



SEMI-NATURAL GRASSLAND SURVEY OF COUNTIES ROSCOMMON AND OFFALY



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Executive Summary

Ninety-one sites and 305 relevés in Roscommon and Offaly were surveyed from May to September 2007. Of the 91 sites 39 were within a designated area, SAC (Special Area of Conservation) or NHA (Natural Heritage Area). Wet grassland was the most frequent semi-natural grassland habitat, recorded at 65% of sites, and dry-humid grassland was the least frequent found at 8% of sites. The most common EU Annex I grassland habitats were *Festuca-Brometalia* (6210/6211) recorded at 18% of sites and *Molinia* meadows (6410) recorded at 13% of sites.

The vegetation classification utilised hierarchical cluster analysis to analyse the relevé data. The classification contained two main groups. The dry grassland group which accounted for 40% of the relevés was named *Cynosurus cristatus* – *Plantago lanceolata*, based on the groups top grass and forb indicators, and included both mesotrophic and calcareous grasslands. This group was further divided into three vegetation types, the *Succisa pratensis* type which had the closest affinity to calcareous grassland, and two mesotrophic grassland types named the *Ranunculus acris* type and *Dactylis glomerata* type. The wet grassland group which accounted for 60% of the relevés was named *Agrostis stolonifera* – *Filipendula ulmaria*. This wet group was further divided into three vegetation types, the *Galium palustre* type which had the closest affinity to marsh habitat, the *Holcus lanatus* type and the *Molinia caerulea* type. The proposed vegetation classification highlights the limitations of Fossitt (2000) which only classifies semi-natural grassland into four groups and marsh into one rigidly defined group.

None of the EU Annex I grassland habitats surveyed during the project were assessed to be in a favourable state. In part this was due to the assessment criteria that were used, therefore based on the vegetation analysis seven new positive indicator species were proposed for *Molinia* meadows (6410) and six new positive indicator species were proposed for Lowland hay meadows (6510). The seven new positive indicator species proposed for 6410 were *Calliergonella cuspidata*, *Carex flacca*, *Carex panicea*, *Centaurea nigra*, *Potentilla erecta*, *Rhianthus minor*, and *Trifolium pratense*. The six new positive indicator species proposed for 6510 were *Crepis capillaris*, *Festuca pratensis*, *Phleum pratense*, *Plantago lanceolata*, *Ranunculus acris*, and *Trifolium pratense*. The annex habitat *Festuca-Brometalia* grassland (6210.6211) was the most vulnerable of the EU Annex I grassland habitats recorded during the survey.

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1. INTRODUCTION

General background

Grassland habitats cover approximately 73% of the land area of Ireland (O'Sullivan 1982), but the overwhelming majority of this is improved agricultural grassland, with semi-natural grassland habitats contributing only a small percentage of the total. The current dominance of grassland habitats in Ireland is the result of millennia of human activity altering the predominantly wooded landscape that existed 5000 years ago (Hall & Pilcher 1995). However, the low intensity agricultural practices that once allowed the development of species-rich semi-natural grassland have now all but ceased, threatening the existence of this habitat type within Ireland. Any semi-natural grasslands that remain are threatened either by the abandonment of all management, which for most grassland areas results in reversion to scrub, or by the intensification of management, resulting in the replacement of a diverse array of species with a small number of high-yielding ones.

During the last fifty years, agriculture in Ireland has changed completely with increases in the mechanisation of agriculture, the use of arterial drainage schemes and the application of fertilisers. Ireland's entry into the European Union (EU) in 1973 resulted in financial incentives to improve agricultural productivity (Feehan 2003) and as a result the nature of Ireland's grasslands has been radically altered. The majority of the remaining areas of semi-natural grassland owe their continued existence to edaphic and topographical conditions that make them unsuitable for the application of fertilisers, reseeding or drainage.

Survey area

Counties Roscommon and Offaly are located in the midlands of Ireland and most of the land within the two counties is below 135m in altitude. The highest point in Co. Offaly is 520m, in the Slieve Bloom Mountains, in the south of the county, while the highest point in Roscommon occurs in the far north of the county, at Corry Mountain (405m). The river Shannon, the largest river system in Ireland, runs along the eastern border of Roscommon and along the border between Roscommon and Offaly. Lakes are numerous in Roscommon and eskers run through both counties, but are more frequent in Offaly. Both counties are dominated by limestone bedrock, with small amounts of sandstone or shale occurring in mountainous areas. The soil is primarily composed of a combination of glacial tills and areas of basin peats, most of which have been cut.

Vegetation studies of Irish grasslands

Since Braun-Blanquet & Tüxen (1952) made the initial attempts at classifying the grasslands of Ireland, the number of vegetation studies of this habitat has been disproportionately small considering the large area of Ireland that grasslands occupy. One reason for this is that the overwhelming majority of Irish grassland vegetation is low diversity agricultural grassland. The most notable research on Irish grasslands was conducted by O'Sullivan (1965, 1968, 1976, 1982) who collected field data from a broad range of grassland habitats. In addition to this research

contributing to the most comprehensive classification of Irish grasslands to date (O'Sullivan 1982), the data from the thousands of individual relevés collected provide researchers with a well-documented and archived dataset (D. Bourke pers. comm.). The majority of the other grassland vegetation studies that have been carried out in Ireland have been more limited in their aims. Research has either focused on a particular region of Ireland, such as the Burren (Ivimey-Cook & Proctor 1966, O'Donovan 1987, Keane & Sheehy Skeffington 1995), Leinster (Byrne 1996) or Fermanagh (Eakin 1995), or on a particular grassland vegetation type, such as callows grassland (Heery 1991, Tolkamp 2001) or esker grasslands (Bleasdale 1998, Tubridy 2006). However, some of the most recent studies have been broader in their remit. O'Donovan & Byrne (2004) carried out research in Sligo and Westmeath with the aim of developing a method for mapping semi-natural grassland across Ireland and Dwyer *et al.* (2007) carried out a countrywide study of priority EU Annex I grassland habitats within SACs (Special Areas of Conservation).

Classification of Irish grasslands

Braun-Blanquet & Tüxen (1952) were the first to systematically classify the Irish grasslands based on the Zurich-Montpellier phytosociological approach but it was not until 1982 that the first comprehensive classification was published (O'Sullivan 1982). Using the same phytosociological approach, O'Sullivan divided all Irish grassland into three classes, the Molinio-Arrhenatheretea, the Nardetea, and the Festuco-Brometea. The Molinio-Arrhenatheretea, which include lowland meadows and pastures on neutral soils, was the most frequent group based on over 2,500 relevés and estimated to cover 65% of the land area of Ireland. The Molinio-Arrhenatheretea is divided into the Arrhenatheretalia elatoris and Molinietales caeruleae orders. The Arrhenatheretalia elatoris generally include drier meadows and pastures, including improved agricultural fields dominated by *Lolium perenne* and *Trifolium repens*. The Molinietales caeruleae represent wet meadows and pasture communities on clay, loam and humus-rich gley soils that are generally not fertilised. The Nardetea include acid grassland communities and was estimated to cover 4.4% of the land area of Ireland. The Festuco-Brometea represented in Ireland by the sole order Brometalia erecti, include dry limestone grasslands on base-rich soils and was estimated to be the least frequent of the three major classes of grassland covering only 0.3% of the Irish land area. White & Doyle (1982) in their catalogue of Irish vegetation types drew heavily on the work of O'Sullivan (1982), reapplying his classification of Irish grasslands with the addition of some rarer associations, such as the Violetea calaminariae class which includes the grassland vegetation of areas rich in heavy metals.

However, the most widely utilised grassland classification in Ireland is the recent system of Fossitt (2000). Unlike O'Sullivan (1982) which is a vegetation classification, Fossitt (2000) is a habitat classification which utilises soils, geology and landscape features, in addition to plant communities, to define each habitat. Fossitt (2000) presents a simplified and standardised way to classify habitats in Ireland but is based on the results of previous phytosociological studies rather than being based objectively on empirical data. The five habitat categories directly relevant to this survey of semi-natural grassland are as follows:

- **GS1 Dry calcareous and neutral grassland.** This encompasses all unimproved and semi-improved grasslands on both calcareous and neutral soil. It is associated with free-draining mineral soils and low intensity agriculture.
- **GS2 Dry meadows and grassy verges.** This habitat is found on free-draining mineral soils and in low intensity farming systems. The management is different from that in GS1 in that the grassland has little or no grazing but instead is cut annually. The pattern of management favours tall, coarse, tussock forming grass species, in particular *Arrhenatherum elatius* and *Dactylis glomerata*.
- **GS3 Dry-humid acid grassland.** This grassland is found on free-draining acid soils that are not waterlogged. This grassland is found mainly on mineral-rich or peaty podzols in uplands but is also found on siliceous sandy soils in the lowlands.
- **GS4 Wet grassland.** This habitat type is found on poorly-drained mineral and organic soils and includes grassland that is seasonally or periodically flooded. It encompasses a range of wet grassland types from wet rushy pasture to callows.
- **GM1 Freshwater marsh.** This habitat is found on waterlogged mineral and shallow peat soils near lake and river edges and other wetland habitats, where the water table is near to the surface for most of the year. It is characteristically rich in broadleaf herbs, and grasses and sedges should not exceed 50% of the ground cover.

The grasslands section of the National Vegetation Classification (NVC) used to classify British plant communities (Rodwell 1992) is not based upon Irish data, but it does provide in detail an indication of the range of plant communities likely to exist in Ireland. It also provides this in a system that does not follow the subjective methods inherent in the central European phytosociological approach of Braun-Blanquet & Tüxen (1952). Recently, Perrin *et al.* (2006a, b) produced an NVC-style classification of Irish woodland vegetation employing a range of more objective techniques.

Conservation of Irish grasslands

Semi-natural grasslands are an extremely vulnerable habitat in Ireland. Areas of semi-natural grassland that are accessible to machinery are particularly vulnerable to agricultural improvement. Keane & Sheehy Skeffington (1995) showed that the addition of fertiliser to semi-natural grasslands resulted in a change of sward composition and a loss of plant species diversity. The vulnerability of semi-natural grasslands to agricultural improvement, afforestation and scrub encroachment was demonstrated by Byrne (1996) who found that 38% of the sites documented by O'Sullivan during the 1970s no longer supported semi-natural grassland communities by 1994.

Grasslands of conservation interest are protected in Ireland through conservation designations that vary in the level of protection they provide to the species and habitats found within them. Grasslands located within National Parks and Nature Reserves have the highest level of protection as they are state-owned and managed for conservation. SACs (Special Areas for

Conservation) and SPAs (Special Protection Areas) designated as a result of EU Directives provide the next highest level of protection, whilst NHAs (Natural Heritage Areas) designated under domestic legislature provide the third tier of protection. However, as there has been no comprehensive survey of semi-natural grassland for over 25 years the application of conservation designations to protect areas of semi-natural grassland has taken place on mainly an *ad hoc* basis.

The EU Habitats Directive has contributed to the conservation of semi-natural grassland in Ireland by listing and defining 28 types of Annex I grassland habitats of conservation importance in Europe (Anon. 2003). Under this directive, Ireland has a responsibility to designate SACs to protect and maintain at a favourable conservation status any of these habitats that occur within the State. Seven of these EU Annex I grassland habitats of conservation importance have been recorded within Ireland and six have been recorded in Offaly and Roscommon by the National Parks and Wildlife Service (NPWS), Calaminarian grasslands of the *Violetalia calaminariae* (6130) is the only EU Annex I grassland habitat that has not been recorded within the study area. The six EU Annex I grassland habitats recorded within Offaly and Roscommon are listed below:

- Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (6210).¹
- Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (important orchid sites) (6211).
- Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and sub-mountain areas, in Continental Europe) (6230).
- *Molinia* meadows on calcareous, peaty or clayey-silt laden soils (*Molinion caerulea*) (6410).
- Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430).
- Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*) (6510).

Only two grasslands habitats in Ireland, 6211 and 6230, are accorded priority status.

The systematic monitoring and assessment of the EU Annex I grassland habitats located within the State has started with 33 orchid-rich calcareous grassland sites (6210/6211) and 9 species-rich *Nardus* grasslands (6230) surveyed during 2006 (Dwyer *et al.* 2007). The methodology employed for the monitoring and assessment adapted those published by the EU (Anon. 2006), the Joint Nature Conservancy Council (JNCC) in Britain (JNCC 2004) and those already utilised for dune systems in Ireland (NPWS 2007). In the UK, the process of monitoring, assessing and reporting on EU Annex I grassland habitats is far in advance of Ireland, as indicated by the recent publication of *The European Context of British Lowland Grasslands* (Rodwell *et al.* 2007).

¹ Festuco-Brometalia is an old synonym for the order Brometalia-erecti. It is not synonymous with the class Festuco-Brometea as indicated in Fossitt (2000)

As semi-natural grasslands in Ireland almost always exist within farming systems there is the possibility that agri-environment schemes such as the Rural Environmental Protection Scheme (REPS) and the Farm Plan Scheme (A. Bleasdale pers. comm.) will be able to significantly contribute to the conservation of semi-natural grassland. However, currently there is little evidence that these schemes are contributing to the conservation of semi-natural grassland within Ireland.

Scope of this report

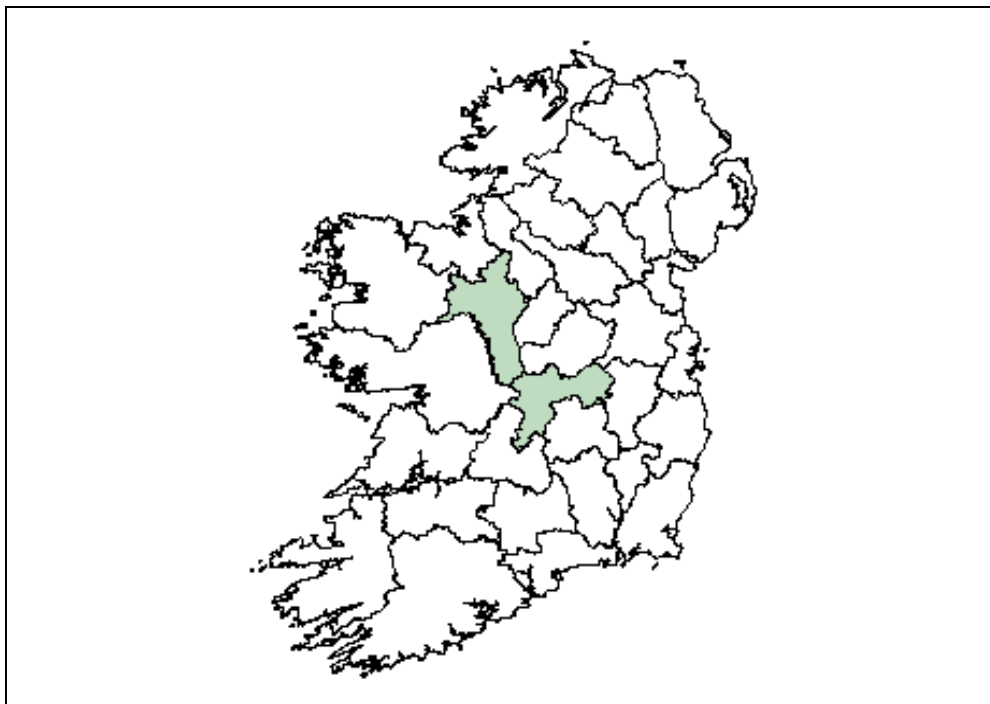
This document reports on a survey of semi-natural grasslands in Cos. Roscommon and Offaly conducted in summer 2007. The remit of the project was to record 300 relevés from the range of semi-natural grassland types which occur across the two counties and to map all habitat types found at each site using GIS. A further aim was to conduct a conservation assessment of any EU Annex I habitat types found and to develop assessment criteria where necessary. Data from the survey was to be used to create an objective classification which described the diversity of vegetation types found and which could be used to evaluate existing classification systems. An assessment of the conservation value of each site as a whole was to be used to highlight important sites outside the designated sites system. This project was to serve as a pilot study to develop the methodology for a potential national survey of semi-natural grasslands in Ireland.

2. METHODS

2.1 Site selection

The target for this project was to record 300 relevés from sites across the two counties. To ensure a good geographical spread of sites, an average of two sites were selected from each 10km square with $\geq 50\%$ of its area located within counties Roscommon and Offaly. This resulted in a target of 91 sites. Additional sites were selected to allow for those that would not be surveyed due to problems such as a lack of actual semi-natural grassland habitats or owners denying access. The geographical location of the survey area is shown in Figure 2.1.

Figure 2.1. Map of Ireland showing the survey area of counties Roscommon and Offaly



In addition to this stratified sampling of the survey area, the criteria listed below were considered during site prioritisation to ensure that a broad range of semi-natural grassland sites were included in the survey:

- Sites already designated for conservation (e.g., NHAs, SACs).
- Sites highlighted by previous reports (e.g., Tubridy 2006) that had not been comprehensively surveyed.
- Large areas of semi-natural grassland for which little or no data are currently available.
- Sites which occurred on different soil types.
- Sites that represented the geographical variation that existed in the study area, such as altitudinal range.
- Sites associated with important landscape features (e.g., eskers, hills).
- Sites adjacent to river systems, ensuring a representative sample of wet grasslands and marshes.

- Large sites of natural grassland or inland marsh indicated by CORINE (2000)
- Information from the Botanical Survey of the British Isles (BSBI) county recorders
- Information from NPWS regional staff.

Each of the criteria listed above were used in conjunction with aerial orthographical photographs, taken between 2000 and 2005, that were used to either identify or confirm all sites.

A subjective approach to site selection was adopted for this survey, primarily due to the practical restraints on the project and the need to acquire a critical mass of data for several habitat types. For example, for rarer grassland habitats, such as marsh, it was desirable to include a minimum number of sites within the survey to ensure that a reasonable level of information about this habitat type was obtained. It was also desirable to survey NHAs and SACs that contained semi-natural grassland so that comparisons could be made with non-designated sites. Given that a limited number of sites could be surveyed within the financial and time limits of the project, a purely randomised approach could well have omitted some or all of these sites. A similar case can be made for most of the criteria listed above. Furthermore, difficulties with obtaining access permission and accurately identifying semi-natural grassland habitats from aerial photographs and GIS datasets made a randomisation approach to site selection unworkable.

For all sites selected for field survey a site pack was compiled. Each site pack included a cover sheet that detailed general site information for the field surveyors, a blank six inch map, an aerial photograph of the site at a six inch scale, and copies of any previous survey notes.

The Technical Annex to this project entitled *Mapping and Predictive Modelling of Grassland Habitats* (Valverde 2007) followed a more detailed version of the methodology listed above to try and map all areas of semi-natural grassland within Roscommon and Offaly. Although Valverde (2007) was not produced in time for the 2007 field survey it will prove to be a useful reference document when trying to identify semi-natural grassland sites within Roscommon and Offaly in the future.

For summary data and the location of the selected sites go to page 22 and Appendices 4, 5 and 6

2.2 General site survey

For each selected site, a decision was made upon arrival in the field on the validity of surveying it based on the presence of semi-natural grassland habitats and the area they covered. Permission was sought from the owner or owners of a site before entering and whenever possible the management of the site was discussed with the landowner. The minimum site size for this project was 0.5ha; sites at which recent habitat loss had reduced the area of suitable habitat to less than 0.5ha were rejected. Areas of non-grassland habitat, such as woodland, >400m² and linear habitats, such as rivers, >4m wide were excluded from the site. Species-poor *Molinia*-dominated vegetation on deeper, often degraded peats (>0.5m deep) were deemed to be peatland and excluded from the site. Areas of improved grassland (GA under Fossitt 2000) that had recently been ploughed, re-seeded with *Lolium perenne* and *Trifolium repens*, and fertilised were also excluded.

However, some intermediate, semi-improved grassland types were retained within sites, especially if it was considered that areas were of potential conservation importance if negative practices such as over-grazing or fertiliser application were removed. When semi-improved GA grassland habitats were recorded an 'I' was prefixed to the Fossitt category of the habitat type that was deemed to have occurred prior to improvement. Thus IGS1 was semi-improved dry calcareous grassland of potential conservation value.

For the project field sheets go to Appendix 1

For the general site survey results go to page 20

The following details were recorded for each site surveyed:

Internal habitats: All habitats that were observed within the boundaries of a site were noted. The internal habitats recorded within each site were categorised as EU Annex I grassland habitats (Anon. 2003), non-Annex I semi-natural grassland habitats (Fossitt 2000) and semi-improved grassland. Non-grassland habitats defined by Fossitt (2000) which had been retained within the site (<400m² in area or linear habitats <4m wide) were also listed. The percentage of the site area that each habitat occupied was recorded. For ease of recording in the field all habitats that were estimated to cover $\leq 1\%$ of the site area were recorded as 1%. Note that these data were used as approximations in the field and were superseded by the more accurate data from the mapping process.

For summary information on the grassland habitats recorded at each site go to Appendix 5

To allow wet meadow habitats along the Shannon and other large rivers to be distinguished from other wet grassland habitats (GS4) it was decided that for the purposes of this survey they would be included within the Fossitt (2000) dry meadows category (GS2). Vegetation composition data from the relevés would allow dry and wet meadow areas recorded as GS2 to be distinguished.

Following Dwyer *et al.* (2007), no differentiation was made between semi-natural dry grassland and scrubland facies on calcareous substrates (6210) and semi-natural dry grassland and scrubland facies on calcareous substrates – important orchid sites (6211). The main reason for Dwyer *et al.* (2007) not distinguishing orchid rich sites is the ephemeral nature of orchids, with large orchid populations present one year and absent the next.

In the Irish context hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430) occur in areas that are generally not prone to flooding or waterlogging during the summer and occur chiefly on the fringe of reed swamp and wet woodland (J. Ryan pers. comm.). Tall herb communities occurring in other situations were not ascribed to this habitat type.

Following the guidelines of JNCC (2004), for areas to be described as *Molinia* meadows on calcareous, peaty or clayey-silt laden soils (6410), the cover of *Molinia* and bulky *Juncus* spp. had to be 25-80%.

Site species list: A comprehensive list of vascular plant species and the major components of the bryophyte flora were recorded for the semi-natural grassland habitats present at each site and inputted in the Access database. Vascular plants which were dominant or abundant were noted. The bryophyte list was supplemented, particularly in the case of smaller and less obvious taxa, by the intensive sampling conducted within each relevé. Identification in the laboratory was conducted as required. Nomenclature throughout the survey followed Stace (1997) for vascular plants, Smith (2004) for mosses, Paton (1999) for liverworts and Dobson (2000) for lichens. The site species field sheet is listed in Appendix 1.

Site geography and topographical situation: Where the site was associated with a particular geographical feature, for example, in a valley or on a drumlin, this was recorded. The topographical position (e.g., upper slope, mid slope, lower slope) occupied by the grassland site was also noted. In many cases the site extended over many topographical positions and this variation was recorded by ticking more than one box on the field sheet.

Soil moisture regime: The predominant soil moisture regime observed at the site was recorded and if seasonal flooding was observed or thought to occur on the site this was noted.

Site management: Semi-natural grasslands are habitats that require some human management, in most cases grazing or mowing. Land managers were consulted, wherever possible, to

ascertain current management (within the last twelve months) and past management. Variables recorded included frequency and timing of grazing/mowing, type of livestock and fertiliser application.

Grazing level: Grazing is an inherent part of natural grassland dynamics, however high and very low grazing levels may have negative impacts on a grassland ecosystem. Encroachment by scrub/heath/bracken is a consequence of low grazing levels and is thus included here. Grazing level was recorded on a three point scale, based on the JNCC Common Standards Monitoring Guidance for grassland habitats (JNCC 2004):

- Overgrazing: High density of dung. Frequent bare ground and/or evidence of run off. Sward height below relevant threshold: GS1 = 3cm; GS2 = 10 cm; GS3 = 5cm; GS4 = 40cm; GM1 = 40cm.
- Appropriate grazing: No indicators of inappropriate grazing.
- Undergrazing: Sward composition contains greater than 5% cover of woody species and/or bracken.

The nature of any encroachment was also noted as follows:

- Scrub: Species include: *Crataegus monogyna*, *Prunus spinosa*, *Rubus fruticosus* agg., *Ulex gallii*, *Ulex europaeus*, *Corylus avellana*, *Salix* spp.
- Heath: Species include: *Calluna vulgaris*, *Erica* spp., *Vaccinium* spp.
- Bracken: *Pteridium aquilinum*

Adjacent habitats and site boundary: Adjacent habitats (e.g., woodlands and heath) and boundary habitats (e.g., hedges and walls) observed during the field survey were recorded for each site using categories defined by Fossitt (2000). Fence and dry ditch are two additional common boundary structures that were recorded. Also, the transition from semi-natural grassland to other habitat types was described as either abrupt or diffuse.

Fauna: In addition to domestic animals (e.g., cattle, sheep and horses) using grassland for pasture there are also several relatively common wild animals that utilise semi-natural grassland habitats. The presence of any of these species was recorded on the field sheets. Herbivore species noted here may contribute to the overall grazing level. Anthills were also recorded within the fauna section as there is evidence that they can indicate the presence of areas of old semi-natural grassland (Breen & O'Brien 1995).

Damaging operations: Five damaging operations were listed on the field sheet: drainage, burning, dumping, ploughing and recent afforestation in the vicinity. Burning may be the result of human activity or a natural event. The occurrence of burning and dumping at a site is often associated with illegal activities, whereas drainage, ploughing and afforestation represent

changes in management practice which are typically detrimental to semi-natural grassland habitats. Damage caused by grazing is not recorded within damaging operations but in the grazing level section listed above.

Habitat mapping: A handheld GPS minicomputer MobileMapper CE (Magellan, Carquefou) with ArcPad 7 GIS software was used in the field to accurately map site boundaries, areas of EU Annex I grassland habitats (Anon. 2003), non-Annex I semi-natural grasslands Fossitt (2000) and semi-improved grassland habitats. The minimum mapping unit for habitats was 400 m², with a minimum habitat width of 4m. An accurate habitat map of each site was produced using these data within ArcView GIS 3.3.

Site area: Site area (ha) was accurately derived from the ArcView GIS habitat maps.

For the site area of each of the 91 surveyed sites go to Appendix 4

Site summary: In addition to the specific data gathered and recorded on the various field sheets, a general description of each site was also made. Included within this description were:

- A summary of the physical nature of the site.
- A list of the habitats and/or vegetation types present at the site.
- A summary of management at the site.
- Rare/protected or notable species recorded at the site.

For the site summary of each site go to the Addendum

When there was ownership information available for a site this was also recorded within the site summary and added to the ownership section of the Access database. Also overview digital photos were taken at many of the 91 surveyed sites and all these images were submitted on CD with the ArcView GIS project.

2.3 Relevé survey

A minimum of one 2 x 2m relevé was recorded from within each grassland habitat area mapped within each site. Multiple relevés were recorded where there was significant variation in the sward composition within a habitat type, for example, in transitional areas, or where Annex I habitat assessments were conducted. Cover in vertical projection for each vascular and bryophyte species was recorded on the Domin scale (Kent & Coker 1991), as were other general parameters: bare soil, bare rock, litter, dead wood, surface water, total vascular plant cover and total bryophyte cover. The Domin scale is superior to the Braun-Blanquet scale, as the greater number of recording subdivisions permits more variation in vegetation composition to be detected in subsequent analysis. It also provides for a more sensitive means for monitoring changes in sward composition over time.

A soil sample was taken from the centre and two corners of each relevé with an aluminium soil corer to a depth of 10cm and bulked. Soil pH of field-fresh material was recorded using a glass electrode and a 1:1 soil / water paste. Soil samples were air-dried and retained for future laboratory analysis. For each relevé a 10 figure grid reference was obtained using a GPS unit, and topography, altitude, slope and aspect were recorded. A soil profile was examined to a minimum depth of 30cm and the soil type defined according to the Great Soil Groups of Gardiner & Radford (1980) with the aid of the soil identification key in Trudgill (1989).

For each relevé additional data were also recorded to define the structure of the grassland within the 2 x 2m plot. These were:

- Overall cover of forbs, measured on the Domin scale.
- Ratio of grass / sedge species to forb species.
- An estimate of the median grass / sedge height.
- An estimate of the median forb height.
- A digital photograph of the relevé (all digital images were submitted on CD with the ArcView GIS project).

Air-dried soil samples were stored for subsequent laboratory analyses of total organic carbon.

All relevé data have been entered onto an Microsoft Access database and into Turboveg

2.4 Assessment of EU Annex I grassland

The conservation status of all mapped areas of EU Annex I grassland habitat was assessed. The methodology used was similar to that taken by the NPWS for their survey of dune systems (Anon. 2007) and grassland (Dwyer *et al.* 2007). *JNCC Common Standards Monitoring Guidelines* (JNCC 2004) were used as a guide to help evaluate the conservation status of the habitats in conjunction with *Assessment, Monitoring and Reporting Under Article 17 of the Habitats Directive* (Anon. 2006).

For each habitat assessment three parameters were scored: area, structure and functions, and future prospects. For a habitat at a site to be given an overall assessment of favourable the habitat had to be assessed as favourable within each of the three assessment parameters (Table 2.1).

Table 2.1 Summary matrix of the parameters and conditions required to assess the conservation status of habitats (Anon. 2006).

	Favourable	Unfavourable - Inadequate	Unfavourable - Bad
Area	Stable	>0% <1% decline/year	> 1% decline/year
Structure & Functions	Stable	1 – 25% decline/failure	> 25% decline/failure
Future Prospects	Good	Poor	Bad
Overall	All green	Combination of green and amber	One or more red

*For the results of the assessment of EU Annex I grassland go to page 31, and Appendix 7
The summary data have also been entered into the Access database*

Area

Loss of extent was assessed by comparing the area of the EU Annex I grassland habitat that was mapped during the 2007 survey with the mapped extent of the habitat present on the 2000 aerial photograph. This comparison was made using ArcView GIS.

