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The Irish Semi-natural Grasslands Survey 2007-2012

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The Irish Semi-natural Grasslands Survey 2007-2012

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Cover photo: Annex I grassland at Glencolumbkille (Site 1696), Co. Clare. Photo taken by Fionnuala O'Neill. © NPWS.

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Executive Summary

The Irish semi-natural grasslands survey (ISGS) took place between May 2007 and September 2012. The six years of the ISGS resulted in the botanical survey and mapping of 1,192 grassland sites covering 23,188.1 ha of Ireland. A total of 4,544 grassland relevés were recorded. The survey found that wet grassland (GS4 under the Fossitt (2000) habitat classification system) was the most extensive semi-natural habitat, covering 55% of the surveyed area, with highest frequencies seen in western counties. The main management activity carried out in the surveyed grasslands was grazing, with 91% of sites having some form of grazing. The most frequent grazers were cattle, found in 72% of sites. The degree of coincidence between ISGS sites and NPWS conservation sites was examined and it was found that 26% of the area surveyed during the ISGS was within an NHA or pNHA, 20% of the area was within an SAC, and 14% of the area was within an SPA.

The conservation scoring system utilised in this report highlighted the best grassland sites in the country, which are listed in this report. Threat scores identifying sites most at risk from agricultural weeds and agricultural intensification were also calculated.

Five grassland habitats listed in Annex I of the Habitats Directive are described, mapped and assessed: [*]6210 Festuco-Brometalia calcareous grassland (including the priority *orchid-rich variant), *6230 Species-rich *Nardus* grasslands of upland areas, 6410 *Molinia* meadows, 6430 Hydrophilous tall herb swamp communities, and 6510 Lowland hay meadows. A total of 1,255 ha of Annex I grassland were surveyed across 324 sites, comprising 5% of the total area of grassland surveyed during the ISGS. [*]6210 was the most extensive Annex I grassland habitat encountered, covering 548 ha; this was followed by 6410 (472 ha). The largest areas of Annex I habitat were recorded in Clare, Donegal and Offaly, with 455 ha of Annex I grassland recorded across these three counties.

The condition of the Annex I habitats was assessed following a rules-based approach using three parameters: area, structure and functions, and future prospects. Overall, a low proportion (7%) of the Annex I habitats had decreased in area since 2000, with area gains recorded in some cases. For the structure and functions assessments, 36% of areas received a *Favourable* result, with 6410 monitoring stops achieving the lowest pass rate (20%). Structure and functions criteria with the lowest pass rates include forb:graminoid ratio, litter cover and sward height, with insufficient positive indicator species also an issue in some 6510 areas. The future prospects assessment involved examining threats and pressures operating on the Annex I habitats. A total of 64% of sites assessed for their future prospects were in *Favourable* condition. The most frequent pressures recorded were all related to under-management or abandonment (e.g., undergrazing, succession to scrub or heath, bracken encroachment), although issues related to intensification (e.g., fertiliser application, overgrazing, drainage) were also recorded. The overall condition assessment for all five of the Annex I grassland habitats is *Unfavourable – Bad*. As this survey is considered to be a baseline for the sites surveyed the criteria to assess quality are being compared to the national standards; subsequent monitoring may show that some Annex I grasslands, due to geographic location or other factors, may already have favourable structure and functions within the context of their local ecosystem.

A new grassland vegetation classification system based on ISGS relevé data is proposed and presented in detail. This system divides grassland habitats into 19 separate communities. Affinities to existing Irish, British and European classification systems are demonstrated. It is recommended that future

grassland surveys in Ireland utilise this classification system for vegetation community description and mapping.

The results are discussed in the context of recent National Conservation Assessments, the link between the ISGS and high nature value farmland is explored, and ways in which the ISGS helps to inform Irish and EU wildlife legislation are outlined. The report makes recommendations regarding the conservation of grassland sites, particularly those that contain Annex I grassland. Included in the appendices is a list of the criteria used to assess Annex I grassland habitats; a monitoring protocol for the future monitoring of Annex I habitats is also provided, together with guidance on assessing the future prospects of Annex I habitats.

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1. Introduction

1.1 General background

1.1.1 Grassland habitats in Ireland[1]

Grassland habitats are reported to cover approximately 60% (Byrne 1996; CSO 2012) of the land area of Ireland, but the overwhelming majority of this is improved agricultural grassland, with semi-natural grassland habitats contributing only a small percentage to the total. The term 'semi-natural', when applied to grassland, implies that it has been altered by human agricultural or pastoral activity, generally grazing or mowing, but without the input of fertilisers (Calaciura and Spinelli 2008) or reseeding with high-yielding species such as *Lolium perenne* and *Trifolium repens*. The current dominance of grassland habitats in Ireland is the result of millennia of human activity altering the predominantly wooded landscape that existed 5,000 years ago (Hall and Pilcher 1995). The low-intensity agricultural practices that once allowed the development of species-rich semi-natural grasslands have now all but ceased, threatening the existence of these habitat types 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 and ultimately woodland, 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 50 years, agriculture in Ireland has changed fundamentally with increases in mechanisation, the implementation of arterial drainage schemes and the application of fertilisers. Ireland's entry into the European Economic Community (EEC) in 1973 brought financial incentives to improve agricultural productivity (Feehan 2003), and as a result the nature of Ireland's grasslands has been radically altered. From 1990 to 2000, arable land (including land used for silage production) and permanent crops increased in area by 35%, followed closely by artificial surfaces (built land), which increased by 31%; these changes were largely at the expense of pasture and mixed farmland (EPA 2006). The majority of the remaining areas of semi-natural grassland within Ireland owe their continued existence to either a continuation of traditional extensive farming practices by some landowners, conservation measures, or edaphic and topographical conditions that make them unsuitable for fertiliser application, reseeding or drainage.

1.1.2 The Irish landscape and climate

The topography of Ireland can be described as being saucer-shaped due to its relatively low, flat midlands being surrounded by a ring of coastal mountains. Four of the five highest peaks in Ireland are in Kerry, including the highest, Carrauntoohil (1,038 m) in the MacGillycuddy Reeks (OSI 2013b). The majority of Ireland's uplands are siliceous in nature with only a few mountainous areas that are calcareous, such as the Dartry Mountains (Sligo and Leitrim). Within the lowlands of Ireland calcareous bedrock extends from the midlands, west to Galway Bay and south-west along the Shannon Estuary (GSI 2013). The area where this calcareous bedrock is most evident is in the Burren,

[1] Throughout this Irish Wildlife Manual, 'Ireland' is used when referring to the 26 counties within the Republic of Ireland.

which covers a region of north Clare and south Galway. The Burren is one of Europe's finest examples of a glaciated karst landscape (Dunford 2002). Glaciation has also influenced the landscape of Ireland through features such as eskers and drumlins. Eskers and moraines extend westwards from Dublin to Galway and northwards from Galway to Mayo (Fealy *et al.* 2006). Drumlins are a dominant feature of Cavan, Leitrim and Monaghan (O'Neill *et al.* 2009).

Lough Corrib (176 km^2) in Co. Galway is the largest lake in the Republic of Ireland. This is followed by Lough Derg (118 km^2), which sits on the county borders of Tipperary, Galway and Clare (OSI 2013b). Many important river systems dissect Ireland, with the largest, the River Shannon, influencing 11 counties within the State. The high number of lakes and rivers in the west of Ireland is a result of topography and the higher rainfall within western counties. Annual rainfall in the west of Ireland is generally within the range of 1000 mm to 1400 mm on average, while in the east it is generally between 750 mm and 1000 mm (Met Éireann 2013). Rainfall increases with altitude and many upland areas receive over 2000 mm of rainfall per year. The Carlingford Mountains (Co. Louth) and the Wicklow Mountains have the highest rainfall in the east of Ireland, while the mountainous areas along the Atlantic seaboard, from Donegal in the north to Cork in the south, have the highest rainfall levels in the country (Met Éireann 2013). Only 11 of the 26 counties within the State are landlocked, and the maritime influence on the Irish climate is significant, especially along Atlantic coasts. The Mayo coastline is the longest in the State at 1,168 km (Anon. 1996). The air temperature does not vary significantly across the country: February has the lowest mean daily temperature, 7.2 °C, and July and August have the highest mean daily temperature, 15.4 °C (Met Éireann 2013).

1.2 Irish Semi-natural Grasslands Survey (ISGS)

1.2.1 Rationale for the survey

Semi-natural grasslands act as an important refuge for invertebrate, bird and mammal species, and also provide suitable habitats for many rare and protected plant species. Despite their importance, however, semi-natural grasslands are extremely vulnerable in Ireland. Areas of semi-natural grassland that are accessible to machinery are particularly susceptible to agricultural improvement. Keane and 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. Similar trends have been reported in England and Wales, where a review of available data showed that only between one and two percent of remaining lowland grasslands comprise semi-natural communities (Blackstock *et al.* 1999). Stevens *et al.* (2010) recently completed a comprehensive study of lowland grasslands in Wales which recognised lowland grassland as a priority for detailed survey and assessment because of the rapid losses and damage that had been taking place to the habitat over a number of decades.

Because of the importance of semi-natural grasslands for both farming and nature conservation, the background of dramatic changes in farming practices that occurred during the twentieth century, and the absence of a comprehensive survey of semi-natural grassland habitats for almost 30 years, the Irish Semi-natural Grasslands Survey (ISGS) was commissioned by the National Parks and Wildlife Service

(NPWS), Department of Arts, Heritage and the Gaeltacht, Ireland, in 2007. The main aims of the ISGS were to map the habitats and record the flora and plant communities of Irish semi-natural grasslands, as well as to survey and assess EU Annex I grassland habitats encountered within a sample number of sites selected from all 26 counties of the Republic of Ireland. Six annual county reports – Martin *et al.* (2007, 2008, 2013), O'Neill *et al.* (2009, 2010) and Devaney *et al.* (2013) – were produced over the lifetime of the ISGS (see below).

1.2.2 The phased study of semi-natural grasslands 2007-2012

From the inception of the project in 2007 to its completion in 2012, the ISGS was executed over four separately funded phases: first phase (pilot study) 2007, second phase 2008, third phase 2009-2010, fourth phase 2011-2012. The pilot study and second phase of the project both had the aim of surveying a stratified sample of semi-natural grasslands across two counties: Offaly and Roscommon for the pilot study (Martin *et al.* 2007), and Cork and Waterford in 2008 (Martin *et al*. 2008). The sampling methodology was refined for the third phase of the project, when Cavan, Leitrim, Longford and Monaghan grasslands were surveyed (O'Neill *et al*. 2009), with the study becoming more focused on areas where less intensive agriculture was practised. The methodology was also updated in 2010 for the survey of Donegal, Dublin, Kildare and Sligo grasslands (O'Neill *et al.* 2010), with areas of grassland within upland SACs no longer surveyed, the remit for this being taken over by the National Survey of Upland Habitats (Perrin *et al*. 2013a). Some areas of upland grassland were still surveyed by the ISGS from 2010 to 2012, and grassland relevés from the NSUH were also incorporated into the vegetation analysis and classification presented in this Irish Wildlife Manual; however, the change in remit resulted in a smaller proportion of upland grassland in the ISGS survey area than previously, with a corresponding reduction in the number of upland grassland relevés recorded. The methodology applied at the end of the third phase of the project was carried through to the fourth and final phase of the project. However, due to resource limitations the sampling density applied over the final two years of the project had to be reduced to ensure that all of the remaining 14 counties were included within the study. This resulted in regions being less intensively surveyed than they would have been during earlier phases of the project, particularly where grasslands were more intensively farmed or occurred in large upland SACs. The data from the fourth phase of the project were presented in two regional reports, one based on the data collected across the five western seaboard counties of Clare, Galway, Kerry, Limerick and Mayo, together with Tipperary (Devaney *et al.* 2013), the other on eight Leinster counties – Carlow, Kilkenny, Laois, Louth, Meath, Westmeath, Wexford and Wicklow (Martin *et al.* 2013).

This Irish Wildlife Manual presents a national synthesis of all the data collected during the ISGS from 2007 to 2012, providing a complete vegetation classification, summary statistics and a refined survey methodology for Irish semi-natural grassland habitats.

1.3 The study and classification of semi-natural grasslands in Ireland

Over the last 50 years, the number of vegetation studies of grassland habitats 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 semi-natural 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, which contributed 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 (Bourke *et al.* 2007).

The majority of studies on semi-natural grassland in Ireland have been more specific in their aims. Research has either focused on a particular region of Ireland, such as the Burren (Ivimey-Cook and Proctor 1966; Keane and Sheehy Skeffington 1995; Long 2011; O'Donovan 1987; Parr *et al.* 2009), Leinster (Byrne 1996), Galway (Sullivan *et al.* 2010), Sligo (O'Donovan 2007) or Fermanagh (Eakin 1995), or on a particular grassland vegetation type, such as callows (seasonally flooded) grassland (Heery 1991; Maher 2013; Tolkamp 2001;), esker grasslands (Bleasdale 1998; Tubridy 2006), grassland associated with limestone pavement (Wilson and Fernández 2013), hay meadows (Martin 1991) or Calaminarian grasslands (Holyoak 2008). However, some studies have been broader in their remit. O'Donovan and 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 Annex I grassland habitats within Special Areas of Conservation (SACs).

Braun-Blanquet & Tüxen (1952) were the first to systematically classify Irish grasslands based on the Zürich-Montpellier phytosociological approach, but it was not until 1982 that the first comprehensive classification of Irish grasslands was published (O'Sullivan 1982). As phytosociological nomenclature has changed since 1982, the most recent nomenclature of Rodwell *et al.* (2002) will be presented in this Irish Wildlife Manual. O'Sullivan divided all non-coastal Irish grassland into three classes: the Molinio-Arrhenatheretea, the Calluno-Ulicetea (Nardetea) and the Festuco-Brometea. The Molinio-Arrhenatheretea, which includes 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 and Molinietalia orders. The Arrhenatheretalia generally includes drier meadows and pastures, including improved agricultural fields dominated by *Lolium perenne* and *Trifolium repens*. The Molinietalia represents wet meadows and pasture communities on clay, loam and humus-rich gley soils that are generally not fertilised. The Calluno-Ulicetea (Nardetea) includes 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, includes 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 and Doyle (1982) in their catalogue of Irish vegetation types drew heavily on the work of O'Sullivan (1982), reapplying his classification of Irish grasslands and adding some rarer associations, such as the Violetea calaminariae class, which includes the grassland vegetation of areas rich in heavy metals, and

the Carici rupestris-Kobresietea bellardii class of arctic-alpine grass heaths, of which one association, the Breutelio-Seslerietum, has been described in Ireland from Ben Bulben in Co. Sligo.

Fossitt (2000) includes the most widely utilised grassland classification system in Ireland. Unlike O'Sullivan (1982), which is a vegetation classification, Fossitt (2000) is a habitat classification which uses 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; however, it is based on the results of previous phytosociological studies rather than being based objectively on empirical data. The five Fossitt (2000) habitat categories directly relevant to Irish grasslands are as follows:

- **GS1 - Dry calcareous and neutral grassland.** This encompasses all unimproved and semi-improved dry 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. The management is different from that in GS1 in that the grassland has little or no grazing but instead is managed primarily by mowing.
- **GS3 - Dry-humid acid grassland.** This grassland is found on free-draining acid soils that are not waterlogged. It 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 watertable is close 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 1991, 1992, 1995, 2000) does not utilise Irish data, but it does provide 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). Perrin *et al.* (2008a, b) produced an NVC-style classification of Irish woodland vegetation employing a range of more objective techniques. These techniques have also been applied in the analysis of the Irish semi-natural grasslands data. Previous ISGS reports (Martin *et al*. 2007, 2008; O'Neill *et al.* 2009, 2010) have outlined interim classifications produced as the survey progressed. As data are now available from all 26 counties, the final vegetation classification of semi-natural grasslands in Ireland is presented in this Irish Wildlife Manual.

1.4 The conservation of grassland habitats

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. For example, the Flora (Protection) Order 1999 affords protection to the 89 individual plant species listed in the Order, and the protection extends to their habitats. The Wildlife Act, 1976 and the subsequent Wildlife (Amendment) Act, 2000 are the two main articles of legislation that provide protection to wild flora, fauna and semi-natural habitats, including grasslands. Additional statutory protection is available under the recent Environmental Impact Assessment Agriculture Regulations (Statutory Instrument 456 of 2011), which offer protection to semi-natural grasslands in the event of their intended conversion to intensive agriculture, requiring screening to take place if the area to be affected exceeds a certain size. Semi-natural grassland habitats are also afforded legal protection by the Environmental Liability Directive, which prevents and remedies environmental damage to natural habitats and protected species.

Grasslands located within National Parks and Nature Reserves can have the highest level of protection, as they are State-owned and managed for conservation. Special Areas of Conservation (SACs) and Special Protection Areas for birds (SPAs), often referred to collectively as Natura 2000 sites and designated as a result of EU directives, provide the next highest level of protection, while Natural Heritage Areas (NHAs) designated under domestic legislature provide the third tier of protection. As not all NHAs have been designated, proposed NHA (pNHA) is used to distinguish non-designated sites. Throughout this report when referring collectively to SACs, NHAs/pNHAs and SPAs, the term 'NPWS conservation sites' is often used. As there had been no comprehensive survey of semi-natural grassland for almost 30 years, the application of conservation designations to protect areas of semi-natural grassland has taken place in the absence of an accurate record of the extent of each habitat on the ground.

The EU Habitats Directive has contributed to the conservation of semi-natural grasslands in Ireland by listing and defining 31 types of grassland habitat of conservation importance in Europe (Anon. 2007) in Annex I of the directive. Under this directive, Ireland has a responsibility to designate SACs to protect any of these habitats that occur within the State and to maintain them at a favourable conservation status. SACs are among the most important wildlife conservation areas in the country, and Annex I habitats that are listed as qualifying interests for the SAC are strictly protected under the EU Habitats Directive. Any plans, projects or activities which are proposed and may significantly impact on an SAC must undergo special scrutiny in the form of an Appropriate Assessment. Also, certain activities which occur within an SAC that might be damaging can only be carried out with the permission of the Minister for Arts, Heritage and the Gaeltacht.

Six Annex I grassland habitats of conservation importance have been recorded within Ireland by the National Parks and Wildlife Service (NPWS):

- [*]6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia)[2].
- *6230 Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and sub-mountain areas, in Continental Europe).
- 6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae).
- 6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels.
- 6510 Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*).
- 6130 Calaminarian grasslands of the Violetalia calaminariae.

Only two grassland habitats in Ireland, the orchid-rich variant of 6210 (*6210) and *6230, are accorded priority status (i.e., habitats in danger of disappearance and whose natural range falls within the territory of the European Union). Priority Annex I habitats are conventionally listed with the habitat code preceded by an asterisk '*'. Throughout this report, [*]6210 is used to denote both 6210 and the priority orchid-rich variant together.

Three distinct communities can be considered for the 6430 habitat in Ireland. The first is a lowland community of watercourses, particularly of unmanaged edges of slow-moving rivers and lake margins. The second occurs in the uplands on ungrazed or lightly grazed cliff ledges, typically occurring as small individual patches less than one metre across. The third variant is another lowland community that possibly occurs as a nitrophilous tall-herb community of woodland edges, referred to as a 'saum' community. However, this community has been little studied in Ireland (see Wilmanns and Brun-Hool 1982) and further investigation and discussion is required to determine if Ireland supports any examples worthy of Annex I status. The first two community types were assessed for the recent National Conservation Assessments (NPWS 2013); however, only the first lowland community was surveyed during the ISGS, and then only if it occurred in association with grassland.

Over recent years there has been an emphasis, due to government funding, on the conservation of semi-natural habitats listed in Annex I of the EU habitats Directive. The monitoring and assessment of the Annex I grassland habitats located within the State started in 2006, with the survey of 33 orchid-rich calcareous grassland sites (*6210) and nine species-rich *Nardus* grasslands (*6230) (Dwyer *et al.* 2007). The methodology employed for the monitoring and assessment of the Annex I habitats adapted those published by the EU (Anon. 2006), the Joint Nature Conservancy Council (JNCC) in Britain (JNCC 2004) and the methodology already utilised for dune systems in Ireland (Ryle *et al.* 2009). Following on from Dwyer *et al.* (2007), Annex I grassland monitoring was an integral part of the ISGS, with the monitoring results published in Martin *et al.* (2007, 2008, 2013), O'Neill *et al.* (2009, 2010), Devaney *et al.* (2013) and this Irish Wildlife Manual. Additional research on Annex I grassland habitats within Ireland includes studies of the Shannon Callows (Heery 1991; Heery & Keane 1999), grasslands associated with limestone pavement (Wilson & Fernández 2013) and Calaminarian grasslands (Holyoak 2008), the last study having a particular emphasis on bryophytes. The NPWS published *The Status of EU Protected Habitats and Species in Ireland* (NPWS 2013) and this lists the overall conservation status of each of the Annex I grassland habitats as *Bad*.

[2] 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)

1.5 Farming and agri-environment schemes

Across Ireland, the environmental conditions and farming practices that shape grassland habitats differ. Although there is variation in both the landscape and farming practices within and between individual counties, there are regions of Ireland that share certain similarities. When presenting the grassland data in this report, the seven Teagasc farming regions (Table 1, Figure 1) have been used to group counties geographically and environmentally, while also taking account of the farming practices that manage the grasslands. Following the Teagasc farming regions, the Co. Tipperary data has been split into North Tipperary and South Tipperary.

Table 1: Teagasc farming regions with county allocation and area presented in hectares (based on county areas in OSI 2013a).

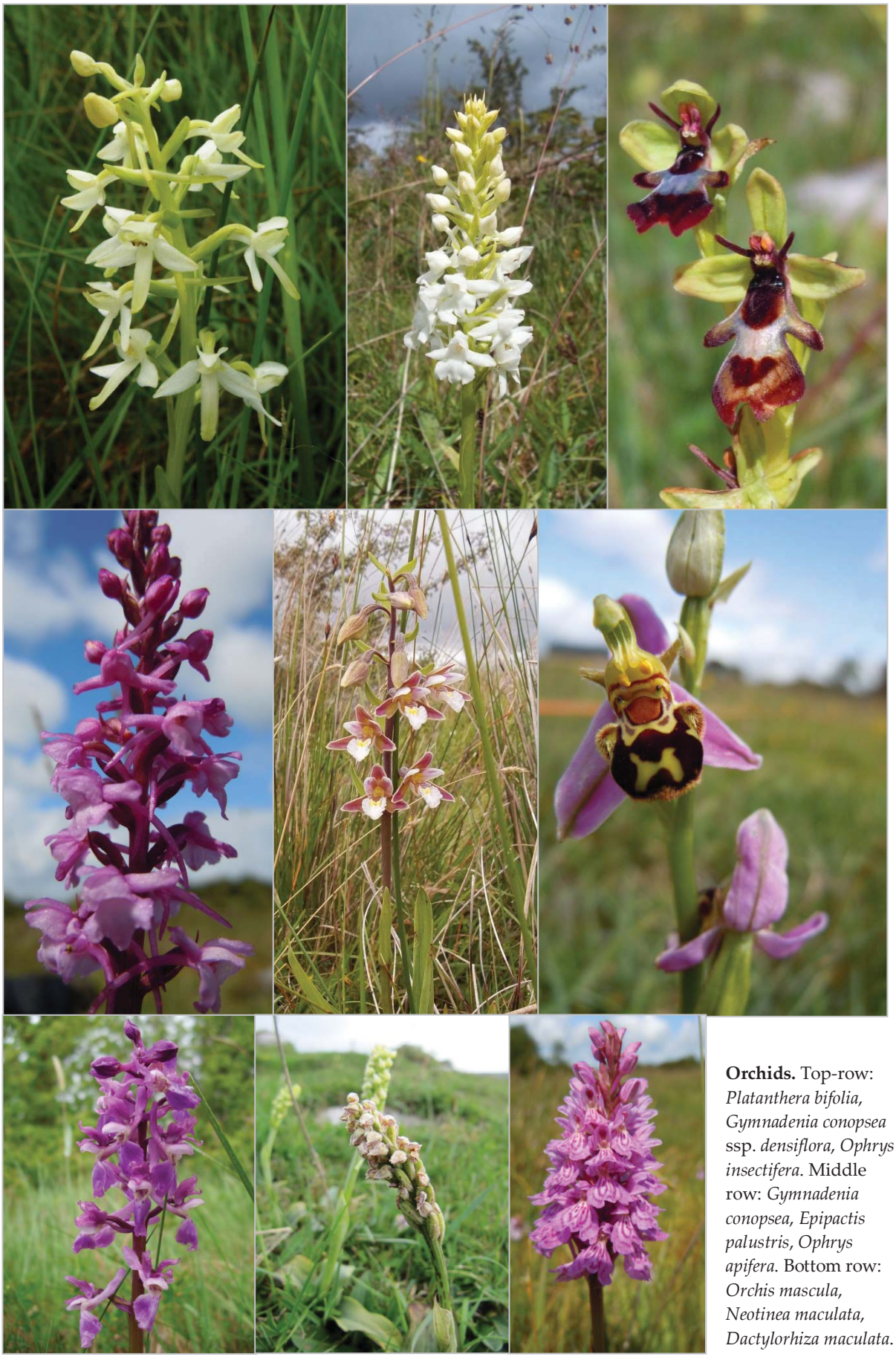
Teagasc region	Counties	Area (ha)
Border	Cavan, Donegal, Leitrim, Louth, Monaghan, Sligo	1,227,150
Midland	Laois, Longford, Offaly, Westmeath	662,530
West	Galway, Mayo, Roscommon	1,418,110
Mid-East & Dublin	Dublin, Kildare, Meath, Wicklow	695,830
Mid-West	Clare, Limerick, North Tipperary	795,190
South-East	Carlow, Kilkenny, South Tipperary, Waterford, Wexford	941,540
South-West	Cork, Kerry	1,219,640

Figure 1: Location of Teagasc regions in Ireland, differentiated by colour

Farming practices vary across Ireland, but for all of the Teagasc farming regions specialist beef production is the most common farming type (CSO 2012). Sheep farming is most prevalent in the Border, West, Mid-East & Dublin and South-West farming regions, with Donegal, Mayo, Wicklow, and Kerry the counties with the highest number of specialist sheep farms within each of these four regions (CSO 2012). Specialist dairy farming is more common in the Mid-West, South-East and South-West regions, with dairy farming particularly common in Cork (CSO 2012). Specialist tillage farming is most common in the Mid-East & Dublin and South-East regions. Farm size measured in both hectares and Standard Output (SO is the average monetary value of the agricultural output at farm-gate prices) provides some indication of farming intensity. The highest average farm size values, in both hectares and SO, are found in the Mid-East & Dublin and South-East regions (CSO 2012), indicating higher intensity farming. The lowest farm size values, in both hectares and SO, are in the Border and West regions (CSO 2012), indicating more extensive farming practices. It should be noted, however, that within the Border region Louth and Monaghan have a relatively high SO, and Louth also has a high average farm size.

As semi-natural grasslands in Ireland almost always exist within farming systems, agri-environment schemes such as the Rural Environment Protection Scheme (REPS), the Agri-Environment Options Scheme (AEOS) and the NPWS Farm Plan Scheme are expected to contribute to the conservation of semi-natural grassland. REPS, launched in 1994, was the largest of these schemes with approximately 45% of Irish farms participating in the scheme in 2008 (Finn and Ó hUallacháin 2011). Participation within REPS differed across the country and was highest among extensive farmers in the west and north-west of Ireland (EPA 2006). REPS has been reported to have delivered environmental benefits, with fertiliser application rates for grassland on participating farms below the rates used on non-REPS farms (EPA 2006; Finn and Ó hUallacháin 2011). However, there has been no overall assessment of the impact of REPS on semi-natural habitats such as grasslands, even though the protection of wildlife habitats was one of the listed objectives of the scheme (Finn and Ó hUallacháin 2011). REPS was closed to new entrants in 2009 and replaced by AEOS, a scheme that is more limited in terms of both funding and scope than its predecessor. However, AEOS has continued some REPS options that should aid the conservation of semi-natural grassland habitats. The NPWS Farm Plan Scheme was launched in 2006 and is limited to farms on Natura 2000 sites or commonages. Within the scheme the NPWS has agreed farming conditions for the Burren region and upland grasslands (Anon. 2005), as well as callows grasslands, all of which will benefit the conservation of grasslands.

Regional conservation projects are also impacting positively on the status of semi-natural grasslands. Wilson & Fernández (2013) report on initiatives in improved land use management by the BurrenLIFE Project and Burren Farming for Conservation Project (Anon. 2013) that aim to reduce current pressures and future threats, such as inappropriate grazing regimes and scrub encroachment within the Burren area. A similar model has been extended to the new AranLIFE Project (McGurn and Moran 2011) that will operate in the Aran Islands from 2014-2017.



Orchids. Top-row: *Platanthera bifolia, Gymnadenia conopsea* ssp. *densiflora, Ophrys insectifera*. Middle row: *Gymnadenia conopsea, Epipactis palustris, Ophrys apifera*. Bottom row: *Orchis mascula, Neotinea maculata, Dactylorhiza maculata*.

2. Methods

Surveying of sites for the Irish semi-natural grasslands survey (ISGS) was carried out between April and September every year from 2008 to 2012. In addition, a pilot study for the project took place between May and September 2007. Throughout this report, the ISGS may be taken to include both the pilot survey of 2007 and the main survey of 2008-2012, unless stated otherwise.

What follows is a summary of the main methods followed during the ISGS, from site selection to Annex I habitat assessment, as well as details of how data from the ISGS were collated for the results presented in this Irish Wildlife Manual. The reader is referred to Devaney *et al.* (2013) or Martin *et al.* (2013) for a more detailed description of the latest methodology used for the ISGS. The evolution of the methodology throughout the lifetime of the ISGS is outlined in Appendix 4. For more details on the survey and monitoring of Annex I grassland habitats, see Appendix 1 for the criteria and thresholds for assessing Annex I grassland habitats, and Appendix 2 for the Monitoring Methods Manual.

2.1 General site survey

The number of sites selected in each county was calculated based on a combination of the size of the county and the amount of agricultural intensification within each county (Lafferty *et al.* 1999). A further downward adjustment of potential survey area was made by excluding all upland SACs from this survey to prevent overlap with the National Survey of Upland Habitats (NSUH) (Perrin *et al.* 2013a).

Sites were primarily selected by interpretation of aerial orthographic photographs (2005 Ordnance Survey of Ireland series) and six-inch (1:10,560) maps. Every effort was made to select an even geographic spread of sites. However, the method used in the earlier years of this project (2008-2009) of selecting 3-5 sites per hectad (10 km grid square) was found to be unworkable due to the uneven distribution of potential grassland sites, mainly because of the occurrence of extensive areas of bog, upland heath, urban housing and improved agricultural land within the survey area. Therefore, there were many hectads that contained no potential grassland sites for survey. Additional sites were selected to allow for those that would not be surveyed due to problems such as a lack of semi-natural grassland habitats or denial of access by landowners.

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 was included in the survey:

- National Parks and Wildlife Service (NPWS) conservation sites[3], particularly those having an Annex I grassland habitat listed as a qualifying interest within the site.
- Large areas of semi-natural grassland for which few or no data were available.

[3] Note that, throughout this report, the term 'NPWS conservation sites' is used to refer collectively to NHAs, proposed NHAs (pNHAs), SACs and SPAs

- Sites which occur on different soil and sub-soil types, as indicated by the digital soils map of Fealy *et al.* (2006).
- Sites that represent the geographical variation that exists in the study area, such as altitudinal range, with the exclusion noted above of upland SACs.
- Sites identified by the National Survey of Upland Habitats (Perrin *et al.* 2013a) as containing the Annex I grassland habitat Species-rich *Nardus* grassland (6230), for which more data were desirable.
- Sites associated with important landscape features (e.g. eskers).
- Sites adjacent to river systems and lakes, ensuring a representative sample of wet grasslands and marshes.
- Sites highlighted by previous publications, such as Dwyer *et al.* (2007), which had highlighted semi-natural grassland of conservation value.
- Sites containing rare plant records, such as *Alchemilla alpina* and *Carum verticillatum*, from the NPWS rare plant records database.
- Information from the Botanical Survey of the British Isles (BSBI) county recorders.
- Information from NPWS regional staff.

Each of the criteria listed above was used in conjunction with the 2005 set of aerial orthographic photographs, which were used either to identify or to confirm all sites.

A subjective approach to site selection was adopted for this survey, primarily due to the practical constraints 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 NPWS conservation sites, such as SACs, that contained semi-natural grassland so that comparisons could be made with sites outside this network. 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 (e.g., townlands, geology, soil types, grid reference), a six-inch map, an aerial photograph of the site at a scale appropriate for mapping, and copies of any previous survey notes. Fully charged-up electronic handheld Personal Digitial Assistants (PDAs) loaded with TurbovegCE version 1.5 for recording site and relevé data were carried by each team of two. Paper data sheets were also carried for recording general site data, Annex I grassland habitat assessment data and Annex I grassland habitat impacts, as well as for recording site and relevé species in the event of PDA battery failure. Copies of the Annex I grassland habitat assessment criteria and impact criteria were also carried by individual surveyors.

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. Sites to which access was denied were rejected. Sites at which recent habitat loss had reduced the area of suitable habitat to less than 0.5 ha were also rejected. Statistics for site rejection, including rejection rates and reasons for rejection, have been presented in previous ISGS reports (Martin *et al*. 2007, 2008, 2013; O'Neill *et al*. 2009, 2010; Devaney *et al*. 2013).

The following details were recorded for each site surveyed. Unless otherwise indicated, these details were recorded on the general site data sheet:

Internal habitats: All habitats that were observed within the boundaries of a site were noted using level 3 codes from Fossitt (2000).

Adjacent habitats: Adjacent habitats, including boundary habitats such as hedgerows or walls, observed during the field survey were recorded for each site using level 2 categories defined by Fossitt (2000).

Site geography: Any geographical feature associated with the site, such as a hill, valley, drumlin or lake, was recorded. Seasonal flooding was also noted if observed or thought to occur on the site.

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 practices. Variables recorded include frequency and timing of grazing/mowing, type of livestock, fertiliser application and burning.

Fauna: In addition to domestic animals such as 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 such species was recorded.

Damaging operations: Three damaging operations were listed on the general site data sheet: drainage, dumping and recent afforestation in the vicinity. There was also an option to list a damaging operation under 'Other'.

Archaeological features: Any archaeological feature (e.g., lazy beds, ringforts) present on a site was recorded.

Habitat mapping: A habitat map of the site was drawn in the field using the colour aerial photograph in the site pack as a base map. A handheld GPS (Garmin GPS 76 with MapSource) was used in the field to accurately map site boundaries, areas of Annex I grassland habitats (Anon. 2007), non-Annex semi-natural grasslands (Fossitt 2000) and semi-improved grassland habitats, particularly where these were not visible on the photograph. The minimum mapping unit for habitats was 400 m^2, with a minimum habitat width of 4 m. A habitat map of each site was produced using these data within ArcMap 9.3 (see example given in Appendix 6).

Site area: The surveyed site area in hectares was derived from the ArcGIS habitat maps as accurately as is possible in the absence of a Digital Terrain Model (DTM). In the absence of a DTM, areas of habitat on steep slopes are likely to be underestimated due to the fact that only a vertical projection has been used to calculate area.

Site summary: In addition to the specific site data gathered and recorded on the general site data field sheet, a general description of each site was also written. A specific format was adhered to when writing descriptions of the sites.

Site species list: For the semi-natural grassland habitats present at each site, a comprehensive list of vascular plant species and the major components of the bryophyte flora found were input into a Turboveg database (TurbovegCE 1.5) on the PDA; these data were subsequently downloaded to a Microsoft® Access relational database. The site bryophyte list was supplemented, particularly in the case of smaller and less obvious taxa, by the intensive sampling conducted within each relevé; macro-lichens were also recorded from relevés and added to the site list. Identification of bryophytes and lichens in the laboratory was conducted as required and problematic species were referred to an expert. Species names used throughout the survey for vascular plants, bryophytes and macro-lichens are according to the current Irish National Biodiversity Data Centre (NBDC) species checklist; at the time of writing, this is Ireland2008v2. This is a composite list that combines a number of separate checklists, as follows: vascular plants, native and alien, list for Ireland: National Botanic Gardens, Glasnevin 2008; bryophytes, native and alien, list for Ireland; National Botanic Gardens, Glasnevin 2008; checklist of lichens of Great Britain and Ireland, London: British Lichen Society 2002; Characeae list for Ireland; National Botanic Gardens, Glasnevin 2008.

As noted above, the site species list was input into the Turboveg database. The remainder of the site data, with the exception of the habitat maps, were input into the Access database. Digital photographs were taken at all of the surveyed sites, and all of these images were submitted on DVD with the ArcMap project, Turboveg and Access databases.

2.2 Relevé survey

A minimum of one 2 m x 2 m relevé was recorded from within each semi-natural grassland habitat mapped in each site, and in semi-improved grassland habitats deemed to have some conservation merit (such relevés being denoted as GSiX, where 'X' is the number of the Fossitt (2000) grassland habitat it most closely resembles). Multiple relevés were recorded where there was significant variation in the sward composition within a habitat type, or where Annex I grassland habitat assessments were conducted. For each relevé, a 12-figure grid reference was obtained using a GPS unit, and topography, altitude (from the OSi Discovery Series of Maps), slope and aspect were recorded.

