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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)

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Summary

The results are presented of a comprehensive survey of the Sciomyzidae (Diptera) and Syrphidae (Diptera) of the case-study farm, which yielded 90 species. A habitat survey of the farm was also conducted. From a knowledge of the habitat associations of the recorded species, their probable disposition among the various parts of the farm is considered. This makes it possible to predict the potential consequences, to the fauna, of changes in management of the farm. The potential significance of the non-productive parts of the farm in maintaining its present fauna is highlighted by this process. So is the capacity of intensification of farm use, occurring on farms in the surrounding landscape, to totally eradicate sciomyzids from the farm and reduce the syrphid fauna to less than 10% of its present total. It is concluded that even if farms cannot be expected to host threatened organisms, their potential to maintain the majority of a regional fauna gives them a biogeographical role of singular significance, albeit largely dependent upon the continued presence within the farmland landscape of a significant proportion of non-productive land.

1. Introduction

There are various studies of syrphids that have been carried out in farmland in Europe. By and large, they focus on particular species or particular crops, usually from the viewpoint of using syrphids with aphidophagous larvae as agents for biological control of plant bug infestations. The resultant literature has been reviewed in different ways by different authors, a recent, and comprehensive, example being incorporated into Barkemeyer (1994). There are a few studies (e.g. Hondelmann, 1998) that are concerned more generally with which species can be caught as adults in farmland, but without focussing much attention on whether the species recorded could be resident within farmland. The situation of sciomyzids is more extreme, there being very little published on farm faunas of these flies. Faunistic studies of any invertebrates, that could be construed as carried out with a view to considering the extent to which farmland in Atlantic parts of Europe may provide a biodiversity maintenance function, have been almost non-existent until recently (Usher, 1986; Goldsmith, 1991), and have largely been focussed on individual landscape features, e.g. hedges (Pollard *et al.*, 1974) or upon the use of ground beetles (see, for example Foster *et al.*, 1997) or butterflies (e.g. Erhardt, 1985) as tools to this end.

In the present text, the results of inventorising the sciomyzid and syrphid faunas of a case study farm, taken as a landscape unit, are presented. The observed fauna is then considered in relation to the potential role of the farm and its component habitats in supporting the regional fauna of these taxonomic groups. For this purpose, the region is taken to be Co. Cork, the county in which the case-study farm is located. A description of this farm is provided in Part 1 of this series (Good, 2001). Whether rightly or wrongly, species are not all perceived as equal in their conservation value, those species that can be classified as being to some extent under threat being regarded as more significant targets for conservation action than more ubiquitous species, and some way of incorporating this reality into the process of considering the role of farmland in maintaining faunas requires to be found. This has been attempted here by employing a rough measure of the threat status of the species observed on the farm.

2. Methods

Syrphids (hoverflies) and sciomyzids (snail-killing flies) were collected on the farm intermittently, over the period 1994-2000, by hand net, from flowers, vegetation and by sweeping. During 2000, a comprehensive sampling programme was carried out, using 27 Malaise traps, which were in operation for a series of 20-day periods between April and September. These were augmented in some fields by emergence traps (20 in all), which were operated over month-long sample periods from April to August. The location of the Malaise trap installations is shown in Figure 1. During 2000, a comprehensive survey of the habitats present on the farm was also undertaken, to allow prediction of its expected sciomyzid and syrphid fauna, for comparison with the observed fauna. In carrying out the syrphid predictions, the Syrph the Net files detailing the Macrohabitat associations of, and Range and status data for, the observed species were employed, from the 2000 version of the database (Speight and Castella, 2000; Speight *et al.*, 2000a), in conjunction with the Co. Cork syrphid list (Speight, 2000a) and following the basic procedures outlined in Speight *et al.* (2000b). Unpublished information on sciomyzid habitats and distribution in Ireland was employed in predicting the expected sciomyzid fauna of the farm and in gauging its potential conservation value.

3. Results

The habitats observed will be considered first, followed by the species observed and their relationships to the habitats observed.

3.1 Habitats observed on the farm

The habitats observed on the farm fall into three main groups, when considered in relation to the role they play in the farm economy:- productive sector habitats, infrastructural habitats and disused sector habitats.

Productive sector land is the *raison d'etre* of farming and can be regarded as omnipresent on farms, even if not in the configuration (i.e. field size and use combination) found on the farm studied here. Essentially, it comprises the surfaces of the fields.

Infrastructural land includes features like hedges, ditches, orchards, ponds etc, which have been introduced to the farm landscape deliberately, because of their utility as adjuncts to farming, although they do not directly produce a cash crop. Many of these features are today no longer required in support of the farm economy and have to be viewed as primarily historical inclusions in the farm landscape, now being progressively removed, except where farm managers are prevailed upon to leave them in place (usually by provision of some form of financial compensation) through the intervention of external influences.

Disused sector land is not necessarily a feature of farmland, being land that is not currently regarded as economical to use in its present condition and not worth conversion to some more economically useful state (it may never have been regarded as economical to use). Obviously, disused sector habitats are not normally deliberately introduced to farmland and they owe their presence either to natural (i.e. non-human) factors or to cessation of management, or a combination of these two. The history of the disused sector land occurring on the case study farm is detailed in Part 1 of this series.

Land consigned to a set-aside role has been excluded from the three sectors delimited above. It is on the one hand part of the area available for productive use, but on the other is deliberately excluded from productive use for the duration of one or more annual cycles. It is technically disused land, in that it is excluded from use and may be unmanaged, but its disuse is short-term and the requirement to re-absorb it into the productive sector is integral to its disuse in the first place. In that it is neither in productive use nor long disused, it could even be regarded as a part of the farm infrastructure. It is for these reasons that set-aside is considered separately in the present text, as an additional, if minor, sectoral category.