Structure and functions

Structure and function were assessed using a number of factors including grass / sedge : forb ratio, positive indicator species, negative indicator species, scrub / bracken encroachment, sward height, litter cover, extent of bare ground, and grazing and disturbance levels.

Positive and negative indicator species and the threshold values for other factors varied by habitat type (Appendix 2). The assessment criteria of Dwyer *et al.* (2007) were used for habitats

6210/6211 and species-rich *Nardus* grasslands on siliceous substrates in mountain areas (6230). For the three remaining Annex I grassland habitats that were found within the survey area the general approach taken by Dwyer *et al.* (2007) and JNCC (2004) was adopted but new lists of positive indicator species had to be compiled. This was done with additional consultation with the *Interpretation Manual of European Union Habitats* (Anon. 2003) and White & Doyle (1982). Only native Irish plant species were utilised for the positive indicator species. Indicators species and threshold values are given in Appendix 2. For a monitoring stop to pass an assessment the threshold value for positive indicators was the presence of a minimum of seven species, for negative indicators a monitoring stop had to pass each of the negative indicator categories.

- *Molinia* meadows on calcareous, peaty or clayey-silt laden soils (6410)

For this habitat the positive indicator species selected included the character species listed for the Molinietales and the Junco conglomerati - Molinion (White & Doyle 1982), except for *Juncus effusus* which was considered too common to be a reliable positive indicator species. *Crepis paludosa* and *Caltha palustris* from the Calthion palustris alliance (White & Doyle 1982) were also included as they are also listed for this habitat in Anon. (2003).

- Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)

For this habitat the native diagnostic species from the Glechometalia hederaceae and Convolvuletalia sepium, the character species from the Aegopodium podagraiae and diagnostic and differential species from the Filipendulion, all listed in White & Doyle (1982) were included. As *Filipendula ulmaria* is often abundant in the Filipendulion it was also included as a positive indicator species for this habitat. The uncommon Irish species *Crepis paludosa*, which is listed for this habitat in Anon. (2003), was also included as a positive indicator species for this habitat.

- Lowland hay meadows (6510)

For this habitat the positive indicator species used in the assessment included the character and diagnostic species listed for the Arrhenatherion elatoris (White & Doyle 1982), except *Bellis perennis* and *Taraxacum* agg. as these can also be indicative of improved grassland (Fossitt 2000). *Arrhenatherum elatius* and *Dactylis glomerata* are other character species of the Arrhenatherion elatoris that were not included in the list of positive indicator species. This was due to the fact that a high cover score for both of these species would indicate a lack of management, such as mowing, and an increase in the rank nature of the grassland. JNCC (2004) lists both these species as negative indicators for lowland meadows when their cover is high. As the Arrhenatherion elatoris represents only plant communities found on well-drained soils, six species were also included within the assessment that are found within lowland meadows on more impeded soils. The six species are listed as positive indicator species for NVC habitat MG4 (JNCC 2004), a UK habitat thought to correspond closely to lowland hay meadows (6510), and they are *Centaurea nigra*, *Filipendula ulmaria*, *Lotus corniculatus*, *Rhinanthus minor*, *Succisa pratensis* and *Thalictrum flavum*. *Sanguisorba officinalis* was also included from this list,

although it should be noted that it is a rare species in Ireland that has not been recorded in Offaly or Roscommon (Preston *et al.* 2000).

When assessing structure and functions in the field a number of monitoring stops, as described in Anon. (2007), were made at which the information required for the assessment was recorded. Where the habitat area was large enough four monitoring stops were made. When the area of the EU Annex I habitat was less than 400m² (the minimum mapping unit for the project), the habitat was not assessed, and in the few cases when the area was only slightly larger than 400m² only one or two monitoring stops were made to avoid monitoring stops being positioned adjacent to each other. The use of four monitoring stops simplified assessing whether more than 25% of the monitoring stops had failed to meet the required structure and functions criteria. At each monitoring stop a full relevé was also recorded with the exception of soil data which was generally only recorded from one stop in each habitat. Each series of monitoring stops was positioned to encompass the variation that existed within the habitat, but did not include seriously disturbed areas or areas suffering from encroachment.

Future Prospects

Future prospects were assessed following the methodology proposed in Anon. (2007) with three particular criteria being examined:

- Indicators of local distinctiveness, such as notable plant species.
- Indicators of negative trends and threats to the site
- Designation status of the habitat.

To assess the three criteria shown fifteen categories were utilised to calculate the overall future prospects for a site. The scoring system that was utilised for each of the fifteen categories is listed in Appendix 3. The importance of each category at a site was assessed and given a score ranging from zero to three. Thirteen of the categories represented threats to a site: drainage, overgrazing, undergrazing, supplementary feeders, other agricultural improvement, burning, dumping, quarries, scrub encroachment, bracken encroachment, heather encroachment, afforestation and other threats. The impact of each threat category was assessed, with a score of zero representing the fact that the category was not recorded on the site, one that the category had a minor negative impact on the site, two a medium negative impact on the site, and a score of three was allocated when the category represented an active and immediate threat to the site. The final two categories represented protection granted to the Annex I grassland at the site: designated site status and occurrence of notable species. Notable species were deemed to be those listed on the Flora Protection Order, 1999 or in the Red Data Book (Curtis & McGough 1988).

For the results of the future prospects go to page 32 and Appendix 7

2.5 Ranking of sites using conservation and threat evaluations

Conservation of habitats is often best achieved on a site by site basis, with specific management plans based on the individual characteristics of a given habitat at a particular site (e.g., management, history, rarity). However, it is also useful to be able to evaluate sites in the context of others, and to make general comparisons regarding status. In the longer term this is also important for monitoring individual sites, so that the effects of any management (conservation orientated or otherwise) may be objectively assessed. To this end, the site survey procedure collected data on a number of criteria which may be used to help to evaluate the condition of a semi-natural grassland site as a whole. Separate assessments were made for the conservation value of each site and the intrinsic threats that were identified. Whilst extrinsic threats, such as the development for housing or a quarry are undoubtedly important factors, it was beyond the scope of this survey to quantify them unless provided with the information by the landowner or local people.

The conservation value of each site was calculated using the scheme presented in Table 2.2. This is a modification of the scheme presented by Martin *et al.* (2005). In addition, the approaches taken by Ratcliffe (1977), Kirby (1988) and Cross (1990) were considered when developing this scheme. The criteria used in Table 2.2 are all based on site information that was recorded during the 2007 survey. The first five criteria summarise the naturalness of a site in terms of the grassland species diversity (vascular and bryophyte species), occurrence of notable species, number of semi-natural grassland habitats and adjacent semi-natural habitats using Fossitt (2000) and number of EU Annex I habitats (Anon. 2003). The final three criteria score the site in terms of area and the important internal features of hedgerows / treelines (as defined by Fossitt 2000) and archaeological features.

The assessment of threats to each site was based on the criteria detailed in Table 2.3. Damaging activities consisted of drainage, burning, dumping, quarries and recent afforestation in the vicinity. Agricultural improvement included fertiliser application, liming, ploughing, topping and supplementary feeding. Negative adjacent habitats, such as improved grassland and disturbed ground again follow the definitions of Fossitt (2000).

Conservation and threat scores were not combined to produce one overall score. Combining scores can lead to misinterpretation when comparing sites, for example comparing a high quality site with many threats and a medium quality site with no threats. It should also be noted that the scores listed in Appendix 4 are written as percentages of the total possible score. The reason for this was to allow a simple comparison to be made between sites even if data were not available in all of the categories shown in Tables 2.3 and 2.4.

For the results of the conservation and threat score go to page 34 and Appendix 4

Table 2.2 Criteria used in the calculation of the conservation score for each site.

Criteria	Scoring		Max. score
Naturalness			
Grassland plant species diversity ¹	1	≤61 species (lower quartile)	3
	2	62-87 species (interquartile range)	
	3	≥88 species (upper quartile)	
Notable species	0	No notable species	3
	1	One Red Data Book (RDB) species	
	2	Two RDB species or one Flora Protection Order (FPO) species	
	3	More than two RDB species or more than one FPO species	
Semi-natural grassland habitats	1	One habitat	3
	2	Two habitats	
	3	More than two habitats	
Annex I grassland habitats	0	No Annex I habitats	4
	2	One habitat	
	4	More than two habitats	
Adjacent semi-natural habitats)	One point scored for each of the following habitat groups recorded:		5
	F (Freshwater)	GS (Semi-natural grassland)	
	H/P (Heath or Bog)	WN (Semi-natural woodland)	
	ER (Exposed rock)		
Other criteria			
Site area ²	1	≤5ha	4
	3	>20.48-100ha	
	2	>5-20.48ha (median)	
	4	=>100ha	
Internal treelines or hedgerows	0	None present	1
	1	Treelines or hedgerows present	
Archaeological features	0	None present	1
	1	One or more present	
Maximum total score			24

¹ Ruderal and woody species were excluded from this calculation.² Divisions based around median area of 20.48ha**Table 2.3** Criteria used in the calculation of the threat score for each site.

Criteria	Scoring		Max. score
Encroachment	One point for each type of encroachment (scrub, bracken or heather) present on the site		3
Grazing	0	No inappropriate grazing occurring	2
	1	Undergrazing or overgrazing occurring on the site	
	2	Undergrazing and overgrazing occurring on the site	
Negative adjacent habitats	0	No negative adjacent habitats	2
	1	Improved grassland (GA) or Disturbed ground (ED) present	
	2	Improved grassland (GA) and Disturbed ground (ED) present	
Damaging activities	0	No damaging activities	3
	2	Two damaging activities	
	1	One damaging activity	
Agricultural improvement	0	No improvements	3
	2	Two improvement types	
	1	One improvement type	
	3	Three or more improvement types	
Maximum total score			13

2.6 Vegetation data analysis

Incorporation of external data

Originally it was planned to supplement the 2007 survey data by the incorporation of other grassland survey data for the two counties from external sources. However, this idea proved unviable as other relevant datasets were either recorded in a format that was incompatible (e.g. Dwyer *et al.* 2006) or were too old to represent a contemporary source (e.g. the O'Sullivan dataset). However, if the semi-natural grassland survey is extended to include other counties it should be noted that there are contemporary datasets that could be incorporated into any further vegetation analysis, notably: Tolkamp (2001), Co. Longford; O'Donovan & Byrne (2004), Cos. Sligo and Westmeath; O'Donovan (2007), Co. Sligo.

Data preparation

A total of 305 relevés recorded during this survey were available for analysis. Of these, five relevés were excluded due to lack of bryophyte species data. Only plant records which had been identified to the species level were included in the analysis, as records at the genus level (e.g. *Carex* sp.) may be amalgams of species with markedly different ecological preferences and therefore meaningless.

Outlier analysis was used to examine the remaining 300 relevés. The mean distance of each sample from each other sample was calculated using Quantitative Sørensen (Bray-Curtis) as the distance measure. Relevé samples with a mean distance of more than three standard deviations above the grand mean were regarded as outliers. This applied to ten samples. Almost all of these relevés represented vegetation which was transitional between wet grassland / marsh and swamp and in which robust species such as *Glyceria maxima*, *Phalaris arundinacea* and *Carex acutiformis* were abundant. Several of these areas had been sampled as they were being managed as pasture / meadow. As the methodology includes measures to reduce outlier influence it was deemed more informative at this preliminary stage of developing a classification to retain these borderline samples within the dataset. This resulted in the inclusion of 302 species. Domin scores were converted to percentage cover using the method of Currall (1987) prior to analysis, as mean values cannot be calculated directly from a non-linear scale.

As soil data were not recorded from all four of the monitoring stops within any given area of Annex I habitat, pH values were missing for 64 of vegetation samples (21%) and total organic content was missing from 63 samples (21%). Missing values were estimated by using the mean value recorded from the other monitoring stops within that area of habitat. Soil type was not recorded for 42 (14%) of relevés; for this variable summary statistics were made using the available data only.

For the results of the vegetation analysis go to page 36

Analysis techniques

A suite of five complementary statistical techniques were used to analyse the dataset. Analysis was conducted using PC-ORD 4 (MjM Software, Oregon) with the aim of defining an objective classification that largely follows the procedures in Perrin *et al.* (2006a,b). Perrin *et al.* (2006a,b) also discuss the advantages of these techniques over the more commonly used methods of Detrended Correspondence Analysis and TWINSpan.

1) Hierarchical, polythetic, agglomerative cluster analysis. This was the main method selected for grouping the data into vegetation types. From a data matrix of n samples $\times$ p species, an $n \times n$ distance matrix is calculated by measuring the dissimilarity (or similarity) between each pair of samples. The most similar samples, which are selected using a predetermined criterion of minimum distance (linkage method), are merged into a group and their attributes are combined. The procedure is repeated $n - 1$ times until the samples have been merged (clustered) into two groups, with the results being displayed as a dendrogram (McCune & Grace 2002). Quantitative Sørensen (Bray-Curtis) was selected as the distance measure, as it has been shown to be one of the most effective measures for ecological community analysis, being less prone to exaggerating the influence of outliers and retaining greater sensitivity with heterogeneous datasets (McCune & Grace 2002). Flexible beta was used as the linkage method with $\beta = -0.25$ (Lance & Williams 1967). This option is compatible with Sørensen distance and is space-conserving, i.e. properties in theoretical space defined by the original dissimilarity matrix are preserved as groups form during the cluster procedure. Space-distorting strategies can lead to undesirable effects such as high levels of chaining, the sequential addition of single items to existing groups (Legendre & Legendre 1998; McCune & Grace 2002).

2) Indicator Species Analysis (ISA; Dufrene & Legendre 1997). This was used as an objective tool to help determine at what level the dendrogram resulting from the hierarchical clustering should be cut, i.e. what is the optimal number of final groups. ISA produces percentage indicator values for species and works on the concept that for a predetermined grouping of samples, an ideal indicator species will be found exclusively within one group and will be found in all the samples in that group at maximum abundance. Indicator values are thus a simple combination of measures of relative abundance between groups and relative frequency within groups. At any given level of clustering, species are assigned to the group for which their indicator value is maximal; the significance of this assignment is tested using Monte Carlo randomizations. Dufrene & Legendre (1997) concluded that ISA was more sensitive at identifying indicator species than TWINSpan and also suggested that this method could be used as a stopping rule for clustering, as IndVals will be low when groups are too finely or too broadly defined, peaking at some intermediate, more informative level of clustering. ISA was run on the output from the hierarchical clustering cycles yielding 2-10 groups with 1000 randomizations used in the Monte Carlo tests. Sum of significant indicator values ($p < 0.05$) was used as the stopping criterion criteria (Dufrene & Legendre 1997)

3) Multi-response Permutation Procedure (MRPP). This was employed to test for significant differences between the groupings determined by the hierarchical clustering and ISA. This is essentially a non-parametric multivariate test and thus avoids the normality requirements of parametric multivariate tests such as discriminant analysis (McCune & Grace 2002). As it is statistically inappropriate to test for differences between groups using the same variables that define them, MRPP was run on a matrix of seventeen environmental variables: soil pH, soil % organic content, slope, altitude, topography (five dummy variables; these are binary variables each signifying the presence or absence of a topographical category), soil type (five dummy variables), bare soil, bare rock and litter cover. In addition to a p -value, MRPP produces a statistic A which describes chance-corrected within-group heterogeneity. $A = 1$ when all samples within groups are identical, $A = 0$ when heterogeneity within groups equals expectation by chance and $A < 0$ when within-group heterogeneity is less than that expected by chance. Sørensen distance was used on a rank transformed matrix following relativization of environmental factors to standard deviates (McCune & Grace 2002).

4) Ellenberg indicator values. Ellenberg (1979, 1988, Ellenberg *et al.* 1991) assigned scores to over 2000 vascular plants indicating how these species “behaved” in respect to a range of environmental factors. By calculating mean values of these scores for vegetation samples it is possible to use them as proxy measures of environmental factors. As the original scores were based on field sites in central Europe, Hill *et al.* (1999) recalibrated the scores for the British conditions in respect to five environmental factors: light, reaction (pH), nitrogen (a measure of soil fertility), moisture and salinity. Using this recalibration, for each of the relevés the mean score for each of these factors was calculated, weighting scores by cover abundance. The scores were then used to calculate means for each grouping produced by the cluster analysis.

5) Non-metric Multidimensional Scaling (NMS). This was used to illustrate the relationships between relevés and between relevés and environmental variables. This iterative ordination technique is particularly well suited for analysis of ecological community data as it works well with non-normal datasets, allows the use of non-Euclidean distance measures, and does not assume that species have linear or unimodal responses to environmental gradients (McCune & Grace 2002). Being based on ranked distances, NMS is less prone to distortion due to outliers. The ‘slow and thorough’ option in PC-ORD was used with Quantitative Sørensen (Bray-Curtis) distance and varimax rotation. The use of this distance measure permits ready comparison of the results with those of the hierarchical cluster analysis and the MRPP. For the NMS ordination, species occurring in less than five relevés were removed from the dataset to reduce noise. Hence, the ordination was run on a matrix of 300 relevés and 161 species. Pearson correlation was used to check for correlation of the resulting ordination axes and the following environmental variables: soil pH, soil % organic content, slope, altitude, topography (five dummy variables), soil type (five dummy variables), bare soil, bare rock and litter cover, grass height, forb height, and mean Ellenberg values for light, reaction, nitrogen, moisture and salinity.

3. RESULTS

3.1 General site survey

Site selection and total number of sites surveyed

In total, 91 semi-natural grassland sites were surveyed, with 51 of the sites being in Co. Roscommon and 40 in Co. Offaly. The data collected at each of the sites is summarised in Appendices 4 and 5 and the location of each site is shown in Appendix 6. The overall area of semi-natural grassland habitat surveyed was 2,756ha and the average site area was 30ha.

During fieldwork 16 sites were rejected representing 15% of the 107 sites that were visited (Table 3.1). Sites may have been rejected on the basis of more than one criterion. The most commonly recorded reasons for rejection relate to habitat. Seven sites were rejected as they were found to be dominated by improved grassland rather than semi-natural grassland, illustrating the difficulty which can arise in identifying a habitat type from aerial photographs. In some cases the land use had changed since the aerial photograph was taken (e.g., young forestry). Four sites were rejected due to access issues. If an owner refused to let surveyors on to a site, or where a dangerous animal was on site (e.g., a bull), no attempt was made to survey the site.

Table 3.1 Number of sites rejected according to different criteria

Rejection criteria	Number of sites
Improved grassland	7
Forestry	3
Old cut-over bog or fen	2
Scrub encroachment	2
Owner denied access	2
Livestock	2

Site designations and ownership

Fig. 3.1 indicates the occurrence of conservation designation status amongst the 91 surveyed sites. It should be noted that of the 91 surveyed sites 31 had been selected because they were either NHAs or SACs. A total of 52 sites had no designated status and of the 39 sites where a conservation designation did occur there was sometimes more than one designation.

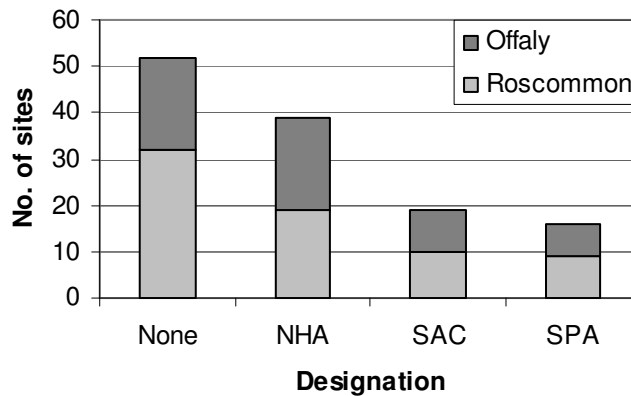


Figure 3.1 Conservation designation status of surveyed sites differentiated by county. It should be noted that 19 sites had two or more conservation designations.

The vast majority (87 of the 91 sites) of the sites were owned privately with only two being owned by a local authority (Fig. 3.2). Of the private sites over half had multiple owners.

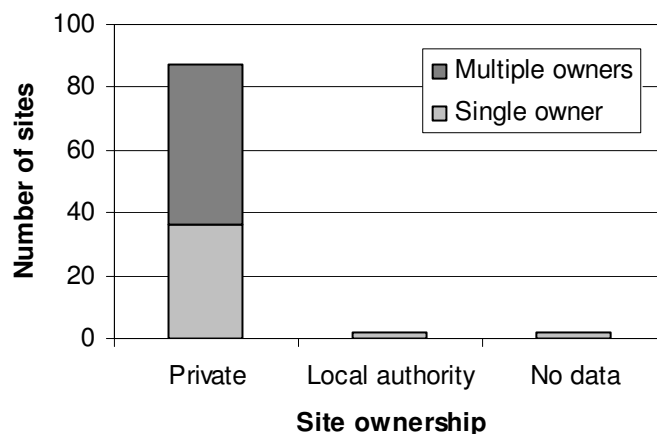


Figure 3.2 Number of sites under private and public ownership.

Semi-natural grassland habitats

Within the total area surveyed, wet grassland (GS4) covered the largest area (1548ha; Fig 3.3a), followed by dry meadows (GS2) with an area of 734ha. It should be noted that most of the GS4 area was wet pasture and 453ha (62%) of the GS2 area was wet meadow found primarily along the River Shannon flood plain. Dry calcareous and neutral grassland (GS1), which covered only 14% of the total semi-natural grassland area, was found at 52% of sites, indicating that GS1 is a widespread grassland type, but typically occurs as small areas. The Fossitt habitats found at each site are summarised in Appendix 5.

Freshwater marsh (GM1) and dry-humid acid grassland (GS3) were rare habitats, both covering less than 60ha. Frequency of occurrence (Fig. 3.3b) largely followed the trends observed in the

total area. GS4 occurred most frequently while GM1 and GS3 occurred least frequently. GM1 was only recorded within seven sites, all within Roscommon, and GS3 was only recorded at five sites.

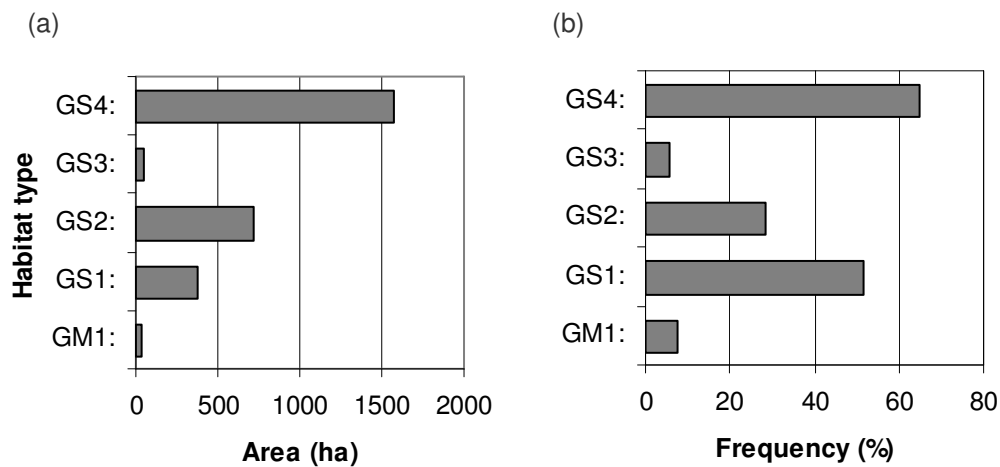


Figure 3.3 Occurrence of semi-natural grassland habitats (Fossitt 2000): (a) total area of semi-natural grassland habitats surveyed, (b) percent of sites where each habitat type was recorded.

The main difference in terms of habitats between the two counties was in the occurrence of GS1, GS2 and GS3 (Fig. 3.4). Less than 2ha of GS3 were recorded in Roscommon, whilst 53ha of GS3 were recorded in Offaly. In Roscommon, the areas covered by GS2 (314ha) and GS1 (312ha) were almost identical, while in Offaly, GS2 covered a far larger area (401ha) than GS1 (63ha). Wet grassland (GS4) habitat dominated in both counties. Note also that 62% of the GS2 habitat in Roscommon and 61% of the GS2 habitat in Offaly were wet meadows.

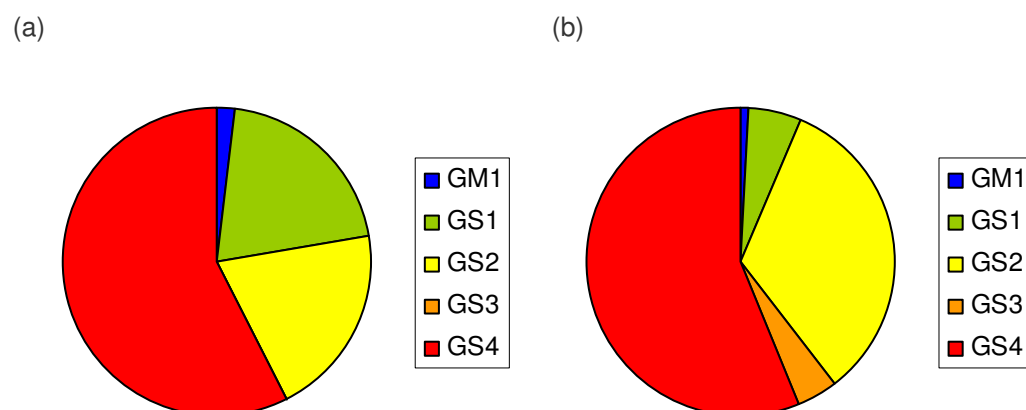


Figure 3.4 Proportion of cover of different habitats by county: a) Roscommon and b) Offaly.

EU Annex I grassland habitats

A total of 379ha of Annex I grassland was recorded, representing 14% of the total surveyed area. The EU Annex I grassland habitats found at each site are summarised in Appendix 5. In

Roscommon, 16.7% of the semi-natural grassland area surveyed was deemed Annex I status, whilst the figure for Offaly was 10.1%. Five Annex I habitats occur in Roscommon and four in Offaly where *Nardus* grassland (6430) was not recorded (Fig. 3.5). *Festuca-Brometalia* grassland (6210/6211) and *Molinia* meadows (6410) covered the largest areas in Roscommon. Lowland hay meadows (6510) and *Molinia* meadows (6410) covered the largest areas in Offaly. *Nardus* grassland (6430) and hydrophilous tall herb communities (6230) covered very small areas in both counties.

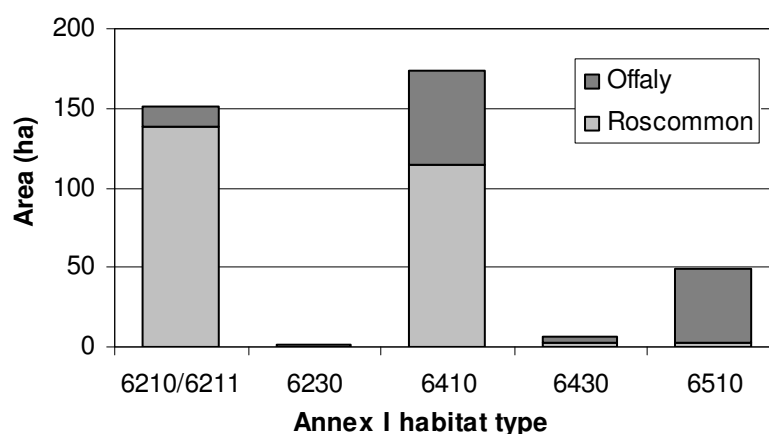


Figure 3.5 Area covered by EU Annex I grassland habitats by county.

Although *Molinia* meadows (6410) covered the largest area of the Annex I habitats surveyed (Fig. 3.5) *Festuca-Brometalia* grassland (6210/6211) was the most frequent of the Annex I habitats recorded at 16 sites (Fig. 3.6). The least frequent of the Annex I habitats was *Nardus* grassland (6430), recorded at one site in Roscommon.

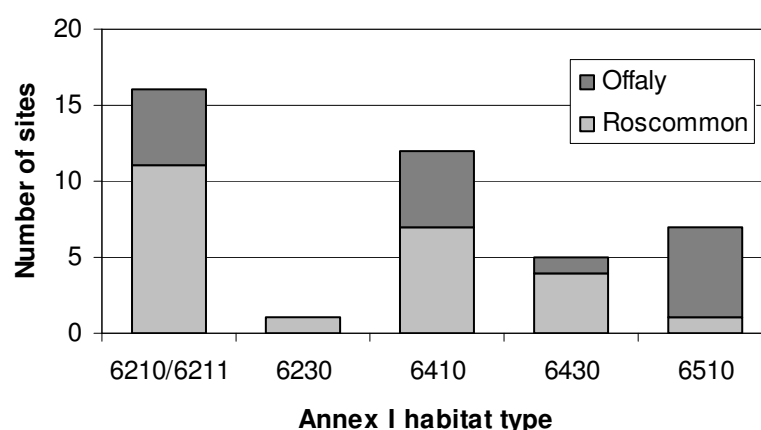


Figure 3.6 Occurrence of Annex I grassland habitats by county.

Adjacent habitats

Semi-natural grassland and marsh occurred adjacent to 34.1% of sites (Fig. 3.7), indicating that these sites formed part of a larger network of semi-natural grasslands. Improved grassland (GA)

was the most frequent adjacent habitat occurring next to 74.7% of sites. The next most common adjacent habitat was treelines and hedgerows (WL), which occurred next to 56.0% of sites, and was related to the presence of treelines and hedgerows as field boundaries. Scrub, which can indicate a lack of land management or low intensity stocking, occurred next to 45.1% of sites. Most habitats were recorded more frequently in Roscommon. This is to be expected as 51 of the 91 sites were located in that county.