Cover in vertical projection for each vascular and bryophyte species was recorded on the Domin scale (Kent and Coker 1992), as were other general parameters: bare soil, bare rock, leaf litter, surface water, total field layer and total bryophyte cover.

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

- Overall cover of forbs (broadleaf herbs, omitting ferns and horsetails), measured on the Domin scale;
- Ratio of %forb cover to %graminoid (grass / sedge / rush) cover, expressed as (%forb/(%forb+%graminoid))x100;

- An estimate of the median graminoid height (omitting flowering heads of grasses unless significant in area, and omitting small clumps of taller species);
- An estimate of the median forb height;
- A digital photograph of the relevé.

A soil profile was examined to a minimum depth of 20 cm, and the soil type was defined according to a simplified version of the Great Soil Groups of Gardiner & Radford (1980) with the aid of the soil identification key in Trudgill (1989). Soil samples were taken from most relevés throughout the survey. 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 subsequent analyses of total organic carbon and total phosphorus by an external laboratory. Soil pH, total organic carbon and total phosphorus were measured for the majority; however, in the final year of the project (2012) only a sub-set of samples, mainly from Annex I relevés, was analysed. Soils not analysed were dried and sent to a storage facility in the Agriculture and Food Science Centre in University College Dublin.

All of the above relevé data, with the exception of the digital photographs, were added directly to the Turboveg database (one database was used to hold both site and relevé data) and subsequently downloaded to the Access database. All digital images were submitted on DVD with the ArcMap project, Turboveg and Access databases.

2.3 Assessment of Annex I grasslands

All surveyed Annex I grasslands above the minimum mapping area were assessed using a unified set of assessment criteria that were finalised for the National Conservation Assessments (NCAs) of Annex I grassland habitats. These NCAs were completed in 2013 as part of Ireland's reporting commitments under Article 17 of the EU Habitats Directive (NPWS 2013). The assessment criteria used are summarised below and in Appendix 1. See Devaney *et al.* (2013) and Martin *et al.* (2013) for a discussion on the development of the Assessment criteria. Refer to the Monitoring Methods Manual (Appendix 2) for the methodology to be followed when monitoring these habitats in the future.

For each Annex I habitat present on a site (some sites had more than one), three parameters were assessed: area, structure and functions, and future prospects. For a habitat at a site to receive an overall assessment of *Favourable*, the habitat had to be assessed as *Favourable* within each of the three assessment parameters (Table 2). Any deviation from stability, as indicated by a negative change in area, structure and functions, or future prospects, implied a negative impact, and the assessment was affected accordingly.

Table 2: Summary matrix of the parameters and conditions required to assess the conservation status of habitats (modified from Ryle *et al.* (2009)).

	Favourable	*Unfavourable – Inadequate*	*Unfavourable – Bad*
Area	Stable	>0% - <1% decline/year	≥1% decline/year
Structure & functions	Stable	1 – 25% monitoring stops decline/failure	>25% monitoring stops decline/failure
Future prospects	Good (≥0)	Poor (<0 to -3)	Bad (<-3)
Overall	All green	Combination of green and / or amber	One or more red

2.3.1 Area assessment

Loss of extent was assessed by comparing the area of the Annex I grassland habitat mapped during field survey with the estimated extent of the habitat apparent in 2000 following interpretation of aerial photographs from 2000. This comparison was made using ArcMap. While small changes in area were difficult to detect, this was nonetheless regarded as the best approach for the baseline assessment in the absence of an established monitoring scheme.

2.3.2 Structure and functions assessment

The information required for the structure and functions assessment was recorded at monitoring stops, as described in Ryle *et al.* (2009). Areas of Annex I grassland habitat measuring less than 400 m^2 were usually not assessed, unless the habitat was rare and deficient in data either nationally or regionally, such as Annex I habitat 6430. In cases where the area was only slightly larger than 400 m^2, only one or two monitoring stops were recorded to avoid stops being positioned adjacent to each other. Where the habitat area was large enough, a minimum of four monitoring stops were recorded, with an increasing number of stops recorded with increasing area. Table 3 shows the scale used to determine the number of monitoring stops to record; this table was proposed in O'Neill *et al.* (2009) to ensure adequate coverage of the Annex I grassland habitat and was followed in subsequent years of the ISGS. At each monitoring stop a full relevé was also recorded, with the exception of soil data, which were generally only recorded from the first stop in each Annex I grassland habitat. Each series of monitoring stops was positioned to encompass the variation that existed within the habitat, but did not usually include seriously disturbed areas or areas with very high levels of encroachment.

Table 3: Monitoring stop scale for Annex I grassland habitats.

Area (ha)	Number of monitoring stops
<0.04	0
0.04 - 0.25	2
>0.25 – 4	4
>4 – 8	6
>8 – 16	8
>16 – 32	10
>32 – 64	12
>64	14+

Structure and functions were assessed at each monitoring stop using a number of factors, namely: forb-to-graminoid ratio, high-quality species, positive indicator species, negative indicator species, scrub and bracken encroachment, sward height, litter cover, extent of bare ground, and grazing and disturbance levels. Threshold values for each of these criteria differ for each of the Annex I grassland habitats assessed (Appendix 1). For the Annex I habitat to receive a *Favourable* assessment for structure and functions, a pass was generally required for all criteria within all monitoring stops; however, high-quality sites which narrowly failed on only one or two criteria were re-examined and, using expert judgement, a decision was made on whether a *Favourable* assessment for structure and functions was warranted. Components of structure and functions that were found to vary seasonally, such as sward height, litter, bare ground or disturbance levels, were all considered in the context of the date that the area was surveyed.

2.3.3 Future prospects assessment

The future prospects assessment relates to the likely development and maintenance of the Annex I grassland habitat in favourable condition for the foreseeable future. In order to assess this likelihood, pressures, threats and activities (including management) were recorded for each area of Annex I grassland habitat surveyed using the EU-devised list of impact codes (Ssymank, 2010). As this list of impact codes only became available in 2010, only Annex I habitats recorded in 2010, 2011 and 2012 could be assessed using this method. Following Ssymank (2010) and recommendations made in Ellmauer (2010), the intensity of each impact at each site was assessed and given a score ranging from 0.5 to 1.5 (Table 4), corresponding to the EU criteria of low, medium and high impact/importance. Negative pressures were assigned a negative value, positive management / impacts were assigned a positive value and a score of zero indicated a neutral impact, balanced in terms of its positive and negative effects. The percentage of the Annex I habitat affected by the impact was also recorded, along with its source, i.e., whether it originated inside or outside the Annex I habitat. The percentage of the Annex I habitat affected was scored from 0.5 to 3 to correspond with the ranges <1% to 100% (Table 4). The source criterion was not scored as this was not deemed to be a key issue when assessing the severity of the impact. As the data collected here are baseline data, trends of impact intensity could not be determined. When assessments are repeated in future years, it will be possible to record whether a particular impact is increasing, decreasing or stable in trend by comparing with assessment data from previous years. To ensure consistency of any future recording, guidance on recording impacts for future prospects assessment is given in Appendix 3.

By multiplying together the scores of intensity and area, and then combining the result with the negative, positive or neutral effect of each (i.e., by multiplying the score by -1, +1 or 0 respectively), a final score for each impact was produced. (Thus a neutral impact would always receive a score of 0 by this scheme.) For an Annex I habitat subject to multiple impacts at a site, the final scores were summed to gain an overall future prospects score for the habitat. Areas of Annex I grassland habitat that scored ≥0 were determined to have *Favourable* future prospects, while those scoring between <0 and -3 were *Unfavourable – Inadequate* and <-3 *Unfavourable – Bad*, as shown in Table 2. Furthering this quantitative analysis of future prospects, the assessment result was examined by a surveyor who took part in the field assessment to determine whether the score was a true reflection of the future prospects of the habitat. All assessment data were input into the Access database.

Table 4: Scoring system used to calculate future prospects scores for Annex I grassland habitats assessed in 2010-2012

Impact	Value	Score
% Area of Annex I habitat impacted	<1%	0.5
	1-25%	1
	26-50%	1.5
	51-75%	2
	76-99%	2.5
	100%	3
Intensity of impact	High	1.5
	Medium	1
	Low	0.5

2.3.4 Primary areas of Annex I habitat

A list of premium-quality sites containing Annex I grassland habitats above a minimum size and of adequate structure and functions (according to field assessments) was produced. Hereafter referred to as ***primary areas*** of Annex I grassland, these represent the best examples of Annex I grassland habitat recorded during the ISGS and are judged to be of primary importance due to a combination of the area they cover and their structure and functions. They should provide a focus for monitoring and conservation efforts in the future. Criteria for primary areas of Annex I grassland habitat include: an extent of at least 1 ha; structure and functions should generally be *Favourable*; however, assessed areas with stops that failed but were considered to be near misses (e.g., only one positive indicator species off a pass, or within 10% of the required forb-to-graminoid ratio) were sometimes included if the condition of the habitat was otherwise good. Future prospects and past changes in extent were not taken into account when compiling this list of sites.

2.4 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. A broad range of sites was surveyed in the ISGS, with varying degrees of naturalness. As part of the survey methodology, data were collected which allowed the general condition of the site to be evaluated, with regard in particular to its conservation value and the presence of threats to the grassland. Factors which contribute to the conservation value of a site include its size, habitat diversity and quality, species richness and the presence of plant species of conservation interest; factors such as these have been used when evaluating sites for conservation in the UK (Usher 1989). By assigning a conservation score to each site, the sites can be compared and those which are of particularly high conservation value can be identified. This allows management efforts to focus on sites which are most valuable from a conservation point of view, and also provides a basis for monitoring individual sites into the future. Human activities such as agriculture, recreation and development can pose threats to semi-natural grassland habitats, as can the abandonment of traditionally managed land.

Conservation status was scored on the basis of seven criteria (Table 5). The final score for each site is given as a percentage of the total possible score of 47.5. The assessment of threats to each site was based on the criteria detailed in Table 6. The final score for each site is given as a percentage of the total possible score of 13. See Devaney *et al*. (2013) and Martin *et al*. (2013) for a more detailed explanation of the individual criteria for both of these tables.

Conservation and threat scores were entered separately into the Access database and were *not* combined to produce one overall score. Combining scores can lead to misinterpretation when comparing sites; for example, a high quality site with many threats could score the same as a medium quality site with no threats. Therefore threats were scored separately from conservation value so that sites with a high conservation score which are threatened could be identified. The scores are written as percentages of the total possible score. This allows a simple comparison to be made between sites, even if data were not available in all of the categories shown in Tables 5 and 6.

Table 5: Criteria used in the calculation of the conservation score for each site.

Criterion	Scoring	Max. score
Semi-natural grassland habitats	1 for each semi-natural grassland habitat 0.5 for each semi-improved grassland habitat where the corresponding semi-natural grassland habitat is not present	5
Annex I grassland habitats	Annex I grassland habitats are divided into primary and secondary areas on the basis of quality 2 One secondary Annex I grassland habitat 4 Two or more secondary Annex I grassland habitats 4 One primary Annex I grassland habitat 8 Two or more primary Annex I grassland habitats	12
Adjacent and internal semi-natural habitats	0.5 for each of the following habitat groups recorded during the survey: F (Freshwater) GS/GM (Semi-natural grassland, marsh) H/P (Heath [excl. bracken], bog, fen) WN/WS/WL (Woodland, scrub) ER/EU/C/L/M (Exposed rock, coastal [excl. coastal constructions], littoral/marine habitats)	2.5
Area	Sites are divided into eight groups on the basis of the percentile distribution. The range is greater in the larger site groups, and this is reflected by the steep increase in the scores for larger sites. 0 0-<0.5ha 1 0.5-<5ha 2 5-<10ha 3 10-<20ha 4 20-<40ha 6 40-<80ha 9 80-<160ha 12 ≥ 160 ha	12
Species density	Modified species density = number of non-woody species divided by $\log_{10}$ (area +1) of the site. The resulting figures were then divided according to percentiles as follows: 0 < 25 spp./ha 1 25 – 56.9 spp./ha 2 57 – 71.9 spp./ha 3 72 – 96.9 spp./ha 4 ≥ 97 spp./ha	4
Notable species	Notable species include those listed on the Flora (Protection) Order 1999 (FPO) and the Red Data Book (RDB) (Curtis and McGough 1988) of vascular plants. 0 No notable species 4 One FPO species 8 Two or more FPO species 2 One RDB species 4 Two RDB species 6 Three or more RDB species	8
High nature value indicator species	Sites were scored on the number of high nature value (HNV) indicator species recorded (see Devaney *et al*. 2013 and Martin *et al* 2013), as follows: 0 1-10 HNV species 1 11-15 HNV species 2 16-20 HNV species 3 21-25 HNV species 4 >25 HNV species	4
Maximum total score		**47.5**

Table 6: Criteria used in the calculation of the threat score for each site.

Criterion	Scoring						Max. score
Negative adjacent habitats	0	No negative adjacent habitats					2
	1	Improved grassland (GA) or cultivated land (BC) adjacent					
	2	Improved grassland (GA) and cultivated land (BC) adjacent					
Damaging activities	0	No damaging activities	1	One damaging activity			3
	2	Two damaging activities	3	Three or more damaging activities			
Agricultural Improvement	0	No improvements	1	One improvement type			3
	2	Two improvement types	3	Three or more improvement types			
Negative species	1	1-3 species	2	4-6 species	3	7-9 species	5
	4	10-12 species	5	13-14 species			
Maximum total score							**13**

2.5 Data consolidation

Several databases were designed and populated throughout the lifetime of the ISGS. These include Access and Turboveg databases and ArcMap shapefiles for each year of the survey. In 2011, all of the data collated between 2007 and 2011 were consolidated into three data formats:

- One ArcMap polygon shapefile containing data for all Fossitt (2000) grassland habitats (including semi-improved grassland) and Annex I grassland habitats
- One Access database following the data format and structures provided to BEC Consultants by NPWS in 2010 and updated in 2011
- One Turboveg database compatible with the National Vegetation Database (Weekes and Fitzpatrick 2010).

After completion of the field season in 2012, the additional data from the remaining 14 counties were appended to all three datasets listed above. Details on the consolidation of the data for each of the three datasets (ArcGIS, Access and Turboveg) are given below.

2.5.1 ArcMap

Six ArcMap shapefiles were consolidated to create one shapefile containing mapped polygons of all sites surveyed in all years, 2007-2011. This involved several changes to the ISGS shapefile from the pilot study in 2007 in order to bring it in line with the mapping practices applied in subsequent years. Once the changes were applied, all individual shapefiles were standardised to contain identical columns, with data following set labelling conventions. Consolidation of the shapefiles occurred after standardisation. The following data-checking procedures were performed on the consolidated shapefile using ArcMap toolbox and ET GeoWizards:

- All polygons and gaps below the minimum mapping size were examined
- Slivers and overlapping polygons were identified and investigated
- Any attribute lines with no corresponding polygon were eliminated
- Relevés lying outside of polygons were examined and addressed
- Conformity of all labels to labelling conventions was assured

- Label mismatches between relevés and polygons were investigated and addressed, as were label mismatches within polygons
- Multi-part features were examined and rendered single-part
- A final general geometry check was run.

Where anomalies with regard to irregular mapping or mismatching of habitats between relevés and polygons occurred, the original field data were consulted and the appropriate changes made to the GIS shapefile and/or consolidated Access and Turboveg databases.

A separate shapefile created for grassland habitats surveyed and mapped in 2012 was appended to this consolidated shapefile after the 2012 field season, and the checks as outlined above were performed again.

2.5.2 Access database

Five Access databases were consolidated in 2011 into one database containing all site and relevé data for all years, 2007-2011. Data collected in 2012 were subsequently appended to this consolidated database.

The Access databases from 2007-2009 had a flat structure, with just two large, non-relational tables holding site and relevé header data, nine tables for site and relevé species data, and two tables holding Annex I habitat conservation assessment criteria. The databases also had a number of lookup tables, some of which were redundant. In early 2010, the structure of the database was completely redesigned to create a relational database with nine tables for site header data (e.g. geography, notable features and internal habitats) and one table each for site species data, relevé species data, relevé header data, Annex I habitat structure and functions data, future prospects data and overall conservation assessment data. Any redundant lookup tables were removed. To conform to the new structure, data from the 2007-2009 databases were first converted to a file structure that was compatible with the new database structure before being uploaded. These conversions were carried out in Microsoft Excel. The data from the 2010 and 2011 field seasons were entered directly into the new database format, so minimal conversion was required to carry them across to the amalgamated database.

Once all data (2007-2011) were amalgamated into a single database, any inconsistencies in data format between separate years were removed and all data were standardised within Access. Fresh intersects with the consolidated 2007-2011 GIS shapefile were carried out to populate site data fields such as sub-soils and parent materials. The 2012 field data were added directly into the consolidated 2007-2011 Access database and general data and standardisation checks were carried out again.

2.5.3 Turboveg database

Five Turboveg databases were consolidated to create one Turboveg database containing all the site and relevé data for all years, 2007-2011. An additional Turboveg database was appended to this consolidated database after the 2012 field season.

Before consolidation of the individual Turboveg databases, the header files within the database structure were compared, adjusted where necessary and then rebuilt so that all individual databases had the same header file attributes (field name, type, length and decimal place). Some exporting and

importing of header data to and from Excel was required for this step, particularly when a field type differed between databases. Superfluous header data were removed, while mandatory fields for all relevés submitted to the National Vegetation Database (Weekes and Fitzpatrick 2010) were added to the databases as necessary. Once the header file field attributes of the individual databases were standardised, the header data were also standardised. The five Turboveg databases were consolidated after data standardisation.

After consolidation of the data from 2007-2011, a search for species synonyms was carried out and obsolete names were replaced with the new approved species names. General data checks were carried out at this point. The Turboveg database containing the field data from 2012 was appended to the consolidated database after the 2012 field season and general data and standardisation checks were carried out again.

2.5.4 *Data cross-checking*

Data checks among the three datasets were carried out to ensure the integrity of the data within and between them. Any differences were investigated, the original files or field data were consulted and the appropriate changes made to the datasets.

2.6 *Post hoc* relevé habitat checking

As the ISGS methodology evolved, clearer and more defined descriptions of both Fossitt (2000) and Annex I habitats developed. After the 2012 field season, the species data within the relevés were re-examined, and in some cases the relevés were reassigned to a non-grassland Fossitt (2000) habitat, or were changed from Annex I to non-Annex grassland habitat. In a similar fashion, some grassland habitat assignments made in the field were reassigned to a different grassland habitat, while some non-Annex I grassland habitats were subsequently upgraded to an Annex I grassland habitat. In particular, relevés with high scores of species such as *Molinia caerulea, Calluna vulgaris, Erica* spp., *Sphagnum* spp. or *Dryas octopetala* were examined to determine if the relevé did genuinely represent a grassland habitat, or whether it was more representative of a heath or fen/flush habitat. The reassignment of some relevés meant that all three datasets (Access, Turboveg and ArcGIS) needed to be updated with the changes.

Both the Access and Turboveg databases for the ISGS still contain any reassigned non-grassland relevés, as the data collected on these non-grassland habitats are still of value. It is important to note that the 'No of releves' field in the Access database includes both grassland and non-grassland relevés at any given site.

In ArcMap, following habitat reassignments of relevés, relevant polygons were either relabelled to the reassigned habitat code, or parts of polygons were cut or merged as necessary, based on aerial photography interpretation, site surveyor knowledge and site photos. The relevé point shapefile was also updated accordingly. All site maps from all years of the survey were produced again (as .pdf files) to reflect the updated habitat assignments. The 'Hab_type', 'Annex_i' and 'Stop' fields were updated in the Turboveg database, while site information such as 'Internal habitats', 'Adjacent habitats', 'Annex I Grassland Habitats' and 'Site notes' were updated in the Access database. The

relevé data within the Access database come directly from the Turboveg database, so when Turboveg was updated, this information was re-imported into Access.

As with the consolidation of datasets above, after all changes were made to the three datasets, data cross-checks were carried out to ensure the integrity of the data within and between them.

2.7 Vegetation data analysis

2.7.1 Data preparation

The combined ISGS 2007-2012 dataset contains 4,633 relevés. Only relevés classified using Fossitt (2000) as GS (semi-natural grassland), GA (GSi, semi-improved grassland) or GM (freshwater marsh) were included in the analysis; 153 relevés classified (or reclassified following review) as HH (heath), PF (fen/flush), FS (swamp), CM (salt marsh) or CD (sand dunes) were excluded[4]. An additional 36 relevés classified as GS from the National Survey of Upland Habitats (NSUH) were included to bolster coverage of the dataset in upland areas.

Species records that had only been identified to the genus level were excluded in most cases as they may be amalgams of species with markedly different ecological preferences and therefore misleading to utilise (e.g. *Carex* sp.). An exception was made for *Hieracium* spp. due to recognised identification issues with microspecies. All records for *Euphrasia* spp. were combined as *Euphrasia officinalis* agg. with the exception of *Euphrasia salisbergensis*. Due to identification issues, the following pairs of species were combined: *Agrostis canina* / *A. vinealis, Juncus acutiflorus* / *J. articulatus, Poa humilis* / *P. pratensis, Thuidium tamariscinum* / *T. delicatulum, Chiloscyphus pallescens* / *C. polyanthos, Fissidens adianthoides* / *F. dubius*. All records of *Viola* species were interpreted as *Viola riviniana*, as it is highly unlikely that *Viola reichenbachiana* would be encountered in grassland and other *Viola* species are distinctive.

As the ISGS relevé data were recorded using the Domin scale, they were converted to percentages using mid-range values as shown in Table 7; mean values needed for the analysis cannot be calculated directly from a non-linear scale. Data from the NSUH were recorded as percentages in the field. Where species records were excluded due to identification only to the genus level, the relevé was excluded if these records totalled 5% or more cover, due to the lack of data on a significant portion of the vegetation. This resulted in the removal of 39 relevés.

Species recorded in fewer than 20 relevés in the combined dataset were initially excluded to reduce noise. Multivariate outlier analysis was used to examine the dataset in PC-Ord 6.09 (MjM Software, Gleneden Beach, Oregon). The mean distance of each sample from each other sample was calculated using Quantitative Sørensen (Bray-Curtis) as the distance measure. A threshold of three standard deviations of the grand mean for all distances between samples was used. Eight samples were flagged as outliers but all were deemed to be within the remit of the analysis; several were samples from rank grasslands. These stages of data preparation yielded a final data matrix of 4,477 plots and 299 species/taxa, which were square-root transformed to down-weight the influence of abundant species.

[4] Subsequent to the analysis, two borderline relevés classified as GS were reassigned as PF and FS, and one borderline reléve classified as PF was reassigned as GS.

Table 7: Conversion of Domin scale to percentage cover

Domin scale	Range (%)	Mid-range value (%)
10	91-100	96
9	76-90	83
8	51-75	63
7	34-50	42
6	26-33	30
5	11-25	18
4	5-10	8
3	1-4	3
2	<1	0.5
1	<1	0.3
+	<1	0.1

2.7.2 *Data analysis*

The aim of the analysis was to sort the relevés to produce a two-tier classification, with broad groups divided into a number of communities at a level of resolution akin to the vegetation communities of the British National Vegetation Classification (NVC; Rodwell 1991 *et. seq.*) and the association level of the Zürich-Montpellier school of phytosociology (for description of which see Kent 2012).

2.7.2.1 Cluster analysis

The data matrix of n samples x p species was used to calculate an n x n distance matrix defining the dissimilarity between each pair of samples. Quantitative Sørensen (Bray-Curtis) dissimilarity 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 and Grace 2002).

Six classification methods, hierarchical agglomerative cluster analysis (HAC), hierarchical divisive cluster analysis (DIANA), two-way indicator species analysis (TWINSPAN), partitioning around medoids (PAM), fuzzy analysis (FANNY) and fuzzy c-medoids (FCMdd) were extensively tested with the distance matrix by comparing a variety of cluster validation measures over a range of cluster levels to see which performed best. Analyses were all conducted in the R statistical environment, except the TWINSPAN analysis which was conducted in PC-Ord 6.09. FANNY was selected as the best performing method. This non-hierarchical method is fully described in Kaufman and Rousseeuw (1990) and was implemented using function FANNY in package CLUSTER. The algorithm seeks to minimize the sum of dissimilarities for k clusters, where k is specified by the user. In traditional 'hard' or 'crisp' classifications, samples have binary membership, that is, they either belong (1) or do not belong (0) to a cluster. In 'fuzzy' classifications each sample has a probability (or goodness of fit) from 0 to 1 of belonging to each cluster, the sum of these probabilities being 1. The degree of fuzziness can be changed by the user through a parameter r, where values approaching 2 are increasingly fuzzy and values approaching 1 are crisper (Maechler *et al.* 2013). From the cluster membership probabilities produced by FANNY, two options arise: i) a crisp classification can be obtained by assigning all samples to the cluster for which they have maximum probability, and ii) plots which have a maximum membership probability below a specified threshold (α) can be regarded as intermediates and can be excluded from further analysis to 'tighten' the definition of the clusters. For all analyses, the function

FANNY was run with a membership exponent (r) of 1.1 (as trials indicated that higher values produced too much fuzziness) and with the number of maximum iterations set to 10,000.

FANNY was conducted over a range of cluster levels (two to six). At each level, intermediate samples (α = 0.5) were excluded and the remaining sub-set of the data was reanalysed to produce a crisp classification. Following examination of constancy (species frequency) tables, the four-group level was selected (sub-set size = 3,507, number of intermediates = 970). At the three-group level, wet and dry acidic grassland was grouped together with marsh, while at the five-group level, dry semi-improved grassland was separated out; neither scenario was deemed desirable. While cluster validation measures can be used to select the optimal level of clustering (number of groups), expert judgement was preferred to ensure that clusters were ecologically meaningful and would be intuitive for fieldworkers.

Separate analyses were then conducted on the data assigned to each of the four groups across a range of cluster levels to define the communities. Again, the procedure was analysis, exclusion of intermediates and reanalysis to produce a crisp classification. This ultimately resulted in a classification composed of four groups divided into nineteen communities and based on 2,191 'core' relevés, with the other 2,286 relevés deemed fuzzy intermediates.

2.7.2.2 Indicator Species Analysis (ISA)

To identify species that differentiated between groups and between communities within a group, Indicator Species Analysis (ISA) developed by Dufrene and Legendre (1997) was used. ISA produces percentage indicator values (IndVals) 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 of the samples in that group. IndVals 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 IndVal is maximal and a permutation test is used to check the significance of the relationship. For this analysis, the extension of this approach presented by De Cáceres and Legendre (2009) was used, which looks for indicator species not only of individual site groups but also of combinations of site groups. ISA was conducted in R using function MULTIPATT from package INDICSPECIES. The analysis was limited to examination of singletons, doublets and triplets of site groups, as higher order combinations were deemed unhelpful.

2.7.2.3 Silhouette analysis

The validity of the four-group structure was assessed by silhouette analysis (also termed average silhouette width) in R using the function CLUSTVAR in package VEGCLUST. It was initially proposed by Rousseeuw (1987). The silhouette width of a sample is calculated from the average dissimilarity of that sample to all samples in the same cluster and from the average dissimilarity of that sample to all samples in the next most similar cluster (Maechler *et al.* 2013). Positive values indicate a good fit and negative values indicate that a sample would fit better elsewhere. The mean silhouette width for a cluster indicates the quality of that cluster, and the global mean silhouette width (or silhouette coefficient) of all samples indicates the quality of the classification (Peet and Roberts 2012). This value is ideally maximised. The silhouette plot for the four cluster solution (Figure 2) indicates a very small number of misclassified plots. Group 1 has the narrowest mean silhouette width and hence is the least cohesive cluster.

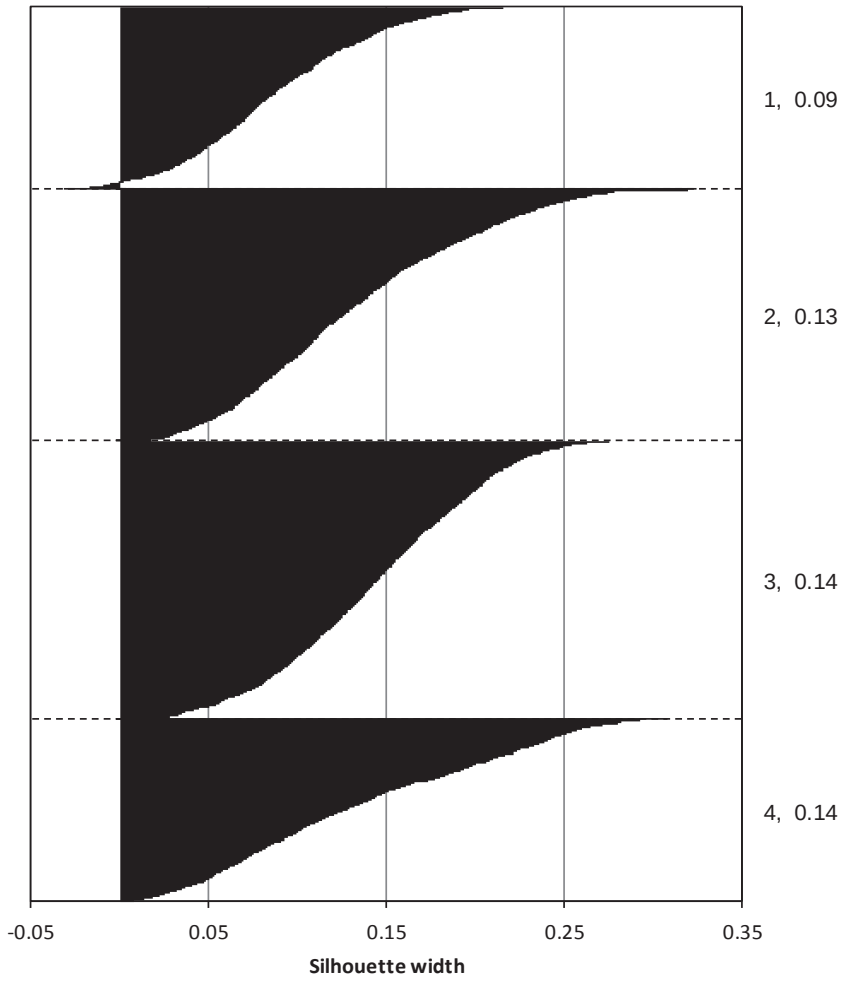


Figure 2: Silhouette plot of grasslands dataset (ISGS and NSUH relevés) with four clusters following fuzzy analysis with exclusion of intermediates (n = 3507). Numbers on the right indicate cluster number and mean silhouette width of cluster. Overall mean silhouette width = 0.13.

2.7.2.4 Assignment of excluded plots

Excluded relevés not used in defining the classification were assigned statistically to communities in R on the basis of best fit. As no assignment function for FANNY has been implemented, the fuzzy c-medoids (FCMdd) algorithm described by Krishnapuram *et al.* (1999) was used through the VEGCLASS function in package VEGCLUST (De Cáceres *et al.* 2010) with a fuzziness exponent (m) of 1.1. This method is similar in principle to FANNY and came second in the initial tests with different classification methods. The 2,286 fuzzy intermediate relevés were assigned to the community for which they scored maximum membership probability. Of the 39 relevés originally excluded from the analysis due to genus level records, a more cautious approach was taken and only the 16 relevés with maximum membership probability >0.5 were assigned.

2.7.2.5 Ordination

A non-metric multidimensional scaling (NMS) ordination was conducted using the function METAMDS in package VEGAN. Six relevés previously flagged as outliers were excluded, resulting in a matrix with 4,471 relevés being used. A two-dimensional solution was sought using Quantitative Sørensen (Bray-Curtis) as the distance measure and a maximum of 20 random starts.

Grassland flowers. Top row: *Centaurea scabiosa, Geranium sanguineum*. Second row: *Primula veris, Cirsium palustre, Leucanthemum vulgare*. Third row: *Carlina vulgaris, Lotus corniculatus*. Bottom row: *Pilosella officinarum, Potentilla palustris*.

3. Results

3.1 Overall national grassland statistics

3.1.1 The location and area of the surveyed grassland sites

Between May 2007 and September 2012, 4,544 grassland relevés were recorded from 1,192 sites surveyed across all 26 counties of Ireland, and a total of 23,188.1 hectares of semi-natural grassland habitats were mapped and digitised according to the habitat classification system of Fossitt (2000).

Summary survey statistics relating to the counties surveyed are presented in Table 8, showing for each county and Teagasc region the number of sites surveyed, number of relevés recorded, area in hectares surveyed, mean number of relevés recorded per site, and median site area.

Sampling intensity among the counties varied over the lifetime of the project; this was due in part to variations in farming intensity among counties, but also because of differences in resource allocation between the early and later years of the project, and because of changes in the survey methodology. Figure 3 illustrates the differences in sampling intensity among the Teagasc regions as it plots the area surveyed in each region as a percentage of the region's area, while Figure 4 shows the proportion of the total surveyed area located in each region. The Border region was the most intensively sampled region and the South-East the least. These differences should be borne in mind when reading and interpreting these results.

The Border region had the highest number of surveyed sites (350), the most relevés recorded (1,558), and the largest survey area (9,667.4 ha). Leitrim alone held 17% of the total area of grassland surveyed during the ISGS, compared to just 0.1% in Wicklow, the least intensively sampled county, with large areas within the Wicklow Mountains SAC (002122) excluded from the survey area (see Introduction). The Border and West regions between them contained 51% of sites surveyed during the ISGS, although they cover just 38% of the area of Ireland. The South-West region, consisting of Cork and Kerry, was the third most intensively sampled region; 192 of the 224 surveyed sites in the region were located in Cork, comprising 16% of the 1,192 sites surveyed during the lifetime of the ISGS. The Mid-East & Dublin region contained a high proportion of more intensively managed farms, and it is also one of the smallest regions (only the Midlands region is smaller); just 68 sites were surveyed and 254 relevés recorded within its four counties, the least of all the regions. However, the region with the smallest surveyed area was the South-East, with 1,009.4 ha surveyed and mapped.

The high level of sampling in the Border region was largely due to the low-intensity farming practised throughout most of the region, which resulted in a larger area of semi-natural grassland available for survey in those counties.

Table 8: Summary of sites surveyed during ISGS 2007-2012, by county and Teagasc region.

County	Year surveyed	No. of sites	No. of relevés	Hectares surveyed[*1]	Mean relevés per site	Median site area (ha)
Border region						
Cavan	2009	66	273	1,841.7	4.1	17.6
Donegal	2010	103	382	1,438.1	3.7	8.8
Leitrim	2009	77	390	3,925.2	5.1	40.6
Louth	2012	5	12	41.4	2.4	4.0
Monaghan	2009	47	189	893.6	4.0	14.0
Sligo	2010	52	312	1,527.4	6.0	24.8
Total Border region		*350*	*1,558*	*9,667.4*	*4.5*	*18.2*
Mid-East & Dublin region						
Dublin	2010	26	97	749.6	3.7	12.7
Kildare	2010	22	107	823.3	4.9	13.6
Meath	2011	14	37	142.3	2.6	6.5
Wicklow	2012	6	13	24.0	2.2	3.4
Total Mid-East & Dublin region		*68*	*254*	*1,739.3*	*3.7*	*3.7*
Midland region						
Laois	2012	8	29	138.5	3.6	16.2
Longford	2009	49	187	1,290.7	3.8	23.1
Offaly	2007[*2]	41	139	1,365.0	3.4	12.1
Westmeath	2011	18	84	215.2	4.7	11.5
Total Midland region		*116*	*439*	*3,009.3*	*3.8*	*17.4*
Mid-West region						
Clare	2011	63	248	1,074.2	3.9	13.5
Limerick	2012	15	86	398.0	5.7	21.6
N. Tipperary	2012	12	42	179.3	3.5	8.5
Total Mid-West region		*90*	*376*	*1,651.5*	*4.2*	*14.2*
South-East region						
Carlow	2012	5	20	47.1	4.0	9.8
Kilkenny	2012	8	27	110.7	3.4	6.9
S. Tipperary	2012	9	29	84.7	3.2	4.6
Waterford	2008	58	176	706.0	3.0	7.1
Wexford	2012	7	15	61.0	2.1	4.0
Total South-East region		*87*	*267*	*1,009.4*	*3.1*	*6.6*
South-West region						
Cork	2008	192	589	1,859.5	3.1	7.2
Kerry	2012	32	136	577.3	4.3	13.5
Total South-West region		*224*	*725*	*2,436.8*	*3.2*	*7.6*
West region						
Galway	2012	91	282	837.0	3.1	5.9
Mayo	2011	115	465	1,456.2	4.0	9.7
Roscommon	2007	51	178	1,381.1	3.5	20.0
Total West region		*257*	*925*	*3,674.4*	*3.6*	*9.2*
Total in ISGS		***1,192***	***4,544***	***23,188.1***	***3.8***	***11.6***

[*1] As well as GS/GM habitats, this includes PF habitats when associated with an Annex I grassland habitat, FS (non-FS1) and semi-improved variants of GS (GSi)

[*2] Additional survey work was carried out in Offaly in 2010, in which one new site and further areas in three existing sites were surveyed

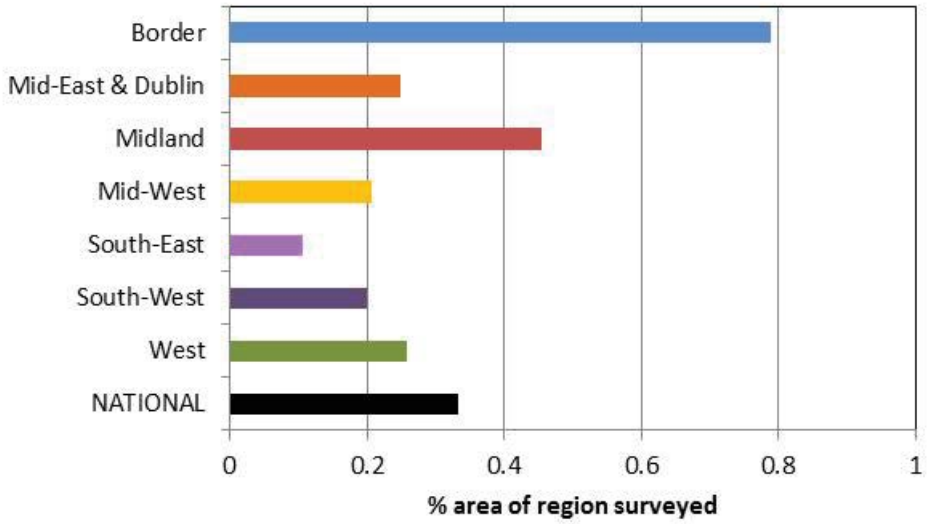


Figure 3: Percentage of total area of each Teagasc region surveyed during ISGS 2007-2012. Percentage of national area has been included for comparison purposes.