Disused sector habitats (*circa* 5ha):

- Atlantic thickets with flushes
- *Alnus* forest (general) with flushes and brook
- unimproved, oligotrophic *Molinia* grassland with flushes and temporary pools/acid fen

Farm infrastructure habitats (*circa* 5ha):

- scattered trees in open ground (tree lines of *Fagus* and *Acer pseudoplatanus*)
- hedges, with and without associated drainage ditches and/or canalised, seasonal brooks
- old walls
- field margins
- orchard
- farmyard organic waste
- pond
- farm buildings

Productive sector habitats (*circa* 30ha):

- improved grassland
- intensive grassland
- crops
- cow dung

Set-aside

- fallow land (set-aside)

Definitions of these habitats are provided in Appendix 2. The disused sector *Molinia* grassland/acid fen habitat is essentially an area of oligotrophic, unimproved, seasonally-flooded *Molinia* grassland incorporating a residuum of acid fen species around the few remaining flushes/seasonally-flooded pools. As has been demonstrated in Part 1 of this account of the farm, acid fen probably predominated in this area within the last 50 years, but partial drainage and associated soil disturbance, plus subsequent cessation of all grazing, has resulted in expansion of the *Molinia* grassland to such an extent that acid fen has all but vanished from the site.

3.2 The sciomyzids and syrphids observed on the farm

The 17 species of Sciomyzidae and 73 species of Syrphidae observed on the farm 1994-2000 are listed, with their authorities, in Appendix 1, together with the numbers of specimens of each that were collected using Malaise traps and emergence traps in 2000. As can be seen from that list, all but five of the species were collected using the Malaise traps. The additional species were syrphids added by hand collecting. Three of those five (*Leucozona laternarius*, *Neoascia tenur*, *Platycheirus scambus*) were collected in 1994, but not subsequently. The other two (*Helophilus trivittatus* and *Scaeva pyrastri*) were present in 2000.

Emergence traps were only installed in some of the productive sector habitats (fields used for grazing and fields used for silage production) and in set-aside. The 14 syrphid species which were collected within them thus provide only a very truncated record of syrphids confirmed as breeding on the farm, and from habitats which would be predicted to have a restricted fauna. All that can be said is that the species bred from the traps are all species predicted to occur on the farm and collected also by Malaise traps on the farm. The eight species which were collected by emergence traps within the productive sector were all predicted to occur within the productive sector, but the 13 species similarly collected in the set-aside traps included two (*Platycheirus manicatus* and *Syrphus vitripennis*) not predicted to occur in productive sector habitats.

Each emergence trap covers only 1m^2 of ground surface. Of the 20 emergence traps used, 12 were installed in fields under grass and the other eight in set-aside. Even one specimen collected in one of these emergence traps thus suggests a potential for prodigious numbers of that species to emerge from the total area of the field in which that emergence trap was located, during the time that the emergence traps were in use. For instance, given that each field in which emergence traps were located had a surface area of substantially more than 1ha, and 1ha comprises 10,000m^2, a naive estimate of the number of specimens produced would be 2,500 per hectare, for a species collected just once in one emergence trap. Looked at in this way, the solitary specimen of one sciomyzid species (*Tetanocera elata*), collected from an emergence trap in one of the fields used as pasturage, is potentially indicative of a large population of this insect developing there.

There are 51 species of Sciomyzidae known from Ireland, 28 of which have been recorded from Co. Cork. The observed farm fauna, of 17 species, represents one third of the known Irish sciomyzid fauna, or 60% of the Cork fauna. The list of Syrphidae observed on the farm also now includes 60% of the syrphid species recorded from Co. Cork (Speight, 2000a), and 40% of the known Irish syrphid fauna. At first glance, these data might seem to suggest farmland can be expected to play a significant role in maintenance of the Irish sciomyzid and syrphid faunas. But this farm is not all one habitat, and in order to establish what contribution might realistically be expected from farmland, in maintaining the species observed on this farm, it is necessary to consider their relationship to the habitats observed and the extent to which these habitats can also be expected to occur on farms.

3.2.1 The syrphids observed, their habitat associations and their conservation value

From the array of habitats observed on the farm, and the habitat associations of the observed species, all but three (*Helophilus trivittatus*, *Sphegina elegans* and *Xylota sylvarum*) of the species observed would also be predicted to occur on the farm. So 96% of the syrphid species observed on the farm would also be predicted to occur there. A small number of additional Co. Cork species would be predicted to occur as well, but were not observed. The present text is concerned with maintenance of the observed fauna, so these predicted but not observed species will not be considered here.

The expected distribution of the observed syrphid species, among the habitats observed on the farm, can be considered at the level of individual habitats or groups of habitats. Here, the three broad groups of habitats defined earlier have been used, namely productive sector habitats, infrastructural habitats and disused sector habitats.

Starting with the productive sector, 46% of the observed syrphid species (32 species) would be predicted to survive in productive sector habitats (see Appendix 1), whereas the other 54% would not. More than half of the observed fauna may, then, be dependent on the presence of other habitats. Some (15) of the species falling into this latter group would be predicted to occur in both infrastructural and disused sector habitats, but most would not. Seven of them would be expected to be dependent on the presence of the infrastructural habitats alone and 16 of them on the disused sector habitats. It follows that, were the entire area of farm infrastructure habitats added to the productive sector, to maximise production, a net reduction of 10% would be predicted to occur in the observed syrphid fauna of the farm. But, if the disused sector habitats were lost from the farm, for instance through the disused sector land being brought back into the productive sector, the reduction would be more than 20%. And, if both the disused sector land and the infrastructural sector land were converted to productive use, more than half of the observed syrphid fauna would be expected to disappear from the farm, leaving only 46% of the species *in situ*.