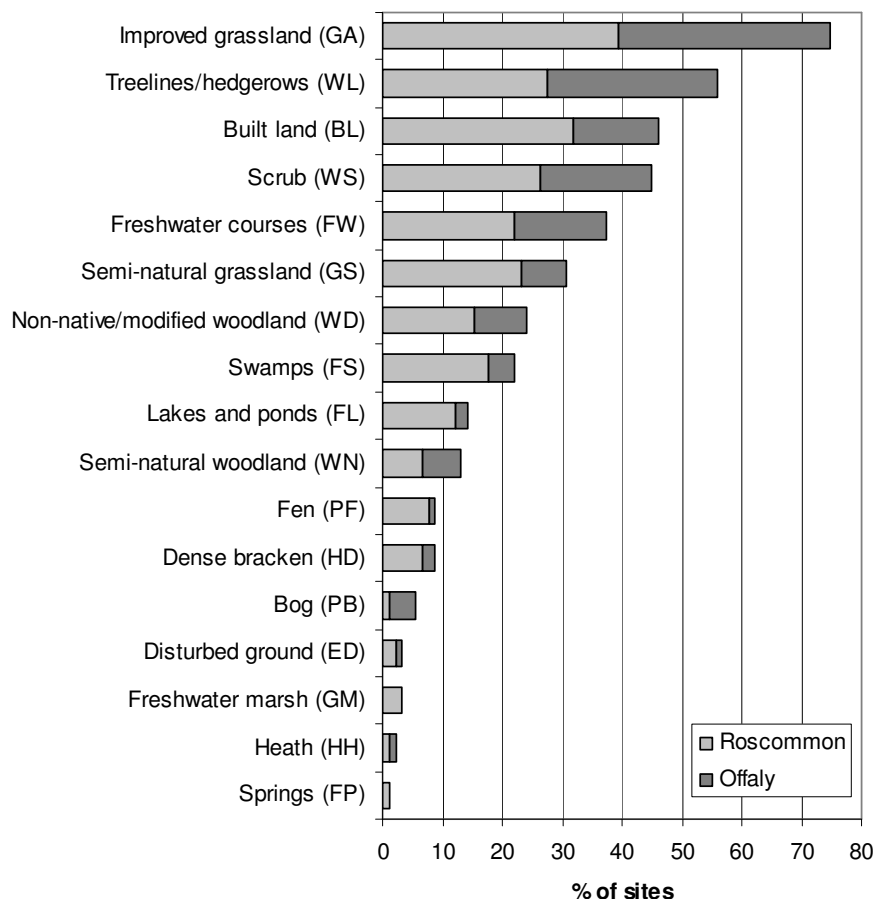


Figure 3.7 Frequency of Fossitt (2000) habitats as adjacent habitats to surveyed sites differentiated by county.

Non-grassland habitats recorded within sites

Non-grassland habitats recorded as internal habitats are shown in Fig. 3.8. The most frequent internal habitats were treelines, scrub, ditches and hedgerows. The “Other” category includes habitats which occurred only once during the survey. These include artificial lakes and ponds (FL8), heath (HH1, HH2), peat habitats (PB4, PF2) and active quarries and mines (ED4).

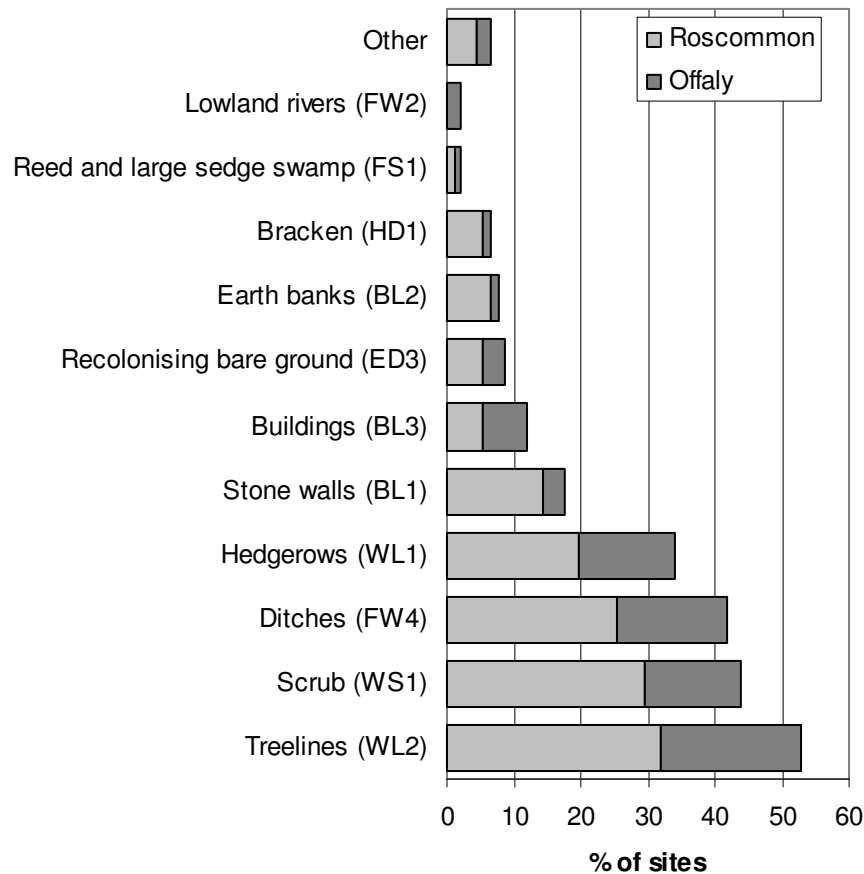


Figure 3.8 Frequency of non-grassland Fossitt (2000) habitats within all surveyed sites differentiated by county.

Landscape features recorded during the survey

Of the landscape features recorded during the survey (Fig 3.9), semi-natural grassland sites occurred most frequently on lowland plain in both Offaly and Roscommon. Of the 42 sites recorded on lowland plain, 16 sites were associated with rivers. Esker sites were more frequently recorded in Offaly whilst association with lakes, valleys and hills was more frequent in Roscommon. Only one site was associated with a drumlin, and this was in Roscommon.

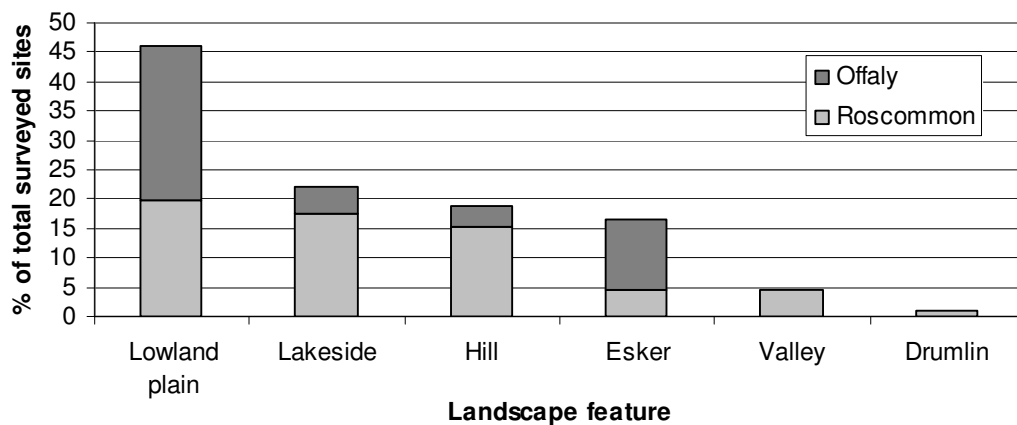


Figure 3.9 Frequency of different geographical features associated with sites differentiated by county.

Site management

The predominant grassland management in both counties was pasture, which was recorded at 70.3% of sites (Fig. 3.10). Both meadow and pasture together were present on 20.9% of sites, whilst hay meadows only were recorded at 7.7% of sites. At one site (not shown in Fig 3.10), there was no formal management with the grassland habitat maintained by wild deer grazing.

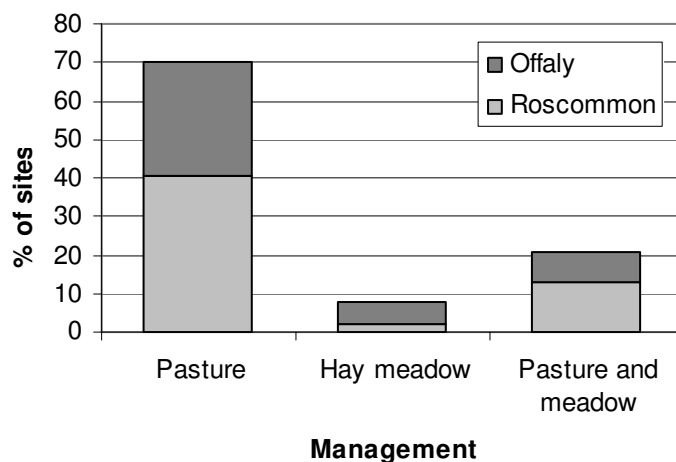


Figure 3.10 Frequency of the different management regimes at sites differentiated by county.

In Roscommon, 94% of sites had at least one type of grazing species present (e.g., cattle, sheep, horse), while in Offaly the figure was lower, with 80% of sites being grazed. At 35% of sites, more than one type of grazer was observed. Cattle were the most frequently recorded grazer, followed by sheep and then horses (Fig. 3.11). Other domestic grazers included donkeys and goats.

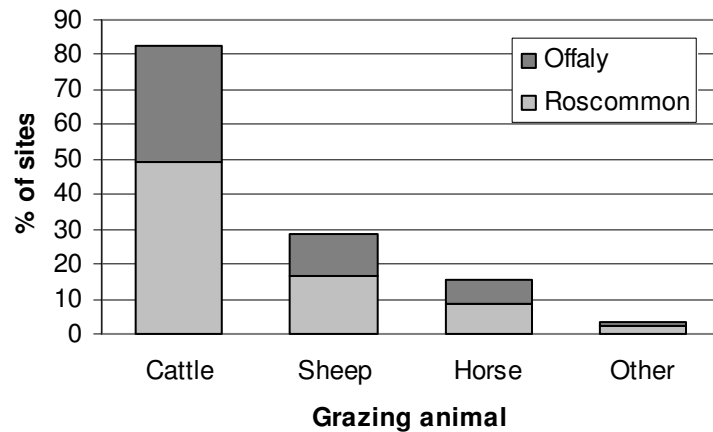


Figure 3.11 Frequency of domestic grazing animals at sites differentiated by county.

Wild grazers were also observed, and these included rabbits, hares, geese and deer. Other wild fauna recorded includes badgers (or badger activity), frogs, foxes and otters.

At the majority of sites (64%), the grazing level was considered to be appropriate for the habitat. Overgrazing was observed at 8% of sites, while undergrazing was more frequent, being observed at 35% of sites (Fig. 3.12). More than one grazing level was recorded at some sites. The frequent occurrence of undergrazing was underlined by the widespread observation of scrub encroachment on to grassland habitats (45.1% of sites). Other potential causes for the increase in scrub may include a reduction of management techniques such as mowing and hedge trimming, or lower stocking rates.

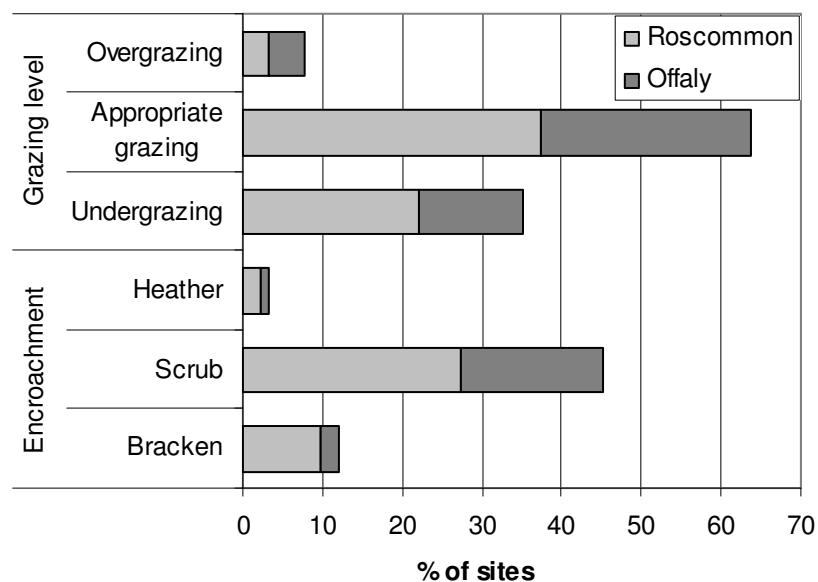


Figure 3.12 Frequency of different grazing levels and encroachment at sites differentiated by county.

Evidence of some degree of agricultural improvement in the form of drainage, fertiliser application, topping, liming, or ploughing was found at 46 of the 91 sites (Fig. 3.13). Liming and herbicide application were only observed in Roscommon. The most frequently observed form of improvement was drainage, recorded at 32% of sites, followed by fertiliser application recorded at 19% of sites and topping at 12% of sites. Organic fertiliser was applied at 9% of sites, non-organic fertiliser at 7% of sites and an unknown type of fertiliser at 10% of sites; at some sites more than one type of fertiliser was applied.

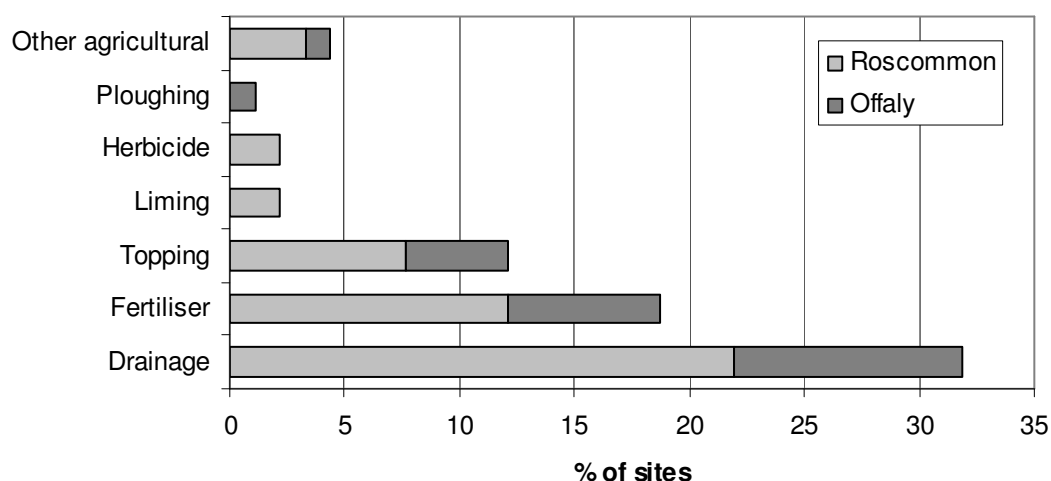


Figure 3.13 Frequency of methods of agricultural improvement at sites differentiated by county.

Afforestation and quarrying were the most frequently recorded damaging activities. Quarrying specifically affected sites associated with eskers. Other damaging activities recorded during the survey included spraying, the presence of an ESB substation on one site, and amenity activities.

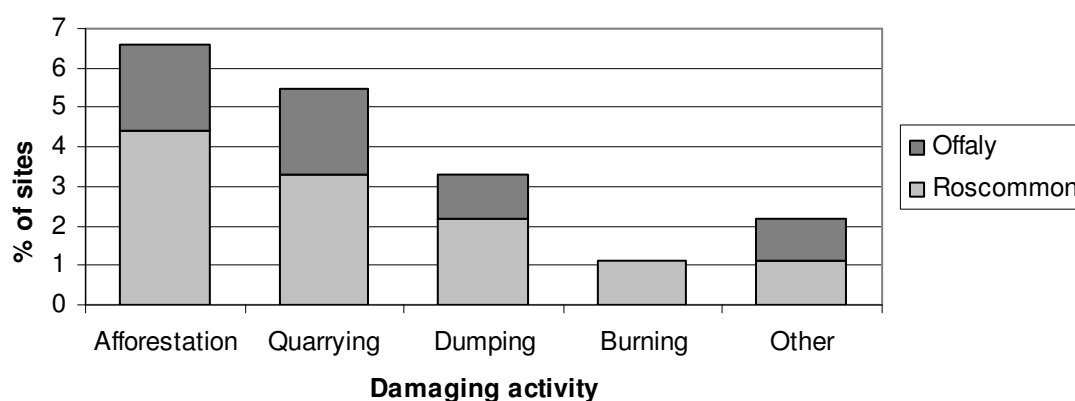


Figure 3.14 Frequency of damaging activities observed at sites differentiated by county.

Species richness

The species richness of each site was assessed using only grassland species. Therefore agricultural species (e.g., *Brassica rapa*) ruderal species (e.g., *Chenopodium album* agg.), woody

species (e.g., *Rubus fruticosus* agg.) and tree species were not included in this calculation. Including both bryophytes and vascular plants a total of 408 grassland species were recorded. Mean overall richness overall was 74.8 species per sites. There was a significant difference (T-test, $t = -2.127$, $p = 0.036$) in the mean species richness per site between Offaly and Roscommon (Fig. 3.15).

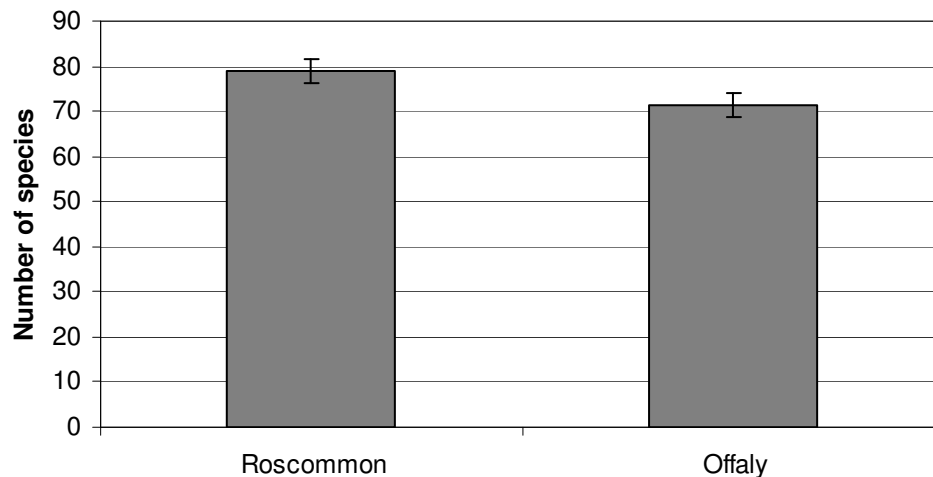


Figure 3.15 Mean species richness per site by county. Error bars indicate standard error.

A linear regression analysis found a significant relationship ($F = 20.9$, $p < 0.001$) between species richness and the natural log of site area (Fig. 3.16). This is a pattern frequently encountered in ecology: as the area surveyed increases the rate at which new species are recorded decreases.

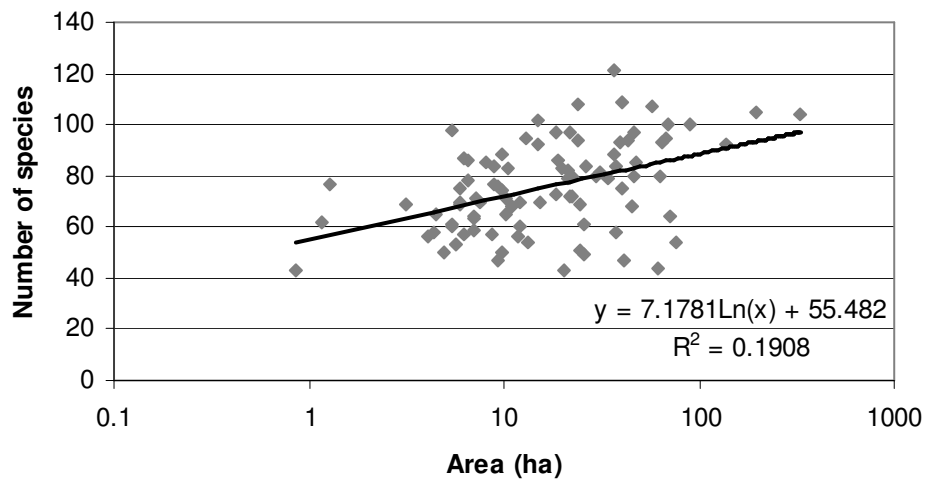


Figure 3.16 Relationship between species richness and site area.

3.2 Assessment of EU Annex I grassland

During the 2007 survey 41 areas of Annex I grassland habitat were identified within 34 different sites. The EU Annex I grassland habitats recorded within each site are summarised in Appendix 5. Three of the 41 areas were not assessed since the area they occupied was smaller than the minimum mapping unit, or in the case of one site, the habitat had already been assessed by Dwyer *et al.* (2006). The remaining 38 areas of Annex I grassland habitat occurred within 32 sites, with six sites (Site Nos. 30, 68, 107, 109, 110 and 210) containing two Annex I grassland habitats each.

Area assessment

Of the 38 areas of habitat assessed, the extent of 23 areas had not declined between 2000 and 2007 (Table 3.2). The habitat areas were scored as Favourable. Of the remaining 15 areas, 11 had a declined in extent greater than 1% per annum and were scored as Unfavourable - Bad. The remaining four areas had declined by less than 1% per annum and were scored as Unfavourable – Inadequate. Of those habitat areas which had declined, 11 areas (73%) were 6210/6211 habitat, demonstrating that this habitat was the most threatened by loss of area.

Table 3.2 Comparison of the extent in 2000 and 2007 of each of the 38 assessed Annex I grassland habitat areas.

Site no.	Annex habitat	Area 2000 (m ²)	Area 2007 (m ²)	% change yr ⁻¹	Site no.	Annex habitat	Area 2000 (m ²)	Area 2007 (m ²)	% change yr ⁻¹
1	6210/6211	14012	9587	-4.5	110	6510	3031	3031	0.0
8	6210/6211	22639	19937	-1.7	113	6410	135749	135749	0.0
18	6410	73730	73730	0.0	114	6510	24935	19422	-3.2
20	6210/6211	40482	33002	-2.6	116	6210/6211	12325	12325	0.0
23	6410	465637	466240	0.0	205	6410	434438	434438	0.0
25	6410	18551	18551	0.0	210	6410	60485	59667	-0.2
30	6410	19654	19654	0.0	210	6430	12132	12132	0.0
30	6430	34206	34206	0.0	215	6210/6211	222803	222803	0.0
68	6410	46889	46889	0.0	216	6230	2695	2695	0.0
68	6510	208757	208757	0.0	224	6210/6211	83511	82263	-0.2
81	6210/6211	23708	19036	-2.8	226	6210/6211	105236	105236	0.0
82	6510	56194	56194	0.0	227	6210/6211	40523	37829	-0.9
101	6410	19963	19963	0.0	230	6210/6211	13147	8744	-4.8
107	6410	340678	340678	0.0	236	6410	8435	6639	-3.0
107	6510	3407	3379	-0.1	246	6210/6211	68836	35957	-6.8
108	6510	67807	67807	0.0	254	6210/6211	10226	4586	-7.9
109	6410	112328	112328	0.0	256	6210/6211	2085	1774	-2.1
109	6510	134910	134910	0.0	259	6210/6211	23868	2139	-13.0
110	6430	31728	31728	0.0	263	6210/6211	875312	875462	0.0

Structure and functions assessment

An assessment of structure and functions was made at 121 monitoring stops. Only 18 of these stops passed the assessment and only one habitat area received an overall assessment of Favourable (a small area of 6230 habitat at site number 216). The remaining 37 habitat areas were all assessed as Unfavourable – Bad. The main reason for this was that relevés recorded at monitoring stops did not contain the minimum requirement for positive indicator species. Of the eight criteria used, positive indicator species had by far the lowest pass rate (Table 3.3). The vast majority of passes were for habitat 6210/6211 (Table 3.4).

Table 3.3 Pass rate for criteria used to assess the structure and functions (sample size was 121 monitoring stops).

Assessment Criteria	% of monitoring stops that passed
Positive indicator species	28
Grass/sedge : forb ratio	67
Negative indicator species	86
Litter cover	96
Bare ground cover	96
Encroachment	98
Sward height	98
Grazing disturbance	99

Table 3.4 Pass rate for the positive indicator species criterion for each Annex I habitat.

Annex I habitat	No. monitoring stops	No. of passes for positive indicator species
6210/6211	54	27
6230	1	1
6410	43	6
6430	6	0
6510	17	0
<i>Total</i>	<i>121</i>	<i>34</i>

Future prospects assessment

Of the 38 Annex I habitat areas, 26 areas were scored as having negative overall future prospects (Table 3.5; full details presented in Appendix 7). These included all 15 areas of 6210/6211 habitat and 8 of the 6410 habitat areas. Only one habitat area was assessed for *Nardus* grassland (6230) and this area (at Site No. 216) had one of the lowest scores for future prospects.

Table 3.5 Future prospects scores for the 38 assessed areas of Annex I grassland habitat.

Site no.	Annex Habitats	Negative threat score	Positive conservation score	Total score
1	6210/6211	-11	3	-8
8	6210/6211	-8	1	-7
18	6410	-2	2	0
20	6210/6211	-2	0	-2
23	6410	-5	1	-4
25	6410	-5	1	-4
30	6410	0	1	1
30	6430	0	1	1
68	6410	-3	0	-3
68	6510	-3	0	-3
81	6210/6211	-8	0	-8
82	6510	-3	0	-3
101	6410	-3	0	-3
107	6410	-2	3	1
107	6510	0	2	2
108	6510	-1	2	1
109	6410	-4	5	1
109	6510	-4	5	1
110	6430	-1	2	1
110	6510	-1	2	1
113	6410	-4	3	-1
114	6510	-1	3	2
116	6210/6211	-3	0	-3
205	6410	-2	1	-1
210	6410	-3	1	-2
210	6430	0	1	1
215	6210/6211	-4	0	-4
216	6230	-11	0	-11
224	6210/6211	-18	2	-16
226	6210/6211	-8	0	-8
227	6210/6211	-9	0	-9
230	6210/6211	-7	0	-7
236	6410	-5	0	-5
246	6210/6211	-18	0	-18
254	6210/6211	-13	0	-13
256	6210/6211	-5	0	-5
259	6210/6211	-7	2	-5
263	6210/6211	-12	0	-12

3.3 Ranking of sites using conservation and threat evaluations

Conservation evaluation

The 91 semi-natural grassland sites each had a conservation and threat evaluation applied to them. The 24 sites that scored over 50% for the conservation evaluation are listed in Table 3.6.

It should be noted that of the top 24 sites only seven are not associated with an NHA or SAC designation. Of the top ten ranked sites all are associated with designated sites and six of these are at least partially within the River Shannon Callows SAC (216). The conservation scores for each of the 91 surveyed sites are listed in Appendix 4.

Table 3.6 The highest ranking semi-natural grassland sites according to their conservation evaluation.

Rank	Site no.	Site name	County	NHA/SAC code	% Score
1	109	Moystown Demesne and Island	Offaly	SAC 216	75
=2	18	Little Brosna Callows	Offaly	NHA 564 / SAC216	71
=2	25	Lough Gara	Roscommon	NHA 587	71
=2	107	Clonmacnoise	Offaly	SAC 216	71
=2	110	Clooncraft	Offaly	SAC 216	71
=2	114	Cappaleitrim	Roscommon	SAC 216	71
=2	210	Portnacrinnaught	Roscommon	NHA 587	71
=8	23	Lough Dromharlow	Roscommon	NHA 1643	67
=8	113	Drumlosh	Roscommon	SAC 216	67
10	30	Kilglas and Grange Lough	Roscommon	NHA 608	63
=11	108	Leitra Callow	Offaly	SAC 216	58
=11	236	Kilnahooan	Roscommon	-	58
=11	241	Cloonaddra	Roscommon	NHA 2310 / SAC 440	58
=14	1	All Saints Bog	Offaly	SAC 566	54
=14	8	Drumakeenan, Eagles Hill & Perry's Mill	Offaly	NHA 900	54
=14	205	Cleaheen	Roscommon	NHA 1643	54
=14	216	Mullaghmacormick	Roscommon	-	54
=14	218	Portruny Bay	Roscommon	NHA 2310 / SAC 440	54
=14	226	Coolteige	Roscommon	-	54
=14	227	Carrownalassan	Roscommon	-	54
=14	230	Kiltrustan	Roscommon	-	54
=14	245	Ahagower	Roscommon	NHA 222	54
=14	246	Skrine	Roscommon	-	54
=14	256	Turrock	Roscommon	-	54

Threat evaluation

The 13 most threatened sites (those that scored over 35% for the threat evaluation) are listed in Table 3.7. Of these sites, five are within designated sites. The most threatened site was All Saints Bog (site number 1), an area of calcareous grassland that included areas of habitat 6210/6211 but was threatened due to fertiliser application, improved/disturbed adjacent habitats, negative grazing regimes, scrub encroachment and the presence of a quarry in the middle of the

site. In total five of the 13 most threatened sites were associated with eskers (Site Nos. 1, 81, 224, 252, 254) highlighting the vulnerability of esker grasslands. The threat scores for each of the 91 surveyed sites are listed in Appendix 4.

It should be noted that three of the most threatened sites (Site Nos. 1, 227 and 246) are also listed amongst the sites with the highest conservation value (Table 3.6).

Table 3.7 The highest ranking semi-natural grassland sites according to their threat evaluation.