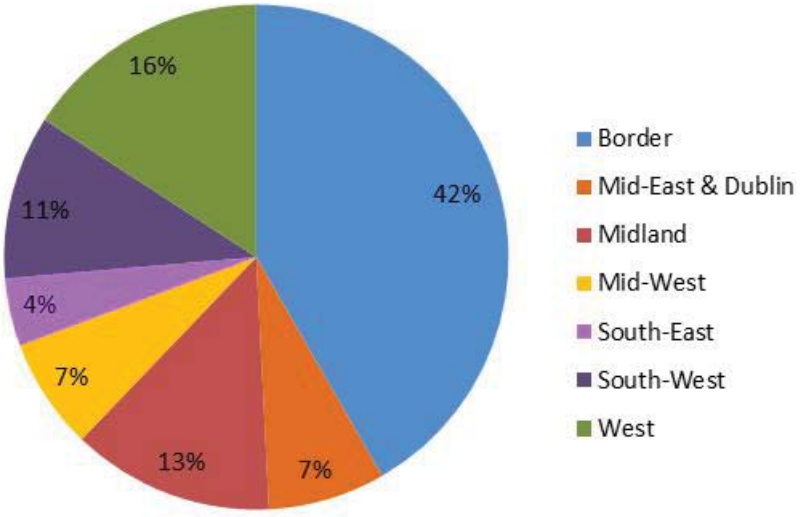


Figure 4: Proportion contributed by each Teagasc region to the total area of grassland surveyed during ISGS 2007-2012. Includes flush/fen habitats if associated with an Annex I grassland habitat.

3.1.2 ISGS sites in NPWS Conservation sites

A total of 566 ISGS sites were found to overlap with an NPWS conservation site, 535 of these within an SAC or NHA/pNHA. For Tables 9, 10 and 11, all surveyed areas of grassland, marsh, tall-herb swamp and Annex I grassland (including some small areas of fen) that intersected with an NPWS conservation site by more than the minimum mapping area of 400 m^2 were investigated. The 566 ISGS sites that overlap with an NPWS conservation site represent 47% of the sites surveyed across the 26 counties. It should be noted that many of the sites overlap with more than one type of NPWS conservation site.

A total of 389 sites (33% of sites surveyed) overlap at least partly with an SAC, the area of overlap representing 20% of the area of surveyed grassland in the country. NHAs/pNHA cover a larger area of the country than SACs, and both the number of ISGS sites and overlapping area are higher as a result, at 445 sites and 26% of the area of grassland surveyed. As would be expected, the figures are lower for SPAs (194 sites and 14% of the surveyed area), as SPAs are designated for bird species rather than for habitats. Of the seven regions, the South-East had the greatest proportion of surveyed grassland area located within SACs, at 33%, while the Mid-East & Dublin and Midland regions had the greatest proportion of surveyed grassland within NHAs/pNHA (40% for each), the latter region also having the highest proportion of surveyed grassland within SPAs (36%).

Table 9: Number and area of ISGS sites overlapping with an NHA/pNHA, and percentage of number and area of ISGS surveyed sites, by county and Teagasc region. Excludes sites with an overlap of less than 400 m². Any slight differences between row and column totals are due to rounding.

County	No. surv. sites in NHA/pNHA	% of total surv. sites	Area in NHA/pNHA (ha)	% of total surv. area
Border region				
Cavan	18	27.3	183.9	10.0
Donegal	41	39.8	296.2	20.6
Leitrim	29	37.7	464.9	11.8
Louth	3	60.0	26.8	64.7
Monaghan	12	25.5	57.6	6.5
Sligo	26	50.0	472.1	30.9
Total Border Region	*129*	*36.9*	*1501.5*	*15.5*
Mid-East & Dublin region				
Dublin	12	46.2	86.8	11.6
Kildare	5	22.7	557.2	67.7
Meath	8	57.1	58.3	41.0
Wicklow	1	16.7	0.7	3.1
Total Mid-East & Dublin region	*26*	*38.2*	*703.0*	*40.4*
Midland region				
Laois	3	37.5	33.6	24.3
Longford	14	28.6	281.9	21.8
Offaly	21	51.2	830.7	60.9
Westmeath	9	50.0	63.1	29.3
Total Midland region	*47*	*40.5*	*1209.3*	*40.2*
Mid-West region				
Clare	39	61.9	360.5	33.6
Limerick	4	26.7	110.4	27.7
N. Tipperary	3	25.0	7.9	4.4
Total Mid-West region	*46*	*51.1*	*478.8*	*29.0*
South-East region				
Carlow	1	20.0	1.8	3.9
Kilkenny	4	50.0	53.2	48.1
S. Tipperary	4	44.4	37.6	44.4
Waterford	17	29.3	182.0	25.8
Wexford	3	42.9	35.9	58.9
Total South-East region	*29*	*33.3*	*310.6*	*30.8*
South-West region				
Cork	42	21.9	297.7	16.0
Kerry	16	50.0	323.5	56.0
Total South-West region	*58*	*25.9*	*621.2*	*25.5*
West region				
Galway	39	42.9	292.8	35.0
Mayo	52	45.2	380.2	26.1
Roscommon	19	37.3	585.8	42.4
Total West region	*110*	*42.8*	*1258.8*	*34.3*
Total in ISGS	***445***	***37.3***	***6083.2***	***26.2***

Table 10: Number and area of ISGS sites overlapping with an SAC, and percentage of number and area of ISGS surveyed sites, by county and Teagasc region. Excludes sites with an overlap of less than 400 m². Any slight differences between row and column totals are due to rounding.

County	No. surv. sites in SAC	% of total surv. sites	Area in SAC (ha)	% of total surv. area
Border region				
Cavan	17	25.8	138.3	7.5
Donegal	40	38.8	260.5	18.1
Leitrim	18	23.4	356.8	9.1
Louth	3	60.0	26.8	64.7
Monaghan	1	2.1	8.9	1.0
Sligo	20	38.5	351.8	23.0
Total Border region	*99*	*28.3*	*1143.1*	*11.8*
Mid-East & Dublin region				
Dublin	6	23.1	53.4	7.1
Kildare	1	4.5	8.4	1.0
Meath	7	50.0	27.6	19.4
Wicklow	1	16.7	0.8	3.2
Total Mid-East & Dublin region	*15*	*22.1*	*90.2*	*5.2*
Midland region				
Laois	3	37.5	23.8	17.2
Longford	12	24.5	251.6	19.5
Offaly	10	24.4	477.3	35.0
Westmeath	6	33.3	44.2	20.5
Total Midland region	*31*	*26.7*	*797.0*	*26.5*
Mid-West region				
Clare	36	57.1	298.7	27.8
Limerick	6	40.0	130.0	32.7
N. Tipperary	4	33.3	31.6	17.6
Total Mid-West region	*46*	*51.1*	*460.3*	*27.9*
South-East region				
Carlow	1	20.0	4.2	9.0
Kilkenny	5	62.5	54.9	49.6
S. Tipperary	3	33.3	43.1	50.9
Waterford	15	25.9	219.9	31.1
Wexford	3	42.9	13.6	22.3
Total South-East region	*27*	*31.0*	*335.7*	*33.3*
South-West region				
Cork	40	20.8	237.7	12.8
Kerry	21	65.6	377.6	65.4
Total South-West region	*61*	*27.2*	*615.4*	*25.3*
West region				
Galway	42	46.2	329.1	39.3
Mayo	58	50.4	376.3	25.8
Roscommon	10	19.6	395.3	28.6
Total West region	*110*	*42.8*	*1100.6*	*30.0*
Total in ISGS	***389***	***32.6***	***4542.3***	***19.6***

Table 11: Number and area of ISGS sites overlapping with an SPA, and percentage of number and area of ISGS surveyed sites, by county and Teagasc region. Excludes sites with an overlap of less than 400 m². Any slight differences between row and column totals are due to rounding.

County	No. surv sites in SPA	% of total surv. sites	Area in SPA (ha)	% of total surv. area
Border region				
Cavan	7	10.6	37.5	2.0
Donegal	15	14.6	185.3	12.9
Leitrim	8	10.4	184.1	4.7
Louth	0	0.0	0.0	0.0
Monaghan	4	8.5	56.5	6.3
Sligo	5	9.6	98.7	6.5
Total Border region	*39*	*11.1*	*562.1*	*5.8*
Mid-East & Dublin region				
Dublin	4	15.4	10.1	1.3
Kildare	0	0.0	0.0	0.0
Meath	2	14.3	0.2	0.1
Wicklow	0	0.0	0.0	0.0
Total Mid-East & Dublin region	*6*	*8.8*	*10.3*	*0.6*
Midland region				
Laois	2	25.0	0.7	0.5
Longford	13	26.5	229.8	17.8
Offaly	9	22.0	794.3	58.2
Westmeath	7	38.9	49.6	23.1
Total Midland region	*31*	*26.7*	*1074.4*	*35.7*
Mid-West region				
Clare	7	11.1	163.7	15.2
Limerick	4	26.7	64.6	16.2
N. Tipperary	3	25.0	12.4	6.9
Total Mid-West region	*14*	*15.6*	*240.7*	*14.6*
South-East region				
Carlow	0	0.0	0.0	0.0
Kilkenny	1	12.5	0.1	0.1
S. Tipperary	0	0.0	0.0	0.0
Waterford	11	19.0	84.6	12.0
Wexford	2	28.6	24.8	40.7
Total South-East region	*14*	*16.1*	*109.5*	*10.8*
South-West region				
Cork	29	15.1	225.1	12.1
Kerry	14	43.8	190.4	33.0
Total South-West region	*43*	*19.2*	*415.5*	*17.0*
West region				
Galway	19	20.9	263.9	31.5
Mayo	19	16.5	95.7	6.6
Roscommon	9	17.6	471.6	34.1
Total West region	*47*	*18.3*	*831.2*	*22.6*
Total in ISGS	***194***	***16.3***	***3243.8***	***14.0***

3.2 Fossitt (2000) habitats

An examination of the grassland habitats surveyed using the Fossitt (2000) habitat classification shows that by far the most abundant habitat recorded during the ISGS was GS4 Wet grassland, covering over half of the surveyed area (Figure 5). The next most abundant habitat was GSi, semi-improved grassland (mapped as GA1), encompassing both wet and dry semi-improved grassland, which accounted for 16% of the surveyed grassland. GS1 Dry calcareous and neutral grassland was the third most abundant grassland habitat surveyed, while GS2 Dry meadows and grassy verges habitat was rare at just under 6%. GM1 Marsh was the rarest of all the grassland habitats: when taken together with grassland-associated swamp habitats such as tall-herb swamp communities, total coverage was just over 1% of the total surveyed area. GS1, GS2 and GS4 Wet grassland were recorded in all 26 counties. However, GS3 Dry-humid acid grassland was not recorded from three counties, Kilkenny, Longford and Wicklow, while GM1 was not recorded from seven counties: Carlow, Kilkenny, Laois, Louth, Meath, Wicklow and Wexford. It should be noted, however, that areas of these habitats probably exist within these counties in locations that were not surveyed for the ISGS. Wicklow in particular would be expected to have large areas of GS3 within the Wicklow Mountains SAC (002122), an area that was excluded from the ISGS survey area.

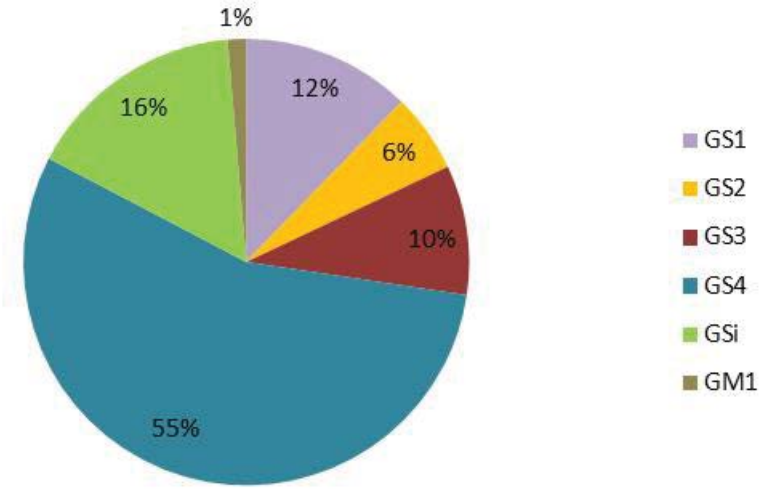


Figure 5: Proportion contributed by each Fossitt grassland habitat to the total area of grassland surveyed during ISGS 2007-2012. GM1 includes small areas of swamp and flush/fen habitats.

When the distribution of the grassland habitat types is examined on a regional rather than a national basis (Table 12), there are striking deviations from the national averages across almost all of the grassland categories. The greatest regional differences are found for GS4 Wet grassland, which varied from a high of 66% of the surveyed area in the Border region, down to just 18% of the surveyed area of the Mid-East & Dublin region. The South-East region had the next lowest proportion of GS4, with 31%. This trend would seem to confirm the expected correlation between wetter habitats and higher rainfall.

Table 12: Summary Fossitt (2000) grassland habitat statistics of sites surveyed, differentiated by Teagasc region. PF is only included when associated with an Annex I grassland habitat. Percentage frequencies only include sites where there was a mapped area of the Fossitt habitat.

		GS1	GS2	GS3	GS4	GM1*	GSi	*Overall*
Border	No. of sites	114	56	102	326	35	229	*350*
	% frequency	32.6	16	29.1	93.1	10	65.4	
	Area (ha)	981.5	106.2	653.1	6366.4	60.7	1499.5	*9667.4*
	% regional surv. area	10.2	1.1	6.8	65.9	0.6	15.5	*100*
Mid-East &	No. of sites	23	32	10	39	12	27	*68*
Dublin	% frequency	33.8	47.1	14.7	57.4	17.6	39.7	
	Area (ha)	122.9	517.4	558.6	306.5	31.3	202.6	*1739.3*
	% regional surv. area	7.1	29.7	32.1	17.6	1.8	11.6	*100*
Midland	No. of sites	41	37	5	94	18	69	*116*
	% frequency	35.3	31.9	4.3	81	15.5	59.5	
	Area (ha)	204.4	203.9	55.1	1737	107.2	701.8	*3009.3*
	% regional surv. area	6.8	6.8	1.8	57.7	3.6	23.3	*100*
Mid-West	No. of sites	44	18	4	62	7	53	*90*
	% frequency	48.9	20	4.4	68.9	7.8	58.9	
	Area (ha)	331.4	77.3	132.1	820.9	12.4	277.3	*1651.5*
	% regional surv. area	20.1	4.7	8	49.7	0.8	16.8	*100*
South-East	No. of sites	31	23	17	55	8	31	*87*
	% frequency	35.6	26.4	19.5	63.2	9.2	35.6	
	Area (ha)	179	108.2	234.5	315.1	14	158.6	*1009.4*
	% regional surv. area	17.7	10.7	23.2	31.2	1.4	15.7	*100*
South-West	No. of sites	73	37	48	172	25	105	*224*
	% frequency	32.6	16.5	21.4	76.8	11.2	46.9	
	Area (ha)	259.2	133.1	367.7	1170.2	49	457.7	*2436.8*
	% regional surv. area	10.6	5.5	15.1	48	2	18.8	*100*
West	No. of sites	153	46	52	186	17	124	*257*
	% frequency	59.5	17.9	20.2	72.4	6.6	48.2	
	Area (ha)	769.4	173.8	175.5	2109.8	37.5	408.3	*3674.4*
	% regional surv. area	20.9	4.7	4.8	57.4	1	11.1	*100*
Total in ISGS	*No. of sites*	*479*	*249*	*238*	*934*	*122*	*638*	*1192*
	% frequency	*40.2*	*20.9*	*20*	*78.4*	*10.2*	*53.5*	
	Area (ha)	*2847.8*	*1320*	*2176.6*	*12825.9*	*312.1*	*3705.7*	*23188.1*
	% total surv. area	*12.3*	*5.7*	*9.4*	*55.3*	*1.3*	*16*	*100*

* Includes small areas of FS or PF habitats

The GS1 Dry calcareous and neutral grassland habitat also had an uneven regional distribution, with the highest proportion, 21%, found in the West region, followed closely by the Mid-West at 20%, the two regions which include the Burren National Park, an area with abundant limestone pavement and calcareous soils. The lowest proportion of GS1 was in the Mid-East & Dublin region and the Midland region, in both of which it comprised 7% of the surveyed area. However, the GS2 Dry meadows and grassy verges habitat was highest in the Mid-East & Dublin region, at 30%, while it comprised just 1% of the surveyed area of the Border region, presented graphically in Figure 6. Within the Mid-East & Dublin region in particular, there has been a recent trend in managing large, publicly owned areas of grassland as traditional hay meadows, with good examples at site 1324 Newbridge Demesne, Dublin, and site 1499 Castletown House, Kildare.

GS3 Dry-humid acid grassland, though comprising a relatively small proportion (9%) of the surveyed grassland, constituted almost one-third (32%) of the surveyed area of the Mid-East & Dublin region, due to large areas of GS3 recorded in Kildare around the Curragh, but only 2% of the Midland region.

GM1/FS Marsh/swamp had a low distribution throughout all regions, with the highest proportion, 3%, recorded in the Midland region.

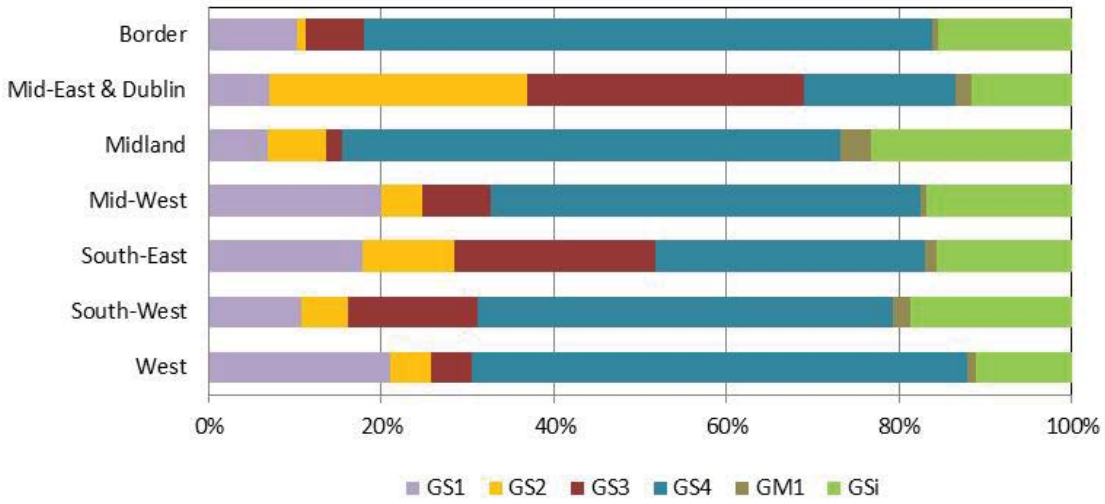


Figure 6: Proportional distribution of grassland habitats throughout the Teagasc regions. GM1 includes small areas of swamp and fen/flush habitats.

Figure 7 shows the broad associations between grassland habitats, as classified under Fossitt (2000), and various geographical landscape features. It should be noted that these are not exact associations, as landscape features were recorded at a site level rather than at a relevé level, but they do give an indication of the landscape context in which the grassland habitats occur. Marsh/swamp habitats were more likely to occur on sites occurring on a floodplain or by a lake, and least likely to be present in sites associated with upland areas (hill or mountain). On eskers and on coastal or island sites, the most frequent grassland habitat was GS1 Dry calcareous and neutral grassland. However, GS3 Dry-humid acid grassland was rarely recorded in association with eskers or in lowland situations but was instead most frequent in sites that occurred in association with bogland or in an upland context.

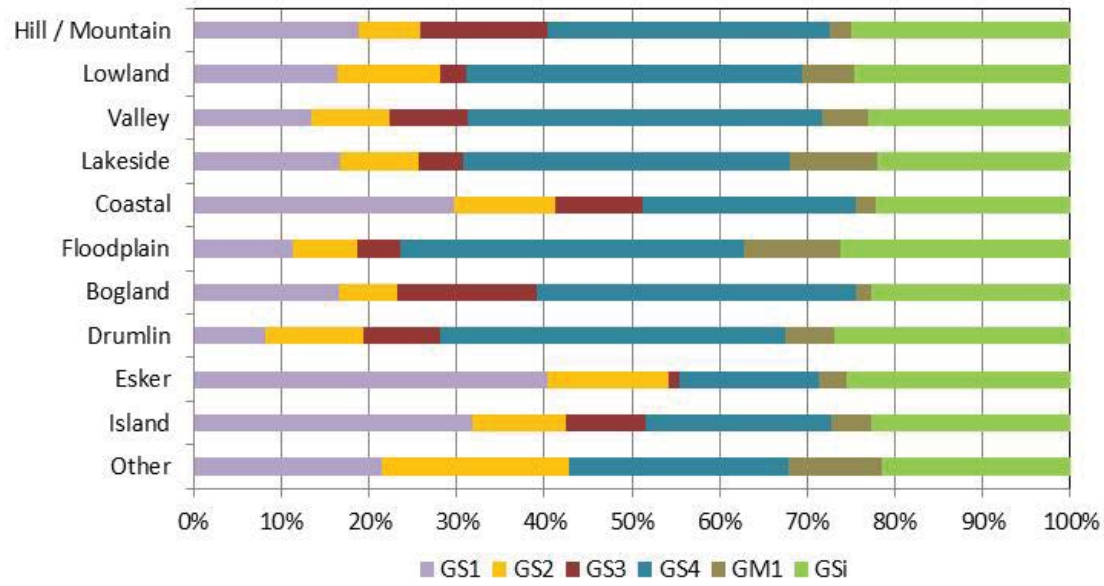


Figure 7: Proportional measure of association between Fossitt (2000) habitats and landscape features

Site size was analysed and the distribution of size classes was plotted using 10 ha interval classes. While site size is to some extent an artificial construct, partly depending on non-ecological factors such as land access, it may also depend on the quality of grassland in an area, with larger sites often signifying the presence of a complex of semi-natural grassland habitats. Figure 8 shows that a large proportion, 45%, of grassland sites were 10 ha or less, with only 5% of sites measuring over 60 ha in size.

An examination of site size on a regional basis (Figure 9) reveals that the region with the greatest proportion of larger sites is the Border region; this region also has the smallest proportion of sites in the smallest size class, while the region with the most sites in the smallest size class is the South-East.

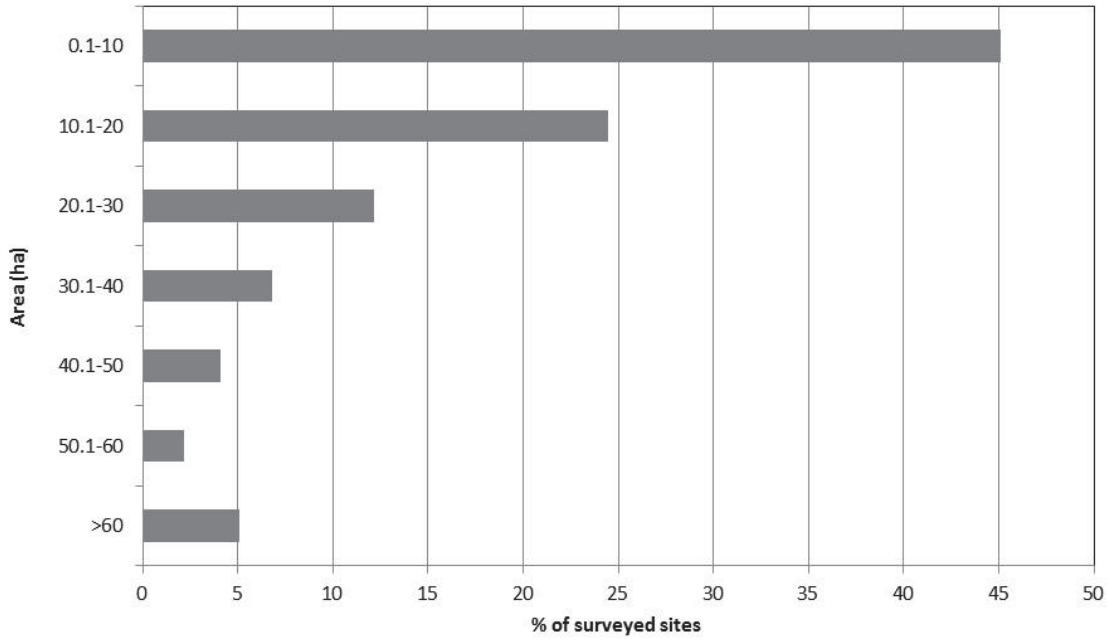


Figure 8: Size class distribution of surveyed sites

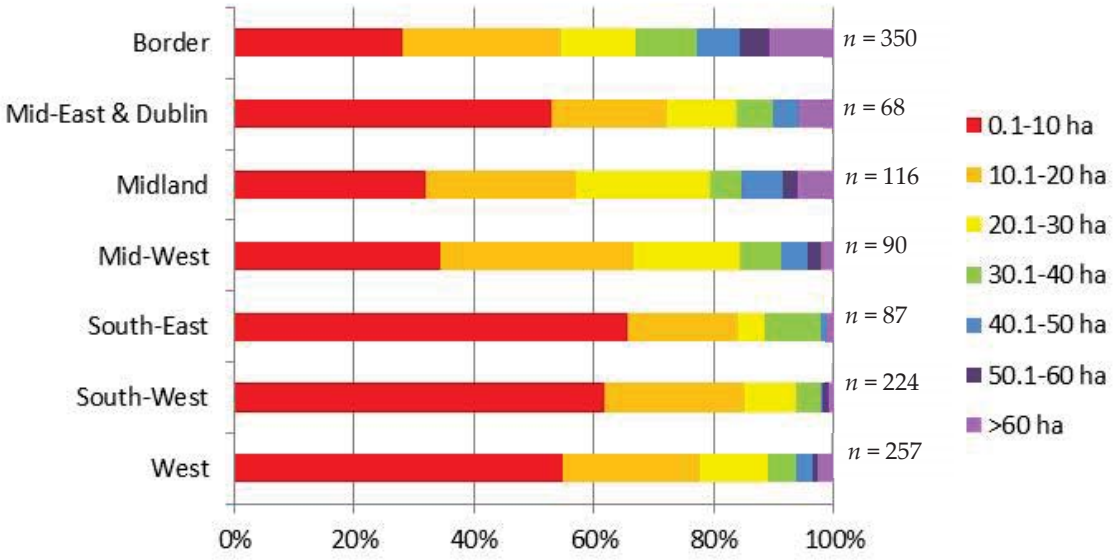


Figure 9: Proportions of sites in each Teagasc region within each size class.

3.3 Site management and features

3.3.1 Grazing and fauna

The occurrence of grazing and the animal species involved were recorded in grassland sites where clear evidence was detected. A distinction is made between grazing animals that form part of the management of a site, e.g. cattle or sheep, and wild grazers such as hares or rabbits. Only grazing livestock that form part of the site management are shown on the graph in Figure 10. The main grazers recorded in grasslands during the ISGS were cattle, which were seen in 72% of sites. Sheep were noted as grazers in one-third of sites, while horses were present in 28% of sites. Other grazers noted at less than 5% of sites include donkeys, feral goats and alpaca.

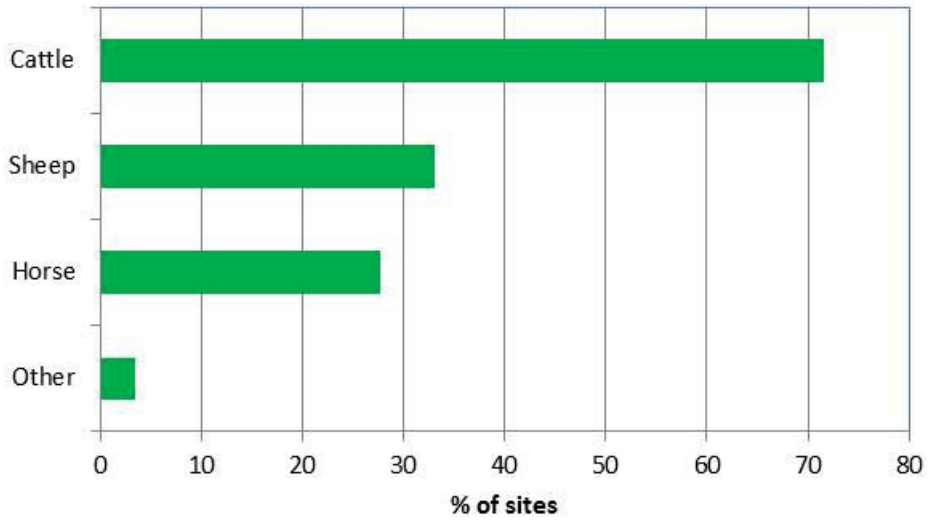


Figure 10: Frequency of grazers recorded on grassland sites.

There were regional differences in the prevalence of the main types of livestock on grasslands. For example, the proportion of sites grazed by sheep was lowest in the Mid-West region, where it was only recorded in nine of the 90 sites in the region (10%), compared to the national average of 33%; however, horse grazing was highest here of all the regions, at 34%, compared to a national average of 28%. The highest rate of sheep grazing was seen in the Border region, where it was recorded at 45% of sites. However, the most striking regional difference was seen in the Mid-East & Dublin, where cattle grazing was only recorded in 32% of sites, compared to a high of 86% in the Mid-West and a national average of 72%.

Grasslands may also be maintained by wild grazers such as hares, rabbits, or deer. During the ISGS, records were kept of wild fauna (animals and key bird and insect species) seen during the surveys, including grazers, such as rabbits and hares, and non-grazers, such as frogs and foxes. The majority of deer records were of wild deer, although there were a few sites where farmed deer were present. Figure 11 shows the occurrence of wild fauna recorded during the ISGS. Species were recorded if they were seen during the survey or information on their presence was provided by a landowner. Therefore, the occurrence of wild grazers and their contribution to the maintenance of Irish grasslands is likely to be higher than these records show.

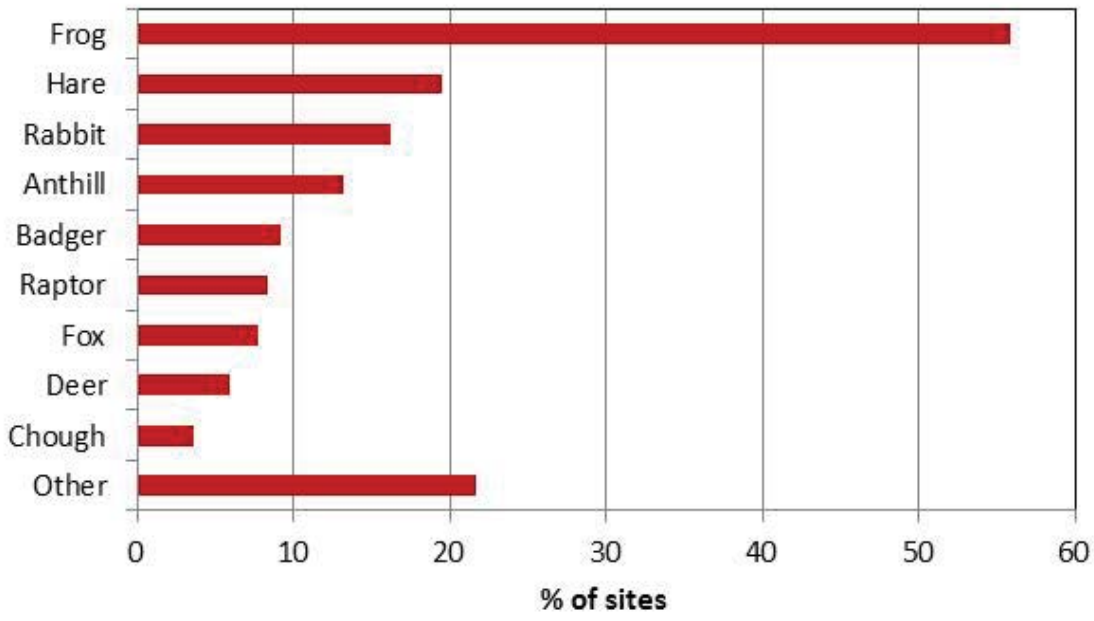


Figure 11: Frequency of wild fauna recorded.

Frogs were by far the most frequently recorded wild species in Irish semi-natural grasslands, present in 56% of sites overall. The highest frequency of this species was seen in the Border region, where they were recorded in 75% of sites, most likely associated with the large areas of wet grassland in this region. The lowest frequency was seen in the South-East (31% of sites).

Hares were also frequent, seen in just under one-fifth of sites overall, most frequent in the Mid-West (28% of sites) and least frequent in the South-West (7% of sites) and Mid-East & Dublin (9% of sites).

Rabbits were recorded slightly less frequently than hares, although this may be due to differences in behaviour when startled: rabbits may freeze, while hares are more likely to run away. Rabbits were often identified through the presence of droppings or burrows, rather than through sightings. Rabbit grazing was particularly evident on site 1165 Tory Island, where some areas were grazed down to bare soil and several warrens were present. Regionally, rabbits were most often recorded in the Mid-East & Dublin region (31% of sites), but in only 4% of sites in the Mid-West.

Anthills were recorded during the ISGS as they are indicative of undisturbed grassland. They were recorded most frequently in the West region, where they were noted in 22% of sites, but were not recorded from the Mid-East & Dublin region. Overall, anthills were seen in 13% of sites. They were most often associated with good quality calcareous grassland, perhaps because of the suitability of the soil (in terms of mineral content, particle size and drainage) for the formation of anthills.

As noted above, deer were recorded both as wild and farmed animals. The Mid-East & Dublin region had by far the highest proportion of sites with deer present (19%), with none recorded in the South-East and a national average of just 6% of sites with deer recorded.

Other species of note recorded during the ISGS include choughs (recorded in coastal sites), marsh fritillary, raptors (mainly buzzard and kestrel) and otter.

3.3.2 *Management activities*

Management activities, including grazing by livestock, were recorded and are shown in Figure 12. Grazing is by far the most frequent management activity carried out in Irish semi-natural grasslands, recorded at 91% of sites, followed by drainage, noted at 40% of sites. Mowing and fertiliser application were less frequent, both recorded at 26% of sites. Liming was recorded separately from fertiliser application, and occurred at a small proportion (2%) of sites.

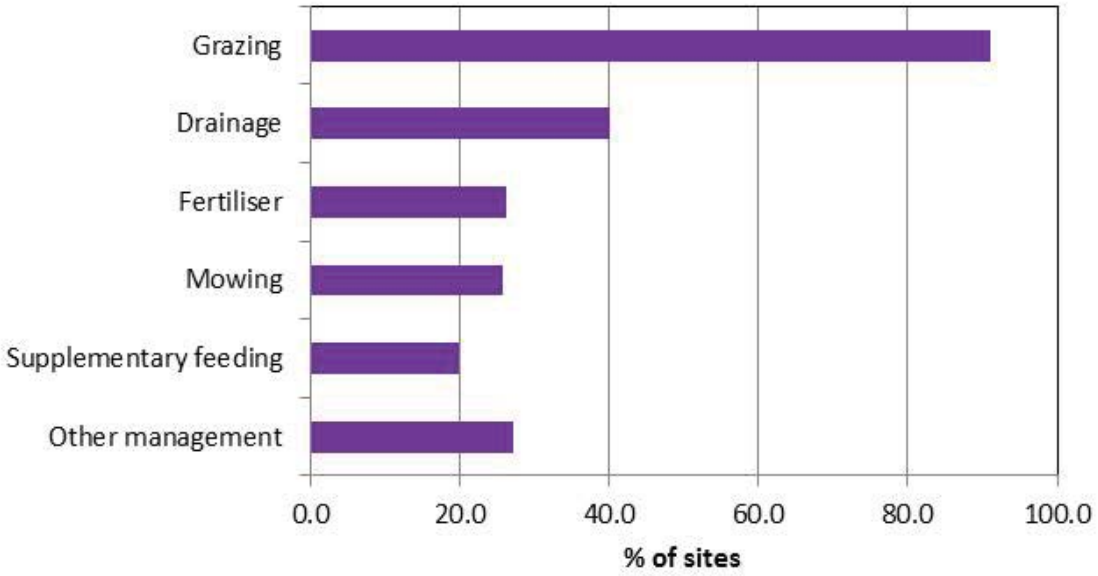


Figure 12: Frequency of agricultural activities recorded.

