineola (Fabricius), 1781

Oulema melanopus (L.), 1758

Oulema septentrionis Weise, 1880

Phratora laticollis (Suffrian), 1851

Phratora vulgatissima (L.), 1757

Coccinellidae

Adalia 2-punctata (L.), 1758

Adalia 10-punctata (L.), 1758

Calvia 14-guttata (L.), 1758

Coccinella 7-punctata L., 1758

Propylea 14-punctata (L.), 1758

Curculionidae

Coeliodes erythroleucos (Gmelin), 1790

Cryptorhynchus lapathi (L.), 1758

Curculio betulae (Stephens), 1831

Rhynchaenus alni (L.), 1758

Elateridae

Adrastus pallens (Fabricius), 1792

Athous haemorrhoidalis (Fabricius), 1801

Melanotus villosus (Geoffroy), 1785

Lagriidae

Lagria hirta (L.), 1758

Melolonthidae

Serica brunnea (L.), 1758

Nitidulidae

Glischrochilus hortensis (Geoffroy), 1785

Salpingidae

Salpingus planirostris (Fabricius), 1787

Silphidae

Nicrophorus vespilloides Herbst, 1784

Phosphuga atrata L., 1758

DIPTERA

Clusiidae

Clusia flava (Meigen), 1830

Clusiodes albimanus (Meigen), 1830

Clusiodes caledonicus (Collin), 1912

Clusiodes gentilis (Collin), 1912

Clusiodes verticalis (Collin), 1912

Conopidae

Conops quadrifasciatus de Geer, 1776

Sicus ferrugineus (L.), 1761

Dolichopodidae

Achalcus britannicus Pollet, 1997

Achalcus cinereus (Haliday in Walker), 1851

Achalcus flavicollis (Meigen), 1824

Anepsiomyia flaviventris (Meigen), 1824

Argyra argentina (Meigen), 1824

Argyra diaphana (Fabricius), 1775

Argyra leucocephala (Meigen), 1824

Argyra perplexa Becker, 1918

Campsicnemus curvipes (Fallen), 1823

Campsicnemus loripes (Haliday), 1832

Campsicnemus scambus (Fallen), 1823

Chrysotus cilipes Meigen, 1824

Chrysotus gramineus (Fallen), 1823
Dolichopus atripes Meigen, 1824
Dolichopus brevipennis Meigen, 1824
Dolichopus festivus Haldiday, 1832
Dolichopus griseipennis Stannius, 1831
Dolichopus latelinbatus Macquart, 1827
Dolichopus pennatus Meigen, 1824
Dolichopus plumipes (Scopoli), 1763
Dolichopus popularis Wiedemann, 1817
Dolichopus simplex Meigen, 1824
Dolichopus trivialis Haliday, 1832
Dolichopus unguatus (L.), 1758
Dolichopus urbanus Meigen, 1824
Dolichopus vitripennis Meigen, 1824
Dolichopus wahlbergi Zetterstedt, 1843
Hercostomus aerosus (Fallen), 1823
Hercostomus chetifer (Walker), 1849
Hercostomus cupreus (Fallen), 1823
Hercostomus metallicus (Stannius), 1831
Hercostomus nanus (Macquart), 1827
Medetera abstrusa Thuneberg, 1955
Medetera muralis Meigen, 1824
Medetera saxatilis Collin, 1841
Poecilobothrus nobilitatus (L.), 1767
Rhaphium crassipes (Meigen), 1824
Rhaphium fasciatum Meigen, 1824
Rhaphium fascipes (Meigen), 1824
Rhaphium macrocerum Meigen, 1824
Rhaphium monotrichum Loew, 1850
Rhaphium nasutum (Fallen), 1823
Rhaphium zetterstedti (Parent), 1925
Sciapus platypterus (Fabricius), 1805
Sybistroma discipes (Germar), 1821
Sybistroma obscurellus (Fallen), 1823
Sympycnus pulicarius (Fallen), 1823
Syntormon aulicum (Meigen), 1824
Syntormon bicolorellum (Zetterstedt), 1843
Syntormon denticulatus (Zetterstedt), 1843
Syntormon monile (Haliday in Walker), 1851
Syntormon pallipes (Fabricius), 1794
Syntormon pumilum (Meigen), 1824
Syntormon sulcipes (Meigen), 1824
Syntormon tarsatus (Fallen), 1823
Syntormon zelleri (Loew), 1850

Drosophilidae

Drosophila andalusiaca Strobl, 1906
Drosophila cameraria Haliday, 1833
Drosophila phalerata Meigen, 1830
Leucophenga maculata (Dufour), 1839
Stegana coleoptrata (Scopoli), 1763

Stegana similis Lastovka & Maca, 1982

Dryomyzidae

Neuroctena anilis (Fallen), 1820

Heleomyzidae

Heteromyza rotundicornis (Zetterstedt), 1846

Scolioctena confusa (Wahlgren), 1918

Suillia affinis (Meigen), 1830

Suillia bicolor (Zetterstedt), 1838

Suillia notata (Meigen), 1830

Suillia parva (Loew), 1862

Suillia variegata (Loew), 1862

Tephrochlamys rufiventris (Meigen), 1830

Hippoboscidae

Ornithomya fringillina Curtis, 1836

Lauxaniidae

Calliopum elisae Meigen

Lyciella decipiens (Loew), 1847

Lyciella pallidiventris (Fallen), 1820

Lyciella platycephala (Loew), 1847

Lyciella stylata Papp, 1978

Minettia inusta (Meigen), 1826

Minettia longipennis (Fabricius), 1794

Minettia rivososa (Meigen), 1826

Peplomyza litura (Meigen), 1826

Sapromyza opaca Becker, 1895

Sapromyza sexpunctata Meigen, 1826

Sapromyza sordida Haliday, 1833

Tricholauxania praeusta (Fallen), 1820

Micropezidae

Calobata petronella (L.), 1761

Compsobata cibaria (L.), 1761

Muscidae

Lispe tentaculata (DeGeer), 1776

Mesembrina meridiana (L.), 1758

Opetiidae

Opetia nigra Meigen, 1830

Opomyzidae

Geomyza balachowskyi Mesnil, 1934

Geomyza hackmani Nartshuk, 1984

Geomyza tripunctata Fallen, 1823

Opomyza germinationis (L.), 1758

Opomyza petrei Mesnil, 1934

Pallopteridae

Palloptera muliebris (Harris), 1780

Palloptera 5-maculata (Macquart), 1835

Palloptera saltuum (L.), 1758

Palloptera scutellata (Macquart), 1835

Palloptera trimacula (Meigen), 1826

Palloptera umbellatarum (Fabricius), 1775

Palloptera ustulata Fallen, 1820

Piophilidae

Allopiophila luteata (Haliday), 1833

Platystomatidae

Rivellia syngenesiae (Fabricius), 1781

Psilidae

Loxocera albiseta (Schrank), 1803

Loxocera aristata (Panzer), 1801

Ptychopteridae

Ptychoptera albimana (Fabricius), 1787

Ptychoptera lacustris Meigen, 1830

Ptychoptera minuta Tonnoir, 1919

Ptychoptera scutellaris Meigen, 1818

Rhagionidae

Chrysopilus auratus (Fabricius), 1805

Ptiolina obscura (Fallen), 1814

Rhagio lineola Fabricius, 1794

Rhagio scolopaceus (L.), 1758

Spania nigra Meigen, 1830

Scathophagidae

Chaetosa punctipes (Meigen), 1826

Coniosternum decipiens (Haliday in Curtis), 1832

Cordilura albipes (Fallen), 1819

Leptopa filiformis Zetterstedt, 1838

Nanna fasciata (Meigen), 1826

Norelliosoma spinimanum (Fallen), 1819

Scathophaga furcata (Say), 1823

Scathophaga inquinata Meigen, 1826

Scathophaga scybalaria (L.), 1758

Scathophaga stercoraria (L.), 1758

Scathophaga suilla (Fabricius), 1794

Sciomyzidae

Antichaeta analis (Meigen), 1830

Colobaea bifasciella (Fallen), 1820

Coremacera marginata (Fabricius), 1775

Elgiva cucularia (L.), 1767

Elgiva sollicita (Harris), 1780

Hydromya dorsalis (Fabricius), 1775

Ilione albiseta (Scopoli), 1763

Ilione lineata (Fallen), 1820

Limnia paludicola Elberg, 1965

Limnia unguicornis (Scopoli), 1763

Pherbellia cinerella (Fallen), 1820

Pherbellia dubia (Fallen), 1820

Pherbellia rozkosnyi Verbeke, 1967

Pherbellia schoenherri (Fallen), 1826

Pherbellia scutellaris (von Roser), 1840

Pherbellia ventralis (Fallen), 1820

Pherbina coryleti (Scopoli), 1763

Pteromicra angustipennis (Staeger), 1845

Pteromicra pectorosa (Hendel), 1902

Renocera pallida (Fallen), 1820
Sepedon sphegea (Fabricius), 1775
Sepedon spinipes (Scopoli), 1763
Tetanocera arrogans Meigen, 1830
Tetanocera elata (Fabricius), 1781
Tetanocera ferruginea Fallen, 1820
Tetanocera fuscineruis (Zetterstedt), 1838
Tetanocera hyalipennis von Roser, 1840
Tetanocera montana Day, 1881
Tetanocera punctifrons Rondani, 1868
Tetanocera robusta Loew, 1847
Tetanura pallidiventrifrons Fallen, 1820
Trypetoptera punctulata (Scopoli), 1763

Stratiomyiidae

Beris chalybata (Forster), 1771
Beris fuscipes Meigen, 1820
Beris geniculata Curtis, 1830
Beris vallata (Forster), 1771
Chloromyia formosa (Scopoli), 1763
Chorisops tibialis (Meigen), 1820
Microchrysa cyaneiventris (Zetterstedt), 1842
Microchrysa flavicornis (Meigen), 1822
Microchrysa polita (L.), 1758
Oplodontha viridula (Fabricius), 1775
Pachygaster leachii Stephens in Curtis, 1824
Sargus bipunctatus (Scopoli), 1763
Sargus flavipes Meigen, 1822
Sargus iridatus (Scopoli), 1763

Syrphidae

Anasimyia contracta Claussen and Torp, 1980
Anasimyia lineata (Fabricius), 1787
Baccha elongata (Fabricius), 1775
Cheilosia albipila Meigen, 1838
Cheilosia albitarsis (Meigen), 1822
Cheilosia antiqua (Meigen), 1822
Cheilosia bergenstammi Becker, 1894
Cheilosia illustrata (Harris), 1780
Cheilosia latifrons (Zetterstedt), 1843
Cheilosia pagana (Meigen), 1822
Cheilosia semifasciata Becker, 1894
Cheilosia vernalis (Fallen), 1817
Chrysogaster coemiteriorum (L.), 1758
Chrysogaster solstitialis (Fallen), 1817
Chrysotoxum bicinctum (L.), 1758
Criorhina berberina (Fabricius), 1805
Dasysyrphus albostrigatus (Fallen), 1817
Dasysyrphus venustus (Meigen), 1822
Epistrophe eligans (Harris), 1780
Epistrophe grossulariae (Meigen), 1822
Episyrphus balteatus (DeGeer), 1776

Eristalinus sepulchralis (L.), 1758
Eristalis abusiva Collin, 1931
Eristalis arbustorum (L.), 1758
Eristalis interrupta (Poda), 1761
Eristalis intricaria (L.), 1758
Eristalis lineata (Harris), 1776
Eristalis pertinax (Scopoli), 1763
Eristalis tenax (L.), 1758
Eumerus strigatus (Fallen), 1817
Eupeodes corollae (Fabricius), 1794
Eupeodes latifasciatus (Macquart), 1829
Eupeodes luniger (Meigen), 1822
Ferdinandea cuprea (Scopoli), 1763
Helophilus hybridus Loew, 1846
Helophilus pendulus (L.), 1758
Helophilus trivittatus (Fabricius), 1805
Lejogaster metallina (Fabricius), 1781
Leucozona glauca (L.), 1758
Leucozona laternaria (Muller), 1776
Leucozona lucorum (L.), 1758
Melangyna lasiophthalma (Zetterstedt), 1843
Melanogaster hirtella (Loew), 1843
Melanostoma mellinum (L.), 1758
Melanostoma scalare (Fabricius), 1794
Meligramma cincta (Fallen), 1817
Meliscaeva auricollis (Meigen), 1822
Meliscaeva cinctella (Zetterstedt), 1843
Merodon equestris (Fabricius), 1794
Myathropa florea (L.), 1758
Neoascia podagrica (Fabricius), 1775
Neoascia tenur (Harris), 1780
Orthonevra geniculata (Meigen), 1830
Orthonevra nobilis (Fallen), 1817
Paragus haemorrhous Meigen, 1822
Parhelophilus versicolor (Fabricius), 1794
Pipiza luteitarsis Zetterstedt, 1843
Pipiza noctiluca L., 1758
Platycheirus albimanus (Fabricius), 1781
Platycheirus ambiguus (Fallen), 1817
Platycheirus angustatus (Zetterstedt), 1843
Platycheirus clypeatus (Meigen), 1822
Platycheirus granditarsus (Forster), 1771
Platycheirus manicatus (Meigen), 1822
Platycheirus occultus Goeldlin, Maibach & Speight, 1990
Platycheirus rosarum (Fabricius), 1787
Platycheirus scambus (Staeger), 1843
Platycheirus scutatus (Meigen), 1822
Rhingia campestris Meigen, 1822
Riponnensia splendens (Meigen), 1822
Scaeva pyrastris (L.), 1758

Scaeva selenitica (Meigen), 1822
Sericomyia silentis (Harris), 1776
Sphaerophoria interrupta (Fabricius), 1805
Sphaerophoria scripta (L.), 1758
Sphegina clunipes (Fallen), 1816
Sphegina elegans Schummel, 1843
Syritta pipiens (L.), 1758
Syrphus ribesii (L.), 1758
Syrphus torvus Osten-Sacken, 1875
Syrphus vitripennis Meigen, 1822
Trichopsomyia flavitarsis (Meigen), 1822
Volucella bombylans (L.), 1758
Volucella pellucens (L.), 1758
Xylota segnis (L.), 1758
Xylota sylvarum (L.), 1758

Tabanidae

Chrysops relictus Meigen, 1820
Haematopota crassicornis Wahlberg, 1848
Haematopota pluvialis (L.), 1758

Tachinidae

Eriothrix rufomaculata (DeGeer), 1776
Lophosia fasciata Meigen, 1824

Tephritidae

Chaetostomella cylindrica (Robineau-Desvoidy), 1830
Philophylla caesio (Harris), 1780
Tephritis bardanae (Schrank), 1803
Trypeta zoe Meigen, 1826
Xyphosia miliaria (Schrank), 1781

Thaumaleidae

Thaumalea verralli Edwards, 1929

Tipulidae

Dictenidea bimaculata (L.), 1761
Tipula maxima Poda, 1761

HEMIPTERA

Saldidae

Saldula saltatoria (L.), 1758

HYMENOPTERA

Apidae

Bombus hortorum (L.), 1761
Bombus lucorum (L.), 1761
Bombus magnus Vogt, 1911
Bombus pascuorum (Scopoli), 1763
Bombus pratorum (L.), 1761
Bombus terrestris (L.), 1758

Argiidae

Arge ciliaris (L.), 1767
Arge gracilicornis (Klug), 1814

Crabronidae

Crossocerus megacephalus (Rossius), 1790
Crossocerus pusillus Lepeletier & Brulle, 1835

Crossocerus tarsatus (Shuckard), 1837
Ectemnius cavifrons (Thomson), 1870
Ectemnius cephalotes (Olivier) 1791
Ectemnius lapidarius (Panzer), 1799
Pemphredon lugubris (Fabricius), 1793
Psenulus atratus (Fabricius), 1804
Rhopalum clavipes (L.), 1758
Spilomena curruca (Dahlbom), 1843

Eumenidae

Ancistrocerus gazella (Panzer), 1798
Symmorphus connexus (Curtis), 1826

Formicidae

Myrmica ruginodis Nylander, 1846

Tenthredinidae

Allantus calceatus (Klug), 1818
Allantus cinctus (L.), 1758
Ametastegia equiseti (Fallen), 1808
Athalia circularis (Klug), 1815
Athalia cordata Lepeletier, 1823
Cladius difformis (Panzer), 1799
Croesus varus (Villaret), 1832
Dolerus aeneus Hartig, 1837
Dolerus nigratus (Muller), 1776
Dolerus puncticollis Thomson, 1871
Empria baltica Conde, 1937
Empria pumila (Konow), 1896
Empria tridens (Konow), 1885
Eriocampa ovata (L.), 1761
Birka cinereipes (Klug), 1814
Nematinus luteus (Panzer), 1805
Nematus lucidus (Panzer), 1801
Protoemphytus carpini (Hartig), 1837
Strombocerina delicatula (Fallen), 1808
Tenthredo livida L., 1758

Vespidae

Dolichovespula norvegica (Fabricius), 1781
Dolichovespula sylvestris (Scopoli), 1763
Vespula austriaca (Panzer), 1799
Vespula rufa (L.), 1758
Vespula vulgaris (L.), 1758

NEUROPTERA

Chrysopidae

Cinctochrysa albolineata (Killington), 1935
Chrysopa ventralis Curtis, 1834
Nineta vittata (Wesmael), 1841

Hemerobiidae

Hemerobius humulinus L., 1761
Hemerobius lutescens Fabricius, 1793
Hemerobius simulans Walker, 1853
Micromus variegatus (Fabricius), 1793

Nesomicromus paganus (L.), 1767

ODONATA

Aeschnidae

Aeschna juncea (L.), 1758

Coenagrionidae

Coenagrion puella (L.), 1758

Ischnura elegans (van der Linden), 1823

Ischnura pumilio (Charpentier), 1825

Pyrrhosoma nymphula (Sulzer), 1776

Lestidae

Lestes sponsa (Hansemann), 1823

Libellulidae

Libellula quadrimaculata L., 1758

Sympetrum sanguineum (Muller), 1764

Sympetrum striolatum (Charpentier), 1840

Acrididae

Chorthippus brunneus Thunberg, 1815

Tetrigidae

Tetrix undulata (Sowerby), 1806

APPENDIX 2: SUMMARY TABLE OF MACROHABITAT CATEGORIES

CATEGORY	NUMBER
FOREST MACROHABITATS (gen.)	1
Deciduous forests (gen.)	11
Dry (gen.)	111
Thermophilous Quercus (gen.)	1111
overmature	11111
mature	11112
saplings	11113
Humid/mesophilous (gen.)	112
Fagus (gen.)	1121
overmature	1121a
mature	1121b
saplings	1121c
Mesophilous Fagus (gen.)	11211
overmature	112111
mature	112112
saplings	112113
Humid Fagus (gen.)	11212
overmature	112121
mature	112122
saplings	112123
Quercus/Carpinus/Ulmus (gen.)	1122
overmature	11221
mature	11222
saplings	11223
Acidophilous Quercus (gen.)	1123
overmature	11231
mature	11232
saplings	11233
Fraxinus (gen.)	1124
overmature	11241
mature	11242
saplings	11243
Betula (gen.)	1125
overmature	11251
mature	11252
saplings	11253
Alnus (gen.)	1126
overmature	11261
mature	11262
saplings	11263
Alluvial forest (gen.)	113
Softwood (gen.)	1131
overmature	11311
mature	11312
saplings	11313
Galley softwood (gen.)	11314
overmature	113141
mature	113142
saplings	113143
Hardwood (gen.)	1132
overmature	11321

CATEGORY		NUMBER
	mature	11322
	saplings	11323
	Brook floodplain (gen.)	1133
	overmature	11331
	mature	11332
	saplings	11333
Deciduous plantations (gen.)		12
	Fraxinus	121
	Populus (gen.)	122
	flooded	1221
	not flooded	1222
	Salix (gen.)	123
	flooded	1231
	not flooded	1232
	gallery	1233
Wet woods (gen.)		13
	Betula/Pinus swamp (gen.)	131
	overmature	1311
	mature	1312
	saplings	1313
	Alnus swamp (gen.)	132
	overmature	1321
	mature	1322
	saplings	1323
	Salix swamp (gen.)	133
	overmature	1331
	mature	1332
	saplings	1333
Broad-leaved, evergreen forest		15
	Quercus ilex (gen.)	151
	overmature	1511
	mature	1512
	saplings	1513
	Quercus suber (gen.)	152
	overmature	1521
	mature	1522
	saplings	1523
	Laurisilva forest (gen.)	153
	Madeiran Laurisilva (gen.)	1531
Scrub (gen.)		16
	Atlantic (gen.)	161
	Ulex thickets	1612
	Corylus thickets	1613
	Dry	162
	Matorral (gen.)	163
	broad-leaved evergreen	1631
	Pinus	1632
	Maquis (gen.)	164
	high maquis	1641
	low maquis	1642
	Mediterranean shrub formations	165
	Garrigue	166
	Alpine (gen.)	167
	Alnus	1671
	Pinus	1672

CATEGORY	NUMBER
Coniferous forests (gen.)	17
Abies (gen.)	1710
overmature	17101
mature	17102
saplings	17103
Picea (gen.)	1711
overmature	17111
mature	17112
saplings	17113
Acidophilous Picea (gen.)	1712
overmature	17121
mature	17122
saplings	17123
Mesophilous/calciophilous Picea (gen.)	1713
overmature	17131
mature	17132
saplings	17133
Mediterranean pine forest	176
overmature	1761
mature	1762
saplings	1763
Black pine forests (general)	177
Salzmann's pine forest (general)	1771
overmature	17711
mature	17712
saplings	17713
Pinus sylvestris (gen.)	1720
overmature	17201
mature	17202
saplings	17203
Dry Pinus sylvestris (gen.)	1721
overmature	17211
mature	17212
saplings	17213
Humid Pinus sylvestris (gen.)	1722
overmature	17221
mature	17222
saplings	17223
Caledonian forest	17224
overmature	172241
mature	172242
saplings	172243
Mountain pine forest	175
overmature	1751
mature	1752
saplings	1753
Larix/Pinus cembra (gen.)	173
overmature	1731
mature	1732
saplings	1733
Western taiga	174
overmature	1741
mature	1742
saplings	1743

CATEGORY	NUMBER
Conifer plantations (gen.)	18
Abies/Larix/Picea	181
mature	1811
saplings	1812
Pinus sylvestris	182
mature	1821
saplings	1822
Scattered trees in open ground (gen.)	19
Deciduous (gen.)	190
overmature	1901
mature	1902
Fagus	1911
overmature	19111
mature	19112
Quercus	1912
overmature	19121
mature	19122
Fraxinus	1913
overmature	19131
mature	19132
other hardwoods	1914
overmature	19141
mature	19142
Populus	1915
overmature	19151
mature	19152
Salix	1916
overmature	19161
mature	19162
Conifers	192
(gen.)	192
overmature	1921
mature	1922
Forest supplementary habitats	
Tall herb clearings/tracksides	211f
Grassy clearings/tracksides	234f
Edge, permanent pool under canopy	7462f
Temporary pool under canopy	713f
Spring in forest	731f, 732f
Flush in forest	733f
Small open areas with flushes in forest	7331f
Drainage ditch in forest	734f
Drainage ditch along track in plantation	735f
Seasonal brook in forest	7332f
Brook edge in forest	7442f
River edge under canopy	7441f
Cow dung in forest	7131f
Rock outcrops in forest	75f
OPEN GROUND MACROHABITATS (gen.)	2
Tall herb communities (general)	21
Lowland	211
Montane/subalpine	212
Thermophilous forest fringes	22
Grassland (gen.)	23
Unimproved grassland (gen.)	231

CATEGORY	NUMBER
Lowland unimproved grassland (gen.)	2311
Xeric/semi-arid (gen.)	23111
open	231111
closed	231112
Dry (general)	23112
acidophilous	231121
calcareous	231122
Humid (gen.)	23113
eutrophic/mesotrophic	231131
oligotrophic	231132
Alluvial	23114
Montane unimproved grassland (gen.)	2312
Acidophilous	23121
Calcareous	23122
Alpine unimproved grassland (gen.)	2313
Acidophilous	23131
Calcareous	23132
Improved grassland (gen.)	232
Lowland improved grassland (gen.)	2321
Lightly grazed	23211
Heavily grazed	23212
cattle	232121
sheep	232122
Hay	23213
Montane improved grassland	2322
Intensive grassland	233
Moorland	24
Heathland	25
lowland	251
alpine	252
Mediterranean	253
Tundra (gen.)	26
Coastal beaches & dunes (gen.)	27
Coastal beaches (gen.)	271
shingle	2711
Coastal dunes (gen.)	272
Ammophila dunes	2721
grey dunes/dune scrub	2722
Machair	2723
dune slacks	2724
Inland sand dunes	273
Moraine and scree (gen.)	28
calcareous	281
non-calcareous	282
Open ground supplementary habitats	
Brook edge in open	7442o
Spring in open	731o, 732o
Flush in open	733o
Seasonal brook in open	7332o
Drainage ditch in open	734o
Temporary pool in open	713o
Permanent pool in open	712o
Edge permanent pool in open	7462o
cow dung in open	7131o
temp pool/edge perm.pool with cow dung, in open	71311o

CATEGORY	NUMBER
rock outcrops in open	75o
Culture supplementary habitats	
Brook edge	7442c
Seasonal brook	7332c
Drainage ditch	734c
Edge perm. pool	7462c
CULTURE MACROHABITATS (gen.)	5
Crops	51
Cereals	511
Fallow	515
Field margins	52
Hedge	53
Hedge plus field margin	58
Old field walls	59
Orchards	54
Urban parks (general)	55
Lawn	551
Flower bed (general)	552
seasonal flower bed	5521
semi-perm. flower bed	5522
rockery	5523
Shrubbery/hedge	553
Understorey trees	554
Canopy trees	555
Water feature (general)	556
veg. water feature	5561
unveg. water feature	5562
Compost heap	557
Gardens, ornamental	56
Farmyard organic waste	57
Wetland supplementary habitats	
brook edge in wetland	7442w
Spring in wetland	731w, 732w
Flush in wetland	733w
Drainage ditch in wetland	734w
Permanent pool in wetland	712w
Edge permanent pool in wetland	7462w
WETLAND MACROHABITATS (gen.)	6
Fen (gen.)	61
Rich fen/fen-sedge beds	611
Acid fen	612
Fen carr	613
Montane/subalpine fen	614
Transition mire	62
Bog (gen.)	63
Raised bog	631
Blanket bog	632
Cutover bog	633
Aapa mire	634
Reed/tall sedge beds (gen.)	64
Reeds	641
Tall sedges	642
Cane beds	643

CATEGORY	NUMBER
Marsh	65
BRACKISH MACROHABITATS (gen.)	67
Lagoons	672
Salt marsh (gen.)	673
Spartina beds	6732
Atlantic salt meadow	6733
Continental salt meadow	6734
FRESHWATER MACROHABITATS (gen.)	7
Standing (gen.)	71
Permanent pool	712
Temporary pool	713
Running (gen.)	72
River (gen.)	721
Brook	722
Seasonal brook	723
Springs/flushes (gen.)	73
rheocrene	731
limnocrene	732
helocrene	733
Water's edge (gen.)	74
Running, edge (gen.)	744
river bank (gen.)	7441
sand/gravel, river edge	74412
brook edge	7442
canal edge	7443
Standing, edge (gen.)	746
Lake edge	7461
Perm.pool edge	7462

APPENDIX 3: GLOSSARY OF MACROHABITAT CATEGORIES

This glossary includes repeatedly reference to numbered CORINE “habitat” categories. For explanation, see the entry under “**corine**”.