Rank	Site no.	Site name	County	NHA/SAC code	% Score
=1	1	All Saints Bog	Offaly	SAC 566	54
=1	220	Crunaun Bridge	Roscommon	-	54
=1	224	Cloonfineen	Roscommon	SAC 218	54
4	254	Pollalaher	Roscommon	-	46
=5	40	Hundred Acres	Offaly	SAC 412	38
=5	81	Mount St Joseph Esker	Offaly	NHA 913	38
=5	87	Bricknagh	Offaly	-	38
=5	208	Cloonalough	Roscommon	NHA 1645	38
=5	212	Dromore	Roscommon	-	38
=5	227	Carrownalassan	Roscommon	-	38
=5	242	Roxborough	Roscommon	-	38
=5	246	Skrine	Roscommon	-	38
=5	252	Ardmullen	Roscommon	-	38

3.4 Clustering and ordination

Indicator Species Analysis (ISA) revealed that the 6-cluster level was the most informative level of clustering according to the criterion of sum of significant indicator values (Fig. 3.17). After manual inspection of the ecological integrity of these clusters it was decided to proceed with 6 **vegetation types**, but to group these together into 2 main **grassland groups** with three vegetation types in each as dictated by the cluster dendrogram. These two grassland groups broadly corresponded to dry and wet grassland. As data are only available from 91 sites in two counties it was deemed appropriate to have relatively broad categories that would be applicable in a wider Irish context. Each group was named after their top grass species indicator and their top non-grass species indicator, hence the broadly dry grassland group was named the *Cynosurus cristatus* – *Plantago lanceolata* grassland group and the wet grassland group was named the *Agrostis stolonifera* – *Filipendula ulmaria* grassland / marsh group.

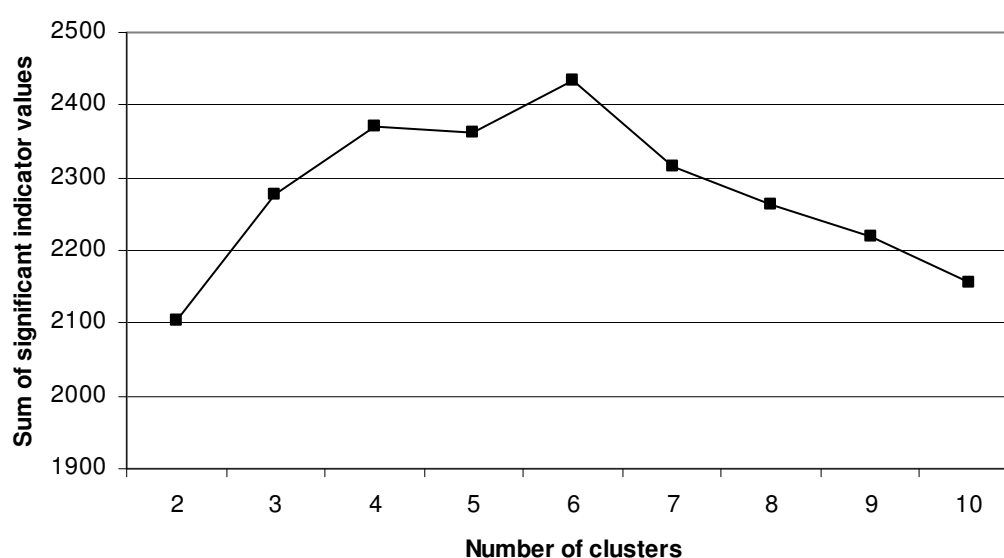


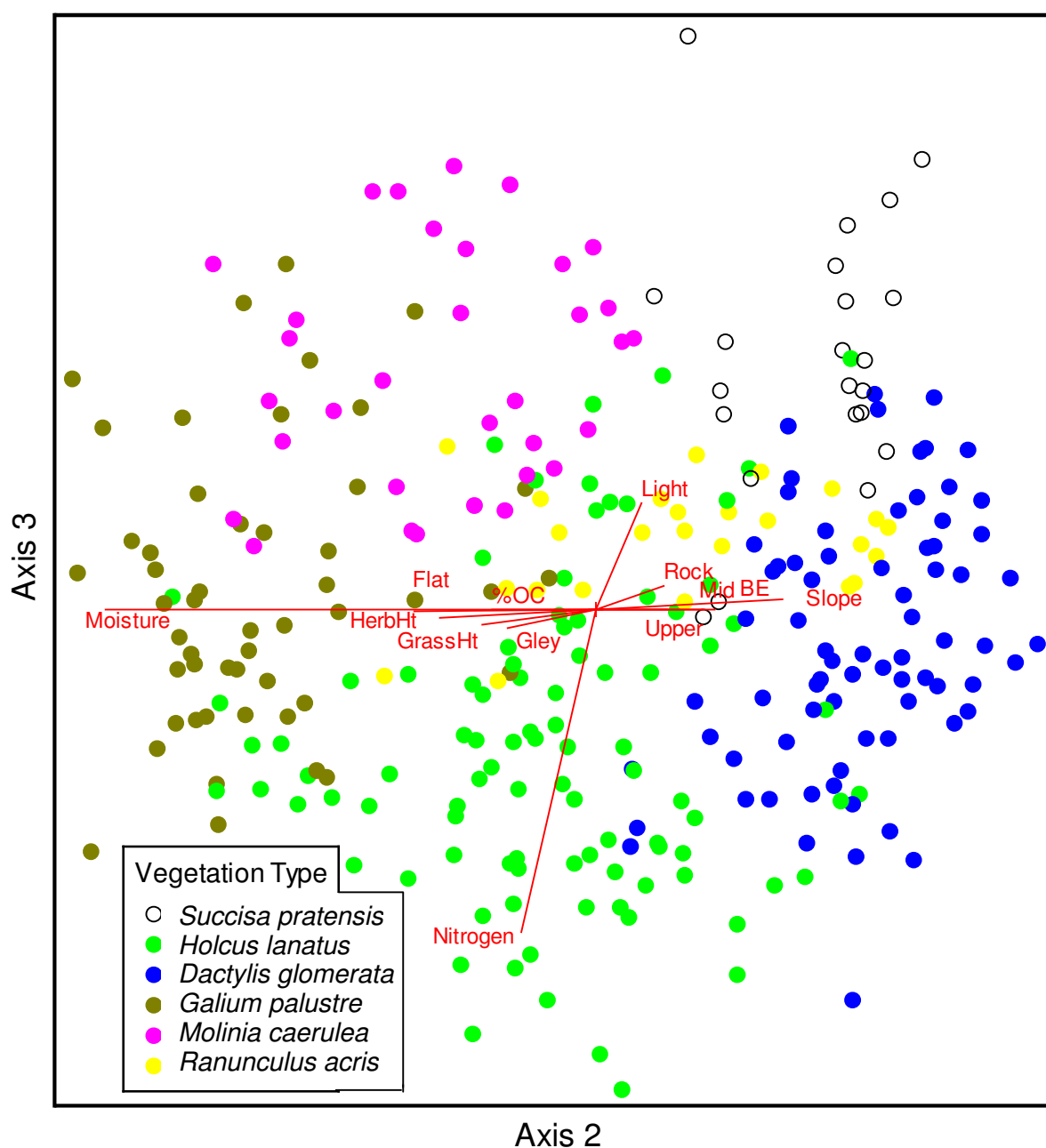
Figure 3.17 Variation in sum of significant indicator values as determined by Indicator Species Analysis, for different stages of the cluster cycle.

For each grassland group ISA was then re-run just for the subset of relevés within that group to characterise differences between their three vegetation types. Each of the vegetation types was named after their top indicator species as defined by this within-group analysis. This resulted in the following classification structure:

<i>Cynosurus cristatus</i> – <i>Plantago lanceolata</i> grassland group	(121 relevés)
<i>Succisa pratensis</i> vegetation type	(22 relevés)
<i>Ranunculus acris</i> vegetation type	(25 relevés)
<i>Dactylis glomerata</i> vegetation type	(74 relevés)

<i>Agrostis stolonifera</i> – <i>Filipendula ulmaria</i> grassland / marsh group	(179 relevés)
<i>Holcus lanatus</i> vegetation type	(96 relevés)
<i>Galium palustre</i> vegetation type	(50 relevés)
<i>Molinia caerulea</i> vegetation type	(30 relevés)

Figure 3.18 Non-metric multidimensional scaling ordination plot of 300 grassland relevés. Direction of red lines from origin shows Pearson correlation of environmental variables with axes. Length indicates strength of correlation. %OC = % organic content, Rock = % bare rock, HerbHt = herb height and GrassHt = grass height. Flat, Mid and Upper refer to topography dummy variables. Gley and BE (Brown Earth) refer to soil type dummy variables. Light, Nitrogen and Moisture refer to mean Ellenberg indicator values. Weaker correlations are omitted for clarity



Multi-response permutation procedure tests found statistically significant differences in the environmental matrix at the 2-cluster level ($A = 0.216$, $p < 0.001$) and at the 6-cluster level ($A = 0.442$, $p < 0.001$). McCune & Grace (2002) warn that statistically significant results (small p values) can be obtained even when the effect size (A) is small, if, as in this case, sample size is large. However, in both cases effect size or chance-corrected within-group agreement is actually quite high for community ecology datasets, providing good environmental support for cutting the cluster dendrogram at these levels.

The non-metric multi-dimensional scaling ordination found a 3-dimensional solution, the main two axes of which are shown in (Fig. 3.18). Stress on this solution was 19.9, which is quite high according to the guidelines of McCune & Grace (2002), but given the large sample size, a fair degree of reliance can be put on interpretation of the plot. The two axes cumulatively represented 55.5% of variance in the distance matrix. Overall relevés within each of the six vegetation types identified by cluster analysis, grouped together in the ordination, provided validation of the cluster solution. Axis 2 ($r^2 = 0.348$) primarily represents a wet-dry gradient. Samples from wet, flat sites with gleyed or organic soils and tall vegetation are found at the lower end of this axis and sites on dry, rocky or mineral soils on sloping ground with short vegetation are found at the upper end. Axis 3 ($r^2 = 0.207$) appears to primarily represent a fertility gradient, with infertile sites being found at the higher end of this axis and strongly fertile sites found at the lower end.

3.5 Vegetation classification

The presentation of the results of the classification analysis broadly follows the style used in the British National Vegetation Classification (NVC) by Rodwell (1992). For each grassland group the ten **key indicators** from the between group analysis are given in descending order with their indicator values in parentheses. A brief description of the grassland group as a whole is given, including the main components of the vegetation and the situations in which it occurs.

This is followed by a more detailed **description** of each of the vegetation types within the group including their topographical occurrence and geographical distribution. A **distribution map** for each vegetation type is presented at the end of the group account. A small number of **example sites** which contain this vegetation are then listed together with their site codes. These have been selected to represent the range of variation within the vegetation type, but emphasis has been placed on providing some useful points of reference to the group rather than listing sites which are strictly the most typical of the vegetation. Therefore, the examples tend to consist of sites which are already designated or to which public access is possible.

The **affinities** that each of the vegetation types has to previously described classifications are then detailed. Comparisons with Irish phytosociological accounts of the Central European tradition use O'Sullivan (1982) and White & Doyle (1982). Systematic comparisons with the grasslands section of the NVC of Rodwell (1992) were made using the TABLEFIT v1.0 software utility (Institute of Terrestrial Ecology, Huntingdon). This utility defines a measure of goodness-of-fit between samples of vegetation and the expected species composition of each NVC community. For each vegetation type, percentage cover and frequency data were used for all species with 5% or greater frequency within that vegetation type, with the exception of a small number of hybrids and recent taxonomic changes which could not be inputted. For each vegetation type the top five matches with NVC communities / sub-communities are given, together with the goodness-of-fit score in percent. A list of relevant NVC codes and communities mentioned in the text is given in Appendix 8. Comparisons of vegetation types with the *a priori* assignment of relevés to Fossitt (2000) categories and Annex I habitat types (Anon. 2003) are made in Tables 3.8 and 3.9 below respectively and are described in the relevant sections.

The **synoptic tables** (Tables 3.11 and 3.13) are presented in the following fashion. Species are included which have 5% or greater frequency in one or more of the vegetation types. Frequency and percentage cover data are given for the occurrence of each species in each vegetation type and in the grassland group as a whole. Frequency is indicated by Roman numerals, where I = 0.1 – 20.0%, II = 20.1 – 40.0%, III = 40.1 – 60.0%, IV = 60.1 – 80.0% and V = 80.1 – 100%. Significant indicator species are denoted by asterisks, with the indicator value score being indicated by the number of asterisks, such that: * = 0.1 – 20.0%, ** = 20.1 – 40.0%, *** = 40.1 – 60.0%, **** = 60.1 – 80.0% and ***** = 80.1 – 100%. Species are ordered within the table as

follows. The first section contains the constant species, which in phytosociological terminology are those with an overall frequency in the grassland group of IV or V. Within this section species are ordered by their indicator status for each of the vegetation types. The following sections contain the indicator species for each of the vegetation types in turn. Within these sections species are ordered by indicator values. Species with only one asterisk are poor indicators whose significance may be a result of small sample size therefore they are separated from the rest to indicate that less emphasis should be placed on them. The final sections contain the remaining species which do not have any significant affinity for one of the vegetation types. These companion species have been divided in sections according to whether they are grasses, sedges or rushes, forbs, other vascular plants or bryophytes, and within these sections they are ordered by frequency.

At the end of the synoptic table mean environmental data is presented for each vegetation type. Species richness simply indicates the mean number of species per relevé. Soil type data is presented for the main three types only. Ellenberg indicator scores are the mean of mean values weighted by abundance for each relevé.

Table 3.8 Confusion table comparing vegetation type assignment of relevés using hierarchical clustering with *a priori* assignment of relevés to Annex I habitat types. Figures are number of relevés. Figures in italics are row and column totals.

	Non Annex I Habitats	Festuco- Brometalia grasslands 6210/11	<i>Nardus</i> grasslands 6230	<i>Molinia</i> meadows 6410	Hydrophilous tall herb community 6430	Lowland hay meadows 6510	
<i>Succisa</i> <i>pratensis</i> type	6	13	0	3	0	0	22
<i>Dactylis</i> <i>glomerata</i> type	44	29	0	0	0	1	74
<i>Ranunculus</i> <i>acris</i> type	8	2	0	2	0	13	25
<i>Holcus</i> <i>lanatus</i> type	78	1	1	12	3	1	96
<i>Molinia</i> <i>caerulea</i> type	15	0	0	16	0	2	33
<i>Galium</i> <i>palustre</i> type	40	0	0	6	3	1	50
	<i>191</i>	<i>45</i>	<i>1</i>	<i>39</i>	<i>6</i>	<i>18</i>	<i>Total</i> =300

Table 3.9 Confusion table comparing vegetation type assignment of relevés using hierarchical clustering with *a priori* classification of relevés using habitat types of Fossitt (2000). Figures are number of relevés. Figures in italics are row and column totals.

	Dry calcareous grassland GS1	Dry meadows / verges GS2	Dry acid grassland GS3	Wet grassland GS4	Marsh GM	Improved GA	
<i>Succisa pratensis type</i>	18	1	0	3	0	0	<i>22</i>
<i>Dactylis glomerata type</i>	61	12	0	0	0	1	<i>74</i>
<i>Ranunculus acris type</i>	4	19	0	2	0	0	<i>25</i>
<i>Holcus lanatus type</i>	5	8	7	68	6	2	<i>96</i>
<i>Molinia caerulea type</i>	2	16	0	15	0	0	<i>33</i>
<i>Galium palustre type</i>	0	21	0	22	7	0	<i>50</i>
	<i>90</i>	<i>77</i>	<i>7</i>	<i>110</i>	<i>13</i>	<i>3</i>	<i>Total =300</i>

3.6 Cynosurus cristatus – Plantago lanceolata grassland

Key indicator species: *Plantago lanceolata* (73%), *Trifolium pratense* (68%), *Cynosurus cristatus* (64%), *Lotus corniculatus* (59%), *Dactylis glomerata* (57%), *Festuca rubra* (52%), *Achillea millefolium* (52%), *Lolium perenne* (49%), *Briza media* (49%), *Cerastium fontanum* (47%).

Description: This grassland group consists of vegetation dominated by *Festuca rubra*, *Plantago lanceolata*, *Trifolium pratense* and *Cynosurus cristatus* (Table 3.11). The other constant species are *Holcus lanatus*, *Anthoxanthum odoratum*, *Dactylis glomerata*, *Lotus corniculatus* and *Cerastium fontanum*. These are essentially dry grassland swards found predominantly on slightly infertile, mildly acid mineral brown earths on gently sloping ground. Sward height is typically fairly low. Within this group three vegetation types have been identified:

a) *Succisa pratensis* type: This is a species-rich sward typically found on sloping ground and on infertile, highly mineral brown earths. The sward is dominated by *Festuca rubra*, *Carex flacca*, *Briza media*, *Succisa pratensis* and *Anthoxanthum odoratum*. Other frequent species include *Lotus corniculatus*, *Trifolium pratense* and *Plantago lanceolata*, *Linum catharticum*, *Centaurea nigra* and *Galium verum*. Less frequent indicators include *Potentilla erecta*, *Euphrasia officinalis* and *Thymus polytrichus*. The sward is relatively short (<20cm). This vegetation type includes samples from esker grassland and grassland found in close association with outcropping limestone and limestone pavement. Also included here are small number of relevés from base-rich, dry fen meadows and fen margins which share similar vegetation. It occurs in southwest Co. Offaly and scattered throughout Co. Roscommon (Fig. 3.19)

Example sites: All Saint's Bog, Co.Offaly (Site No.1); Carrickmore, Co. Roscommon (Site No. 215); Portruny Bay, Co. Roscommon (Site No. 218).

b) *Ranunculus acris* type: This vegetation type differs from the others in this group by occurring on flat ground and on gleyed soils as often as brown earths. It is also relatively species-poor with a high sward (>35cm). There is a marked abundance of *Plantago lanceolata* with *Trifolium pratense*, *Festuca rubra*, *Phleum pratense* and *Agrostis stolonifera* also dominating. Other frequent species include *Lotus corniculatus*, *Anthoxanthum odoratum*, *Ranunculus acris*, *Filipendula ulmaria*, *Centaurea nigra* and *Rhinanthus minor*. Less frequent indicators include *Festuca pratensis*, *Crepis capillaris* and *Ranunculus repens*. This group largely consists of lowland hay meadows within the Shannon callows and are hence found along the northwest Co. Offaly border with a few further callows sites in north Co. Roscommon (Fig. 3.19). These samples would generally occur on higher ground within the callows systems and hence would not be subject to regular inundation.

Example sites: Moystown Demesne & Island, Co. Offaly (Site 109); Clonmacnoise, Co. Offaly (Site 107).

c) *Dactylis glomerata* type: This is a relatively common sward type occurring on brown earths of intermediate fertility with low organic content. It occurs throughout both counties. Sward height and species richness are between those of the other vegetation types in this group. The sward is dominated by *Cynosurus cristatus*, *Festuca rubra*, *Holcus lanatus* and *Trifolium pratense*. Other frequent species include *Plantago lanceolata*, *Dactylis glomerata*, *Cerastium fontanum*, *Achillea millefolium* and *Lotus corniculatus*. This vegetation type includes swards from calcareous and neutral semi-natural pasture and swards from semi-improved sites, indicated by the frequency of *Lolium perenne*, *Taraxacum* agg. and *Trifolium repens*. Other samples are from undergrazed eskers and areas with outcropping limestone.

Example sites: Little Brosna Callows (Site No. 18); Cloonfineen, Co. Roscommon (Site No. 224); Carrownalassan, Co. Roscommon (Site No. 227).

Affinities: The majority of the samples in the *Succisa pratensis* vegetation type were classified as GS1 Dry calcareous and neutral grassland (Table 3.8). Over half of the samples in this species-rich grouping were classified as Annex I habitat type Semi natural grasslands and scrubland facies on calcareous substrates (6210/6211) (Table 3.9). The small number of samples in this vegetation type from wetter ground were classified as GS4 Wet grassland and *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (6410).

More than half of the relevés in the *Ranunculus acris* vegetation type were classified as the Annex I habitat 6510 Lowland hay meadows and nearly all of the samples in this vegetation type were assigned to GS2 Dry meadows and grassy verges. The more common *Dactylis glomerata* vegetation type differed in that most of the relevés were not assigned to any Annex I habitat although a significant number were classified as habitat type 6210/6211. Under the Fossitt (2000) scheme, samples within this vegetation type were mostly allocated to the GS1 category with a smaller number being ascribed to GS2.

The *Cynosurus cristatus* – *Plantago lanceolata* grassland group as a whole may be compared with the mesotrophic grasslands of the Molinio-Arrhenatheretea phytosociological class described by O'Sullivan (1982). The *Dactylis glomerata* and *Ranunculus acris* vegetation types can be ascribed to the Centaureo-Cynosuretum association of moderate quality pastures. Aspects of the Lolio-Cynosuretum association of improved pastures may occur in *Dactylis glomerata* sward due the occurrence of *Lolium perenne* and *Trifolium repens*. The *Succisa pratensis* vegetation type with its abundance of *Briza media* and high frequency of *Galium verum* contains elements of the Centaureo-Cynosuretum galietosum subassociation. However, it may be more favourably compared with the Antennarietum hibernicae association

which belongs to the calcareous grasslands of the Festuco-Bromotea class. Character species for this association are *Polygala vulgaris* and *Antennaria dioica*. Companion species include *Lotus corniculatus*, *Briza media*, *Linum catharticum*, *Carex flacca* and *Thymus polytrichus*. All these species match well with the details for this vegetation type. None of the samples from meadow sites could be ascribed to the Arrhenatherion elatioris alliance as suggested by Fossitt (2000) due to the scarcity of *Arrhenatherum elatius*.

The affinities between the vegetation types of the *Cynosurus cristatus* – *Plantago lanceolata* grassland group and the NVC classification of Rodwell (1992) are shown in Table 3.10. All three vegetation types most closely correlate with MG5 *Cynosurus cristatus* – *Centaurea nigra* grassland which is a dicotyledon-rich sward typical of traditionally grazed hay meadows. Both the *Succisa pratensis* and *Dactylis glomerata* vegetation types match best with the MG5b *Galium verum* sub-community that is found on calcareous loam pastures and has a varied grass component. The *Ranunculus acris* vegetation type matches best with the MG5a *Lathyrus pratensis* sub-community that is found on calcareous clay pastures and has a high legume component with rather poor grass growth. There is some affinity between the *Succisa pratensis* vegetation type and the more strictly calcareous CG6 *Avenula pubescens* grassland.

Table 3.10 Goodness-of-fit comparisons between *Cynosurus cristatus* – *Plantago lanceolata* grassland vegetation types and NVC communities (See Appendix 8 for details of codes and communities).

a <i>Succisa pratensis</i>		b <i>Ranunculus acris</i>		c <i>Dactylis glomerata</i>	
MG5b	41%	MG5a	50%	MG5b	58%
CG6a	38%	MG5	48%	MG5a	56%
MG5	36%	MG4	46%	MG5	55%
MG5c	35%	MG5b	43%	MG3b	43%
MG5a	35%	MG3b	43%	MG5c	43%

Table 3.11 Synoptic table for the *Cynosurus cristatus* – *Plantago lanceolata* grassland group

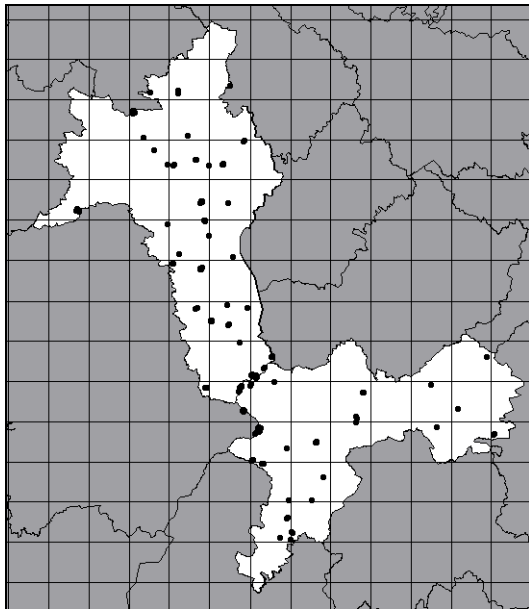
	a			b			c			Group	
Constants											
<i>Plantago lanceolata</i>	IV	3.4		V	30.1	****	V	7.4		V	11.4
<i>Trifolium pratense</i>	IV	4.0		V	15.8	***	IV	8.4		IV	9.1
<i>Dactylis glomerata</i>	II	1.3		II	0.4		V	7.8	****	IV	5.1
<i>Holcus lanatus</i>	III	3.1		II	2.0		IV	8.9	***	IV	6.4
<i>Cynosurus cristatus</i>	III	4.4		III	4.6		V	11.0	***	IV	8.5
<i>Cerastium fontanum</i>	II	0.3		III	0.5		IV	1.2		IV	0.9
<i>Festuca rubra</i>	V	13.6		V	14.3		V	10.9		V	12.1
<i>Lotus corniculatus</i>	V	6.2		IV	5.9		IV	3.0		IV	4.2
<i>Anthoxanthum odoratum</i>	V	8.5		IV	6.7		III	5.0		IV	6.0
a <i>Succisa pratensis</i> type indicators											
<i>Succisa pratensis</i>	IV	10.6	****	I	0.2		I	0.5		II	2.3
<i>Briza media</i>	V	11.0	****	I	0.6		III	4.5		III	4.9
<i>Carex flacca</i>	V	12.4	****	II	1.5		III	3.6		III	4.8
<i>Potentilla erecta</i>	III	1.6	***	I	<0.1		I	0.3		II	0.5
<i>Linum catharticum</i>	IV	1.1	**	I	0.5		II	0.4		II	0.6
<i>Danthonia decumbens</i>	II	1.4	**	I	<0.1		I	0.2		I	0.4
<i>Euphrasia officinalis</i>	III	2.3	**	II	1.3		II	0.9		II	1.2
<i>Thymus polytrichus</i>	II	4.1	**				I	0.2		I	0.9
<i>Carex panicea</i>	II	2.3	**	I	0.4		I	0.1		I	0.6
<i>Hypericum pulchrum</i>	II	0.4	**				I	<0.1		I	0.1
<i>Pilosella officinale</i>	III	1.5	**	I	0.1		II	0.6		II	0.6
<i>Rhytidiadelphus triquetrus</i>	II	1.9	**	I	<0.1		I	0.1		I	0.4
<i>Polygala vulgaris</i>	II	0.5	**				I	<0.1		I	0.1
<i>Carlina vulgaris</i>	II	0.5	**				I	<0.1		I	<0.1
<i>Carex pulicaris</i>	II	0.5	**							I	<0.1
<i>Hylocomium splendens</i>	II	3.0	**				I	0.3		I	0.7
<i>Schoenus nigricans</i>	I	2.5	*							I	0.0
<i>Fraxinus excelsior</i>	I	<0.1	*							I	<0.1
<i>Crataegus monogyna</i>	I	0.2	*				I	<0.1		I	<0.1
<i>Anthyllis vulneraria</i>	I	0.6	*				I	<0.1		I	0.1
<i>Dactylorhiza fuchsii</i>	I	0.1	*	I	<0.1		I	<0.1		I	<0.1
<i>Mentha aquatica</i>	I	0.5	*							I	<0.1
<i>Salix repens</i>	I	0.1	*							I	<0.1
<i>Potentilla anglica</i>	I	<0.1	*							I	<0.1
<i>Parnassia palustris</i>	I	<0.1	*							I	<0.1
<i>Carex viridula</i>	I	<0.1	*							I	<0.1
<i>Anagallis tenella</i>	I	0.4	*							I	<0.1
<i>Antennaria dioica</i>	I	0.6	*				I	<0.1		I	0.1
b <i>Ranunculus acris</i> type indicators											
<i>Ranunculus acris</i>	II	0.3		IV	5.4	****	II	1.0		III	1.8
<i>Filipendula ulmaria</i>	I	0.2		IV	4.8	****	I	<0.1		I	1.1
<i>Rhinanthus minor</i>	I	0.6		IV	3.8	***	I	0.5		II	1.2
<i>Festuca pratensis</i>				III	5.6	***	I	0.1		I	0.1
<i>Phleum pratense</i>	I	<0.1		III	8.9	***	II	1.7		II	2.9
<i>Crepis capillaris</i>				III	3.1	***	II	1.2		II	1.4
<i>Vicia cracca</i>	I	0.5		III	1.5	**	I	0.1		I	0.5
<i>Centaurea nigra</i>	IV	4.7		IV	7.6	**	III	2.5		III	3.9
<i>Ranunculus repens</i>	II	0.8		III	3.4	**	II	0.9		II	1.4
<i>Rumex acetosa</i>	I	<0.1		III	0.9	**	II	0.7		II	0.6
<i>Agrostis stolonifera</i>	I	2.2		III	8.7	**	III	4.2		III	4.8

	a		b		c		Group	
<i>Stellaria graminea</i>	I	<0.1	II	0.3 **	I	<0.1	I	<0.1
<i>Lathyrus pratensis</i>	I	<0.1	II	0.6 **	I	0.2	I	0.3
<i>Lychnis flos-cuculi</i>			I	<0.1 *			I	<0.1
<i>Crepis biennis</i>			I	0.3 *				
<i>Lathyrus palustris</i>			I	<0.1 *				
c <i>Dactylis glomerata</i> type indicators								
<i>Lolium perenne</i>	I	<0.1	III	2.6	IV	7.0 ***	III	4.8
<i>Trifolium repens</i>	II	0.3	I	1.5	III	6.4 **	III	4.3
<i>Taraxacum agg.</i>	I	<0.1	II	0.2	III	1.5 **	II	1.0
<i>Trisetum flavescens</i>			I	0.4	II	3.1 **	I	2.0
<i>Ranunculus bulbosus</i>	I	<0.1			II	1.8 **	I	1.1
Other grasses, sedges and rushes								
<i>Luzula campestris</i>	I	0.2	I	<0.1	II	0.2	II	0.2
<i>Arrhenatherum elatum</i>	I	0.7	I	0.4	II	1.7	I	1.2
<i>Helictotrichon pubescens</i>	I	0.5	I	0.4	I	0.3	I	0.3
<i>Poa trivialis</i>			I	0.1	I	0.9	I	0.6
<i>Carex nigra</i>	I	0.4	I	0.6	I	0.2	I	0.3
<i>Koeleria macrantha</i>	I	0.6			I	0.1	I	0.2
<i>Carex caryophylla</i>	I	0.3	I	<0.1	I	<0.1	I	<0.1
<i>Bromus hordeaceus</i>			I	<0.1	I	0.3	I	0.2
<i>Poa pratensis</i>			I	0.2	I	0.4	I	0.3
<i>Molinia caerulea</i>	I	2.0	I	1.5			I	0.7
<i>Carex hirta</i>			I	0.7	I	0.3	I	0.3
<i>Juncus articulatus</i>	I	0.1			I	<0.1	I	0.0
<i>Juncus acutiflorus</i>	I	0.7	I	0.4	I	<0.1	I	0.2
<i>Alopecurus pratensis</i>			I	1.3	I	0.2	I	0.2
<i>Deschampsia cespitosa</i>			I	0.5	I	0.4	I	0.3
<i>Poa annua</i>	I	<0.1			I	<0.1	I	<0.1
<i>Festuca arundinacea</i>	I	0.2	I	0.2			I	<0.1
<i>Brachypodium sylvaticum</i>	I	<0.1			I	<0.1	I	<0.1
<i>Juncus conglomeratus</i>			I	0.2			I	<0.1
<i>Elytrygia repens</i>			I	0.3			I	<0.1
Other forbs								
<i>Achillea millefolium</i>	III	1.0	II	1.4	IV	2.1	III	1.7
<i>Prunella vulgaris</i>	III	1.5	II	0.6	III	1.7	III	1.4
<i>Galium verum</i>	IV	2.1	II	2.3	III	1.4	III	1.7
<i>Hypochaeris radicata</i>	III	1.8	II	2.2	III	2.4	III	2.3
<i>Leucanthemum vulgare</i>	III	2.0	II	2.2	II	1.3	II	1.6
<i>Bellis perennis</i>	II	0.5	I	<0.1	II	1.0	II	0.7
<i>Cirsium palustre</i>	II	0.4	I	<0.1	II	0.7	II	0.5
<i>Leontodon hispidus</i>	II	1.4			II	2.6	II	1.8
<i>Conopodium majus</i>	II	0.3	I	<0.1	II	0.8	II	0.6
<i>Senecio jacobea</i>	I	0.1	I	0.2	II	0.5	I	0.4
<i>Cirsium arvense</i>	I	0.2			II	0.9	I	0.6
<i>Primula veris</i>	I	1.0			I	0.2	I	0.3
<i>Medicago lupulina</i>	I	<0.1	I	0.7	I	0.8	I	0.7
<i>Daucus carota</i>	I	0.2	I	0.8	I	0.7	I	0.6
<i>Viola riviniana</i>	I	0.3			I	0.1	I	0.1
<i>Veronica chamaedrys</i>	I	<0.1			I	0.5	I	0.3
<i>Cirsium vulgare</i>	I	<0.1			I	0.2	I	0.1
<i>Veronica montana</i>					I	<0.1	I	<0.1
<i>Odontites verna</i>			I	<0.1	I	<0.1	I	<0.1