The prediction that 46% of the existing syrphid fauna would persist, if the entire farm were converted to productive land, is dependent upon the continued presence of all of the productive sector habitats occurring on the farm at the moment. It should be recognised that this scenario is highly unlikely. The presence of the existing productive sector habitats on the farm is due to the concurrent practice of different management regimes within the *circa* 30ha of productive area of the farm in the same year. Some fields are used for grazing, others for silage production, or a combination of silage production and grazing, a third group of fields is used for crop production and one field is used for production of hay. On the hillside across the valley from this farm, within 1km from its boundary, there is an area of 25ha of land on another farm that has recently been converted from a group of hedged fields to one large field. Within this converted area there are now no hedges or field boundaries of any sort and the entire 25ha is managed as a unit, for one form of intensive use: crop production. Were a similar conversion to be carried out on the entire area of Glinny House Farm (and fields of unit size greater than 40ha are no longer unknown in the farmed landscape in Ireland), the predicted reduction in its observed syrphid fauna would not be 50%, but more than 80%, the fauna being reduced to 12 species. This is because of loss not only of disused sector and infrastructural habitats, but also of all but one of the productive sector habitats. It is debatable whether even these 12 species could survive on the farm under these conditions, because cropland is subject to annual cultivation and, during the time that the ground is ploughed, no syrphid species can be expected to survive there - it would be necessary to assume the availability of habitat for these 12 species somewhere else than on the ploughed area, but within its immediate vicinity, in order for populations of them to be available to colonise the ploughed field once it again carried a crop.

The productive sector land can thus be seen to have a potential to support at most less than half of the existing fauna of the farm and at worst virtually no species at all, dependent upon the management regimes put in place on the farm and on other farms in the vicinity. But from the emergence trap results it can be deduced that the species which can be supported by productive sector land may be produced there in considerable numbers, due to the large area of the surfaces involved and the forced homogeneity of the habitats they carry. Taking the two species collected most numerously in the grassland emergence traps, and given that the area of productive sector grassland available on the farm in 2000 was *circa* 7.5ha, a crude estimate of the population of *Platycheirus albimanus* produced by productive sector grassland in that year would be in excess of 450,000 individuals, and for *P. clypeatus* the figure would be more than 500,000 individuals. The total available hectarage of alternative habitats for these two species on the farm would be more-or-less the same as the hectarage of productive sector grassland, but would be more heterogenous in character. Data are not available to show whether the numbers of specimens of these two species potentially produced by these alternative habitats would be greater or smaller than potentially produced by the productive sector grasslands. But it has to be recognised that, for these species at least, the productive sector may, at present, provide the bulk of the population produced by the farm per annum.

Given that disused sector habitats might be deemed impractical to convert to productive land and thus remain disused, even if the land occupied by the existing farm infrastructure was nearly all converted to productive use, it is apposite to consider what is the potential contribution of the disused sector to maintenance of the present syrphid fauna. The disused sector habitats would be predicted to support 55 of the syrphid species observed on the farm, or three quarters of the existing fauna. A further nine of the observed farm species would be predicted to occur in productive sector habitats. So, in the scenario that the existing productive sector and disused sector habitats remain on the farm, but the infrastructural elements are lost, the farm syrphid fauna might be expected to diminish by seven species, or 9%.

By contrast, were the existing productive sector habitats to be somehow lost, leaving only the disused sector and infrastructural habitats present on the farm, the existing farm fauna would be predicted to change hardly at all. There is only one species, *Rhingia campestris* (which has cow-dung inhabiting larvae), that would be predicted to disappear from the farm under these circumstances, being the only syrphid species observed on the farm that would not be predicted to occur in any of the disused sector or infrastructural habitats.

The observed, disused sector habitats are identified here as potentially supporting as much as 75% of the syrphid species recorded from the farm, so it is worthwhile to consider how the species predicted to be supported by these habitats would be expected to be partitioned between them. In simple numerical terms, the *Molinia* grassland would be expected to support more (32) of the observed farm species than any of the other disused sector habitats. Acid fen would come next, supporting 20 species, followed by the *Alnus* wood (19), with Atlantic scrub supporting the fewest species (15). But, given the presence of other habitats on the farm, the contribution of any one of these disused sector habitats to maintenance of the farm fauna requires also to be viewed in terms of the extent to which its faunal complement is unique to that habitat i.e. not shared with other habitats occurring on the farm. Viewed in this way, the Atlantic scrub makes no contribution to the farm fauna, beyond providing additional habitat for species expected to be supported by other habitats represented on the farm at the moment. Indeed, it would be expected that all species predicted to occur within the Atlantic scrub would be supported by productive sector and/or infrastructural habitats represented on the farm, so the presence of the scrub would not be expected to be instrumental in supporting any species at present confined to disused sector habitats. The other disused sector habitats all have associated with them species that would be expected to be dependent upon the existing disused sector, four with the *Alnus* wood, ten with the *Molinia* grassland and 12 with acid fen. Only two of the disused sector species associated with the *Alnus* wood, *Criorhina berberina* and *Sphegina clunipes*, would not be shared with other disused sector habitats, so the *Alnus* wood would be perceived as playing only a minor role in adding to the farm's fauna, given the array of habitats occurring there at the moment. By contrast, the mosaic of *Molinia* grassland/acid fen habitats would be expected to support 14 of the disused sector species between them (eight shared, two only in the *Molinia* grassland and four only in the acid fen), 12 of which would not be expected to occur in other disused sector habitats. So, then, considering the species probably dependent on disused sector habitats for their presence on the farm, the largest contingent of species would seem to require *Molinia* grassland/poor fen, which would also be expected to be uniquely responsible for maintenance of some 16% of the farm's observed syrphid fauna.