There were, however, differences between the regions in the relative importance of the various activities in the management of the grasslands. For example, grazing was practised at 96% of

grasslands in the Border region, but only 71% of grasslands in the Mid-East & Dublin. Burning was recorded at 12% of sites in the Mid-East & Dublin, but not at all in the Mid-West region. Topping – usually of rushes – and supplementary feeding (24% and 31% of Border sites, respectively) were recorded more frequently in the Border region than in any of the other regions.

3.4 Conservation and threat ranking

3.4.1 Conservation scores

Conservation scores were calculated for all sites, based on a combination of characteristics such as grassland habitats present, non-grassland habitats adjacent, occurrence and quality of Annex I grassland habitats, and number and quality of plant species (see Table 6 in Methods). A high score indicates a site that is of excellent conservation value. Table 13 shows the top 21 sites by Conservation score, that is, those that received a score of more than 50%. The highest Conservation score was 70.5%, calculated for site 2404 Aughinish, Limerick, in the Mid-West region. Figure 13 shows the distribution of Conservation scores for each region, and overall. The overall distribution is skewed towards the lower end of the scale, with the majority of sites – 75% – having a Conservation score of between 0 and 20%.

Table 13: Top 21 sites by Conservation score surveyed during the ISGS 2007-2012.

Site no.	Site name	County	NHA/pNHA	SAC	% score	Rank
2704	Aughinish	Limerick	000435	002165	70.5	1
109	Moystown Demesne and Bullock Island	Offaly	000216, 002104	000216	65.3	=2
818	Lugnafaughery	Leitrim	002435	000623	65.3	=2
811	Larganavaddoge	Leitrim	000623	000623	62.1	4
1300	Glenasmole Valley	Dublin	001209	001209	58.9	5
850	Letterfine	Leitrim			57.9	=6
2701	Barrigone	Limerick	000432	000432	57.9	=6
825	Ballynaboll	Leitrim			56.8	=8
1248	Rossnowlagh Lower	Donegal	000138	000138	56.8	=8
808	Keeloges	Leitrim	001403	001403	55.8	10
1067	Manragh Upper	Cavan			54.7	=11
2012	Creaghduff	Westmeath	000440	000440	54.7	=11
712	Coolberrin	Monaghan			53.7	=11
1250	St. John's Point	Donegal	000191	000191	52.6	=14
1502	Edenbaum	Sligo	002435		52.6	=14
1541	Cloonmacduff	Sligo	001898	001898	52.6	=14
807	Aghadunvane	Leitrim	001403	001403	51.6	=17
813	Aghalateeve	Leitrim	000623, 001919	000623, 001919	51.6	=17
1004	Moneen	Cavan		002032	50.5	=19
1249	Drumhome	Donegal	000138	000138	50.5	=19
2329	Killure More	Galway	000254		50.5	=19

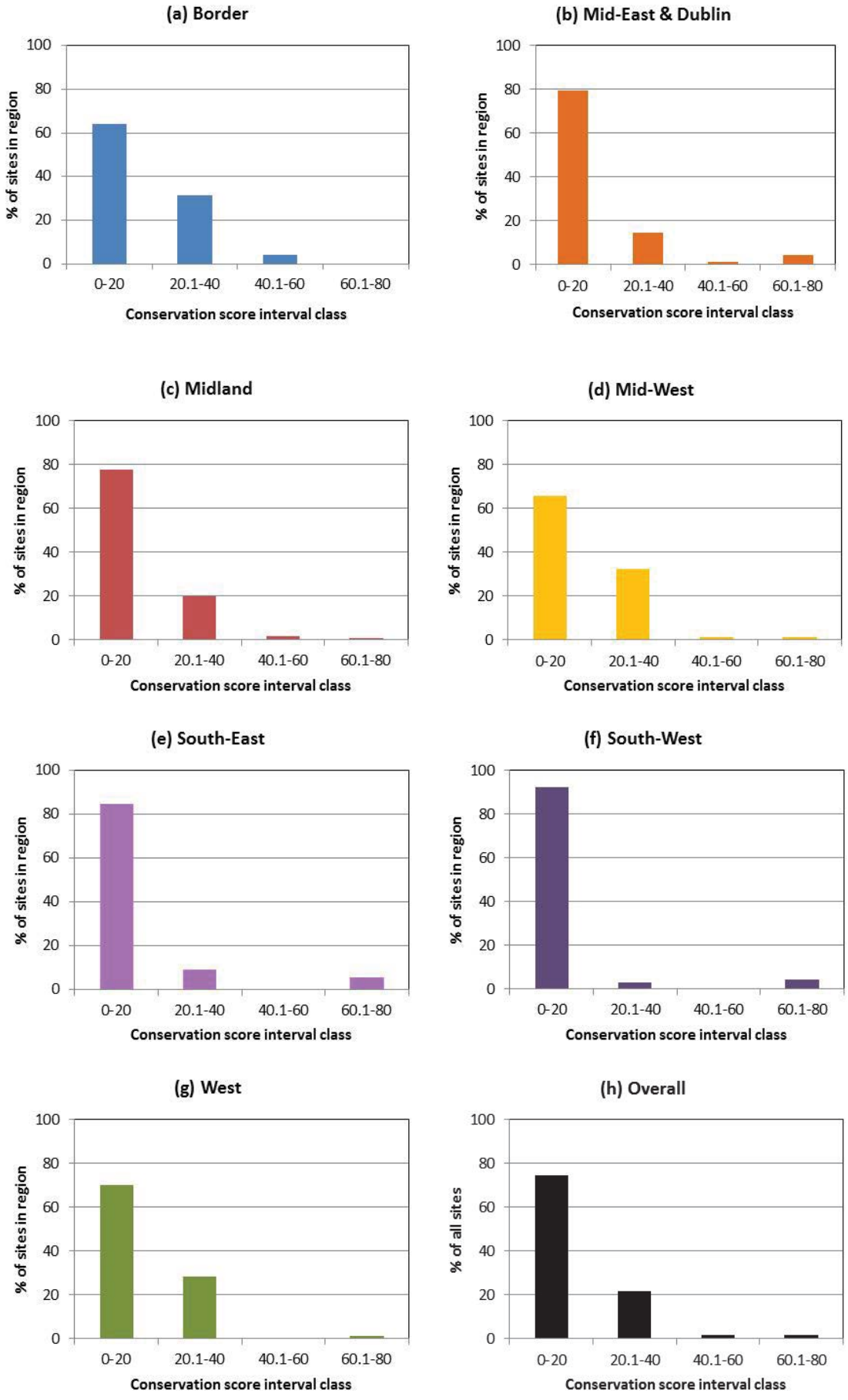


Figure 13: Distribution of Conservation score interval classes for each Teagasc region, and overall

For all regions, the highest frequency of Conservation score was in the 0-20% interval class. Analysis using a finer resolution of interval class revealed that the South-East, South-West and Mid-East & Dublin regions all had the highest frequency of Conservation scores in the 10.1-20% interval class, with the other four regions having highest frequency in the 20.1-30% interval class. Overall, only 1% of sites achieved a Conservation score of more than 50%, and only the Border, Midland and Mid-West regions had sites that achieved a Conservation score above 60%.

Within a county or region, calculating the median Conservation score gives an indication of the conservation value of sites within the group: a higher median Conservation score generally indicates a greater proportion of sites having a high conservation value. The county with the highest median Conservation score was Sligo (median score = 34.2%; n = 52), followed by Leitrim (median score = 30.5%; n = 77) and Limerick (median score = 28.4%; n = 15). The lowest ranked county was Wicklow (median score = 13.2%; n = 6), followed by Waterford (median score = 15.8%; n = 58) and Cork and Wexford (both with a median score of 16.8%; n = 192 and n = 7 respectively).

Ranking regions in the same way, the Mid-West region was ranked highest (median score = 26.8%; n = 90), followed by the Border and West regions (both with a median score of 25.3%; n = 350 and n = 257 respectively). The lowest ranked region was the South-East (median score = 16.8%; n = 87).

3.4.2 Threat scores

Threat scores were calculated based on parameters such as presence of negative species that can indicate agricultural intensification, proximity of disturbed or agricultural habitats, and damaging activities recorded on site (see Table 5), with a high score indicating more threats to grassland habitats from these sources. Table 14 shows the top 35 sites by Threat score, those that received a score of more than 60%. The highest Threat score was 84.6%, calculated for site 1512 Portinch, Sligo, which received high scores for damaging activities, agricultural improvements and negative species. Three sites, however, had a calculated Threat score of 0%: two sites in Waterford, 326 Barnankile and 360 Curraheen, and one site in Kerry, 2402 Maghanveel.

Figure 14 shows the distribution of Threat scores plotted against interval classes for each region, and overall. The distribution of the Threat scores is more normal (i.e., less skewed) than that of the Conservation scores. The interval class with the highest frequency in every region is the 20.1-40% class: 63% of all sites had a Threat score within this interval class.

Calculating the median Threat score within a county or region gives an indication of the degree to which sites within the group suffer from threats: a higher median Threat score generally indicates that a group has more sites with higher Threat scores. When counties were ranked by median Threat score, six counties were jointly ranked on top with the highest median score of 38.5%: Cavan (n = 66), Leitrim (n = 77), Limerick (n = 15), Longford (n = 49), Monaghan (n = 47) and Sligo (n = 52). Five counties were also ranked together with the lowest median score of 23.1%: Clare (n = 63), Dublin (n = 26), Galway (n = 91), Louth (n = 5) and Offaly (n = 41).

If regions were ranked in the same way, the Border region received the highest ranking (median score = 38.5%; n = 350), and the Mid-East & Dublin was ranked lowest (median score = 23.1%; n = 68). Therefore, Border sites are at greater risk from such practices as agricultural improvements and damaging activities. As the Border region also has a high proportion of sites of good conservation value, this is cause for concern.

Table 14: Top 35 sites by Threat score surveyed during the ISGS 2007-2012.

Site no.	Site name	County	NHA/pNHA	SAC	% score	Rank
1512	Portinch	Sligo	000636	000636	84.6	1
835	Corcusconny	Leitrim	001976	001976	76.9	2
1001	Killyvally	Cavan	000007	000007	69.2	=3
1018	Cashelbane	Cavan			69.2	=3
891	Attimanus	Leitrim			69.2	=3
732	Tusker	Monaghan	001605		69.2	=3
737	Boughill	Monaghan			69.2	=3
758	Killycooly	Monaghan	000558		69.2	=3
2113	Ballymoon Esker	Carlow	000797		61.5	=9
1008	Moneensauran	Cavan	000584	000584	61.5	=9
1067	Manragh Upper	Cavan			61.5	=9
566	Reenaknock	Cork			61.5	=9
1134	Breaghy Head	Donegal			61.5	=9
1232	Cloghboy	Donegal	000190	000190	61.5	=9
1248	Rossnowlagh Lower	Donegal	000138	000138	61.5	=9
1306	Kilmashogue	Dublin			61.5	=9
2600	Ballyprior	Laois		002256	61.5	=9
828	Carrickleitrim	Leitrim		001976	61.5	=9
829	Munakill	Leitrim			61.5	=9
857	Annaghoney	Leitrim			61.5	=9
2706	Court	Limerick			61.5	=9
2710	Ballynort	Limerick			61.5	=9
917	Agharra	Longford			61.5	=9
942	Carrickmoyragh	Longford			61.5	=9
954	Lissagernal	Longford	001818	001818	61.5	=9
1846	Derrintogher	Mayo			61.5	=9
709	Glencorick	Monaghan			61.5	=9
718	Ardginny	Monaghan	001782		61.5	=9
733	Drumgoose	Monaghan			61.5	=9
757	Drumfurrer	Monaghan			61.5	=9
73	Silver River	Offaly			61.5	=9
220	Crunaun Bridge	Roscommon			61.5	=9
1511	Tawnatruffan	Sligo			61.5	=9
1523	Annagh Beg	Sligo		001898	61.5	=9
1549	Curry (Sligo)	Sligo		002298	61.5	=9

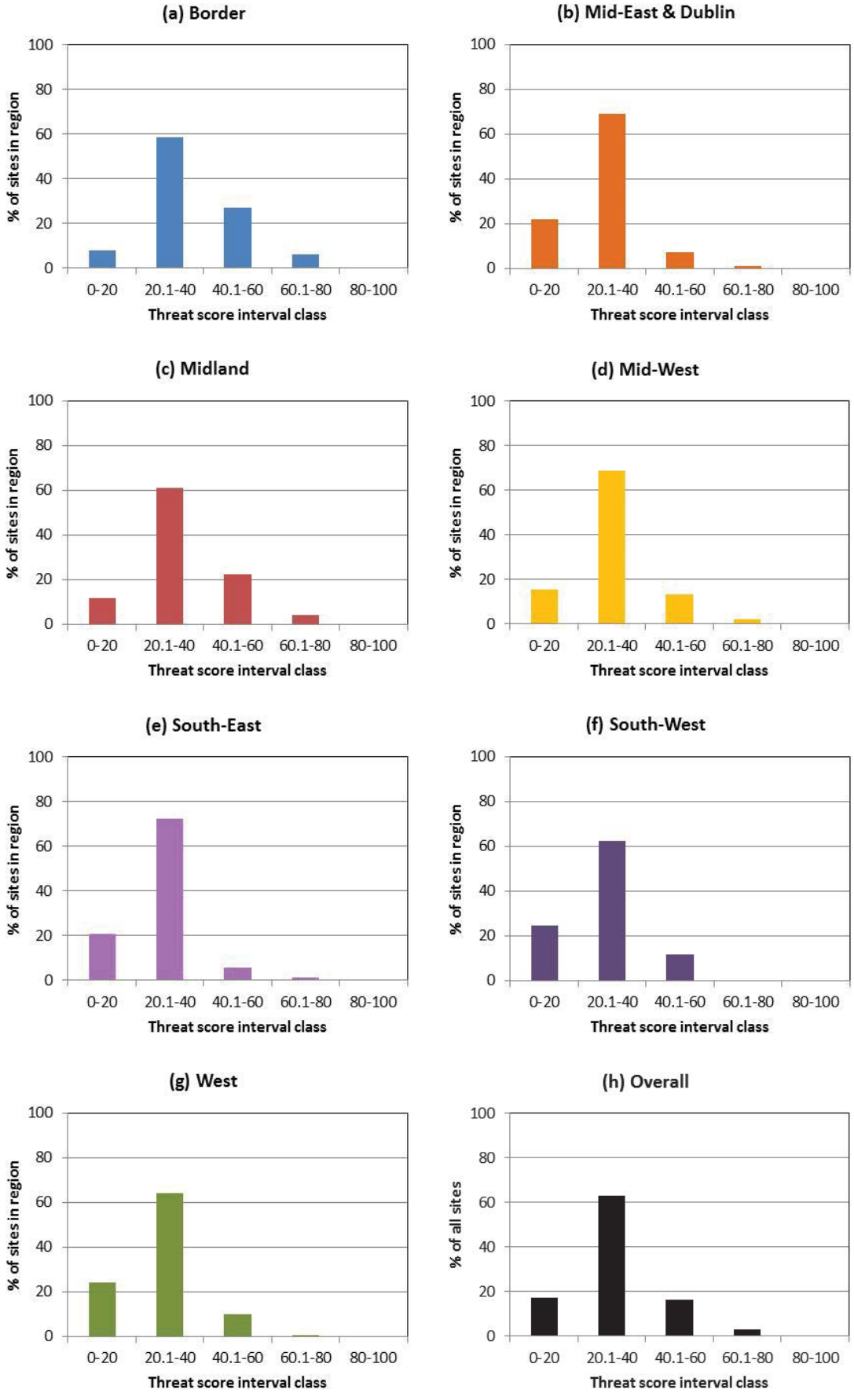


Figure 14: Distribution of Threat score interval classes for each region, and overall

3.5 Annex I habitat data

3.5.1 General statistics

This report documents the occurrence of five grassland habitats: [*]6210 Festuco-Brometalia (the [*] superscript is used to encompass both the non-priority Annex I 6210 and the priority Annex I *6210 orchid-rich variant), *6230 *Nardus* grassland, a priority Annex I habitat, 6410 *Molinia* meadows, 6430 Hydrophilous tall herb communities, and 6510 Lowland hay meadows. 6130 Calaminarian grassland is not reported on here, as the assessment criteria have been amended for the National Conservation Assessment (NCA) reporting since 6130 was recorded in 2008 during the ISGS (Martin *et al*. 2008), and the few ISGS sites recorded for this habitat were repeat surveys of those carried out by Holyoak (2008). The reader is referred to Holyoak (2008) and the recent NCA reporting for a fuller account of the 6130 Annex I habitat in Ireland.

In total, these five Annex I grassland habitats cover a surveyed area of 1244.5 ha, which comprises 5% of the total area of grassland surveyed during the ISGS. Annex I grassland habitats were recorded in 23 of the 26 counties in Ireland, the exceptions being Louth, Wexford and Wicklow; however, as has already been noted, survey intensity was lower in these counties, and Annex I grassland habitat is likely to exist in areas as yet unsurveyed, for example, in the uplands of Wicklow. In total, 361 areas of Annex I grassland were recorded and mapped in 324 sites, with 35 sites containing more than one Annex I grassland habitat (including two sites that contained three Annex I habitats). Throughout the following section on Annex I habitat data, therefore, reference will frequently be made to *areas* of Annex I grassland rather than *sites*, particularly where several Annex I habitats are being discussed together.

Of the 1,244.5 ha of Annex I grassland habitat recorded during the ISGS, the greatest proportion – 37% – was recorded in the Border region (Table 15). This was followed by the West (20%) and Mid-West (18%). The lowest proportion was found in the South-East region (2%).

The largest area of Annex I grassland was recorded in Clare, where 157.4 ha were recorded, followed by Donegal (155.4 ha) and Offaly (142.0 ha), as shown in Table 16. The county with the largest proportion of its surveyed grassland classed as Annex I was Limerick, where 17% of the surveyed grassland was mapped as Annex I grassland.

Table 15: Area in hectares of Annex I grassland in each Teagasc region.

Region	Total area Annex I	% overall Annex I
Border	461.1	37
Mid-East & Dublin	58.5	5
Midland	160.7	13
Mid-West	227.5	18
South-East	20.2	2
South-West	68.2	5
West	248.5	20
Total	*1244.5*	*100*

Table 16: Area in hectares (number of areas) of Annex I habitats and number of sites where Annex I habitats were recorded during the ISGS 2007-2012, by county and Teagasc region. Thirty-five of the 324 sites contain more than one Annex I habitat. Any slight differences between row and column totals are due to rounding.

County	**[*]6210**	***6230**	**6410**	**6430**	**6510**	***Total area Annex I***	**No. of sites**
Border region							
Cavan	22.2 (5)	2.9 (3)	52.3 (7)	0.1 (1)	6.1 (3)	*83.5*	17
Donegal	88.8 (7)	1.8 (4)	53.5 (19)	4.7 (3)	6.7 (3)	*155.4*	32
Leitrim	52.9 (13)	5.0 (2)	45.6 (12)	0.8 (3)	11.2 (3)	*115.6*	30
Monaghan	0.1 (1)	0.3 (1)	6.3 (2)	0.3 (2)	0.0 (0)	*7.0*	5
Sligo	60.1 (13)	0.0 (0)	35.8 (15)	1.0 (3)	2.6 (2)	*99.5*	31
Total Border region	*224.1 (39)*	*10.0 (10)*	*193.5 (55)*	*7.0 (12)*	*26.5 (11)*	*461.1*	
Mid-East & Dublin region							
Dublin	2.6 (4)	1.9 (1)	2.2 (1)	0.1 (1)	4.5 (1)	*11.4*	6
Kildare	1.7 (2)	0.0 (0)	37.6 (3)	2.6 (3)	0.0 (0)	*41.9*	7
Meath	0.2 (3)	0.0 (0)	0.0 (0)	4.4 (2)	0.6 (1)	*5.2*	5
Total Mid-East & Dublin region	*4.5 (9)*	*1.9 (1)*	*39.8 (4)*	*7.1 (6)*	*5.1 (2)*	*58.5*	
Midland region							
Laois	0.0 (0)	0.0 (0)	0.8 (1)	0.0 (0)	0.0 (0)	*0.8*	1
Longford	0.0 (0)	0.0 (0)	8.1 (3)	0.2 (1)	1.7 (1)	*10.0*	5
Offaly	25.1 (8)	0.0 (0)	83.2 (6)	0.0 (0)	33.7 (5)	*142.0*	15
Westmeath	3.8 (6)	0.0 (0)	1.0 (1)	0.1 (1)	2.9 (2)	*7.8*	7
Total Midland region	*28.9 (14)*	*0.0 (0)*	*93.1 (11)*	*0.4 (2)*	*38.3 (8)*	*160.7*	
Mid-West region							
Clare	107.9 (18)	0.0 (0)	37.5 (10)	1.6 (2)	10.3 (4)	*157.4*	32
Limerick	16.9 (3)	0.0 (0)	40.5 (3)	1.1 (1)	8.4 (2)	*66.9*	6
N. Tipperary	0.5 (2)	0.2 (1)	2.4 (3)	0.1 (1)	0.0 (0)	*3.2*	6
Total Mid-West region	*125.2 (23)*	*0.2 (1)*	*80.5 (16)*	*2.9 (4)*	*18.7 (6)*	*227.5*	
South-East region							
Carlow	1.1 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	*1.1*	1
Kilkenny	7.8 (3)	0.0 (0)	0.0 (0)	0.2 (1)	0.0 (0)	*8.0*	4
S. Tipperary	0.9 (2)	1.1 (2)	0.0 (0)	0.0 (0)	3.3 (1)	*5.3*	4
Waterford	0.0 (0)	0.0 (0)	4.0 (1)	1.7 (3)	0.0 (0)	*5.7*	4
Total South-East region	*9.8 (6)*	*1.1 (2)*	*4.0 (1)*	*1.9 (4)*	*3.3 (1)*	*20.2*	
South-West region							
Cork	0.0 (0)	10.5 (3)	17.9 (6)	3.2 (5)	0.0 (0)	*31.6*	14
Kerry	0.0 (0)	28.3 (4)	8.1 (1)	0.3 (1)	0.0 (0)	*36.6*	6
Total South-West region	*0.0 (0)*	*38.8 (7)*	*26.0 (7)*	*3.5 (6)*	*0.0 (0)*	*68.2*	
West region							
Galway	78.9 (25)	3.2 (4)	11.0 (7)	2.5 (1)	0.0 (0)	*95.7*	34
Mayo	17.5 (10)	14.1 (10)	11.0 (9)	0.2 (1)	13.2 (6)	*55.9*	33
Roscommon	59.5 (11)	0.3 (1)	13.1 (3)	1.7 (3)	22.3 (2)	*96.8*	19
Total West region	*155.9 (46)*	*17.5 (15)*	*35.2 (19)*	*4.4 (6)*	*35.5 (8)*	*248.5*	
Total in ISGS	***548.4 (137)***	***69.5 (36)***	***472.0 (113)***	***27.0 (39)***	***127.5(36)***	***1244.5***	***324***

The main Annex I grassland habitats recorded were [*]6210 Festuco-Brometalia (548.4 ha, which is 44% of all Annex I grassland recorded, recorded in 137 sites during the ISGS), followed by 6410 *Molinia* meadows (472.0 ha, 38% of Annex I grassland recorded, found in 113 sites). [*]6210 was the most abundant Annex I grassland habitat in ten counties: Carlow, Clare, Donegal, Galway, Kilkenny, Leitrim, Mayo, Roscommon, Sligo and Westmeath. The greatest total area of [*]6210 habitat was recorded in Clare (107.9 ha), where it comprised 20% of the area of [*]6210 recorded during the ISGS. 6410 was the most abundant Annex I grassland habitat recorded in nine counties: Cavan, Cork, Kildare, Laois, Limerick, Longford, Monaghan, Offaly and Waterford. The greatest total area of 6410 was recorded from Offaly (83.2 ha, 18% of all 6410 recorded), largely associated with the wet meadows of the Shannon Callows.

The other three Annex I grassland habitats occurred at a much lower frequency and over a smaller area. 6510 Lowland hay meadows, recorded from 36 sites, covered 127.5 ha, 10% of all Annex I grassland habitat recorded. The greatest area of 6510 was recorded in Offaly (33.7 ha, 26% of all 6510 recorded) predominantly from the Shannon Callows. 6510 was the most abundant Annex I grassland in Dublin and Tipperary (all of it recorded in South Tipperary). *6230 *Nardus* grassland was recorded from 36 sites, a large proportion (28.3 ha, or 41% of all 6230 mapped) from Kerry, where it was the most abundant Annex I grassland habitat. It should be noted that the proportion of *6230 surveyed is lower than would be expected due to the fact that areas of grassland within upland SACs were not surveyed from 2010 to 2012 to prevent overlap with the National Survey of Upland Habitats (NSUH; for assessment results of *6230 surveyed during the NSUH, see Perrin *et al*. 2013a). 6430 Hydrophilous tall herb communities was the least abundant Annex I grassland habitat found during the ISGS, with just 27.0 ha recorded from 39 sites, the largest area was recorded from Donegal (4.7 ha, 17% of all 6430 recorded). It was the most common Annex I grassland habitat in Meath, where 4.4. ha were recorded and mapped.

3.5.2 Annex I grassland habitats in NPWS conservation sites

Data were analysed to investigate how much of the surveyed Annex I grassland was located within an NPWS conservation site. Table 17 shows that NHAs/pNHAs contain 43% of all Annex I grassland recorded during the ISGS, while SACs hold 37%. SPAs, which are designated for birds rather than for habitats, contain just 17%. The best coverage, in terms of area, of [*]6210, 6410 and 6510 habitats is afforded by NHAs (42%, 37% and 58% of their respective total areas recorded were located in an NHA/pNHA), while *6230 and 6430 have a higher coverage in SACs (65% and 60% of each is located in an SAC).

Tables 18, 19 and 20 show the area in hectares of each Annex I grassland habitat that is located within NHAs, SACs and SPAs, respectively. Data for NHAs and SPAs have been included for completeness, but the data of most relevance for Annex I habitats are those relating to SACs, as SACs are designated specifically for the conservation of Annex I habitats. Therefore, an additional table (Table 21) is also included to show the percentages of each Annex I grassland habitat within the SAC network, and the percentage listed as a qualifying interest (QI) for the SACs, for each county, region and overall.

From Table 21, it can be seen that only Kerry's Annex I grasslands are completely within SACs; however, none of the *6230 or 6430 habitats are listed as a QI and they therefore lack the full protection of a listed habitat. Meath and Kilkenny also fare well in that both have over 90% of their mapped Annex I grasslands within SACs. In Kilkenny, most of the Annex I grassland areas occur in

SACs where they are listed as a QI. However, none of the Annex I grasslands in Meath are listed as a QI in the SACs in which they occur. In the rest of the counties where Annex I grassland was recorded, at least 40% of it is located outside an SAC. Four counties – Carlow, Kildare, Laois and Monaghan – have none of their recorded Annex I grassland under the protection of an SAC.

The Annex I grassland habitat that is currently most protected by the SAC designation is *6230, as 65% of it is within SACs, mostly in Kerry; however, only 3.5% of this (a total of 2.4 ha) is listed as a QI. The Annex I habitat with the highest proportion listed as a QI is 6510, with 43% of it occurring in SACs where 6510 is listed as a QI; the Shannon Callows SAC provides a large proportion of this. The habitat least protected by the SAC designation is 6410, with only 30% of it within an SAC, followed by [*]6210, where 34% is within an SAC; however, in both cases 21% of the Annex I habitat within the SAC is listed as a QI, and their protection status is therefore better than that of *6230. It should also be borne in mind that these two Annex I grassland habitats are the most abundant, with 141.0 ha of the 472.0 ha of 6410 mapped during the ISGS located within an SAC (98 ha as a QI), and 186.1 ha of the 548.4 ha of [*]6210 within an SAC (113 ha as a QI). So, while the percentages of the national resource within SACs of these two habitats are low, the actual areas under SAC protection, and the areas listed as a QI, are actually higher than for the other three Annex I habitats.

Table 17: Area in hectares of each Annex I grassland habitat found in NPWS conservation sites, and percentage of total area of each Annex I habitat. Non-Annex values are included for comparison purposes.

		[*]6210	***6230**	**6410**	**6430**	**6510**	***Total Annex***	***Non-Annex***	***ISGS***
NHA/pNHA	Area (ha)	229.3	41.0	176.4	15.2	74.1	*536.1*	*5547.5*	*6083.5*
	% of Annex I habitat area	42	59	37	56	58	*43*	*25*	*26*
SAC	Area (ha)	186.1	45.0	141.0	16.2	71.2	459.4	*4082.9*	*4542.3*
	% of Annex I habitat area	34	65	30	60	56	*37*	*19*	*20*
SPA	Area (ha)	17.1	12.3	119.9	6.2	50.3	*205.8*	*3038.3*	*3244.1*
	% of Annex I habitat area	3	18	25	23	39	*17*	*14*	*14*
Total in ISGS	***Area (ha)***	***548.4***	***69.5***	***472.0***	***27.0***	***127.5***	***1244.5***	***21943.2***	***[†]23187.7***

[†]6130 Annex areas (0.4 ha) have been excluded from ISGS Total.

Table 18: Area in hectares of Annex I grassland within NHAs/pNHAs, by county and Teagasc region. No Annex I grassland habitat was recorded in Louth, Wexford or Wicklow. Any slight differences between row and column totals are due to rounding.

County	[*]6210	*6230	6410	6430	6510	*Total area Annex in (p)NHA*	Total Annex	% Annex in NHA
Border region								
Cavan	14.1	1.4	0.0	0.1	0.0	*15.5*	83.5	18.6
Donegal	19.5	0.0	29.4	1.5	0.0	*50.4*	155.4	32.5
Leitrim	37.0	0.0	22.9	0.0	0.3	*60.2*	115.6	52.1
Louth	0.0	0.0	0.0	0.0	0.0	*0.0*	0.0	N/A*
Monaghan	0.0	0.0	4.8	0.0	0.0	*4.8*	7.0	68.3
Sligo	46.7	0.0	12.3	0.2	0.0	*59.1*	99.5	59.4
Total Border region	*117.3*	*1.4*	*69.3*	*1.8*	*0.3*	*190.2*	*461*	*41.2*
Mid-East & Dublin region								
Dublin	0.3	0.0	0.0	0.1	4.1	*4.6*	11.4	40.1
Kildare	0.4	0.0	1.5	0.3	0.0	*2.2*	41.9	5.1
Meath	0.1	0.0	0.0	3.5	0.6	*4.2*	5.2	80.4
Wicklow	0.0	0.0	0.0	0.0	0.0	*0.0*	0.0	N/A*
Total Mid-East & Dublin region	*0.8*	*0.0*	*1.5*	*3.9*	*4.7*	*10.9*	*58.5*	*18.6*
Midland region								
Laois	0.0	0.0	0.0	0.0	0.0	*0.0*	0.8	0.0
Longford	0.0	0.0	4.4	0.2	0.0	*4.7*	10.0	46.8
Offaly	17.0	0.0	57.2	0.0	26.1	*100.3*	142.0	70.6
Westmeath	1.4	0.0	1.0	0.0	0.0	*2.4*	7.8	30.7
Total Midland region	*18.4*	*0.0*	*62.7*	*0.2*	*26.1*	*107.4*	*160.6*	*66.9*
Mid-West region								
Clare	54.4	0.0	12.9	1.6	6.7	*75.6*	157.4	48.0
Limerick	8.6	0.0	0.0	0.0	2.7	*11.3*	66.9	16.9
N. Tipperary	0.2	0.0	0.0	0.1	0.0	*0.3*	3.2	9.7
Total Mid-West region	*63.2*	*0.0*	*12.9*	*1.8*	*9.4*	*87.2*	*227.5*	*38.3*
South-East region								
Carlow	1.1	0.0	0.0	0.0	0.0	*1.1*	1.1	99.2
Kilkenny	7.3	0.0	0.0	<0.1	0.0	*7.4*	8.0	92.1
S. Tipperary	0.7	0.3	0.0	0.0	0.0	*1.0*	5.3	19.1
Waterford	0.0	0.0	0.0	0.5	0.0	*0.5*	5.7	9.0
Wexford	0.0	0.0	0.0	0.0	0.0	*0.0*	0.0	N/A*
Total South-East region	*9.1*	*0.3*	*0.0*	*0.5*	*0.0*	*10.0*	*20.1*	*49.7*
South-West region								
Cork	0.0	6.5	3.4	2.2	0.0	*12.2*	31.6	38.5
Kerry	0.0	28.3	8.0	0.3	0.0	*36.6*	36.6	100.0
Total South-West region	*0.0*	*34.8*	*11.4*	*2.5*	*0.0*	*48.8*	*68.2*	*71.5*
West region								
Galway	7.8	0.5	5.0	2.5	0.0	*16.0*	95.7	16.7
Mayo	12.5	4.0	1.7	0.2	11.3	*29.7*	55.9	53.1
Roscommon	0.2	0.0	11.9	1.7	22.3	*36.1*	96.8	37.3
Total West region	*20.6*	*4.6*	*18.6*	*4.4*	*33.6*	*81.7*	*248.4*	*32.9*
Total in ISGS	***229.3***	***41.0***	***176.4***	***15.2***	***74.1***	***536.1***	***1244.5***	***43.1***

Table 19: Area in hectares of Annex I grassland within SACs, by county and Teagasc region. No Annex I grassland habitat was recorded in Louth, Wexford or Wicklow. Any slight differences between row and column totals are due to rounding. QI = Listed as Qualifying Interest for the SAC.

County	[*]6210	*6230	6410	6430	6510	*Total area Annex in SAC*	Total Annex	% Annex in SAC	% as QI
Border region									
Cavan	14.1	1.4	0.0	0.1	0.0	15.5	83.5	*18.6*	*1.6*
Donegal	18.3	0.0	29.1	1.5	0.0	48.9	155.4	*31.5*	*20.6*
Leitrim	10.4	0.0	1.9	0.2	0.0	12.6	115.6	*10.9*	*0.0*
Louth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*N/A**	*N/A**
Monaghan	0.0	0.0	0.0	0.0	0.0	0.0	7.0	*0.0*	*0.0*
Sligo	24.1	0.0	11.5	0.8	0.0	36.5	99.5	*36.6*	*11.3*
Total Border region	*66.9*	*1.4*	*42.5*	*2.6*	*0.0*	*113.4*	*461.0*	*24.6*	*9.7*
Mid-East & Dublin region									
Dublin	0.3	0.0	0.0	0.0	4.1	4.4	11.4	*38.7*	*2.9*
Kildare	0.0	0.0	0.0	0.0	0.0	0.0	41.9	*0.0*	*0.0*
Meath	0.0	0.0	0.0	4.4	0.6	5.0	5.2	*97.0*	*0.0*
Wicklow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*N/A**	*N/A**
Total Mid-East & Dublin region	*0.4*	*0.0*	*0.0*	*4.4*	*4.7*	*9.5*	*58.5*	*16.2*	*0.6*
Midland region									
Laois	0.0	0.0	0.0	0.0	0.0	0.0	0.8	*0.0*	*0.0*
Longford	0.0	0.0	3.8	0.2	0.0	4.1	10.0	*40.7*	*0.0*
Offaly	6.7	0.0	49.9	0.0	26.5	83.1	142.0	*58.5*	*58.2*
Westmeath	0.5	0.0	1.0	0.0	0.0	1.6	7.8	*20.1*	*6.7*
Total Midland region	*7.2*	*0.0*	*54.8*	*0.2*	*26.5*	*88.8*	*160.6*	*55.3*	*51.8*
Mid-West region									
Clare	54.4	0.0	5.7	1.6	6.7	68.3	157.4	*43.4*	*43.4*
Limerick	8.7	0.0	5.5	1.1	4.2	19.5	66.9	*29.1*	*18.4*
N. Tipperary	0.0	0.0	0.0	0.0	0.0	0.0	3.2	*1.3*	*1.3*
Total Mid-West region	*63.0*	*0.0*	*11.2*	*2.7*	*10.9*	*87.9*	*227.5*	*38.6*	*35.4*
South-East region									
Carlow	0.0	0.0	0.0	0.0	0.0	0.0	1.1	*0.0*	*0.0*
Kilkenny	7.3	0.0	0.0	0.2	0.0	7.5	8.0	*94.0*	*93.9*
S. Tipperary	0.0	1.1	0.0	0.0	0.0	1.1	5.3	*19.9*	*19.7*
Waterford	0.0	0.0	0.0	1.2	0.0	1.2	5.7	*20.4*	*0.0*
Wexford	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*N/A**	*N/A**
Total South-East region	*7.3*	*1.1*	*0.0*	*1.4*	*0.0*	*9.7*	*20.1*	*48.4*	*42.5*
South-West region									
Cork	0.0	10.1	7.1	1.3	0.0	18.6	31.6	*58.7*	*0.0*
Kerry	0.0	28.3	8.0	0.3	0.0	36.6	36.6	*100.0*	*22.0*
Total South-West region	*0.0*	*38.4*	*15.2*	*1.6*	*0.0*	*55.2*	*68.2*	*80.9*	*11.8*
West region									
Galway	28.5	0.5	5.6	2.5	0.0	37.1	95.7	*38.8*	*10.5*
Mayo	12.5	3.6	2.5	0.2	6.7	25.6	55.9	*45.7*	*5.8*
Roscommon	0.2	0.0	9.3	0.5	22.3	32.3	96.8	*33.3*	*32.8*
Total West region	*41.3*	*4.1*	*17.3*	*3.2*	*29.0*	*95.0*	*248.4*	*38.2*	*18.1*
Total in ISGS	***186.1***	***45.0***	***141.0***	***16.2***	***71.2***	***459.4***	***1244.5***	***36.9***	***21.7***

Table 20: Area in hectares of Annex I grassland within SPAs, by county and Teagasc region. No Annex I grassland habitat was recorded in Louth, Wexford or Wicklow. Any slight differences between row and column totals are due to rounding.