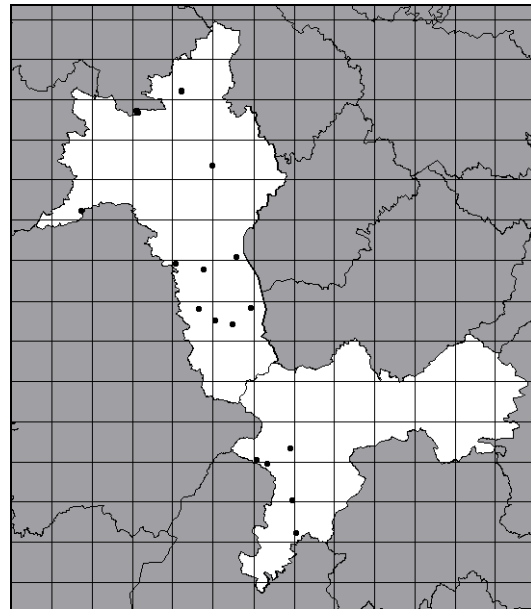
	a		b		c		Group	
<i>Trifolium dubium</i>					I	0.6	I	0.3
<i>Potentilla anserina</i>	I	0.1			I	<0.1	I	<0.1
<i>Leontodon autumnalis</i>	I	0.4	I	0.4	I	0.2	I	0.2
<i>Veronica officinalis</i>					I	0.2	I	0.1
<i>Knautia arvensis</i>	I	0.2			I	0.3	I	0.2
<i>Cardamine pratensis</i>			I	<0.1	I	<0.1	I	<0.1
<i>Trifolium campestre</i>			I	0.5	I	<0.1	I	0.2
<i>Heracleum sphondylium</i>					I	0.5	I	0.3
<i>Crepis vesicaria</i>			I	<0.1	I	<0.1	I	<0.1
<i>Cirsium dissectum</i>	I	1.9	I	1.4			I	0.6
<i>Senecio aquaticus</i>	I	<0.1	I	<0.1			I	<0.1
<i>Leontodon saxatilis</i>	I	<0.1			I	<0.1	I	<0.1
<i>Angelica sylvestris</i>	I	<0.1	I	0.2			I	<0.1
Other vascular species								
<i>Pteridium aquilinum</i>	I	0.4			I	0.5	I	0.5
<i>Rubus fruticosus</i>	I	0.2			I	<0.1	I	<0.1
Other bryophytes								
<i>Calliergonella cuspidata</i>	III	1.5	III	0.7	III	0.6	III	0.8
<i>Rhytidiadelphus squarrosus</i>	II	1.0	I	0.3	III	1.4	III	1.1
<i>Pseudoscleropodium purum</i>	III	0.9	I	<0.1	II	0.7	II	0.6
<i>Ctenidium molluscum</i>	I	0.7			I	0.1	I	0.2
<i>Brachythecium rutabulum</i>	I	<0.1	I	<0.1	I	<0.1	I	<0.1
<i>Thuidium tamarascinum</i>	I	<0.1	I	<0.1	I	<0.1	I	<0.1
<i>Plagiomnium undulatum</i>	I	<0.1	I	<0.1	I	<0.1	I	<0.1
<i>Homalothecium lutescens</i>					I	0.2	I	0.2
<i>Kindbergia praelonga</i>	I	<0.1	I	0.2	I	<0.1	I	<0.1
<i>Hypnum lacunosum</i>	I	0.3			I	0.1	I	0.1
<i>Tortella tortuosa</i>	I	<0.1			I	<0.1	I	<0.1
<i>Lophocolea bidentata</i>	I	<0.1			I	<0.1	I	<0.1
<i>Climacium dendroides</i>	I	<0.1	I	<0.1	I	<0.1	I	<0.1
Number of relevés	22		25		74		121	
Species richness	27		22		25		25	
Altitude (m)	68		47		76		69	
Slope (°)	10		2		9		8	
Soil pH	6.6		6.4		6.4		6.4	
Soil organic content (%)	6.7		7.8		8.4		7.9	
Soil types (%)	89		47		89		82	
Brown Earths								
Gleys	11		47		11		16	
Basin Peats	0		7		0		1	
Grass height (cm)	19		39		27		28	
Forb height (cm)	13		36		16		20	
Mean Ellenberg scores	Light		7.4		7.2		7.2	
	Reaction		5.8		6.0		6.0	
	Nitrogen		3.3		4.5		4.3	
	Moisture		5.4		5.3		5.2	
	Salt		0.3		0.3		0.2	

Figure 3.19 Distribution maps for *Cynosurus cristatus* – *Plantago lanceolata* grassland and vegetation types. Grid lines indicate hectads.

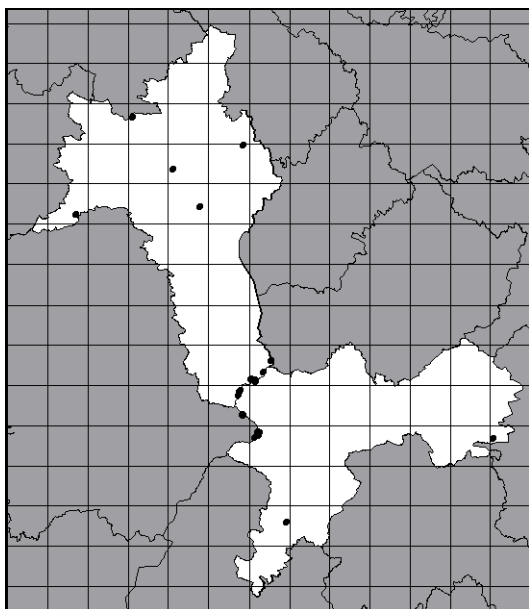
Cynosurus cristatus – *Plantago lanceolata*
grassland



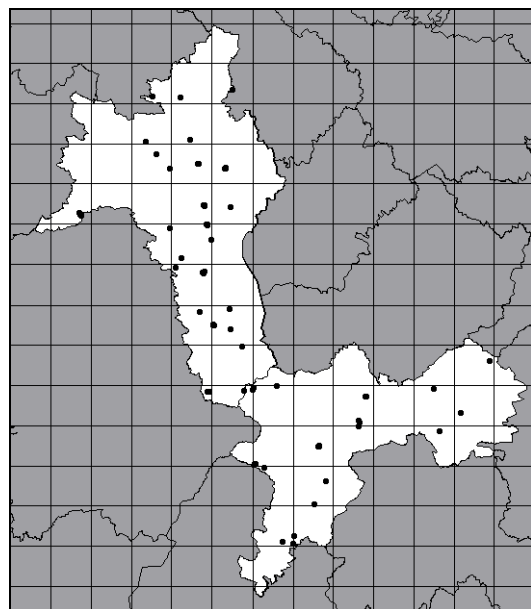
a *Succisa pratensis*



b *Ranunculus acris*



c *Dactylis glomerata*



3.7 *Agrostis stolonifera* – *Filipendula ulmaria* grassland/marsh

Key indicator species: *Filipendula ulmaria* (55%), *Agrostis stolonifera* (51%), *Ranunculus repens* (44%), *Juncus effusus* (38%), *Galium palustre* (37%), *Mentha aquatica* (32%), *Calliergonella cuspidata* (29%), *Carex nigra* (28%), *Potentilla anserina* (28%), *Molinia caerulea* (28%).

Description: This grassland / marsh group consists of a rather diverse range of vegetation types with only two constant species *Agrostis stolonifera* and *Filipendula ulmaria* (Table 3.13). However, these swards are all predominantly found on wet or periodically inundated gleys, brown earths or basin peats on flat ground. Soils have a higher organic content than those of the *Cynosurus cristatus* – *Plantago lanceolata* grassland group. Soil fertility is intermediate and sward height is typically quite high whilst species richness is rather low. Within this group three vegetation types have been identified:

a) *Holcus lanatus* type: This is a common vegetation type found throughout both counties frequently on gleys or brown earths and occasionally on basin peats. The species-poor sward is dominated by *Agrostis stolonifera*, *Holcus lanatus*, *Juncus effusus* and *Festuca rubra*. Other frequent species are *Filipendula ulmaria*, *Trifolium repens*, *Cerastium fontanum*, *Rumex acetosa*, *Ranunculus acris* and *R. repens*. Less frequent indicators are *Potentilla anserina*, *Cynosurus cristatus* and *Cirsium palustre*. The majority of these samples are from lowland wet pasture but also included here are a small number of samples from upland acid grassland found in mosaic with wet grassland in the Slieve Bloom Mountains.

Example sites: Hundred Acres, Co. Offaly (Site No. 40); Cleaheen, Co. Roscommon (Site No. 205); Crunaun Bridge, Co. Roscommon (Site No. 220).

b) *Galium palustre* type: This vegetation type is the wettest all those described in this report occurring predominantly on gleyed soil of intermediate fertility. Sward height is generally high (>40cm). The community is species-poor and is dominated by *Agrostis stolonifera*, *Filipendula ulmaria*, *Ranunculus repens*, *Carex disticha* and *C. nigra*. Other indicator species include *Caltha palustris*, *Mentha aquatica*, *Galium palustre*, *Phalaris arundinacea* and *Phleum pratense*. These samples are from sedge-rich wet meadows, callows and freshwater marsh and include eutrophic tall herb relevés which are transitional to swamp communities. They are predominantly from the western Co. Offaly border along the Shannon (Fig. 3.20).

Example sites: Little Brosna Callows, Co. Offaly (Site No. 18); Kilglas & Grange Lough, Co. Roscommon (Site. No. 30); Clooncraff, Co. Offaly (Site No. 110).

c) *Molinia caerulea* type: This vegetation type occurs on wet, relatively organic basin peats, gleys and brown earths of poor nutrient status. The sward is strongly dominated by *Molinia*

caerulea with *Carex panicea*, *Agrostis stolonifera* and *Filipendula ulmaria* is also abundant. Other frequent species are *Succisa pratensis*, *Anthoxanthum odoratum*, *Holcus lanatus*, *Festuca rubra*, *Ranunculus repens*, *Potentilla erecta*, *Plantago lanceolata*, *Trifolium pratense* and *Calliergonella cuspidata*. Less frequent indicators include *Carex flacca*, *Cirsium dissectum*, *Centaurea nigra* and *Rhinanthus minor*. These samples were generally found in association with lowland river systems, particularly the Shannon, with a few samples from eastern Co. Offaly.

Example sites: Slate River, Co. Offaly (Site No. 68); Moystown Demesne & Island, Co. Offaly (Site No. 109); Drumlosh, Co. Roscommon (Site No. 113).

Affinities: The *Holcus lanatus* vegetation type consisted largely of relevés classified in the field as GS4 Wet grassland under the scheme of Fossitt (2000) with other relevés drawn from the full range of categories (Table 3.9). The small number of GS3 Dry acid grassland relevés recorded were clustered here. Relatively few samples were assigned Annex I status (Table 3.8). Most of those assigned status were classified as 6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils, but notably half of the 6430 Hydrophilous tall herb community samples belong to this vegetation type.

Both the *Galium palustre* and *Molinia caerulea* vegetation types split fairly evenly between GS2 Dry meadows and grassy verges and GS4 Wet grassland; this is due largely to the decision made during fieldwork to classify wet grassland or marsh managed as meadow under GS2. Just over half of the GM Freshwater marsh relevés are found in the *Galium palustre* vegetation type, the remainder having been assigned to the *Holcus lanatus* type. Only a few relevés within the *Galium palustre* vegetation type had been matched to Annex I; these were 6410 and 6430 habitats. However, over half of the *Molinia caerulea* vegetation type samples were classified as 6410 habitat.

It was found to be difficult to make firm comparisons with the phytosociological schemes presented by O'Sullivan (1982) and White & Doyle (1982) largely due to the poor definition given to wet grassland and marsh communities in these studies. Additional guidance was however provided by the work of Tolkamp (2001) on classifying callows grassland communities in Co. Longford. The *Molinia caerulea* vegetation type may be compared to the *Junco conglomerati* – Molinion alliance within the Molinietalia order due to the abundance of *Molinia caerulea*, *Carex panicea* and *Potentilla erecta*. It relates best with the Cirsio-Molinietum association due to the occurrence *Carex panicea* and *Cirsium dissectum* and the general paucity of cover by *Juncus* species. The *Galium palustre* vegetation type contains elements of several phytosociological groupings. Samples transitional to swamp and dominated by *Phalaris arundinacea* or *Glyceria maxima* maybe ascribed to the order Phragmitetalia. Other samples may be related to either the Calthion or Filipendulion alliances. The *Holcus lanatus* vegetation type is referable to the *Junco acutiflori* – Molinietum

association within the Molinietales order due to the dominance of *Juncus* species, but it is important to note that *Juncus effusus* rather than *Juncus acutiflorus* is the more abundant species in these samples.

The affinities between the vegetation types of the *Agrostis stolonifera* – *Filipendula ulmaria* grassland / marsh group and the NVC classification of Rodwell (1992) are shown in Table 3.12. There is reasonably good correlation between the *Molinia caerulea* vegetation type and M24 *Molinia caerulea* – *Cirsium dissectum* fen-meadow which is found on fairly dry peats and peaty mineral soils and is associated with the fringes of bogs and fens. The best match is with the M24b typical sub-community in which smaller grasses and sedge (*Carex* spp.) are common. It is the most common sub-community in central and eastern England. The *Holcus lanatus* vegetation type can be loosely compared with several British wet grassland types but most closely matches the typical subcommunity of MG10 *Holcus lanatus* – *Juncus effusus* rush-pasture, which occurs on a range of mineral soils of varying pH throughout the British lowlands and on the upland fringes that have consistently high soil moisture and may sometimes be waterlogged. The *Galium palustre* vegetation type correlates very poorly with NVC communities possibly due to rather more diverse range of vegetation that it includes . The top match is actually with SD17 *Potentilla anserina* – *Carex nigra* dune slacks, but a more appropriate comparison would be with M22 *Juncus subnodulosus* – *Cirsium palustre* fen-meadow, in particular the M22b *Briza media* – *Trifolium* spp. sub-community. It is found on moist, rather base-rich, peaty soils in southern lowland Britain in association with springs, flushes and mires.

Table 3.12 Goodness-of-fit comparisons between *Agrostis stolonifera* – *Filipendula ulmaria* grassland / marsh vegetation types and NVC communities. (See Appendix 8 for details of codes and communities).

a <i>Holcus lanatus</i>		b <i>Galium palustre</i>		c <i>Molinia caerulea</i>	
MG10a	34%	SD17	27%	M24	57%
MG8	33%	M22b	22%	M24b	54%
MG9	33%	M27c	21%	M24c	47%
MG11	32%	M22	21%	M13	43%
MG9a	32%	SD17c	21%	M25b	37%

Table 3.13 Synoptic table for the *Agrostis stolonifera* – *Filipendula ulmaria* grassland / marsh group.

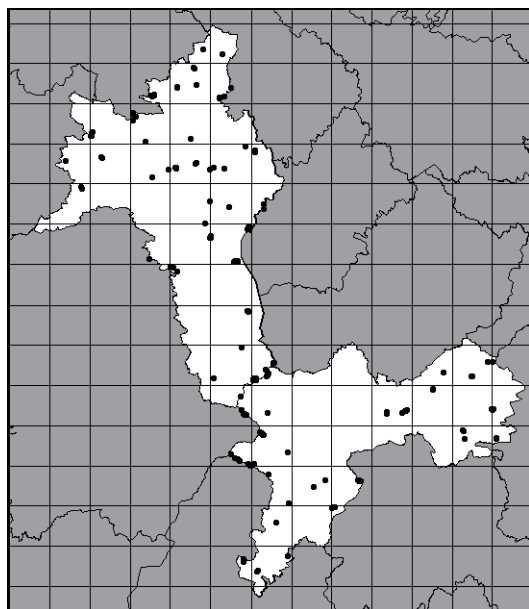
	a		b		c		Group	
Constants								
<i>Agrostis stolonifera</i>	IV	13.0	IV	11.1	IV	9.5	IV	11.8
<i>Filipendula ulmaria</i>	III	6.9	IV	13.0 **	IV	9.2	IV	9.0
a <i>Holcus lanatus</i> type indicators								
<i>Holcus lanatus</i>	IV	11.6 ****	I	0.9	III	1.2	III	6.7
<i>Juncus effusus</i>	III	10.8 ***	I	1.2	I	0.5	II	6.2
<i>Festuca rubra</i>	IV	11.0 **	I	1.1	III	6.1	III	7.4
<i>Anthoxanthum odoratum</i>	IV	7.7 **	I	0.6	IV	5.1	III	5.2
<i>Trifolium repens</i>	III	3.4 **	II	1.8	II	0.5	III	2.4
<i>Cerastium fontanum</i>	III	0.5 **	I	<0.1	I	0.1	II	0.3
<i>Rumex acetosa</i>	III	1.8 **	I	0.4	II	0.7	II	1.2
<i>Potentilla anserina</i>	II	5.7 **	II	1.9	I	0.2	II	3.6
<i>Cirsium palustre</i>	II	0.8 **	I	<0.1	II	0.2	II	0.5
<i>Cynosurus cristatus</i>	II	1.8 **	I	0.3	I	0.2	I	1.1
<i>Lolium perenne</i>	I	1.4 *			I	<0.1	I	0.8
<i>Galium saxatile</i>	I	0.8 *					I	0.4
<i>Carex hirta</i>	I	0.7 *	I	<0.1			I	0.4
b <i>Galium palustre</i> type indicators								
<i>Galium palustre</i>	I	0.2	IV	2.6 ****	II	0.4	II	0.9
<i>Caltha palustris</i>	I	<0.1	III	2.2 ***	I	0.2	I	0.7
<i>Mentha aquatica</i>	I	0.8	IV	5.8 ***	II	2.0	II	2.4
<i>Carex disticha</i>	I	0.9	III	13.0 **	II	4.9	II	5.0
<i>Ranunculus repens</i>	III	4.9	IV	8.7 **	III	3.6	III	5.7
<i>Phalaris arundinacea</i>	I	0.5	II	6.1 **			I	2.0
<i>Carex nigra</i>	I	1.2	III	8.9 **	II	4.0	II	3.9
<i>Phleum pratense</i>	II	2.0	II	6.5 **	I	0.3	II	2.9
<i>Vicia cracca</i>	I	0.3	II	1.6 *	II	1.0	II	0.8
<i>Equisetum fluviatile</i>	I	0.3	II	0.8 *			I	0.4
<i>Achillea ptarmica</i>			I	1.0 *	I	<0.1	I	0.3
<i>Lysimachia vulgaris</i>			I	0.9 *	I	0.3	I	0.3
<i>Carex acutiformis</i>	I	0.2	I	5.1 *			I	1.5
<i>Hydrocotyle vulgaris</i>	I	0.3	II	1.9 *	I	1.2	I	0.9
<i>Persicaria maculatum</i>			I	0.3 *			I	<0.1
<i>Agrostis gigantea</i>			I	0.8 *			I	0.2
<i>Lathyrus palustris</i>			I	0.4 *			I	0.1
<i>Lysimachia nummularia</i>	I	<0.1	I	0.1 *			I	<0.1
<i>Glyceria maxima</i>			I	2.6 *			I	0.7
<i>Hippuris vulgaris</i>	I	<0.1	I	0.7 *			I	0.2
<i>Rhizomnium punctatum</i>			I	<0.1 *			I	<0.1
c <i>Molinia caerulea</i> type indicators								
<i>Molinia caerulea</i>	I	1.4	I	3.1	V	28.3 ****	II	6.8
<i>Succisa pratensis</i>	I	0.7	I	0.4	IV	6.6 ***	II	1.7
<i>Carex panicea</i>	I	0.7	I	0.6	III	11.1 ***	I	2.6
<i>Potentilla erecta</i>	II	0.8	I	0.3	IV	3.0 ***	II	1.1

	a		b		c		Group	
<i>Plantago lanceolata</i>	II	1.3	II	0.7	III	5.1 **	II	1.8
<i>Calliergonella cuspidata</i>	II	1.1	II	2.6	IV	2.9 **	III	1.8
<i>Trifolium pratense</i>	II	1.4	I	<0.1	III	2.5 **	II	1.2
<i>Carex flacca</i>	I	1.0	I	0.8	II	4.6 **	I	1.6
<i>Cirsium dissectum</i>			I	0.3	II	3.2 **	I	0.7
<i>Centaurea nigra</i>	I	0.7	I	0.3	II	1.6 **	I	0.8
<i>Rhinanthus minor</i>	I	<0.1	I	0.4	II	1.3 **	I	0.4
<i>Lotus corniculatus</i>	I	0.4	I	<0.1	II	1.6 *	I	0.5
<i>Briza media</i>	I	0.5	I	<0.1	II	1.3 *	I	0.5
<i>Angelica sylvestris</i>	I	0.3	I	0.2	II	0.6 *	I	0.3
<i>Carex pulicaris</i>	I	<0.1			I	0.8 *	I	0.2
<i>Galium uliginosum</i>	I	<0.1	I	<0.1	I	0.5 *	I	0.1
<i>Thalictrum flavum</i>			I	0.2	I	0.4 *	I	0.1
<i>Climacium dendroides</i>	I	<0.1			I	0.1 *	I	<0.1
<i>Pinguicula vulgaris</i>					I	0.1 *	I	<0.1
<i>Fissidens adianthoides</i>					I	<0.1 *	I	<0.1
<i>Ctenidium molluscum</i>					I	0.3 *	I	<0.1
<i>Brachythecium mildeanum</i>					I	0.1 *	I	<0.1
Other grasses, sedges and rushes								
<i>Festuca pratensis</i>	I	1.4	II	3.1	I	0.9	I	1.8
<i>Juncus acutiflorus</i>	I	2.0	I	0.7	I	0.4	I	1.3
<i>Deschampsia cespitosa</i>	II	2.2	I	1.6	I	1.2	I	1.9
<i>Poa trivialis</i>	I	1.1	I	0.8	I	0.4	I	0.9
<i>Festuca arundinacea</i>	I	0.2	I	2.7	II	2.0	I	1.2
<i>Juncus articulatus</i>	I	0.7	I	0.7	I	0.1	I	0.6
<i>Agrostis capillaris</i>	I	1.2	I	0.3	I	0.3	I	0.8
<i>Juncus inflexus</i>	I	2.1	I	0.3	I	0.1	I	1.2
<i>Dactylis glomerata</i>	I	0.8			I	0.1	I	0.4
<i>Carex echinata</i>	I	0.4	I	<0.1	I	0.3	I	0.3
<i>Juncus conglomeratus</i>	I	0.6	I	<0.1	I	0.2	I	0.4
<i>Carex ovalis</i>	I	0.9	I	<0.1			I	0.5
<i>Poa pratensis</i>	I	0.3	I	0.3			I	0.3
<i>Luzula campestris</i>	I	0.1	I	<0.1			I	<0.1
<i>Agrostis canina</i>	I	1.0	I	<0.1			I	0.6
<i>Luzula multiflora</i>	I	<0.1			I	<0.1		
<i>Carex viridula</i>	I	0.2			I	0.1	I	0.1
<i>Arrhenatherum elatius</i>	I	1.0					I	0.5
Other forbs								
<i>Ranunculus acris</i>	III	1.5	II	1.7	II	0.6	II	1.4
<i>Lathyrus pratensis</i>	I	0.5	II	1.0	II	1.4	II	0.8
<i>Cardamine pratensis</i>	I	0.1	II	0.2	I	0.4	I	0.2
<i>Senecio aquaticus</i>	I	0.5	I	0.8	I	<0.1	I	0.5
<i>Crepis capillaris</i>	I	0.2	II	0.8	II	1.3	I	0.6
<i>Taraxacum agg.</i>	I	0.4	I	0.2	I	0.4	I	0.3
<i>Ranunculus flammula</i>	I	0.2	I	0.5	II	0.4	I	0.3
<i>Prunella vulgaris</i>	I	0.6	I	<0.1	I	0.3	I	0.4
<i>Stellaris graminea</i>	I	0.4	I	<0.1	I	<0.1	I	0.2
<i>Iris pseudacorus</i>	I	1.6	II	2.0	I	<0.1	I	1.4
<i>Lythrum salicaria</i>	I	1.0	I	0.3	I	<0.1	I	0.6
<i>Potentilla palustris</i>	I	0.2	I	0.3	I	1.1	I	0.4
<i>Hypochaeris radicata</i>	I	<0.1	I	<0.1	I	0.3	I	0.1

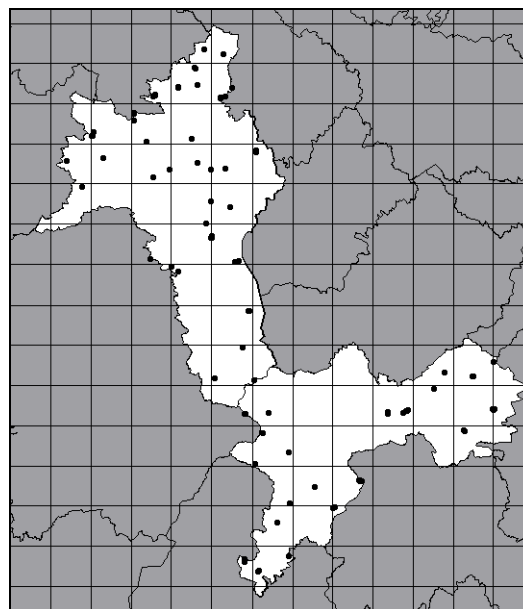
	a	b	c	Group
<i>Valeriana officinalis</i>	I 0.3	I 0.2	I 0.2	I 0.3
<i>Potentilla anglica</i>	I 0.3		I 0.1	I 0.2
<i>Lychnis flos-cuculi</i>	I <0.1	I <0.1	I <0.1	I <0.1
<i>Epilobium palustre</i>	I 0.1	I <0.1		I 0.1
<i>Rumex crispus</i>	I 0.2	I 0.3		I 0.2
<i>Stellaria palustris</i>		I 0.1	I <0.1	I <0.1
<i>Myosotis laxa</i>	I <0.1	I <0.1		I <0.1
<i>Euphrasia officinale</i>	I 0.2		I 0.2	I 0.2
<i>Dactylorhiza fuchsii</i>	I <0.1	I <0.1	I <0.1	I <0.1
<i>Menyanthes trifoliata</i>		I 0.5	I 0.6	I 0.2
<i>Epilobium parviflorum</i>	I 0.1	I 0.2		I 0.1
<i>Senecio jacobaea</i>	I 0.2			I 0.1
<i>Achillea millefolium</i>	I 0.2			I 0.1
<i>Pedicularis sylvatica</i>	I <0.1	I 0.2	I 0.1	I 0.1
<i>Triglochin palustre</i>	I <0.1	I <0.1	I <0.1	I <0.1
<i>Linum catharticum</i>	I <0.1		I 0.2	I <0.1
Other vascular plants				
<i>Equisetum palustre</i>	I 0.2	I 0.6	I <0.1	I 0.25
<i>Equisetum arvense</i>	I 0.2	I <0.1	I <0.1	I 0.11
Other bryophytes				
<i>Rhytidiadelphus squarrosus</i>	II 1.1	I 0.2	I 1.0	I 0.8
<i>Pseudoscleropodium purum</i>	I 0.2	I 0.1	I 0.2	I 0.2
<i>Kindbergia praelonga</i>	I <0.1			I <0.1
<i>Lophocolea bidentata</i>			I <0.1	
<i>Hylocomium splendens</i>	I 0.2		I 0.3	I 0.1
Number of relevés	96	50	33	179
Species richness	17	16	20	17
Altitude (m)	83	50	47	67
Slope (°)	2	0	0	1
Soil pH	5.8	6.0	5.8	5.9
Soil organic content (%)	17.3	17.5	20.8	18.0
Soil types (%)				
Brown Earths	37	26	30	33
Gleys	46	61	30	48
Basin Peats	15	13	30	17
Grass height (cm)	43	47	45	45
Forb height (cm)	32	41	36	36
Mean Ellenberg scores				
Light	7.1	7.1	7.2	7.1
Reaction	5.7	6.0	4.9	5.6
Nitrogen	4.8	5.0	3.4	4.6
Moisture	6.4	7.2	7.0	6.7
Salt	0.4	0.3	0.2	0.3

Figure 3.20 Distribution maps for *Agrostis stolonifera* – *Filipendula ulmaria* grassland / marsh and vegetation types. Grid lines indicate hectads.