The potential role of set-aside, in maintaining the farm syrphid fauna, remains to be considered. None of the species observed on the farm would be predicted to be dependent upon set-aside for their survival on the farm. And all of the species collected from set-aside in the emergence traps were also collected on the farm by Malaise traps. However, comparison between the species collected by emergence trap in the productive sector and in set-aside (see Appendix 1) shows differences:- eight species collected in productive sector traps and 13 species in set-aside traps. With the small quantity of data available, it is difficult to come to any conclusions, but these data do suggest that the presence of set-aside on a farm may well provide for additional species than would otherwise be supported by productive sector land - so long as there is a nearby population source of those additional species, from which to colonise the set-aside. In the case of the farm studied here, both disused sector and infrastructural habitats would be predicted to have provided species that were collected in the set-aside emergence traps, in addition to those species that could have been derived from productive sector land. Given the transitory nature of set-aside, all of the species that might occur there would, of necessity, have to have an alternative and more permanent habitat in the immediate vicinity, in order to be able to use set-aside during those periods when it was available. But, when it is available, it clearly has the potential to produce enormous numbers of specimens of the species it can support, to judge from the emergence trap results.

Turning to the question of the potential conservation value of maintaining the syrphid fauna of the various habitats present on the farm, at the international level of Europe in general, none of the syrphids recorded from the farm would be regarded as threatened (Speight and Castella, 2000), though *Orthonevra geniculata* would be signalled as decreasing within the Atlantic and continental zones of its European range and as approaching threatened status within both the Atlantic and Alpine zones.

The number of 50km UTM squares in which each species is known (Speight, 2000a) can be used as a basis for comparison of the frequency of syrphid species in Ireland. The average number of grid squares from which each of the observed farm syrphid species are known is 34. The average number of grid squares from which the other syrphid species recorded for Co. Cork (Speight, 2000b) are known is 17. Since the maximum number of these grid squares from which a species can be recorded in Ireland is 50, it can thus be said that, on average, the farm species are species that are widely distributed (in that they would be found in more than 50% of the available grid squares) in Ireland, whereas the other species known from Co. Cork are not. Indeed, only 14 of the observed farm species are known from fewer than 26 of the 50km UTM squares. If degree of threat is to be used as a measure of the conservation value of a species, it would be upon these 14 species that any potential conservation value of the farm fauna would be largely dependent.

While there are syrphid species that have been found in Ireland only in one 50km UTM square, none of those species is known from Co. Cork. However, there are species known from Co. Cork that have been found in five or less of these grid squares in Ireland. There are three of these among the species observed on the farm, and seven of them among the other species known from Co. Cork. In this sense then, the three farm species in this group represent the least frequent of the syrphid species observed on the farm. The species involved are *Helophilus trivittatus*, *Orthonevra geniculata* and *Sphegina elegans*. *H. trivittatus* is a wetland species that was until recently very localised in Ireland, but now seems to be experiencing a phase of rapid expansion (Speight and Nelson, 2000). To consider it as under threat simply on the basis of the number of grid squares from which it is known is thus not very realistic, and in Ireland it has to be regarded more as a species that is progressively occupying new habitat than one retreating from existing habitat. Its presence on the farm is thus largely an irrelevance, in considering the potential conservation value of the fauna. Further, *H. trivittatus* is not predicted to occur in association with any habitat present on the farm, so its occurrence there may well be due to flight into the farm from elsewhere. Indeed, *H. trivittatus* is recognised as one of a small group of European syrphids that characteristically undertake long distance movements as adults (Speight, 2000b). The two specimens collected on the farm came from flowers within one of the fields. Both were collected by hand net, on the same day. *O. geniculata* is a crenal species, judged to be vulnerable to extinction in Ireland, whose habitat is arguably becoming increasingly scarce as a consequence of intensification of farming activities (Speight, 2000a). So its presence on the farm can be regarded as having some conservation interest. The single specimen collected on the farm came from a Malaise trap in the fen/oligotrophic *Molinia* grassland, immediately adjacent to a wet flush, the habitat combination with which it would be predicted to occur on the farm. *S. elegans* is a deciduous forest insect whose larvae are known to live in sap-runs on the trunks of living, overmature trees. It is scarce, but not regarded as threatened, in Ireland (Speight, 2000a). The two specimens collected from the farm came from a Malaise trap located within the *Alnus* woodland, but it is a moot point whether this species is associated with *Alnus* woodland. However, *S. elegans* is not noted as a "migrant" species, so the suspicion must remain that it may be surviving on the farm, even if it would not be predicted to do so.

There are 11 other species recorded from the farm that are known in Ireland from no more than 25 grid squares. While none of them can reasonably be regarded as under threat in Ireland they could be viewed as having some conservation value as less frequent species, so it is worthwhile considering which of the habitats observed on the farm would be expected to support them. Disused sector habitats would be expected to support all but four of these species, the exceptions being *Cheilosia semifasciata*, *Eumerus strigatus*, *Orthonevra nobilis* and *Sphaerophoria scripta*. These four would all be expected to occur in association with the infrastructural habitats. The productive sector habitats present could be expected to support three of these 11 species: *E. strigatus*, *Meliscaeva auricollis* and *Sphaerophoria scripta*.

C. semifasciata offers an extreme case of potential dependency upon infrastructural habitat for its survival within the farmed landscape, since it is associated with old walls, where its larvae mine the tissues of *Umbilicus*. Its natural habitats are scree and cliffs, neither of which occur in the countryside surrounding the farm studied here. It is difficult to see how this insect could have extended its range into the farmland of this part of Co. Cork until field walls and the small quarries from which the wall stone (plus the stone for farm building construction) was derived were introduced to the landscape. Similarly, with removal of the network of old field walls there would be no other habitat to sustain this species, except where disused stone buildings, or disused quarries not overgrown by vegetation, occur.