County	[*]6210	*6230	6410	6430	6510	*Total area Annex in SPA*	Total Annex	% Annex in SPA
Border region								
Cavan	0.0	0.0	0.0	0.1	0.0	0.1	83.5	0
Donegal	0.0	0.0	12.7	1.2	0.0	13.9	155.4	9
Leitrim	10.1	0.0	0.0	0.0	0.0	10.1	115.6	9
Louth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A*
Monaghan	0.0	0.0	4.8	0.0	0.0	4.8	7.0	68
Sligo	2.9	0.0	1.1	0.0	0.0	4.0	99.5	4
Total Border region	*13.0*	*0.0*	*18.6*	*1.3*	*0.0*	*32.9*	*461.0*	*7*
Mid-East & Dublin region								
Dublin	0.0	0.0	0.0	0.0	0.0	0.0	11.4	0
Kildare	0.0	0.0	0.0	0.0	0.0	0.0	41.9	0
Meath	0.0	0.0	0.0	0.0	0.0	0.0	5.2	0
Wicklow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A*
Total Mid-East & Dublin region	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*58.5*	*0*
Midland region								
Laois	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0
Longford	0.0	0.0	4.1	0.2	0.0	4.3	10.0	43
Offaly	1.2	0.0	57.0	0.0	25.7	83.9	142.0	59
Westmeath	0.4	0.0	1.0	0.0	0.0	1.4	7.8	18
Total Midland region	*1.6*	*0.0*	*62.1*	*0.2*	*25.7*	*89.6*	*160.6*	*56*
Mid-West region								
Clare	0.0	0.0	7.1	0.0	0.0	7.1	157.4	4
Limerick	0.0	0.0	17.4	0.0	2.4	19.8	66.9	30
N. Tipperary	0.0	0.2	0.0	0.1	0.0	0.3	3.2	10
Total Mid-West region	*0.0*	*0.2*	*24.5*	*0.1*	*2.4*	*27.2*	*227.5*	*12*
South-East region								
Carlow	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0
Kilkenny	0.0	0.0	0.0	0.1	0.0	0.1	8.0	1
S. Tipperary	0.0	0.0	0.0	0.0	0.0	0.0	5.3	0
Waterford	0.0	0.0	0.0	0.5	0.0	0.5	5.7	8
Wexford	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A*
Total South-East region	*0.0*	*0.0*	*0.0*	*0.6*	*0.0*	*0.6*	*20.1*	*3*
South-West region								
Cork	0.0	0.0	0.9	0.5	0.0	1.4	31.6	5
Kerry	0.0	10.9	0.0	0.3	0.0	11.2	36.6	31
Total South-West region	*0.0*	*10.9*	*0.9*	*0.8*	*0.0*	*12.6*	*68.2*	*18*
West region								
Galway	0.8	0.0	4.0	2.5	0.0	7.3	95.7	8
Mayo	1.4	1.2	0.6	0.0	0.0	3.2	55.9	6
Roscommon	0.2	0.0	9.3	0.6	22.3	32.3	96.8	33
Total West region	*2.4*	*1.2*	*13.9*	*3.1*	*22.3*	*42.8*	*248.4*	*17*
Total in ISGS	***17.1***	***12.3***	***119.9***	***6.2***	***50.3***	***205.8***	***1244.5***	***17***

Table 21: Percentage of Annex I grassland that is within an SAC, and percentage of Annex I habitat that is listed as a Qualifying Interest within an SAC, by county and Teagasc region. A dash '-' signifies that that Annex I habitat was not recorded in the county.

	[*]6210		*6230		6410		6430		6510	
County	**SAC**	**QI**	**SAC**	**QI**	**SAC**	**QI**	**SAC**	**QI**	**SAC**	**QI**
Border region										
Cavan	63.3	0.0	48.0	48.0	0.0	0.0	100.0	0.0	0.0	0.0
Donegal	20.6	18.8	1.6	0.0	54.4	28.6	32.9	0.0	0.1	0.0
Leitrim	19.7	0.0	0.0	0.0	4.2	0.0	24.7	0.0	0.0	0.0
Louth	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0
Monaghan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0
Sligo	40.2	18.6	-	0.0	32.2	0.0	79.9	0.0	0.0	0.0
Total Border region	29.9	12.4	14.0	13.7	22.0	7.9	38.0	0.0	0.0	0.0
Mid-East & Dublin region										
Dublin	12.5	12.5	0.1	0.1	0.0	0.0	0.0	0.0	90.2	0.0
Kildare	0.0	0.0	-	0.0	0.0	0.0	0.0	0.0	-	0.0
Meath	17.3	0.0	-	0.0	-	0.0	100.0	0.0	100.0	0.0
Wicklow	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0
Total Mid-East & Dublin region	*8.2*	*7.2*	*0.1*	*0.1*	*0.0*	*0.0*	*61.7*	*0.0*	*91.3*	*0.0*
Midland region										
Laois	-	0.0	-	0.0	0.0	0.0	-	0.0	-	0.0
Longford	-	0.0	-	0.0	47.5	0.0	100.0	0.0	0.0	0.0
Offaly	26.7	26.7	-	0.0	60.0	60.0	-	0.0	78.6	77.4
Westmeath	13.9	13.9	-	0.0	100.0	0.0	0.0	0.0	0.0	0.0
Total Midland region	*25.0*	*25.0*	*-*	*0.0*	*58.9*	*53.6*	*69.2*	*0.0*	*69.2*	*68.1*
Mid-West region										
Clare	50.4	50.4	-	0.0	15.1	15.1	100.0	96.2	64.9	64.9
Limerick	51.4	40.3	-	0.0	13.5	13.5	100.0	0.0	50.5	0.0
N. Tipperary	0.0	0.0	0.0	0.0	1.7	1.7	0.0	0.0	-	0.0
Total Mid-West region	*50.3*	*48.8*	*0.0*	*0.0*	*13.9*	*13.9*	*95.7*	*55.3*	*58.4*	*35.8*
South-East region										
Carlow	0.0	0.0	-	0.0	-	0.0	-	0.0	-	0.0
Kilkenny	93.8	93.8	-	0.0	-	0.0	100.0	100.0	-	0.0
S. Tipperary	0.0	0.0	98.1	98.1	-	0.0	-	0.0	0.0	0.0
Waterford	-	0.0	-	0.0	0.0	0.0	68.9	0.0	-	0.0
Wexford	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0
Total South-East region	*74.5*	*74.5*	*98.1*	*98.1*	*0.0*	*0.0*	*72.1*	*10.3*	*0.0*	*0.0*
South-West region										
Cork	-	0.0	96.1	0.0	39.8	0.0	42.1	0.0	-	0.0
Kerry	-	0.0	100.0	0.0	99.8	99.8	100.0	0.0	-	0.0
Total South-West region	*-*	*0.0*	*98.9*	*0.0*	*58.4*	*31.0*	*47.3*	*0.0*	*-*	*0.0*
West region										
Galway	36.2	7.1	16.2	0.0	50.4	40.8	100.0	0.0	-	0.0
Mayo	71.8	18.5	25.8	0.0	22.7	0.0	100.0	0.0	51.0	0.0
Roscommon	0.4	0.4	0.0	0.0	70.8	70.8	29.5	0.0	100.0	100.0
Total West region	*26.5*	*5.8*	*23.6*	*0.0*	*49.3*	*39.2*	*73.0*	*0.0*	*81.7*	*62.7*
Total in ISGS	***33.9***	***20.6***	***64.6***	***3.5***	***29.9***	***20.8***	***60.0***	***6.6***	***55.8***	***43.2***

3.6 Assessment of Annex I grassland habitats

3.6.1 Overall statistics

In all, 361 areas of Annex I grassland were assessed at 324 sites across 23 counties during the ISGS between 2007 and 2012. An area of 6510 that was surveyed and mapped but not assessed has been excluded from this analysis. An assessment stop that was recorded in an area that was below the minimum mapping unit was included, however, due to the presence of an additional unsurveyed area of the habitat at the same site. The total number of assessed areas of 6430 is therefore 40, and the total number of assessed areas of 6510 is 35.

The data presented below summarise the assessment results for the area, structure and functions, and future prospects assessment parameters for the Annex I grassland habitats recorded. Area and structure and functions were assessed in all 361 areas of Annex I grassland. However, because of a methodological change in the EU-wide assessment protocol of future prospects, only Annex I habitat surveyed in 2010, 2011 and 2012 could be assessed for future prospects, as retrospective application of the protocol was not possible due to insufficient data gathered in the earlier years of the ISGS. This means that only 241 areas of Annex I habitat were assessed for future prospects, instead of the 361 areas that were assessed for the area and structure and functions parameters.

The assessment results for all Annex I grassland areas assessed are given in the Access database that accompanies this report, but a summary of the data is given below.

3.6.2 Area assessment

Of the 361 areas of Annex I grassland assessed across 23 counties, 16 had increased in extent, 27 had decreased in extent, and the remainder were unchanged (Table 22), based on an area comparison between aerial photographs of 2000 and the areas mapped during the ISGS. All Annex I grassland areas were scored as *Favourable* for area assessment, except for 10 sites, which were assessed as *Unfavourable – Bad* due to loss in extent of more than 1% per annum, and in 17 sites, which were assessed as *Unfavourable – Inadequate* due to a loss in extent of between 0 and 1% per annum. Table 23 summarises these assessments.

The main losses, both in terms of frequency and area, were due to succession, usually to scrub or heath; this mainly affected [*]6210, *6230 and 6410. House and road construction also accounted for losses, particularly in Galway, where 1.5 ha of [*]6210 habitat was lost from one site. Quarrying was the cause of loss of [*]6210 habitat in three instances, one case in Carlow resulting in the loss of over 1 ha. Disposal of waste reduced the extent of 6510 in Limerick by almost 1 ha.

Scrub clearance was the main cause of habitat recovery, with 1.3 ha of Annex I grassland habitat recovered in this way. Modest gains in habitat extent were also noted due to recovery of bare ground after livestock trampling, and there were two cases of abandoned quarries revegetating with [*]6210 habitat.

Table 22: Changes in area since 2000 noted in Annex I grassland habitat areas during the ISGS 2007-2012. Only Annex I areas that changed in area are included in table. Any slight differences between individual data and totals are due to rounding.

Site no.	County	Region	Annex I habitat	Area in 2000 (ha)	Area when surveyed (ha)	% change per yr
1	Offaly	Midland	[*]6210	1.62	1.18	-3.89
8	Offaly	Midland	[*]6210	2.06	1.99	-0.49
224	Roscommon	West	[*]6210	8.00	8.01	0.02
227	Roscommon	West	[*]6210	3.97	3.78	-0.68
230	Roscommon	West	[*]6210	1.39	0.87	-5.29
263	Roscommon	West	[*]6210	92.20	87.55	-0.72
807	Leitrim	Border	[*]6210	0.94	0.69	-2.98
815	Leitrim	Border	[*]6210	2.87	2.76	-0.42
826	Leitrim	Border	[*]6210	0.74	0.71	-0.54
1061	Cavan	Border	[*]6210	0.36	0.34	-0.59
1072	Cavan	Border	[*]6210	2.82	2.78	-0.16
1272	Donegal	Border	[*]6210	34.12	34.18	0.02
1324	Dublin	Mid-East & Dublin	[*]6210	1.25	1.31	0.49
1401	Kildare	Mid-East & Dublin	[*]6210	0.43	0.43	0.05
1556	Sligo	Border	[*]6210	7.96	7.81	-0.18
1561	Sligo	Border	[*]6210	7.53	7.58	0.06
1654	Clare	Mid-West	[*]6210	7.4	8.0	0.70
1853	Mayo	West	[*]6210	3.6	3.2	-1.10
2113	Carlow	South-East	[*]6210	2.16	1.11	-4.07
2301	Galway	West	[*]6210	1.4	1.3	-0.60
2303	Galway	West	[*]6210	9.2	7.7	-1.30
2337	Galway	West	[*]6210	0.6	0.6	1.00
2500	Kilkenny	South-East	[*]6210	6.63	6.59	-0.05
2502	Kilkenny	South-East	[*]6210	0.46	0.49	0.52
762	Monaghan	Border	*6230	0.32	0.28	-1.51
836	Leitrim	Border	*6230	5.13	4.96	-0.36
1016	Cavan	Border	*6230	1.10	0.99	-1.16
1088	Cavan	Border	*6230	0.54	0.51	-0.76
1249	Donegal	Border	*6230	1.23	1.27	0.31
1305	Dublin	Mid-East & Dublin	*6230	1.93	1.94	0.05
717	Monaghan	Border	6410	4.96	4.78	-0.40
804	Leitrim	Border	6410	2.69	2.50	-0.77
837	Leitrim	Border	6410	2.94	2.73	-0.79
874	Leitrim	Border	6410	21.96	21.66	-0.15
1250	Donegal	Border	6410	19.45	19.47	0.02
1275	Donegal	Border	6410	0.05	0.06	2.53
1422	Kildare	Mid-East & Dublin	6410	10.18	11.22	1.02
1526	Sligo	Border	6410	2.99	2.92	-0.24
1546	Sligo	Border	6410	1.81	1.83	0.12
418	Cork	South-West	6430	1.90	1.68	-1.46
1300	Dublin	Mid-East & Dublin	6510	4.44	4.54	0.23
1572	Sligo	Border	6510	2.45	2.46	0.03
2704	Limerick	Mid-West	6510	6.9	6.0	-1.20

Table 23: Area assessment results for the five Annex I grassland habitats recorded during the ISGS 2007-2012.

Annex I habitat	*Favourable*	*Unfavourable – Inadequate*	*Unfavourable – Bad*	*Total no. of areas*
[*]6210	121	6	10	137
*6230	32	2	2	36
6410	108	0	5	113
6430	39	1	0	40
6510	34	1	0	35
Total	*334*	*10*	*17*	*361*

3.6.3 Structure and functions assessment

The criteria used to assess structure and functions are outlined in the Methods section and detailed in Devaney *et al.* (2013) and Martin *et al.* (2013). Structure and functions were assessed at monitoring stops by means of several criteria. Each criterion could pass or fail an assessment. If at least one criterion failed its assessment, the monitoring stop as a whole failed. Overall, therefore, each individual criterion had a pass rate, and the monitoring stops had a different, lower, pass rate. The pass rates for each of the criteria are shown in Table 24, together with the pass rates for the monitoring stops within each Annex I habitat type. Expert judgement was applied to allow monitoring stops to pass in the event that criteria narrowly failed the assessment. For example, a forb:graminoid ratio of 35-39% was generally acceptable if all other criteria were passed.

The high-quality (HQ) positive indicator species criterion passed most often in 6510 Lowland hay meadows (94% of monitoring stops passed), and least often in 6410 *Molinia* meadows (82% of monitoring stops passed). The overall positive indicator species criterion (count of HQ + non-HQ positive indicator species) was not consistent in relation to the pass rate of HQ species, in that [*]6210 and 6510 both had a lower pass rate for this criterion than for HQ species, i.e. general positive species were more likely to be lacking, while *6230 and 6410 both achieved a higher pass rate for the combined indicator species than for HQ species alone. The criterion passed most often in 6230 grassland (98% of stops passed) but failed most often in 6510 grassland (78% of stops passed).

High pass rates overall were achieved across all Annex I grassland habitats for the non-native species criterion, indicating that non-native species do not present a serious threat to our semi-natural grasslands. Among the non-native species recorded were *Crepis biennis* and *Epilobium brunnescens*, the latter most commonly encountered in upland *6230 areas. Negative native species, however (e.g., tussocky grass species such as *Dactylis glomerata* or *Arrhenatherum elatius*, or species indicative of agricultural improvement such as *Trifolium repens*), were more of a problem, particularly in 6510 and *6230, where the criterion failed in 15% and 14% of stops, respectively. The problematic species in 6510 tended to be tussocky species, while in *6230 *Trifolium repens* was more likely to be the problem. Pass rates for this criterion were high for the two wet Annex I grassland habitats, 6410 and 6430.

The encroachment criterion, assessing encroachment of grassland by non-grassland habitats such as heath, scrub or bracken, had a high pass rate across all Annex I grassland habitats (lowest for [*]6210

and *6230, at 96% each), but it should be noted that, as this criterion was measured within the monitoring plots, it does not take into account former grassland areas that have been completely lost through encroachment. However, two other assessment parameters, area and future prospects, measure and assess changes due to encroachment at a broader level.

Table 24: Pass rates of criteria used in structure and functions assessments for Annex I grassland habitats in ISGS 2007-2012. Note: A monitoring stop fails if only one criterion fails; expert judgement may be exercised to override marginal failures. N/A=criterion not assessed for that Annex I habitat.

	% of monitoring stops that passed on each criterion				
Assessment Criteria	**[*]6210**	***6230**	**6410**	**6430**	**6510**
Positive indicator species (HQ)	93	84	82	N/A	94
Positive indicator species (HQ + Non-HQ)	89	98	84	90	78
Non-native species	99	99	99	100	100
Negative indicator species	92	86	97	98	85
Encroachment	96	96	98	100	99
Sward height	92	94	97	73	96
Litter cover	98	88	67	N/A	92
Bare soil cover	99	100	99	94	100
Grazing & disturbance	99	100	99	94	100
Forb-to-graminoid ratio	85	82	60	80	92
Species richness	N/A	60	N/A	N/A	N/A
Pass rate for monitoring stops before expert judgement applied	*63*	*34*	*29*	*49*	*57*
Pass rate for monitoring stops after expert judgement applied	*74*	*51*	*41*	*51*	*63*

The sward height criterion was rarely the cause of stop failure, although a number of stops of 6430 Hydrophilous tall herb communities did fail due to insufficient sward height. In [*]6210 and *6230 also, insufficient sward height was sometimes an issue, usually due to exposure in the former, and sheep grazing in the latter, although the sward was frequently of good quality otherwise. Such stops were allowed to pass by expert judgement.

The pass rate for the litter cover criterion was particularly low for 6410, only 67%, compared to pass rates of over 85% for the other Annex I habitats in which it was assessed. High litter cover is often an indication of lack of management (for example, lack of mowing), and as grassland habitats need constant management, either by mowing or grazing, for their continued existence, this may be cause for concern.

Extent of bare soil (as distinct from bare rock) was a measure of trampling and was not a significant cause of failure for the assessed Annex I grasslands, although the failure rate was slightly higher, at 6%, in 6430 Hydrophilous tall herb communities monitoring stops compared to the other Annex I habitats. The grazing and disturbance criterion is similar to the bare soil criterion, but was assessed in the vicinity of the monitoring stop, rather than within the stop itself. Pass rates were generally high, but were lowest in 6430 habitats, where the criterion failed in 5% of stops. This was due in most cases to disturbance and poaching by cattle, with wet habitats more vulnerable to damage from overgrazing.

The forb-to-graminoid ratio is an important structural criterion that examines the ratio between broadleaf herbs (forbs) and graminoids such as grasses, sedges and rushes. A high proportion of forbs is generally regarded as an indication of good quality grassland, as the addition of fertiliser or lime to swards often causes the proliferation of more competitive grass species; rank, unmanaged swards also tend to be forb-poor. The lower threshold usually applied for a pass is 40% forbs; however, it was found that *6230 swards in Ireland appeared to be naturally less forb-rich, so a lower cut-off of 20% was applied. Four of the five Annex I grassland habitats achieved at least 80% pass rates for this criterion; however, 40% of 6410 monitoring stops failed this criterion, indicating that they were more graminoid-rich. Further rounds of monitoring may establish whether this is the natural condition for Irish *Molinia* meadows; if this is found to be the case, a lower threshold may be more appropriate.

Species richness was only assessed for 6230 *Nardus* grassland, due to the specific requirement in EU guidelines for this Annex I habitat to be particularly species-rich. A total of 60% of stops passed this criterion, which requires at least 25 species to be present in the 2 m x 2 m assessment relevé; the corollary of this, however, is that 40% of 6230 stops assessed lacked the species richness required for the Annex I habitat at the time of assessment.

Table 25 gives the assessment results for structure and functions for the five Annex I grassland habitats. Overall, 130 (36%) of the 361 areas received a *Favourable* assessment result, 44 areas (12%) were *Unfavourable – Inadequate* and 187 areas (52%) were *Unfavourable – Bad*. The habitat with the highest percentage of areas achieving a *Favourable* assessment was 6430 (48% of areas). 6410 had the fewest *Favourable* assessments (20%), and had the highest proportion of areas that received an *Unfavourable – Bad* assessment (71%).

Table 25: Structure and functions assessment results for the five Annex I grassland habitats recorded during ISGS 2007-2012.

Annex I habitat	***Favourable***	***Unfavourable – Inadequate***	***Unfavourable – Bad***	***Total no. of areas***
[*]6210	58	26	53	137
*6230	17	1	18	36
6410	23	10	80	113
6430	19	1	20	40
6510	13	6	16	35
Total	*130*	*44*	*187*	*361*

3.6.4 Future prospects assessment

Assessment of the future prospects parameter for each of the Annex I grassland areas identified was carried out according to the scoring system outlined in Tables 2 and 4, where a score of 0 or more is assessed as *Favourable*, less than 0 to -3 is *Unfavourable – Inadequate*, and less than -3 is *Unfavourable – Bad*.

Due to a methodological change in the EU-wide assessment protocol of future prospects, only the results for sites surveyed in 2010, 2011 and 2012 are presented here: retrospective application of the protocol was not possible due to insufficient data gathered in the earlier years of the ISGS (no positive management data were recorded prior to 2010). This means that only 241 areas of Annex I habitat

were assessed for future prospects, rather than the 361 areas that were assessed for the area and structure and functions parameters.

In total, 154 out of 241 (64%) Annex I grassland habitat areas assessed for future prospects were scored as *Favourable* (i.e. with the effects of positive and negative impacts balanced in favour of the positive), 66 (27%) were *Unfavourable – Inadequate*, and the remaining 21 (9%) were *Unfavourable – Bad* (Table 26). The Annex I habitat with the best overall future prospects was 6510, with 86% of its 21 areas assessed as having *Favourable* future prospects. The next most favourably rated habitat was 6430, with 73% of its assessed areas (16 out of 22) receiving a *Favourable* score. [*]6210 had the lowest proportion of sites receiving a *Favourable* assessment (58 out of 99 sites, or 59%), while 6410 had the highest percentage of sites receiving an *Unfavourable – Bad* assessment.

Table 26: Future prospects assessment results for the five Annex I grassland habitats recorded during the ISGS 2010-2012.

Annex I habitat	***Favourable***	***Unfavourable – Inadequate***	***Unfavourable – Bad***	***Total no. of areas***
[*]6210	58	34	7	99
*6230	17	8	1	26
6410	45	18	10	73
6430	16	5	1	22
6510	18	1	2	21
Total	*154*	*66*	*21*	*241*

In terms of the impacts recorded, 31 negative impacts were recorded on Annex I grassland habitats, with 16 positive and 25 neutral impacts also noted (Table 27). By far the most frequent negative impact recorded was species composition change (succession), which occurred at 134 of the 241 Annex I areas (55.6%). The issue of problematic native species (e.g. bracken) was also a frequent negative impact, recorded in 63 areas. Abandonment of management, whether grazing or mowing, was another issue of concern, affecting 30 areas in total. It should be noted that all of the top five negative impacts can be related to lack of management and/or agricultural abandonment.

A similar trend was noted in the years prior to 2010, where negative impacts related to abandonment (e.g. undergrazing, encroachment of scrub, heath or bracken) were noted at 51 of the 92 Annex I grassland areas recorded between 2007 and 2009 for which data were available. Undergrazing was noted at 41 of those Annex I areas, with scrub/heath encroachment specifically recorded at 29 of the areas and bracken encroachment noted as a problem at 12 areas. Other negative impacts recorded between 2007 and 2009 include agricultural improvement (18 areas), drainage (17 areas, with the highest frequency in 6410 habitat), quarrying (5 occurrences, all in 6210 areas), overgrazing (5 occurrences), dumping (3 occurrences) and stock feeding (3 occurrences). These 2007-2009 negative impact data, while not analysed further in this report, have been included in the Access database for information purposes.

Of the 16 positive impacts recorded in Annex I grasslands, ten relate to management of grassland either through grazing or mowing. Collectively, grazing (mostly non-intensive) was identified as the most frequent positive impact, noted at 157 areas of Annex I grassland habitat, with cattle the most frequent grazing animal, recorded at 81 areas. Mowing was a positive feature for 34 areas, and all but two of the areas of Lowland hay meadow (6510) were mown.

It should be noted that grazing was identified in some sites as a positive effect and at others as a negative impact, as well as occurring with a neutral effect (neither positive nor negative) in 34 areas. Grazing was generally recorded as having a negative impact in areas where it was insufficient to control sward rankness, or where negative impacts due to trampling or enrichment outweighed any other positive effect that grazing might achieve; but cattle grazing was recorded as having a positive effect where it successfully controlled sward rankness and more than cancelled out any of the negative effects of grazing. This was a highly context-sensitive assessment, requiring a weighing-up of all of the individual impacts seen at a site. Guidance on achieving consistency in scoring future prospects is given in Appendix 3.

Table 27: All impacts recorded for each of the Annex I grassland habitats assessed during the ISGS 2010-2012, showing the number of areas each impact occurred at for each Annex I habitat.

(a) Negative impacts

Impact code	Description	[*]6210	*6230	6410	6430	6510	Total
K02.01	Species composition change (succession)	75	20	25	7	7	134
I02	Problematic native species	51	5	3		4	63
A03.03	Abandonment / lack of mowing	1		11		3	15
A04.03	Abandonment of pastoral systems, lack of grazing	2		12	1		15
I01	Invasive non-native species	6	5	1			12
A08	Fertilisation	6	1	1		2	10
G01.02	Walking, horse-riding and non-motorised vehicles	3	4			1	8
A04.01.01	Intensive cattle grazing	4		1			5
J02.07.01	Groundwater abstractions for agriculture			4	1		5
A02.01	Agricultural intensification	1	1	1		1	4
A04.02.01	Non-intensive cattle grazing	1		3			4
A04.01.03	Intensive horse grazing	2		1			3
B01.02	Artificial planting on open ground (non-native trees)	1		2			3
B02	Forest and plantation management & use	1	1	1			3
D01.01	Paths, tracks, cycling tracks		1	2			3
A04.02.03	Non-intensive horse grazing			1	1		2
G05.01	Trampling, overuse	2					2
H05.01	Garbage and solid waste	2					2
K02.02	Accumulation of organic material			2			2
A02.03	Grassland removal for arable land					1	1
A04.01.05	Intensive mixed animal grazing	1					1
A04.02.05	Non-intensive mixed animal grazing	1					1
A05.02	Stock feeding	1					1
A11	Agriculture activities not referred to above	1					1
D01.02	Roads, motorways	1					1
D01.03	Car parks and parking areas					1	1
G01.03	Motorised vehicles			1			1
G02.08	Wildlife watching	1					1
G05	Other human intrusions and disturbances					1	1
H01.03	Other point source pollution to surface water				1		1
J02.09.01	Saltwater intrusion			1			1

(b) Positive impacts

Impact code	Description	[*]6210	*6230	6410	6430	6510	Total
A04.02.01	Non-intensive cattle grazing	40	3	30	6	2	81
A03.02	Non intensive mowing	4		10		16	30
A04.02.02	Non-intensive sheep grazing	14	11	3		1	29
A04.02.03	Non-intensive horse grazing	11	1	8	1	2	23
A04.02.05	Non-intensive mixed animal grazing	11	1	4			16
J02.04.01	Flooding			1	4	1	6
A04.02	Non-intensive grazing	1	4				5
A10.01	Removal of hedges and copses or scrub	3		1			4
J02.07.01	Groundwater abstractions for agriculture			3		1	4
A03	Mowing / cutting of grassland			1		1	2
A03.01	Intensive mowing or intensification					2	2
A04.02.04	Non-intensive goat grazing	2					2
A07	Use of biocides, hormones and chemicals	2					2
A04.01.05	Intensive mixed animal grazing	1					1
J01.01	Burning down			1			1
K01.04	Submersion	1					1

(c) Neutral impacts

Impact code	Description	[*]6210	*6230	6410	6430	6510	Total
A04.02.01	Non-intensive cattle grazing	15		9			24
G01.02	Walking, horse-riding and non-motorised vehicles		3	1	2	1	7
X	No threats or pressures				7		7
A04.02.02	Non-intensive sheep grazing	2	4				6
B02	Forest and plantation management & use		1	4			5
D01.01	Paths, tracks, cycling tracks	2	1		2		5
A04.03	Abandonment of pastoral systems, lack of grazing	1	1	1			3
C01.01.01	Sand and gravel quarries	2	1				3
J02.07.01	Groundwater abstractions for agriculture		1	2			3
K02.01	Species composition change (succession)	2		1			3
A04.02.05	Non-intensive mixed animal grazing		1	1			2
B01	Forest planting on open ground			2			2
C01	Mining and quarrying	2					2
A03.02	Non intensive mowing			1			1
A03.03	Abandonment / lack of mowing			1			1
A04.02	Non-intensive grazing				1		1
A04.02.03	Non-intensive horse grazing					1	1
A08	Fertilisation	1					1
A10.01	Removal of hedges and copses or scrub	1					1
F03.01	Hunting			1			1
G01.03.02	Off-road motorised driving	1					1
H04.03	Other air pollution					1	1
I02	Problematic native species	1					1
K01	Abiotic (slow) natural processes	1					1
K01.01	Erosion	1					1

3.6.5 Overall condition assessment

For the reasons outlined above, future prospects could only be assessed for areas surveyed in 2010 or later. This in turn affected the overall condition assessment, as this is partly based on the future prospects assessment. Because of this, the overall condition assessment could also only be derived for sites surveyed in 2010 or later. This means that no overall condition assessment could be derived for the 120 areas of Annex I habitat in the eight counties surveyed between 2007 and 2009: Offaly, Roscommon, Cork, Waterford, Cavan, Leitrim, Longford and Monaghan.

The overall condition assessment scores for the 241 areas of Annex I grassland habitat assessed across the remaining 18 counties were derived as outlined in the methods section by combining all three assessment parameters, with reference to the matrix presented in Table 2. The overall condition assessments of assessed Annex I grassland habitat areas are provided in the Access database that accompanies this report.

The percentage of areas of each Annex I habitat that received a *Favourable*, *Unfavourable – Inadequate* or *Unfavourable – Bad* assessment are shown in Table 28. The habitat that achieved the greatest percentage of *Favourable* assessments was *6230 (42% of areas), while the habitat with the lowest *Favourable* percentage was 6410. 6410 received the highest percentage of *Unfavourable – Bad* (75%), and [*]6210 the lowest (36%). There is some disparity between habitats' pass rates for structure and functions and for future prospects. This may be due in part to the exclusion of future prospects data but the inclusion of structure and functions data for sites surveyed prior to 2010. Many sites surveyed between 2007 and 2009 were seen to be suffering from abandonment (as evidenced by undergrazing or scrub encroachment, for example), with consequent negative effects on vegetation structure and poor assessment results obtained for structure and functions. The future prospects for these sites have not been included, however, as they are incomplete, lacking as they do any records of positive management impacts; any calculated assessment results would therefore be likely to be more harsh than those calculated from 2010 onwards, which take into account both positive and negative impacts. Also, future prospects may appear more favourable because negative impacts such as agricultural improvement were under-recorded; this occurred because no baseline data were available for comparison, and such impacts would have had to have been observed on the day of survey to be recorded. Furthermore, an absence of monitoring data for structure and functions means that, by default, monitoring stops are being compared to the highest standards; subsequent monitoring may show that some Annex I grasslands, due to geographic location or other factors, may already have favourable structure and functions within the context of their local ecosystem. For example, 6410 *Molinia* meadows and 6510 Lowland hay meadows are often compared to examples of these habitats in the Shannon Callows, but due to variation in factors such as geography, climate and soil, such comparisons are too simplistic.

In the Discussion section, the overall conservation assessments presented in Table 28 will be discussed in the context of the recently produced National Conservation Assessments (NCAs) for each of the five Annex I grassland habitats.

Table 28: Percentage of Annex I areas that received *Favourable* (F), *Unfavourable-Inadequate* (U-I) and *Unfavourable-Bad* (U-B) assessments in the three assessment parameters (area, structure and functions, future prospects) and in the overall condition assessment. †n = 361; ‡ n = 241.

Annex	**†Area**			**†Structure & functions**			**‡Future prospects**			***‡Overall***		
I	**F**	**U-I**	**U-B**	**F**	**U-I**	**U-B**	**F**	**U-I**	**U-B**	***F***	***U-I***	***U-B***
[*]6210	88.3	7.3	4.4	42.3	19.0	38.7	58.6	34.4	7.0	*28.3*	*34.3*	*37.4*
*6230	88.9	5.5	5.6	47.2	2.8	50.0	65.4	30.8	3.8	*42.3*	*7.7*	*50.0*
6410	95.6	4.4	0.0	20.4	8.8	70.8	61.6	24.7	13.7	*11.0*	*12.3*	*76.7*
6430	97.5	0.0	2.5	47.5	2.5	50.0	72.7	22.7	4.6	*40.9*	*18.2*	*40.9*
6510	97.1	0.0	2.9	37.1	17.1	45.7	85.7	4.8	9.5	*28.6*	*9.5*	*61.9*

3.6.6 Primary areas of Annex I grassland habitat

Between 2007 and 2012 during the ISGS, 361 areas of assessed Annex I grassland habitat greater than the minimum mapping area located at 324 sites were recorded across 23 of Ireland's 26 counties. Many of these 361 areas were either small (less than 1 ha) or were assessed as having *Unfavourable* structure and functions. Following the proposal in Martin *et al.* (2008) that a list of premium quality sites containing Annex I grassland habitats above a minimum size and of adequate structure and functions be produced, Table 29 shows the list of such sites compiled from the Annex I grassland habitats assessed during the ISGS between 2007 and 2012. The 135 areas of Annex I grassland listed are hereafter referred to as ***primary areas*** of Annex I grassland and represent the best examples of Annex I grassland habitat recorded across the country. They are judged to be of primary importance due to a combination of the area they cover (at least 1 ha) and their structure and functions, and should provide a focus for monitoring and conservation efforts in the future. Of the 131 areas that received a *Favourable* structure and functions assessment, 49 were included in the list of primary areas, the majority of the areas being too small.

Table 30 gives a summary of the occurrence and extent of the primary areas of Annex I habitat, by county and Teagasc region. Of the 135 primary areas of Annex I grassland habitat 67 are [*]6210 with 44 of these areas potentially the orchid-rich priority habitat *6210. 6410 has the second largest number of primary areas, with 37. Clare is the county with the highest number of primary areas of Annex I habitat (18), followed closely by Donegal and Sligo (17 each), Leitrim (16) and Galway (15). However, the county with the greatest area of primary Annex I habitat is Donegal, which has 126.6 ha, most of it [*]6210, followed by Clare (101.8 ha; again, the majority is [*]6210). Offaly is next, with 90.2 ha, most of this 6410. Donegal is the only county to have primary areas of all five Annex I grassland habitats. No primary areas of Annex I habitat were recorded in Cork, Laois, North Tipperary, Louth, Wexford or Wicklow, with the last three counties having no Annex I grassland habitats recorded during the survey.

Of the 135 primary areas identified during the ISGS, 48 were located completely outside of an NPWS conservation site, while 87 were located within an NPWS conservation site. Of those within an NPWS conservation site, 72 were located in an SAC, although only 37 of them were in SACs where the Annex I grassland habitat was listed as a qualifying interest. For 57 of the 87 primary areas located within an NPWS conservation site, between 90% and 100% of the Annex I habitat was located within an SAC or pNHA; 49 of these 57 were in an SAC.