(gen.): abbreviation for in general; referring to a general category also treated as two or more sub-categories in this database

aapa mire, wetlands: boreal string-mire complexes, with attenuated ridges alternating with linear pools, or flarks, the outer (marginal) ridges usually dominated by *Pinus sylvestris*, *Alnus*, *Betula*, *Calluna* and *Empetrum*, the flarks by *Eriophorum*, *Menyanthes*, *Utricularia*, *Rhynchospora* etc. The central parts of the complexes are characterised by minerotrophic fen vegetation, in which poor *Sphagnum* fens are most common, but brown moss fens can be frequent in some regions. The category includes the sloping fens typical of eastern Finland and parts of Lappland. Habitats Directive, Natura 2000 code: 7310.

Abies (gen.), coniferous forests: forests dominated by firs (*Abies spp.*) with stands of overmature, mature and young (saplings/scrub) trees. CORINE 42.1: FIR FOREST; conifer forests dominated by firs (*Abies spp.*)

Abies/Larix/Picea, conifer plantations: plantations of fir, larch or spruce: CORINE 83.3111: EUROPEAN FIR, SPRUCE, LARCH PLANTATIONS

acid fen, fen: CORINE 54.4: ACIDIC FENS; *Caricetalia fuscae*, *Caricion fuscae*. Topogenous or soligenous valley, basin or spring mire systems fed by waters poor in bases. As in the rich fens, the water level is at or near the surface of the substratum and peat formation is infra-aquatic. The mire communities themselves, dominated by small sedges and brown mosses or *Sphagnum*, belong to the *Caricetalia fuscae*, but, in large fen systems, they are accompanied by acidocline wet grasslands (*Molinietalia caeruleae*), large sedge beds (*Magnocaricion*) and reed or related communities (*Phragmition*). *Sphagnum* hummocks (51.11) from locally and transition mires (54.5) or aquatic (22.3), amphibian (22.2) and spring (54.1) communities colonise small depressions. Thus, codes from all the above categories may need to be used in conjunction to completely describe the fen. The general category in any case includes, as understood here, beside strict mire communities, their transitions to humid grasslands; and groupings phytosociologically affiliated with *Molinia* associations, but rich in species of the *Caricion fuscae*, provided they are integrated in a fen system. Acidic fen communities also occur on small surfaces or within mosaics in other ecosystems, in particular in typical humid grasslands (37), humid woodlands and thickets (44), decalcified dune slacks (16.3) and spring systems (54.1). Their presence can be indicated by codes from this unit used in conjunction with the relevant main codes. Characteristic species of acidic mire communities are *Carex canescens*, *C. echinata*, *C. nigra*, *Eriophorum angustifolium*, *E. scheuchzeri*, *Scirpus cespitosus*, *Juncus filiformis*, *Agrostis canina*, *Viola palustris*, *Cardamine pratensis*, *Ranunculus flammula* and the mosses *Calliergeon sarmentosum*, *C. stramineum*, *C. cuspidatum*, *Drepanocladus exannulatus*, *D. fluitans*, *Sphagnum recurvum*, *S. auritum*, *S. cuspidatum*, *S. subsecundum*, *S. apiculatum*, *S. papillosum*, *S. russowii*.

acidophilous, alpine unimproved grassland: acidophilous unimproved alpine/subalpine grassland, developed over crystalline rocks and other lime-deficient substrates: CORINE 36.31, 36.32, 36.34. CORINE 36.31: MAT-GRASS SWARDS AND RELATED COMMUNITIES; closed grasslands of deep, acid soils of the Alps, Pyrenees, northern Apennines, Jura and higher Hercynian ranges, developed mostly and abundantly in the subalpine level, dominated or co-dominated by *Nardus stricta*, *Festuca eskia*, *F.nigrescens*, *F.rubra*, *Alopecurus gerardii*, *Bellardiochloa (Poa) violacea*, *Carex sempervirens*, *Anthoxanthemum odoratum*. CORINE 36.32: ORO-CALEDONIAN GRASSLANDS; boreo-alpine formations of the higher summits of Scotland, Cumbria, northern England and northern Wales with *Juncus trifidus*, *Carex bigelowii*, mosses and lichens. CORINE 36.34: CROOKED-SEDGE SWARDS AND RELATED COMMUNITIES; *Caricion curvulae*, *Festucion sapinae*. Mostly closed *Carex curvula*, *Festuca* spp., *Oreochloa* spp. or *Juncus trifidus* grasslands on siliceous soils of the alpine level of the Alps and the Pyrenees, with very local outposts in the great Hercynian ranges and the Cantabrian Range. *Androsace obtusifolia*, *A.carnea ssp.laggeri*, *Campanula barbata*, *Juncus jacquinii*, *J.trifidus*, *Silene exscapa*, *Gentiana alpina*, *Achillea erba-rotta*, *Euphrasia minima*, *Luzula lutea*, *L.spicata*, *L.hispanica*, *Lychnis alpina*, *Minuartia recurva*, *M.sedoides*, *Pedicularis kernerii*, *P.pyrenaica*, *Phyteuma globularifolium*, *Ph.hemisphericum*, *Potentilla frigida*, *Armeria alpina*, *Secenio incanus*, *Trifolium alpinum*, *Veronica bellidioides*, *Ranunculus pyrenaicus* are characteristic.

acidophilous, dry, lowland unimproved grassland: acidophilous, unimproved grassland usually maintaining by livestock grazing, on freely-draining substrates: CORINE 35.1: ATLANTIC MAT-GRASS SWARDS AND RELATED COMMUNITIES; *Nardetalia: Violo-Nardion (Nardo-Galion saxatilis, Violion caninae)*.

acidophilous, montane unimproved grassland: acidophilous, montane, unimproved grassland, usually maintained by livestock grazing: CORINE 36.31, 36.33. CORINE 36.31: MAT-GRASS SWARDS AND RELATED COMMUNITIES; closed grasslands of deep, acid soils of the Alps, Pyrenees, northern Apennines, Jura and higher Hercynian ranges, developed mostly and abundantly in the subalpine level, dominated or co-dominated by *Nardus stricta*, *Festuca eskia*, *F.nigrescens*, *F.rubra*, *Alopecurus gerardii*, *Bellardiochloa (Poa) violacea*, *Carex sempervirens*, *Anthoxanthemum odoratum*. CORINE 36.33: SUBALPINE, THERMOPHILE SILICEOUS GRASSLANDS; *Festucion varieae*, *Festucion eskiae*, *Poion violaceae*, *Festucion spadiceae*. Subalpine thermophile formations on often skeletal soils of the southern Alps, the Pyrenees and, very locally, the Massif Central and the Apennines.

acidophilous Picea, coniferous forests: acidophile forests dominated by spruce (*Picea abies*) with stands of overmature, mature and young (saplings/scrub) trees, on peaty soils or siliceous, crystalline or schistous substrates (including CORINE 42.211, 42.212, 42.213, 42.221, 42.225, 42.231, 42.252).

acidophilous Quercus (gen.), deciduous forests: acid oak forest, with stands of overmature, mature and young (saplings/scrub) trees. CORINE 41.5; 41.6. CORINE 41.5: ACIDOPHILOUS OAK FORESTS; *Quercion robori-petraeae*. Forests of *Quercus robur* or *Q. petraea* on acid soils with a herb layer mostly constituted by the ecological groups of *Deschampsia flexuosa*, *Vaccinium myrtillus*, *Pteridium aquilinum*, *Lonicera periclymenum*, *Holcus mollis*, and of *Maianthemum bifolium*,

Convallaria majalis, *Hieracium sabaudum*, *Hypericum pulchrum*, *Luzula pilosa*, and the mosses *Polytrichum formosum* and *Leucobryum glaucum*. CORINE 41.6: *Quercus pyrenaica* forests; *Q.pyrenaica*-dominated forests of the Iberian peninsula and, locally, south-western France.

alluvial forest (gen.): deciduous forests of river floodplains, with stands of overmature, mature and young (saplings/scrub) trees. CORINE 44. CORINE 44: ALLUVIAL AND VERY WET FORESTS AND BRUSH; tree and shrub vegetation of flood plains, marshes, fens and bogs.

alluvial, lowland unimproved grassland. Humid grasslands on active floodplains of rivers, or within the inundation zone of lakes with fluctuating water levels, and so subject to periodic inundation. Some types of humid, lowland, unimproved grassland (CORINE 37.21, 22, 24) can also occur in alluvial contexts and thus are also referred to here. CORINE 37.21: ATLANTIC AND SUB-ATLANTIC HUMID MEADOWS; *Calthion palustris*, *Bromion racemosi*, *Deschampsion cespitosae*; lightly managed hay meadows and pastures on both basocline and acidocline, nutrient-rich soils of middle European lowlands, hills and low mountains under Atlantic or sub-Atlantic climatic conditions. Among the characteristic plant components of the highly diverse communities forming this unit are *Caltha palustris*, *Cirsium palustre*, *C. rivularis*, *C. oleraceum*, *Epilobium parviflorum*, *Lychnis flos-cuculi*, *Mentha aquatica*, *Scirpus sylvaticus*, *Stachys palustris*, *Bromus racemosus*, *Crepis paludosa*, *Fritillaria meleagris*, *Geum rivale*, *Polygonum bistorta*, *Senecio aquaticus*, *Trollius europaeus*, *Lotus uliginosus*, *Trifolium dubium*, *Equisetum palustre*, *Myosotis palustris*, *Deschampsia cespitosa*, *Angelica sylvestris*, *Oenanthe silaifolia*, *Gratiola officinalis*, *Inula salicina*, *Succisella inflexa*, *Dactylorhiza majalis*, *Ranunculus acris*, *Rumer acetosa*, *Holcus lanatus*, *Alopecurus pratensis*, *Festuca pratensis*, *Juncus effusus*, *J.fliformis*. CORINE 37.22: SHARP-FLOWERED RUSH MEADOWS; *Juncion acutiflori*; Humid meadows dominated by, or rich in, *Juncus acutiflorus*. They are floristically and phytosociologically very varied and many are as related to the oligorophic *Molinion* communities of 37.3 as to the more eutrophic *Calthion* ones of 37.2. Sharp-flowered rush meadows are particularly characteristic of the oceanic and sub-oceanic regions to the western seaboard of Europe from north-western Iberia to the Low Countries. CORINE 37.23: SUBCONTINENTAL CNIDION MEADOWS; *Cnidion dubii*; moist-soil, flood-subjected meadows of river valleys under continental or subcontinental climatic conditions, with *Cnidium dubium*, *Viola persicifolia*, *Allium angulosum*, *Iris sibirica*, *Oenanthe lachenalii*, *O. silaifolia*, *Gratiola officinalis*, *Juncus atratus*, *Leucojum aestivum*, *Carex praecox var. suzae*, *Lythrum virgatum*. CORINE 37.24: FLOOD SWARDS AND RELATED COMMUNITIES; *Agropyro-Rumicion crispis p.*; grasslands of occasionally flooded river and lake banks, of depressions where rain water collects, of disturbed humid areas and of pastures submitted to intensive grazing.

Alnus (gen.), deciduous forests: alder (*Alnus*) forest, with stands of overmature, mature and young (saplings/scrub) trees. CORINE 41.C. CORINE 41.C: ALDERWOODS; non-riparian, non-marshy formations dominated by *Alnus spp.*

Alnus, alpine scrub: alpine thickets of *Alnus viridis*: CORINE 31.611 CORINE 31.611: alpine green alder scrub, *Alnetum viridus*. Green alder (*Alnus viridis* ssp. *viridis*) dominated formations, rich in tall herbs, of slopes with a good water-holding capacity, mostly on siliceous soils, in the subalpine and lower alpine belts of the Alps.

Alnus swamp (gen.), wet woods: *wet alder* (*Alnus*) woods, with stands of overmature, mature and young (saplings/scrub) trees. CORINE 44.91. CORINE 44.91: ALDER SWAMP WOODS; *Carici elongatae-Alnetum* (*Irido-Alnenion*); mesotrophic and meso-eutrophic *Alnus glutinosa* swamp woods of marshy depressions, with *Carex elongata*, *Thelypteris palustris*, *Dryopteris cristata*, *Osmunda regalis*, *Solanum dulcamara*, *Calystegia sepium*, *Ribes nigrum*, and often, in acidocline variants, *Betula pubescens*. The constancy of *Carex paniculata*, *C.acutiformis*, *C.elata*, often dominates the herb layer in the most humid types.

alpine (gen.), unimproved grassland: unimproved, alpine/subalpine grasslands, i.e. occurring above the natural tree-line: 36.32, 36.34, 36.38, 36.431, 36.433, 36.434, 36.44.

alpine, heath: CORINE 31.4: small, dwarf or prostrate shrub formations of the alpine and subalpine belts, dominated by ericaceous species, *Dryas* or dwarf junipers. Habitats Directive: Natura 2000 code: 4060.

alpine scrub (gen.): *Alnus viridis* and *Pinus mugo* scrub of the Alps: CORINE 31.5, 31.611. CORINE 31.5: DWARF MOUNTAIN PINE SCRUB; *Mugo-Rhodoretum hirsuti*. *Pinus mugo* brushes of well-drained, often calcareous, soils in the Alps and Apennines, frequently accompanied by *Rhododendron hirsutum*, *Erica herbacea*, *Arctostaphylos uva-ursi*, *A.alpina*, *Rhodothamnus chamaecistus*. CORINE 31.611: alpine green alder scrub, *Alnetum viridus*. Green alder (*Alnus viridis* ssp. *viridis*) dominated formations, rich in tall herbs, of slopes with a good water-holding capacity, mostly on siliceous soils, in the subalpine and lower alpine belts of the Alps.

Ammophila dunes, coastal dunes: CORINE 16.21, with the exclusion of all Mediterranean, Iberian and Canarian communities. CORINE 16.21: SHIFTING DUNES; *Agropyron juncei*, *Ammophilion arenariae*, *Zygophyllion fontanesii*; mobile sands, unvegetated or occupied by open grasslands; they may form tall dune ridges or, particularly along the Mediterranean, be limited to a fairly flat upper beach, still subject in part to inundation.

arctic-alpine, tundra: upland tundra with vegetation often dominated by single species, e.g. *Dryas octopetala*, *Silene acaulis*, *Diapensia lapponica*, *Juncus trifidus*, but with an admixture of dwarf ericaceous shrubs such as *Arctostaphylos*, *Loiseleuria*, *Phyllodoce* and *Empetrum*.

atlantic salt meadows, saltmarsh: coastal salt meadows belonging phytosociologically to the order *Glauco-Puccinellietalia maritimae*. CORINE 15.3. CORINE 15.3: ATLANTIC SALT MEADOWS; *Glauco-Puccinellietalia maritimae*; salt meadows of Baltic, North Sea, Channel and Atlantic shores. *Aster tripolium* can be present or abundant in most subdivisions.

atlantic thickets (gen.) scrub/thickets: CORINE 31.83 and 31.85, excluding *Cytisus* formations. CORINE 31.83: ATLANTIC POOR SOIL THICKETS; *Prunetalia p.*: *Pruno-Rubion fruticosi p.*: *Frangulo-Rubenion* (*Rubion subatlanticum*; *Franguletalia*); thickets of *Rubus* spp., *Frangula* *Alnus*, *Sorbus aucuparia*, *Corylus avellana*, *Lonicera periclymenum*, *Cytisus scoparius*, characteristic of forest edges, hedges and (mostly *Quercion*) woodland recolonisation developed on soils relatively poor in nutrients, usually acid, mostly under climates with strong Atlantic influence. CORINE 31.85: GORSE THICKETS; *Ulex europaeus* thickets of the Atlantic domain (including British *Ulex europaeus-Rubus fruticosus* scrub p.)

Betula (gen.), deciduous forests: birch (*Betula*) forests, with stands of overmature, mature and young (saplings/scrub) trees. CORINE 41.B. CORINE 41.B: BIRCH WOODS; Formations dominated by *Betula pendula*, *B. pubescens*, or their allies, on non-marshy terrain.

Betula/Pinus swamp (gen.), wet woods: bog woodland of pine and birch, with stands of overmature, mature and young (saplings/scrub) trees. CORINE 44.A. CORINE 44.A: BIRCH AND CONIFER SWAMP WOODS; *Vaccinio-Piceetea: Piceo-Vaccinienion uliginosi* (*Betulion pubescentis*, *Ledo-Pinion*) i.a. Woods of *Betula pubescens*, *Pinus spp.* or *Picea abies* colonising bogs and acid fens. Habitats Directive, Natura 2000 code: 91D0.

black pine forests, conifer forest: CORINE 42.6, forests dominated by pines of the *Pinus nigra* group.

blanket bog: CORINE 52.1: LOWLAND BLANKET BOGS; *Sphagnetalia magellanici: Pleurozio purpureae-Ericetum tetralicis*; *Scheuchzerietalia palustris p.*, *Caricetalia fuscae p.*, *Utricularietalia intermedio-minoris p.*, *Littorelletalia*, *Potamogetonetalia*; hyper-Atlantic blanket bogs of the western coastlands of Ireland, western Scotland and its islands, Cumberland, northern Wales and Devon, developed under very high rainfall climates. The main vascular plants are *Molinia caerulea*, *Eriophorum angustifolium*, *E. vaginatum*, *Scirpus cespitosus*, *Schoenus nigricans*, *Rhynchospora alba*, *Narthecium ossifragum*, *Carex panicea*, *Calluna vulgaris*, *Erica tetralix*, *Myrica gale*, *Pedicularis sylvatica*, *Potentilla erecta*, *Polygala serpyllifolia*, *Pinguicula lusitanica*, *Drosera rotundifolia*. The colourful mucinal layer comprises the black and crimson liverwort *Pleurozia purpurea*, the black and gold moss *Campylopus atrovirens*, the woolly fringe moss *Rhacomitrium lanuginosum*; it is often dominated by sphagnum (*Sphagnum auriculatum*, *S. magellanicum*, *S. compactum*, *S. papillosum*, *S. nemoreum*, *S. rubellum*, *S. tenellum*, *S. subnitens*), or, particularly in parts of western Ireland, mucilaginous algal deposits (*Zygogonium*). Some of the distinctive features of the blanket bog can be, as in 52.1, individualised by the codes below. CORINE 52.2: UPLAND BLANKET BOGS; *Sphagnetalia magellanici: Vaccinio-Ericetum tetralicis*; *Ericion tetralicis p.*, *Scheuchzerietalia palustris p.*, *Caricetalia fuscae p.*, *Utricularietalia intermedio-minoris p.*, *Littorelletalia*, *Potamogetonetalia*; Blanket bogs of high ground, hills and mountains in Scotland, Ireland, western England and Wales. Characteristic species are *Eriophorum vaginatum*, *Calluna vulgaris*, *Erica tetralix*, *Rubus chamaemorus*, *Narthecium ossifragum*, *Scirpus cespitosus*, *Drosera rotundifolia*, *Rhacomitrium lanuginosum* and abundant sphagnum mosses. Habitats Directive, Natura 2000 code: 7130.

bog (gen.), wetlands: peatlands with a permanently water-logged ground surface, where the water is retained by the water-holding capacity of the vegetation and derived directly from rainfall, i.e. the vegetation is above the influence of the groundwater: CORINE 51.1, 52.1, 52.2. CORINE 51.1: NEAR-NATURAL RAISED BOGS; undisturbed, or little disturbed, peat-forming bogs, often taking the shape of a convex lens. Such intact or nearly intact systems have become very rare or even exceptional. They are composed of a number of communities, which form and occupy the topological features of the bog. These communities are interrelated and function as a unit, so that they cannot be regarded as separate subhabitats; their presence and combination, however, characterize the various types of bogs. Simultaneous use of an appropriate selection of the sub-units below can thus contribute to a description of individual bog systems.

CORINE 52.1; LOWLAND BLANKET BOGS; *Sphagnetalia magellanici*: *Pleurozio purpureae-Ericetum tetralicis*; *Scheuchzerietalia palustris p.*, *Caricetalia fuscae p.*, *Utricularietalia intermedio-minoris p.*, *Littorelletalia*, *Potamogetonetalia*; Hyper-Atlantic blanket bogs of the western coastlands of Ireland, western Scotland and its islands, Cumberland, northern Wales and Devon, developed under very high rainfall climates. The main vascular plants are *Molinia caerulea*, *Eriophorum angustifolium*, *E. vaginatum*, *Scirpus cespitosus*, *Schoenus nigricans*, *Rhynchospora alba*, *Narthecium ossifragum*, *Carex panicea*, *Calluna vulgaris*, *Erica tetralix*, *Myrica gale*, *Pedicularis sylvatica*, *Potentilla erecta*, *Polygala serpyllifolia*, *Pinguicula lusitanica*, *Drosera rotundifolia*. The colourful mucinal layer comprises the black and crimson liverwort *Pleurozia purpurea*, the black and gold moss *Campylopus atrovirens*, the woolly fringe moss *Rhacomitrium lanuginosum*; it is often dominated by sphagnum (Sphagnum *auriculatum*, *S. magellanicum*, *S. compactum*, *S. papillosum*, *S. nemoreum*, *S. rubellum*, *S. tenellum*, *S. subnitens*), or, particularly in parts of western Ireland, mucilaginous algal deposits (*Zygogonium*). Some of the distinctive features of the blanket bog can be, as in 52.1, individualized by the codes below. CORINE 52.2: UPLAND BLANKET BOGS; *Sphagnetalia magellanici*: *Vaccinio-Ericetum tetralicis*; *Ericion tetralicis p.*, *Scheuchzerietalia palustris p.*, *Caricetalia fuscae p.*, *Utricularietalia intermedio-minoris p.*, *Littorelletalia*, *Potamogetonetalia*; Blanket bogs of high ground, hills and mountains in Scotland, Ireland, western England and Wales. Characteristic species are *Eriophorum vaginatum*, *Calluna vulgaris*, *Erica tetralix*, *Rubus chamaemorus*, *Narthecium ossifragum*, *Scirpus cespitosus*, *Drosera rotundifolia*, *Rhacomitrium lanuginosum* and abundant sphagnum mosses.

brackish macrohabitats: habitat categories where the surface water varies in character from being entirely fresh to partially, or entirely, salt at different stages of the tide or periods of the year.

broad-leaved, evergreen forests: Mediterranean forests dominated by broad-leaved, evergreen trees: CORINE 45.2, 45.3 CORINE 45.2: cork-oak forests: western Mediterranean silicolous forests dominated by *Quercus suber*, usually more thermophile and hygrophile than 45.3. CORINE 45.3: meso- and supra-Mediterranean holm-oak forests: *Quercion ilicis*; evergreen oak forests dominated by *Quercus ilex* or *Q. rotundifolia*, often, but not necessarily, calcicolous.

broad-leaved, evergreen, matorral, scrub/thickets: evergreen oak and olive/lentisc matorral: CORINE 3211, 3212. CORINE 3211: meso-mediterranean arborescent matorral organised around evergreen oaks; dense, low, coppice-like woods of evergreen oaks (see also under *Quercus ilex* forests). CORINE 3212: olive/lentisc matorral: thermo-mediterranean arborescent matorral with *Olea europaea ssp. sylvestris*, *O. europaea ssp. cerasiformis*, *Ceratonia siliqua*, *Pistacia lentiscus*, *P. atlantica* or *Myrrus communis*.

brook, running freshwater: the bottom and aquatic vegetation of 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. Included in this category are both natural brooks and permanently flowing drainage ditches. See also "brook edge".

brook edge, culture supplementary habitat: the banks and immediate environs of small, freshwater, running water bodies within cultures

brook edge, edge of running freshwater: the banks of small, freshwater, running water bodies, i.e. that part of a brook channel not permanently submerged in water. and its immediate environs.

brook edge in forest, forest supplementary habitat: the banks and immediate environs of small, freshwater, running water bodies within forest.

brook edge in wetland, wetland supplementary habitat: the banks and immediate environs of small, freshwater, running water bodies occurring in wetlands.

brook floodplain, alluvial forest: riparian forests of *Fraxinus excelsior* and *Alnus glutinosa*, of the rhitral section of watercourses of temperate and boreal Europe and of *Alnus incanae* in montane and sub-montane zones of the Alps and northern Apennines; subject to intermittent flooding: CORINE 44.2, 44.3. Small *Salix* spp. and/or *Populus tremula* may also be present. There are significant differences between the degree of subdivision of these riparian floodplain forests that is recognised in current habitat classification systems, as may be observed by contrasting the CORINE approach with that of Delarze *et al* (1998) and Riecken *et al* (1994). CORINE 44.2: riparian forests of *Alnus incanae*. Natura 2000 code: 91E0 CORINE 44.3: riparian forests of *Fraxinus excelsior* and *Alnus glutinosa*, or sometimes *A.incana*, of middle European and northern Iberian lowland or hill watercourses, on soils periodically inundated by the annual rise of the river level, but otherwise well-drained and aerated during low-water; they differ from riparian alder woods (CORINE 44.9) by the strong representation of forest plant species not able to grow in permanently waterlogged soils. Natura 2000 code: 91E0

brook/river edge in open, open ground supplementary habitats: the banks and immediate environs of running freshwater bodies in open ground.

calcareous, alpine unimproved grassland: unimproved calciphilous grassland of the alpine/subalpine zone: CORINE 36.42, 36.431, 36.433, 36.434, 36.44 CORINE 36.42, 36.44; ALPINE AND SUB-ALPINE CALCIPHILOUS GRASSLANDS; *Elyno-Seslerietea*. Alpine and sub-alpine grasslands of base-rich soils with *Dryas octopetala*, *Gentiana nivalis*, *G.campestris*, *Alchemilla hoppeana*, *A.conjuncta*, *A.flabellata*, *Anthyllis vulneraria*, *Astragalus alpinus*, *Aster alpinus*, *Draba azoides*, *Globularia nudicaulis*, *Helianthemum nummularium ssp.grandiflorum*, *H.alpestre*, *Pulsatilla alpine ssp. alpina*, *Phyteuma orbiculare*, *Astrantia major*, *Polygala alpestris*. CORINE 36.42: wind-edge naked rush swards; *Oxytropo-Elynion*. CORINE 36.431: blue moorgrass-evergreen sedge slopes; *Seslerion albicantis* p. CORINE 36.433: cushion-sedge carpets; *Seslerion caeruleae*: *Caricetum firmae* (*Firmetum*). CORINE 36.434: *Festuca airoides* grasslands; *Festucion supinae*: *Pumilieto-Festucetorum supinae*, *Luzulo-Festucetum supinae*. Low, fairly dry swards of the alpine zone of the eastern Pyrenees dominated by *Festuca airoides* (*F.supina*). CORINE 26.44: alpine heavy metal communities; *Violetalia calaminariae*: *Galio anisophyllii* - *Minuartion verna* i.a.

calcareous, dry, lowland unimproved grassland: calcareous, unimproved grassland on freely-draining substrates: CORINE 34.2, 34.321 CORINE 34.2: LOWLAND HEAVY METAL GRASSLANDS; dry, short grasslands, often rich in lichens and mosses, colonizing western and central European soils with a high content in heavy metals such as zinc and lead, and comprising uniquely adapted species, ecotypes or populations mostly related to, or derived from, otherwise montane, boreo-montane or steppic species. CORINE 34.321: north-western,

semi-dry calcareous grasslands; *Mesobromion* grasslands of Denmark and the British Isles (maintained by livestock grazing).

calcareous, montane unimproved grassland: calcareous, montane, unimproved grassland, normally maintained by livestock grazing: CORINE 36.41, 36.51, 38.3. CORINE 36.41: Rusty sedge meadows and related communities. *Caricion ferrugineae*, *Primulion intricatae*, *Laserpitio-Ranunculion thorae*, *Caricion austroalpinae*, *Armerion cantabricae*. Mesophile, mostly closed, vigorous, often grazed or mowed, grasslands on deep soils of the subalpine and lower alpine levels of the Alps, the Pyrenees and, locally, of the Apennines and the Jura. CORINE 36.51: Subalpine yellow oatgrass hay meadows. *Polygono-Trisetion* p. *Trisetum flavescens*-dominated grasslands of the subalpine level. CORINE 38.3: Mountain hay meadows. *Polygono-Trisetion* (*Trisetio-Polygonion bistorti*). Species-rich mesophile hay meadows of the montane and subalpine levels usually dominated by *Trisetum flavescens* and with *Heracleum spondylium*, *Viola cornuta*, *Astrantia major*, *Carum carvi*, *Crepis mollis*, *C.pyrenaica*, *Polygonum bistorta*, *Silene dioica*, *S.vulgaris*, *Campanula glomerata*, *Salvia pratensis*, *Centaurea nemoralis*, *Anthoxanthum odoratum*, *Crocus albiflorus*, *Geranium phaeum*, *G.sylvaticum*, *Narcissus poeticus*, *Malva moschata*, *Valeriana repens*, *Trollius europaeus*, *Pimpinella major*, *Muscari botryoides*, *Lilium bulbiferum*, *Thlaspi caerulescens*, *Viola tricolor* ssp.*subalpina*, *Phyteuma halleri*, *P.orbicolare*, *Primula elatior*, *Chaerophyllum hirsutum* and many others.

calc., moraine and scree: moraine and scree derived from calcareous rock and with some pioneer vegetation, including *Drabion hoppeanae*, *Petasition parradoxi*, *Thlaspion rotundifolii* (Delarze et al, 1998), but excluding thermophilous scree.