Today, *S. scripta* is archetypally a productive sector habitat syrphid, almost throughout the Atlantic zone of Europe. It is regarded as highly migratory and a tide of millions of specimens of this species is perceived as surging northwards through the continent in most summers. It is a polyvoltine species with a generation time of only a few weeks, and larvae aphid-feeding on low-growing plants in open ground. On the farm it would be expected to occupy field margins, set-aside and crop land. But its situation on the farm is equivocal, in that only one specimen of this species has been collected there. To any continental syrphidologist this situation would probably seem impossible - if the species is present (and it is nearly always present in grassland on the continent) the expectation would be that it would occur in large numbers. In Ireland, *S. scripta* is rarely found away from low-altitude land close to the coast, and there is no evidence that it ever builds up large numbers in cropland here. Whether it survives the winter months in Ireland is unclear, but the presumption is that it must do so, in favoured locations (Speight, 2000a). Certainly, if this species is dependent upon annual immigration from elsewhere to maintain its presence in Ireland, there is little indication of successful breeding by the immigrant population. And the farm data gathered in this study is a case in point - the solitary specimen collected was derived from a Malaise trap catch in the first half of August, in set-aside. Was this a migrant specimen? If it originated from a local population, why was the species not recorded more abundantly, and earlier in the year as well? The emergence traps located in set-aside on the farm produced no specimens of *S. scripta*. Given the propensity of this species to build up populations rapidly, within the types of habitat represented over large surfaces in the productive sector of the farm, but the lack of any indication that it did so, despite being apparently able to reach the farm, suggests that *S. scripta* may not be a resident species there, even though predicted to occur.

Essentially, then, of the 14 syrphid species observed on the farm which might be regarded as having some conservation value, in that they are known from no more than half of the 50km UTM grid squares in Ireland, eight would be expected to occur in association with disused sector habitats on the farm, and the rest with infrastructural habitats, with the exception of two (*H. trivittatus* and *S. elegans*) that may not be resident on the farm. The productive sector habitats would be expected to support a few of these species, all of which would be supported by either infrastructural or disused sector habitats as well. Among these 14 species, the one which might be singled out as of some particular conservation interest is *O. geniculata*, because of its status both nationally and internationally. This syrphid would not be expected to survive on the farm other than in the disused sector, where it would be predicted to occur in association with acid fen.

3.2.2 The Sciomyzidae observed, their habitat associations and their conservation value

All of the sciomyzid species observed would be predicted to occur on the farm, on the basis of the habitats observed, if it is accepted that some sort of fen is present on the farm. However, many more sciomyzid species would be predicted to occur than have been observed, if it is accepted that fen is present. If the alternative interpretation, of humid, flooded grassland is used (i.e. fen is regarded as absent) a much closer approximation to the observed farm sciomyzid fauna is predicted, but three of the observed species (*Elgiva solicita*, *Renocera pallida* and *Tetanocera punctifrons*) would not then be predicted to occur. One of these three species, *R. pallida*, is also associated with wet woodland and would be predicted to occur if the *Alnus* woodland were to be classed as *Alnus* swamp. However, it clearly is not swamp woodland and, running the prediction of the farm sciomyzid fauna on the assumption that wet woodland is present would predict also the presence of a large number of species that have not been observed on the farm. Nonetheless, it has to be recognised that the *Alnus* woods may be wet enough to allow the presence of *R. pallida* there, even if they are not swamp woodland. Certainly, from examination of the Malaise trap results, it is apparent that *R. pallida* was collected on a number of occasions in both parts of the disused sector land, the wet grassland/fen and the *Alnus* woodland, not just in the wet grassland/fen. This species was not collected in any Malaise trap outside the disused sector.

If the disused sector land was brought into production on the farm, it would be predicted that the sciomyzid fauna would be reduced to eight species. If the infrastructural land were also converted to productive use, a further reduction to five species would be expected, if the current mix of management regimes were maintained on the productive sector land. However, were the entire farm area converted to crop production, all sciomyzids would be predicted to disappear from the farm. For the sciomyzids, then, the disused sector land is the farm's most significant feature, with more than half of the observed fauna probably dependent upon it, the infrastructural habitats also have some species dependent upon them and the management regimes that are used within the productive sector would be expected to determine the survival of the rest of the farm sciomyzid fauna.

The status in Ireland of the various sciomyzid species recorded from the farm is less certain than the status of syrphid species, due to less emphasis having been placed on the study of sciomyzids. However, it can be said that two of the species observed on the farm, *E. solicita* and *T. punctifrons*, are among the least frequently encountered sciomyzids known in Ireland and, when considered in this light, are potentially of some "conservation value". They are both species of fen habitats and their loss from the farm would be predicted to accompany conversion of the disused sector land to productive use.

Discussion

The sciomyzid situation parallels what has been found for the syrphids, namely that regarding the wet grassland as unimproved, seasonally-flooded, oligotrophic *Molinia* grassland provides a close agreement between observed and predicted faunas, except for a few species whose presence would not be predicted unless it were accepted that the wet grassland represents also a residual acid fen. So, using both syrphid and sciomyzid data, the grassland of the disused sector land appears to be most reasonably interpreted as faunistically somewhat intermediate between Molinia grassland and acid fen, assuming the observed species are resident. Further, the entire observed sciomyzid fauna of the farm would be predicted to occur in association with the disused sector *Molinia* grassland/acid fen habitats, and most of the observed sciomyzid species would be expected to disappear from the farm were the disused sector land converted to productive use, emphasising the potential significance of the disused sector land in maintaining the existing fauna of the farm. Consideration of other elements of the farm fauna, in Part 1 of this series, identified the infrastructural land as supporting more dependent species than any other part of the farm. That assessment was based on taxonomic groups whose total observed fauna on the farm amounted to 75 species. The sciomyzids and syrphids observed on the farm together comprise 95 species. If the 170 species covered in Parts 1 and 2 of this series are considered together, the disused land habitats would be identified as the part of the farm potentially supporting a marginally greater number of dependent species than any other part of the farm. Of perhaps rather greater significance is the fact that, whether taken together or separately, the disused sector land and the infrastructural land would seem to be of far greater significance in maintaining the existing farm fauna than the productive sector land, whichever of these taxonomic groups are considered and in whatever combination. And this is so despite the fact that the productive land hectarage on the farm is three times as great as is the hectarage of disused and infrastructural land combined.