Table 29: The 135 primary areas of Annex I grassland habitat recorded during the ISGS 2007-2012. '% in NPWS site' refers to the percentage of the Annex I habitat located in an SAC or, if the habitat does not coincide with an SAC, in an NHA/pNHA. '% as QI' is the %Annex I habitat listed as a Qualifying Interest for the SAC.

(a) Primary areas of [*]6210 Festuco-Brometalia; potential orchid-rich priority habitat *6210 indicated by '*' preceding the site number.

Site no.	County	Region	Area (ha)	Structure and functions	% in NPWS site	NPWS site no.	% as QI
*1	Offaly	Midland	1.18	50% Pass = *Unfavourable-Bad*	100	SAC 566	100
*3	Offaly	Midland	3.37	100% Pass = *Favourable*	97	SAC 919	97
*8	Offaly	Midland	1.99	50% Pass = *Unfavourable-Bad*	36	pNHA 900	
16	Offaly	Midland	6.63	100% Pass = *Favourable*	95	pNHA 910	
120	Offaly	Midland	6.56	100% Pass = *Favourable*	34	SAC 580	34
*215	Roscommon	West	22.28	100% Pass = *Favourable*	0	-	
*224	Roscommon	West	8.01	60% Pass = *Unfavourable-Bad*	0	-	
811	Leitrim	Border	3.57	50% Pass = *Unfavourable-Bad*	100	SAC 623	0
*815	Leitrim	Border	2.76	89% Pass = *Unfavourable-Inadequate*	76	pNHA 1421	
818	Leitrim	Border	25.82	50% Pass = *Unfavourable-Bad*	80	NHA 2435	
*825	Leitrim	Border	2.39	50% Pass = *Unfavourable-Bad*	0	-	
890	Leitrim	Border	2.52	80% Pass = *Unfavourable-Inadequate*	0	-	
894	Leitrim	Border	2.56	75% Pass = *Unfavourable-Inadequate*	100	SAC 623	0
1067	Cavan	Border	4.79	63% Pass = *Unfavourable-Bad*	0	-	
*1250	Donegal	Border	16.66	88% Pass = *Unfavourable-Inadequate*	100	SAC 191	100
*1266	Donegal	Border	18.14	71% Pass = *Unfavourable-Bad*	0	-	
*1272	Donegal	Border	33.69	90% Pass = *Unfavourable-Inadequate*	4	pNHA 2068	
*1283	Donegal	Border	1.61	100% Pass = *Favourable*	99	SAC 115	0
1284	Donegal	Border	4.87	83% Pass = *Unfavourable-Inadequate*	0	-	
1285	Donegal	Border	13.39	75% Pass = *Unfavourable-Inadequate*	0	-	
*1324	Dublin	Mid-East & Dublin	1.31	50% Pass = *Unfavourable-Bad*	0	-	
1423	Kildare	Mid-East & Dublin	1.23	50% Pass = *Unfavourable-Bad*	0	-	
1501	Sligo	Border	15.63	100% Pass = *Favourable*	99	pNHA	
1502	Sligo	Border	6.95	50% Pass = *Unfavourable-Bad*	100	NHA 2435	
*1513	Sligo	Border	3.94	100% Pass = *Favourable*	0	-	
*1519	Sligo	Border	3.10	50% Pass = *Unfavourable-Bad*	88	SAC 1656	88
1527	Sligo	Border	3.45	100% Pass = *Favourable*	100	NHA 2435	
1529	Sligo	Border	3.37	75% Pass = *Unfavourable-Inadequate*	87	SAC 627	0
1532	Sligo	Border	2.18	100% Pass = *Favourable*	0	-	
1538	Sligo	Border	2.04	75% Pass = *Unfavourable-Inadequate*	0	-	
1541	Sligo	Border	2.20	100% Pass = *Favourable*	100	SAC 1898	0
*1556	Sligo	Border	7.81	67% Pass = *Unfavourable-Bad*	100	SAC 1976	0
1561	Sligo	Border	7.58	100% Pass = *Favourable*	100	SAC 1656	100
*1608	Clare	Mid-West	5.38	67% Pass = *Unfavourable-Bad*	0	-	
*1612	Clare	Mid-West	2.02	100% Pass = *Favourable*	88	SAC 20	88
1614	Clare	Mid-West	1.89	25% Pass = *Unfavourable-Bad*	0	-	

Table 29 (a) (continued)

Site no.	County	Region	Area (ha)	Structure and functions	% in NPWS site	NPWS site no.	% as QI
*1615	Clare	Mid-West	5.00	100% Pass = *Favourable*	100	SAC 20	100
*1616	Clare	Mid-West	2.98	80% Pass = *Unfavourable-Inadequate*	100	SAC 1926	100
*1617	Clare	Mid-West	6.38	100% Pass = *Favourable*	84	SAC 20	84
*1622	Clare	Mid-West	1.82	75% Pass = *Unfavourable-Inadequate*	92	SAC 54	92
*1623	Clare	Mid-West	7.84	67% Pass = *Unfavourable-Bad*	100	SAC 54	100
*1649	Clare	Mid-West	2.24	100% Pass = *Favourable*	100	SAC 1926	100
1654	Clare	Mid-West	7.98	86% Pass = *Unfavourable-Inadequate*	100	SAC 1926	100
*1671	Clare	Mid-West	18.16	89% Pass = *Unfavourable-Inadequate*	9	SAC 20	9
*1672	Clare	Mid-West	1.67	100% Pass = *Favourable*	100	SAC 54	100
*1676	Clare	Mid-West	14.05	75% Pass = *Unfavourable-Inadequate*	100	SAC 1926	100
*1839	Mayo	West	1.69	75% Pass = *Unfavourable-Inadequate*	100	SAC 1774	100
*1853	Mayo	West	3.21	75% Pass = *Unfavourable-Inadequate*	0	-	
*1864	Mayo	West	3.66	67% Pass = *Unfavourable-Bad*	99	SAC 1536	0
*1865	Mayo	West	5.70	50% Pass = *Unfavourable-Bad*	100	SAC 479	0
*2001	Westmeath	Midland	1.19	80% Pass = *Unfavourable-Inadequate*	39	SAC 1831	39
2113	Carlow	South-East	1.11	100% Pass = *Favourable*	99	pNHA 797	
*2259	Galway	West	1.15	75% Pass = *Unfavourable-Inadequate*	0	-	
*2260	Galway	West	1.84	60% Pass = *Unfavourable-Bad*	0	-	
2267	Galway	West	10.41	50% Pass = *Unfavourable-Bad*	0	-	
*2271	Galway	West	1.34	100% Pass = *Favourable*	6	SAC 1926	6
*2273	Galway	West	5.01	100% Pass = *Favourable*	0	-	
*2282	Galway	West	16.34	100% Pass = *Favourable*	0	-	
*2301	Galway	West	1.31	75% Pass = *Unfavourable-Inadequate*	0	-	
2303	Galway	West	7.70	71% Pass = *Unfavourable-Bad*	0	-	
*2307	Galway	West	2.64	75% Pass = *Unfavourable-Inadequate*	99	SAC 606	99
*2310	Galway	West	20.70	100% Pass = *Favourable*	100	SAC 2244	0
*2329	Galway	West	3.38	100% Pass = *Favourable*	11	NHA 254	
*2345	Galway	West	2.00	75% Pass = *Unfavourable-Inadequate*	100	SAC 2241	0
*2500	Kilkenny	South-East	6.59	100% Pass = *Favourable*	100	SAC 831	100
*2701	Limerick	Mid-West	7.47	67% Pass = *Unfavourable-Bad*	78	SAC 432	78
*2704	Limerick	Mid-West	8.48	67% Pass = *Unfavourable-Bad*	22	SAC 2165	0

(b) Primary areas of *6230 *Nardus* grassland

Site no.	County	Region	Area (ha)	Structure and functions	% in NPWS site	NPWS site no.	% as QI
1249	Donegal	Border	1.27	25% Pass = *Unfavourable-Bad*	2	SAC 138	0
1749	Mayo	West	1.19	50% Pass = *Unfavourable-Bad*	100	SAC 534	0
2205	Galway	West	2.22	100% Pass = *Favourable*	9	SAC 2031	0
2401	Kerry	South-West	13.09	50% Pass = *Unfavourable-Bad*	100	SAC 375	0
2415	Kerry	South-West	1.72	100% Pass = *Favourable*	100	SAC 365	0
2434	Kerry	South-West	12.79	75% Pass = *Unfavourable-Inadequate*	100	SAC 375	0

(c) Primary areas of 6410 *Molinia* meadows

Site no.	County	Region	Area (ha)	Structure and functions	% in NPWS site	NPWS site no.	% as QI
107	Offaly	Midland	33.73	100% Pass = *Favourable*	100	SAC 216	100
110	Offaly	Midland	3.82	33% Pass = *Unfavourable-Bad*	91	SAC 216	91
113	Roscommon	West	9.28	50% Pass = *Unfavourable-Bad*	100	SAC 216	100
717	Monaghan	Border	4.78	86% Pass = *Unfavourable-Inadequate*	100	NHA 1603	
802	Leitrim	Border	2.71	100% Pass = *Favourable*	50	SAC 428	0
804	Leitrim	Border	2.50	60% Pass = *Unfavourable-Bad*	23	SAC 428	0
818	Leitrim	Border	1.35	100% Pass = *Favourable*	100	NHA 2435	
837	Leitrim	Border	2.73	50% Pass = *Unfavourable-Bad*	0	-	
874	Leitrim	Border	21.66	50% Pass = *Unfavourable-Bad*	95	pNHA 1643	
881	Leitrim	Border	2.15	50% Pass = *Unfavourable-Bad*	0	-	
893	Leitrim	Border	3.28	100% Pass = *Favourable*	0	-	
947	Longford	Midland	2.41	100% Pass = *Favourable*	100	SAC 1818	0
949	Longford	Midland	4.89	100% Pass = *Favourable*	29	SAC 440	0
1142	Donegal	Border	1.94	80% Pass = *Unfavourable-Inadequate*	0	-	
1157	Donegal	Border	1.04	50% Pass = *Unfavourable-Bad*	0	-	
1248	Donegal	Border	7.34	50% Pass = *Unfavourable-Bad*	0.4	SAC 138	0.4
1249	Donegal	Border	1.01	50% Pass = *Unfavourable-Bad*	98	SAC 138	98
1250	Donegal	Border	13.56	63% Pass = *Unfavourable-Bad*	100	SAC 191	100
1252	Donegal	Border	1.45	75% Pass = *Unfavourable-Inadequate*	0	-	
1402	Kildare	Mid-East & Dublin	1.48	75% Pass = *Unfavourable-Inadequate*	98	pNHA 1772	
1526	Sligo	Border	2.92	100% Pass = *Favourable*	0	-	
1537	Sligo	Border	2.10	75% Pass = *Unfavourable-Inadequate*	20	SAC 636	0
1541	Sligo	Border	9.97	50% Pass = *Unfavourable-Bad*	100	SAC 1898	0
1546	Sligo	Border	1.83	75% Pass = *Unfavourable-Inadequate*	0	-	
1568	Sligo	Border	8.36	100% Pass = *Favourable*	0	-	
1576	Sligo	Border	2.23	75% Pass = *Unfavourable-Inadequate*	0	-	
1603	Clare	Mid-West	6.05	50% Pass = *Unfavourable-Bad*	93	SAC 994	93
1634	Clare	Mid-West	7.55	50% Pass = *Unfavourable-Bad*	0	-	
1655	Clare	Mid-West	2.73	25% Pass = *Unfavourable-Bad*	0	-	
1666	Clare	Mid-West	1.28	75% Pass = *Unfavourable-Inadequate*	33	pNHA 11	
1718	Mayo	West	1.94	75% Pass = *Unfavourable-Inadequate*	0	-	
1744	Mayo	West	4.08	33% Pass = *Unfavourable-Bad*	61	SAC 1899	0
1827	Mayo	West	2.23	50% Pass = *Unfavourable-Bad*	0	-	
2012	Westmeath	Midland	1.04	50% Pass = *Unfavourable-Bad*	100	SAC 440	0
2261	Galway	West	1.73	75% Pass = *Unfavourable-Inadequate*	0	-	
2307	Galway	West	1.06	100% Pass = *Favourable*	100	SAC 606	0
2708	Limerick	Mid-West	5.52	50% Pass = *Unfavourable-Bad*	99	SAC 2165	99

(d) Primary areas of 6430 Hydrophilous tall herb swamp communities

Site no.	County	Region	Area (ha)	Structure and functions	% in NPWS site	NPWS site no.	% as QI
359	Waterford	South-East	1.16	100% Pass = *Favourable*	100	SAC 2170	0
1144	Donegal	Border	3.13	50% Pass = *Unfavourable-Bad*	0	-	
1149	Donegal	Border	1.23	100% Pass = *Favourable*	100	SAC 2176	0
1915	Meath	Mid-East & Dublin	1.05	100% Pass = *Favourable*	100	SAC 2299	0
2708	Limerick	Mid-West	1.10	100% Pass = *Favourable*	100	SAC 2165	0

(e) Primary areas of 6510 Lowland hay meadows

Site no.	County	Region	Area (ha)	Structure and functions	% in NPWS site	NPWS site no.	% as QI
82	Offaly	Midland	5.62	0% Pass = *Unfavourable-Bad*	0	-	
108	Offaly	Midland	6.74	80% Pass = *Unfavourable-Inadequate*	99	SAC 216	99
109	Offaly	Midland	20.58	75% Pass = *Unfavourable-Inadequate*	93	SAC 216	93
111	Roscommon	West	20.34	100% Pass = *Favourable*	100	SAC 216	100
114	Roscommon	West	1.94	50% Pass = *Unfavourable-Bad*	100	SAC 216	100
849	Leitrim	Border	2.90	100% Pass = *Favourable*	11	pNHA	
850	Leitrim	Border	4.09	100% Pass = *Favourable*	0	-	
872	Leitrim	Border	4.20	50% Pass = *Unfavourable-Bad*	0	-	
1051	Cavan	Border	4.16	100% Pass = *Favourable*	0	-	
1248	Donegal	Border	2.09	100% Pass = *Favourable*	0	-	
1282	Donegal	Border	4.07	100% Pass = *Favourable*	0	-	
1300	Dublin	Mid-East & Dublin	4.54	100% Pass = *Favourable*	90	SAC 1209	0
1696	Clare	Mid-West	6.69	60% Pass = *Unfavourable-Bad*	100	SAC 1926	100
1733	Mayo	West	3.38	50% Pass = *Unfavourable-Bad*	3	SAC 2298	0
1735	Mayo	West	5.78	100% Pass = *Favourable*	100	SAC 2298	0
1864	Mayo	West	1.32	75% Pass = *Unfavourable-Inadequate*	0	-	
2000	Westmeath	Midland	2.09	75% Pass = *Unfavourable-Inadequate*	0	-	
2701	Limerick	Mid-West	2.42	75% Pass = *Unfavourable-Inadequate*	66	SAC 432	0
2704	Limerick	Mid-West	5.97	100% Pass = *Favourable*	44	SAC 2165	0
2908	S. Tipperary	South-East	3.34	100% Pass = *Favourable*	0	-	

Table 30: Area in hectares (no. of areas) of primary Annex I grassland identified during the ISGS 2007-2012, by county and Teagasc region. Counties which have no primary Annex I grassland (Cork, Laois, Louth, North Tipperary, Wexford and Wicklow) have been omitted.

County	**[*]6210**	***6230**	**6410**	**6430**	**6510**	***Total***
Border region						
Cavan	4.8 (1)				4.2 (1)	*9.0 (2)*
Donegal	88.4 (6)	1.3 (1)	26.4 (6)	4.4 (2)	6.2 (2)	*126.6 (17)*
Leitrim	39.6 (6)		36.4 (7)		11.2 (3)	*87.2 (16)*
Monaghan			4.8 (1)			*4.8 (1)*
Sligo	58.2 (11)		27.4 (6)			*85.6 (17)*
Total Border region	*191.1 (24)*	*1.3 (1)*	*95.0 (20)*	*4.4 (2)*	*21.5 (6)*	*313.1 (53)*
Mid-East & Dublin region						
Dublin	1.3 (1)				4.5 (1)	*5.9 (2)*
Kildare	1.2 (1)		1.5 (1)			*2.7 (2)*
Meath				1.1 (1)		*1.1 (1)*
Total Mid-East & Dublin region	*2.5 (2)*	*0.0 (0)*	*1.5 (1)*	*1.1 (1)*	*4.5 (1)*	*9.6 (5)*
Midland region						
Longford			7.3 (2)			*7.3 (2)*
Offaly	19.7 (5)		37.5 (2)		33.0 (3)	*90.2 (10)*
Westmeath	1.2 (1)		1.0 (1)		2.1 (1)	*4.3 (3)*
Total Midland region	*20.9 (6)*	*0.0 (0)*	*45.8 (5)*	*0.0 (0)*	*35.1 (4)*	*101.8 (15)*
Mid-West region						
Clare	77.5 (13)		17.6 (4)		6.7 (1)	*101.8 (18)*
Limerick	16.0 (2)		5.5 (1)	1.1 (1)	8.4 (2)	*31.0 (6)*
Total Mid-West region	*93.5 (15)*	*0.0 (0)*	*23.1 (5)*	*1.1 (1)*	*15.1 (3)*	*132.8 (24)*
South-East region						
Carlow	1.1 (1)					*1.1 (1)*
Kilkenny	6.6 (1)					*6.6 (1)*
S. Tipperary					3.3 (1)	*3.3 (1)*
Waterford				1.2 (1)		*1.2 (1)*
Total South-East region	*7.7 (2)*	*0.0 (0)*	*0.0 (0)*	*1.2 (1)*	*3.3 (1)*	*12.2 (4)*
South-West region						
Kerry		27.6 (3)				*27.6 (3)*
Total South-West region	*0.0 (0)*	*27.6 (3)*	*0.0 (0)*	*0.0 (0)*	*0.0 (0)*	*27.6 (3)*
West region						
Galway	73.8 (12)	2.2 (1)	2.8 (2)			*78.8 (15)*
Mayo	14.3 (4)	1.2 (1)	8.3 (3)		10.5 (3)	*34.2 (11)*
Roscommon	30.3 (2)		9.3 (1)		22.2 (2)	*61.8 (5)*
Total West Region	*118.3 (18)*	*3.4 (2)*	*20.3 (6)*	*0.0 (0)*	*32.7 (5)*	*174.8 (31)*
Total in ISGS	***433.9 (67)***	***32.3 (6)***	***185.8 (37)***	***7.7 (5)***	***112.2 (20)***	***771.9 (135)***

3.6.7 Areas of priority Annex I habitat *6210 – important orchid sites

The [*]6210 relevé data were examined to determine what sites, if any, could be considered for qualification as the priority orchid-rich variant *6210. The [*]6210 assessment information sheet in Appendix 1 gives a list of the orchid species found in this survey that were used to make this determination. Table 31 gives a list of sites with monitoring stops that contained at least one of the relevant orchid species. This should only be regarded as a preliminary list of *6210 sites; it does not mean that all other [*]6210 sites absent from the list are the non-priority 6210, nor does it imply that priority status has been confirmed for these 64 sites. It does, however, indicate the possibility that the priority habitat is present on these sites and may determine the direction of future monitoring and management of the sites.

Table 31: Preliminary list of 64 sites containing Annex I habitat that may qualify as the priority orchid-rich *6210 variant, based on data recorded during the ISGS.

Site no.	Site name	County	Region
1	All Saint's Bog	Offaly	Midland
3	Ridge Road	Offaly	Midland
8	Drumakeenan, Eagle Hill and Perry's Mill	Offaly	Midland
215	Carrickmore	Roscommon	West
224	Cloonfineen	Roscommon	West
815	Sheemore	Leitrim	Border
825	Ballynaboll	Leitrim	Border
826	Gortermone	Leitrim	Border
850	Letterfine	Leitrim	Border
1061	Crossrah	Cavan	Border
1250	St. John's Point	Donegal	Border
1266	Legaltan	Donegal	Border
1270	Cashelard	Donegal	Border
1272	Garvanagh	Donegal	Border
1283	Ballynacarrick	Donegal	Border
1324	Newbridge Demesne	Dublin	Mid-East & Dublin
1513	Farranyharpy	Sligo	Border
1519	Greenan (Sligo)	Sligo	Border
1556	Clogher Beg	Sligo	Border
1608	Ballyelly	Clare	Mid-West
1612	Cahermaclanchy	Clare	Mid-West
1615	Lislarheenmore	Clare	Mid-West
1616	Keelhilla	Clare	Mid-West
1617	Murrooghkilly	Clare	Mid-West
1622	Cahergrillaun	Clare	Mid-West
1623	Rannagh West	Clare	Mid-West
1625	Bishopsquarter	Clare	Mid-West
1649	Clab	Clare	Mid-West
1668	Mogouhy Lead Mines	Clare	Mid-West
1671	Derreen West	Clare	Mid-West
1672	Deelin More	Clare	Mid-West
1676	Poulaphuca	Clare	Mid-West
1839	Annies	Mayo	West

Table 31 (continued)

Site no.	Site name	County	Region
1853	Lissanisky	Mayo	West
1864	Knocknageeha	Mayo	West
1865	Ballisnahyny	Mayo	West
1909	Baltrasna Esker	Meath	Mid-East & Dublin
2001	Ballymachugh	Westmeath	Midland
2003	Toorfelim	Westmeath	Midland
2015	Derrya	Westmeath	Midland
2249	Carrowmoreknock	Galway	West
2253	Ballydotia	Galway	West
2259	Garraun North	Galway	West
2260	Kilcurriv Eighter	Galway	West
2269	Ballybranagan	Galway	West
2270	Inishroo	Galway	West
2271	Leagh South	Galway	West
2273	Ballybuck South	Galway	West
2282	Frenchfort	Galway	West
2299	Inishmore Island West	Galway	West
2301	Grange (Galway)	Galway	West
2307	Cartron (E.D. Drumacoo)	Galway	West
2310	Ardrahan Grasslands	Galway	West
2317	Dunblaney	Galway	West
2320	Cloonshivna (Kelly)	Galway	West
2329	Killure More	Galway	West
2337	Cloonascragh	Galway	West
2345	Portumna Demesne	Galway	West
2500	Coolnacrutta	Kilkenny	South-East
2501	Ballyspellan	Kilkenny	South-East
2701	Barrigone	Limerick	Mid-West
2703	Toryhill	Limerick	Mid-West
2704	Aughinish	Limerick	Mid-West
2912	Clonmakilladuff	N. Tipperary	Mid-West

3.7 Vegetation classification

3.7.1 Ordination of relevé data

The final solution to the non-metric multidimensional scaling (NMS) ordination (Figure 15) had a stress of 24%, which is reasonable given the large size of the dataset. Centroids for each community were calculated from the mean co-ordinates of their constituent relevés. Relevés from Groups 2, 3 and 4 are fairly well-clustered, while relevés from Group 1 display considerably greater dispersion and overlap. In particular, community 1b is close to Group 2 and community 4d is close to Group 1.

Correlation analyis (Pearson correlation coefficient) was run using function COR in package STATS to compare centroid co-ordinates on the two axes with thirteen summary variables: species richness, forb height, graminoid height, forb proportion, altitude, slope, soil pH, soil organic content, soil total phosphorus, light, wetness, reaction and fertility. These variables were calculated as means of the core relevés. Species richness was calculated from the original data matrix before exclusion of rare species. Light, wetness, reaction and fertility were mean cover-weighted Ellenberg scores calculated by the *Modular Analysis of Vegetation Information System* (MAVIS; Centre for Ecology and Hydrology) based on the British and Irish calibrations for vascular plants. The results of the correlation analysis are shown as a joint plot in Figure 16; the angle and length of the lines indicates the direction and strength of the relationship. Axis 1 primarily represents a fertility/slope/richness gradient, with species-poor communities from fertile soils on flat land occurring towards the lower end of the axis, and species-rich communities from low-fertility soils on sloping land occurring towards the higher end of the axis. Axis 2 primarily represents a soil pH/organic content/wetness gradient with communities from wet, acidic, peaty soils lower on the axis and communities of dry, base-rich, mineral soils higher on the axis.

3.7.2 Presentation of the vegetation classification

An overview of the classification is presented in Table 32. IndVals at the group level are presented in Table 33. Maps for each group (Figure 17) indicate the distribution of the groups at the hectad scale, with the occurrence of core relevés indicated by dark symbols and the occurrence of non-core relevés indicated by pale symbols.

Descriptions, summary data, photographs and maps (colour-coded in the same way as the groups) for each community are presented on pages 88-133. Quantitative affinities with Fossitt (2000) and Annex I habitat categories in terms of percentages of core relevés are presented. The top three matches with grassland sub-communities of the NVC (Rodwell 1991 *et. seq.*), as defined by MAVIS, are listed. The EUNIS Habitat Classification 200711 category that corresponds to the top NVC match, as classified at http://eunis.eea.europa.eu/habitats-code.jsp, is also presented. Subjective affinities with phytosociological alliances of the Zürich-Montpellier school (ZM) are given following the conspectus presented by Rodwell *et al.* (2002) with guidance from Rodwell (2000).

Under 'Environmental data', the number of core relevés and the total number of relevés assigned to that community are presented, together with the summary variables used in the ordination analysis above. A synoptic table includes the floristic data from the core relevés for the 30 most frequent

species. Under 'Freq' (frequency) the percentage of relevés in which each species occurs, irrespective of how much is present, 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 = 80.1-100.0%; note that in the descriptions, species with frequencies of IV or V are referred to as 'constants'. Under 'Cover', the minimum, median and maximum Domin values for each species are presented. Under 'Ind' (indicator) the significant IndVals are indicated by a symbol, where ① = 0.1 – 20.0%, ② = 20.1 – 40.0%, ③ = 40.1 – 60.0%, ④ = 60.1 – 80.0% and ⑤ = 80.1 – 100%, together with the letters of the communities with which each indicator species is associated within that group.

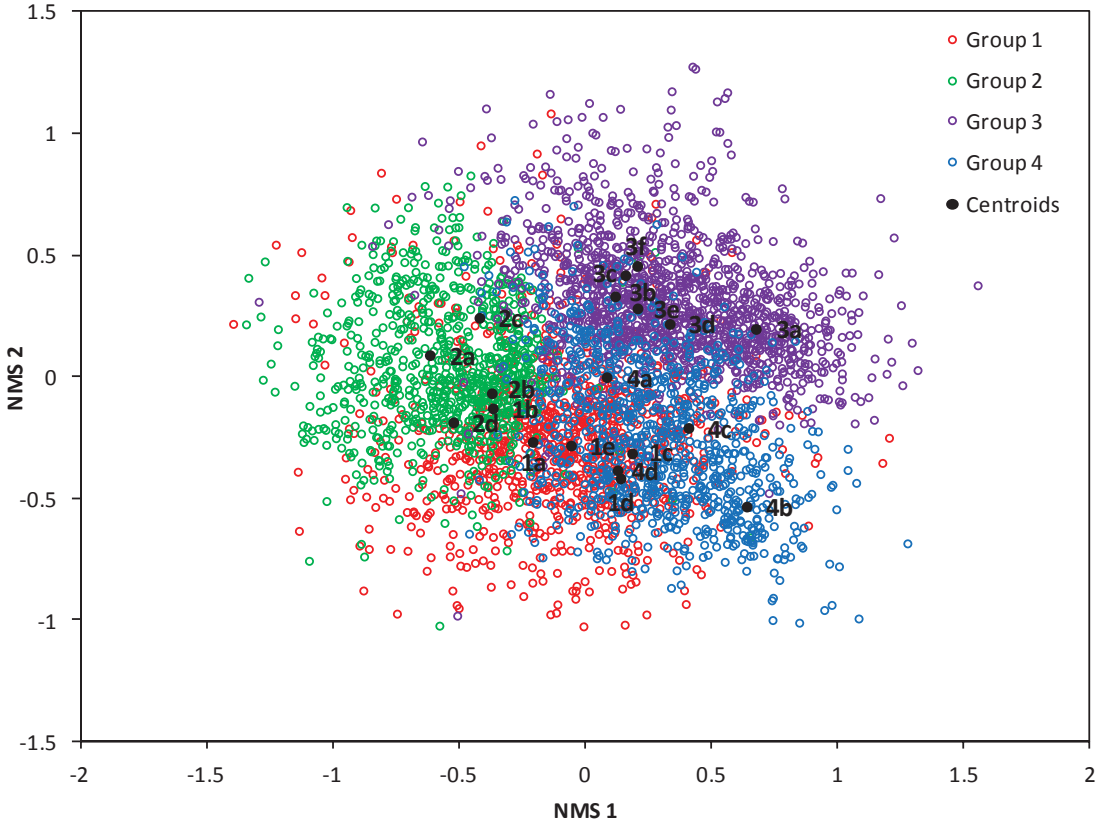


Figure 15: NMS ordination of 4,471 relevés coloured by group with vegetation community centroids.

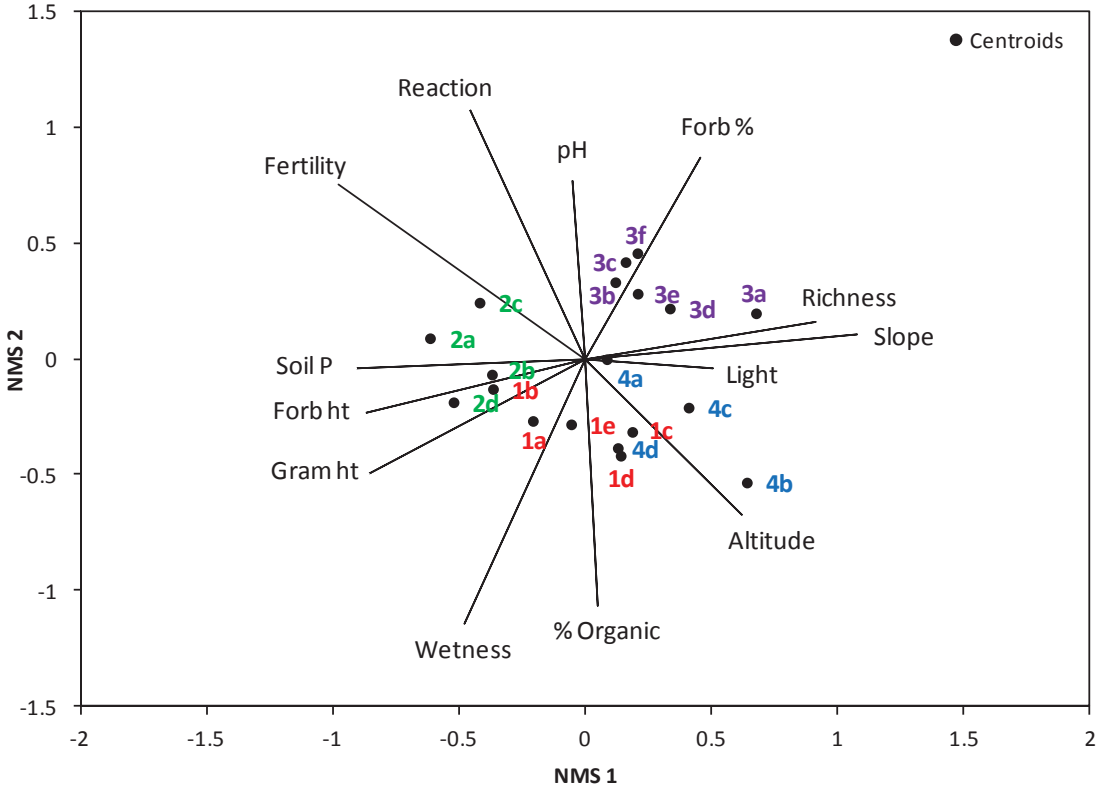


Figure 16: Correlation of summary variables with vegetation community centroids.

Table 32: Overview of the grasslands classification.