Caledonian forest, humid *Pinus sylvestris*, coniferous forest: relict, indigenous pine forests of *Pinus sylvestris* var.*scotica*, endemic in the central and north-eastern Grampians and the northern and western Highlands of Scotland. CORINE 42.51.

These forests frequently have associated *Betula* and *Juniperus*. The species coding for Caledonian forest does not take into account the associated *Betula*. In using the Macrohabitats Table, Caledonian forest sites exhibiting significant quantities of *Betula* should also be regarded as *Betula* forest. CORINE 42.51: mostly open *Pinus sylvestris* forests with a ground layer rich in ericaceous species and bryophytes, in particular *Hylocomium splendens*, and often harbouring abundant *Deschampsia flexuosa*, *Goodyera repens*, *Listera cordata*, *Corallorhiza trifida*, *Linnaea borealis*, *Trientalis europaea*, *Pyrola minor*, *Moneses uniflora* and *Orthilia secunda*. Accompanying dominant trees are *Sorbus aucuparia*, *Betula pubescens*, *B.pendula*, *Juniperus communis*, *Ilex aquifolium* and *Populus tremula*. (EU Habitats Directive, Natura 2000 code: 91C0).

canal edge, edge of running freshwater: land-water interface of slow-moving artificial waterways, un-faced with stone. CORINE 89.21. CORINE 89.21: NAVIGABLE CANALS

cane beds, reed/tall sedge beds: southern European cane beds of temporary water courses and intermittent high ground-water level: CORINE 53.61-62 CORINE 53.61: Ravenna cane communities; Mediterranean tall cane formations of temporary water courses, formed by *Imperata cylindrica*, *Saccharum (Erianthus) ravennae*, *S.strictum*, *Arundo plinii*. CORINE 53.62: Provence cane beds; very tall formations of the long-introduced *Arundo donax* along water courses.

- canopy trees**, urban park: individuals or stands of mature/overmature canopy trees, often with ornamental flowers (e.g. *Aesculus*, *Castanea*, *Tilia*), or contrasting growth forms and foliage (e.g. *Cupressus*, *Fraxinus*, *Pinus*, *Populus*, *Taxus*). CORINE 85.11: Park woodlots
- cattle**, heavily-grazed improved grassland: cropping of ground vegetation by cattle, resulting in reduction in general sward height to less than 5cm
- cereals**, crops: monoculturally sown stands of species of *Avena*, *Hordeum*, *Secale*, *Triticum* or *Zea* produced as grain crops and involving seeding into cultivated (or stubble) ground, control of weeds, diseases and pests by chemical, mechanical and/or cultural methods, nutrient application in the form of inorganic fertiliser or organic manures, harvesting at grain maturation and post-harvest recultivation.
- cliff and rock** (gen.): cliffs and expanses of rock, including horizontal surfaces, bare or vegetated, weathered or unweathered.
- closed**, xeric/semi-arid, unimproved grassland: unimproved dry grassland with a dense sward and no exposed rock/loose stones. CORINE 34.3 (except 34.321). CORINE 34.3: DENSE PERENNIAL GRASSLANDS AND MIDDLE EUROPEAN STEPPES; *Festuco-Brometea*; Dry closed thermophilous grasslands of middle European or Mediterranean lowlands and hills, up to the montane zone, dominated by perennial grasses; steppic grasslands of continental middle European affinities.
- coastal beaches** (gen.): CORINE 16.1: SAND BEACHES: gently sloping sand-covered shorelines fashioned by wave action. CORINE 17.1, 17.2, 17.3. CORINE 17.1: UNVEGETATED SHINGLE BEACHES: Shingle beaches devoid of phanerogamic vegetation. Mediollittoral (intertidal) and supralittoral invertebrate communities can be used to define subdivisions. CORINE 17.2: SHINGLE BEACH DRIFT LINES; *Cakiletea maritimae* p. ; Formations of annuals occupying accumulations of drift material and gravels rich in nitrogenous organic matter; characteristic are *Cakile maritima*, *Salsola kali*, *Atriplex* spp. (particularly *A. glabriuscula*), *Polygonum* spp., *Euphorbia peplis*, *Mertensia maritima*, *Glaucium flavum*, *Matthiola sinuata*. CORINE 17.3: SEA KALE COMMUNITIES; *Honkenyo-Crambion* ; Halo-nitrophilous perennial vegetation of the upper beach formed by *Crambe maritima*, *Honkenya peploides* and species characteristic of the regional communities as indicated below.
- coastal beaches and dunes** (gen.): CORINE 16, 17.1, 17.2, 17.3, 1A, with the exclusion of all mediterranean, iberian and canarian communities. CORINE 16: COASTAL SAND-DUNES AND SAND BEACHES; sand-covered shorelines in general, but in particular, onshore areas of sand created by the action of wind and often colonized and stabilized by communities of coarse maritime grasses. CORINE 17.1: UNVEGETATED SHINGLE BEACHES: Shingle beaches devoid of phanerogamic vegetation. Mediollittoral (intertidal) and supralittoral invertebrate communities can be used to define subdivisions. CORINE 17.2: SHINGLE BEACH DRIFT LINES; *Cakiletea maritimae* p.; Formations of annuals occupying accumulations of drift material and gravels rich in nitrogenous organic matter; characteristic are *Cakile maritima*, *Salsola kali*, *Atriplex* spp. (particularly *A. glabriuscula*), *Polygonum* spp., *Euphorbia peplis*, *Mertensia maritima*, *Glaucium flavum*, *Matthiola sinuata*. CORINE 17.3: SEA KALE COMMUNITIES; *Honkenyo-Crambion*; Halo-nitrophilous perennial vegetation of the upper beach formed by *Crambe*

maritima, *Honkenya peploides* and species characteristic of the regional communities as indicated below. CORINE 1 A: MACHAIR: Plains behind dunes especially characteristic of the western seaboard of the Outer Hebrides. Wind-blown calcareous sands deposited on peat support a flower-rich, and correspondingly insect-rich, dune grassland studded with shallow lochs and cultivated on a strip rotation. The grassland is dominated by *Poa pratensis* and *Festuca rubra*, accompanied by *Thalictrum minus*, *Thymus drucei*, *Bellis perennis*, *Prunella vulgaris*, *Erodium cicutarium*, *Tripolium spp.*, *Euphrasia spp.* and many orchids, among which *Dactylorhiza fuchsii spp. hebridensis*, *D. purpurella*, *Gymnadenia conopsea*, *Coeloglossum viride*, *Platanthera chlorantha* and *Orchis mascula* are the most prominent. This grassland harbours a plant community of very restricted distribution comprising vulnerable species; *Cochlearia scotica*, *Euphrasia marshallii* and *Dactylorhiza fuchsii spp. hebridensis* are endemic. Other elements of the ecosystem, such as pools and fallow fields, can be noted by addition of codes from other units (22, 16.2, 34, 37, 53, 54, 82, 87). As a whole, machair is an essential habitat for breeding waders such as *Haematopus ostralegus*, *Vanellus vanellus*, *Charadrius hiaticula*, *Calidris alpina*, *Tringa totanus* and *Gallinago gallinago*; it supports the healthiest European population of the threatened corncrake *Crex crex*.

coastal dunes (gen.): CORINE 16.2, 16.3, 1A, with the exclusion of all Mediterranean, Iberian and Canarian communities. CORINE 16.2: DUNES; onshore wind-carried sand deposits arranged in cordons of ridges parallel to the coast. CORINE 16.3: HUMID DUNE-SLACKS; humid depressions of the dunal systems. The most important habitats are included in the following units. If the divisions proposed are not sufficient, appropriate codes from 22.4, 22.3, 54.2, 54.4, 53 can be used in conjunction with them. Humid dune-slacks are extremely rich and specialized habitats very threatened by the lowering of water tables. CORINE 1 A: MACHAIR; plains behind dunes especially characteristic of the western seaboard of the Outer Hebrides. Wind-blown calcareous sands deposited on peat support a flower-rich, and correspondingly insect-rich, dune grassland studded with shallow lochs and cultivated on a strip rotation. The grassland is dominated by *Poa pratensis* and *Festuca rubra*, accompanied by *Thalictrum minus*, *Thymus drucei*, *Bellis perennis*, *Prunella vulgaris*, *Erodium cicutarium*, *Tripolium spp.*, *Euphrasia spp.* and many orchids, among which *Dactylorhiza fuchsii spp. hebridensis*, *D. purpurella*, *Gymnadenia conopsea*, *Coeloglossum viride*, *Platanthera chlorantha* and *Orchis mascula* are the most prominent. This grassland harbours a plant community of very restricted distribution comprising vulnerable species; *Cochlearia scotica*, *Euphrasia marshallii* and *Dactylorhiza fuchsii spp. hebridensis* are endemic. Other elements of the ecosystem, such as pools and fallow fields, can be noted by addition of codes from other units (22, 16.2, 34, 37, 53, 54, 82, 87). As a whole, machair is an essential habitat for breeding waders such as *Haematopus ostralegus*, *Vanellus vanellus*, *Charadrius hiaticula*, *Calidris alpina*, *Tringa totanus* and *Gallinago gallinago*; it supports the healthiest European population of the threatened corncrake *Crex crex*).

compost heap, urban park: stored accumulations of rotting debris of herbaceous vegetation resultant from management operations, including grass cuttings and fallen leaves.

conifer plantation (gen.): planted, uniformly-aged, usually single-species stands of coniferous trees. CORINE 83.31. CORINE 83.31: CONIFER PLANTATIONS

coniferous forest (gen.): forest and woodland of native coniferous trees other than floodplain and mire woods and with stands of overmature, mature and young (saplings/scrub) trees; formations dominated by coniferous trees, but including broad-leaved evergreen trees, are included. CORINE 42. CORINE 42: CONIFEROUS WOODLANDS; forests and woodlands of native coniferous trees other than floodplain and mire woods; formations dominated by coniferous trees, but comprising broad-leaved evergreen trees, are included.

conifers, scattered trees in open ground: see scattered trees in open ground (gen.).

continental salt meadows, saltmarsh: continental salt meadows belonging phytosociologically to the order *Puccinellietalia distantis*. CORINE 15.4. CORINE 15.4: CONTINENTAL SALT MEADOWS; *Puccinellietalia distantis*; Salt meadows of salt basins of interior middle Europe. Continental saltmarshes are remarkable, extremely threatened communities occurring in a few isolated stations of Saxony and Lower Saxony, Schleswig-Holstein, Thuringe, Hesse, Lorraine, Auvergne and the Midlands. They comprise this unit and continental glasswort swards (15.112). Habitats Directive, Natura 2000 code: 1340. CORINE: the CORINE "habitats" classification system; a hierarchical, numerical categorisation of "habitat" categories, each of which is defined in the "CORINE Biotopes Manual, Data specifications", Part 2, published by the Office for Official publications of the European Communities, 1991. (ISBN 92-826-3211-3). Most CORINE "habitat" categories are defined entirely in terms of flowering-plant communities. Macrohabitat categories which co-incide with numbered CORINE "habitat" categories have their corresponding CORINE code numbers given in this glossary, followed, word for word, by the definitions of those CORINE categories as provided in the CORINE Biotopes Manual mentioned above. The references provided in the CORINE Biotopes Manual, to published sources of information on the different CORINE categories, are not included here. The extension of the CORINE system to cover northern Europe has not yet been published in any readily accessible form. References made to northern European categories here follow Romau (1996). A French language version of the CORINE Biotopes Manual, restricted in its coverage to the CORINE habitat types known to occur in France, has recently become available—see Bissardon and Guibal (1998).

Corylus thickets, Atlantic scrub: thickets of *Corylus avellanae*. CORINE 31.8C.

cow dung, forest and open ground supplementary habitat: dung of cows/cattle, produced in situ, by grazing livestock (this does not include manure, imported from elsewhere and spread mechanically, as fertiliser).

crop: CORINE 82: Crops; fields of cereals, beets, sunflowers, leguminous fodder, potatoes and other annually harvested plants. Faunal and floral quality and diversity depend on the intensity of agricultural use. If a tree layer is present, it can be indicated by simultaneous use of a code of 83 or 84 with the present one.

culture macrohabitats: anthropogenic landscape features. CORINE 8. CORINE 8: Cultivated or built-up areas under the overwhelming influence of human activity; the natural vegetation cover has been totally replaced as a result of agricultural practices, urbanization or industrialization. A natural flora and fauna subsists mainly in areas of extensive and traditional cultivation and dwelling. Wild plants may grow among crops, in hedges, along roads, on walls

and in fallow fields. Many animals have, during the course of the past few thousand years, adapted to these man-created habitats.

cutover bog, bog: areas of valley bog (raised bog) or 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.

deciduous forests(gen.): natural/semi-natural tree formations of deciduous species, with stands of overmature, mature and young (saplings/scrub) trees.

deciduous plantations (gen.): planted areas of deciduous trees, usually of uniform age and single species. CORINE 83.32. CORINE 83.32: PLANTATIONS OF BROAD-LEAVES TREES

deciduous trees, scattered trees in open ground: see scattered trees in open ground (gen.).

drainage ditch, culture supplementary habitat: intermittently-flooded, man-made drainage channels dug in cultures.

drainage ditch along trackside in plantation, forest supplementary habitat: intermittently-flooded, man-made drainage channel dug alongside a track in a plantation of conifers or deciduous trees.

drainage ditch in forest, forest supplementary habitat: intermittently-flooded, man-made drainage channels dug in forest or plantation.

drainage/irrigation ditch in open ground, open ground supplementary habitats: intermittently-flooded, man-made drainage or irrigation channels dug in open ground.

drainage ditch in wetland, wetland supplementary habitat: intermittently-flooded, man-made drainage channels dug in wetlands.

dry (gen.), deciduous forests: dry forest formations, with stands of overmature, mature and young (saplings/scrub) trees, belonging to the phytosociological units of thermophilous mixed oak woods, *Quercetalia pubescentis-petraeae*. CORINE 41.7. CORINE 41.7: THERMOPHILOUS AND SUPRA-MEDITERRANEAN OAK WOODS; *Quercetalia pubescenti-petraeae*; forests or woods of sub-Mediterranean climate regions and supra-Mediterranean altitudinal levels, dominated by deciduous or semi-deciduous thermophilous oak species; they may, under local microclimatic or edaphic conditions, replace the evergreen oak forests in meso-Mediterranean or thermo-Mediterranean areas, and radiate far north into medio-European or sub-Atlantic regions.

dry *Pinus sylvestris* (gen.), coniferous forests: dry coniferous forests dominated by scots pine (*Pinus sylvestris*), with stands of overmature, mature and young (saplings/scrub) trees. CORINE 42.52. CORINE 42.52: MIDDLE EUROPEAN SCOTS PINE FORESTS; indigenous *Pinus sylvestris* forests of the lowlands of northern and middle Europe and of the mountain level of the central Europe hercynian ranges.

dry, scrub/thickets: CORINE 31.81: MEDIO-EUROPEAN RICH-SOIL THICKETS; *Prunetalia: Pruno-Rubion fruticosi* p., *Berberidion*; thickets of *Prunus spinosa*, *P. mahaleb*, *Rosa* spp. *Cornus mas*, *C. sanguinea*, *Sorbus aria*, *Crataegus* spp., *Lonicera xylosteum*, *Rhamnus catharticus*, *R. alpinus*, *Clematis vitalba*, *Ligustrum vulgare*, *Viburnum lantana*, *V. opulus*, *Rubus* spp., *Amelanchier ovalis*,

Cotoneaster integerrimus, *C. nebrodensis*, *Pyrus pyraister*, *Malus sylvestris*, *Euenymus europaeus*, *Corylus avellana*, *Ulmus minor*, *Acer campestre*, *A. monspessulanum*, *Carpinus betulus* characteristic of forest edges, hedges and (mostly *Carpinion* or *Quercion pubescenti-petraeae*) woodland recolonisation, developed on soils relatively rich in nutrients, neutral or calcareous.

dry (general), lowland unimproved grassland: lowland unimproved grassland usually maintained by management (grazing by livestock), on freely-draining substrates: CORINE 34.2, 34.321, 35.1.

dune slacks, coastal dunes: CORINE 16.3: HUMID DUNE-SLACKS; humid depressions of the dunal systems. The most important habitats are included in the following units. If the divisions proposed are not sufficient, appropriate codes from 22.4,22.3, 54.2, 54.4, 53 can be used in conjunction with them. Humid dune-slacks are extremely rich and specialized habitats very threatened by the lowering of water tables.

dwarf Betula/Salix scrub, tundra: dwarf birch (*Betula nana*) and willow (*Salix glauca*, *S.lanata*) scrub, with a ground vegetation of *Arctostaphylos* spp., *Phyllodoce*, *Rubus chamaemorus* and *Vaccinium* spp., developed on mineral-poor soils.

dwarf-heath, tundra: stunted and creeping shrub formations (rarely more than 25cm. high). On sandy soils ericaceous species (e.g. *Arctostaphylos*, *Phyllodoce*, *Rhododendron*, *Vaccinium*) often predominate, together with dwarf *Salix* (*S.glauca*, *S.lanata*), cloud berry (*Rubus chamaemorus*) and stone bramble (*Rubus saxatile*). On neutral, or alkaline soils *Dryas* heaths are characteristic, with a more diverse ground flora, including such species as *Draba nivalis*, *Potentilla nivea*, *Campanula uniflora* and *Arnica alpina*.

edge, perm. pool, culture supplementary habitat: the land/water ecotone of small, permanently flooded, standing-water bodies in cultures (including man-made ponds).

edge, perm. pool in open ground, open ground supplementary habitats: the land/water ecotone of small, permanently flooded, standing-water bodies in open ground.

edge, perm. pool in wetland, wetland supplementary habitat: the land/water ecotone of small, permanently flooded, standing-water bodies in wetlands.

edge, perm. pool under canopy, forest supplementary habitat: the land/water ecotone of small, permanently flooded, standing-water bodies in forests, overshadowed by the tree canopy.

eutrophic/mesotrophic, humid, lowland unimproved grassland CORINE 37.21: ATLANTIC AND SUB-ATLANTIC HUMID MEADOWS; *Calthion palustris*, *Bromion racemosi*, *Deschampsion cespitosae*; lightly managed hay meadows and pastures on both basocline and acidocline, nutrient-rich soils of middle European lowlands, hills and low mountains under Atlantic or sub-Atlantic climatic conditions. Among the characteristic plant components of the highly diverse communities forming this unit are *Caltha palustris*, *Cirsium palustre*, *C. rivularis*, *C. oleraceum*, *Epilobium parviflorum*, *Lychnis flos-cuculi*, *Mentha aquatica*, *Scirpus sylvaticus*, *Stachys palustris*, *Bromus racemosus*, *Crepis paludosa*, *Fritillaria meleagris*, *Geum rivale*, *Polygonum bistorta*, *Senecio aquaticus*, *Trollius europaeus*, *Lotus uliginosus*, *Trifolium dubium*, *Equisetum palustre*, *Myosotis palustris*, *Deschampsia cespitosa*, *Angelica sylvestris*, *Oenanthe silaifolia*, *Gratiola officinalis*, *Inula salicina*, *Succisella inflexa*, *Dactylorhiza majalis*, *Ranunculus acris*, *Rumer acetosa*, *Holcus lanatus*, *Alopecurus pratensis*, *Festuca pratensis*, *Juncus effusus*, *J.fliformis*. CORINE 37.22: SHARP-

FLOWERED RUSH MEADOWS; *Juncion acutiflori*; Humid meadows dominated by, or rich in, *Juncus acutiflorus*. They are floristically and phytosociologically very varied and many are as related to the oligotrophic *Molinion* communities of 37.3 as to the more eutrophic *Calthion* ones of 37.2. Sharp-flowered rush meadows are particularly characteristic of the oceanic and sub-oceanic regions to the western seaboard of Europe from north-western Iberia to the Low Countries. CORINE 37.24: FLOOD SWARDS AND RELATED COMMUNITIES; *Agropyro-Rumicion crispip.*; grasslands of occasionally flooded river and lake banks, of depressions where rain water collects, of disturbed humid areas and of pastures submitted to intensive grazing.

Fagus (gen.), deciduous forests: beech (*Fagus*) forests, with stands of overmature, mature and young (saplings/scrub) trees. CORINE 41.1. CORINE 41.1: BEECH FORESTS; forests dominated by *Fagus sylvatica* or, in Greece, *F.orientalis* or *F.moesica*. Many montane formations are beech-fir or beech-fir-spruce forests, to be noted as 43 (mixed forests), but with the suffixes below; they are discussed with the corresponding deciduous forests.

Fagus, scattered trees in open ground: see scattered trees in open ground (gen.).

fallow, culture macrohabitat: farmland in its first year (or at most second year) after cultivation that has been left unsown with any crop (including grass-crops) for the duration of at least one growing season. Fallowing is normally carried out as part of an arable rotation system and as defined here includes unsown "setaside" land (now employed within the EU as a standard mechanism for crop production control).

farmyard organic waste, culture macrohabitat: accumulations of solid farmyard livestock waste (manure) and/or seepages of either slurry (liquid livestock waste) or silage (preserved grassland vegetation) from holding facilities

fen (gen.), wetlands: peatlands in which the ground surface is permanently water-logged and subject to periodic flooding by groundwater, rather than rain water.

fen carr: *Salix* dominated formations of fen and transition mire: CORINE 44.92. This same CORINE category is used to define "Salix swamp woods" in this database. There are significant differences between the habitats represented in *Salix* woods on fen and along lake shores, this being the reason for separating the two situations here. CORINE does not distinguish between these situations. CORINE 44.92: MIRE WILLOW SCRUB; *Salicion cinereae* (*Frangulo-Salicion auritae*); willow-dominated formations with *Salix aurita*, *S. cinerea*, *S. atrocinerea*, *S. pentandra*, *Frangula alnus*, *Betula humilis*, of fens, marshy floodplains and fringes of lakes and ponds.

field margin/hedge bank (general): uncultivated, linear strip of land along the boundary of a cropland or intensive grassland, that has been in place for at least 5 years, is at least 1.5m wide and covered in herbaceous vegetation in which grasses predominate. Coding of this habitat category assumes there is an electric fence separating the field margin from the field itself, in fields used for stock grazing. There is otherwise no definable field margin in fields used for stock grazing (field margins that have been in place for less than 5 years are treated under setaside).

flooded, *Populus*, deciduous plantations: *Populus* plantations subject to periodic flooding

flooded, *Salix*, deciduous plantations: *Salix* plantations subject to periodic flooding

flower bed (general), urban park: area of rotovated, or otherwise maintained bare ground, or area of natural or introduced bare rock (when constructed, rather than natural, normally composed of large stones/boulders grouped or cemented together), planted with herbaceous plants with decorative flowers or foliage or with small shrubs. CORINE 85.14: Park flower beds, arbors and shrubbery

flush in forest, forest supplementary habitat: helocene water sources emerging on the forest floor.

flush in open ground, open ground supplementary habitats: helocene water sources emerging in open ground.

flush in wetland: helocene water sources emerging in wetlands.

forest macrohabitats: natural or semi-natural formations of trees, incorporating stands of overmature, mature and young (saplings/scrub) trees, used in contradistinction to plantations, hedges and scattered trees.

Fraxinus (gen.), deciduous forests: ash (*Fraxinus*) forests, with stands of overmature, mature and young (saplings/scrub) trees. CORINE 41.3. CORINE 41.3: ASH FORESTS; *Carpinion betuli* (*Fraxino-Carpinion*): *Corylo-Fraxinetum p.*, *Polysticho setiferi-Fraxinetum excelsioris p.*, *Mercurialidi perennis-Fraxinetum excelsioris p.*, *Isopyro-Quercetum roboris*, *Adoxo-Aceretum*; Non-alluvial Atlantic or sub-Atlantic forests dominated by *Fraxinus excelsior*, particularly characteristic of Britain, of the north-western Iberian peninsula and of the Baltic moraine hills of Mecklenburg. Secondary formations pioneering on abandoned cultivated land (e.g. Belgian Condroz) are included.