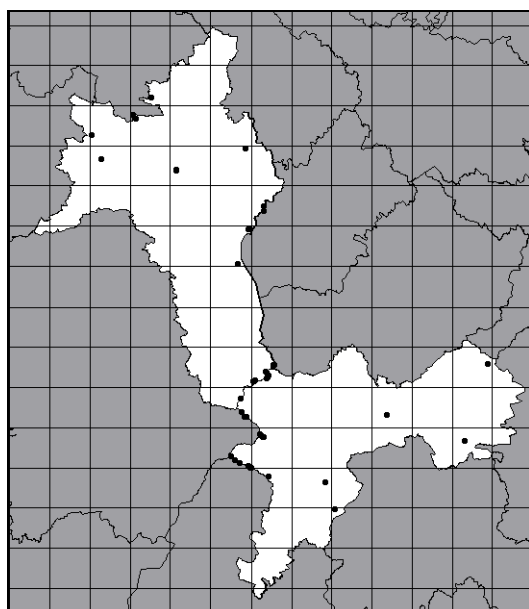
Agrostis stolonifera – *Filipendula ulmaria*
grassland /marsh



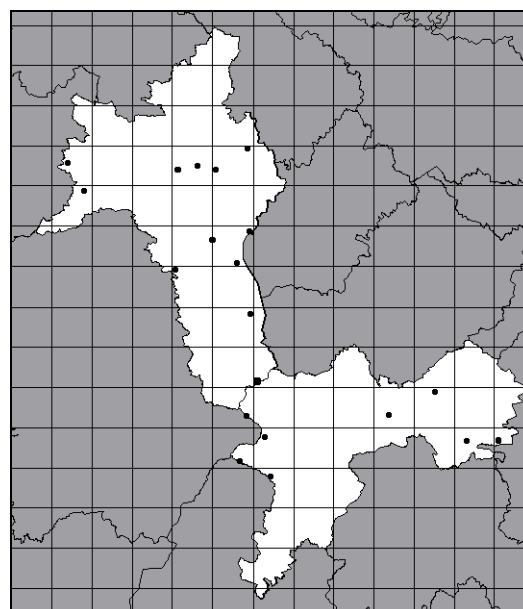
a *Holcus lanatus*



b *Galium palustre*



c *Molinia caerulea*



4. DISCUSSION

4.1 Assessment of EU Annex I grassland and the ranking of all surveyed sites.

No areas of EU Annex I grassland habitat surveyed as part of this project were assessed to be in a favourable state. The limited data available for *Nardus* grassland (6230) and hydrophilous tall herb communities (6430) mean that no inferences can be made with regards to these habitats. For *Festuca-Brometalia* grassland (6210/6211) however, unfavourable status was a consequence of 15 of the assessed areas having negative future prospects and a significant decline in habitat area being recorded for 11 of these 15 areas. The landscape that *Festuca-Brometalia* grassland (6210/6211) was associated with was also highly threatened with five of the 13 most threatened sites occurring on eskers. These factors in combination make *Festuca-Brometalia* grassland (6210/6211) the most vulnerable habitat recorded during the survey. It should be noted, however, that some of the best examples of this Annex I habitat were surveyed by Dwyer *et al.* (2007) and were therefore not included within this survey.

A large proportion of the assessed areas of *Molinia* meadows (6410) and lowland hay meadows (6510) were assigned an Unfavourable-Bad status due to a lack of positive indicator species. Considering the high conservation status attributed to the Shannon Callows, it would be predicted that the areas of *Molinia* meadows (6410) and lowland hay meadows (6510) occurring within this system would be of a high quality and when surveying them this appeared, *prima facie*, to be the case. However, this was not upheld by the quantitative assessment of structure and functions. The failure of the majority of the monitoring stops within the Shannon Callows to meet the threshold for number of positive indicator species suggests that the lists of species used are deficient. One probable reason for this is that there are simply too few species on the lists for *Molinia* meadows (6410) and lowland hay meadows (6510). In comparison, the list for *Festuca-Brometalia* grassland (6210/6211) which fared better in regards to this criterion, is more extensive. By examining the species associated with these Annex I habitats within the current dataset it should be possible to identify candidate species for addition to the lists of positive indicator species.

Molinia meadows (6410) had close affinity to *Molinia caerulea* vegetation type with 16 of the 33 relevés recorded within this vegetation type described as 6410 habitat. The indicator species for the *Molinia caerulea* vegetation type therefore include species that were frequently recorded within 6410 monitoring stops. Table 4.1 lists the top 11 indicator species for this vegetation type (all those with an indicator value score greater than 20%). Lowland hay meadows (6510) had closest affinity to the *Ranunculus acris* vegetation type with 13 of the 25 relevés recorded within this vegetation type described as 6510 habitat. Table 4.2 lists the top eight indicator species for this vegetation type (all with an indicator value score greater than 40%).

Table 4.1 Top indicator species for the *Molinia caerulea* vegetation type. * denotes species currently positive indicators for *Molinia* meadows (6410).

IndVal (40.1 – 60%): *Molinia caerulea**, *Succisa pratensis**, *Carex panicea*, *Potentilla erecta*

IndVal (20.1 – 40%): *Plantago lanceolata*, *Calliergonella cuspidata*, *Trifolium pratense*,
Carex flacca, *Cirsium dissectum**, *Centaurea nigra*, *Rhinanthus minor*

Table 4.2 Top indicator species for the *Ranunculus acris* vegetation type. * denotes species currently positive indicators for lowland hay meadows (6510).

IndVal (60.1 – 80%): *Plantago lanceolata*

IndVal (40.1 – 60%): *Trifolium pratense*, *Ranunculus acris*, *Filipendula ulmaria**,
*Rhinanthus minor**, *Festuca pratensis*, *Phleum pratense*, *Crepis capillaris*

It is recommended that seven of the eight additional positive indicator species listed for *Molinia* meadows (6410) and six additional positive indicator species listed for lowland hay meadows (6510) are incorporated into any future assessments of these two EU Annex I grassland habitats in Ireland. The reason for only including seven of the eight additional species listed for *Molinia* meadows (6410) is that *Plantago lanceolata* will not be carried forward to the assessment sheets. *P. lanceolata* can not always be regarded as a positive indicator for the condition of *Molinia* meadows (6410) as it can be indicative of drier sites that are suffering from drainage.

Overall, unlike the esker grasslands, many of the areas of *Molinia* meadows (6410) and lowland hay meadows (6510) were located within sites that were ranked near the top of the conservation evaluation. Five of the top ten ranked sites were callows sites that contained the 6410 and 6510 habitats and were located within the Shannon Callows SAC (Table 3.6). Eight of the twelve areas of Annex I habitat that had positive future prospects were either 6410 or 6510 habitat within a callows grassland site. The conservation designation of these areas of callows grassland undoubtedly aids their conservation, however, it is the regular flooding of callows grasslands that has protected these sites from commercial development in the past, and will continue to contribute to their protection in the future. Unfortunately, it is the accessibility and commercial value of eskers and the grasslands associated with them that contribute to the vulnerability of *Festuca-Brometalia* grassland (6210/6211).

4.2 Classification

The vegetation classification comprised six vegetation types, three of which included dry grassland plant communities and three which included wet grassland communities. Each of these six vegetation types are fairly broad and are likely to be relevant in a wider Irish context outside of the survey area. If the survey is extended to include other counties the addition of more samples to the dataset will refine the classification further. Rarer plant communities that were only represented by a small number of relevés within this survey did not produce their own vegetation types at this stage. Notable examples of this were a number of samples from base-rich, dry fen meadows and fen margins that are located within the *Succisa pratensis* vegetation type, and a small number of samples from upland acid grassland sites and hydrophilous tall herb communities that are located within the *Holcus lanatus* vegetation type.

Of the six vegetation types proposed the largest, consisting of 96 of the 300 relevés, was the *Holcus lanatus* type, which corresponded well to the Fossitt (2000) habitat wet grassland (GS4). The second most frequent was the *Dactylis glomerata* vegetation types with 74 of the 300 relevés, which corresponded well to the dry calcareous and neutral grassland (GS1) of Fossitt (2000).

None of the relevés from GS2 sites could be ascribed to the *Arrhenatherion elatioris* alliance as suggested by Fossitt (2000), due to the scarcity of *Arrhenatherum elatius*. O'Sullivan (1982) also found that the *Arrhenatherion elatioris* alliance no longer occurred in normal farm situations in Ireland.

The vegetation classification presented in this report divides wet grassland and marsh into three vegetation types, *Holcus lanatus* type, *Galium palustre* type, and *Molinia caerulea* type, rather than the two habitats used by Fossitt (2000). For ecologists classifying and mapping grassland habitats it should prove useful to have this additional tier of classification. In particular, this additional tier will allow wet grasslands of high conservation value, such as *Molinia* meadows (6410) and fen meadows (both classified within the *Molinia caerulea* type) to be distinguished from more common wet grasslands (often classified within the *Holcus lanatus* type).

The rigid requirement in Fossitt (2000) for freshwater marsh (GM1) to contain no more than 50% sedge and grass cover can result in some examples of genuine marsh communities being classified as wet grassland (GS4). The *Galium palustre* and *Holcus lanatus* vegetation types described in this report probably represent a more natural system for classifying marsh plant communities. GM1 was the second rarest Fossitt habitat recorded during the survey, only occurring at seven Roscommon sites. This rarity is largely due to drainage and improvement for agriculture, but the criteria used by Fossitt (2000) may also have resulted in marsh habitat appearing to be rarer than it is.

4.3 Utilisation of the dataset

The GIS package which accompanies this report contains the habitat map for each of the 91 sites. To this has been added a data layer entitled 'Relevé'. This contains the co-ordinates of all 305 relevés together with the classification of each relevé according to Fossitt (2000) and the vegetation type assigned by the analysis presented in this report. Any information collected at the relevé scale can be added to this data layer. A second GIS project includes a map of all known areas of semi-natural grassland within the survey area and a predictive model for the occurrence of semi-natural grassland habitats within Cos. Roscommon and Offaly. The methodology used to produce these maps and models is presented in the technical annex to this report (Valverde 2007).

The GIS component of this project will assist semi-natural grassland conservation at a regional level by providing spatial information on the existing occurrence of the different grassland habitats within the landscape. In particular, it could assist environmental managers who wish to establish extensive networks of high conservation value semi-natural grassland, or monitor a particular EU Annex I habitat within a county or region. The vegetation classification methodology used can contribute to a more accurate classification of Ireland's semi-natural grassland habitats. The conservation and threat evaluation criteria provide a baseline for monitoring semi-natural grassland sites and the EU Annex I grassland habitats assessment data provide important baseline information, especially for delineating the positive indicator species for certain Annex I habitats.

4.4 Concluding remarks

This survey of 91 semi-natural grassland sites in Roscommon and Offaly has produced a methodology that can be utilised to study the range of different semi-natural grassland habitats within a region, identify and assess EU Annex I grassland habitats, and accurately map and store all survey data using a combination of GIS and a database.

This report has presented a hierarchical vegetation classification for semi-natural grassland with two main grassland groups, *Cynosurus cristatus* – *Plantago lanceolata* dry grassland group and *Agrostis stolonifera* – *Filipendula ulmaria* wet grassland / marsh group. Each group was further subdivided into three vegetation types, *Succisa pratensis* vegetation type, *Ranunculus acris* vegetation type, and *Dactylis glomerata* for the dry grassland group, and *Holcus lanatus* vegetation type, *Galium palustre* vegetation type, and *Molinia caerulea* vegetation type for the wet grassland group. The vegetation classification proposed highlights the limitations of Fossitt (2000) which only classifies semi-natural vegetation into four groups and marsh into one rigidly defined group.

Criteria are proposed for the evaluation of the conservation status and the threats affecting grassland sites. For the first time within the Republic of Ireland, a field study of the Annex I habitats *Molinia* meadows (6410), hydrophilous tall herb communities (6430) and lowland hay meadows (6510) has been conducted. A new list of positive indicator species has been recommended for the assessment of the structure and functions of monitoring stops for two of the Annex I habitats. Detailed habitat maps for each site have been produced, as has a predictive GIS map for all areas that are yet to be surveyed in Roscommon and Offaly (Valverde 2007).

The survey has highlighted the vulnerability of esker grassland sites and the EU Annex I habitat *Festuca-Brometalia* grassland (6210/6211) within the survey area. Callows grasslands, particularly within the Shannon Callows SAC, and the associated EU Annex I grassland habitats *Molinia* meadows (6410) and lowland hay meadows (6510) are currently the least vulnerable of the important grassland habitats recorded within the survey area.

The timing of this survey has coincided with a critical period for the conservation of the Irish countryside and the grassland habitats that cover most of this landscape. People have become more aware of the environment and the loss of habitat diversity and government bodies have accepted their responsibility in conserving Ireland's biodiversity. Land management practices are changing and ecologists need to be cognisant of this with grasslands at risk from afforestation, or agricultural abandonment and consequent reversion to scrub. Global warming is also changing our weather patterns with consequences for grassland habitats which vary from increased growing seasons to the ploughing of large areas for the planting of bio-fuels. The only certainty is that over the next 25 years there will be changes in the Irish countryside that will have an affect on the grassland habitats found within it.

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Appendix 1: Field sheets

- General site survey sheet
- Site species list
- Relevé sheet
- EU Annex I grassland habitat assessment sheet

Site ID:	Adjacent Habitats (✓)			Fossitt Grassland within Site	%	Releve No.	Description/Habitat Codes
Recorder ID:	FL		WN	GS1 Dry calcareous & neutral			
Date:	FW		WD	GS2 Dry meadows & grass verges			
Site Area (ha):	FP		WS	GS3 Dry-humid grassland			
	FS		WL	GS4 Wet grassland			
Site Geography ✓	GA		BC	GM1 Freshwater marsh			
Esker	GS		BL				
Drumlin	GM		ER				
Hill	HH		ED	Other Fossitt Habitats	%		
Valley	HD		Other	FW4 Drainage ditches			
Lakeside	PB		Dry ditch	HD1 Dense bracken			
Bogland	PF		Fence	PB4 Cutover bog			
Lowland plain	Boundary Type		✓	WL1 Hedgerows			
Other:	Abrupt			WL2 Treelines			
	Diffuse			WS1 Scrub			
Topographical Situation ✓	Site Management (✓)		P C	ED3 Recolonising bare ground			
Flat	Cattle pasture			BL1 Stone walls			
Summit	Sheep pasture			BL2 Earth banks			
Upper slope	Horse pasture			BL3 Buildings & artificial surfaces			
Mid-slope	Hay meadow			Other:		No. relevés:	
Lower slope	Org. fertilizer application						
	Non-org fertilizer app.						
Soil Moisture Regime ✓	Unknown fertilizer app.						
Freely draining	Liming			EU Habitats	%		
Moderately free	Topping			6130 Calaminarian grasslands			
Impeded	Mown: May-Jun			6210 <i>Festuco-Brometalia</i>			
Strongly impeded	Mown: Jul-Oct			6211 <i>*Festuco-Brometalia</i>			
	Spring grazing: May-Jun			6230 Species-rich <i>Nardus</i> grassland			
Seasonal flooding	Summer grazing: Jul-Aug			6410 <i>Molinion</i> meadows			
	Autumn grazing: Sep-Nov			6430 Hydrophilous tall herb comm.			
Damaging Operations ✓	Winter grazing: Dec- Apr			6510 Lowland hay meadows			
Drainage	Cut/grazed once or less per year						
Burning							
Dumping	Cut/grazed more than once per year			Grazing level	✓		
Ploughing				Undergrazing			
Afforestation	Supplementary feeding			Appropriate grazing			
Other:	Fauna		✓	Overgrazing			
	Rabbits						
Archaeological Features ✓	Hares			Encroachment	✓		
Earthworks	Deer			Bracken			
Lazy beds	Badgers			Scrub			
Ringforts	Frogs			Heath			

General Site Notes

Woody	Herbs	Herbs	Rushes	Grasses	Horsetails	Mosses	Mosses			
Call vulg	Gera robe	Ranu acris	Junc acut	Agro cani	Equi arve	Ambl serp	Spha palu			
Crat mono	Gymn cono	Ranu bulb	Junc arti	Agro capi	Equi fluv	Atri undu	Tham alop			
Hede heli	Hydr vulg	Ranu flam	Junc bufo	Agro stol	Equi palu	Brac riv	Thui tama			
Prun spin	Hera spho	Ranu repe	Junc bulb	Alop geni	Equi sylv	Brac rut	Zygo viri			
Rubu frut	Hype perf	Rhin mino	Junc cong	Alop prat	Equi telm	Call cord				
Sola dulc	Hype pulc	R. acetosa	Junc effu	Anis ster		Call cusp	Liverworts			
Ulex euro	Hype tetr	R. acetose	Junc infl	Anth odor		Cinc font	Caly fiss			
Ulex gali	Hypo radi	Rume cong	Junc squa	Arrh elat	Ferns	Cirr pili	Caly muel			
	Iris pseu	Rume cris	Luzu camp	Brac pinn	Aspl tric	Clim den	Chil poly			
Herbs	Knau arve	Rume obtu	Luzu pilo	Brac sylv	Athy feli	Cryp hete	Cono coni			
Achi mill	Laps comm	Sagi proc	Luzu mult	Briz medi	Blec spic	Cten moll	Dipl albi			
Achi ptar	Lath lini	Sang mino	Luzu sylv	Brom errec	Dryo aem	Dicr maju	Leje ulic			
Ajug rept	Lath prat	Scut gale		Brom hord	Dryo affi	Dicr scop	Lepi rept			
Anac pyra	Leon autu	Sene aqua	Sedges	Brom ramo	Dryo cart	Eurh stri	Loph bide			
Anag arve	Leuc vulg	Sene jaco	Care acui	Cyno cris	Dryo dila	Fiss adia	Lunu cruc			
Ange sylv	Linu cath	Sile dioi	Care bine	Dact glom	Dryo feli	Fiss bryo	Marc mach			
Anth sylv	List ovat	Soli virg	Care cary	Dant decu	Ophi vulg	Fiss taxi	Metz frut			
Anth vuln	Lotu corn	Sonc aspe	Care demi	Desc cesp	Osmu rega	Font anti	Metz furc			
Bell pere	Lotu pedu	Sonc oler	Care dist	Desc flex	Phly scol	Homa seri	Pell endi			
Blac perf	Lych flos	Stac palu	Care echi	Fest alti	Poly seti	Hook luce	Pell epip			
Calt palu	Lysi nemo	Stac sylv	Care elat	Fest arun	Pter aqui	Hylo brev	Plag aspl			
Camp rotu	Lysi numm	Stel gram	Care flac	Fest ovin		Hylo sple	Plag pore			
Card flex	Lysi vulg	Stel holo	Care hirt	Fest prat		Hyoc armo	Sacc viti			
Card hirs	Lyth sali	Stel medi	Care laev	Fest rubr		Hypn cupr	Scap grac			
Card prat	Medi lupu	Stel ulig	Care nigr	Fest gigi		Hypn jutl	Scap nemo			
Carl vulg	Ment aqua	Succ prat	Care oval	Glyc flui		Isop eleg	Scap undu			
Cent nigr	Meny trif	Tara agg.	Care pane	Heli pube		Isot alop	Tric tome			
Cera font	Myos disc	Teuc scor	Care pnlt	Holc lana		Kind prae				
Cirs arve	Myos scor	Thym poly	Care pend	Holc moll		Leuc glau	Other species			
Cirs palu	Orch masc	Tori japo	Care pilu	Koel macr		Mniu horn				
Cirs vulg	Orch mori	Trif prat	Care puli	Loli pere		Neck crisp				
Cono maju	Orig vulg	Trif repe	Care remo	Meli unif		Orth affi				
Crep capi	Pedi sylv	Tuss farf	Care rost	Moli caer		Oxyr hian				
Crep palu	Peta hybr	Urti dioi	Care stri	Nard stri		Pleu schr				
Dact fuch	Pilo offi	Vale offi	Care sylv	Phal arun		Plth dent				
Dact macu	Pimp saxi	Vero becc	Care vesi	Phle prat		Plth undu				
Dauc caro	Plan lanc	Vero cham	Care viri	Phra aust		Pmni undu				
Digi purp	Plan majo	Vero mont		Poa annu		Poly comm				
Epil hirs	Poly vulg	Vero offi		Poa nemo		Poly form				
Epil parv	Pote anse	Vero pers		Poa prat		Pseu puru				
Fili ulma	Pote errec	Vero serp		Poa triv		Rhiz punc				
Gali apar	Pote palu	Vici crac		Sesl caer		Rhyn ripa				
Gali odor	Pote rept	Vici sepi		Tris flav		Rhyt lore				
Gali palu	Pote ster	Viol palu				Rhyt squa				
Gali saxa	Prim veri	Viol reic				Rhyt triq				
Gali veru	Prim vulg	Viol rivi				Spha capi				
Gent amar	Prun vulg	Viol sp.				Spha cusp				

Site ID:
Date:
Surveyors:

Woody sp.	Herbs	Herbs	Rushes	Grasses	Horsetails	Mosses	Mosses				Site ID: Grid Ref: Date: Topography:	Habitat ID: ± Recorder ID: Altitude:	Releve ID:
Call vulg	Gera robe	Ranu acris	Junc acut	Agro cani	Equi arve	Ambl serp	Spha palu						
Crat mono	Gymn cono	Ranu bulb	Junc arti	Agro capi	Equi fluv	Atri undu	Tham alop						
Hede heli	Hydr vulg	Ranu flam	Junc bufo	Agro stol	Equi palu	Brac riv	Thui tama						
Prun spin	Hera spho	Ranu repe	Junc bulb	Alop geni	Equi sylv	Brac rut	Zygo viri						
Rubu frut	Hype perf	Rhin mino	Junc cong	Alop prat	Equi telm	Call cord							
Sola dulc	Hype pulc	R. acetosa	Junc effu	Anis ster		Call cusp	Liverworts						
Ulex euro	Hype tetr	R. acetose	Junc infl	Anth odor		Cinc font	Caly fiss						
Ulex gali	Hypo radi	Rume cris	Junc squa	Arrh elat	Ferns	Cirr pili	Caly muel						
	Iris pseu	Rume cong	Luzu camp	Brac pinn	Aspl tric	Clim den	Chil poly						
Herbs	Knau arve	Rume obtu	Luzu pilo	Brac sylv	Athy feli	Cryp hete	Cono coni						
Achi mill	Laps comm	Sagi proc	Luzu mult	Briz medi	Blec spic	Cten moll	Dipl albi						
Achi ptar	Lath lini	Sang mino	Luzu sylv	Brom erec	Dryo aem	Dicr maju	Leje ulic						
Ajug rept	Lath prat	Scut gale		Brom hord	Dryo affi	Dicr scop	Lepi rept						
Anac pyra	Leon autu	Sene aqua	Sedges	Brom ramo	Dryo cart	Eurh stri	Loph bide						
Anag arve	Leuc vulg	Sene jaco	Care acui	Cyno cris	Dryo dila	Fiss adia	Lunu cruc						
Ange sylv	Linu cath	Sile dioi	Care bine	Dact glom	Dryo feli	Fiss bryo	Marc mach						
Anth sylv	List ovat	Soli virg	Care cary	Dant decu	Ophi vulg	Fiss taxi	Metz frut						
Anth vuln	Lotu corn	Sonc aspe	Care demi	Desc cesp	Osmu rega	Font anti	Metz furc						
Bell pere	Lotu pedu	Sonc oler	Care dist	Desc flex	Phly scol	Homa seri	Pell endi						
Blac perf	Lych flos	Stac palu	Care echi	Fest alti	Poly seti	Hook luce	Pell epip						
Calt palu	Lysi nemo	Stac sylv	Care elat	Fest arun	Pter aqui	Hylo brev	Plag aspl						
Camp rotu	Lysi numm	Stel gram	Care flac	Fest ovin		Hylo sple	Plag pore						
Card flex	Lysi vulg	Stel holo	Care hirt	Fest prat		Hyoc armo	Sacc viti						
Card hirs	Lyth sali	Stel medi	Care laev	Fest rubr		Hypn cupr	Scap grac						
Card prat	Medi lupu	Stel ulig	Care nigr	Fest gigi		Hypn jutl	Scap nemo						
Carl vulg	Ment aqua	Succ prat	Care oval	Glyc flui		Isop eleg	Scap undu						
Cent nigr	Meny trif	Tara agg.	Care pane	Heli pube		Isot alop	Tric tome						
Cera font	Myos disc	Teuc scor	Care pnlt	Holc lana		Kind prae							
Cirs arve	Myos scor	Thym poly	Care pend	Holc moll		Leuc glau	Other species						
Cirs palu	Orch masc	Tori japo	Care pilu	Koel macr		Mniu horn							
Cirs vulg	Orch mori	Trif prat	Care puli	Loli pere		Neck crisp							
Cono maju	Orig vulg	Trif repe	Care remo	Meli unif		Orth affi							
Crep capi	Pedi sylv	Tuss farf	Care rost	Moli caer		Oxyn hian							
Crep palu	Peta hybr	Urti dioi	Care stri	Nard stri		Pleu schr							
Dact fuch	Pilo offi	Vale offi	Care sylv	Phal arun		Plth dent							
Dact macu	Pimp saxi	Vero becc	Care vesi	Phle prat		Plth undu							
Dauc caro	Plan lanc	Vero cham	Care viri	Phra aust		Pmni undu							
Digi purp	Plan majo	Vero mont		Poa annu		Poly comm							
Epil hirs	Poly vulg	Vero offi		Poa nemo		Poly form							
Epil parv	Pote anse	Vero pers		Poa prat		Pseu puru							
Fili ulma	Pote erec	Vero serp		Poa triv		Rhiz punc							
Gali apar	Pote palu	Vici crac		Sesl caer		Rhyn ripa							
Gali odor	Pote rept	Vici sepi		Tris flav		Rhyt lore							
Gali palu	Pote ster	Viol palu				Rhyt squa							
Gali saxa	Prim veri	Viol reic				Rhyt triq							
Gali veru	Prim vulg	Viol rivi				Spha capi							
Gent amar	Prun vulg	Viol sp.				Spha cusp							

Bare soil	
Bare rock	
Surface water	
Leaf litter	
Ground layer	
Field layer	
Broadleaf herbs	
Grass height	
Herb height	
Grass:herb ratio	
Soil pH	
Sample 1	
Sample 2	
Mean	

EU Annex Habitat Assessment Field Sheet 1 – semi-natural grassland

Site ID	Date	Recorder ID	EU habitat

Each stop (2 x 2m)	Stop 1		Stop 2		Stop 3		Stop 4		Stop 5		Stop 6		Stop 7		Stop 8	
Reference no. (GPS)																
Easting																
Northing																
Slope																
Aspect																
	P	F	P	F	P	F	P	F	P	F	P	F	P	F	P	F
Positive indicator species																
Negative indicator species																
Grass:herb ratio (%)																
Scrub/bracken encroachment (%)																
Sward height (cm)																
Litter cover (%)																
Extent of bare ground (record %)																
Grazing and disturbance levels																
Note presence of distinctive features e.g.orchid-rich areas or rare plants																
General stop notes (include habitat loss)																

Overall site notes	
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Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and sub-mountain areas, in Continental Europe) (6230)

Positive indicator species

Achillea millefolium
Agrostis capillaris
Anthoxanthum odoratum
Carex pilulifera
Danthonia decumbens
Festuca ovina
Galium saxatile
Hypericum maculatum
Juncus squarrosus
Lathyrus montanus
Luzula multiflora
Pseudorchis albida
Nardus stricta (in small quantities)
Pedicularis sylvatica
Polygala serpyllifolia
Polygala vulgaris
Potentilla erecta
Rhynchospora squarrosus
Succisa pratensis
Viola canina
Viola riviniana
 Pass = ≥ 7 of listed species present

Negative indicator species

Arrhenatherum elatius
Bellis perennis
Cirsium arvense
Cirsium vulgare
Cynosurus cristatus
Holcus lanatus
Juncus effusus
Lolium perenne
Ranunculus repens
Rumex obtusifolius
Rumex crispus
Senecio jacobaea
Trifolium repens
Urtica dioica
 Pass = Individual cover $\leq 10\%$
Neophyte species
 Pass = Collective cover $\leq 5\%$
 Both passes required for overall pass

Other assessment criteria

Grass/sedge : Forb ratio
 Pass = Forb component $> 25\%$

Scrub/Bracken/Heath encroachment
 Pass = Cover of woody species plus *Pteridium* $\leq 5\%$ cover.