Group/community	Fossitt[1]	Annex[2]	NVC	EUNIS	Zürich-Montpellier school	*n* = (core)	*n* = (all)
1. *Juncus acutiflorus/articulatus – Molinia caerulea*							
1a. *Juncus acutiflorus/articulatus – Holcus lanatus*	GS4	6410	M23b	E3.42	Juncion acutiflori	84	241
1b. *Agrostis stolonifera – Filipendula ulmaria*	GS4/GM1	6410	M23a	E3.42	Filipendulion/Calthion palustris	91	278
1c. *Molinia caerulea – Succisa pratensis*	GS4	6410	M26b	E3.51	Junco-Molinion	50	178
1d. *Molinia caerulea – Potentilla erecta*	GS4	6410	M24c	E3.51	Junco-Molinion	61	136
1e. *Juncus acutiflorus/articulatus – Rhytidiadelphus squarrosus*	GS4	6410	M23b	E3.42	Juncion acutiflori	62	92
2. *Juncus effusus – Ranunculus repens*							
2a. *Agrostis stolonifera – Ranunculus repens*	GS4/GM1	-	MG10a	E3.44	Calthion palustris	142	265
2b. *Juncus effusus – Holcus lanatus*	GS4	-	MG10a	E3.44	Junci acutiflori	206	356
2c. *Holcus lanatus – Lolium perenne*	GA1/GS4	-	MG10a	E3.44	Calthion palustris	212	355
2d. *Juncus effusus – Rumex acetosa*	GS4	-	M23b	E3.42	Juncion acutiflori	230	301
3. *Cynosurus cristatus – Plantago lanceolata*							
3a. *Briza media – Thymus polytrichus*	GS1	6210	CG9b	E1.26	Bromion erecti/Xerobromion	149	401
3b. *Cynosurus cristatus – Trifolium repens*	GS1/GA1	-	MG6b	E2.11	Cynosurion cristati	60	234
3c. *Festuca rubra – Plantago lanceolata*	GS2	6510	MG5a	E2.11	Cynosurion cristati/Arrhenatherion	70	188
3d. *Cynosurus cristatus – Trifolium pratense*	GS1	-	MG6b	E2.11	Cynosurion cristati	69	153
3e. *Festuca rubra – Rhinanthus minor*	GS2	6510	MG5a	E2.11	Cynosurion cristati	64	112
3f. *Festuca rubra – Lotus corniculatus*	GS1	-	MC9a	B3.31	Silenion maritimae/Cynosurion cristati	69	274
4. *Nardus stricta – Galium saxatile*							
4a. *Agrostis capillaris – Trifolium repens*	GS3/GS4	-	U4b	E1.72	Violinion caninae	163	313
4b. *Nardus stricta – Festuca ovina*	GS3	6230	U5d	E1.71	Violinion caninae	160	191
4c. *Agrostis capillaris – Festuca rubra*	GS3	6230	U5c	E1.71	Violinion caninae	114	216
4d. *Agrostis canina/vinealis – Carex echinata*	GS4	6410	M25b	E3.51	Junco-Molinion	135	209

[1] Categories shown with ≥25% correlation; [2] Categories shown with ≥10% correlation, those underlined have ≥25% correlation

Table 32 (continued)

Group/community	Species Richness	Forb height (cm)	Graminoid height (cm)	Forb proportion (%)	Altitude (m)	Slope (°)	Soil pH	Soil % organic	Soil P (mg/g)
1. *Juncus acutiflorus/articulatus – Molinia caerulea*									
1a. *Juncus acutiflorus/articulatus – Holcus lanatus*	18	36	53	28	74	2	4.9	30	0.72
1b. *Agrostis stolonifera – Filipendula ulmaria*	24	28	38	41	45	0	5.5	37	0.58
1c. *Molinia caerulea – Succisa pratensis*	29	23	39	35	84	3	5.6	38	0.13
1d. *Molinia caerulea – Potentilla erecta*	19	39	56	26	76	3	5.0	37	0.66
1e. *Juncus acutiflorus/articulatus – Rhytidiadelphus squarrosus*	25	15	35	27	88	3	4.8	29	0.59
2. *Juncus effusus – Ranunculus repens*									
2a. *Agrostis stolonifera – Ranunculus repens*	15	31	35	34	50	0	5.5	27	0.86
2b. *Juncus effusus – Holcus lanatus*	19	27	48	23	91	2	5.0	26	0.80
2c. *Holcus lanatus – Lolium perenne*	13	22	31	26	84	4	5.1	18	0.98
2d. *Juncus effusus – Rumex acetosa*	13	38	81	16	98	1	4.8	29	0.73
3. *Cynosurus cristatus – Plantago lanceolata*									
3a. *Briza media – Thymus polytrichus*	46	7	12	50	92	13	6.2	29	0.23
3b. *Cynosurus cristatus – Trifolium repens*	27	9	15	42	83	9	5.4	16	0.79
3c. *Festuca rubra – Plantago lanceolata*	23	28	35	50	67	5	5.8	19	0.39
3d. *Cynosurus cristatus – Trifolium pratense*	28	11	15	44	95	10	5.0	18	0.51
3e. *Festuca rubra – Rhinanthus minor*	24	28	30	58	63	3	5.2	14	0.39
3f. *Festuca rubra – Lotus corniculatus*	19	10	13	39	34	10	5.2	24	0.37
4. *Nardus stricta – Galium saxatile*									
4a. *Agrostis capillaris – Trifolium repens*	17	12	22	22	132	9	4.6	21	0.48
4b. *Nardus stricta – Festuca ovina*	22	6	13	20	249	16	4.1	38	0.62
4c. *Agrostis capillaris – Festuca rubra*	27	11	19	31	148	14	4.6	27	0.27
4d. *Agrostis canina/vinealis – Carex echinata*	21	16	30	27	106	5	4.2	33	0.52

Table 32 (continued)

Group/community	Ellenberg Light	Ellenberg Wetness	Ellenberg Reaction	Ellenberg Fertility
1. *Juncus acutiflorus/articulatus – Molinia caerulea*				
1a. *Juncus acutiflorus/articulatus – Holcus lanatus*	7.0	7.0	5.0	4.0
1b. *Agrostis stolonifera – Filipendula ulmaria*	7.3	6.7	5.9	4.8
1c. *Molinia caerulea – Succisa pratensis*	7.4	6.8	4.9	3.4
1d. *Molinia caerulea – Potentilla erecta*	7.1	7.2	4.3	3.2
1e. *Juncus acutiflorus/articulatus – Rhytidiadelphus squarrosus*	7.4	7.1	4.4	3.4
2. *Juncus effusus – Ranunculus repens*				
2a. *Agrostis stolonifera – Ranunculus repens*	7.0	6.7	6.2	5.5
2b. *Juncus effusus – Holcus lanatus*	7.0	6.4	5.4	4.7
2c. *Holcus lanatus – Lolium perenne*	7.0	5.8	6.1	5.4
2d. *Juncus effusus – Rumex acetosa*	7.0	6.7	4.9	4.4
3. *Cynosurus cristatus – Plantago lanceolata*				
3a. *Briza media – Thymus polytrichus*	7.3	5.3	5.6	2.6
3b. *Cynosurus cristatus – Trifolium repens*	7.1	5.2	5.7	4.7
3c. *Festuca rubra – Plantago lanceolata*	7.2	5.1	6.2	4.8
3d. *Cynosurus cristatus – Trifolium pratense*	7.1	5.3	5.4	4.1
3e. *Festuca rubra – Rhinanthus minor*	7.2	5.3	5.6	4.2
3f. *Festuca rubra – Lotus corniculatus*	7.6	5.2	5.8	4.3
4. *Nardus stricta – Galium saxatile*				
4a. *Agrostis capillaris – Trifolium repens*	7.0	5.9	4.6	3.8
4b. *Nardus stricta – Festuca ovina*	7.1	6.4	4.0	2.7
4c. *Agrostis capillaris – Festuca rubra*	7.3	6.4	4.6	3.1
4d. *Agrostis canina/vinealis – Carex echinata*	7.6	7.2	4.1	2.7

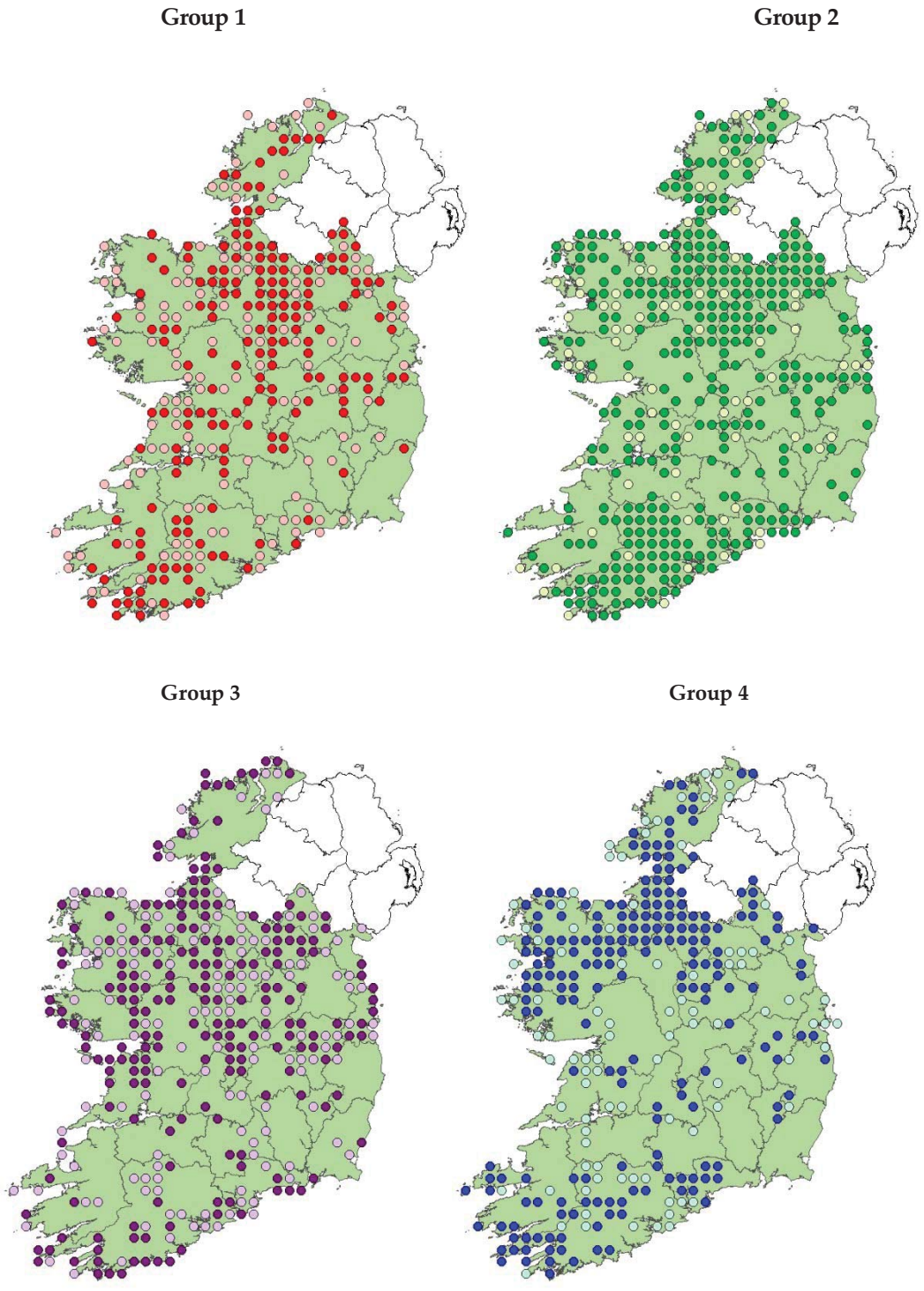


Figure 17: Hectad maps showing the distribution of each group, with dark symbols indicating occurrence of core relevés and pale symbols indicating occurrence of non-core relevés. Sampling intensity was not consistent across the country, with Cork, Waterford and northern counties sampled more intensively.

Table 33: Groups of grassland vegetation types defined by fuzzy analysis. Species listed are the best significant indicators as defined by Indicator Species Analysis. Values are percentages. Indicators are listed for one group if IndVal ≥ 20%, for two groups if IndVal ≥ 40% and for three groups if IndVal ≥ 50%.

1 ***Juncus acutiflorus/articulatus – Molinia caerulea* group**

Peaty wet grassland and marsh **348 relevés**

Indicator	IndVal	Groups	Indicator	IndVal	Groups
Juncus acutiflorus/articulatus	77.1	1	*Cardamine pratensis*	59.1	1,2
Carex nigra	57.1	1	*Molinia caerulea*	51.5	1,4
Mentha aquatica	53.2	1	*Agrostis canina /vinealis*	51.1	1,4
Lychnis flos-cuculi	39.6	1	*Ranunculus flammula*	51.0	1,2
Cirsium dissectum	37.6	1	*Poa trivialis*	45.6	1,2
Hydrocotyle vulgaris	33.8	1	*Lotus pedunculatus*	44.2	1,2
Juncus conglomeratus	33.7	1	*Carex echinata*	44.0	1,4
Equisetum palustre	32.7	1	*Leontodon autumnalis*	43.3	1,3
Climacium dendroides	31.7	1	*Senecio aquaticus*	43.3	1,2
Potentilla palustris	30.6	1			
Angelica sylvestris	30.0	1	*Anthoxanthum odoratum*	84.4	1,3,4
Caltha palustris	26.0	1	*Holcus lanatus*	82.9	1,2,4
Valeriana officinalis	23.4	1	*Rhytidiadelphus squarrosus*	80.3	1,3,4
Hypericum tetrapterum	21.1	1	*Festuca rubra*	79.3	1,3,4
Triglochin palustre	20.1	1	*Potentilla erecta*	74.3	1,3,4
			Trifolium repens	73.5	1,3,4
Agrostis stolonifera	85.6	1,2	*Calliergonella cuspidata*	72.4	1,2,3
Juncus effusus	71.4	1,2	*Ranunculus acris*	63.0	1,2,3
Carex flacca	70.1	1,3	*Succisa pratensis*	61.2	1,3,4
Ranunculus repens	69.4	1,2	*Carex panicea*	59.8	1,3,4
Prunella vulgaris	65.0	1,3	*Cerastium fontanum*	59.3	1,2,3
Filipendula ulmaria	62.4	1,2	*Rumex acetosa*	57.4	1,2,4
Galium palustre	61.5	1,2	*Brachythecium rutabulum*	51.0	1,2,3

2 ***Juncus effusus – Ranunculus repens* group**

Mesotrophic wet grassland **790 relevés**

Indicator	IndVal	Groups	Indicator	IndVal	Groups
Alopecurus pratensis	33.8	2	*Ranunculus flammula*	51.0	1,2
Glyceria fluitans	31.5	2	*Lolium perenne*	50.9	2,3
Alopecurus geniculatus	25.2	2	*Poa trivialis*	45.6	1,2
Rumex obtusifolius	24.7	2	*Lotus pedunculatus*	44.2	1,2
Rumex crispus	22.9	2	*Senecio aquaticus*	43.3	1,2
Agrostis stolonifera	85.6	1,2	*Holcus lanatus*	82.9	1,2,4
Juncus effusus	71.4	1,2	*Calliergonella cuspidata*	72.4	1,2,3
Ranunculus repens	69.4	1,2	*Ranunculus acris*	63.0	1,2,3
Filipendula ulmaria	62.4	1,2	*Cerastium fontanum*	59.3	1,2,3
Galium palustre	61.5	1,2	*Rumex acetosa*	57.4	1,2,4
Cardamine pratensis	59.1	1,2	*Brachythecium rutabulum*	51.0	1,2,3

Table 33 (continued)

3	*Cynosurus cristatus – Plantago lanceolata* group	
	Dry calcareous and neutral grassland	1088 relevés

Indicator	IndVal	Groups	Indicator	IndVal	Groups
Plantago lanceolata	82.6	3	*Trisetum flavescens*	24.8	3
Lotus corniculatus	80.3	3	*Homalothecium lutescens*	24.7	3
Trifolium pratense	77.3	3	*Alchemilla filicaulis*	24.2	3
Centaurea nigra	72.3	3	*Heracleum sphondylium*	24.1	3
Galium verum	68.5	3	*Antennaria dioica*	23.9	3
Dactylis glomerata	68.3	3	*Centaurium erythraea*	23.9	3
Cynosurus cristatus	66.4	3	*Neckera crispa*	23.5	3
Achillea millefolium	63.8	3	*Ditrichum gracile*	23.3	3
Leucanthemum vulgare	61.8	3	*Carlina vulgaris*	22.9	3
Briza media	61.4	3	*Trifolium dubius*	22.8	3
Euphrasia officinalis agg.	60.5	3	*Rosa spinosissima*	21.8	3
Linum catharticum	60.4	3	*Geranium sangineum*	21.7	3
Pilosella officinarum	54.0	3	*Scapania aspera*	21.1	3
Ranunculus bulbosus	53.9	3	*Gymnadenia conopsea*	20.6	3
Bellis perennis	53.5	3	*Primula vulgaris*	20.4	3
Ctenidium molluscum	51.9	3	*Solidago virgaurea*	20.0	3
Koeleria macrantha	51.7	3			
Thymus polytrichus	51.0	3	*Agrostis capillaris*	77.3	3,4
Helictotrichon pubescens	50.3	3	*Carex flacca*	70.1	1,3
Senecio jacobaea	49.3	3	*Scleropodium purum*	68.9	3,4
Carex caryophyllea	46.6	3	*Hypochaeris radicata*	65.6	3,4
Rhinanthus minor	45.0	3	*Prunella vulgaris*	65.0	1,3
Daucus carota	44.0	3	*Luzula campestris*	51.8	3,4
Sesleria caerulea	43.8	3	*Lolium perenne*	50.9	2,3
Leontodon hispidus	39.9	3	*Thuidium tamariscinum/delicatulum*	50.8	3,4
Campanula rotundifolia	39.8	3	*Danthonia decumbens*	47.4	3,4
Polygala vulgaris	39.3	3	*Festuca ovina*	45.8	3,4
Fissidens adianthoides/dubius	37.9	3	*Viola riviniana*	44.8	3,4
Hypnum lacunosum	37.7	3	*Leontodon autumnalis*	43.3	1,3
Plantago maritima	36.4	3			
Anthyllis vulneraria	36.3	3	*Anthoxanthum odoratum*	84.4	1,3,4
Conopodium majus	36.1	3	*Rhytidiadelphus squarrosus*	80.3	1,3,4
Hypericum pulchrum	35.4	3	*Festuca rubra*	79.3	1,3,4
Pimpinella saxifraga	34.4	3	*Potentilla erecta*	74.3	1,3,4
Tortella tortuosa	34.0	3	*Trifolium repens*	73.5	1,3,4
Veronica chamaedrys	33.7	3	*Calliergonella cuspidata*	72.4	1,2,3
Rhytidiadelphus triquetrus	33.0	3	*Ranunculus acris*	63.0	1,2,3
Primula veris	29.7	3	*Succisa pratensis*	61.2	1,3,4
Leontodon saxatilis	28.2	3	*Carex panicea*	59.8	1,3,4
Crepis capillaris	27.7	3	*Cerastium fontanum*	59.3	1,2,3
Pteridium aquilinum	26.7	3	*Brachythecium rutabulum*	51.0	1,2,3
Medicago lupulina	25.6	3			

Table 33 (continued)

4	*Nardus stricta – Galium saxatile* group		
	Dry-humid acid grassland		718 relevés

Indicator	IndVal	Groups	Indicator	IndVal	Groups
Hylocomium splendens	71.9	4	*Agrostis capillaris*	77.3	3,4
Galium saxatile	71.2	4	*Scleropodium purum*	68.9	3,4
Nardus stricta	64.2	4	*Hypochaeris radicata*	65.6	3,4
Luzula multiflora	53.9	4	*Luzula campestris*	51.8	3,4
Carex binervis	49.6	4	*Molinia caerulea*	51.5	1,4
Rhytidiadelphus loreus	39.1	4	*Agrostis canina/vinealis*	51.1	1,4
Polytrichum formosum	38.2	4	*Thuidium tamariscinum/delicatulum*	50.8	3,4
Juncus squarrosus	37.3	4	*Danthonia decumbens*	47.4	3,4
Carex pilulifera	37.0	4	*Festuca ovina*	45.8	3,4
Calluna vulgaris	36.1	4	*Viola riviniana*	44.8	3,4
Pedicularis sylvatica	33.3	4	*Carex echinata*	44.4	1,4
Polytrichum commune	32.3	4			
Polygala serpyllifolia	29.1	4	*Anthoxanthum odoratum*	84.4	1,3,4
Hypnum jutlandicum	28.7	4	*Holcus lanatus*	82.9	1,2,4
Vaccinium myrtillus	27.4	4	*Rhytidiadelphus squarrosus*	80.3	1,3,4
Festuca vivipara	26.6	4	*Festuca rubra*	79.3	1,3,4
Diplophyllum albicans	24.1	4	*Potentilla erecta*	74.3	1,3,4
Blechnum spicant	21.8	4	*Trifolium repens*	73.5	1,3,4
Pleurozium schreberi	20.9	4	*Succisa pratensis*	61.2	1,3,4
Scapania gracilis	20.8	4	*Carex panicea*	59.8	1,3,4
			Rumex acetosa	57.4	1,2,4

1a *Juncus acutiflorus/articulatus – Holcus lanatus* grassland

This is a rather species-poor, marshy grassland community of mildly acidic, organic gley soils or peats. *Juncus acutiflorus/articulatus* is the main component, usually forming a tall sward with *Holcus lanatus*, *Anthoxanthum odoratum* and *Agrostis stolonifera*. *Filipendula ulmaria* is also a constant and can be abundant. Other frequent forbs include *Rumex acetosa*, *Ranunculus repens*, *Ranunculus acris*, *Galium palustre*, *Lathyrus pratensis* and *Lotus pedunculatus*. *Juncus effusus* is fairly frequent but is never as abundant as it can be in the more mesotrophic wet grasslands of Group 2. The chief bryophyte is *Calliergonella cuspidata*, which grows alongside *Kindbergia praelonga*, *Rhytidiadelphus squarrosus* and *Brachythecium rutabulum*. There are usually few signs of agricultural improvement in this grassland, which occurs across the country but has been recorded particularly frequently in Cork and in association with drumlins in Leitrim.

Affinities:

Fossitt: GM1 - 8.3% GS1 - 0.0% GS2 - 0.0% GS3 - 0.0% GS4 - 91.7% GA1 - 0.0%

Annex I: 6210 - 0.0% 6230 - 0.0% 6410 - 16.7% 6430 - 2.4% 6510 - 0.0%

NVC: M23b *Juncus effusus/acutiflorus-Galium palustre* rush-pasture *Juncus effusus* sub-com. (61.9%)
MG9a *Holcus lanatus-Deschampsia cespitosa* grassland *Poa trivialis* sub-com. (61.3%)
M23a *Juncus effusus/acutiflorus-Galium palustre* rush-pasture *Juncus acutiflorus* sub-com. (61.1%)

EUNIS: E3.42 *Juncus acutiflorus* meadows

ZM: Juncion acutiflori

Environmental data:

Number of relevés:	84 (core) 241 (all)		Soil pH:	4.9	(*n* = 61)
Species richness:	18	(*n* = 84)	Soil organic content:	30 %	(*n* = 50)
Forb height:	36 cm	(*n* = 84)	Soil P:	0.72 mg/g	(*n* = 50)
Graminoid height:	53 cm	(*n* = 84)	Ellenberg Light:	7.0	
Forb proportion:	28 %	(*n* = 84)	Ellenberg Wetness:	7.0	
Altitude:	74 m	(*n* = 84)	Ellenberg Reaction:	5.0	
Slope:	2 °	(*n* = 84)	Ellenberg Fertility:	4.0	

Table 34: Synoptic table for core relevés in community 1a.

Species	Freq	Cover	Ind		Species	Freq	Cover	Ind	
Juncus acutiflorus/articulatus	V	4-(7)-9	a,c,e	⑤	*Rhytidiadelphus squarrosus*	II	+-(2)-5		
Holcus lanatus	V	1-(5)-7	a,c,e	⑤	*Trifolium repens*	II	1-(2)-5		
Anthoxanthum odoratum	V	+-(4)-7	a,c,e	⑤	*Brachythecium rutabulum*	II	+-(2)-5	a,c,e	③
Agrostis stolonifera	IV	1-(4)-8	a,b,d	④	*Cardamine pratensis*	II	+-(2)-5		
Filipendula ulmaria	IV	+-(4)-8	a,b,d	④	*Potentilla erecta*	II	+-(3)-5		
Rumex acetosa	III	+-(2)-6	a,b,e	④	*Cerastium fontanum*	II	+-(2)-3	a,c,e	③
Festuca rubra	III	1-(3)-8	a,c,d	④	*Poa trivialis*	II	1-(3)-6	a,b,e	③
Ranunculus acris	III	+-(2)-7	a,c,e	④	*Cirsium palustre*	II	+-(2)-4	a,c,e	③
Calliergonella cuspidata	III	1-(2)-6			*Plantago lanceolata*	II	+-(2)-4		
Ranunculus repens	III	+-(2)-6	a,b,e	④	*Ranunculus flammula*	II	+-(2)-3		
Galium palustre	III	+-(2)-5			*Poa humilis/pratensis*	I	+-(2)-5	a,b,e	③
Lathyrus pratensis	III	+-(3)-6	a,b,c	③	*Agrostis capillaris*	I	2-(4)-6	a,e	③
Lotus pedunculatus	III	+-(3)-9	a,d,e	③	*Epilobium obscurum*	I	+-(2)-3	a	②
Kindbergia praelonga	II	+-(2)-3	a,d	③	*Epilobium palustre*	I	+-(2)-3		
Juncus effusus	II	1-(3)-4			*Angelica sylvestris*	I	+-(3)-4	a,c,d	②

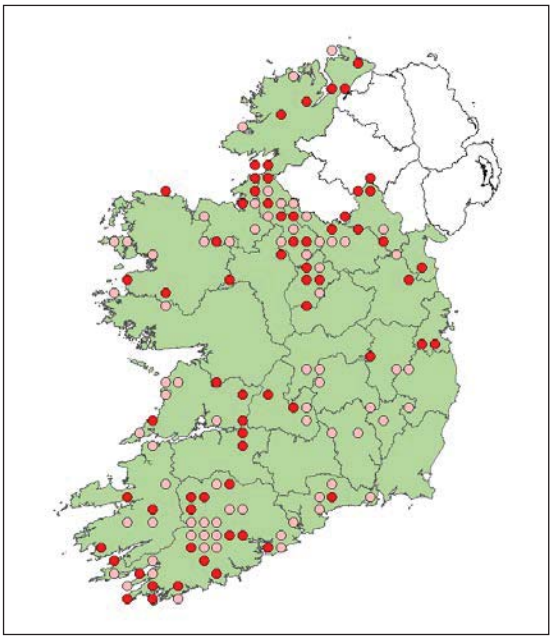


Figure 18: Distribution map community 1a.

Plate 1: Community 1a (relevé 618/03) Kilcolman Bog Nature Reserve, Cork.

1b *Agrostis stolonifera – Filipendula ulmaria* marsh-grassland

The *Agrostis-Filipendula* marsh-grassland occurs on basin peats and gleys on seasonally flooded level ground. Broadleaved herbs are at their most abundant here out of all the wet grassland communities, with grass species being much less prominent. Nevertheless, *Agrostis stolonifera* is the most frequent species, with *Festuca rubra* and *Holcus lanatus* also often found. Sedges are a noteworthy component of the assemblage, with *Carex nigra* being a constant species and often plentiful, while *Carex disticha*, *C. panicea* and *C. flacca* may also occur. *Filipendula ulmaria* is the mainstay of the forb cover, typically accompanied by *Galium palustre*, *Ranunculus repens*, *Cardamine pratensis* and *Trifolium repens*, and less frequently by *Mentha aquatica*, *Ranunculus flammula*, *Potentilla anserina* and *Caltha palustris*. *Calliergonella cuspidata* is also a constant and may be the only bryophyte present but it can be very abundant. On the wettest sites, *Equisetum fluviatile* and *E. palustre* may occur. This community is found mainly in the midlands and the west, being scarcer in the east and south.

Affinities:

Fossitt: GM1 - 26 .4% GS1 - 2.2% GS2 - 1.1% GS3 - 0.0% GS4 - 70.3% GA1 - 0.0%

Annex I: 6210 - 0.0% 6230 - 0.0% 6410 - 20.9% 6430 - 5.5% 6510 - 1.1%

NVC: M23a *Juncus effusus/acutiflorus-Galium palustre* rush-pasture *Juncus acutiflorus* sub-com (57.1%)
M23b *Juncus effusus/acutiflorus-Galium palustre* rush-pasture *Juncus effusus* sub-com. (52.6%)
M22b *Juncus subnodulosus-Cirsium palustre* fen-meadow *Briza media-Trifolium* spp. sub-com. (51.9%)
(also has high affinity with SD17 *Potentilla anserina-Carex nigra* dune-slack community)

EUNIS: E3.42 *Juncus acutiflorus* meadows

ZM: Filipendulion/Calthion palustris

Environmental data:

Number of relevés:	91 (core) 278 (all)		Soil pH:	5.5	(n = 70)
Species richness:	24	(n = 91)	Soil organic content:	37 %	(n = 63)
Forb height:	28 cm	(n = 91)	Soil P:	0.58 mg/g	(n = 54)
Graminoid height:	38 cm	(n = 91)	Ellenberg Light:	7.3	
Forb proportion:	41 %	(n = 91)	Ellenberg Wetness:	6.7	
Altitude:	45 m	(n = 91)	Ellenberg Reaction:	5.9	
Slope:	0 °	(n = 91)	Ellenberg Fertility:	4.8	

Table 35: Synoptic table for core relevés in community 1b.

Species	Freq	Cover	Ind		Species	Freq	Cover	Ind	
Agrostis stolonifera	V	2-(5)-7	a,b,d	④	*Holcus lanatus*	III	+-(3)-7		
Filipendula ulmaria	V	1-(5)-9	a,b,d	④	*Caltha palustris*	III	+-(3)-8	b	④
Calliergonella cuspidata	V	+-(6)-10	b,c,e	⑤	*Anthoxanthum odoratum*	III	+-(3)-6		
Carex nigra	V	1-(5)-8	b,c,e	④	*Hydrocotyle vulgare*	II	+-(3)-7	b,d	③
Galium palustre	V	+-(2)-7	b,d,e	④	*Senecio aquaticus*	II	+-(2)-4	b,e	③
Ranunculus repens	IV	+-(3)-8	a,b,e	④	*Carex disticha*	II	2-(4)-7	a,b,d	③
Cardamine pratensis	IV	+-(2)-4	b,c,e	④	*Carex flacca*	II	+-(4)-7	b,c,d	④
Trifolium repens	IV	1-(2)-6	b,c,e	④	*Rumex acetosa*	II	+-(2)-4	a,b,e	④
Juncus acutiflorus/articulatus	III	+-(3)-7			*Juncus effusus*	II	+-(4)-7	b,c,e	③
Mentha aquatica	III	+-(3)-5	b,c,d	④	*Poa trivialis*	II	+-(3)-6	a,b,e	③
Ranunculus acris	III	+-(2)-5			*Plantago lanceolata*	II	+-(2)-6	b,c,e	③
Carex panicea	III	+-(3)-7	b,c,e	④	*Equisetum fluviatile*	II	+-(2)-4	b	③
Festuca rubra	III	2-(4)-8	b,d	④	*Equisetum palustre*	II	+-(2)-7	b,c	②
Potentilla anserina	III	+-(3)-8	b,d	③	*Festuca arundinacea*	II	1-(3)-6	b	③
Ranunculus flammula	III	+-(2)-5	b,e	④	*Lathyrus pratensis*	II	+-(2)-5	a,b,c	③

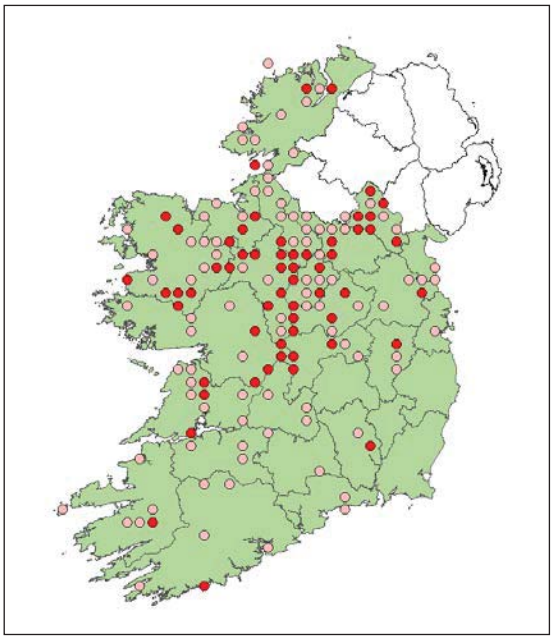


Figure 19: Distribution map community 1b.

Plate 2: Community 1b (relevé 109/02) Bullock Island, Shannon Callows SAC (000216), Offaly.

1c *Molinia caerulea – Succisa pratensis* grassland

The *Molinia-Succisa* grassland occurs primarily on gleys but also on basin peats. There is usually some calcareous influence and these soils have a higher pH than those of the related 1d *Molinia-Potentilla* grassland. The infertile organic soils also have very low levels of total P. It is species-rich with a number of constant species. *Molinia caerulea* is usually the most abundant species, but tends not to form large, dominating tussocks and may even be absent. *Succisa pratensis* is a strong indicator and can be plentiful, while *Calliergonella cuspidata* is usually abundant beneath the sward. Other constant graminoids include *Carex panicea, Carex flacca, Juncus acutiflorus/articulatus, Holcus lanatus, Festuca rubra* and *Anthoxanthum odoratum*. Apart from *Succisa*, the main forbs are *Potentilla erecta, Trifolium* spp., *Plantago lanceolata, Filipendula ulmaria* and *Cirsium dissectum*. *Briza media* and *Carex pulicaris* occur on the more calcareous soils. Areas of *Molinia-Succisa* grassland are often seasonally flooded and can be managed as rough grazing or through a traditional regime of mowing during the drier summer months. They occur primarily in the midlands and the north-west, and less often in the south and east. Seventy-two percent of the relevés within this community were identified as the EU Annex I habitat 6410 *Molinia* meadows.

Affinities:

Fossitt: GM1 - 0.0% GS1 - 0.0% GS2 - 0.0% GS3 - 0.0% GS4 - 100.0% GA1 - 0.0%

Annex I: 6210 - 0.0% 6230 - 0.0% 6410 - 72.0% 6430 - 0.0% 6510 - 0.0%

NVC: M26b *Molinia caerulea-Crepis paludosa* mire *Festuca rubra* sub-com. (52.8%)

M22b *Juncus subnodulosus-Cirsium palustre* fen-meadow *Briza media-Trifolium* spp. sub-com. (51.3%)

M24b *Molinia caerulea-Cirsium dissectum* mire typical sub-com. (47.7%)

EUNIS: E3.51 *Molinia caerulea* meadows and other related communities

ZM: Junco – Molinion

Environmental data:

Number of relevés:	50 (core) 178 (all)		Soil pH:	5.6	(*n* = 23)
Species richness:	29	(*n* = 50)	Soil organic content:	38 %	(*n* = 22)
Forb height:	23 cm	(*n* = 50)	Soil P:	0.13 mg/g	(*n* = 21)
Graminoid height:	39 cm	(*n* = 50)	Ellenberg Light:	7.4	
Forb proportion:	35 %	(*n* = 50)	Ellenberg Wetness:	6.8	
Altitude:	84 m	(*n* = 50)	Ellenberg Reaction:	4.9	
Slope:	3 °	(*n* = 50)	Ellenberg Fertility:	3.4	

Table 36: Synoptic table for core relevés in community 1c.

Species	Freq	Cover	Ind		Species	Freq	Cover	Ind	
Succisa pratensis	V	1-(4)-7	c	④	*Filipendula ulmaria*	III	+-(3)-5		
Carex panicea	V	2-(4)-8	b,c,e	④	*Carex pulicaris*	III	1-(3)-5	c	④
Calliergonella cuspidata	V	2-(5)-8	b,c,e	⑤	*Rhytidiadelphus squarrosus*	III	+-(3)-5		
Carex flacca	V	+-(3)-7	b,c,d	④	*Cirsium dissectum*	III	2-(5)-8	c,d	③
Juncus acutiflorus/articulatus	V	+-(5)-8	a,c,e	⑤	*Mentha aquatica*	III	+-(2)-5	b,c,d	④
Anthoxanthum odoratum	V	2-(4)-6	a,c,e	⑤	*Prunella vulgaris*	III	+-(2)-4	c,e	③
Festuca rubra	V	1-(4)-7	a,c,d	④	*Cirsium palustre*	III	+-(1)-4	a,c,e	③
Holcus lanatus	V	+-(3)-8	a,c,e	⑤	*Galium palustre*	II	+-(2)-3		
Molinia caerulea	V	2-(6)-7	c,d	⑤	*Scleropodium purum*	II	+-(3)-5	c,d,e	③
Potentilla erecta	IV	1-(3)-6	c,d	④	*Taraxacum officinalis* agg.	II	+-(1)-3	c	③
Ranunculus acris	IV	+-(2)-6	a,c,e	④	*Carex nigra*	II	2-(3)-5	b,c,e	④
Agrostis stolonifera	IV	2-(3)-6			*Cynosurus cristatus*	II	2-(3)-4	c,e	③
Trifolium pratense	IV	1-(2)-5	c	③	*Plagiomnium undulatum*	II	1-(2)-3	b,c,e	③
Plantago lanceolata	IV	+-(2)-5	b,c,e	③	*Briza media*	II	+-(3)-5	c	③
Trifolium repens	III	+-(2)-4	b,c,e	④	*Ranunculus repens*	II	+-(2)-4		

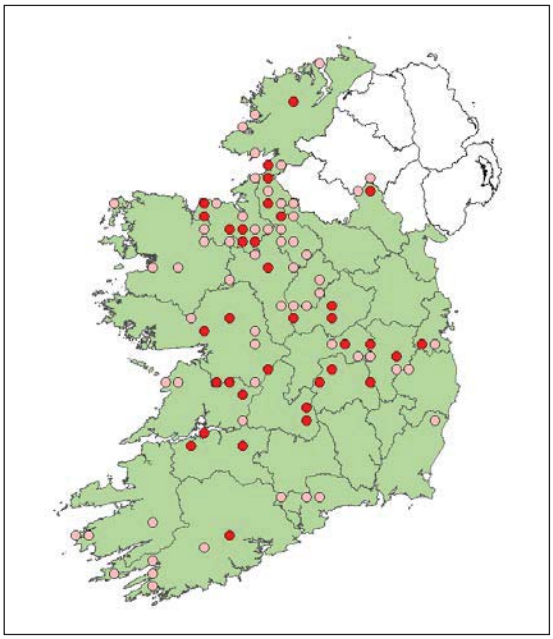


Figure 20: Distribution map community 1c.

Plate 3: Community 1c (relevé 1417/12), Annex I habitat 6410 *Molinia* meadows, Dunshane Common, Kildare.

1d *Molinia caerulea – Potentilla erecta* grassland

The *Molinia-Potentilla* grassland is a rather species-poor assemblage on infertile, acidic basin peats and peaty gleys. It typically constitutes marginal grazing land rather than meadows, and is sometimes abandoned. *Molinia caerulea* is the dominant species, usually growing as large tussocks. *Potentilla erecta* grows through the tussocks and can be abundant. Other constant species are *Juncus acutiflorus/articulatus*, *Agrostis stolonifera*, *Anthoxanthum odoratum* and *Holcus lanatus*, which help form a fairly tall, rank sward. A component of small sedges consists of *Carex panicea*, *C. flacca*, *C. nigra* and *C. echinata*. *Succisa pratensis* is frequent but less abundant than in the more species-rich 1c *Molinia-Succisa* grassland, which also has a higher forb cover. Examples of the *Molinia-Potentilla* grassland with *Cirsium dissectum* or *Juncus conglomeratus* are only occasional, but these examples represent sites of greater conservation value. This community is widespread but has been recorded most often in western Donegal, in the seasonally flooded callows along the Shannon, and in the south-west.

Affinities:

Fossitt: GM1 - 1.6% GS1 - 0.0% GS2 - 0.0% GS3 - 0.0% GS4 - 98.4% GA1 - 0.0%

Annex I: 6210 - 0.0% 6230 - 0.0% 6410 - 34.4% 6430 - 0.0% 6510 - 0.0%

NVC: M24c *Molinia caerulea-Cirsium dissectum* fen-meadow *Juncus acutiflorus-Erica tetralix* sub-com. (57.0%)

M23a *Juncus effusus/acutiflorus-Galium palustre* rush-pasture *Juncus acutiflorus* sub-com. (53.6%)

M25c *Molinia caerulea-Potentilla erecta* mire *Angelica sylvestris* sub-com. (53.3%)

(also has high affinity with M13 *Schoenus nigricans-Juncus subnodulosus* mire)

EUNIS: E3.51 *Molinia caerulea* meadows and other related communities

ZM: Junco – Molinion

Environmental data:

Number of relevés:	61(core) 136 (all)		Soil pH:	5.0	(*n* = 36)
Species richness:	19	(*n* = 61)	Soil organic content:	37 %	(*n* = 34)
Forb height:	39 cm	(*n* = 61)	Soil P:	0.66 mg/g	(*n* = 28)
Graminoid height:	56 cm	(*n* = 61)	Ellenberg Light:	7.1	
Forb proportion:	26 %	(*n* = 61)	Ellenberg Wetness:	7.2	
Altitude:	76 m	(*n* = 61)	Ellenberg Reaction:	4.3	
Slope:	3 °	(*n* = 61)	Ellenberg Fertility:	3.2	

Table 37: Synoptic table for core relevés in community 1d.