Fraxinus, deciduous plantations: mature plantations of *Fraxinus*. CORINE 83.325: OTHER BROAD-LEAVED TREE PLANTATIONS

Fraxinus, scattered trees in open ground: see scattered trees in open ground (gen.).

freshwater macrohabitats: bodies of running or standing freshwater, permanent or temporary, large or small.

gallery, *Salix* plantation: linear strip of small *Salix* (*S.atrocinerea*, *S.caprea*, *S.pentandra*, *S.viminalis*, etc.) planted along the edge of rivers, streams or standing-water bodies (including man-made water bodies)

gallery softwood, softwood, alluvial forest: residual softwood alluvial forest formation of the potamal section of a river's course, subject to annual flooding; often in an almost linear form of small patches or lines of trees along the river course, with associated patches of understorey and herb layer. CORINE 44.13 CORINE 44.13: white willow galley forests; *Salicion albae*, *Salicetum albae*, *Salicetum fragilis*; arborescent galleries of *Salix*, sometimes including *Populus nigra*, along medio-European lowland rivers, submitted to regular inundation.. Natura 2000 code: 91E0.

garden, ornamental, culture macrohabitats: plots of land, usually urban/suburban, attached to residential dwellings, or maintained by public authorities etc, planted with a miscellany of

indigenous and exotic flowering plants, shrubs and trees for recreation, rather than for food production of forestry purposes. CORINE 85.31: ORNAMENTAL GARDENS

garrigue, scrub/thickets: shrubby formations of the Mediterranean zone, often formed as a degradation stage of thermophile deciduous forests: CORINE 32.4, 32.5, 32.6 CORINE 32.4: WESTERN MESO-MEDITERRANEAN CALCICOLOIJS GARRIGUES; *Rosmarinetalia: Rosmarino-Ericion, Aphyllanthion. p.* Shrubby formations, often low, on mostly calcareous soils of the meso- Mediterranean zone of the Iberian peninsula, France, Italy and the large western Mediterranean islands. Included here are those formations that reach their optimal development within the meso-Mediterranean zone although they often enter the thermo- or supra-Mediterranean levels.. CORINE 32.5: EASTERN GARRIGUES; *Micromerietea p.* Shrubby formations, often low, of the meso-, thermo- and occasionally supra-Mediterranean zones of Greece. Included here are all sclerophyllous formations, regardless of substrate, except those with conspicuous cushion structure (*phrygas s.s.*, listed in 33, and hedgehog-heaths, listed in 31.7), those with abundant *Pistacia lentiscus*, *Myrtus communis* or other thermo-Mediterranean brush elements (*Phillyrea spp.*, *Erica manipulifloru*, *Styrax officinalis*, *Genista fasselata*, *Euphorbia dendroides*, *Calicotome villosa*, *Sarcopoterium spinosum*) listed in 32.2 and high maquis with *Erica arborea* and *Arbutus spp.*, listed in 32.3. CORINE 32.6: SUPRA-MEDITERRANEAN CARRIGUES; *Ononidion striatae p. Aphyllanthion p., Lavandulo-Genistion boissieri* Low shrub formations with pronounced Mediterranean affinities formed as a degradation stage of thermophile deciduous forests (*Quercion pubeccentis*, *Ostryo-Carpinion*) or sometimes of *Quercus rotundifolia* forests in the supra-Mediterranean belt. Included here are only those formations that are characteristic of the supra-Mediterranean level; formations, particularly of the lower supra-Mediterranean that are closely related to meso-Mediterranean communities have been included under 32.4 and 32.5.

grassland (gen.): sparsely to densely-vegetated open ground over which grasses are a dominant component, whether natural (climatic or physiographic) or maintained primarily by the action of grazing animals, domestic or wild, or by mechanical harvesting regimes.

grassy clearings/tracksides, forest supplementary habitat: open areas within forest 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. This category may contain elements of CORINE category 31.87 but tends to be less transitory, being largely maintained by grazing. It may also occur in conjunction with elements of CORINE category 34.4 (thermophilous forest fringes).

grey dunes/dune scrub, coastal dunes: fixed dunes, with the exclusion of all mediterranean, iberian and canarian communities. CORINE 16.22, 16.25. CORINE 16.22: GREY DUNES; fixed dunes, stabilised and colonized by more or less closed perennial grasslands. Habitats Directive, Natura 2000 code: 2130. CORINE 16.25: DUNE THICKETS; *Prunetalia spinosae p. (Ligustro-Hippophaeion rhamnoidis, Lonicerion periclymeni, Pruno-Rubion ulmifolii p., Sambuco-Berberidion)*; Dense formations of large shrubs including sea-buckthorn, privet, elder, willow, gorse or broom, often festooned with creepers such as honeysuckle (*Lonicera*) or white bryony. Codes of 31.8 can be used, in addition to 16.252, to specify the habitat.

hardwood (gen.), alluvial forests: lower and higher zones of hardwood forests with stands of overmature, mature and young (saplings/scrub) trees, of the formations *Pruno-Fraxinetum* and *Ulmo-Fraxinetum* on the floodplains of great rivers. CORINE 44.33, 44.4. CORINE 44.33: ASH-ALDER WOODS OF SLOW RIVERS; *Pruno-Fraxinetum*, *Ulmo-Fraxinetum*; central, and locally western, European woods of large valleys of lowland slow and even-flowing rivers, with *Fraxinus excelsior*, *Alnus glutinosa*, *Prunus padus*, *Ulmus laevis*, *Quercus robur*, *Humulus lupulus*, *Rubus idaeus*, *R. caesius*, *Ribes nigrum*, *R. rubrum*, *Sambucus nigra*, *Aegopodium podagraria*, *Peucedanum palustre*, *Glyceria maxima*, *Iris pseudacorus*, *Carex acutiformis*, *C. riparia*, *Phalaris arundinacea*, *Filipendula ulmaria*, *Cirsium oleraceum*, *C. palustre*. CORINE 44.4: MIXED OAK-ELM-ASH FORESTS OF GREAT RIVERS; *Ulmion minoris*; diverse riparian forests of the middle courses of great rivers, inundated only by large floods.

hay, improved grassland: CORINE 38.2. lowland hay meadows. Improved grassland where the vegetation is mechanically cut when leaf growth has finished and flowering of the dominant grasses is occurring (but before seed formation), followed by in-situ drying of the cut crop and its subsequent removal once dry. CORINE 38.2: Mesophile hay meadows of low altitudes, fertilised and well-drained, with *Arrhenatherum elatius*, *Trisetum flavescens*, *Anthriscus sylvestris*, *Heracleum sphondylium*, *Daucus carota*, *Crepis biennis*, *Knautia arvensis*, *Luecanthemum vulgare*, *Pimpinella major*, *Trifolium dubium*, *Geranium pratense*; they are most characteristic of the Euro-Siberian zone, but extend to Atlantic Iberia, the Cordillera Central and Montseny, to the Apennines and to the supra-Mediterranean zone of Greece.

heath: CORINE 31.22, 31.23, 31.4 with the exclusion of all mediterranean and iberian communities. CORINE 31.22: SUB-ATLANTIC *CALLUNA-GENISTA* HEATHS; *Calluno-Genistion pilosae* p.; Low *Calluna* heaths often rich in *Genista*, mostly of the North Sea lowlands. Similar formations occurring in British upland areas, montane zones of high mountains of the western Mediterranean basin and high rainfall influenced Adriatic areas are most conveniently listed here. CORINE 31.23: ATLANTIC *ERICA-ULEX* HEATHS; *Ulicion minoris*; *Daboecenion cantabricae* p.; *Ulicion maritimae*; heaths rich in gorse (*Ulex*) of Atlantic margins. CORINE 31.4: small, dwarf or prostrate shrub formations of the alpine and subalpine belts, dominated by ericaceous species, *Dryas* or dwarf junipers. Habitats Directive: Natura 2000 code: 4060.

hedge, culture macrohabitats: strips of deciduous trees and/or shrubs, planted along field edges, roadsides etc., frequently spinose (e.g. *Crataegus*, *Prunus spinosus*) and maintained, usually by mechanical cutting, to regulate height and width, so forming a dense and continuous band of woody vegetation a few metres high, with an associated herb layer and, frequently, isolated, emergent trees at irregular intervals. CORINE 84.2: HEDGEROWS

hedge plus field margin, culture macrohabitats: a hedge occurring together with a field margin (see definitions for hedge and field margin)

helocrene, spring/flush: groundwater outflows emerging over a diffuse area to produce seepages or flushes.

high maquis, maquis, scrub/thickets: western mediterranean high maquis: CORINE 32311: *Ericenion arboreae*: *Phillyrea angustifoliae-Arbutetum unedi*, *Phillyrea rodriguezii-Arbutetum unedi*, *Erica arboreae-Arbutetum unedi*. Formations with *Erica arborea*, *Arbutus unedo*, *Quercus ilex*,

Phyllyrea angustifolia, *P. media*, *Viburnum tinus*, *Rhamnus alaternus*, *Juniperus oxycedrus*, *Fraxinus ornus*.

humid *Fagus* (beech) forests: CORINE 41.11, 41.12, 41.13, 41.15, except 41.122: Forests dominated by *Fagus sylvatica*. Many montane formations are beech-fir or beech-fir-spruce (*Fagus/Abies/Picea*) forests, noted in the CORINE system as category 43 (mixed forests), which is not used in the Macrohabitats file. Syrphids associated with *Fagus* in montane mixed forests are treated under the humid *Fagus* forest category. Syrphids associated with *Abies* or *Picea* in montane mixed forests are treated under the *Abies/Picea* forest category. Syrphids that may occur in association with *Fagus* or *Abies/Picea* in montane mixed forests are treated under both humid *Fagus* and *Abies/Picea* forest categories. CORINE 41.11: CENTRAL EUROPEAN ACIDOPHILOUS BEECH FORESTS WITH WOODRUSH; *Luzulo-Fagenion*. Medio-European beech and, in higher mountains, beech-fir or beech-fir-spruce forests on acid soils, with *Luzula luzuloides*, *Polytrichum formosum*, and often *Deschampsia flexuosa*, *Vaccinium myrtillus*, *Pteridium aquilinum*. CORINE 41.12: ATLANTIC ACIDOPHILOUS BEECH FORESTS, *Ilici-Fagenion*. Atlantic forests on acid soils, differing from 41.11 by the absence of *Luzula luzuloides* and a greater abundance of *Ilex aquifolium*. CORINE 41.13: NEUTROPHILOUS BEECH FORESTS, *Asperulo-Fagenion*. Medio-European and Atlantic forests, on neutral or near-neutral soils, with mull humus, characterised by a strong representation of species belonging to the ecological groups of *Anemone nemorosa*, of *Lamium galeobdolon*, of *Galium odoratum* and *Melica uniflora* and, in mountains, various *Dentaria*, forming a richer and more abundant herb layer than in 41.11 and 41.12. CORINE 41.15: SUBALPINE BEECH WOODS, *Aceri-Fagenion*. Woods usually composed of low, low-branching trees, with much *Acer pseudoplatanus*, situated near the tree limit, mostly in low mountains with oceanic climate (Vosges, Schwarzwald, Rhön, Jura, outer Alps, Massif Central, Pyrenees). The herb layer is similar to that of 41.13 or locally 41.11 and with elements of adjacent open grasslands.

humid (general), lowland unimproved grassland. Humid, lowland unimproved grasslands not normally subject to flooding (though temporary pools may be present at times of high rainfall and temporary seepages and streams can occur during periods of high groundwater levels). This category overlaps with the alluvial, lowland, unimproved grassland category and shares with it several (CORINE 37.21, 22, 24) grassland types.

humid *Pinus sylvestris* (gen.), coniferous forests: wet coniferous forests dominated by *Pinus sylvestris*, with stands of overmature, mature and young (saplings/scrub) trees: CORINE 42.51 and boreal *Pinus* forest. CORINE 42.51: CALEDONIAN FOREST; relict, indigenous Scots pine forests of endemic *Pinus sylvestris* var. *scotica*, limited to the central and north-eastern Grampians of Scotland. They are mostly open and have a ground layer usually rich in ericaceous species and mosses, in particular, *Hylocomium splendens*, and often arbouring, together with abundant *Deschampsia flexuosa*, *Goodyera repens*, *Listera cordata*, *Corallorhiza trifida*, *Linnaea borealis*, *Trientalis europeae*, *Pyrola minor*, *Moneses uniflora*, *Orthilia secunda*. Accompanying, dominated, tree species include *Juniperus communis*, *Scorbus aucuparia*, *Betula pubescens*, *B. pendula*, *Ilex aquifolium*, *Populus tremula*.

humid/mesophilous (gen.), deciduous forests: acidophilous/mesophilous beech forests (*Eu-Fagion* - CORINE 41.1) including Central European acidophilous beech forest with woodrush (*Luzulo-Fagenion* - CORINE 41.11); humid types of oak-hornbeam forests (*Carpinion betuli* - CORINE 41.2) and in particular ash forest dominated by *Fraxinus excelsior* (CORINE 41.3) and humid/mesophilous acidophilous oak forest (*Quercus robur-petraeae* - CORINE 41.5), all with stands of overmature, mature and young (saplings/scrub) trees. CORINE 41.1: BEECH FORESTS; forests dominated by *Fagus sylvatica* or, in Greece, *F.orientalis* or *F.moesica*. Many montane formations are beech-fir or beech-fir-spruce forests, to be noted as 43 (mixed forests), but with the suffixes below; they are discussed with the corresponding deciduous forests. CORINE 41.11: CENTRAL EUROPEAN ACIDOPHILOUS BEECH FORESTS WITH WOODRUSH *LUZULO-FAGENION*, Medio-European beech and, in higher mountains, beech-fir or beech-fir-spruce forests on acid soils, with *Luzula luzuloides*, *Polytrichum formosum*, and often *Deschampsia flexuosa*, *Vaccinium myrtillus*, *Pteridium aquilinum*. CORINE 41.2: OAK-HORNBEAM FORESTS; *Carpinion betuli*; Atlantic and medio-European forests dominated by *Quercus robur* or *Q.petraea*, on eutrophic or mesotrophic soils, with usually ample and species-rich herb and bush layers. *Carpinus betulus* is generally present. They occur under climates too dry or on soils too wet or too dry for beech or as a result of forestry practices favouring oaks. CORINE 41.3: ASH FORESTS; *Carpinion betuli* (*Fraxino-Carpinion*): *Corylo-Fraxinetum p.*, *Polysticho setiferi-Fraxinetum excelsioris p.*, *Mercurialidi perennis-Fraxinetum excelsioris p.*, *Isopyro-Quercetum roboris*, *Adoxo-Aceretum*; non-alluvial Atlantic or sub-Atlantic forests dominated by *Fraxinus excelsior*, particularly characteristic of Britain, of the north-western Iberian peninsula and of the Baltic moraine hills of Mecklenburg. Secondary formations pioneering on abandoned cultivated land (e.g. Belgian Condroz) are included. CORINE 41.5: ACIDOPHILOUS OAK FORESTS; *Quercion robori-petraeae*; Forests of *Quercus robur* or *Q. petraea* on acid soils with a herb layer mostly constituted by the ecological groups of *Deschampsia flexuosa*, *Vaccinium myrtillus*, *Pteridium aquilinum*, *Lonicera periclymenum*, *Holcus mollis*, and of *Maianthemum bifolium*, *Convallaria majalis*, *Hieracium sabaudum*, *Hypericum pulchrum*, *Luzula pilosa*, and the mosses *Polytrichum formosum* and *Leucobryum glaucum*.

improved grassland (gen.), grassland: improved pasture and meadow. CORINE 38.1, 38.2, 36.52.

inland sand dunes: CORINE 64: INLAND SAND-DUNES; Sand bodies of eolian origin, possessing constructional relief and separated from the coast and its dune cordons by non-dunal habitats. They support vegetation which differs markedly from coastal sand-dune communities.

intensive grassland: intensively used pasture and meadow. CORINE 81. CORINE 81: IMPROVED GRASSLANDS; heavily fertilised or reseeded grasslands, subjected to periodic cultivation and frequently alternated with crops in rotational systems; sometimes treated by selective herbicides and with very impoverished flora and fauna.

lagoons, brackish macrohabitats: coastal pools of standing, brackish or salt water, with a restricted and intermittent inflow of sea water and with freshwater inputs. CORINE 21. CORINE 21: LAGOONS; saline or hypersaline coastal waters, often formed from sea inlets by

silting and cut off from the sea by sand or mud banks. The presence of vegetation can be indicated by addition of codes 23.21 or 23.22. Habitats Directive, Natura 2000 code: 1150.

lake edge, standing, edge, water's edge: vegetated and unvegetated shores/beaches of lakes.

Larix/Pinus cembra (gen.), coniferous forests: CORINE 42.31, 42.32 CORINE 42.31: EASTERN SILICEOUS LARCH AND AROLLA FORESTS; *Larici-Cembrion*. Subalpine *Larix decidua*, *Pinus cembra*, or *Larix decidua*-*Pinus cembra* forests of the eastern and central Alps, mostly of the inner ranges, mostly on siliceous substrates, with an often species-poor undergrowth comprising *Vaccinium myrtillus*, *Rhododendron ferrugineum*, *Calamagrostis villosa*, *Luzula albida*. CORINE 42.32: EASTERN CALCICOLOUS LARCH AND AROLLA FORESTS; *Laricetum*, *Larici-Cembretum rhododendretosum hirsuti*. Subalpine and montane *Larix decidua*, *Larix decidua-Picea abies*, *Pinus cembra* or *Larix decidua-Pinus cembra* forests of the eastern and central Alps, mostly of the outer ranges, on calcareous substrates, with a usually species-rich undergrowth including *Erica herbacea*, *Polygala chamaebuxus*, *Rhododendron hirsutum* or *Pinus mugo*.

Laurisilva forests, *Pruno-Laurelalia*, Humid to hyper-humid, mist-bound, luxuriant, evergreen, lauriphyllous forests of the cloud belt of the Macaronesian islands, extremely rich in floral and faunal species, among which many are restricted to these communities. Genera such as *Picconia*, *Semele*, *Gesnouinia*, *Lactucosonchus*, *Ixanthus* are entirely endemic to these communities, while others, such as *Isoplexis*, *Visnea* and *Phyllis* reach in them their maximum development; in addition, each of the formations of the various archipelagoes harbours distinctive endemic species. Laurel forests are the most complex and remarkable relict of the humid sub-tropical vegetation of the Miocene-Pliocene late Tertiary of southern Europe. Areas of intact forests have been drastically reduced to a level below which the preservation of their elements could not be sustained. CORINE 45.62 CORINE 45.62: MADEIRAN LAURISILVAS; *Pruno-Laurelalia azoticae*: *Gethro-Laurion azoticae*, Lauriphyllous forests of Madeira with *Laurus azorica*, *Persea indica*, *Ocotea foetens*, *Apollonias barbuiana*, *Pittosporum coriaceum*, *Clethra arborea*, *Visnea mocanera*, *Picconia excelsa*, *Prunus lusitanica* ssp. *hixa*, *Heberdenia excelsa*, *Vaccinium padifolium*, *Ilex perado* ssp. *perado*, *I.canariensis*, *Myrica faya*, *Erica arborea*, *Hledera canariensis*, *Isoplexis canariensis*, *Euphorbia mellifera*, *Sambucus lanceolata*, *Teline maderensis*, *Sonchus fruticosus*, *Senecio auritus*, *Ruscus streptophyllus*, *Rubus bollei*, *Semele androgyna*, *Smilax canariensis*, *Tamus edulis*, *Carex peregrina* and many ferns. These forests, which still occupy a relatively large surface, of the order of 10 000 ha (15% of their former surface), are the habitat of the threatened endemic Madeiran Pigeon, *Columba trocaz*.

lawn, urban park: area of planted (and frequently reseeded), dense grass sward, maintained at a height of less than 10cm by frequent mechanical mowing. CORINE 85.12: Park lawns

lightly-grazed, improved grassland: cropping of ground vegetation, resulting normally in dominance by grasses, inhibition of extensive scrub cover and a sward height greater than 10cm

limestone pavement, cliff and rock: CORINE 63.2: regular blocks of limestone known as "clints" with loose flags separated by a network of vertical fissures known as "grykes" or "shattered pavements", containing more loose limestone rubble. The rock surface is almost devoid of overlying soils (considerably less than 50% cover) except for some patches of shallow skeletal or

loessic soils, although more extensive areas of deeper soil occasionally occur. This morphology offers a variety of microclimates allowing the establishment of complex vegetation consisting of a mosaic of different communities. The ecosystem is usually maintained by grazing - without grazing such areas would normally become covered by scrub and then woodland. In Atlantic parts of Europe the fissures provide a cold, humid microclimate where shade-tolerant vascular plants such as *Geranium robertianum* and *Ceterach officinale* occur, as well as formations of herbaceous species typical of calcareous woodland; the small pockets of soil are occupied by communities of *Mesobromion* (e.g. *Seslerio-Mesobromenion*). Marginal areas of *Geranium sanguineum* may occur. Scrub (e.g. *Corylo-Fraxinetum*, *Prunetalia spinosae*) and patches of heath and moorland vegetation may be present, but should be treated as additional habitats. These pavements may be subject to severe winds, so that isolated shrubs can only there survive in prostrate growth-form (e.g. *Dryas octopetal*, *Juniperus*). In Sweden, limestone blocks are larger and cracks are smaller. The species composition reflects a more continental, drier and cooler climate. The pavements are mostly exposed with scattered cushions of bryophytes, more seldom covered by a thin layer of soil. The surface is covered by *Sedum album*, *Cerastium pumilum*, *C.semidecandrium*, lichens (*Aspicilia calcarea*, *Thamnolia vermicularis*, *Verrucaria nigrescens*) and bryophytes (*Tortella tortuosa*, *Grimmia pulvinata*). The vegetation in the cracks contains *Gymnocarpium robertianum*, *Asplenium ruta-muraria*, *A.trichomanes* ssp. *quadriovalens* and, occasionally, bushes of *Prunus spinosa*, *Fraxinus excelsior*, *Cotoneaster* spp., *Rosa* spp. In sub-mediterranean conditions, limestone pavements may carry patches of thermophilous *Quercus* scrub, with an understory of *Buxus* - these should be regarded as separate habitats. The pockets of grassland present are variable in character but would normally be described as xeric, and unimproved (i.e.CORINE 34.5).

limnocrene, spring/flush: springs emerging in small pools. Limnocrens emerging in larger water bodies such as lakes or dead arms are not covered here.

lowland, heath: CORINE 31.22, with the exclusion of all mediterranean, iberian, and alpine communities; CORINE 31.23. CORINE 31.22: SUB-ATLANTIC *CALLUNA-GENISTA* HEATHS; *Calluno-Genistion pilosae* p.; Low *Calluna* heaths often rich in *Genista*, mostly of the North Sea lowlands. Similar formations occurring in British upland areas are also included here. CORINE 31.23: ATLANTIC *ERICA-ULEX* HEATHS; *Ulicenion minoris*; *Daboecenion cantabrigae* p.; *Ulicenion maritimae*; heaths rich in gorse (*Ulex*) of Atlantic margins

lowland improved grassland: improved pasture and meadow occurring at altitudes up to, and including, that of *Fagus* forest: CORINE 38.1, 38.2. CORINE 38.1: MESOPHILE PASTURES; *Cynosurion*; regularly grazed mesophile pastures, fertilised and on well-drained sites, with *Lolium perenne*, *Cynosurus cristatus*, *Poa* ssp., *festuca* ssp., *Trifolium repens*, *Leontodon autumnalis*, *Bellis perennis*, *Ranunculus repens*, *R.acris*, *Cardamine pratensis*; they are most characteristic of the Euro-Siberian zone, but extend to Atlantic Iberia and the Cordillera Central, the Apennines and the supra-Mediterranean zone of Greece. CORINE 38.2: LOWLAND HAY MEADOWS; *Arrhenatherion*, *Brachypodio-Centaureion nemoralis*; mesophile hay meadows of low altitudes, fertilized and well-drained, with *Arrhenatherion elatius*, *Trisetum flavescens*, *Anthriscus sylvestris*, *Heracleum sphondylium*, *Daucus carota*, *Crepis biennis*, *Knautia arvensis*, *Leucanthemum vulgare*, *Pimpinella major*, *Trifolium dubium*, *Geranium pratense*; they are most characteristic of the Euro-

Siberian zone, but extend to Atlantic Iberia, the Cordillera Central and Montseny, to the Apennines and to the supra-Mediterranean zone of Greece.

lowland, tall herb communities: tall-herb communities at altitudes up to, and including, that of *Fagus* forest. CORINE 37.1: meadowsweet stands and related communities. *Filipendulion ulmariae* i.a. Hygrophile tall herb strips of fertile alluvial stream banks, often dominated by *Filipendula ulmaria*, and tall herb stands (*F.ulmaria*, *Angelica sylvestris*) colonising humid hay meadows and pastures after more or less long discontinuation of mowing or grazing; characteristic species are *Filipendula ulmaria*, *Angelica sylvestris*, *Achillea ptarmica*, *Cirsium palustre*, *Deschampsia cespitosa*, *Epilobium hirsutum*, *Geranium palustre*, *Veronica longifolia*, *Scutellaria hastifolia*, *Eupatorium cannabinum*, *Lysimachia vulgaris*, *Lythrum salicaria*, *Phalaris arundinacea*, *Polygonum bistorta*, *Valeriana officinalis*. CORINE 37.7: humid tall herb fringes. *Convolvuletalia sepium*, *Glechometalia hederaceae* p. (*Calystegio-Alliarietalia*). Watercourse veil and shady woodland edge communities.

lowland unimproved grassland (general), unimproved grassland: unimproved grasslands occurring at altitudes up to, and including, that of *Fagus* forest. Used in contradistinction to montane/subalpine unimproved grasslands (unimproved grasslands occurring primarily in the *Abies/Picea/Larix* altitudinal belt) and alpine unimproved grasslands (unimproved grasslands above the tree-line).

low maquis, maquis, scrub/thickets: low *Cistus* maquis. CORINE 3234, 3235. For predominantly ericaceous formations, see under mediterranean heath. CORINE 3234: western Mediterranean formations of small or medium *Cistus* spp., most characteristic of the siliceous soils of the meso-mediterranean zone, but also widely occurring in the thermo-mediterranean zone and in the siliceous supra-mediterranean zone. CORINE 3235: low *Cistus-Lavandula stoechas* maquis. Usually varied, western Mediterranean maquis rich in *Lavandula stoechas*, accompanied by *Cistus* spp., *Erica* spp., brooms (*Genista* spp., *Cytiscus* spp.).

machair, coastal dunes: CORINE 1A. CORINE 1A: MACHAIR; plains behind dunes especially characteristic of the western seaboard of the Outer Hebrides. Windblown calcareous sands deposited on peat support a flower-rich, and correspondingly insect-rich, dune grassland studded with shallow lochs and cultivated on a strip rotation. The grassland is dominated by *Poa pratensis* and *Festuca rubra*, accompanied by *Thalictrum minus*, *Thymus drucei*, *Bellis perennis*, *Prunella vulgaris*, *Erodium cicutarium*, *Trifolium* spp., *Euphrasia* spp. and many orchids, among which *Dactylorhiza fuchsii* spp. *hebridensis*, *D.purpurella*, *Gymnadenia conopsea*, *Coeloglossum viride*, *Platanthera chlorantha* and *Orchis mascula* are the most prominent. This grassland harbours a plant community of very restricted distribution comprising vulnerable species; *Cochlearia scotica*, *Euphrasia marshallii* and *Dactylorhiza fuschii* ssp.*hebridensis* are endemic. Other elements of the ecosystem, such as pools and fallow fields, can be noted by addition of codes from the other units (22, 16.2, 34, 37, 53, 54, 82, 87). As a whole, machair is an essential habitat for breeding waders such as *Haematopus ostralegus*, *Vanellus vanellus*, *Charadrius hiaticula*, *Calidris alpina*, *Tringa totanus* and *Gallinago gallinago*; it supports the healthiest European population of the threatened corncrake *Crex crex*. Habitats Directive, Natura 2000 code: 21A0.