Sward height
 Pass = $\geq 25\%$ of the sward $> 5\text{cm}$ high (No upper limit)

Litter cover
 Pass = "Thatches" of dead plant litter $> 2\text{cm}$ across should not cover $> 20\%$ of ground area

Bare ground
 Pass = Total extent is $\leq 10\%$ cover

Grazing and disturbance
 Pass = No more than 20m^2 in vicinity of monitoring stops showing signs of serious disturbance

***Molinia* meadows on calcareous, peaty or clayey-silt laden soils (*Molinion caeruleae*) (6410)**

Positive indicator species

Achillea ptarmica
Angelica sylvestris
Caltha palustris
Cirsium dissectum
Cirsium palustre
Crepis paludosa
Deschampsia caespitosa
Equisetum palustre
Filipendula ulmaria
Juncus acutiflorus
Juncus conglomeratus
Lotus pedunculatus
Lychnis flos-cuculi
Lythrum salicaria
Molinia caerulea
Myosotis laxa
Potentilla anglica
Senecio aquaticus
Succisa pratensis
Orchid sp.

Pass = ≥ 7 of listed species present

Negative indicator species

Cirsium arvense
Cirsium vulgare
Rumex crispus
Rumex obtusifolius
Urtica dioica
Pass = Collective cover $\leq 5\%$

Glyceria maxima
Phalaris arundinacea
Phragmites australis
Pass = Collective cover $\leq 10\%$

Lolium perenne
Trifolium repens
Ranunculus repens
Pass = Collective cover $\leq 20\%$
and individual cover $\leq 10\%$

Neophyte species
Pass = Collective cover $\leq 5\%$

Four passes required for overall pass

Other assessment criteria

Grass/sedge : Forb ratio

Pass = Forb component 40-90%

Scrub/Bracken/Heath encroachment

Pass = Cover of woody species plus *Pteridium* $\leq 5\%$ cover.

Sward height

Pass = 30-70% of the sward 5-80cm high

Litter cover

Pass = Total extent is $\leq 25\%$ cover

Bare ground

Pass = Total extent is $\leq 10\%$ cover

Grazing and disturbance

Pass = No more than 20m² in vicinity of monitoring stop showing signs of serious disturbance

Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)

Positive indicator species

Calystegia sepium
Crepis paludosa
Epilobium hirsutum
Epilobium parviflorum
Eupatorium cannabinum
Filipendula ulmaria
Glechoma hederacea
Galium aparine
Geum urbanum
Hypericum tetrapterum
Lythrum salicaria
Moehringia trinervia
Silene dioica
Solanum dulcamara
Stachys palustris
Symphytum officinale
Viola odorata

Pass = ≥ 7 of listed species present

Negative indicator species

Glyceria maxima
Phalaris arundinacea
Phragmites australis
Pass = Collective cover $\leq 10\%$

Neophyte species
Pass = Collective cover $\leq 5\%$

Both passes required for overall pass

Other assessment criteria

Grass/sedge : Forb ratio
Pass = Forb component 40-90%

Scrub/Bracken/Heath encroachment
Pass= Cover of woody species plus *Pteridium* $\leq 5\%$ cover.

Sward height
Pass= 30-70% of the sward 5-80cm high

Litter cover
Pass = Total extent is $\leq 25\%$ cover

Bare ground
Pass = Total extent is $\leq 10\%$ cover

Grazing and disturbance
Pass = No more than 20m² in vicinity of monitoring stop showing signs of serious disturbance

Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*) (6510)

Positive indicator species

Alopecurus pratensis
Anthriscus sylvestris
Centaurea nigra
Daucus carota
Filipendula ulmaria
Heracleum sphondylium
Knautia arvensis
Leucanthemum vulgare
Leontodon hispidus
Lotus corniculatus
Pimpinella major
Rhinanthus minor
Sanguisorba officinalis
Succisa pratensis
Thalictrum flavum
Tragopogon pratensis
Trisetum flavescens
Orchid sp.

Pass = ≥ 7 species present

Negative indicator species

Cirsium arvense
Cirsium vulgare
Galium aparine
Plantago major
Rumex crispus
Rumex obtusifolius
Senecio jacobaea
Urtica dioica
Pass = Collective cover $\leq 5\%$

Glyceria maxima
Phalaris arundinacea
Phragmites australis
Pass = Collective cover $\leq 20\%$

Lolium perenne
Trifolium repens
Pass = Collective cover $\leq 20\%$
and individual cover $\leq 10\%$

Arrhenatherum elatius
Dactylis glomerata
Pass = Collective cover $\leq 10\%$

Neophyte species
Pass = Collective cover $\leq 5\%$

Five passes required for overall pass

Other assessment criteria

Grass/sedge : Forb ratio
Pass = Forb component 40-90%

Scrub/Bracken/Heath encroachment
Pass= Cover of woody species plus *Pteridium* $\leq 5\%$ cover.

Sward height
Pass = $>50\%$ of the sward $>5\text{cm}$ (No upper limit)

Litter cover
Pass = Total extent is $\leq 25\%$ cover

Bare ground
Pass = Total extent is $\leq 5\%$ cover

Grazing and disturbance
Pass= No more than 20m^2 in vicinity of monitoring stop showing signs of serious disturbance

Appendix 3: Future prospects categories

Listed here are the fifteen categories used to assess the future prospects of Annex I grassland habitats.

Negative threat categories (13)

Drainage

- 0 Not recorded.
- 1 Recorded as occurring on the site but not in the vicinity of the Annex I habitat.
- 2 Recorded in the vicinity of the Annex I habitat.
- 3 Recorded adjacent or within the Annex I habitat and noted to be impacting on it.

Burning

- 0 Not recorded.
- 1 Minor scorch marks (e.g. from campfire).
- 2 Localised fires which have scorched surrounding vegetation.
- 3 Widespread fires which have purposefully or accidentally burnt large area of grassland.

Dumping

- 0 Not recorded.
- 1 Recorded on the site but not within Annex I habitat.
- 2 Recorded within the Annex I habitat but little or no impact
- 3 Recorded within the Annex I habitat and noted to be impacting on it.

Afforestation

- 0 Not recorded.
- 1 Afforestation recorded adjacent to site but not near Annex I habitat.
- 2 Afforestation recorded adjacent to Annex I habitat.
- 3 Afforestation recorded adjacent to Annex I habitat and plans for future forestry on the site.

Quarries

- 0 Not recorded.
- 1 Small quarry or quarries used sporadically by landowners for infill or farm maintenance.
- 2 Medium sized quarry used sporadically by landowner for infill or farm maintenance.
- 3 Large quarry actively used for commercial purposes.

Undergrazing

- 0 Not recorded
- 1 Undergrazing recorded on site but sward height appropriate at all monitoring stops.
- 2 Undergrazing recorded from one monitoring stop.
- 3 Undergrazing recorded from more than one monitoring stop and rank sward noted.

Overgrazing

- 0 Not recorded.
- 1 Overgrazing recorded on site but sward height appropriate at all monitoring stops.
- 2 Overgrazing recorded from one monitoring stop.
- 3 Overgrazing recorded from more than one monitoring stop.

Bracken

- 0 Not recorded.
- 1 Recorded on site but not recorded within monitoring stops.
- 2 Recorded recorded from one monitoring stop.
- 3 Recorded recorded from more than one monitoring stop.

Scrub

- 0 Not recorded.
- 1 Recorded on site but not recorded within monitoring stops.
- 2 Recorded recorded from one monitoring stop.
- 3 Recorded recorded from more that one monitoring stop.

Heath

- 0 Not recorded.
- 1 Recorded on site but not recorded within monitoring stops.
- 2 Recorded recorded from one monitoring stop.
- 3 Recorded recorded from more that one monitoring stop.

Agricultural improvement

This includes ploughing, fertiliser application, topping and liming.

- 0 Not recorded.
- 1 Recorded on site but not in close vicinity to Annex I habitat.
- 2 Recorded in close vicinity to Annex I habitat
- 3 Recorded within Annex I habitat.

Supplementary feeders

- 0 Not recorded
- 1 Recorded on site but not in close vicinity to Annex I habitat.
- 2 Recorded in close vicinity to Annex I habitat
- 3 Recorded within Annex I habitat.

Other

- 0 Not recorded
- 1 Old quarries that are currently inactive and where the substrate has re-vegetated / Evidence of negative past management where the vegetation has recovered from the activities and semi-natural communities are re-established / Occurrence of other low intensity negative or destructive managements activities.
- 2 Landowner considering change of land management to a negative management practice / Occurrence of other medium intensity negative or destructive management activities.
- 3 Landowner has actively carried out some activity not previously listed that is or will in the near future cause the functioning of the semi-natural grasslands to be seriously impaired or cease.

Positive conservation categories (2)**Notable species**

- 0 None recorded
- 1 Species listed in Red Data Book recorded on site.
- 2 Species listed under Flora Protection Order recorded on site.
- 3 Both Red Data Book and Flora Protection Order species recorded on the site.

Designated site status

- 1 Annex habitat within NHA boundary
- 2 Annex habitat within SAC boundary
- 3 Annex habitat within National Park or NPWS managed Nature Reserve.

Overall score

Scores from both threat and conservation categories were totalled.

- ≥0 Favourable
- 1 to -10 Unfavourable Inadequate
- 11 to -39 Unfavourable Bad

Appendix 4: Summary information for each of the 91 surveyed sites

This appendix contains the following information on each site:

- Site ID
- Site Name
- Townland Name
- County
- Site Area (ha)
- Grid Reference
- NHA (Natural Heritage Area)
- SAC (Special Area of Conservation)
- Parent material ID
- Soil ID
- Conservation score
- Threat score

Site ID	Site Name	Townland Name	County	Site Area (ha)	Grid Reference	NHA	SAC	Parent material ID	Soil ID	Conservation score	Threat score
0001	All Saints Bog	Glaster	Offaly	6.5	N008104	000566	000566	Bedrock at surface: calcareous; Limestone sands & gravels; Cutover peat; Basic esker sands & gravels	renzina/lithosol; lithosol/peat; cutover basin peat	54	54
0003	Ridge Road	Beggarstown, Turnersglaster, Kilnaglinney	Offaly	9.4	N039090	000919	000919	Limestone till; Limestone sands & gravels; Fen peat; Basic esker sands & gravels;	renzina/lithosol; grey brown podzolic/brown earth; basin peat	46	31
0007	Derrykeel Meadows	Breaghmore, Kyle	Offaly	4.4	N156046	000897		Limestone till; Cutover peat; Alluvium;	grey brown podzolic/brown earth; mineral alluvium; peaty gley; cutover basin peat	33	8
0008	Drumakeenan, Eagles Hill and Perry's Mill	Drumakeenan	Offaly	24.2	S105924	000900		Limestone till; Limestone sands & gravels; Basic esker sands & gravels; Alluvium;	grey brown podzolic/brown earth; mineral alluvium; surface water gley/ground water gley; shallow peaty gleys; renzina/lithosol	54	23
0015	Clonfinlough Esker	Clonfinlough	Offaly	3.1	N059297			Limestone sands & gravels; Basic esker sands & gravels;	renzina/lithosol; shallow surface water gley/ground water gley	25	15
0016	Lough Nanag Esker	Crevagh	Offaly	18.8	N001288	000910		Limestone sands & gravels; Cutover peat; Basic esker sands & gravels;	shallow peaty gleys; shallow surface water gley/ground water gley; lithosol/peat; renzina/lithosol; cutover basin peat	38	31
0017	Dovegrove Callows	Dovegrove, Clondallow	Offaly	46.1	N045074	000010		Limestone sands & gravels; Cutover peat; Alluvium;	shallow surface water gley/ground water gley; mineral alluvium; lithosol/peat; renzina/lithosol; cutover basin peat	42	23
0018	Little Brosna Callows	Clonaheoge Cloghan Demense, Gortskena, Kilmochoonna	Offaly	332.1	M985111	000564	000216	Marl (shell); Limestone sands & gravels; Cutover peat; Basic esker sands & gravels; Alluvium	marl type soil; mineral alluvium; shallow surface water gley/ground water gley; lithosol/peat; renzina/lithosol; cutover basin peat	71	15
0020	Ballyduff Esker	Ballynasrah	Offaly	31.4	N280273	000885		Limestone till; Limestone sands & gravels; Basic esker sands & gravels;	renzina/lithosol; grey brown podzolic/brown earth;	50	15
0021	Pallas Lough	Pallas Park	Offaly	1.2	N264197	000916		Water; Limestone till; Marl (shell);	grey brown podzolic/brown earth; marl type soil; water	38	15
0023	Lough Dromharlow	Annaghbeg, Cloonfad, Carrigfen, Derreenannagh	Roscommon	69.7	G949032	001643		Water; Sanstone till; Cutover peat; Alluvium;	acid brown earth/brown podzolic; mineral alluvium; surface water gley/ground water gley; peaty gley; cutover basin peat; water	67	23

Site ID	Site Name	Townland Name	County	Site Area (ha)	Grid Reference	NHA	SAC	Parent material ID	Soil ID	Conservation score	Threat score
0025	Lough Gara	Tivannagh, Coolnagranshy, Ardsallagh	Roscommon	24.1	G760019	000587		Sanstone till; Alluvium;	acid brown earth/brown podzolic; mineral alluvium; surface water gley/ground water gley; peaty gley	71	23
0027	Annaghmore Lough	Annaghmore, Doonard, Doonard More	Roscommon	5.4	M909834	001626	001626	Water; Limestone till; Cutover peat;	peaty gley; surface water gley/ground water gley; cutover basin peat; water	46	0
0030	Kilglas and Grange Lough	Cartron, Cuiltyshinnoge, Cloonglasny Beg	Roscommon	8.9	M989895	000608		Water; Sanstone till; Cutover peat;	peaty gley; surface water gley/ground water gley; cutover basin peat; water	63	8
0034	Lough Glin	Loughglinn Demesne	Roscommon	23.0	M637860	001644		Water; Sanstone till; Fen peat;	basin peat; surface water gley/ground water gley; water	50	15
0039	Drumbridge	Warren/Drum, Tawnytaskin, Erris	Roscommon	20.1	G820042	001631		Water; Sanstone till; Cutover peat;	surface water gley/ground water gley; acid brown earth/brown podzolic; cutover basin peat; water	33	23
0040	Hundred Acres	Hundred Acres	Offaly	21.4	S203996	000412	000412	Sanstone till; Bedrock at surface: non-calcareous; Blanket peat; Alluvium	surface water gley/ground water gley; mineral alluvium; peaty gley; shallow surface water gley; lithosol/peat; blanket peat	46	38
0041	Slieve Bloom	Barlahan	Offaly	7.1	N267058	000412	000412	Bedrock at surface: non-calcareous; Blanket peat;	blanket peat; lithosol/peat;	25	0
0044	Croghan Hill	Ballybeg lower, Croghan hill, Croghan demesne	Offaly	41.5	N480332			Limestone till; Bedrock at surface: non-calcareous; Bedrock at surface: calcareous;	renzina/lithosol; lithosol/peat; grey brown podzolic/brown earth; renzina/lithosol	38	15
0045	Kilcormac Esker	Kilmore	Offaly	71.5	N265210	000906		Lake sediments; Limestone sands & gravels; Basic esker sands & gravels; Limestone till;	surface water gley/ground water gley; grey brown podzolic/brown earth; renzina/lithosol; lacustrine-type soil	33	23
0053	Kilcolman	Cree, Kilcolman, Killenbreaghan	Offaly	10.2	N093004			Limestone till; Cutover peat;	surface water gley/ground water gley; grey brown podzolic/brown earth; cutover basin peat	33	23
0054	Pigeon Park	Scrub or pigeon Park, Walshisland	Offaly	20.5	N517230			Limestone till; Cutover peat;	surface water gley/ground water gley; grey brown podzolic/brown earth; peaty gley; cutover basin peat	29	8
0057	Clooncreen-Clonbulloge	Clooncreen-Clonboogue	Offaly	37.5	N603243			Limestone till; Cutover peat; Alluvium;	surface water gley/ground water gley; mineral alluvium; peaty gley; cutover basin peat	25	15

Site ID	Site Name	Townland Name	County	Site Area (ha)	Grid Reference	NHA	SAC	Parent material ID	Soil ID	Conservation score	Threat score
0060	Moanvane	Moanvane, Cushina	Offaly	6.3	N528167			Limestone till; Cutover peat;	cutover basin peat; peaty gley;	25	0
0061	Raheenakeeran	Raheennakeeran	Offaly	9.4	N529187			Cutover peat;	cutover basin peat	29	23
0062	Roosk	Roosk	Offaly	24.3	N606356			Limestone till; Cutover peat; Alluvium;	grey brown podzolic/brown earth; mineral alluvium; surface water gley/ground water gley; cutover basin peat	38	15
0067	Raheen Lough	Ahanvilla, Raheen	Offaly	9.7	N465185	000917		Water; Limestone sands & gravels; Basic esker sands & gravels;	renzina/lithosol; lithosol/peat; water	29	8
0068	Slate River	Bracknagh	Offaly	25.6	N610168			Marl (shell);	marl type soil	50	15
0073	Silver River	Ballincloghan	Offaly	6.0	N152144			Limestone sands & gravels; Basic esker sands & gravels; Alluvium;	shallow surface water gley/ground water gley; mineral alluvium; renzina/lithosol	42	31
0081	Mount St Joseph Esker	Mount Heaton, Scorduff	Offaly	5.4	S76910	000913		Limestone till; Limestone sands & gravels; Alluvium;	grey brown podzolic/brown earth; mineral alluvium; surface water gley/ground water gley; shallow surface water gley/ground water gley; renzina/lithosol	42	38
0082	Coolderry	Coolderry	Offaly	5.6	S94960			Limestone till; Limestone sands & gravels; Cutover peat; Alluvium	grey brown podzolic/brown earth; mineral alluvium; lithosol/peat; renzina/lithosol; cutover basin peat	33	0
0083	Boveen	Boveen	Offaly	12.1	S63957			Limestone till; Cutover peat; Alluvium;	grey brown podzolic/brown earth; mineral alluvium; surface water gley/ground water gley; peaty gley; cutover basin peat	33	15
0084	Island	Island	Offaly	7.1	S15835			Limestone till; Limestone sands & gravels; Cutover peat;	peaty gley; surface water gley/ground water gley; shallow surface water gley/ground water gley; renzina/lithosol; cutover basin peat	38	23
0086	Glasscloon	Glasscloon (Clonlisk Offaly by)	Offaly	11.8	S90876			Limestone till; Limestone sands & gravels; Cutover peat;	shallow peaty gleys; peaty gley; cutover basin peat	33	31
0087	Bricknagh	Bricknagh, Gorraun	Offaly	24.4	R983865			Limestone till; Cutover peat;	surface water gley/ground water gley; grey brown podzolic/brown earth; peaty gley; cutover basin peat	38	38
0090	Derrinlough	Derrinlough	Offaly	1.3	N92133	000909		Limestone sands & gravels; Fen peat;	basin peat; lithosol/peat;	33	31

Site ID	Site Name	Townland Name	County	Site Area (ha)	Grid Reference	NHA	SAC	Parent material ID	Soil ID	Conservation score	Threat score
0092	Rathcobican	Rathcobican, Clonlack, Ballybrittan	Offaly	12.3	N55132	002104		Limestone till; Cutover peat;	peaty gley; grey brown podzolic/brown earth; cutover basin peat	25	8
0093	Clonmore	Clonmore	Offaly	6.0	N590359			Limestone till; Cutover peat;	cutover basin peat; peaty gley;	38	23
0097	Ballymullen	Ballymullen	Offaly	6.6	N453290			Limestone till; Alluvium;	grey brown podzolic/brown earth; mineral alluvium; surface water gley/ground water gley	38	15
0099	Cappancur	Cappancur	Offaly	12.1	N380241			Marl (shell); Cutover peat;	cutover basin peat; marl type soil;	42	23
0101	Clonminch	Ballard, Spollanstown, Clonminch	Offaly	21.9	N338229			Limestone till; Cutover peat; Alluvium;	grey brown podzolic/brown earth; mineral alluvium; surface water gley/ground water gley; cutover basin peat	50	15
0102	Drumcullen Church	Knockbarron	Offaly	8.8	N17961			Limestone till; Lake sediments; Limestone sands & gravels; Alluvium	grey brown podzolic/brown earth; mineral alluvium; surface water gley/ground water gley;shallow surface water gley/ground water gley; renzina/lithosol; lacustrine-type soil	38	15
0107	Clonmacnoise	Clonmacnoise	Offaly	56.8	N15315	000216	000216	Water; Limestone sands & gravels; Cutover peat; Basic esker sands & gravels; Alluvium	renzina/lithosol; mineral alluvium; cutover basin peat; water	71	15
0108	Leitra Callow	Clonliffen, Garrymore, Killaphort	Offaly	89.2	M980240	000216	000216	Water; Limestone till; Cutover peat; Alluvium	grey brown podzolic/brown earth; mineral alluvium; surface water gley/ground water gley; peaty gley; cutover basin peat; water	58	15
0109	Moystown Demesne and Island	Moystown Demesne, Clononybeg, Bullock Island	Offaly	194.0	N24180	000216	000216	Water; Limestone till; Cutover peat; Alluvium	surface water gley/ground water gley; mineral alluvium; peaty gley; cutover basin peat;made; water	75	8
0110	Clooncraff	Clooncraff	Offaly	46.3	N41326	000216	000216	Water; Limestone sands & gravels; Cutover peat; Alluvium	lithosol/peat; mineral alluvium; renzina/lithosol; cutover basin peat; water	71	8
0111	Long Island	Long Island	Roscommon	62.5	N55355	000216	000216	Water; Alluvium;	water; mineral alluvium;	38	0
0112	Callowbeg	Callowbeg	Roscommon	76.5	N38339	000216	000216	Water; Limestone till; Cutover peat; Alluvium	surface water gley/ground water gley; mineral alluvium; peaty gley; cutover basin peat; water	38	8
0113	Drumlosh	Drumlosh, Coolumber	Roscommon	64.2	N5320	000216	000216	Water; Cutover peat; Cutover peat; Alluvium;	water, cut basin peat, mineral alluvium	67	15

Site ID	Site Name	Townland Name	County	Site Area (ha)	Grid Reference	NHA	SAC	Parent material ID	Soil ID	Conservation score	Threat score
0114	Cappaleitrim	Cappaleitrim, Cloonburren	Roscommon	137.8	M975280	000216	000216	Water; Limestone sands & gravels; Alluvium;	lithosol/peat; mineral alluvium; water	71	15
0116	Culliaghmore	Culliaghmore	Roscommon	9.9	M889285			Limestone till; Limestone sands & gravels; Cutover peat; Basic esker sands & gravels;	renzina/lithosol; peaty gley; cutover basin peat	46	15
0117	Rathpeake	Beagh	Roscommon	0.9	M910318			Limestone till;	grey brown podzolic/brown earth	21	15
0200	Derryhanee	Derryhanee	Roscommon	34.4	N31743			Water; Limestone till; Cutover peat; Alluvium	surface water gley/ground water gley; mineral alluvium; peaty gley; cutover basin peat; water	42	23
0201	Coggalbeg	Coggalbeg, Tully, Cloonerra, Curry, Glenameeltoge,	Roscommon	15.2	M908756			Limestone till; Cutover peat;	surface water gley/ground water gley; grey brown podzolic/brown earth; peaty gley; cutover basin peat	38	23
0202	Cloonroughan	Clooroughan	Roscommon	37.4	M865851			Water; Limestone till; Cutover peat;	peaty gley; surface water gley/ground water gley; cutover basin peat; water	50	15
0203	Glenballythomas	Glenballythomas, Toberrory	Roscommon	18.6	M795836			Limestone till; Bedrock at surface: calcareous;	shallow surface water gley/ground water gley; surface water gley/ground water gley;	38	31
0205	Cleaheen	Cleaheen	Roscommon	48.1	G92914	001643		Water; Sanstone till; Cutover peat;	surface water gley/ground water gley; acid brown earth/brown podzolic; peaty gley; cutover basin peat; water	54	23
0206	Rathmoyle	Rathmoyle, Ballindollaghan, Kilmurry	Roscommon	61.4	M755816			Limestone till; Sanstone till; Bedrock at surface: calcareous;	surface water gley/ground water gley; shallow surface water gley/ground water gley	38	23
0208	Cloonalough	Cloonalough, Willsborough, Lough O'Flynn	Roscommon	8.1	M580786	001645		Water; Sanstone till; Limestone sands & gravels;	peaty gley; surface water gley/ground water gley; shallow surface water gley/ground water gley; lithosol/peat; water	42	38
0210	Portnacrinnaught	Portnacrinnaught, Derry Coagh	Roscommon	40.6	M711970	000587		Water; Sanstone till; Cutover peat;	surface water gley/ground water gley; acid brown earth/brown podzolic; peaty gley; cutover basin peat; water	71	15
0212	Dromore	Bolarry, Dromore, Carrickadraan	Roscommon	44.9	G928121			Shales & sandstones tills; Bedrock at surface: calcareous;	surface water gley/ground water gley; acid brown earth/brown podzolic; renzina/lithosol	42	38
0214	Clerragh	Clerragh, Woodfield	Roscommon	10.6	G86189			Sanstone till; Bedrock at surface: non-calcareous;	surface water gley/ground water gley; acid brown earth/brown podzolic; renzina/lithosol	46	31

Site ID	Site Name	Townland Name	County	Site Area (ha)	Grid Reference	NHA	SAC	Parent material ID	Soil ID	Conservation score	Threat score
0215	Carrickmore	Carrickmore	Roscommon	29.5	G825014			Limestone till; Sanstone till; Bedrock at surface: calcareous;	grey brown podzolic/brown earth; surface water gley/ground water gley; surface water gley/ground water gley; renzina/lithosol	46	15
0216	Mullaghmacormick	Mullaghmacormick, Kilgarve	Roscommon	22.6	N101879			Sanstone & shale till; Bedrock at surface: non-calcareous;	shallow surface water gley; surface water gley/ground water gley;	54	31
0218	Portruny Bay	Cruit & Lackan	Roscommon	36.7	M964599	002310	000440	Limestone till; Bedrock at surface: calcareous; Cutover peat; water	peaty gley; surface water gley/ground water gley; lithosol/peat; cutover basin peat; water	54	15
0220	Crunaun Bridge	Crunaun, Kittybranks, Roosky	Roscommon	36.6	M604919			Sanstone till; Cutover peat; Alluvium;	surface water gley/ground water gley; mineral alluvium; peaty gley; cutover basin peat	50	54
0221	Cartroncaran	Cartroncaran, Carrowntogher, Skeanavart,	Roscommon	11.1	M845912			Sanstone till; Bedrock at surface: calcareous;	shallow surface water gley/ground water gley; surface water gley/ground water gley;	46	31
0224	Cloonfineen	Cloonfineen, Coolcam	Roscommon	24.8	M573722	000218	000218	Water; Lake sediments; Limestone sands & gravels; Cutover peat; Basic esker sands & gravels	lithosol/peat; shallow surface water gley/ground water gley; renzina/lithosol; cutover basin peat; lacustrine-type soil; water	50	54
0225	Errit	Errit, Gortaganny	Roscommon	6.2	M540857	000607	000607	Water; Limestone sands & gravels;	shallow peaty gleys; shallow surface water gley/ground water gley; lithosol/peat; renzina/lithosol; water	33	8
0226	Coolteige	Coolteige	Roscommon	22.6	M888699			Limestone till; Bedrock at surface: calcareous; Cutover peat;	renzina/lithosol; grey brown podzolic/brown earth; cutover basin peat	54	31
0227	Carrownalassan	Carrownalassan, Cartron	Roscommon	21.6	M877749			Limestone till; Bedrock at surface: calcareous; Cutover peat;	surface water gley/ground water gley; grey brown podzolic/brown earth; renzina/lithosol; cutover basin peat	54	38
0229	Reagh	Reagh, Aghalahard	Roscommon	7.0	M946739			Sanstone & shale till; Bedrock at surface: non-calcareous;	shallow surface water gley; surface water gley/ground water gley;	29	15
0230	Kiltrustan	Kiltrustan, Curry	Roscommon	9.7	M935837			Limestone till; Bedrock at surface: calcareous;	surface water gley/ground water gley; grey brown podzolic/brown earth; renzina/lithosol	54	31

Site ID	Site Name	Townland Name	County	Site Area (ha)	Grid Reference	NHA	SAC	Parent material ID	Soil ID	Conservation score	Threat score
0233	Cloonfenbaun	Cloonfenbaun	Roscommon	8.7	M798688			Limestone till; Bedrock at surface: calcareous; Cutover peat;	peaty gley; grey brown podzolic/brown earth; shallow peaty gleys; renzina/lithosol; cutover basin peat	25	15
0234	Peak	Peak, Tullaghan, Drummin	Roscommon	8.6	M764873			Sanstone till; Bedrock at surface: calcareous;	peaty gley; surface water gley/ground water gley; shallow surface water gley/ground water gley	29	31
0236	Kilnahooan	Kilnahooan	Roscommon	20.5	M815836			Limestone till; Bedrock at surface: calcareous; Lake sediments;	shallow surface water gley/ground water gley; surface water gley/ground water gley; lacustrine-type soil	58	31
0238	Cloonshanville	Cloonshanville, Leggatinty, Corskeagh	Roscommon	6.2	M739904			Sanstone till; Bedrock at surface: calcareous; Cutover peat;	peaty gley; surface water gley/ground water gley; shallow surface water gley/ground water gley; lithosol/peat; cutover basin peat	42	8
0239	Castlestrange	Cstlestrange, Coolmeen	Roscommon	13.1	M827616			Limestone till; Bedrock at surface: calcareous;	renzina/lithosol; grey brown podzolic/brown earth;	21	23
0241	Cloonaddra	Cloonaddra, Ballyclare, Kilnacloghy, Shanballymore	Roscommon	39.1	M987687	002310	000440	Limestone till; Sanstone & shale till; Bedrock at surface: calcareous; Lake sediments; Water	surface water gley/ground water gley; peaty gley; lithosol/peat; lacustrine-type soil	58	23
0242	Roxborough	Roxborough, Killarney, Emmo, Cartron	Roscommon	43.1	M903666			Limestone till; Lake sediments;	surface water gley/ground water gley; grey brown podzolic/brown earth; lacustrine-type soil	46	38
0243	Carraun South	Carraun South	Roscommon	17.6	M751611			Sanstone till; Alluvium;	acid brown earth/brown podzolic; mineral alluvium;	29	23
0245	Ahagower	Ahagower, Farranykelly, Toberavaddy, Gorteendoogh	Roscommon	67.2	M814580	000222		Limestone till; Bedrock at surface: calcareous; Alluvium;	grey brown podzolic/brown earth; mineral alluvium; surface water gley/ground water gley; peaty gley; renzina/lithosol	54	31
0246	Skrine	Skrine	Roscommon	26.6	M880577			Limestone till; Bedrock at surface: calcareous;	surface water gley/ground water gley; grey brown podzolic/brown earth; renzina/lithosol	54	38
0252	Ardmullen	Ardmullen, Rackans	Roscommon	25.8	M947487			Limestone till; Bedrock at surface: calcareous; Basic esker sands & gravels;	surface water gley/ground water gley; grey brown podzolic/brown earth; renzina/lithosol	38	38

Site ID	Site Name	Townland Name	County	Site Area (ha)	Grid Reference	NHA	SAC	Parent material ID	Soil ID	Conservation score	Threat score
0254	Pollalaher	Pollalaher, Brideswell, Knockanool, Ratawragh	Roscommon	5.9	M949442			Limestone sands & gravels; Cutover peat; Basic esker sands & gravels;	shallow peaty gleys; shallow surface water gley/ground water gley; renzina/lithosol; cutover basin peat	38	46
0256	Turrock	Turrock, Gortaphuill, Garrynphort, Cronin	Roscommon	39.9	M870483			Limestone till; Bedrock at surface: calcareous;	surface water gley/ground water gley; grey brown podzolic/brown earth; renzina/lithosol	54	23
0259	Carrowmurragh	Carrowmurragh	Roscommon	13.1	M998480	002310	000440	Limestone till; Bedrock at surface: calcareous; Cutover peat; Water	surface water gley/ground water gley; grey brown podzolic/brown earth; lithosol/peat; renzina/lithosol; cutover basin peat; water	50	23
0260	Mihanboy	Mihanboy, Taduffeast, Taduff West	Roscommon	21.2	M978393			Limestone sands & gravels; Alluvium;	lithosol/peat; mineral alluvium;	38	15
0263	Curry	Curry, Cloonacstry, Cuilleenoolagh	Roscommon	10.2	M900448			Limestone till;	surface water gley/ground water gley; grey brown podzolic/brown earth;	46	23
0264	Derreen Lough	Derreen Lough	Roscommon	7.1	G867044			Sanstone till; Cutover peat;	surface water gley/ground water gley; acid brown earth/brown podzolic; cutover basin peat	38	31
0265	Cashel	Cashel	Roscommon	7.5	G882134			Shales & sandstones tills	surface water gley/ground water gley; acid brown earth/brown podzolic;	33	15

Appendix 5: Summary habitat information for each of the 91 surveyed sites

This appendix contains the following information on each site.