The significance of the disused sector habitats, and the *Molinia* grassland/acid fen area in particular, as a "refugium" for species not otherwise likely to survive on the farm, has been highlighted at various points in the preceding paragraphs. That this area is in a transitional condition is apparent from its fauna, suggesting that without some sort of active management it may well not remain in its present condition. But identifying its interest does not ensure its survival, in the face of pressures to intensify use of farmland. Neither does identifying its interest ensure appropriate management will occur, even in the event that the area was retained in its disused state, as apparently having some conservation value. These issues are considered in more detail in Part 3 of this series).

The case study farm is entirely ringed about by other farms. On most of them the infrastructural habitats observed on the case study farm are, to a greater or lesser extent, still in place. The surrounding farms exhibit a range of conditions, in terms of the degree to which their management is oriented to production of one or more outputs. But in all cases, the surrounding farms are operating intensive farming regimes. As to disused sector land carrying natural/semi-natural habitats, within 1km of the boundary of the case study farm several enclaves of scrub are present, there are two areas of *Molinia* grassland and one area of acid fen, plus one area of mixed deciduous woodland (trees include *Quercus*, *Fraxinus*, *Acer* and *Betula*) and some riparian *Alnus/Salix* woodland along a river. There is also one additional productive sector habitat, in the form of approximately 1ha of *Picea* plantation. Viewed in this light, the case study farm is a microcosm of the landscape in which it is located, lacking only *Quercus/Betula* woodland, a river and conifer plantation, of the habitat types occurring in its surround. Given the extent to which the range of habitats observed on the case study farm is also present elsewhere, in its vicinity, how confident can one be that the syrphids collected on the farm are derived from the farm, rather than its vicinity - especially since adult syrphids are fully flighted and highly mobile and survey of the farm syrphid fauna has been largely dependent upon trapping of the adult flies? Without more extensive use of emergence traps, to demonstrate which species are hatching within the farm boundaries, there is no direct answer to this question. What can be said is that the relationship between the species observed and the habitats observed remains the same, whether the farm is considered as a unit or as a proxy for the landscape in which it is situated. Viewed in this light, what is said of the farm in the preceeding pages also highlights the importance of the presence of both infrastructural habitats, and disused sector habitats, in the surrounding farmland landscape.

Conclusions

One reality suggested by this study is that it may be unreasonable to expect farms to play much of a role in maintenance of seriously threatened species (e.g. species classified as endangered), since such organisms are unlikely to be present on farmland. This may be regarded as a matter of minor significance, if farms could nonetheless support more than half (in this case 60%) of the species known from the region in which they are located, given sympathetic management of whatever infrastructural and disused sector land is included within their area. Sympathetic management is clearly critical to the achievement of any such level of species representation - failure to retain and maintain existing patches of disused land within the farm studied here would be predicted to reduce the proportion of the regional fauna supported by the farm to 45% for the syrphids and to 30% for the sciomyzids. And failure to retain and maintain farm infrastructural habitats (in particular hedges, field margins and open ditches) as well would be expected to cause a further reduction of 15% in the syrphid fauna, from loss of species shared by disused land and infrastructural habitats but not found in productive land, plus a reduction of 5% due to species dependent upon the infrastructural habitats themselves. So the farm would then support only some 25% of the regionally occurring syrphid fauna. For the sciomyzids, a further loss of 10% of the regional fauna would be expected, following from loss of infrastructural habitats.

The use to which the productive land on the farm is put could evidently cause additional shrinkage in the fauna, subjection of the entire area of the farm to a single management regime like crop production producing the most extreme scenario, resulting in the farm being predicted to support no more than 10% of the present regional syrphid fauna and no sciomyzids at all.

Further, the remaining syrphids would probably be reduced to the status of only temporary residents, dependent upon adjacent land for survival when the surface of the case study farm was at a stage in the crop production cycle that rendered it unsuitable for sustaining their populations. And if the land of the surrounding farms was in the same condition at the same time, there would no population source available, from which this 10% of the original syrphid fauna could recolonise the farm.

A summary of these percentage decreases is shown in Table 1.

TABLE 1. The proportion of the observed fauna of the farm predicted to survive there in the event of loss of particular habitats from the farm, expressed as a percent of the Co. Cork fauna. Abbreviations: DS lost = loss of disused sector habitats; IS lost = loss of infrastructural habitats; grass lost = conversion of all grassland to crop production.

Taxonomic group	Percentage of Co. Cork list present on farm				
	observed	predicted to remain in event of habitat loss			
		DS lost	IS lost	DS, IS lost	DS, IS & grass lost
Sciomyzidae	60	30	60	20	0
Syrphidae	60	45	5	25	10

There are clearly grounds for concluding that, whatever manipulation of productive sector land may be achieved by attempts to make farming more "eco-friendly", little may be gained by such efforts, that would not be as easily achieved by effective maintenance of farm infrastructural habitats, notably field margins and associated hedges and ditches. Similarly, where there are areas of what has been termed here "disused land" included within the perimeter of a farm, efficient maintenance of these disused areas can have the potentiality to further increase the size of the fauna surviving in the farmland landscape by more than one third. These conclusions are based on a study of one farm, two families of flies and the particular habitat strata they inhabit - the grass-root zone (inclusive) upwards - so the extent to which they can be extrapolated to other groups of organism and farmland in general is uncertain. The taxonomic groups considered in Part 1 of this series gave a somewhat different result from the taxonomic groups considered here, and it may only be because a greater number of species have been covered in the present (Part 2) account, that considering the species covered by both Parts 1 and 2 together produces a result more akin to the findings of Part 2 than Part 1. All together, the taxonomic groups covered in Parts 1 and 2 probably represent little more than 2-3% of the total faunal diversity of the farm and this could also be deemed an insufficient sample. However, the conclusions drawn here are very much in line with what is known of the ecological effects of present-day farming regimes in general and prescriptions offered for managing biodiversity on farms (see, for example, Hill *et al.*, 1995). So there are good grounds for assuming that what we have found on this farm does reflect the general situation existing in equivalent farmland landscapes elsewhere in Ireland, not just for the taxonomic groups we have investigated, but for many other taxonomic groups as well. Even so, it would be helpful if equivalent studies of other taxonomic groups of invertebrates were carried out.