maquis (gen.), scrub/thickets: shrubby formations, often tall, on mostly siliceous soils of the meso-mediterranean zone of the Iberian peninsula, France, Italy and the large, western Mediterranean islands, degradation stages of evergreen oak forests. CORINE 32311, 3234, 3235. CORINE 32311: western mediterranean high maquis: *Ericenion arboreae*: *Phillyrea angustifoliae*-*Arbutetum unedi*, *Phillyrea rodriguezii*-*Arbutetum unedi*, *Erica arboreae*-*Arbutetum unedi*. Formations with *Erica arborea*, *Arbutus unedo*, *Quercus ilex*, *Phillyrea angustifolia*, *P. media*, *Viburnum tinus*, *Rhamnus alaternus*, *Juniperus oxycedrus*, *Fraxinus ornus*. CORINE 3234: low *Cistus* maquis: western Mediterranean formations of small or medium *Cistus* spp., most characteristic of the siliceous soils of the meso-mediterranean zone, but also widely occurring in the thermo-mediterranean zone and in the siliceous supra-mediterranean zone. CORINE 3235: low *Cistus-Lavandula stoechas* maquis. Usually varied, western Mediterranean maquis rich in *Lavandula stoechas*, accompanied by *Cistus* spp., *Erica* spp., brooms (*Genista* spp., *Cytiscus* spp.).

marsh, wetlands: permanently-water-logged ground on mineral soils, subject to flooding by surface water following rain.

matorral (gen.), scrub/thickets: pre- or post-forest formations with a more-or-less dense arborescent cover and with a usually thick, high evergreen shrub stratum. They are mostly degradation or reconstitution stages of the broad-leaved evergreen forests or their substitution; intermediate between them and maquis; some are substitution stages of thermophilous *Quercus* or *Pinus* forests. CORINE: 3211, 3212, 3214. CORINE 3211: evergreen oak matorral: meso-mediterranean arborescent matorral organised around evergreen oaks; dense, low, coppice-like woods of evergreen oaks (see also under *Quercus ilex* forests). CORINE 3212: olive and lentisc matorral: thermo-mediterranean arborescent matorral with *Olea europaea* ssp. *silvestris*, *O. europaea* ssp. *cerasiformis*, *Ceratonia siliqua*, *Pistacia lentiscus*, *P. atlantica* or *Myrrus communis*. CORINE 3214: pine matorral: mediterranean and sub-mediterranean sclerophyllous brush and scrub dotted by pines (*Pinus* spp.).

mature, forest: stands of trees that have reached the age of fructification without yet developing the features described under "overmature forest", but have developed closed canopy conditions.

mediterranean (gen.), heath: low ericaceous maquis: CORINE 3232. CORINE 3232: *Erico sporariae-Lavandulo storchidis*; *Ampelodesmo-Ericetum*; *Erico scopariae-Cistetum populifolii*: lower (usually less than 1m high) maquis rich in *Calluna vulgaris*, *Erica scoparia*, *E. cinerea* or sometimes low *E. arborea*; often accompanied by *Cistus* spp., *Lavandula stoechas* and various brooms.

mediterranean pine forest, conifer forests: Mediterranean and thermo-Atlantic woods of thermophilous pines, mostly appearing as substitution or paraclimatic stages of forests of the *Quercetalia ilicis* or *Ceratonio-Rhamnetalia*. Long-established plantations of these pines, within their natural area of occurrence, and with an undergrowth basically similar to that of paraclimatic formations, are included. CORINE 42.81, 42.82, 42.84 CORINE 42.81: maritime pine forests and plantations of *Pinus pinaster* ssp. *atlantica* of south-western France and the western Iberian peninsula. CORINE 42.82: mesogeian pine forests of *Pinus pinaster* ssp. *pinaster* (*Pinus mesogeensis*) of the western Mediterranean, upper meso-Mediterranean and supra-Mediterranean situations of Spain, Corsica, south-eastern France, north-western Italy, Sardinia and Pantelleria. CORINE 42.84: forests and woods of Aleppo pine, *Pinus halepensis*, a

frequent colonist of thermo- and calcicolous meso-Mediterranean scrubs. The distinction between spontaneous forests and long-established formations of artificial origin is often difficult.

med.shrub formations, scrub/thickets: Mediterranean shrub formations. Included here are formations, for the most part indifferent to the siliceous or calcareous nature of the substrate, that reach their greatest extension or optimal development in the thermo-mediterranean zone. CORINE 32214 CORINE 32214: lentisc brush: *Pistacia lentiscus*-dominated or -rich formations, widespread and abundant in thermo-mediterranean and coastal meso-mediterranean zones of the entire Mediterranean basin. Locally, similar formations may appear in warm inland meso-mediterranean areas. Often low and sometimes very open, the lentisc brush can, in favourable situations, reach a height of several metres, grading into arborescent matorral.

mesophilous/calciphilous Picea, coniferous forests: mesophilous/calciphilous spruce (*Picea abies*) forests, with stands of overmature, mature and young (saplings/scrub) trees (including CORINE 42.2121, 42.222, 42.223, 42.224, 42.232).

mesophilous *Fagus* (gen.), deciduous forests: neutrophilous/calciphilous beech (*Fagus*) forests and dry acidophilous forests, with stands of overmature, mature and young (saplings/scrub) trees, CORINE 41.122, 41.16, 41.17. CORINE 41.122: SUB-ATLANTIC ACIDOPHILOUS BEECH FORESTS, *Deschampsio-Fagetum*. Transition forests of the Paris basin, the Morvan, the periphery of the Massif Central, the eastern and central Pyrenees. CORINE 41.16: BEECH FORESTS ON LIMESTONE; *Cephalanthero-Fagenion* ; Xero-thermophile medio-European and Atlantic forests on calcareous, often superficial, soils, usually of steep slopes, with a generally abundant herb and shrub undergrowth, characterized by sedges (*Carex digitata*, *C.flacca*, *C.montana*, *C.alba*), grasses (*Sesleria albicans*, *Bracypodium pinnatum*), orchids (*Cephalanthera* spp., *Neottia nidus-avis*, *Epipactis leptochila*, *E.microphylla*) and thermophile species, transgressive of the *Quercetalia pubescenti-petraeae*. The bush-layer includes several calcicolous species. CORINE 41.17: SOUTHERN MEDIO-EUROPEAN BEECH FORESTS, *Fagion sylvaticae*. Forests of the southern flanks of the Alps and the western Mediterranean mountains with an often species-rich herb layer composed of an admixture of medio-european, Mediterranean and local endemic species.

montane improved grassland, improved grassland: improved pasture and meadow in occurring primarily in the natural *Abies/Picea* forest altitudinal zone, maintained by livestock grazing: CORINE 36.52. CORINE 36.52: Rough hawkbit pastures. *Poion alpinae*. Species-poor manured cattle pastures of the subalpine and lower alpine levels, with *Agrostis alpina*, *Phleum alpinum*, *Poa alpina*, *Cerastium fontanum*, *Crepis aurea*, *Leontodon hispidus*, *Trifolium badium*, *T.thalii*.

montane/subalpine fen, fen: fen within the montane/subalpine altitudinal zones, from the level of natural *Picea/Abies* forest upwards.

montane/subalpine, tall herb communities, tall herb communities within the altitudinal zone of natural *Abies/Picea* forest and upwards into alpine grassland: CORINE 37.8: subalpine and alpine tall herb communities. Luxuriant tall herb formations of deep, humid soils in the montane to alpine, but mostly subalpine, levels of the higher mountains.

montane unimproved grassland (general): unimproved grasslands occurring primarily in the natural *Abies/Picea* forest altitudinal zone, usually maintained by livestock grazing (or by the grazing activities of other large herbivores). Both *Abies* and *Picea* species have also been planted at lower altitudes, to replace deciduous forest, notably *Fagus*. These lower altitude grasslands are not covered by the "montane unimproved grassland" categories. CORINE: 36.41, 36.51, 38.3.

moor: wet heathland: CORINE 31.1, 31.211, 31.212, 31.45. CORINE 31.1: WET HEATHS; *Ericion tetralicis*; *Ulicion minoris p.*; *Genistion micrantho-anglicae p*; Humid, peaty or semi-peaty heaths (other than blanket bogs). CORINE 31.211: NORTHERN ISLES VACCINIUM HEATHS; *Calluna-Empetrum hermaphroditum-Vaccinium vitis-idaea* heaths of the Orkneys and Shetlands. CORINE 31.212: UPLAND BRITISH VACCINIUM HEATHS; upland *Vaccinium-Empetrum* heaths of northern and western Britain, with *Vaccinium myrtillus* or *V.vitis-idaea* and *Empetrum nigrum* or *E. hermaphroditum*. They can further subdivided as follows: 31.2121: British southern bilberry heaths; 31.2122: British chionophilous bilberry heaths; 31.2123: British species-rich bilberry heaths; 31.2124: British mat-grass-bilberry heaths; 31.2125: British mountain crowberry-bilberry heaths; 31.2126: British lichen-bilberry heaths; 31.2127: British cowberry heaths; 31.2128: British ling-liverwort heaths, CORINE 31.45:BOREO-ALPINE SCOTTISH HEATHS; Alpine heaths of the highlands and islands of Scotland, with *Juniperus nana*, *Loiseleuria procumbens*, *Empetrum hermaphroditum*, *Arctostaphylos uva-ursi*, *A.alpina* and elements of Alpine flora.

moraine and scree (gen.), screes and glacial moraines, calcareous and non-calcareous, with some pioneer vegetation (e.g. *Androsacion* and *Sedo-Scleranthion* communities). These habitats are more effectively categorised by Delarze *et al* (1998) than in the CORINE system.

mountain pine forests, coniferous forests: mostly subalpine forests of the Pyrenees and Iberia, dominated by *Pinus uncinata*, usually open and with a very developed shrubby understorey. CORINE: 42.41 CORINE 42.41: *Pinus uncinata* forests of the Pyrenees, developed on siliceous or decalcified soils of the subalpine level with a predominantly ericaceous undergrowth comprising *Rhododendron ferrugineum* (dominant), *Vaccinium myrtillus*, *Calluna vulgaris*, *Deschampsia flexuosa*, *Lycopodium annotinum*.

new field margin, field margin/hedge bank: uncultivated, linear strip of land along the boundary of a cropland or intensive grassland, that has been in place for at least 5 years, but less than 15 years, is at least 1.5m wide and covered in herbaceous vegetation in which grasses predominate (field margins that have been in place for less than 5 years are treated under setaside).

non-calc., moraine and scree: moraine and scree derived from non-calcareous, primarily siliceous, rock types and with some pioneer vegetation, e.g. *Androsacion alpinae* (Delarze *et al*, 1998), but excluding thermophilous scree.

not flooded, *Salix*, deciduous plantations: large-willow (*Salix*) plantations not subject to periodic flooding

not flooded, *Populus*, deciduous plantations: poplar (*Populus*) plantations not subject to periodic flooding

old field walls: walls made from blocks of natural rock, that have been in situ long enough to gather a partial covering of vegetation e.g. *Sedum*, *Umbilicus*, thus providing a secondary habitat for some syrphids of moraine and scree.

oligotrophic, humid, lowland unimproved grassland: nutrient-poor, humid, rush and mat-grass grassland. CORINE 37.31 PURPLE MOORGRASS MEADOWS AND RELATED COMMUNITIES: humid grasslands of soils poor in nutrients, unfertilised and with a fluctuating water level, with *Molinia caerulea*, *Succisa pratensis*, *Deschampsia cespitosa*, *Potentilla erecta*, *Allium angulosum*, *A.suaveolens*, *Betonica officinalis*, *Cirsium dissectum*, *C.tuberosum*, *Dianthus superbus*, *Trollius europaeus*, *Galium boreale*, *Gentiana asclepiadea*, *G.pneumonanthe*, *Gladiolus palustris*, *Silaum silaus*, *Selinum carvifolia*, *Inula salicina*, *Iris sibirica*, *Laserpitium prutenicum*, *Lathyrus pannonicus*, *Tetragonolobus maritimus*, *Serratula tinctoria*, *Carex tomentosa*, *C.panicea*, *C.pallescens*, *Parnassia palustris*, *Platanthera bifolia*, *Colchicum autumnale*, *Ophioglossum vulgatum*, *Dactylorhiza maculata*. CORINE 37.32: HEATH RUSH MEADOWS AND HUMID MAT-GRASS SWARDS; *Nardetalia*: *Juncion squarrosi*; Humid, often peaty or semipeaty swards with *Nardus stricta*, *Juncus squarrosus*, *Festuca ovina*, *Gentiana pneumonanthe*, *Pedicularis sylvatica*, *Scirpus cespitosus* and sometimes *Sphagnum* spp. CORINE 51.2: PURPLE MOORGRASS BOGS; *Ericion tetralicis* p.; drying, mowed or burned bogs invaded by *Molinia caerulea*.

open, xeric/semi-arid, unimproved grassland: unimproved, thinly-vegetated dry grassland with scattered stones/patches of bare ground/small patches of exposed bedrock. CORINE 34.1; 34.5; 34.71; 34.72. CORINE 34.1: MIDDLE EUROPEAN PIONEER SWARDS; *Sedo-Scleranthetea* p; open, thermophile formations of sandy or rocky ground in non-Mediterranean lowland to montane areas. 34.5 Mediterranean xeric grasslands. *Thero-Brachypodietea*. Meso- and thermo-Mediterranean xerophile, mostly open, short-grass perennial grasslands rich in therophytes; therophyte communities of oligotrophic soils on base-rich, often calcareous substrates. CORINE 34.71: MEDITERRANEO-MONTANE STEPPES; *Ononidion striatae*. Sparse or discontinuous xerophile grasslands of *Stipa pennata*, *Festuca auquiare* (*F.duriscula*), *F.hervieri*, *Koeleria vallesiana* or *Sesleria albicans* var.*elegantissima* with *Helianthemum apenninum*, *H.canum*, *Genista* spp., *Globularia* spp., *Ononis striata*, *Euphorbia seguieriana*, *Potentilla crantzii*, *Thymus dolomiticus*, *Plantago argentea*, *Rosa pimpinellifolia*, *Dianthus sylvestris*, *Lavandula angustifolia*, *Aster alpinus*, *Anthyllis* spp., *Carex humilis*, best developed in the Causses, but also present locally in Provence and Languedoc, for the Alps to Catalonia. CORINE 34.72: APHYLLANTHUS GRASSLANDS AND SUPRA-MEDITERRANEAN STEPPES *Aphyllanthion* p. Coarse or steppe-like grasslands rich in chamaephytes of pronounced Mediterranean affinities formed as a degradation stage of thermophile deciduous oak forests, or of *Quercus rotundifolia* forests, in the supra-Mediterranean belt of Iberia, southern France and Liguria; grassland facies of the supra-Mediterranean garrigues (32.6) and hedgehog heaths (31.7).

open ground macrohabitats: this term is used in contradistinction to forest, wetland, freshwater and brackish-water habitats: natural/semi-natural unforested land not covered by wetland. This category includes grasslands (whether natural or maintained by grazing animals or mowing), heath, moor and dune systems.

orchard: CORINE 83.1: HIGH-STEM ORCHARDS; tree crops of standards, cultivated for fruit production.

other hardwoods, scattered trees in open ground: see scattered trees in open ground (gen.).

overmat., forest: overmature forest. The term overmature forest is not applied here as in commercial forestry, i.e. a stand of trees which has exceeded the age at which it would normally be harvested. Here overmature/ senescent trees are taken to be those on which microhabitats for saproxylic organisms (i.e. sap runs, rot-holes, trunk cavities, observable areas of dead wood or loose bark) have developed. As a generality, such trees are significantly older than those which would be regarded as overmature by foresters. They may occur in stands or scattered among trees of much younger age, a significant proportion of overmature trees would be approximately 1 to 2 % of the tree cover per ha.

palsa mire, wetlands: arctic hummock mire communities, with bog mosses and lichens dominating on the hummocks, dwarf *Betula/Salix* scrub occurring toward their bases and acid fen with *Potentilla palustre*, *Eriophorum* and *Carex* species in the surrounding watery hollows.

permanent field margin, field margin/hedge bank: permanently uncultivated, linear strip of land along the boundary of a cropland or intensive grassland, at least 1.5m wide and covered in herbaceous vegetation in which grasses predominate..

perm. pool, standing freshwater: permanent pool. Small permanent water bodies of natural origin e.g.ox-bows and/or man-made e.g. ponds, with standing water. This term is used here in contradistinction to lakes and temporary pools.

perm. pool edge, standing, edge, water's edge: vegetated and unvegetated margins of permanent pools, either in the open or under a tree canopy.

perm. pool in open ground, open ground supplementary habitats: small permanent water bodies of natural origin e.g.ox-bows and/or man-made e.g. ponds, with standing water and not shaded by a tree canopy.

perm. pool in wetland, wetland supplementary habitat: small, permanently-flooded, standing-water bodies situated in wetlands.

Picea (gen.), coniferous forests: forests dominated by spruce (*Picea abies*), with stands of overmature, mature and young (saplings/scrub) trees. CORINE 42.2: SPRUCE FORESTS; *Vaccinio-Piceion i.a.*; conifer forests dominated by *Picea abies*.

Pinus, alpine scrub: dwarf alpine *Pinus mugo* scrub: CORINE 31.5 CORINE 31.5: DWARF MOUNTAIN PINE SCRUB; *Mugo-Rhodoretum hirsuti*. *Pinus mugo* brushes of well-drained, often calcareous, soils in the Alps and Apennines, frequently accompanied by *Rhododendron hirsutum*, *Erica herbacea*, *Arctostaphylos uva-ursi*, *A.alpina*, *Rhodothamnus chamaecistus*.

Pinus, matorral, scrub/thickets: pine matorral: CORINE 3214: mediterranean and sub-mediterranean sclerophyllous brush and scrub dotted by pines (*Pinus* spp.).

Pinus sylvestris (gen.), coniferous forests: forests of scots pine (*Pinus sylvestris*), with stands of overmature, mature and young (saplings/scrub) trees. CORINE 42.5: SCOTS PINE FORESTS; forests dominated by *Pinus sylvestris*.

Pinus sylvestris, conifer plantations: CORINE 83.3112: EUROPEAN PINE PLANTATIONS

Populus (gen.), deciduous plantations: CORINE 83.3211: POPLAR PLANTATIONS WITH MEGAPHORB HERB LAYER; Old poplar plantations with a tall herb-rich undergrowth, substitution habitat for some riparian forest species of plants and animals.

Populus, scattered trees in open ground: see scattered trees in open ground (gen.).

Quercus, scattered trees in open ground: see scattered trees in open ground (gen.).

Quercus/Carpinus/Ulmus (gen.), deciduous forests: oak/hornbeam (*Quercus/ Carpinus*) forests, with stands of overmature, mature and young (saplings/scrub) trees: CORINE 41.2. CORINE 41.2: OAK-HORNBEAM FORESTS; *Carpinion betuli*; Atlantic and medio-European forests dominated by *Quercus robur* or *Q.petraea*, on eutrophic or mesotrophic soils, with usually ample and species-rich herb and bush layers. *Carpinus betulus* is generally present. They occur under climates too dry or on soils too wet or too dry for beech or as a result of forestry practices favouring oaks.

Quercus ilex (gen.), broad-leaved, evergreen forests: forest dominated by *Quercus ilex* or *Q.rotundifolia*, with stands of overmature, mature and young (saplings/scrub) trees: CORINE 45.3. Species associated with *Q.ilex* scrub, which could fall into CORINE 32311 (see under high maquis) are coded in the Macrohabitats table both under *Quercus ilex* saplings (macrohabitat category 1613) and under high maquis (macrohabitat category 12321).

Quercus suber (gen.), broad-leaved, evergreen forests: western-Mediterranean silicolous forest dominated by *Quercus suber*, with stands of overmature, mature and young (saplings/scrub) trees: CORINE 45.2; usually more thermophile and hygrophile than *Q.ilex*-dominated forest.

raised bog, bog: CORINE 51.1: NEAR-NATURAL RAISED BOGS; undisturbed, or little disturbed, peat-forming bogs, often taking the shape of a convex lens. Such intact or nearly intact systems have become very rare or even exceptional. They are composed of a number of communities, which form and occupy the topological features of the bog. These communities are interrelated and function as a unit, so that they cannot be regarded as separate subhabitats; their presence and combination, however, characterise the various types of bogs. Typically, fen/acid fen communities occur round the outer edge of the bog, where its water-supply is maximally influenced by ground-water, pools occur over the bog surface and *Sphagnum* -bog communities occur toward the more-raised centre of the bog, where it is sustained by rain water. The perennial vegetation is dominated by hummock-forming *Sphagna* (*Erico-Sphagnetalia magellanici*, *Scheuchzeritalia palustris* p., *Utricularitalia intermedio-minoris* p., *Caricetalia fuscae* p.). Habitats Directive, Natura 2000 code: 7110.

reed/tall sedge beds (gen.), wetlands: CORINE 53.1, 53.2: Reed beds of the phytosociological categories *Phragmition australis* and *Scirpion maritimi* (CORINE 53.1) and tall sedge beds of the alliance *Magnocaricion* (CORINE 53.2), on the margin of standing and running waters, fens and marshes, including also patches of *Phalaris arrundinacea* and *Glyceria maxima*. CORINE 53.1:

REED BEDS; *Phragmites australis*, *Scirpus maritimi*; reed bed formations of tall helophytes, usually species-poor and often dominated by one species, growing in stagnant or slowly flowing water of fluctuating depths, and sometimes on waterlogged ground. They can be classified according to the dominant species, which gives them a distinctive appearance. CORINE 53.2: LARGE SEDGE COMMUNITIES; *Magnocaricion*; Formations of large Cyperaceae of genera *Carex* or *Cyperus* occupying the edge or the entirety of humid depressions, oligotrophic mires and rich fens, on ground that can be dry for part of the year. They occur, in particular, on the landward side of reedbeds in waterside successions and as colonists of humid depressions on mineral soils, or of acid and alkaline fens.

reeds, reed/tall sedge beds: CORINE 53.1: REED BEDS; *Phragmites australis*, *Scirpus maritimi*; Reed bed formations of tall helophytes, usually species-poor and often dominated by one species, growing in stagnant or slowly flowing water of fluctuating depths, and sometimes on waterlogged ground. They can be classified according to the dominant species, which gives them a distinctive appearance.

rheocrene, spring/flush: springs emerging as streams of running water (gushing springs).

rich fen/fen sedge beds, fen: rich fen/beds of small sedges: CORINE 54.2, 53.3. CORINE 54.2: RICH FENS; *Tofieldietalia* (*Caricetalia davalliana*): *Caricion davalliana*; wetlands mostly or largely occupied by peat- or tufa-producing small sedge and brown moss communities developed on soils permanently waterlogged, with a soligenous or topogenous base-rich, nutrient-poor, often calcareous water supply, and with the water table at, or slightly above or below, the substratum. Peat formation, when it occurs, is infra-aquatic. Calciphile small sedges and other Cyperaceae usually dominate the mire communities, which belong to the *Caricion davalliana*, characterized by a usually prominent “brown moss” carpet formed by *Campylium stellatum*, *Drepanocladus intermedius*, *D. revolvens*, *Cratoneuron commutatum*, *Acrocladium cuspidatum*, *Ctenidium molluscum*, *Fissidens adianthoides*, *Bryum pseudotriquetrum* and others, a grasslike growth of *Schoenus nigricans*, *S. ferrugineus*, *Eriophorum latifolium*, *Carex davalliana*, *C. flava*, *C. lepidocarpa*, *C. hostiana*, *C. panicea*, *Juncus subnodulosus*, *Scirpus cespitosus*, *Eleocharis quinqueflora*, and a very rich flora including *Tofieldia calyculata*, *Dactylorhiza incarnata*, *D. traunsteineri*, *D. traunsteinerioides*, *D. russowii*, *D. majalis* ssp. *brevifolia*, *D. cruenta*, *Liparis loeselii*, *Herminium monorchis*, *Epipactis palustris*, *Pinguicula vulgaris*, *Pedicularis sceptrum-carolinum*, *Primula farinosa*, *Swertia perennis*. Wet grasslands (*Molinietalia caerulea*, 37), tall sedge beds (*Magnocaricion*, 53.2), reed formations (*Phragmites*, 53.1), fen-sedge beds (*Cladietum mariscae*, 53.3), may form part of the fen system, with communities related to transition mires (54.5, 54.6) and amphibious or aquatic vegetation (22.3, 22.4) or spring communities (54.1) developing in depressions. Outside of rich fen systems, fen communities can occur on small surfaces in dune slack systems (16.3), in transition mires (54.5), in wet grasslands (37), on tufa cones (54.121) and in a few other situations. Rich fens are exceptionally endowed with spectacular, specialised, strictly restricted species. They are among the habitats that have undergone the most serious decline. They are essentially extinct in several regions and gravely endangered in most. A very few large systems remain, in particular in pre-Alpine Bavaria, in the Italian pre-Alpes, in collinar and montane eastern France, in north-eastern Germany, in the coastal marshes of northern France, in south-eastern and northern England, in Wales and in Ireland. CORINE 53.3: FEN-SEDGE BEDS;

Cladietum marisci i.a.; *Cladium mariscus*-dominated formations, mostly limited in the northern part of their range, where they have a distinct relict distribution, to alkaline and sometimes acid fens and to the land-building zone of calcareous lakes, somewhat more widespread in the Mediterranean region as a waterside vegetation. Habitata Directive, Natura 2000 code: 7210.

river (gen.), running freshwater: permanent running-water bodies in which the channel is too broad for herb layer vegetation or bushes to form a closed canopy over the water.

river bank (gen.), water edge: the rising land bordering a river channel, subject to periodic inundation by water.

river edge u. canopy, forest supplementary habitat: river margins beneath a tree canopy

rock outcrops in forest, forest supplementary habitats: exposed rock (small cliffs, outcroppings, pavements, occupying 5% or more of ground surface) with sparse and patchy vegetation of vascular plants (i.e. excluding moss cover).

rock outcrops in open, open ground supplementary habitat: exposed rock (small cliffs, outcroppings, pavements, occupying 5% or more of ground surface) with sparse and patchy vegetation of vascular plants (i.e. excluding moss cover)

rockery (or rock garden), urban park: area of natural or introduced bare rock (when constructed, rather than natural, normally composed of large stones/boulders grouped or cemented together) with soil pockets planted with often tussock-forming, low-growing herbaceous plants (frequently alpine in origin, e.g. *Saxifraga*, *Sedum*, *Sempervivum*) or shrubs (e.g. procumbent *Juniperus*). CORINE 85.14: Park flower-beds, arbors and shrubbery

running (gen.), freshwater: this category includes rivers, brooks, springs and flushes (helocrene, limnocrene and rheocrene forms of spring and flush are all included here, for convenience).

running, edge (gen.), water edge: land/water ecotones of rivers and brooks.