- 1) Site ID
- 2) Site Name
- 3) County
- 4) The % of each site occupied by semi-natural grassland / marsh Fossitt (2000) habitat types:
 - Dry calcareous and neutral grassland (GS1).
 - Dry meadows and grassy verges (GS2).
 - Dry-humid acid grassland (GS3)
 - Wet grassland (GS4).
 - Freshwater marsh (GM1).

NB: When semi-improved grassland habitats of potential conservation value were recorded an 'I' was prefixed to the Fossitt category of the habitat type that was deemed to have occurred prior to improvement.

- 5) The % of each site occupied by EU Annex I grassland habitats:
 - Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (6210).
 - Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (important orchid sites) (6211).
 - Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and sub-mountain areas, in Continental Europe) (6230).
 - *Molinia* meadows on calcareous, peaty or clayey-silt laden soils (*Molinion caerulea*) (6410).
 - Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430).
 - Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*) (6510).

- 6) The number of relevés within each site occupied by the six semi-natural grassland vegetation types defined by this project:

Cynosurus cristatus – *Plantago lanceolata* grassland group

- *Succisa pratensis* vegetation type (CynPlaSuc)
- *Ranunculus acris* vegetation type (CynPlaRan)
- *Dactylis glomerata* vegetation type (CynPlaDac)

Agrostis stolonifera – *Filipendula ulmaria* grassland / marsh group

- *Holcus lanatus* vegetation type (AgrFilHol)
- *Galium palustre* vegetation type (AgrFilGal)
- *Molinia caerulea* vegetation type (AgrFilMol)

Site ID	Site Name	County	GS1	GS2	GS3	GS4	GM1	Other GS	6210/6211	6230	6410	6430	6510	CynPlaSuc	CynPlaRan	CynPlaDac	AgrFilHol	AgrFilGal	AgrFilMol
1	All Saints Bog	Offaly	28%	40%	0%	0%	0%		30%	0%	0%	0%	0%	1	1	1			
3	Ridge Road	Offaly	93%	0%	0%	0%	0%		5%	0%	0%	0%	0%	1	1				
7	Derrykeel Meadows	Offaly	0%	47%	0%	50%	0%		0%	0%	0%	0%	0%		1	1			
8	Drumakeenan, Eagles Hill and Perry's Mill	Offaly	5%	0%	0%	0%	0%	85% IGS1	5%	0%	0%	0%	0%	1	1				
15	Clonfinlough Esker	Offaly	20%	20%	0%	0%	0%	60% IGS1	0%	0%	0%	0%	0%			2			
16	Lough Nanag Esker	Offaly	72%	0%	0%	0%	0%	25% IGS1	0%	0%	0%	0%	0%			3			
17	Dovegrove Callows	Offaly	0%	0%	0%	96%	0%		0%	0%	0%	0%	0%				1	1	
18	Little Brosna Callows	Offaly	1%	18%	0%	74%	2%	3% IGS4	0%	0%	2%	0%	0%			1	6	1	
20	Ballyduff Esker	Offaly	5%	0%	0%	0%	0%	73% IGS1	15%	0%	0%	0%	0%			2			
21	Pallas Lough	Offaly	1%	94%	0%	0%	0%		0%	0%	0%	0%	0%			1			
23	Lough Dromharlow	Roscommon	3%	0%	0%	27%	0%		0%	0%	60%	0%	0%			1	1		
25	Lough Gara	Roscommon	5%	0%	0%	52%	25%		0%	0%	10%	1%	0%			1	5	1	
27	Annaghmore Lough	Roscommon	63%	0%	0%	37%	0%		0%	0%	0%	0%	0%	1		1		1	
30	Kilglas and Grange Lough	Roscommon	0%	28%	0%	10%	15%		0%	0%	30%	15%	0%		1		3	2	
34	Lough Glin	Roscommon	0%	0%	0%	94%	3%		0%	0%	0%	0%	0%				1	2	
39	Drumbridge	Roscommon	0%	0%	0%	96%	0%		0%	0%	0%	0%	0%				2		
40	Hundred Acres	Offaly	0%	0%	60%	30%	0%		0%	0%	0%	0%	0%				2	1	
41	Slieve Bloom	Offaly	0%	0%	100%	0%	0%		0%	0%	0%	0%	0%				4		
44	Croghan Hill	Offaly	1%	1%	97%	0%	0%		0%	0%	0%	0%	0%				1		
45	Kilcormac Esker	Offaly	5%	0%	0%	0%	0%	91% IGS1	0%	0%	0%	0%	0%			2			
53	Kilcolman	Offaly	30%	0%	0%	0%	0%	67% IGS1	0%	0%	0%	0%	0%	1			1		
54	Pigeon Park	Offaly	0%	100%	0%	0%	0%		0%	0%	0%	0%	0%			1			
57	Clooncreen-Clonbulloge	Offaly	0%	0%	0%	50%	0%	48% IGS1	0%	0%	0%	0%	0%				3		
60	Moanvane	Offaly	0%	0%	0%	100%	0%		0%	0%	0%	0%	0%				1	1	
61	Raheenakeeran	Offaly	0%	0%	0%	98%	0%		0%	0%	0%	0%	0%				2		
62	Roosk	Offaly	0%	0%	0%	99%	0%		0%	0%	0%	0%	0%				1		
67	Raheen Lough	Offaly	99%	0%	0%	0%	0%		0%	0%	0%	0%	0%			1			
68	Slate River	Offaly	0%	0%	0%	0%	0%		0%	0%	50%	0%	50%	1				2	
73	Silver River	Offaly	2%	94%	0%	0%	0%		0%	0%	0%	0%	0%			3			
81	Mount St Joseph Esker	Offaly	40%	0%	0%	0%	0%	20% IGS1	40%	0%	0%	0%	0%			2			
82	Coolderry	Offaly	0%	0%	0%	0%	0%		0%	0%	0%	0%	100%	1					
83	Boveen	Offaly	0%	0%	0%	99%	0%		0%	0%	0%	0%	0%				1		
84	Island	Offaly	0%	0%	0%	96%	0%		0%	0%	0%	0%	0%				2		
86	Glasscloon	Offaly	0%	0%	0%	97%	0%		0%	0%	0%	0%	0%				1		

Site ID	Site Name	County	GS1	GS2	GS3	GS4	GM1	Other GS	6210/6211	6230	6410	6430	6510	CynPlaSuc	CynPlaRan	CynPlaDac	AgrFilHol	AgrFilGal	AgrFilMol
87	Bricknagh	Offaly	0%	0%	0%	32%	0%	32% IGS4, 32% IGS2	0%	0%	0%	0%	0%			2			
90	Derrinlough	Offaly	69%	0%	0%	30%	0%		0%	0%	0%	0%	0%	1		2			
92	Rathcobican	Offaly	0%	0%	0%	100%	0%		0%	0%	0%	0%	0%			3			
93	Clonmore	Offaly	0%	19%	0%	80%	0%		0%	0%	0%	0%	0%		1		1		
97	Ballymullen	Offaly	17%	0%	0%	80%	0%		0%	0%	0%	0%	0%		1	1		1	
99	Cappancur	Offaly	10%	35%	0%	50%	0%		0%	0%	0%	0%	0%			3			
101	Clonminch	Offaly	0%	68%	0%	0%	0%	20% IGS1	0%	0%	10%	0%	0%			4	1	1	
102	Drumcullen Church	Offaly	80%	0%	0%	20%	0%		0%	0%	0%	0%	0%		1		1		
107	Clonmacnoise	Offaly	0%	23%	0%	5%	0%		0%	0%	67%	0%	2%	3			1	4	
108	Leitra Callow	Offaly	0%	20%	0%	62%	0%		0%	0%	0%	0%	15%	2		2	3	1	
109	Moystown Demesne and Island	Offaly	0%	58%	0%	30%	0%		0%	0%	5%	0%	5%	6		1	4	3	
110	Clooncruff	Offaly	0%	22%	0%	50%	0%	10% IGS2	0%	0%	0%	10%	5%			1	4		
111	Long Island	Roscommon	0%	98%	0%	0%	0%		0%	0%	0%	0%	0%	1			3		
112	Callowbeg	Roscommon	98%	0%	0%	0%	0%		0%	0%	0%	0%	0%	1			2		
113	Drumlosh	Roscommon	0%	20%	0%	42%	0%	5% IGS4	0%	0%	30%	0%	0%	1		1	2	4	
114	Cappaleitrim	Roscommon	0%	83%	0%	10%	0%		0%	0%	0%	0%	5%	3	1		1		
116	Cullighmore	Roscommon	31%	0%	0%	0%	0%	31% IGS1	30%	0%	0%	0%	0%		5				
117	Rathpeake	Roscommon	0%	99%	0%	0%	0%		0%	0%	0%	0%	0%			1			
200	Derryhanee	Roscommon	0%	0%	0%	97%	0%		0%	0%	0%	0%	0%				2		
201	Coggalbeg	Roscommon	0%	0%	0%	99%	0%		0%	0%	0%	0%	0%			1			
202	Cloonroughan	Roscommon	15%	15%	0%	68%	0%		0%	0%	0%	0%	0%		2	2		1	
203	Glenballythomas	Roscommon	42%	0%	0%	52%	0%		0%	0%	0%	0%	0%		1	1			
205	Cleaheen	Roscommon	0%	0%	0%	15%	0%		0%	0%	80%	0%	0%			5			
206	Rathmoyle	Roscommon	0%	0%	0%	92%	0%		0%	0%	0%	0%	0%			1			
208	Cloonalough	Roscommon	20%	0%	0%	73%	0%		0%	0%	0%	0%	0%			1		1	
210	Portnacrinnaght	Roscommon	5%	0%	0%	20%	46%		0%	0%	20%	5%	0%	3	1	4	2		
212	Dromore	Roscommon	0%	0%	0%	90%	0%		0%	0%	0%	0%	0%			1			
214	Clerragh	Roscommon	1%	0%	10%	82%	0%		0%	0%	0%	0%	0%			2			
215	Carrickmore	Roscommon	19%	0%	0%	0%	0%		78%	0%	0%	0%	0%	2		1			
216	Mullaghmacormick	Roscommon	0%	10%	0%	85%	0%		0%	2%	0%	0%	0%			2			
218	Portruny Bay	Roscommon	0%	16%	0%	69%	10%		0%	0%	0%	0%	0%	1		3	1	1	
220	Crunaun Bridge	Roscommon	0%	11%	0%	80%	0%	5% IGS4	0%	0%	0%	0%	0%			4	1		
221	Cartroncaran	Roscommon	5%	0%	0%	50%	1%	41% IGS4	0%	0%	0%	0%	0%		1	1			
224	Cloonfineen	Roscommon	29%	0%	0%	0%	0%	30% IGS1	38%	0%	0%	0%	0%	1	2	4			
225	Errit	Roscommon	15%	0%	0%	83%	0%		0%	0%	0%	0%	0%			2		1	
226	Coolteige	Roscommon	40%	0%	0%	0%	10%		47%	0%	0%	0%	0%		4	1			

Site ID	Site Name	County	GS1	GS2	GS3	GS4	GM1	Other GS	6210/6211	6230	6410	6430	6510	CynPlaSuc	CynPlaRan	CynPlaDac	AgrFilHol	AgrFilGal	AgrFilMol
227	Carrownalassan	Roscommon	32%	0%	0%	20%	0%	25% IGS1	20%	0%	0%	0%	0%	1	5				
229	Reagh	Roscommon	49%	0%	0%	49%	0%		0%	0%	0%	0%	0%		1	1			
230	Kiltrustan	Roscommon	73%	0%	0%	3%	0%		20%	0%	0%	0%	0%		5	1			
233	Cloonfenbaun	Roscommon	75%	0%	0%	2%	0%	22% IGS1	0%	0%	0%	0%	0%		1				
234	Peak	Roscommon	0%	0%	0%	0%	0%	99% IGS1	0%	0%	0%	0%	0%		1				
236	Kilnahooan	Roscommon	30%	0%	0%	60%	0%		0%	0%	8%	0%	0%	1			4	2	
238	Cloonshanville	Roscommon	8%	0%	0%	75%	0%	15% IGS4	0%	0%	0%	0%	0%		1	1			
239	Castlestrange	Roscommon	75%	0%	0%	0%	0%	25% IGS1	0%	0%	0%	0%	0%		1				
241	Cloonaddra	Roscommon	0%	0%	0%	97%	0%		0%	0%	0%	1%	0%				2	1	
242	Roxborough	Roscommon	0%	10%	0%	86%	0%		0%	0%	0%	0%	0%		1	3		2	
243	Carraun South	Roscommon	0%	0%	0%	98%	0%		0%	0%	0%	0%	0%			1			
245	Ahagower	Roscommon	10%	2%	0%	84%	0%		0%	0%	0%	0%	0%	1	1	2		1	
246	Skrine	Roscommon	60%	0%	0%	0%	0%	20% IGS1, 10% IGS2	5%	0%	0%	0%	0%	1	4				
252	Ardmullen	Roscommon	10%	0%	0%	0%	0%	86% IGS1	0%	0%	0%	0%	0%		1				
254	Pollalaher	Roscommon	25%	0%	0%	0%	0%	63% IGS1	10%	0%	0%	0%	0%	4	1				
256	Turrock	Roscommon	70%	0%	0%	0%	0%	25% IGS1	2%	0%	0%	0%	0%	1	1				
259	Carrowmurragh	Roscommon	0%	0%	0%	97%	0%		1%	0%	0%	0%	0%	1		2		1	
260	Mihanboy	Roscommon	40%	0%	0%	56%	0%		0%	0%	0%	0%	0%		1	1			
263	Curry	Roscommon	20%	0%	0%	0%	0%		79%	0%	0%	0%	0%	1	3				
264	Derreen Lough	Roscommon	0%	0%	0%	96%	0%		0%	0%	0%	0%	0%			1			
265	Cashel	Roscommon	0%	0%	0%	95%	0%		0%	0%	0%	0%	0%			1			

Appendix 6: Maps showing the location of the 91 surveyed sites

Site ID	Site Name	County	County Map No. 1:250 000	Detailed Map No. 1:100 000
1	All Saints Bog	Offaly	Map 1 of 2	Map 4 of 6
3	Ridge Road	Offaly	Map 1 of 2	Map 5 of 6
7	Derrykeel Meadows	Offaly	Map 1 of 2	Map 5 of 6
8	Drumakeenan, Eagles Hill and Perry's Mill	Offaly	Map 1 of 2	Map 5 of 6
15	Clonfinlough Esker	Offaly	Map 1 of 2	Map 4 of 6
16	Lough Nanag Esker	Offaly	Map 1 of 2	Map 4 of 6
17	Dovegrove Callows	Offaly	Map 1 of 2	Map 5 of 6
18	Little Brosna Callows	Offaly	Map 1 of 2	Map 4 of 6
20	Ballyduff Esker	Offaly	Map 1 of 2	Map 6 of 6
21	Pallas Lough	Offaly	Map 1 of 2	Map 4 of 6
23	Lough Dromharlow	Roscommon	Map 2 of 2	Map 2 of 6
25	Lough Gara	Roscommon	Map 2 of 2	Map 1 of 6
27	Annaghmore Lough	Roscommon	Map 2 of 2	Map 2 of 6
30	Kilglas and Grange Lough	Roscommon	Map 2 of 2	Map 2 of 6
34	Lough Glin	Roscommon	Map 2 of 2	Map 1 of 6
39	Drumbridge	Roscommon	Map 2 of 2	Map 2 of 6
40	Hundred Acres	Offaly	Map 1 of 2	Map 5 of 6
41	Slieve Bloom	Offaly	Map 1 of 2	Map 5 of 6
44	Croghan Hill	Offaly	Map 1 of 2	Map 6 of 6
45	Kilcormac Esker	Offaly	Map 1 of 2	Map 4 of 6
53	Kilcolman	Offaly	Map 1 of 2	Map 5 of 6
54	Pigeon Park	Offaly	Map 1 of 2	Map 6 of 6
57	Clooncreen-Clonbulloge	Offaly	Map 1 of 2	Map 6 of 6
60	Moanvane	Offaly	Map 1 of 2	Map 6 of 6
61	Raheenakeeran	Offaly	Map 1 of 2	Map 6 of 6
62	Roosk	Offaly	Map 1 of 2	Map 6 of 6
67	Raheen Lough	Offaly	Map 1 of 2	Map 6 of 6
68	Slate River	Offaly	Map 1 of 2	Map 6 of 6
73	Silver River	Offaly	Map 1 of 2	Map 4 of 6
81	Mount St Joseph Esker	Offaly	Map 1 of 2	Map 5 of 6
82	Coolderry	Offaly	Map 1 of 2	Map 5 of 6
83	Boveen	Offaly	Map 1 of 2	Map 5 of 6
84	Island	Offaly	Map 1 of 2	Map 5 of 6
86	Glasscloon	Offaly	Map 1 of 2	Map 5 of 6
87	Bricknagh	Offaly	Map 1 of 2	Map 5 of 6
90	Derrinlough	Offaly	Map 1 of 2	Map 4 of 6
92	Rathcobican	Offaly	Map 1 of 2	Map 6 of 6
93	Clonmore	Offaly	Map 1 of 2	Map 6 of 6
97	Ballymullen	Offaly	Map 1 of 2	Map 6 of 6
99	Cappancur	Offaly	Map 1 of 2	Map 6 of 6
101	Clonminch	Offaly	Map 1 of 2	Map 6 of 6
102	Drumcullen Church	Offaly	Map 1 of 2	Map 5 of 6
107	Clonmacnoise	Offaly	Map 1 of 2	Map 4 of 6
108	Leitra Callow	Offaly	Map 1 of 2	Map 4 of 6
109	Moystown Demesne and Island	Offaly	Map 1 of 2	Map 4 of 6
110	Clooncraff	Offaly	Map 1 of 2	Map 4 of 6
111	Long Island	Roscommon	Map 2 of 2	Map 4 of 6
112	Callowbeg	Roscommon	Map 2 of 2	Map 4 of 6
113	Drumlosh	Roscommon	Map 2 of 2	Map 4 of 6
114	Cappaleitrim	Roscommon	Map 2 of 2	Map 4 of 6
116	Culliaghmore	Roscommon	Map 2 of 2	Map 4 of 6
117	Rathpeake	Roscommon	Map 2 of 2	Map 4 of 6
200	Derryhanee	Roscommon	Map 2 of 2	Map 3 of 6
201	Coggalbeg	Roscommon	Map 2 of 2	Map 3 of 6
202	Cloonroughan	Roscommon	Map 2 of 2	Map 2 of 6
203	Glenballythomas	Roscommon	Map 2 of 2	Map 2 of 6
205	Cleaheen	Roscommon	Map 2 of 2	Map 2 of 6
206	Rathmoyle	Roscommon	Map 2 of 2	Map 1 of 6
208	Cloonalough	Roscommon	Map 2 of 2	Map 1 of 6
210	Portnacrinnaught	Roscommon	Map 2 of 2	Map 1 of 6
212	Dromore	Roscommon	Map 2 of 2	Map 2 of 6

Site ID	Site Name	County	County Map No. 1:250 000	Detailed Map No. 1:100 000
214	Clerragh	Roscommon	Map 2 of 2	Map 2 of 6
215	Carrickmore	Roscommon	Map 2 of 2	Map 2 of 6
216	Mullaghmacormick	Roscommon	Map 2 of 2	Map 2 of 6
218	Portruny Bay	Roscommon	Map 2 of 2	Map 3 of 6
220	Crunaun Bridge	Roscommon	Map 2 of 2	Map 1 of 6
221	Cartroncaran	Roscommon	Map 2 of 2	Map 2 of 6
224	Cloonfineen	Roscommon	Map 2 of 2	Map 1 of 6
225	Errit	Roscommon	Map 2 of 2	Map 1 of 6
226	Coolteige	Roscommon	Map 2 of 2	Map 3 of 6
227	Carrownalassan	Roscommon	Map 2 of 2	Map 3 of 6
229	Reagh	Roscommon	Map 2 of 2	Map 3 of 6
230	Kiltrustan	Roscommon	Map 2 of 2	Map 2 of 6
233	Cloonfenbaun	Roscommon	Map 2 of 2	Map 3 of 6
234	Peak	Roscommon	Map 2 of 2	Map 1 of 6
236	Kilnanooan	Roscommon	Map 2 of 2	Map 2 of 6
238	Cloonshanville	Roscommon	Map 2 of 2	Map 1 of 6
239	Castlestrange	Roscommon	Map 2 of 2	Map 3 of 6
241	Cloonaddra	Roscommon	Map 2 of 2	Map 3 of 6
242	Roxborough	Roscommon	Map 2 of 2	Map 3 of 6
243	Carraun South	Roscommon	Map 2 of 2	Map 3 of 6
245	Ahagower	Roscommon	Map 2 of 2	Map 3 of 6
246	Skrine	Roscommon	Map 2 of 2	Map 3 of 6
252	Ardmullen	Roscommon	Map 2 of 2	Map 3 of 6
254	Pollalaheer	Roscommon	Map 2 of 2	Map 3 of 6
256	Turrock	Roscommon	Map 2 of 2	Map 3 of 6
259	Carrowmurragh	Roscommon	Map 2 of 2	Map 3 of 6
260	Mihanboy	Roscommon	Map 2 of 2	Map 3 of 6
263	Curry	Roscommon	Map 2 of 2	Map 3 of 6
264	Derreen Lough	Roscommon	Map 2 of 2	Map 2 of 6
265	Cashel	Roscommon	Map 2 of 2	Map 2 of 6

Appendix 7: Future prospects assessment scores

Site No.	Annex Habitat	Drainage	Burning	Dumping	Afforestation	Quarries	Undergrazing	Overgrazing	Bracken	Scrub	Heath	Agricultural improvement	Supplementary feeding	Other threats	Notable species	Designated site status	Total score
0001	6211	0	0	0	0	-3	-1	-1	-1	-2	0	-3	0	0	1	2	-8
0008	6211	0	0	0	0	0	-3	0	-2	-3	0	0	0	0	0	1	-7
0018	6410	-1	0	0	0	0	0	0	0	-1	0	0	0	0	1	1	0
0020	6211	0	0	0	0	-2	0	0	0	0	0	0	0	0	0	0	-2
0023	6410	-2	0	0	0	0	0	-3	0	0	0	0	0	0	0	1	-4
0025	6410	-2	0	0	0	0	0	0	0	-2	0	-1	0	0	0	1	-4
0030	6410	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
0030	6430	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
0068	6410	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	-3
0068	6510	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	-3
0081	6210	0	0	0	0	0	0	-2	0	0	0	-3	0	-3	0	0	-8
0082	6510	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	-3
0101	6410	0	0	0	0	0	-2	0	0	0	0	0	0	-1	0	0	-3
0107	6410	-1	0	0	0	0	0	0	0	0	0	0	0	-1	1	2	1
0107	6510	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
0108	6510	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1
0109	6410	0	0	0	0	0	0	0	0	-2	0	-2	0	0	3	2	1
0109	6510	0	0	0	0	0	0	0	0	-2	0	-2	0	0	3	2	1
0110	6430	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1
0110	6510	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1
0113	6410	-1	0	0	0	0	0	0	0	-1	0	0	0	-2	1	2	-1
0114	6510	-1	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2
0116	6210	0	0	0	0	0	0	0	0	-1	0	0	0	-2	0	0	-3
0205	6410	-1	0	0	0	0	0	0	0	0	0	-1	0	0	0	1	-1
0210	6410	0	0	-1	0	0	0	0	0	-2	0	0	0	0	0	1	-2
0210	6430	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
0215	2611	0	0	0	0	0	0	0	0	-2	0	0	0	-2	0	0	-4
0216	6230	0	0	0	-1	0	-1	0	0	-2	-2	0	-2	-3	0	0	-11
0224	6210	0	0	0	0	0	-3	0	-3	-3	-2	-2	-2	-3	0	2	-16
0226	6210	0	0	0	0	0	-3	0	-2	-3	0	0	0	0	0	0	-8
0227	6210	-1	0	-3	0	0	-3	0	0	0	0	-2	0	0	0	0	-9
0230	6210	0	0	0	0	0	-2	0	-3	-2	0	0	0	0	0	0	-7
0236	6410	-1	0	0	0	0	-2	0	0	0	0	0	-2	0	0	0	-5
0246	6210	0	0	0	0	0	0	0	-3	-3	-3	-3	-3	-3	0	0	-18
0254	6210	0	0	-3	0	-3	-3	0	-2	-2	0	0	0	0	0	0	-13
0256	6210	0	0	0	0	0	0	0	-3	-2	0	0	0	0	0	0	-5
0259	6210	0	0	0	0	0	-2	0	0	-3	-2	0	0	0	0	2	-5
0263	6210	0	0	0	0	0	-2	0	-3	-2	-2	0	0	-3	0	0	-12

Appendix 8: NVC codes and communities

A full list of the NVC codes and communities listed within the report text.

Mesotrophic grasslands

MG3 *Anthoxanthum odoratum* – *Geranium sylvaticum* grassland

MG3b *Briza media* sub-community

MG4 *Alopecurus pratensis* – *Sanguisorba officinalis* grassland

MG5 *Cynosurus cristatus* – *Centaurea nigra* grassland

MG5a *Lathyrus pratensis* sub-community

MG5b *Galium verum* sub-community

MG5c *Danthonia decumbens* sub-community

MG8 *Cynosurus cristatus* – *Caltha palustris* grassland

MG9 *Holcus lanatus* – *Deschampsia cespitosa* grassland

MG9a *Poa trivialis* sub-community

MG10 *Holcus lanatus* – *Juncus effusus* rush-pasture

MG10a Typical sub-community

MG11 *Festuca rubra* – *Agrostis stolonifera* – *Potentilla anserina* grassland

Calcareous grasslands

CG6 *Avenula pubescens* grassland

CG6a *Dactylis glomerata* – *Briza media* sub-community

Mires

M13 *Schoenus nigricans* – *Juncus subnodulosus* mire

M13a *Festuca rubra* – *Juncus acutiflorus* sub-community

M22 *Juncus subnodulosus* – *Cirsium palustre* fen-meadow

M22b *Briza media* – *Trifolium* spp. sub-community

M24 *Molinia caerulea* – *Cirsium dissectum* fen-meadow

M24b typical sub-community

M24c *Juncus acutiflorus* – *Erica tetralix* sub-community

M25 *Molinia caerulea* – *Potentilla erecta* mire

M25b *Anthoxanthum odoratum* sub-community

M27 *Filipendula ulmaria* – *Angelica sylvestris* mire

M27c *Juncus effusus* – *Holcus lanatus* sub-community

Dune slacks

SD17 *Potentilla anserina* – *Carex nigra* dune slacks

SD17c *Caltha palustris* sub-community