The numbers of species associated with different habitats have been used here as a basis for looking at which parts of a farm may be the most important to the maintenance if its fauna. This is arguably a rather simple-minded approach to a very complex issue. However, it does result in predictions which can easily be tested and involves a methodology that could be applied on almost any farm in Ireland. It is hoped that the veracity of at least some of the predictions relating to the fauna of the test-case farm can be investigated by further work there, now on-going.

Recent studies, in parts of Atlantic Europe that are subject to the same forms of intensive farming as those occurring in the part of Co. Cork studied here, have shown an alarming decrease in many of the more traditional components of farmland fauna (see, e.g. Gregory *et al.*, 2001), so it would seem a valid objective to attempt to identify mechanisms that would ensure the survival of existing farmland faunas, whatever may be the perceived conservation value of the constituent species. Once again, on the basis of what has been found on the farm studied here, the potential role of infrastructural and disused sector habitats is thrust to the fore in any such initiative - these components of the farmland landscape would seem to hold the key to survival of existing farm faunas, much more so than the land actually used for production. In the case of the case study farm (see Part 1), it is also from these habitats that most recorded species losses have already occurred, during the last 50 years.

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APPENDIX 1. Sciomyzids and syrphids observed on the farm 1994-2000, plus the sectoral habitat groups with which the syrphid species are known to be associated.
Numbers of specimens collected are not recorded for species collected only by hand net.
Association between a species and habitat(s) occurring in a particular sector on the farm is indicated by a "1" opposite the name of the species, in the relevant Habitat Assocations column.
Abbreviations used: no specs = number of specimens; t = traps; Grass = improved/intensive grassland used for grazing and/or silage production; Seta = set-aside; Prod = productive sector habitats; Infra = infrastructural habitats; disuded = disused sector habitats.

	Numbers of specimens collected			Habitat Associations			
	Malaise traps	Emergence traps		Prod	Infra	Disused	Seta
SPECIES OBSERVED		Grass	Seta				
Syrphidae (Diptera)							
Anasimyia lineata (Fabricius, 1787)	1					1	
Baccha elongata (Fabricius, 1775)	11				1	1	
Cheilosia albipila Meigen, 1838	3					1	
Cheilosia albitarsis (Meigen, 1822)	17			1	1	1	
Cheilosia antiqua (Meigen, 1822)	1				1	1	
Cheilosia bergenstammi Becker, 1894	2			1	1		
Cheilosia illustrata (Harris, 1780)	3				1		
Cheilosia pagana (Meigen, 1822)	85			1	1		
Cheilosia semifasciata Becker, 1894	15				1		
Cheilosia vernalis (Fallén, 1817)	1			1	1		
Chrysogaster solstitialis (Fallén, 1817)	1				1	1	
Chrysotoxum bicinctum (L., 1758)	18			1	1	1	
Criorhina berberina (Fabricius, 1805)	3					1	
Dasysyrphus albostriatus (Fallén, 1817)	3				1	1	
Epistrophe eligans (Harris, 1780)	94			1	1		
Episyrphus balteatus (DeGeer, 1776)	87	2	6	1	1	1	1
Eristalinus sepulchralis (L., 1758)	13			1	1	1	
Eristalis abusivus Collin, 1931	6					1	
Eristalis arbustorum (L., 1758)	31			1	1	1	
Eristalis horticola (DeGeer, 1776)	5			1		1	
Eristalis interruptus (Poda, 1761)	20			1	1	1	
Eristalis intricarius (L., 1758)	9			1		1	
Eristalis pertinax (Scopoli, 1763)	77			1	1	1	

APPENDIX 1 (continued)

Eristalis tenax (L., 1758)	7			1	1	1	
Eumerus strigatus (Fallén, 1817)	121		1	1	1		
Eupeodes corollae (Fabricius, 1794)	40	1	18		1	1	1
Eupeodes latifasciatus (Macquart, 1829)	631		49	1		1	1
Eupeodes luniger (Meigen, 1822)	2			1	1		
Helophilus hybridus Loew, 1846	10					1	
Helophilus pendulus (L., 1758)	292			1	1	1	
Helophilus trivittatus (Fabricius, 1805)							
Lejogaster metallina (Fabricius, 1781)	86					1	
Leucozona laternaria (Müller, 1776)					1		
Leucozona lucorum (L., 1758)	11				1		
Melangyna lasiophthalma (Zetterstedt, 1843)	1				1	1	
Melanogaster hirtella (Loew, 1843)	38				1	1	
Melanostoma mellinum (L., 1758)	1010	22	16	1	1	1	1
Melanostoma scalare (Fabricius, 1794)	505	2	4	1	1	1	
Meligramma cincta (Fallén, 1817)	10				1		
Meliscaeva auricollis (Meigen, 1822)	9			1	1	1	
Meliscaeva cinctella (Zetterstedt, 1843)	1				1	1	
Myathropa florea (L., 1758)	2			1		1	
Neoascia podagrica (Fabricius, 1775)	56		2	1	1	1	
Neoascia tenur (Harris, 1780)						1	
Orthonevra geniculata (Meigen, 1830)	1					1	
Orthonevra nobilis (Fallén, 1817)	1				1		
Platycheirus albimanus (Fabricius, 1781)	1146	79	73	1	1	1	1
Platycheirus ambiguus (Fallén, 1817)	4				1	1	
Platycheirus angustatus (Zetterstedt, 1843)	23					1	
Platycheirus clypeatus (Meigen, 1822)	1310	91	5	1		1	
Platycheirus granditarsus (Forster, 1771)	547	156	18	1		1	
Platycheirus manicatus (Meigen, 1822)	21		1			1	
Platycheirus occultus Goeldlin, Maibach and Speight, 1990	8					1	
Platycheirus rosarum (Fabricius, 1787)	23					1	
Platycheirus scambus (Staeger, 1843)						1	
Platycheirus scutatus (Meigen, 1822)	160				1	1	
Rhingia campestris Meigen, 1822	305	1		1			
Riponnensia splendens (Meigen, 1822)	10				1	1	
Scaeva pyrastri (L., 1758)				1	1	1	1
Sericomyia silentis (Harris, 1776)	52					1	
Sphaerophoria interrupta (Fabricius, 1805)	14			1	1	1	
Sphaerophoria scripta (L., 1758)	1			1	1		1