Salix (gen.), deciduous plantations: substitution habitat for some riparian forest species of plants and animals. CORINE 83.325: OTHER BROAD-LEAVED TREE PLANTATIONS

Salix, scattered trees in open ground: see scattered trees in open ground (gen.).

Salix swamp (gen.), wet woods: small-willow (*Salix* spp.) dominated wet woodlands of lake edges and seepages/springs on river or brook floodplains, with stands of overmature, mature and young (saplings/scrub) trees (see also under fen carr).

salt marsh (gen.), brackish habitats: CORINE 15: SALT MARSHES, SALT STEPPES AND GYPSUM SCRUBS: Plant communities which are submerged by high tides at some stage of the annual tidal cycle; also continental and coastal halophile and gypsophile communities.

Salzmann's pine forest, conifer forest: *Pinus nigra v. salzmanni* forests of Spain and southern France. CORINE 42.631: Causses Salzmann's pine forest, of the southern edge of the Massif Central, with an undergrowth typical of supra-Mediterranean white oak forest at the upper limit and of evergreen oak forest at lower altitudes; *Buxus sempervirens* is usually abundant. Usually rather open pine forest on very dry, calcareous sites, maintained by occasional fires that

the pines survive but other trees do not, so that various deciduous and broadleaved, evergreen species form a maquis-like understorey and there is also a well-developed garrigue vegetation.

sand/gravel, river edge, water edge: sparsely vegetated sandy/gravelly margins of rivers.

saplings, forest: stands of young trees which have not reached maturity or a height to create closed canopy conditions

scattered trees in open ground (gen.): individual mature or overmature trees, isolated from one another, or occurring only in scattered clumps or lines, or as occasional outstanding trees in hedgerows. These trees mostly require consideration according to their genera so that they appear as a series of categories: *Fagus*, *Quercus*, *Fraxinus*, other hardwood genera, *Populus*, *Salix*, conifers.

scrub/thickets (gen.): thickets encompassing scrub formations of the phytosociological units *Prunetalia* on rich and poor soils: CORINE 31.81, 31.83; gorse thickets with *Ulex europaea*: CORINE 31.85 and alpine scrub: CORINE 31.5, 31.611. CORINE 31.5: DWARF MOUNTAIN PINE SCRUB; *Mugo-Rhodoretum hirsuti*. *Pinus mugo* brushes of well-drained, often calcareous, soils in the Alps and Apennines, frequently accompanied by *Rhododendron hirsutum*, *Erica herbacea*, *Arctostaphylos uva-ursi*, *A.alpina*, *Rhodothamnus chamaecistus*. CORINE 31.611: alpine green alder scrub, *Alnetum viridus*. Green alder (*Alnus viridis* ssp. *viridis*) dominated formations, rich in tall herbs, of slopes with a good water-holding capacity, mostly on siliceous soils, in the subalpine and lower alpine belts of the Alps. CORINE 31.81: MEDIO-EUROPEAN RICH-SOIL THICKETS; *Prunetalia*: *Pruno-Rubion fruticosi* p., *Berberidion*; Thickets of *Prunus spinosa*, *P. mahaleb*, *Rosa* spp. *Cornus mas*, *C. sanguinea*, *Sorbus aria*, *Crataegus* spp., *Lonicera xylosteum*, *Rhamnus catharticus*, *R. alpinus*, *Clematis vitalba*, *Ligustrum vulgare*, *Viburnum lantana*, *V. opulus*, *Rubus* spp., *Amelanchier ovalis*, *Cotoneaster integerrimus*, *C. nebrodensis*, *Pyrus pyraeaster*, *Malus sylvestris*, *Euenymus europaeus*, *Corylus avellana*, *Ulmus minor*, *Acer campestre*, *A. monspessulanum*, *Carpinus betulus* characteristic of forest edges, hedges and (mostly *Carpinion* or *Quercion pubescenti-petraeae*) woodland recolonization, developed on soils relatively rich in nutrients, neutral or calcareous. CORINE 31.83: ATLANTIC POOR SOIL THICKETS; *Prunetalia* p.: *Pruno-Rubion fruticosi* p.: *Frangulo-Rubion* (*Rubion subatlanticum*; *Franguletalia*); Thickets of *Rubus* spp., *Frangula* *Alnus*, *Sorbus aucuparia*, *Corylus avellana*, *Lonicera periclymenum*, *Cytisus scoparius*, characteristic of forest edges, hedges and (mostly *Quercion*) woodland recolonization developed on soils relatively poor in nutrients, usually acid, mostly under climates with strong Atlantic influence. CORINE 31.85: GORSE THICKETS; *Ulex europaeus* thickets of the Atlantic domain (including British *Ulex europaeus-Rubus fruticosus* scrub p.)

seasonal brook, running, freshwater: shallow, ground-water fed brooks flowing continuously autumn/spring, when the ground-water levels are high, but only intermittently at other times of the year (presence of these features may be difficult to detect when they are not flowing). This category does not include torrents (temporary streams dependent primarily upon snow melt, that normally flow for only a short period in each year, but with great vigour)

seasonal brook in cultures, cultures supplementary habitat: shallow, ground-water fed brooks flowing autumn/spring, when the ground-water levels are high, but not usually throughout the year (presence of these features may be difficult to detect when they are not flowing). In

cultures, seasonal brooks are normally canalised and resemble ditches. They differ from ditches in that they flood from groundwater sources as well as from surface run-off.

seasonal brook in forest, forest supplementary habitat: shallow, ground-water fed brooks flowing in forest autumn/spring, when the ground-water levels are high, but not usually throughout the year (presence of these features may be difficult to detect when they are not flowing)

seasonal brook in open, open ground supplementary habitat: shallow, ground-water fed brooks flowing in open ground autumn/spring, when the ground-water levels are high, but not usually throughout the year (presence of these features may be difficult to detect when they are not flowing)

seasonal flower bed, urban park: area of rotovated, or otherwise maintained bare ground, into which has been planted various herbaceous plants with decorative flowers, the plants usually being replaced a number of times during any one year, in order to maintain a display of flowers for as long a season as possible. CORINE 85.14: Park flower-beds, arbors and shrubbery

semi-permanent flower bed, urban park: area of rotovated, or otherwise maintained bare ground, into which has been planted either tall, perennial herbaceous plants (e.g. *Iris*, *Narcissus*) or small shrubs (e.g. *Erica*, *Lavandula*, *Rosa*) that are left in place for more than one year, often acting as an edging or backdrop to a seasonal flower bed, or as a hedge or path border. CORINE 85.14: Park flower beds, arbors and shrubbery

sheep, heavily-grazed improved grassland: cropping of ground vegetation by sheep throughout the growing season, resulting in reduction in general sward height to less than 2cm.

shingle beaches, coastal beaches: CORINE 17.1, 17.2, 17.3. CORINE 17.1: UNVEGETATED SHINGLE BEACHES: Shingle beaches devoid of phanerogamic vegetation. Mediolittoral (intertidal) and supralittoral invertebrate communities can be used to define subdivisions. CORINE 17.2: SHINGLE BEACH DRIFT LINES; *Cakiletea maritima* p.; Formations of annuals occupying accumulations of drift material and gravels rich in nitrogenous organic matter; characteristic are *Cakile maritima*, *Salsola kali*, *Atriplex* spp. (particularly *A. glabriuscula*), *Polygonum* spp., *Euphorbia peplis*, *Mertensia maritima*, *Glaucium flavum*, *Matthiola sinuata*. CORINE 17.3: SEA KALE COMMUNITIES; *Honkenyo-Crambion*; Halo-nitrophilous perennial vegetation of the upper beach formed by *Crambe maritima*, *Honkenya peploides* and species characteristic of the regional communities as indicated below.

shrubby/hedge, urban park: stands or hedges of usually broad-leaved, evergreen, shrubs of 1-3m height, with dense, ornamental foliage and/or ornamental flowers (e.g. *Buxus*, *Laurus*, *Ligustrum*, *Prunus laurocerasus*, *Rhododendron*, *Viburnum tinus*). CORINE 85.14: Park flower beds, arbors and shrubbery

small open area with flushes in forest, forest supplementary habitats: glades and small clearings within forest, containing helocene groundwater outflows and usually with a ground cover of tall-herb communities (see under tall herb communities), though sometimes predominantly grassy with *Juncus* and or *Carex* spp.

softwood, alluvial forests : formations of *Salicetea purpureae* and *Pupuletalia albae* subject to periodic flooding, with stands of overmature, mature and young (saplings/scrub) trees: CORINE 44.1. Temporary pools are features intrinsic to this habitat category. CORINE 44.1: RIPARIAN WILLOW FORMATIONS; *Salicetea purpureae*; *Populetalia albae* p.; *Salix* spp. brush or arborescent formations, lining flowing water and submitted to periodic flooding. Habitats Directive Natura 2000 code: 91E0 (see also under gallery softwood forest).

Spartina beds, saltmarsh: perennial, pioneer cordgrass (*Spartina*) grasslands of coastal salt muds: CORINE 15.2. CORINE 15.2: CORDGRASS SWARDS; *Spartinion maritimae*; perennial pioneer *Spartina* grasslands of coastal salt muds.

spring/flush (gen.), running freshwater: running water outflows at their point of emergence above ground. CORINE 54.1: SPRINGS. For convenience helocrene features (flushes and seepages) are included under this general category, with limnocrene and rheocrene springs. This category includes CORINE 54.12: petrifying springs with tufa formations (Natura 2000 category code 7220). CORINE 54.1: *Montio-Cardaminetea* i.a.; gushing spring (rheocrenes), springs basins (limnocrenes) and seepages (helocrenes) and the communities closely associated with them and dependent on the peculiar microclimatic and hydrological situation created by the spring. These comprise the specialised spring communities (*Montio-Cardaminetea*) as well as the fen communities (*Caricetalia davallianae*, 54.2, *Caricetalia fuscae*, 54.4) or other communities (*Caricion bicoloris-atrofuscae*, 54.3, *Festuco-Brometea*, 34.3) that are interwoven with them. CORINE 54.12: Hard water springs with active formation of travertine or tufa. These formations are found in such diverse environments as forests or open countryside. They are generally small (point or linear formations) and dominated by bryophytes (*Cratoneurion commutati*).

spring in forest, forest supplementary habitat: limnocrene and rheocrene springs emerging within forests, under the tree canopy.

spring in open ground, open ground supplementary habitats: limnocrene and rheocrene springs emerging in open ground.

spring in wetland, wetland supplementary habitat: limnocrene and rheocrene springs emerging within wetlands.

standing (gen.), freshwater: lakes, pools and ponds (reservoirs are not covered), including temporary standing-water bodies (e.g. turloughs): CORINE 22. CORINE 22: STANDING FRESH WATER; lakes, pools of natural origin, containing fresh (i.e. non-saline) water; man-made fresh water bodies, including ponds, reservoirs and canals.

standing, edge, (gen.), edge of freshwater: land/water ecotones of permanent standing water bodies.

tall herb clearings/tracksides in forest, forest supplementary habitats: tall herb-rich communities of open areas and tracksides within forest, largely excluding thermophilous forest fringe vegetation (CORINE 34.4) and humid tall herb communities (CORINE 37.71), but including the communities of usually large-leaved herbs developing along woodland edges, with *Galium aparine*, *Glechoma hederacea*, *Geum urbanum*, *Aegopodium podagraria*, *Silene dioica*, *Carduus crispus*,

Chaerophyllum hirsutum, *Lamium album*, *Alliaria petiolata*, *Lapsana communis*, *Geranium robertianum*, *Viola alba*, *V.odorata* (CORINE: 37.72). Also included here are tall herb communities colonising medio-European and sub-Mediterranean deciduous or coniferous woodland clearings, clear-felled or burnt areas (CORINE: 31.87): *Epilobion angustifolii* and *Antropion*.

tall herb communities: CORINE 37.1, 37.7, 37.8. Formations of tall herbs in lowland, humid grassland, montane/subalpine grassland and alluvial sites, and edging rivers and streams, excluding reed and tall sedge beds (CORINE 53.1-3).

tall sedges: CORINE 53.2, 53.3. CORINE 53.2: LARGE SEDGE COMMUNITIES; *Magnocaricion*; Formations of large Cyperaceae of genera *Carex* or *Cyperus* occupying the edge or the entirety of humid depressions, oligotrophic mires and rich fens, on ground that can be dry for part of the year. They occur, in particular, on the landward side of reedbeds in waterside successions and as colonists of humid depressions on mineral soils, or of acid and alkaline fens. CORINE 53.3: FEN-SEDGE BEDS; *Cladietum marisci* i.a; *Cladium mariscus*-dominated formations, mostly limited in the northern part of their range, where they have a distinct relict distribution, to alkaline and sometimes acid fens and to the land-building zone of calcareous lakes, somewhat more widespread in the Mediterranean region as a waterside vegetation.

temp. pool, standing freshwater: 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. CORINE 22.5, in part (?). Deep, temporary lakes, which would be included in the turlough category, are not covered by the interpretation of temporary pools used here, since many of the syrphid species associated with small, shallow, temporary pools cannot validly be predicted to occur in association with deep turloughs. CORINE 22.5: bodies of water that are completely and recurrently emptied of water for part of the time, such as Irish turloughs. This definition seems to imply that the small, temporary pools that occur seasonally all over Europe are not included in this CORINE category. If so, then the CORINE category 22.5 does not coincide with the interpretation of temporary pool used here and should not be used to link this category to the CORINE system. Turloughs: Natura 2000 code 3180: temporary lakes principally filled by subterranean waters and particular to karstic limestone areas in Ireland. Most flood in the autumn and then dry up between April and July. However, some may flood at any time of the year. The soils are variable, including limestone bedrock, marls, peat, clay and humus, while aquatic conditions range from ultra oligotrophic to eutrophic. The vegetation mainly belongs to the alliance *Lolio-Potentillion anserinae* Tx.1947, but also *Caricion davallianae* Klika 1934.

temp pool/edge perm.pool with cow dung, in open, open ground supplementary habitats: edges of temporary pools or of permanent pools or ponds in open ground, visited by cows or cattle, so that the strip of water-logged ground at the water margin is both trampled and enriched by cow dung.

temp.pool in open ground, open ground supplementary habitats: small temporary water bodies of natural origin, flooded by river overflow, fluctuation in ground-water level, and/or rain or snow melt, and not shaded by a tree canopy.

temp. pool u. canopy, forest supplementary habitat: small temporary water bodies of natural origin, flooded by river overflow, fluctuation in ground-water level, and/or rain or snow melt, and shaded by a tree canopy.

thermophilous forest fringes: woodland edge communities of *Trifolio-Geranieta* forming a belt between mesophilous grassland and shrubby forest mantle: CORINE 34.4. CORINE 34.4: THERMOPHILE FOREST FRINGES; *Trifolio-Geranieta*; Woodland edge (hem) communities of warmth-requiring, drought-resistant herbaceous perennials and frutescent vegetation forming a belt between dry or mesophile grasslands and the shrubby forest mantle, on the sunny side, where the nutrient supply is limited, or, sometimes, pioneering the woodland colonisation into grasslands.

thermophilous Quercus (gen.), deciduous forests: dry oak forests (*Quercetalia pubescenti-petraeae*), with stands of overmature, mature and young (saplings/scrub) trees: CORINE 41.7. CORINE 41.7: THERMOPHILOUS AND SUPRA-MEDITERRANEAN OAK WOODS; *Quercetalia pubescenti-petraeae*; forests or woods of sub-Mediterranean climate regions and supra-Mediterranean altitudinal levels, dominated by deciduous or semi-deciduous thermophilous oak species; they may, under local microclimatic or edaphic conditions, replace the evergreen oak forests in meso-Mediterranean or thermo-Mediterranean areas, and irradiate far north into medio-European or sub-Atlantic regions.

transit. mire, wetlands: transition mire, wetland type intermediate between fen and bog: CORINE 54.5. CORINE 54.5: TRANSITION MIRE; *Scheuchzerietalia palustris*; *Caricion lasiocarpae*, *Rhynchosporion albae p. i.a.*; Wetlands mostly or largely occupied by peat-forming plant communities developed at the surface of oligotrophic or meso-oligotrophic water reaching a level above, sometimes well above, the substratum, providing little or no mineral or nutrient supply. Their characteristics are thus intermediate between those of soligenous and topogenous mires and those of strictly ombrogenous bogs. In large systems, the most prominent communities are swaying swards, floating carpets or quaking mires formed by medium-sized or small sedges, associated with sphagnum or brown mosses. They are accompanied by aquatic and amphibious communities (22.3, 22.4) and by formations transitional to these on the one hand, to fens (54.2, 54.4), bogs (51.1) or humid grasslands (37) on the other; sphagnum buttes (51.11), in particular, are often an important feature. Tall sedge and reed communities (53), willow and alder carrs (44) invade part of the peatland. Transition mires form mostly as colonists of oligotrophic ponds and lakes, large bog pools or lags. Their distribution is mostly northern peri-Alpine, peri-Hercynian and northern European. Outside of transition mire systems, their communities can be found in bog hollows (51.12), in blanket bogs (52), in depressions of rich or acidic fens (54.2, 54.4), in spring systems (54.1), in humid heaths (31.1) and a few other habitats. Characteristic species include *Eriophorum gracile*, *Carex lasiocarpa*, *C.chordorrhiza*, *C.limosa*, *Scheuchzeria palustris*, *Hammarbya paludosa*, *Liparis loeselii*, *Calla palustris*. Transition mires are an extremely important refuge of specialized, threatened species of both plants and animals; their richness and diversity in remarkable invertebrates, dragonflies among others, is even greater than that of most other mire ecosystems.

tundra (gen.): open, gently undulating ground, treeless due to low prevailing temperatures and, often, permanently frozen subsoil. Vegetated by dwarf ericaceous shrubs (see dwarf-heath definition), dwarf *Betula* and *Salix* spp. (see dwarf *Betula/Salix* scrub tundra definition), *Dryas* mats (see arctic-alpine tundra definition) or palsa mire (see palsa mire definition) communities, dependent upon soil characteristics and exposure. The more exposed elevations are dominated by mosses and lichens. The mires have an abundance of shallow pools and their plant communities vary from those of acid fen to bog.. Palsa mire is here treated as a wetland macrohabitat category.

Ulex thickets, Atlantic scrub: gorse/furze (*Ulex*) thickets: CORINE 31.85 CORINE 31.85: GORSE THICKETS; *Ulex europaeus* thickets of the Atlantic domain (including British *Ulex europaeus-Rubus fruticosus* scrub p.)

understorey trees, urban park: individuals or stands of small, usually deciduous trees, with ornamental blossoms or foliage (e.g. *Crataegus*, *Ilex*, *Laburnum*, *Prunus*, *Robinia*, *Sorbus*). CORINE 85.11: Park woodlots

unimproved grassland (gen.): lightly-grazed grassland (i.e. grassland cropped sufficiently to result normally in dominance by grasses, inhibition of extensive scrub cover and a sward height greater than 10cm) which is not fertilised or cultivated and not subject to reseeding or to systematic removal of loose, surface stones. Modification of species-association coding dictated by heavy grazing (i.e. reduction in general sward height to less than 5cm) can be achieved by reference to the "heavy grazing, cattle" and "heavy grazing, sheep" categories in the Farm Management operations impacts spreadsheet.

unvegetated water feature, urban park: constructed (or much modified) standing/slow moving body of water, often shallow (depth no more than 1m), with a solid (e.g. concrete or rock), unvegetated margin and an absence of aquatic macrophytes. CORINE 85.13: Park basins

urban parks: CORINE 85.1: LARGE PARKS; Large, varied green spaces. Their constituting elements can be specified by use of the codes below: 85.11 Park woodlots; 85.12 Park lawns; 85.13 Park basins; 85.14 Park flower beds, arbors and shrubbery.

vegetated water feature, urban park: constructed (or much modified) standing/slow moving body of water, often shallow (depth no more than 1m), with at least an edging of planted or spontaneous emergent hydrophytes or tall-herb vegetation. CORINE 85.13: Park basins

water edge (gen.): this general category addresses the ecotone situations occurring between freshwater and terrestrial environments.

water feature (general), urban park: constructed (or much modified) standing/slow moving body of water, often shallow (depth no more than 1m), with or without planted or spontaneous emergent hydrophytes or tall-herb vegetation. This category includes linear features, like permanently water-filled channels/ditches, but excludes fountains. CORINE 85.13: Park basins

western taiga, coniferous forest: northern conifer forest dominated by *Pinus sylvestris*, in which *Picea abies* and *Betula* species may also occur, with a shrub layer of dwarf ericaceous shrubs e.g. *Empetrum nigrum*, *Ledum palustre*, *Vaccinium vitis-idaea*, and a ground layer dominated by bog mosses in wetter places and by *Cladonia* and *Cetraria* lichens in drier, more northern areas. This

category includes the forest stages developing after fires, which are natural to these forests (though rare today due to human influence). Large quantities of dead, burned wood are typical for burned areas. This category does not include *Betula* or *Picea*-dominated locations - these should be treated as *Betula* forest or *Picea* forest (respectively). Habitata Directive, Natura 2000 code: 9010

wet woods (gen.): tree and shrub vegetation of marshes, fens and bogs, with stands of overmature, mature and young (saplings/scrub) trees (CORINE 44). Encompassing very wet swampy woods: CORINE 44.A, 44.91. CORINE 44: ALLUVIAL AND VERY WET FORESTS AND BRUSH; Tree and shrub vegetation of flood plains, marshes, fens and bogs. CORINE 44.A: BIRCH AND CONIFER SWAMP WOODS; *Vaccinio-Piceetea*: *Piceo-Vaccinienion uliginosi* (*Betulion pubescentis*, *Ledo-Pinion*) i.a. Woods of *Betula pubescens*, *Pinus* spp. or *Picea abies* colonizing bogs and acid fens. CORINE 44.91: ALDER SWAMP WOODS; *Carici elongatae-Alnetum* (*Irido-Alnenion*); Mesotrophic and meso-eutrophic *Alnus glutinosa* swamp woods of marshy depressions, with *Carex elongata*, *Thelypteris palustris*, *Dryopteris cristata*, *Osmunda regalis*, *Solanum dulcamara*, *Calystegia sepium*, *Ribes nigrum*, and often, in acidocline variants, *Betula pubescens*. The constancy of *Carex paniculata*, *C.acutiformis*, *C.elata*, often dominates the herb layer in the most humid types.

wetland macrohabitats: land on which either surface water (standing or running) or water-logged conditions persist throughout, or during a substantial part of, the year.

xeric/semi-arid (gen.), lowland unimproved grassland: unimproved, very dry grasslands. CORINE 34.1; 34.3 (except 34.313-4, 34.321); 34.5; 34.71-2. (CORINE categories 34.6; 34.73-75 and 34.8 are not covered by the database).

APPENDIX 4: HABITAT SURVEY FORM

SITE NAME:

LOCATION:

SAMPLE STATION:

DATE OF HABITAT SURVEY:

CODE NUMBER OF HABITAT OBSERVED	CODE NUMBERS OF ASSOCIATED SUPPLEMENTARY HABITATS

APPENDIX 5: SUMMARY TABLE OF MICROSITE FEATURE CATEGORIES

LARVAL ACTIVITY ZONE: TERRESTRIAL	
Plants (gen.)	
	Trees (gen.)
	Foliage (gen.)
	Overmature/senescent trees (gen.)
	trunk cavities
	rot-holes
	insect workings
	sap runs/lesions
	loose bark
	Mature trees
	Understorey trees
	Shrubs/bushes/saplings (gen.)
	Tall shrubs
	Low shrubs
	Upward climbing lianas
	Herb layer (gen.)
	On herb layer plants (gen.)
	tall strong herbs
	low-growing plants
	tussocks
	In herb-layer plants (gen.)
	in leaves/stems
Timber (gen.)	
	Standing
	Fallen (gen.)
	with bark
	no bark
	Stumps
Ground surface debris (gen.)	
	Dung (gen.)
	cow dung
	cow manure
	Compost
	Litter (gen.)
	forest
	herb layer
	Stones
Nests of social insects (gen.)	
	in trees
	in timber
	ground level
<i>Hypogeon</i>	
Root zone (gen.)	
	Rotting tree roots
	Grass-roots
	With root aphids
	Bulbs/tubers

	Stem bases	
LARVAL ACTIVITY ZONE: AQUATIC		
Water plants (gen.)		
	Emergent (gen.)	out of water
		at surface
		below surface
	Floating	
	Submerged	
Submerged sediment/debris (gen.)		
	Fine sediment (gen.)	sand
		mud/ooze
		organic detritus
	Coarse sediment (gen.)	dead wood
		twigs
		non-woody plant debris
Water-saturated ground (gen.)		
	Wet mud/ooze	
	Peat (gen.)	
	Sodden plant debris (gen.)	timber
		twigs
		non-woody
	Sodden cow-dung	
HIBERNATION/OVERWINTERING ZONE		
Above ground surface (gen.)		
	Trees (gen.)	Rot-holes
		Rotten wood
		Under bark
	Plant stems	
Timber (gen.)	Standing	
	Fallen	
Ground surface (gen.)		
	Tussocks	
	Litter (gen.)	herb layer litter
		Forest litter
	Under stones/boulders	
Root zone (gen.)		
	Bulbs/stem bases	
	Rotten tree roots	

	Crevices/tunnels
Water-saturated ground (gen.)	
	Wet mud/ooze
	Peat
	Plant debris
Nests of social insects	
In water (gen.)	
	Submerged plants
	Submerged debris
	Bottom sediments
SOIL/WATER CONDITIONS	
Soil drainage	
	Poorly drained/gleyed
	Freely draining
Water trophic status	
	Oligotrophic
	Mesotrophic
	Eutrophic
Water movement	
	Slow moving
	Standing

APPENDIX 6: GLOSSARY OF MICROSITE FEATURE CATEGORIES

above ground surface (gen.), hibernation/overwintering: self explanatory.

larval activity zone: the habitat strata and microsites within which the larvae occur. The data for hibernation/overwintering periods is coded separately, under "hibernation/overwintering" and refers to the overwintering stage of the life cycle.

aquatic, larval activity zone: microsite features occurring within surface water or groundwater. Larvae living in water in rot-holes in the trunks etc. of living trees are not coded under the aquatic activity zone. They are coded under rot-holes, in the terrestrial activity zone.

at surface, emergent, water plants: on emergent water plants, at, or within a centimetre from, the surface of the water.

below surface, emergent, water plants: on parts of emergent water plants below the water surface.

bottom sediments, in water, hibernation/overwintering: in surface layers of bottom sediments of temporary or permanent water bodies.

bulbs/stem bases, in the root zone, hibernation/overwintering: within the tissues of bulbs or corms, swollen stem bases, tubers or root stocks of herbaceous plants.

bulbs/tubers, root zone: within the tissues of bulbs, tubers or corms.

coarse sediment (gen.), submerged sediment/debris: in mineral or organic sediment or debris with a mineral particle size above 2mm. Organic material included is predominantly above 1mm in size and frequently includes much larger fragments.

compost, ground surface debris: a man-made, heaped, usually moist, accumulation of (predominantly non-woody) plant debris and soil left to rot down to provide an enriched medium for growing vegetables or other plants

cow dung, ground surface debris: in cow-dung in grassland or forest (see also sodden cow-dung)

cow manure, dung: a mixture of cow-dung and straw, traditionally left in heaps (a practice now decreasing due to concerns over environmental pollution) in farmland to rot, after removal from cow-houses and prior to being spread on fields

crevices/tunnels, root zone, hibernation/overwintering: in crevices/tunnels in the plant-root zone of soils, caused mainly by actions of small mammals, earthworms or the rotting of plant roots.

dead wood, coarse sediment, submerged sediment/debris: large pieces of floating or submerged dead wood, such as sections of trunk or major branches.

dung (gen.), among/under surface debris: the dung of mammals, both predatory and herbivorous.

emergent, water plants (gen.): bottom rooting perennials (helophytes) such as *Phragmites australis*, *Scirpus*, *Alisma*, *Iris*, *Typha*.

eutrophic, water trophic status: waters rich in the mineral nutrients required by green plants, and so having high primary production.

fallen (gen.), timber: in fallen dead trunks and/or large branches of trees.