APPENDIX 1 (continued)

Sphegina clunipes (Fallén, 1816)	8					1	
Sphegina elegans Schummel, 1843	2						
Syritta pipiens (L., 1758)	18		3	1	1	1	
Syrphus ribesii (L., 1758)	56			1	1	1	1
Syrphus torvus Osten-Sacken, 1875	1				1	1	
Syrphus vitripennis Meigen, 1822	26		1		1	1	
Trichopsomyia flavitarsis (Meigen, 1822)	4					1	
Volucella bombylans (L., 1758)	31				1	1	
Volucella pellucens (L., 1758)	3				1		
Xylota segnis (L., 1758)	44				1	1	
Xylota sylvarum (L., 1758)	4						
number of species:	68	8	13	32	47	55	8
number of specimens:	7161	354	197				
Sciomyzidae (Diptera)							
Coremacera marginata (Fabricius, 1775)	1			1		1	
Elgiva solicita (Harris, 1780)	1					1	
Hydromya dorsalis (Fabricius, 1775)	14					1	
Ilione albiseta (Scopoli, 1763)	1					1	
Ilione lineata (Fallén, 1820)	39					1	
Limnia paludicola Elberg, 1965	1					1	
Pherbellia cinerella (Fallén), 1820	2			1		1	
Pherbellia dubia (Fallén), 1820	3				1	1	
Pherbellia scutellaris (von Roser, 1840)	1				1	1	
Pherbellia ventralis (Fallén, 1820)	2				1	1	
Renocera pallida (Fallén, 1820)	11					1	
Tetanocera arrogans Meigen, 1830	9					1	
Tetanocera elata (Fabricius, 1781)	61	1		1		1	
Tetanocera ferruginea Fallén, 1820	17			1		1	
Tetanocera fuscinervis (Zetterstedt, 1838)	9					1	
Tetanocera punctifrons Rondani, 1868	1					1	
Tetanocera robusta Loew, 1847	9			1	1	1	
number of species:	17	1	0	5	4	17	0
number of specimens:	182	1					

APPENDIX 2. Definitions of habitat categories referred to in text.

These definitions include repeatedly reference to numbered CORINE "habitat" categories. For explanation, see the entry under "**corine**". Where a habitat category used here more-or-less corresponds with a habitat category referred to in *A Guide to Habitats in Ireland* (Fossitt, 2000), this is indicated at the end of the definition provided for it here, by the letters GHI, followed by the code number allocated to the corresponding category by Fossitt (*loc. cit.*). Where there is no such indication, the categories do not correspond. For instance, the term "flush" is used by Fossitt (2000) to denote only a part of the spectrum of helocrene features and the flushes recognised in the present text gain no expression in Fossitt's work. Similarly, the category "dry meadows and grassy verges", recognised by Fossitt, is an amalgam of different habitats dependent upon different forms of management lumped together, which does not provide a functional category that may be used here, because field margins require to be treated separately and defined separately from field surfaces. In all, less than half of the habitat categories recognised here are given separate identity in Fossitt (2000).

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 colonize 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

APPENDIX 2 (continued)

(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*.
GHI: PF2

Alnus, deciduous forests: alder (*Alnus*) woods, 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.
GHI: WN6

atlantic thickets, 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 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 fructicosis* scrub *p.*)
GHI: WS1

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

APPENDIX 2 (continued)

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, 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.

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.

cow dung: 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.
GHI: BC1

drainage ditch: intermittently-flooded, man-made drainage channels dug in cultures.

APPENDIX 2 (continued)

fallow: 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 "set-aside" land (now employed within the EU as a standard mechanism for crop production control).

farmyard organic waste: accumulations of solid farmyard livestock waste (manure) and/or seepages of either slurry (liquid livestock waste) or silage (preserved grassland vegetation) from holding facilities.

field margin/hedge bank: permanently uncultivated, linear strip of land along the boundary of a cropland or intensive grassland, usually less than 2m wide and covered in herbaceous vegetation in which grasses predominate, and frequently backed by a hedge or fence. 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.

flush: helocrene groundwater outflows emerging over a diffuse area to produce seepages or flushes.

hedge: linear strips of deciduous trees and/or shrubs, planted along field margins, 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 treees at irregular intervals.
CORINE 84.2: HEDGEROWS
GHI: WL1

APPENDIX 2 (continued)

improved grassland: improved pasture and meadow: 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, butextend 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.

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.
GHI: GA1

old 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 moraine and scree organisms.
GHI: BL1

oligotrophic *Molinia*, humid/flooded, unimproved grassland: nutrient-poor purple moorgrass (*Molinia coerulea*) grassland, developed on peat. CORINE 51.2.

APPENDIX 2 (continued)

CORINE 51.2: PURPLE MOORGRASS BOGS; *Ericion tetralicis p.*; drying, mowed or burned bogs invaded by *Molinia caerulea.*

orchard: CORINE 83.1: HIGH-STEM ORCHARDS; tree crops of standards, cultivated for fruit production.

permanent pond/pool: small, permanent water body of man-made or natural origin with standing water. This term is used here in contradistinction to lakes, reservoirs and temporary pools.

scattered trees in open ground: 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.
GHI: WD5

seasonal brook in cultures: 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.

set-aside: see fallow.

temporary 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.

FIGURE 1. The case study farm, showing location of Malaise trap emplacements.