- fallen**, timber, hibernation/overwintering: in fallen dead trunks and/or large branches.
- fine sediment** (gen.), submerged sediment/debris: in mineral or organic sediment with a mineral particle size below 2mm and organic particles predominantly below 1mm..
- floating**, water plants: among or attached to floating parts of aquatic plants.
- foliage** (gen.), trees: leaves and twigs of deciduous or coniferous trees. Foliage of any type or age of tree, shrub and woody bush is included here.
- forest litter**, among/under surface debris: non woody plant debris on the forest floor and small woody debris, e.g. twigs, fir cones, fragments of bark.
- forest litter**, on the ground, hibernation/overwintering: among non woody plant debris and/or small woody debris (e.g. twigs, fir cones, fragments of bark) on the forest floor.
- freely draining**, soil drainage: soils in which the free downward passage of water from the soil surface is not impeded.
- grass-root zone**, root zone: among roots of grasses or herbs in non-forest situations.
- ground level**, in nests of social insects: in nests of aculeate Hymenoptera on, or just under, the ground surface, including the mound nests of certain ants (Formicidae).
- ground surface debris** (gen.): living among or under plant remains and/or isolated stones on the ground surface. Twigs and similar small woody debris are covered by this category, but large woody debris is not. It is covered by the "Timber" category.
- ground surface** (gen.), hibernation/overwintering: under or in terrestrial ground surface microhabitats.
- herb layer** (gen.), on/in plants: ground-living, non-woody plants (including basidiomycete fungi).
- herb layer litter**, on the ground, hibernation/overwintering: among non-woody plant debris in terrestrial, non-forested situations.
- herb layer litter**, among/under surface debris: among non-woody plant debris in non-forested situations.
- hibernation/overwintering zone**: the habitat strata and microsites used for shelter from winter weather conditions by syrphids (mostly as larvae: to see in which life-cycle stage a species overwinters, see Traits spreadsheet).
- in herb layer plants** (gen.), in/on plants: living in the tissues of ground-living, non-woody plants.
- in leaves/stems**, in herb layer plants: living in the tissues of leaves or stems of low-growing, non-woody plants, above the ground surface.
- insect workings**, overmature/senescent trees: wet/humid tunnels made through wood by other insects, especially cerambycids, scolytids or *Cossus* (Cossidae), usually with insect faeces (partially-digested wood) and seeping sap.
- in standing water**, water movement: self-explanatory.

in timber, in nests of social insects: in aculeate nests in fallen or standing stumps, trunks or fallen big branches of dead trees.

in trees, in nests of social insects: self explanatory.

in water (gen.), hibernation/overwintering: in permanent or temporary water bodies, on submerged parts of plants, among submerged debris or in bottom mud. Aquatic, tree rot-hole dwelling larvae of Syrphidae are not coded under this category. They are coded under rot-holes.

litter (gen.), among/under surface debris: organic debris on the ground surface (rubbish left by man excluded).

litter (gen.), on the ground, hibernation/overwintering: organic debris on the ground surface (rubbish left by man excluded).

loose bark, overmature/senescent trees: under loose bark.

low shrubs/bushes/saplings: woody plants up to the height of 0.5 m, e.g. *Vaccinium*, *Calluna*, *Salix repens*.

low-growing plants, on herb layer plants: ground-living, non-woody flowering plants up to 0.5m in height.

mature trees: trees that have reached the age of fructification without yet developing the features described under "overmature/senescent".

mesotrophic, water trophic status: waters having intermediate levels of mineral nutrients required by green plants, and so having an intermediate level of primary production.

mud/ooze, fine sediment, submerged sediment/debris: in organo-mineral substrates composed of silt, clay and organic matter in varying proportions, with the maximum grain size of the mineral fraction below 0.06 mm.

nests of social insects (gen.): in nests of aculeate Hymenoptera; ants (Formicidae), wasps (Vespidae) or bumble bees (*Bombus*).

nests of social insects, hibernation/overwintering: in nests of aculeate Hymenoptera; ants (Formicidae), wasps (Vespidae) or bumble bees (*Bombus*).

no bark, fallen (timber): self-explanatory.

non-woody, plant debris, coarse sediment, submerged sediment/debris: among/in decaying stalks and leaves of higher plants.

non-woody, odden plant debris: among/in sodden, decaying stalks and leaves of higher plants, including compost heaps, manure and silage.

twigs, sodden plant debris: among small diameter (twigs, bark fragments etc.) woody plant debris.

oligotrophic, water trophic status: waters having low levels of mineral nutrients required by green plants, and so having low primary production.

on herb layer plants, in/on plants: living on the surface of ground-living, non-woody plants.

plants (gen.): the parts of living plants on, or in, which the larvae live are categorised here. Vegetative and reproductive parts are included, as are both soft and woody tissues. For convenience, epigeal dead woody material is also categorised under this heading.

on/in timber (gen.) (hibernation/overwintering): overwintering on, in or under tree stumps, dead standing or fallen trunks or fallen major branches.

organic detritus, fine sediment, submerged sediment/debris: in fine (0.045 - 1mm) particulate organic material. At one extreme, this includes bottom sediments of water bodies in peat.

out of water, emergent, water plants: on the parts of emergent water plants projecting above the water surface.

overmature/senescent trees (gen.): the term overmature tree is not applied here as in commercial forestry, i.e. a tree which has exceeded the age at which it would normally be harvested. Here an overmature/senescent tree is taken to be one on which microhabitats for saproxylic organisms have developed. As a generality, such trees are significantly older than those which would be regarded as overmature by foresters.

peat, water-saturated ground: in water-logged surface peat layers of wetlands.

plant debris, water-saturated ground, hibernation/overwintering: water-sodden remains of macrophytes, including non-woody and small woody material.

plant stems, above ground surface, hibernation/overwintering: in hollow, standing stems of dead plants or between plant stem and leaf sheath. This category includes species overwintering in these situations on emergent parts of plants in water, for example, standing dead *Phragmites* or *Typha*.

poorly drained/gleyed, soil drainage: soils in which the free downward passage of water is to a significant extent prevented or impeded, such that a perched water-table can occur.

proximity to surface water: species are coded here according to whether or no they occur in terrestrial/freshwater ecotones.

root zone (gen.): the root zone of herb-layer plants.

root zone (gen.), hibernation/overwintering: in the root zone of herb-layer plants (excluding situations where the root zone is water sodden) or in rotting tree roots.

rot-holes, trees, activity and hibernation/overwintering zones: dendrothelmic tree holes (a dendrothelm is a rain-fed temporary water body on a tree).

rotten wood, trees, hibernation/overwintering: in rotten wood on living trees, including in trunk cavities and insect workings.

rotting tree roots, hibernation/overwintering: within rotting tree roots at/under the ground surface.

rotting tree roots, root zone: within rotting tree roots at/under the ground surface.

sand, fine sediment, submerged sediment/debris: in submerged mineral substrates, ranging in size from 0.06 to 2 mm.

sap runs/lesions, overmature/senescent trees: wet tree wounds maintained by sap and/or the activities of fungi or saproxylic invertebrates. These have a variety of origins, including mechanical damage caused by man or storms, or fire, and may or may not be evident externally.

shrubs/bushes/saplings (gen.), trees, on/in plants: on shrubs, bushes or young trees.

slow moving, water movement: in lentic zones of running waters with a current velocity below 25 cm/s.

sodden cow-dung, water-saturated ground: cow-dung on water-saturated mud or in water-sodden plant debris/ground vegetation

sodden plant debris (gen.), water-sodden ground: among water sodden remains of macrophytes, including non-woody and small woody material.

soil drainage: only two very broad categories of soil drainage conditions are distinguished here, relating to the extent to which the soil surface layers are pervious or impervious. Species whose larvae or puparia do not spend some phase of their life history in either the litter layer or the root zone are not coded for soil drainage categories.

standing, timber: in standing trunks or stumps of dead trees with or without bark.

standing, water movement: in waters with either slight water movements not affecting the stability of the sediment (e.g. at the margin of reed beds) or with no detectable water movement.

stem bases, root zone: in swollen stem bases or root stocks of herbaceous plants.

stones, among/under surface debris: isolated pieces of rock, ranging in size from 64 to 256 mm, lying on the ground surface in more or less vegetated, non-forested situations.

stumps, timber: the *in situ* trunk base remaining after a tree has either been cut or broken off within one metre or so of the ground surface.

submerged, water plants: submerged moss or rooted macro-vegetation such as *Potamogeton*, *Calitriche*, or *Ranunculus*, together with Characeae and non-rooted macro-vegetation (*Utricularia*).

submerged debris, in water, hibernation/overwintering: among submerged plant debris, including small diameter woody debris, e.g. twigs.

submerged plants, in water, hibernation/overwintering: in or on submerged parts of aquatic perennials.

submerged sediment/debris (gen.): in/among permanently submerged sediment or debris in running or standing waters.

tall shrubs/bushes/saplings: woody plants between the heights of 0.5 and 2m, e.g. *Ligustrum vulgare*, *Viburnum*, *Rubus* and young trees (saplings).

- tall strong herbs**, on herb layer plants: plants such as *Urtica dioica*, *Impatiens*, *Solidago* or *Petasites albus*, on wetter sites including helophytes such as *Iris palustris* .
- terrestrial**, larval activity zone: this term is used in contradistinction to "aquatic". Sub-aquatic categories are dealt with as "aquatic" categories.
- timber** (gen.), activity and hibernation/overwintering zones: in standing or fallen dead wood. This category does not refer to dead wood still attached to living trees.
- timber**, sodden plant debris: water-logged, fallen trunks or major branches of trees.
- trees** (gen.), activity zone and hibernation/overwintering zone: only tree features important for syrphids are included here: overmature/senescent trees, mature trees, shrubs/bushes/saplings, understorey trees, foliage and subcategories of these. Dead tree features are dealt with separately (see timber category).
- trunk cavities**, overmature/senescent trees: large dry tree holes formed in the trunk of living trees.
- tussocks**, hibernation/overwintering: in tussocks formed by grasses, sedges or rushes, or in moss hummocks.
- tussocks**, on herb layer plants: on/within tussocks formed by grasses, sedges and rushes (Graminae, Cyperaceae, Juncaceae), or in moss hummocks.
- twigs**, coarse sediment, submerged sediment/debris: among small diameter (twigs, bark fragments etc.) woody plant debris.
- twigs**, sodden plant debris: among small diameter (twigs, bark fragments etc.) woody plant debris.
- under bark**, trees, hibernation/overwintering: under bark of rotting parts of living trees.
- under stones/boulders**, on the ground, hibernation/overwintering: under pieces of rock, ranging in size from 64 mm up to approximately 50 cm, lying on vegetated or unvegetated ground.
- understorey trees**: trees of more than 2m in height which, at maturity, reach the height of e.g. *Crataegus* , *Juniperus communis*, *Sorbus aucuparia*, or are immature specimens of canopy-forming species. These trees may form a shade-tolerant stratum within a forest canopy or occur away from forest conditions.
- upward-climbing lianas**, on/in plants: woody or herbaceous plants climbing 2m or more above the ground surface on trees.
- water movement**: rate of flow of surface water (species living in tree rot-holes are not coded under water movement).
- water plants** (gen.): on or in higher plants living entirely or partly in water, including floating, submerged and emergent species.
- water-saturated ground** (gen.), hibernation/overwintering: in situations where the surface layer of the soil is permanently or temporarily (at least for some weeks) water-logged.

water-saturated ground (gen.): in a permanently or temporarily (at least for some weeks) water-logged soil surface layer. Aquatic/semi-aquatic syrphid larvae living in tree humus in rot holes are not coded in this category. They are coded under rot-holes.

water trophic status: the terms olig-, meso- and eutrophic are here used loosely. The description of each trophic category is based on biotic and abiotic features of surface waters recognizable in the field, and/or easily measured parameters (oxygen, pH). They are not based upon the concentrations of total N, P and chlorophyll-a. Species that do not spend some stage of their life history in water are not coded under water trophic status. Neither are species whose larvae live in tree rot-holes.

wet mud (hibernation/overwintering): terrestrial water-logged surface mud.

wet mud/ooze, water-saturated ground: in water-logged surface mud.

with bark, fallen (timber): self-explanatory.

with root aphids, root zone: in association with colonies of root aphids (usually tended by ants).

APPENDIX 7: SUMMARY TABLE OF RANGE, STATUS AND DISTRIBUTION SPREADSHEET CATEGORIES

1. NOMENCLATURE AND TAXONOMY

Checklist of Irish Syrphidae

last nomenclatural update

taxonomic status

2. RANGE

World Range

- Afrotropical Region
- Australasian/Oceanian Region
- Nearctic Region
- Neotropical Region
- Oriental Region
- Palearctic Region

European Range

- Alpine region
- Atlantic region (gen.)
- Continental region
- Macaronesian region
- Mediterranean region
- Northern region
- other

European States and other entities

- Austria
- Belgium
- Czech Republic
- Denmark
- Faroes
- Estonia
- Finland
- France (gen.)
 - North-west
 - Alsace/Vosges
 - Central
 - South-west
 - Corsica
- Germany (gen.)
- N Germany (gen.)
 - Schleswig-Holstein
 - Nieder-sachsen & Bremen
 - Mecklenburg-Vorpommern
- S Germany (gen.)
 - Baden-Württemberg
 - Bayern
- Greece
- Hungary
- Iceland
- Ireland (gen.)
- Italy

	Sardinia	
	Sicily	
former Yugoslavia		
	Montenegro	
	Serbia	
Latvia		
Liechtenstein		
Lithuania		
Luxembourg		
Malta		
Netherlands		
Norway		
Poland		
Portugal		
	Azores	
	Madeira	
Republic of Ireland		
Roumania		
Russia (European)		
Slovak Republic		
Slovenia		
Spain		
	Balearic Isles	
	Canaries	
Sweden		
Switzerland (gen.)		
	lowland	
	non-alpine	
	Jura	
Turkey		
United Kingdom (gen.)		
	Britain	
	Northern Ireland	
3. DEGREE OF ENDEMISM		
Extra-European		
European (gen.)		
	Endemic (gen.)	
		localised
4. STATUS		
Europe		
	threatened	
	decreasing	
	unthreatened	
Alpine zone		
	threatened	
	decreasing	
	unthreatened	

Atlantic zone	threatened decreasing unthreatened
Continental zone	threatened decreasing unthreatened
Belgium	threatened decreasing unthreatened
Britain	threatened decreasing unthreatened
Denmark	threatened decreasing unthreatened
France	threatened decreasing unthreatened
Germany	threatened decreasing unthreatened
Ireland	threatened decreasing unthreatened
Netherlands	threatened decreasing unthreatened
5. DISTRIBUTION IN IRELAND	
Universal Transverse Mercator Grid 50km squares	
	MA2
	MA4
	MT1
	MT2
	MT3
	MT4
	MU2
	MU3
	MU4
	MV1

	MV2
	MV3
	MV4
	NA1
	NA2
	NA3
	NA4
	NB2
	NB4
	NT1
	NT2
	NT3
	NT4
	NU1
	NU2
	NU3
	NU4
	NV1
	NV2
	NV3
	NV4
	PA1
	PA2
	PA3
	PA4
	PB2
	PB4
	PT1
	PT3
	PU1
	PU2
	PU3
	PU4
	PV1
	PV2
	PV3
	PV4
	UF1
	UF2
Counties	
	ANTRIM
	ARMAGH
	CARLOW
	CAVAN
	CLARE
	CORK
	DERRY
	DONEGAL
	DOWN

DUBLIN
FERMANAGH
GALWAY
KERRY
KILDARE
KILKENNY
LAOIS
LEITRIM
LIMERICK
LONGFORD
LOUTH
MAYO
MEATH
MONAGHAN
OFFALY
ROSCOMMON
SLIGO
TIPPERARY
TYRONE
WATERFORD
WESTMEATH
WEXFORD
WICKLOW

APPENDIX 8: GLOSSARY OF RANGE, STATUS AND DISTRIBUTION CATEGORIES

afrotropical: the Afrotropical region. Essentially, Africa south of the Sahara desert.

alpine region: the Alpine region of Europe, as understood in the EU Habitats Directive, excluding its Scandinavian part, which is included in the “Northern Region” category used here (see Romau, C., 1996 Interpretation manual of European Union Habitats, version EUR 15, DG XI, EC, 103pp.), plus Liechtenstein and nearly all of Switzerland.

Alps, alpine region: the massif of the Alps, including its valleys, as included in the alpine region defined by the EU Habitats Directive (see Romau, C., 1996 Interpretation manual of European Union Habitats, version EUR 15, DG XI, EC, 103pp.).

Alsace/Vosges, France: that part of north-east France comprising the Départements of Bas-Rhin, Belfort, Haut-Rhin and Vosges.

Atlantic region: the Atlantic region of Europe, as defined by the EU Habitats Directive (see Romau, C., 1996 Interpretation manual of European Union Habitats, version EUR 15, DG XI, EC, 103pp.).

australasian/oceanian: the australasian and oceanian regions treated together.

Austria, European States and other entities: the European State of Austria

Azores, European States and other entities, Portugal: the Macaronesian island archipelago of the Azores (including Faial, Flores, Pico, Santa Maria, São Jorge, São Miguel, Terceira)

Balearic Isles, European States and other entities, Spain: the group of Mediterranean islands comprising Ibiza, Mallorca and Menorca.

Belgium, degree of threat: the European State of Belgium (for Belgium, status is coded for the entire territory of the State).

Britain, European States and other entities: the island of Great Britain.

Canaries, European States and other entities, Spain: the Macaronesian island archipelago of the Canary Isles, including El Hierro, Fuerteventura, Gran Canaria, La Palma, Lanzarote and Tenerife

central France, France: the Départements of Allier, Cher, Cote d'Or, Indre, Indre-et-Loire, Loir-et-Cher, Loiret, Nièvre, Saône-et-Loire and Yonne

Checklist of Irish Syrphidae: names currently in use for Irish Microdontidae and Syrphidae, including taxa of doubtful validity (for a guide to the degree of reliability with which each taxon can be recognised, see "taxonomic status" category)

continental region: the continental region of Europe, as defined by the EU Habitats Directive (see Romau, C., 1996 Interpretation manual of European Union Habitats, version EUR 15, DG XI, EC, 103pp.), plus the Czech and Slovak Republics

Corsica, European States and other entities, France: the Mediterranean island of Corsica

Czech Republic, European States and other entities: the European State of the Czech Republic (including the regions Bohemia and Moravia).

Denmark, European States and other entities: the European State of Denmark, excluding the Faroes, which are treated as a separate geographical entity (see under Faroes).

decreasing: although not yet recognisably threatened, exhibiting a noticeable decrease in numbers of populations and/or range within the geographical area concerned, during the 20th. century.

degree of endemism: the extent to which a species is confined to Europe, as indicated by its geographical range.

degree of threat: extent to which a species is threatened with extinction in the continent of Europe and various subdivisions of Europe, using very generalised threat categories.

Estonia, European States and other entities: the European State of Estonia.

Europe (gen.), degree of threat: extent to which a species is threatened with extinction in the continent of Europe, from the Ural mountains to the Atlantic Ocean.

European (gen.), degree of endemism: a species whose range is predominantly or entirely within Europe.

European endemic (gen.), degree of endemism: a species confined to Europe.

European range: the regions of Europe within which a species is known to occur.

European regions, European range and Degree of endemism: biogeographic regions of Europe as delimited by the EU (see Romau, C., 1996 Interpretation manual of European Union Habitats, version EUR 15, DG XI, EC, 103pp.). As yet, these regions only cover that part of Europe within the EU (see also under Northern region).

European States and other entities, European Range: States, Principalities and other recognisable geographical, or socio-political, units within Europe, including EU Member States. At present, the database does not provide separate categories (i.e. columns) for the syrphid faunas of Austria, Finland, Greece, Italy, Portugal, Spain or Sweden. Recent species lists are either published or in preparation for most of these States, so coverage of their faunas is potentially possible. However, national species lists do not seem to be either available, or in preparation, for either Austria or Greece.

extra-european, degree of endemism: a species whose range is predominantly outside Europe, or as extensive outside Europe as in Europe.

Faroes, European States and other entities, Denmark: the Faroe islands, as depicted by Jensen (2001). The Faroe islands are here treated separately from the rest of the State of Denmark.

Finland, European States and other entities: the European State of Finland.

France, European States and other entities: the European State of France, exclusive of France- Outre-Mer and Corsica.

Germany (gen.), European States and other entities: the European State of Germany (for Germany, status is coded for the entire territory of the State)

Greece, European States and other entities: the European State of Greece, including islands (e.g. Crete, Cyclades, Rhodes & the Dodecanese)

Hungary, European States and other entities: the European State of Hungary

Iceland, European States and other entities: the European State of Iceland

Ireland, European States and other entities: the island of Ireland, including the Republic of Ireland and Northern Ireland (for Ireland, status is coded for the entire island).

Italy, European States and other entities: the European State of Italy, excluding Sardinia and Sicily, which are treated as separate geographic areas

Jura, European States and other entities, Switzerland: that part of the Jura massif lying within Switzerland

last nomenclatural update: the date when the name used for a taxon in the StN database was last amended (in most cases this is also the date when the name of the taxon was first added to the StN files)

Latvia, European States and other entities: the European State of Latvia.

Lithuania, European States and other entities: the European State of Lithuania.

Liechtenstein, European States and other entities: the European Principality of Liechtenstein.

localised endemic, European endemic: a species confined to a restricted part of Europe, such as part of one region of the continent, or one site.

lowland, Switzerland: Switzerland below 1000m altitude (in the 1998 version of the database, lowland Switzerland was defined as Switzerland below 650m, but this proved to be an impractical grouping).

Luxembourg, European States and other entities: the European Grand-Duchy of Luxembourg.

Macaronesian region: the Macaronesian region of Europe, as defined by the EU Habitats Directive (see Romau, C., 1996 Interpretation manual of European Union Habitats, version EUR 15, DG XI, EC, 103pp.), comprising the Azores, the Canaries and Madeira, but excluding Cape Verde.

Madeira, European States and other entities, Portugal: the Macaronesian islands of Madeira and Porto Santo

Malta: the State of Malta, comprising the Mediterranean islands of Gozo and Malta.

Mediterranean region: the Mediterranean region of Europe, as defined by the EU Habitats Directive (see Romau, C., 1996 Interpretation manual of European Union Habitats, version EUR 15, DG XI, EC, 103pp.).

N Germany, Germany: the Länder of Bremen, Schleswig-Holstein, Mecklenburg-Vorpommern and Nieder-Sachsen.

nearctic: the nearctic region, taken here as North America north of Mexico, including the USA (apart from Hawaii), Canada and Greenland, plus associated offshore islands.

neotropical: the neotropical region, essentially South America north to Mexico (inclusive).

Netherlands, European States and other entities: the State of the Netherlands

non-alpine, Switzerland: those parts of Switzerland below 1700m altitude

N Ireland, United Kingdom: the administrative region of the island of Ireland comprising the counties Antrim, Armagh, 'Derry, Down, Fermanagh and Tyrone.

Northern region: northern Europe, north of the Atlantic and continental regions as defined by the EU Habitats Directive, and including the boreal region and the Scandinavian part of the alpine region recognised by the EU (see Romau, C., 1996 Interpretation manual of European Union Habitats, version EUR 15, DG XI, EC, 103pp.), plus Norway.

Norway, European States and other entities: the European State of Norway.

oriental: the oriental region, as delimited in Delfinado & Hardy (1975); essentially southern Asia from Pakistan and India eastwards through southern China to Taiwan (inclusive) and south-east to the Celebes (inclusive)

other, European regions: used for species known entirely from regions of Europe not yet covered by the database files, or for non-European species known from Turkey

palaeartic: the palaeartic region, essentially Europe plus Africa south to the Sahara (inclusive) and Asia south to the Himalayas and across to Honshu (Japan) (inclusive).

Poland, European States and other entities: the European State of Poland

Portugal, European States and other entities: the European State of Portugal, excluding Macaronesian islands (e.g. Azores) and Madeira

Pyrenees, alpine region: the massif of the Pyrenees, including its valleys, as included in the alpine region defined by the EU Habitats Directive (see Romau, C., 1996 Interpretation manual of European Union Habitats, version EUR 15, DG XI, EC, 103pp.).

range: the geographical area in which a species occurs.

Republic of Ireland, European States and other entities: the European State of the Republic of Ireland

Roumania, European States and other entities: the European State of Roumania

Russia (European): those parts of the Russian Federation located within the continent of Europe, including the Caucasian area to the frontier between the Russian Federation and Georgia and Azerbaijan

Sardinia, European States and other entities, Italy: the Mediterranean island of Sardinia

S Germany, Germany: the Länder of Baden-Württemberg and Bayern.

Sicily, European States and other entities, Italy: the Mediterranean island of Sicily

Slovak Republic, European States and other entities: the European State of the Slovak Republic

Slovenia, European States and other entities: the European State of Slovenia

south-west France, France: the Départements of Ariège, Aude, Gers, Gironde, Haute-Garonne, Hautes-Pyrénées, Landes, Lot, Lot-et-Garonne, Pyrénées-Atlantiques, Pyrénées-Orientales, Tarn, Tarn-et-Garonne.

Spain, European States and other entities: the European State of Spain, excluding the Balearics and the Canary islands, which are treated as separate geographic areas

Sweden, European States and other entities: the European State of Sweden.

Switzerland (gen.), European States and other entities: the Confederation of Switzerland

taxonomic status: the degree of reliability with which the taxon associated with a name used in the checklist can be recognised/degree of stability of the name of the taxon

threatened: probably threatened with extinction in the geographical area concerned. Critical use of the IUCN threat categories has not been possible and estimations of threat status are based simply on best available expert judgement.

Turkey, European States and other entities: the State of Turkey, including both European and Asiatic elements.

United Kingdom, European States and other entities: the European State of the United Kingdom, including England, Scotland, Wales and Northern Ireland (and offshore islands, including the Channel Isles, the Orkneys and the Shetlands).

unthreatened: apparently neither threatened nor decreasing in either number of populations or range within the geographical area concerned.

world range: the biogeographical regions in which a species occurs.

APPENDIX 9: SUMMARY TABLE OF TRAIT CATEGORIES

Food type (larvae)	
micro-organisms (gen.)	saproxyllic
living plants	
living animals	
unknown	
Commensalism (larvae)	
unknown	
none	
quasi-commensals	
within Aculeate Hymenoptera nests	
Duration of development (egg/larva/puparium)	
<2 months	
2-6 months	
7-12 months	
>1 year	
Overwintering phase	
unknown	
larva	
puparium	
adult	
Inundation tolerance (larvae)	
unknown	
short respiratory tube, non tolerant	
short respiratory tube, tolerant	
medium respiratory tube	
long respiratory tube	
Number of generations /year	
<1	
1	
2	
>2	
Food sources (adults)	
Nectar-bearing flowers (gen.)	Trees
	Lianas
	Shrubs/bushes (gen.)
	Tall shrubs
	Low shrubs
	Herbs (gen.)
	tall strong herbs
	low-growing plants

Pollen-only flowers (gen.)	Trees	
	Lianas	
	Shrubs/bushes	
		Herbs (gen.)
	Monocot.	
	Dicot.	
Leaf surfaces		
Sap-runs		
None known		
Migratory status (adult)		
Not migrant		
recorded migrant		
Strongly migratory		
Flight period, Europe (gen.)		
Feb		
Mar		
Apr		
May		
Jun		
Jul		
Aug		
Sep		
Oct		
Nov		
Flight period, IRELAND (IRL)		
IRL Feb	1st.half	
	2nd.half	
IRL Mar	1st.half	
	2nd.half	
IRL Apr	1st.half	
	2nd.half	
IRL May	1st.half	
	2nd.half	
IRL Jun	1st.half	
	2nd.half	
IRL Jul	1st.half	
	2nd.half	
IRL Aug	1st.half	
	2nd.half	
IRL Sep	1st.half	
	2nd.half	
IRL Oct	1st.half	
	2nd.half	
IRL Nov	1st.half	
	2nd.half	

APPENDIX 10: GLOSSARY OF TRAIT CATEGORIES

- <1**, number of generations per year: less than one generation per year i.e. larval development takes more than one year to complete
- <2 months**, duration of development: the length of time taken for development, from egg-deposition to eclosion of the adult insect, is less than two months.
- >1 year**, duration of development: the length of time taken for development, from egg-deposition to eclosion of the adult insect, is more than one year
- >2**, number of generations per year: polyvoltine species in which the number of successive life cycles completed within a year is greater than 2
- 1**, number of generations per year: univoltine species i.e. species in which the life cycle takes a year to complete
- 1st.half**, (month), flight period: the first half of a month, varying in length according to the number of days in the month concerned.
- 2**, number of generations per year: bivoltine species i.e. species in which the life cycle is completed twice during the course of a year (one generation being more protracted than the other, due to overwintering)
- 2-6 months**, duration of development: the length of time taken for development, from egg-deposition to eclosion of the adult insect, is from two to six months
- 2nd.half**, {month}, flight period: the second half of a month, varying in length according to the number of days in the month concerned.
- 7-12 months**, duration of development: the length of time taken for development, from egg-deposition to eclosion of the adult insect, is from seven months to one year
- adult**, overwintering phase: species which passes the winter as the adult insect
- Apr**, flight period: April
- Aug**, flight period: August
- commensal**, commensalism: species whose larvae are commensal within nests of some species of Aculeate Hymenoptera. The term commensal is applied rather loosely here. Larvae of *Xanthogramma* are probably more accurately regarded as inquilines and those of *Microdon* as kleptoparasites.
- commensalism** (larvae): larvae living commensally, or quasi-commensally with species of Hymenoptera Aculeata or saproxylic species. The term commensal is applied rather loosely here. Larvae of *Xanthogramma* are probably more accurately regarded as inquilines and those of *Microdon* as kleptoparasites.
- Dicot.**, herbs: dicotyledonous plants whose flowers produce only pollen (i.e. do not produce nectar), e.g. *Epilobium*, Papaveraceae, *Urtica*.

duration of development (egg/larva/puparium): the length of time taken for development, from egg-deposition to eclosion of the adult insect

Feb, flight period: February

flight period: the period of the year during which the adults of a species occur (for species in which adults overwinter, the period spent inactive while overwintering is not included as part of the flight period). In the case of the data presented for Europe (gen.), the unit of time used for each category is one month. It has been possible to be more precise in the presentation of flight period data for Ireland and a ½ month time span unit is used for each category in that part of the spreadsheet.

food sources (adults): sources of sugars or protein recorded as used by adult syrphids as food, usually in the form of nectar or pollen (respectively). One recognised food source category not coded is “honey-dew” deposits dropped on leaf surfaces by Aphididae (Homoptera), because authors have not been consistent in recording use of this food source and available observations are insufficient to make coding of the species worthwhile.

food type (larvae): larval food, categorised according to whether it is living animals or plants, or decomposing organic matter. Although the larvae which feed on decomposing organic matter are generally understood to be microphagous, their actual food is uncertain. They are all considered as microphages here, but it is recognised that their status may change following more detailed investigation.

herbs (gen.), pollen-only flowers: non-woody plants whose flowers produce only pollen (i.e. do not produce nectar), e.g. Cyperaceae, Gramineae, Juncaceae, Plantaginaceae, *Chelidonium*, *Epilobium*, *Papaver*, *Urtica*.

herbs (gen.), nectar-bearing flowers: non-woody plants whose flowers produce both pollen and nectar e.g. Apiaceae, Asteraceae.

inundation tolerance (larvae): the capacity of larvae to withstand submersion in water, categorised primarily according to the extent to which they exhibit relevant morphological adaptation in the respiratory processes or tegument

Ireland: the island of Ireland

IRL: Ireland

Jul, flight period: July

Jun, flight period: June

larva, overwintering phase: species which pass the winter period as a larva

leaf surfaces, food sources (adults): upper surface of leaves of large-leaved herbs and shrubs, e.g. *Rubus fruticosus* agg., *Urtica*, where pollen grains from other plants can accumulate.

lianas, pollen-only flowers: woody or herbaceous plants climbing 2m or more above the ground surface, with anaemophilous flowers e.g. *Rosa canina*.

lianas, nectar-bearing flowers: woody or herbaceous plants climbing 2m or more above the ground surface and with nectar-producing flowers, e.g. *Clematis*, *Convolvulus*, *Hedera*, *Lonicera periclymenum*, *Polygonum baldschuanicum*.

living animals, food type: species whose larvae are predatory.

living plants, food type: species whose larvae feed on the tissues of living, non-woody plants (it is not clear whether the larvae of some of the species consigned to this category feed primarily on living plant tissue or necrotic plant tissue, or micro-organisms associated with necrotic plant tissue, but, the larvae are essentially dependent on living plants, rather than dead plants).

long resp. tube, tolerant: species whose larvae possess a long (extensile) respiratory tube, enabling them to survive prolonged periods of submersion in water and to continue development whilst submerged.

low-growing plants, herbs: non-woody flowering plants up to 0.5m in height., with flowers producing both pollen and nectar, e.g. *Ajuga*, *Euphorbia spp.*, *Galium*, *Hieracium*, *Potentilla erecta*, *Ranunculus*, *Saxifraga*, *Sedum*, *Stellaria*, *Taraxacum*.

low shrubs, shrubs/bushes: woody plants up to the height of 0.5 m, with nectar-producing flowers, e.g. *Calluna*, *Erica*, *Potentilla fruticosa*, *Salix repens*, *Vaccinium*.

Mar, flight period: March

May, flight period: May

medium resp. tube, tolerant: species whose larvae possess a moderately long respiratory tube, enabling them to survive prolonged periods of shallow submergence/partial submergence in water and continue their development whilst submerged

micro-organisms (gen.), food type: species whose larvae feed on micro-organisms associated with various forms of decomposing organic matter

migrant (gen.): species known to undertake long-distance movements.

migratory status (adult): categorisation of the species according to the extent to which they are known to undertake long-distance movements

Monocot., herbs: monocotyledonous plants whose flowers produce only pollen (i.e. do not produce nectar), e.g. Cyperaceae, Gramineae, Juncaceae, Plantaginaceae, Typhaceae

nectar-bearing flowers (gen.), food sources (adults): plants whose flowers produce both nectar and pollen.

non tolerant, inundation tolerance: species whose larvae have a short respiratory tube, exhibit no other adaptation to withstand submersion in water and characteristically occur only in habitats not subject to seasonal flooding

non-migrant, migratory status: species not known to migrate

none, commensalism: species whose larvae exhibit no tendencies towards commensalism

none known, food sources, adults: species for which no adult food source is known, including both poorly species and those species not known to feed as adults (i.e. *Microdon* spp.).

Nov, flight period: November

number of generations per year: the number of successive life cycles completed by a species during a year

Oct, flight period: October

overwintering phase: the phase (larva, puparium or adult) of the life cycle in which the species overwinters

pollen-only flowers (gen.): plants with flowers which produce only pollen (i.e. that are without nectar). These flowers are generally regarded as wind-pollinated, but progressively it is becoming recognised that pollen-using insects, like syrphids, can play a role in pollination of such flowers

puparium, overwintering phase: species which pass the winter as a puparium

quasi-commensals, commensalism: species whose larvae exhibit some degree of commensal association, either with species of aculeate Hymenoptera (in particular species whose larvae appear to a significant extent dependent upon the root-aphid-farming activities of ant colonies) or other insects (e.g. saproxylics which provide microhabitat for saproxylic syrphid larvae, like *Cossus* or *Hylobius*).

saproxylic, micro-organisms: species whose larvae feed on micro-organisms dependent upon dead or dying wood or the activities of other saproxylics (saproxylic: an organism dependent upon the dead or dying wood of moribund or dead trees, or upon the presence of other saproxylics)

sap runs, food sources (adults): wet tree wounds maintained by sap and/or the activities of fungi or saproxylic invertebrates, especially those of trees with sugar-rich sap i.e. *Acer* spp.

Sep, flight period: September

short respiratory tube, tolerant: species whose larvae have a short respiratory tube but characteristically occur in parts of habitats subject to seasonal flooding and may exhibit additional morphological adaptation to withstand submersion in water (e.g. a covering of hydrofuge hairs, as in *Eupeodes latifasciatus*).

shrubs/bushes, pollen-only flowers: woody plants up to 2.0m, with flowers that do not produce nectar, e.g. *Alnus viridis*, *Corylus*, *Empetrum*, *Juniperus*.

shrubs/bushes (gen.), nectar-bearing flowers: woody plants up to 2m with nectar-producing flowers.

strongly migratory, migratory status: species repeatedly recorded as undergoing migrational activity

tall shrubs, shrubs/bushes: woody plants between the heights of 0.5 and 2m with nectar-producing flowers, e.g. *Cistus*, *Cornus*, *Euonymus*, *Ligustrum vulgare*, *Lonicera xylosteum*, *Prunus spinosa*, *Rubus* spp., *Sambucus*, *Salix* spp., *Viburnum*.

tall, strong herbs, herbs: non-woody plants with nectar-producing flowers, normally reaching more than 0.5m in height, e.g. *Adenostyles*, *Angelica*, *Cirsium palustre*, *Heracleum*, *Iris palustris*, *Impatiens*, *Petasites albus*, *Sambucus ebulus*, *Senecio*, *Solidago*,

tolerant (gen.), inundation tolerance: species whose larvae exhibit morphological adaptation to survive periods of submersion in water

trees, pollen-only flowers: woody plants normally 2m or more at maturity, with flowers that do not produce nectar, e.g. *Alnus*, *Betula*, *Castanea*, *Fraxinus excelsior*, *Pinus*, *Populus*, *Ulmus*.

trees, nectar-bearing flowers: woody plants with nectar-producing flowers, normally 2m or more at maturity, e.g. *Crataegus*, *Salix spp.*, *Sorbus aucuparia*.

unknown: species for which data are insufficient to enable coding of the trait category concerned.

weakly migratory, migratory status: species occasionally recorded as exhibiting migrational activity

APPENDIX 11: SUMMARY TABLE OF FARM MANAGEMENT OPERATION CATEGORIES (ANIMAL FARMING)

MANAGEMENT OPERATION	frequency/season
CHEMICAL	
Pesticide application (gen.)	
Anti-helminthic	
dose/injection	1
	>1
	non-growing season
	growing season
bolus	
	non-growing season
	growing season
Herbicide (gen.)	
broad-spectrum	
selective (gen.)	
dock	
ragwort	
thistles	
Insecticide (gen.)	
Plant nutrient application	
Soil pH maintenance	
Liming	
FIRING	
Scrub burning	
Stubble burning	
GRAZING	
Grazing (gen.)	
Cattle	
light grazing	growing season
moderate grazing	growing season
heavy grazing	growing season
Sheep	
heavy grazing	growing season
Poaching	
Trampling	
	growing season
MECHANICAL	
Chain-harrowing	
	non-growing season
	growing season
Cultivation (gen.)	
Harrowing	1
	>1
Ploughing (gen.)	
	non-growing season
	growing season

	Rotavation	
Crop harvesting (gen.)	Cereals/sunflowers/protein crops	
	Hay-making	
	Maize	
	Root crops	
	Silage-making	1
		>1
Cutting (gen.)	Field margins/hedge banks	1
		>1
	Hedge (gen.)	
	light	non-growing season
		growing season
	severe	
	non-growing season	
		growing season
	Rushes	1
		>1
	Scrub	non-growing season
		growing season
	Topping	
Drainage (gen.)	Canalisation of brooks (gen.)	
	construction	
	maintenance	
	Mole-ploughing	
	Open ditch (gen.)	
	construction	
	maintenance	
	Pipe drain	
Grubbing (gen.)	Ragwort pulling	
	Scrub	non-growing season
		growing season
	Tussock-levelling	
Land-rolling		1
		>1
Rock clearance		
Re-seeding		
	Agri. cv. introduction	

APPENDIX 12: GLOSSARY OF FARM MANAGEMENT OPERATION CATEGORIES

1, frequency/season: operation carried out only once in a calendar year

>1, frequency/season: operation carried out more than once in a calendar year

agri.cv introduction, reseeding: introduction of agricultural cultivars (CVs) of grasses (often accompanied by *Trifolium* spp.) to an existing sward (using a technique such as slot-seeding), to increase dominance of the sward by grasses (almost invariably accompanied by application of plant nutrients: see definition of plant nutrients)

anti-helminthics, pesticide: prophylactic treatment of livestock against endo- and ecto-parasites (e.g. nematodes, helminths, lice, ticks) administered by injection, dose or a slow-release system (e.g. bolus); including, in particular, use of ivermectins and related copmpounds

bolus, anti-helminthic, pesticide application:

bracken, selective, herbicide: general land surface application of chemicals with selective activity against *Pteridium*

broad-spectrum, herbicide: general land surface application of chemicals active against all (or almost all) herbaceous vegetation e.g. glyphosate, paraquat

canalisation of brooks: mechanical digging out and re-routing of stream channels, springs and flushes to increase drainage and convert them to rectilinear features that are more conveniently located (e.g. along field edges) and managed, plus maintenance of these modified channels. These features differ from ditches in that they contain water throughout the year (see also under open ditch)

cattle, grazing: cropping of ground vegetation by cattle, with variable effects on the syrphid fauna, dependent upon grazing intensity levels. At all intensities, cattle grazing inevitably results in trampling of ground vegetation, and its impact is coded accordingly. Three intensity levels of cattle grazing are recognised here, light, moderate and heavy.

cereals/sunflowers/protein crops, crop harvesting: mechanical cutting of the stalks of cereal crops, sunflower crops or protein crops (beans and peas), grown for animal feed. The plants are cut within c10cm of the ground surface and then left on the ground surface minus their seeds. This operation is carried out when the vegetative parts of the plants have senesced i.e. are more-or-less dead. Cereal harvesting may occur as late as August/September or as early as April, dependent upon latitude and climate.

chain-harrowing: mechanically combing the ground vegetation to remove moss and dead grass

construction, canalisation of brooks: mechanical digging out and re-routing of stream channels, springs and flushes to increase drainage and convert them to rectilinear features that are more conveniently located (e.g. along field edges) and managed; normally carried out during the growing season. These features differ from ditches in that they contain water throughout the year

construction, open ditch, drainage: mechanical digging of channels into the soil, to conduct water away from the general land surface; normally carried out during the growing season.

The term ditch is used here to denote an intermittently-flooded drainage channel (see also under canalisation of brooks).

cultivation: mechanical inversion and or comminution and mixing up of the soil surface layers, their vegetation cover and litter layers

cutting (gen.): mechanical mowing or trimming of herbaceous or woody vegetation, with or without removal of the cut material

dock, selective herbicide: general land surface application of chemicals with selective activity against *Rumex*

dose/injection, anti-helminthic, pesticide application:

drainage (gen.): digging of open drains or pipe drains, or use of a mole plough, to channel water away from the general land surface (the impact of ditches dug expressly to drain particular water bodies is not covered here)

field margin/hedge bank, cutting: mechanical cutting of herbaceous vegetation along field margins, hedgerows and farm tracks. This may be carried out at any time of the year and more than once in any year, but when carried out outside the growing season its impact is assessed as negligible. Here it is assumed that the operation is carried out during the growing season, using a topping machine i.e. that the operation results in a vegetation height of 5-10 cm

grazing (gen.): cropping of vegetation by domestic stock, resulting in increase in grasses in the ground vegetation and reduction in its overall height

growing season, frequency/season: operation carried out during the growing season, i.e. the period April to September in the Atlantic zone

grubbing (gen.): mechanical uprooting of herbaceous and/or woody vegetation, followed by its removal if woody or its dissemination over the ground surface as an even-depth layer, if herbaceous.

harrowing, cultivation: mechanical comminution of the top 2-10cm. of the soil and its ground vegetation cover (if present), using disc harrow, power harrow or tined harrow; characteristically carried out during the growing season and frequently more than once in any given year.

hay-making, cutting: mechanical cutting of grassland vegetation to a height of less than 5cm, when leaf growth has finished and flowering of the dominant grasses is occurring (but before seed formation), followed by in-situ drying of the cut crop and its subsequent removal once dry.

heavy grazing, cattle: cropping of ground vegetation by cattle, resulting in reduction in general sward height to less than 5cm

heavy grazing, sheep: cropping of ground vegetation by sheep throughout the growing season, resulting in reduction in general sward height to less than 2cm.

hedge browsing: browsing back of twig-sized hedge growth by cattle, during the growing season

hedge (gen.), cutting: mechanical cutting of woody shrub vegetation of hedges, to control hedge height and/or breadth

herbicide (gen.), pesticide application: general land surface application of chemicals active against scrub or herbaceous vegetation

insecticide (gen.), pesticide application: general land-surface application of chemicals active against insects feeding on crop plants, normally applied, as either systemically active or contact sprays, during the growing season

land-rolling: mechanical compaction of the top c5cm of soil, using a land-roller; normally carried out during the growing season

light grazing, cattle: cropping of ground vegetation by cattle, resulting normally in dominance by grasses, inhibition of extensive scrub cover and a sward height greater than 10cm

light, hedge cutting: cutting back of twig-sized hedge growth

liming, soil pH maintenance: general land surface application of fine-textured, crushed limestone or chalk

maintenance, canalisation of brooks: mechanical removal of vegetation growing in canalised brooks and deepening/widening of the channel; normally carried out during the growing season. These features differ from ditches in that they contain water throughout the year (see also under open ditch)

maintenance, open ditch, drainage: mechanical removal of vegetation growing in open ditches and deepening/widening of the ditch; normally carried out during the growing season. The term ditch is used here to denote an intermittently-flooded drainage channel (see also under canalisation of brooks).

maize, crop harvesting: mechanical cutting of the stalks of maize crops grown for animal feed. The plants are cut at c10cm from the ground surface and then removed. This operation is normally carried out when the plants have finished their growth and have started to senesce.

mechanical weeding, cultivation: shallow (c.5cms) cultivation of the general land surface to pull up weed seedlings, which may be carried out more than once during the growing season either: a) between the rows in row crops, using mechanical inter-row cultivators (e.g. steerage hoes, brush weeders, rolling cultivators) or b) within cereal crops, using a chain harrow (prior to crop seedling emergence) or light, spring-tined harrow (after crop seedling emergence). Mechanical weeding normally leaves reduced populations of some weed species in place.

moderate grazing, cattle: cropping of ground vegetation by cattle, resulting in increased dominance by grasses and a sward height ranging from 5-10cm

mole-ploughing, drainage: mechanical tunnelling of subsoil to increase drainage of the general land surface; normally carried out during the growing season

non-growing season, frequency/season: operation carried out outside the growing season, i.e. during the period October to March in the Atlantic zone

open ditch (gen.), drainage: mechanical digging and maintenance of channels to conduct water away from the general land surface; normally carried out during the growing season. The term ditch is used here to denote an intermittently-flooded drainage channel (see also under canalisation of brooks).

pesticide application (gen.): prophylactic treatment of livestock against endo- and ecto-parasites and general land surface application of chemicals active against scrub or herbaceous vegetation. Insecticides are not normally applied in grassland management for livestock except following cultivation, when they are used against organisms such as *Oscinella frit* or larvae of Tipulidae. Cultivation is itself so destructive of grassland faunas that identification of an additional effect on grassland syrphid faunas due to a following insecticidal application is here regarded as not possible. Insecticide application is thus not treated as a management operation category in the spreadsheet.

pipe-drain, drainage: mechanical installation of sub-surface pipes and gravel in the soil, to increase drainage of the general land surface; normally carried out during the growing season

plant nutrient application: mechanical land spreading of chemical fertilisers, farm manures, composts, crop wastes and/or liquid slurry, farmyard waste water or silage effluent, as carried out in commercial farming enterprises, to increase the yield of fodder grasses or field crops, which also increases the competitive advantage of those plants. In traditional farming systems, rates of application of organic wastes would be significantly lower, resulting in a lesser effect on nutrient levels in fields than would be produced by chemical fertiliser application. In commercial farming today, effects on nutrient levels from organic wastes are as great as those from application of chemical fertiliser, allowing all forms of nutrient application to be considered together, under the one general heading of plant nutrient application. The various forms of plant nutrient application grouped under this heading may be listed as follows: fertiliser - land-spreading of inorganic nitrate, potash or phosphate or some combination of these, by use of booms, mechanical broadcasting or drilling methods liquid organic waste: mechanical land-spreading of liquid slurry, farmyard waste water or silage effluent; solid organic waste - mechanical land spreading of farm manures, composts, crop wastes and/or other solid organic wastes

ploughing, cultivation: mechanical inversion of the top 15-30cm of the soil (and its ground vegetation cover)

poaching: trampling (under wet conditions) of ground vegetation and soil surface layers into mud, by livestock, at any time of the year

ragwort, selective herbicide: herbicide: general land surface application of chemicals with selective activity against *Senecio jacobaea*.

ragwort pulling, grubbing: manual removal of ragwort (*Senecio jacobaea*) plants prior to their seeding, normally carried out in late summer (August)

rock clearance: mechanical removal of loose surface/sub-surface rock and boulders, followed by levelling of the ground surface

- root crops**, crop harvesting: mechanical digging out of root crops used for animal feed. The soil is dug to a depth of 20-30 cm and the vegetative parts of the plants are cut and left on the ground surface. Harvesting of fodder beet, turnips and mangolds is normally carried out within the period September/January, while the plant foliage is still growing. In the case of potatoes, the vegetative parts of the plants are first sprayed to bring about wilting and harvesting occurs in the period April/September, dependent upon latitude.
- rotavation**, cultivation: mechanically breaking up and mixing the top 10cm of the soil (and its ground vegetation cover), normally carried out during the growing season
- rushes**, cutting: mechanical cutting of *Juncus* (and associated vegetation) to increase the competitive advantage of fodder grasses; normally carried out outside the growing season
- scrub burning**, firing: burning (usually carried out once a year, outside the growing season) of scrub vegetation (usually *Calluna* or *Ulex* in the Atlantic region), also leading to burning of ground vegetation and ground surface litter
- scrub**, cutting: mechanical cutting of scrub and its removal, at any time of the year
- scrub**, grubbing: mechanical uprooting and removal of bramble thickets, bushes, shrubs and young trees, carried out at any time of the year
- severe**, hedge cutting: cutting back of twig and branch-sized hedge growth, reducing hedge dimensions to c1.5m in height and c1.0m in width
- sheep**, grazing: cropping of ground vegetation by sheep. Light to moderate levels of sheep grazing result in a mosaic of patches of ground vegetation of different heights, incorporating scattered thickets of scrub (if present initially) and no definite adverse effects on the syrphid fauna can be identified. Impact of sheep grazing is only coded here at heavy intensity level
- silage making**, cutting: mechanical cutting of grassland vegetation to a height of less than 5cm, during the phase of maximum leaf-growth of the dominant grasses and before they flower, often including mechanical comminution and always involving removal of the cut crop within 24 hours (at the most) of cutting.
- stubble-burning**, firing: burning of dead stem-bases of harvested crops
- thistles**, selective herbicide: herbicide: general land surface application of chemicals with selective activity against *Cirsium* species
- topping**, cutting: mechanical cutting of the flowering heads of grassland plants in pasture, leaving a sward 5-10cm high.
- trampling**: breaking and flattening of herb layer vegetation by livestock
- tussock-levelling**, grubbing: mechanical grubbing-up of tussocks and spreading the product over the ground surface in an even-depth layer; normally carried out during the growing season

APPENDIX 13: FREQUENCY AND SEASON OF OCCURRENCE OF FARM MANAGEMENT OPERATIONS

MANAGEMENT OPERATION	Frequency(per ann.)		Season	
	1	>1	Non-growing	Growing
CHEMICAL	1			
Pesticide application				
Anti-helminthic		*	*	*
Herbicide (gen.)				
broad-spectrum	*			*
selective (gen.)				
dock	*			*
ragwort	*			*
thistles	*			*
Insecticide	*			*
Plant nutrient application	*	*	*	*
Soil pH maintenance				
Liming	*		*	*
FIRING				
Scrub burning	*		*	
Stubble burning	*			*
GRAZING				
Grazing (gen.)				
cattle				
light			*	*
moderate (cattle)				
heavy				
sheep			*	*
Poaching			*	*
Trampling				*
MECHANICAL				
Chain-harrowing	*		*	*
Cultivation				
Harrowing	*	*		*
Mechanical weeding		*		*
Ploughing	*	*	*	*
Rotavation	*			*
Cutting (gen.)				
Field-margins/hedge banks	*	*	*	*
Hay-making	*			*
Hedge (gen.)				
light	*		*	*
severe	*		*	*
Rushes	*	*	*	*
Scrub	*		*	*
Silage making	*	*		*
Topping		*		*
Drainage (gen.)				
Canalisation of brooks(gen.)				
construction	*			*
maintenance	*			*
Mole-ploughing	*			*
Open drain (gen.)				
construction	*			*
maintenance	*			*

Pipe drain	*			*
Grubbing (gen.)				
ragwort pulling	*			*
scrub	*		*	*
tussock-levelling	*			*
Land-rolling	*	*		*
Rock clearance	*		*	*
Re-seeding				
agri.cv introduction	*		*	