Species	Freq	Cover	Ind		Species	Freq	Cover	Ind	
Molinia caerulea	V	4-(7)-9	c,d	⑤	*Carex nigra*	II	1-(3)-4		
Potentilla erecta	V	1-(3)-7	c,d	④	*Cirsium dissectum*	II	1-(5)-7	c,d	③
Juncus acutiflorus/articulatus	IV	+-(4)-7			*Mentha aquatica*	II	+-(2)-5	b,c,d	④
Agrostis stolonifera	IV	+-(4)-8	a,b,d	④	*Juncus effusus*	II	+-(2)-5		
Anthoxanthum odoratum	IV	1-(3)-6			*Kindbergia praelonga*	II	+-(2)-5	a,d	③
Holcus lanatus	IV	+-(4)-8			*Lotus pedunculatus*	II	1-(2)-5	a,d,e	③
Calliergonella cuspidata	III	+-(3)-7			*Scleropodium purum*	II	+-(2)-5	c,d,e	③
Festuca rubra	III	2-(4)-7	a,b,d	④	*Brachythecium rutabulum*	II	+-(1)-3		
Filipendula ulmaria	III	2-(4)-7	a,b,d	④	*Cirsium palustre*	II	+-(1)-4		
Carex panicea	III	+-(3)-7			*Vicia cracca*	II	+-(1)-4	b,c,d	③
Galium palustre	III	+-(2)-4	b,d,e	④	*Juncus conglomeratus*	II	1-(2)-7	c,d,e	②
Succisa pratensis	III	1-(2)-5			*Luzula multiflora*	II	+-(2)-3	c,d,e	③
Carex flacca	II	1-(3)-8	b,c,d	④	*Ranunculus repens*	II	+-(2)-4		
Rhytidiadelphus squarrosus	II	+-(2)-6			*Trifolium repens*	II	1-(2)-4		
Ranunculus acris	II	+-(2)-3			*Carex echinata*	II	1-(2)-4	c,d,e	③

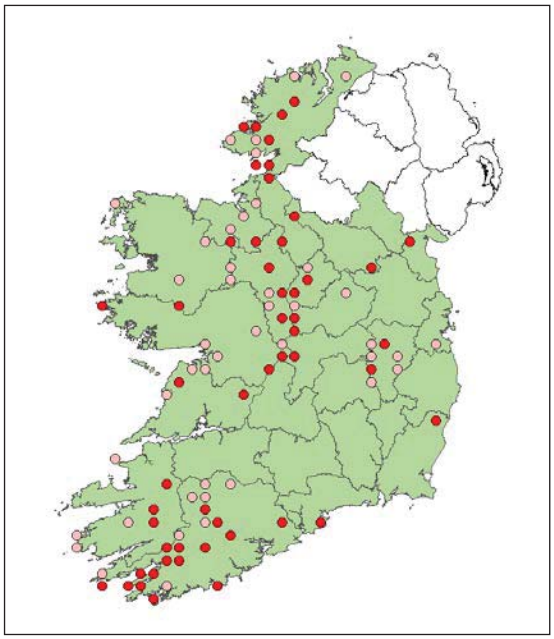


Figure 21: Distribution map community 1d.

Plate 4: Community 1d (view from relevé 344/03), Ballynamona Lower, Waterford.

1e *Juncus acutiflorus/articulatus – Rhytidiadelphus squarrosus* grassland

The *Juncus-Rhytidiadelphus* grassland is found on infertile, rather acidic peaty gleys and has a distinct distribution of records, having been found frequently on the sides of drumlins in Leitrim, with another cluster of records from eastern Clare. The sward is comprised mainly of *Holcus lanatus*, *Juncus acutiflorus/articulatus*, *Anthoxanthum odoratum*, *Juncus effusus* and *Agrostis canina/vinealis*. This latter taxon is unusual in its abundance and is a good indicator for this community. The forb component is low growing and consists mostly of *Trifolium repens*, *Ranunculus acris*, *R. repens* and *R. flammula*, with *Cardamine pratensis*, *Galium palustre*, *Succisa pratensis* and *Senecio jacobaea* also frequent. This grassland is more species-rich than the other main *Juncus acutiflorus/articulatus* sward (community 1a), and also differs in that small sedges can often be found in the present community, mainly *Carex nigra* and *C. panicea*, with *C. echinata* less frequent. The bryophyte layer is also quite distinctive, with *Rhytidiadelphus squarrosus* being abundant and sometimes forming a carpet with *Calliergonella cuspidata* and *Brachythecium rutabulum*.

Affinities:

Fossitt: GM1 - 0.0% GS1 - 0.0% GS2 - 0.0% GS3 - 0.0% GS4 - 96.8% GA1 - 3.2%

Annex I: 6210 - 0.0% 6230 - 0.0% 6410 - 14.5% 6430 - 0.0% 6510 - 0.0%

NVC: M23a *Juncus effusus/acutiflorus-Galium palustre* rush-pasture *Juncus acutiflorus* sub-com. (57.2%)
M23b *Juncus effusus/acutiflorus-Galium palustre* rush-pasture *Juncus effusus* sub-com. (56.4%)
MG10a *Holcus lanatus-Juncus effusus* rush-pasture typical sub-com. (49.0%)

EUNIS: E3.42 *Juncus acutiflorus* meadows

ZM: Juncion acutiflori

Environmental data:

Number of relevés:	62 (core) 92 (all)		Soil pH:	4.8	(n = 45)
Species richness:	25	(n = 62)	Soil organic content:	29 %	(n = 33)
Forb height:	15 cm	(n = 62)	Soil P:	0.59 mg/g	(n = 33)
Graminoid height:	35 cm	(n = 62)	Ellenberg Light:	7.4	
Forb proportion:	27 %	(n = 62)	Ellenberg Wetness:	7.1	
Altitude:	88 m	(n = 62)	Ellenberg Reaction:	4.4	
Slope:	3 °	(n = 62)	Ellenberg Fertility:	3.4	

Table 38. Synoptic table for core relevés in community 1e.

Species	Freq	Cover	Ind		Species	Freq	Cover	Ind	
Holcus lanatus	V	2-(4)-6	a,c,e	⑤	*Galium palustre*	III	+-(2)-4	b,d,e	④
Juncus acutiflorus/articulatus	V	3-(6)-9	a,c,e	⑤	*Cynosurus cristatus*	III	1-(3)-6	c,e	③
Anthoxanthum odoratum	V	2-(5)-7	a,c,e	⑤	*Brachythecium rutabulum*	III	+-(2)-6	a,c,e	③
Rhytidiadelphus squarrosus	V	1-(5)-10	e	⑤	*Succisa pratensis*	III	+-(3)-6		
Trifolium repens	V	+-(3)-7	b,c,e	④	*Senecio aquaticus*	III	+-(2)-4	b,e	③
Calliergonella cuspidata	V	+-(4)-8	b,c,e	⑤	*Prunella vulgaris*	III	+-(2)-4	c,e	③
Ranunculus acris	V	1-(3)-7	a,c,e	④	*Potentilla erecta*	II	+-(2)-5		
Agrostis canina/vinealis	IV	2-(5)-8	e	④	*Agrostis capillaris*	II	+-(3)-6	a,e	③
Juncus effusus	IV	+-(3)-8	b,c,e	③	*Cirsium palustre*	II	+-(2)-4	a,c,e	③
Ranunculus flammula	IV	+-(2)-5	b,e	④	*Rumex acetosa*	II	+-(2)-5	a,b,e	④
Ranunculus repens	IV	1-(3)-6	b,c,e	④	*Luzula multiflora*	II	+-(2)-3	c,d,e	③
Carex nigra	IV	+-(3)-7	b,c,e	④	*Festuca rubra*	II	1-(3)-5		
Cardamine pratensis	III	+-(2)-3	b,c,e	④	*Carex echinata*	II	+-(2)-5	c,d,e	③
Agrostis stolonifera	III	+-(3)-6			*Cerastium fontanum*	II	+-(2)-3	a,c,e	③
Carex panicea	III	+-(3)-7	b,c,e	④	*Lophocolea bidentata*	II	+-(2)-4	c,d,e	③

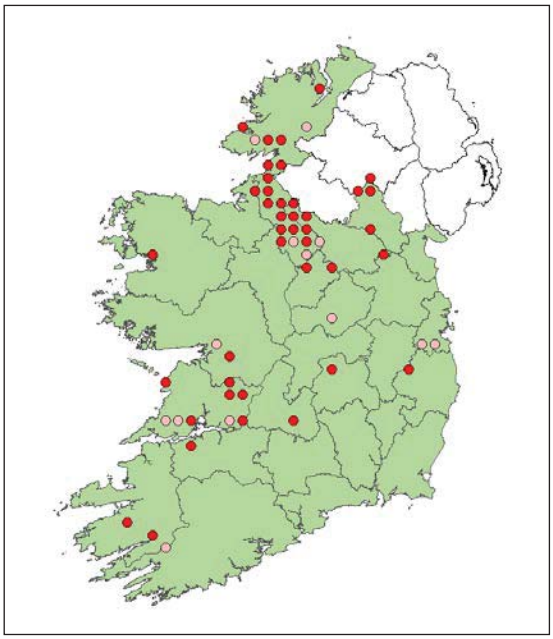


Figure 22: Distribution map community 1e.

Plate 5: Community 1d (relevé 824/04), Cornaroy, Leitrim.

Plate 6: 1b *Agrostis stolonifera – Filipendula ulmaria* marsh-grassland and Annex I habitat 6410 *Molinia* meadows, Inch Level (Site 1147), Donegal.

Plate 7: 1c *Molinia caerulea – Succisa pratensis* grassland and Annex I habitat 6410 *Molinia* meadows, Cahirguillamore (Site 2719 view from relevé 2), Limerick.

Plate 8: 1d *Molinia caerulea – Potentilla erecta* grassland, Killarney National Park SAC (000365), Bunrower (Site 2403), Kerry.

Plate 9: 1e *Juncus acutiflorus/articulatus – Rhytidiadelphus squarrosus* grassland, Roes (Site 1252), Donegal.

2a *Agrostis stolonifera – Ranunculus repens* marsh-grassland

The *Agrostis-Ranunculus* marsh-grassland is a variable grouping of vegetation from mesotrophic, wet grassland and marsh on gleys and basin peats in the lowlands. *Agrostis stolonifera* is the main species, with *Ranunculus repens* being the only other constant. These are frequently accompanied by *Galium palustre*, *Cardamine pratensis*, *Filipendula ulmaria* and *Juncus effusus*. The community differs from others in this group due to its higher forb component and the presence of more species tolerant of seasonal flooding. Some of the better indicator species for this category include *Potentilla anserina*, *Carex disticha*, *Mentha aquatica*, *Iris pseudacorus*, *Caltha palustris* and *Rumex crispus*. *Calliergonella cuspidata* tends to be the only bryophyte. It differs from the closely related 1b *Agrostis-Filipendula* marsh-grassland in being species-poor, more fertile, and also more heavily grazed. This community has been recorded from across the country but most frequently in the central midlands, the River Shannon floodplain, and in the southern counties. Examples of this vegetation having a high cover of tall herbs are of particular conservation value, while only a small proportion of sites show signs of improvement.

Affinities:

Fossitt: GM1 - 13.4% GS1 - 0.7% GS2 - 3.5% GS3 - 0.0% GS4 - 74.6% GA1 - 7.7%

Annex I: 6210 - 0.0% 6230 - 0.0% 6410 - 2.1% 6430 - 5.6% 6510 - 0.7%

NVC: MG10a *Holcus lanatus-Juncus effusus* rush-pasture typical sub-com. (63.4%)
MG10c *Holcus lanatus-Juncus effusus* rush-pasture *Iris pseudacorus* sub-com. (57.5%)
M27c *Filipendula ulmaria-Angelica sylvestris* mire *Juncus effusus-Holcus lanatus* sub-com. (53.8%)

EUNIS: E3.44 Flood swards and related communities

ZM: Calthion palustris

Environmental data:

Number of relevés:	142 (core) 265 (all)		Soil pH:	5.5	(*n* = 115)
Species richness:	15	(*n* = 142)	Soil organic content:	27 %	(*n* = 109)
Forb height:	31 cm	(*n* = 140)	Soil P:	0.86 mg/g	(*n* = 90)
Graminoid height:	35 cm	(*n* = 142)	Ellenberg Light:	7.0	
Forb proportion:	34%	(*n* = 140)	Ellenberg Wetness:	6.7	
Altitude:	50 m	(*n* = 142)	Ellenberg Reaction:	6.2	
Slope:	0 °	(*n* = 142)	Ellenberg Fertility:	5.5	

Table 39: Synoptic table for core relevés in community 2a.

Species	Freq	Cover	Ind		Species	Freq	Cover	Ind	
Agrostis stolonifera	V	4-(7)-10	a,b,c	⑤	*Mentha aquatica*	II	+-(3)-5	a	③
Ranunculus repens	IV	+-(4)-8	a,b,c	⑤	*Senecio aquaticus*	II	+-(2)-5	a,b	③
Galium palustre	III	+-(2)-6	a,b,d	③	*Equisetum fluviatile*	II	+-(2)-6	a,d	②
Cardamine pratensis	III	+-(2)-5	a,b,d	④	*Ranunculus flammula*	II	+-(2)-5	a,b,d	③
Filipendula ulmaria	III	+-(4)-8	a,b,d	③	*Lolium perenne*	I	+-(3)-6		
Juncus effusus	III	+-(4)-7			*Glyceria fluitans*	I	1-(4)-10	a,b	②
Potentilla anserina	II	2-(4)-8	a	③	*Iris pseudacorus*	I	1-(4)-7	a	②
Calliergonella cuspidata	II	+-(3)-9	a,b,d	④	*Ranunculus acris*	I	+-(2)-4		
Trifolium repens	II	+-(2)-6	a,b,c	④	*Alopecurus pratensis*	I	+-(2)-8	a,c	③
Holcus lanatus	II	+-(3)-7			*Taraxacum officinalis* agg.	I	+-(2)-3	a,c	③
Poa trivialis	II	+-(3)-6	a,b,c	③	*Caltha palustris*	I	+-(3)-5	a	②
Juncus acutiflorus/articulatus	II	+-(3)-8	a,b,d	④	*Cerastium fontanum*	I	+-(1)-5		
Carex nigra	II	1-(3)-7	a,b,d	③	*Deschampsia cespitosa*	I	1-(4)-8	a,d	③
Carex disticha	II	1-(4)-8	a	③	*Poa humilis/pratensis*	I	+-(2)-7	a,b,d	③
Rumex acetosa	II	+-(2)-5			*Rumex crispus*	I	+-(2)-4	a	②

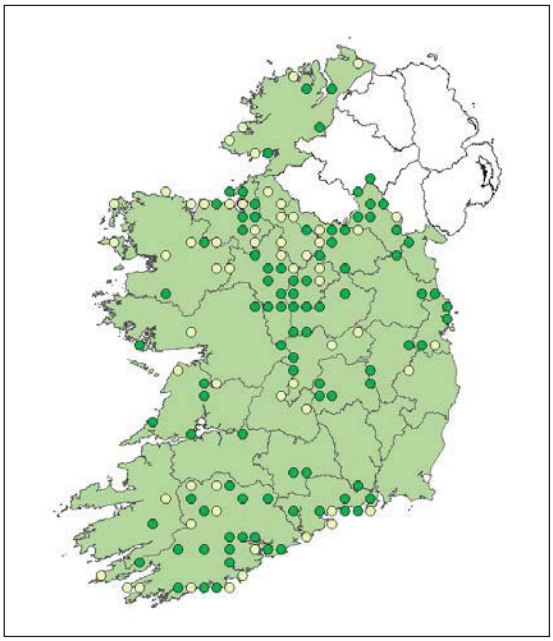


Figure 23: Distribution map community 2a.

Plate 10: Community 2a (relevé 109/08), Bullock Island, Shannon Callows SAC (000216), Offaly.

2b *Juncus effusus – Holcus lanatus* grassland

This grassland community is typical of unimproved neutral, wet pasture and is encountered on gleyed soils on flat ground or gentle slopes, and sometimes on basin peats. The main graminoids are *Holcus lanatus*, *Juncus effusus*, *J. acutiflorus/acutiflorus*, *Agrostis stolonifera* and *Anthoxanthum odoratum*, which form a fairly tall, rank sward, while the forb component consists largely of *Ranunculus repens*, *R. acris*, *Trifolium repens* and *Rumex acetosa*. *Cirsium palustre* is a reasonable indicator for this community, while *Filipendula ulmaria* and *Lotus pedunculatus* are occasionally abundant. *Calliergonella cuspidata* is frequent and can form a dense bryophyte layer. This community differs from the other main mesotrophic rush-pasture community, 2d *Juncus-Rumex* grassland, by tending to be relatively more species-rich. *J. effusus* is also not generally as abundant, so the overall sward tends to be shorter. This common grassland community is of relatively low conservation value and is found across the country on farmland with impeded drainage.

Affinities:

Fossitt: GM1 - 1.0% GS1 - 0.0% GS2 - 0.0% GS3 - 0.0% GS4 - 93.7% GA1 - 5.3%

Annex I: 6210 - 0.0% 6230 - 0.0% 6410 - 0.0% 6430 - 0.0% 6510 - 0.0%

NVC: MG10a *Holcus lanatus-Juncus effusus* rush-pasture typical sub-com. (62.2%)
M23b *Juncus effusus/acutiflorus-Galium palustre* rush-pasture *Juncus effusus* sub-com. (61.3%)
M23a *Juncus effusus/acutiflorus-Galium palustre* rush-pasture *Juncus acutiflorus* sub-com. (56.5%)

EUNIS: E3.44 Flood swards and related communities

ZM: Juncion acutiflori

Environmental data:

Number of relevés:	206 (core) 356 (all)		Soil pH:	5.0	(*n* = 178)
Species richness:	19	(*n* = 206)	Soil organic content:	26 %	(*n* = 152)
Forb height:	27 cm	(*n* = 205)	Soil P:	0.80 mg/g	(*n* = 141)
Graminoid height:	48 cm	(*n* = 206)	Ellenberg Light:	7.0	
Forb proportion:	23 %	(*n* = 205)	Ellenberg Wetness:	6.4	
Altitude:	91 m	(*n* = 206)	Ellenberg Reaction:	5.4	
Slope	2 °	(*n* = 206)	Ellenberg Fertility:	4.7	

Table 40: Synoptic table for core relevés in community 2b.

Species	Freq	Cover	Ind		Species	Freq	Cover	Ind	
Holcus lanatus	V	3-(6)-9	b,c,d	⑤	*Brachythecium rutabulum*	II	+-(2)-5	b,c,d	③
Juncus effusus	V	2-(5)-8	b,d	⑤	*Filipendula ulmaria*	II	+-(3)-8	a,b,d	③
Agrostis stolonifera	V	2-(5)-8	a,b,c	⑤	*Poa trivialis*	II	+-(3)-6	a,b,c	③
Anthoxanthum odoratum	V	+-(4)-7	b,c,d	⑤	*Galium palustre*	II	+-(2)-4	a,b,d	③
Ranunculus repens	IV	+-(3)-7	a,b,c	⑤	*Lotus pedunculatus*	II	2-(4)-8	b,d	③
Trifolium repens	IV	+-(3)-7	a,b,c	④	*Cynosurus cristatus*	II	+-(3)-7	b,c	③
Juncus acutiflorus/articulatus	IV	+-(3)-8	a,b,d	④	*Kindbergia praelonga*	II	+-(2)-6	b,c,d	③
Rumex acetosa	IV	+-(3)-5	b,c,d	④	*Ranunculus flammula*	II	+-(2)-4	a,b,d	③
Ranunculus acris	IV	+-(3)-5	b,c,d	④	*Agrostis capillaris*	II	1-(3)-7	b,c,d	③
Calliergonella cuspidata	III	+-(3)-9	a,b,d	④	*Stellaria uliginosa*	II	+-(2)-4		
Festuca rubra	III	+-(4)-7	b,c,d	③	*Senecio aquaticus*	II	+-(2)-5	a,b	③
Cerastium fontanum	III	+-(2)-3	b,c	④	*Epilobium obscurum*	II	+-(1)-3	b,d	③
Cirsium palustre	III	+-(2)-5	b	③	*Carex leporina*	II	+-(2)-6	a,b,d	②
Rhytidiadelphus squarrosus	II	+-(2)-6	b,d	③	*Lolium perenne*	I	+-(2)-5		
Cardamine pratensis	II	+-(2)-4	a,b,d	③	*Lathyrus pratensis*	I	+-(2)-5		

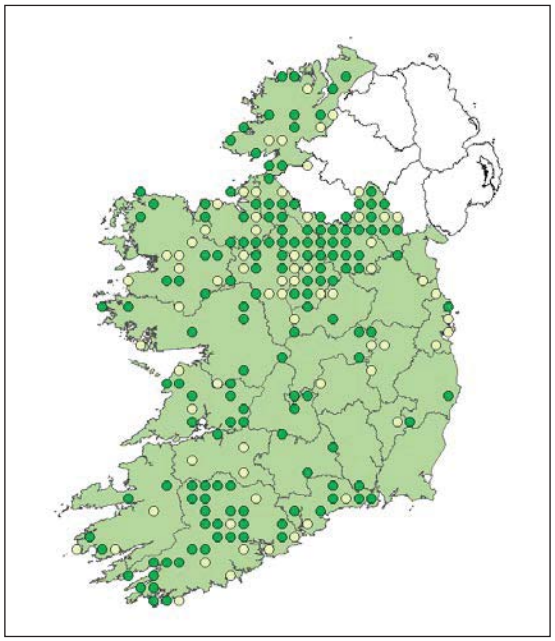


Figure 24: Distribution map community 2b.

Plate 11: Community 2b (relevé 2916/01), Behaghglass, Tipperary.

2c *Holcus lanatus – Lolium perenne* grassland

Holcus-Lolium grassland is a variable semi-improved community of wet pastures and meadows that occurs on gleyed or drained mineral soils. It is a very species-poor assemblage and there are only a few constant species. *Holcus lanatus* and *Agrostis stolonifera* form the bulk of the medium-height sward alongside *Ranunculus repens*. These species are typically accompanied by a trio of indicators of agricultural intensification, *Lolium perenne*, *Trifolium repens* and *Cerastium fontanum*, with *L. perenne* being a good indicator for this community within this group. Less frequent indicators include *Dactylis glomerata*, *Senecio jacobaea* and *Cirsium arvense*. *Juncus* spp. are not as frequent as they are in communities 2b and 2d and should not dominate. This community is of low conservation value and is very common, occurring across the country.

Affinities:

Fossitt: GM1 - 0.9% GS1 - 9.9% GS2 - 20.3% GS3 - 0.5% GS4 - 26.9% GA1 - 41.5%

Annex I: 6210 - 0.0% 6230 - 0.0% 6410 - 0.5% 6430 - 0.9% 6510 - 0.0%

NVC: MG10a *Holcus lanatus-Juncus effusus* rush-pasture typical sub-com. (72.8%)
MG9a *Holcus lanatus-Deschampsia cespitosa* grassland *Poa trivialis* sub-com. (72.3%)
MG7c *Lolium perenne* leys and related grasslands *Lolium perenne-Alopecurus pratensis-Festuca pratensis* grassland (69.5%)

EUNIS: E3.44 Flood swards and related communities

ZM: Calthion palustris

Environmental data:

Number of relevés:	212 (core) 355 (all)		Soil pH:	5.1	(*n* = 193)
Species richness:	13	(*n* = 212)	Soil organic content:	18 %	(*n* = 176)
Forb height:	22 cm	(*n* = 209)	Soil P:	0.98 mg/g	(*n* = 167)
Graminoid height:	31 cm	(*n* = 212)	Ellenberg Light:	7.0	
Forb proportion:	26 %	(*n* = 209)	Ellenberg Wetness:	5.8	
Altitude:	84 m	(*n* = 212)	Ellenberg Reaction:	6.1	
Slope:	4 °	(*n* = 212)	Ellenberg Fertility:	5.4	

Table 41: Synoptic table for core relevés in community 2c.

Species	Freq	Cover	Ind		Species	Freq	Cover	Ind	
Holcus lanatus	V	2-(6)-10	b,c,d	⑤	*Kindbergia praelonga*	II	+-(2)-4	b,c,d	③
Agrostis stolonifera	V	2-(5)-9	a,b,c	⑤	*Dactylis glomerata*	II	+-(4)-8	c	③
Ranunculus repens	IV	+-(4)-9	a,b,c	⑤	*Cynosurus cristatus*	I	2-(4)-8	b,c	③
Lolium perenne	IV	+-(4)-8	c	④	*Agrostis capillaris*	I	1-(4)-7	b,c,d	③
Trifolium repens	IV	+-(3)-7	a,b,c	④	*Cardamine pratensis*	I	+-(2)-3		
Cerastium fontanum	IV	+-(2)-5	b,c	④	*Festuca rubra*	I	2-(4)-8	b,c,d	③
Rumex acetosa	III	+-(3)-6	b,c,d	④	*Calliergonella cuspidata*	I	+-(2)-4		
Anthoxanthum odoratum	II	1-(4)-8	b,c,d	④	*Rumex obtusifolius*	I	+-(1)-4	a,c	②
Poa trivialis	II	+-(3)-7	a,b,c	③	*Cirsium palustre*	I	+-(2)-4		
Ranunculus acris	II	+-(2)-6	b,c,d	④	*Juncus acutiflorus/articulatus*	I	+-(3)-7		
Taraxacum officinalis agg.	II	+-(2)-6	a,c	③	*Senecio jacobaea*	I	+-(2)-4	c	②
Plantago lanceolata	II	+-(2)-8	a,b,c	③	*Stellaria graminea*	I	+-(2)-4		
Alopecurus pratensis	II	+-(4)-8	a,c	③	*Cirsium arvense*	I	+-(2)-5	c	②
Brachythecium rutabulum	II	+-(2)-4	b,c,d	③	*Potentilla anserina*	I	+-(3)-9		
Juncus effusus	II	1-(3)-6			*Trifolium pratense*	I	+-(3)-6	b,c	②

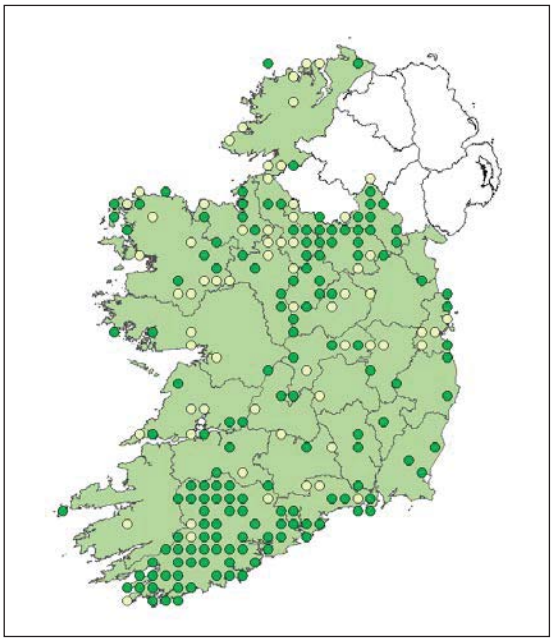


Figure 25: Distribution map community 2c.

Plate 12: Community 2c (relevé 1316/01), Shanganagh Park, Dublin.

2d *Juncus effusus – Rumex acetosa* grassland

The *Juncus-Rumex* grassland is a very species-poor community of wet, gleyed soils, usually on flat ground or gentle slopes. It is dominated by tall, waist-high tussocks of *Juncus effusus*, between which can be found a lower sward of *Agrostis stolonifera* and *Holcus lanatus* that is often poached by grazing stock. No other species are constant here. *Rumex acetosa* and *Ranunculus repens* are frequently present, but forb cover is very low within this assemblage. *Anthoxanthum odoratum* is frequent, while *Juncus acutiflorus/articulatus* occurs occasionally and can be abundant, but is subordinate to *J. effusus*. Occasional forbs characteristic of the poorly draining soil conditions include *Cardamine pratensis*, *Filipendula ulmaria*, *Galium palustre*, *Epilobium obscurum* and *Lotus pedunculatus*. The bryophyte layer is a rather standard, scanty mixture of *Kindbergia praelonga*, *Calliergonella cuspidata*, *Rhytidiadelphus squarrosus* and *Brachythecium rutabulum*. This is a very common sward type across Ireland on poorly draining soils and is of relatively low conservation value.

Affinities:

Fossitt: GM1 - 1.3% GS1 - 0.0% GS2 - 0.0% GS3 - 0.0% GS4 - 97.8% GA1 - 0.9%

Annex I: 6210 - 0.0% 6230 - 0.0% 6410 - 0.4% 6430 - 0.4% 6510 - 0.0%

NVC: M23b *Juncus effusus/acutiflorus-Galium palustre* rush-pasture *Juncus effusus* sub-com. (68.0%)

MG10a *Holcus lanatus-Juncus effusus* rush-pasture typical sub-com. (65.5%)

M27c *Filipendula ulmaria-Angelica sylvestris* mire *Juncus effusus-Holcus lanatus* sub-com. (62.5%)

EUNIS: E3.42 *Juncus acutiflorus* meadows

ZM: Junci acutiflori

Environmental data:

Number of relevés:	230 (core) 301 (all)		Soil pH:	4.8	(*n* = 195)
Species richness:	13	(*n* = 230)	Soil organic content:	29 %	(*n* = 169)
Forb height:	38 cm	(*n* = 228)	Soil P:	0.73 mg/g	(*n* = 162)
Graminoid height:	81 cm	(*n* = 230)	Ellenberg Light:	7.0	
Forb proportion:	16 %	(*n* = 228)	Ellenberg Wetness:	6.7	
Altitude:	98 m	(*n* = 230)	Ellenberg Reaction:	4.9	
Slope:	1 °	(*n* = 230)	Ellenberg Fertility:	4.4	

Table 42: Synoptic table for core relevés in community 2d.

Species	Freq	Cover	Ind		Species	Freq	Cover	Ind	
Juncus effusus	V	6-(8)-10	b,d	⑤	*Festuca rubra*	II	2-(3)-8	b,c,d	③
Agrostis stolonifera	V	1-(5)-8			*Brachythecium rutabulum*	II	+-(2)-4	b,c,d	③
Holcus lanatus	V	+-(4)-8	b,c,d	⑤	*Lotus pedunculatus*	II	+-(4)-8	b,d	③
Rumex acetosa	III	+-(3)-5	b,c,d	④	*Deschampsia cespitosa*	II	+-(4)-8	a,d	③
Anthoxanthum odoratum	III	+-(3)-8	b,c,d	④	*Trifolium repens*	II	+-(2)-4		
Kindbergia praelonga	III	+-(2)-7	b,c,d	③	*Poa humilis/pratensis*	I	+-(3)-6	a,b,d	③
Ranunculus repens	III	+-(3)-7			*Ranunculus flammula*	I	+-(2)-4	a,b,d	③
Juncus acutiflorus/articulatus	II	+-(3)-7	a,b,d	④	*Agrostis capillaris*	I	1-(3)-6	b,c,d	③
Calliergonella cuspidata	II	+-(3)-8	a,b,d	④	*Poa trivialis*	I	+-(3)-5		
Cardamine pratensis	II	+-(2)-4	a,b,d	③	*Agrostis canina/vinealis*	I	1-(4)-8	b,d	②
Filipendula ulmaria	II	+-(3)-9	a,b,d	③	*Carex nigra*	I	+-(2)-6	a,b,d	③
Rhytidiadelphus squarrosus	II	+-(3)-8	b,d	③	*Cerastium fontanum*	I	+-(1)-2		
Galium palustre	II	+-(2)-5	a,b,d	③	*Cirsium palustre*	I	+-(2)-4		
Epilobium obscurum	II	+-(2)-4	b,d	③	*Epilobium palustre*	I	+-(2)-4	a,b,d	②
Ranunculus acris	II	+-(2)-5	b,c,d	④	*Lophocolea bidentata*	I	+-(2)-5	b,d	②

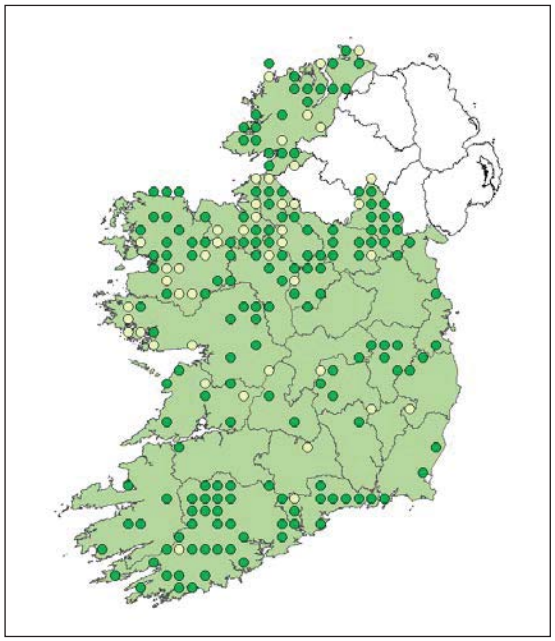


Figure 26: Distribution map community 2d.

Plate 13: Community 2d (relevé 1715/02), Largan Beg, Mayo.

Plate 14: 2a *Agrostis stolonifera – Ranunculus repens* marsh-grassland, Killourney (Site 1651 view from relevé 2), East Burren Complex SAC (001926), Clare.

Plate 15: 2b *Juncus effusus – Holcus lanatus* grassland, Derrylosset (Site 711 view from relevé 3), Monaghan.

Plate 16: 2c *Holcus lanatus – Lolium perenne* grassland, Carrickmoyragh (Site 942 view from relevé 2), Longford.

Plate 17: 2d *Juncus effusus – Rumex acetosa* grassland, The Curragh (Site 1400 view from relevé 3), pNHA 00392, Kildare.

3a *Briza media – Thymus polytrichus* grassland

This community comprises swards of calcareous grassland on shallow, well-drained mineral soils of poor fertility, usually managed as low-intensity pasture. It is typically a very species-rich assemblage and has a large number of constants. The main graminoids are *Carex flacca*, *Briza media*, *Anthoxanthum odoratum* and *Festuca* spp., with *Carex caryophyllea* and *Koeleria macrantha* being less abundant but characteristic plants. The high forb component contains several good indicators in *Thymus polytrichus*, *Succisa pratensis*, *Linum catharticum*, *Galium verum*, *Campanula rotundifolia*, *Polygala vulgaris*, *Pilosella officinarum* and *Viola riviniana*. *Lotus corniculatus*, *Plantago lanceolata*, *Potentilla erecta*, *Centaurea nigra*, *Euphrasia officinalis* agg., *Leucanthemum vulgare* and the moss *Ctenidium molluscum* are also usually present. This is the typical grassland community to be found in association with limestone pavement and eskers. It has a distinct geographical distribution, with some of the best examples being concentrated in the Burren and the Darty Mountains. Ninety-seven percent of the relevés within this community were identified as the EU Annex I habitat [*]6210 Festuco-Brometalia.

There are three sub-communities. In the *Sesleria caerulea* sub-community (3ai), *S. caerulea* is present. The *Silene acaulis* sub-community (3aii) is restricted to high altitudes in the Dartry Mountains. The typical sub-community (3aiii) lacks these two species.

Affinities:

Fossitt: GM1 - 0.0% GS1 - 97.3% GS2 - 0.0% GS3 - 0.7% GS4 - 2.0% GA1 - 0.0%

Annex I: 6210 - 96.6% 6230 - 0.7% 6410 - 2.0% 6430 - 0.0% 6510 - 0.0%

NVC: CG9b *Sesleria albicans-Galium sterneri* grassland typical sub-com. (55.8%)
CG9c *Sesleria albicans-Galium sterneri* grassland *Carex pulicaris-Carex panicea* sub-com. (53.0%)
CG2c *Festuca ovina-Avenula pratensis* grassland *Holcus lanatus-Trifolium repens* sub-com. (52.9%)

EUNIS: E1.26 Sub-Atlantic semi-dry calcareous grassland

ZM: Bromion erecti/Xerobromion

Environmental data:

Number of relevés:	149 (core) 401 (all)		Soil pH:	6.2	(*n* = 47)
Species richness:	46	(*n* = 149)	Soil organic content:	29 %	(*n* = 46)
Forb height:	7 cm	(*n* = 148)	Soil P:	0.23 mg/g	(*n* = 44)
Graminoid height:	12 cm	(*n* = 148)	Ellenberg Light:	7.3	
Forb proportion:	50 %	(*n* = 148)	Ellenberg Wetness:	5.3	
Altitude:	92 m	(*n* = 149)	Ellenberg Reaction:	5.6	
Slope:	13 °	(*n* = 149)	Ellenberg Fertility:	2.6	

Table 43: Synoptic table for core relevés in community 3a.

Species	Freq	Cover	Ind		Species	Freq	Cover	Ind	
Carex flacca	V	2-(4)-7	a,d,f	⑤	*Trifolium pratense*	IV	+-(2)-6		
Lotus corniculatus	V	2-(4)-7	a,d,f	④	*Centaurea nigra*	IV	+-(3)-6	a,c,e	④
Thymus polytrichus	V	1-(4)-7	a	⑤	*Festuca ovina*	IV	2-(4)-7	a	⑤
Scleropodium purum	V	+-(3)-7	a,d	⑤	*Hypochaeris radicata*	IV	+-(2)-4		
Plantago lanceolata	V	+-(3)-5			*Festuca rubra*	IV	+-(4)-7		
Succisa pratensis	V	+-(5)-7	a	⑤	*Euphrasia officinalis* agg.	IV	+-(2)-6	a,c,e	④
Ctenidium molluscum	V	+-(3)-8	a	⑤	*Carex caryophyllea*	IV	+-(2)-5	a	④
Linum catharticum	V	+-(2)-3	a	④	*Rhytidiadelphus squarrosus*	IV	+-(2)-6	a,b,d	④
Potentilla erecta	V	+-(3)-6	a,f	④	*Trifolium repens*	IV	+-(2)-4		
Galium verum	V	+-(2)-6	a	④	*Leucanthemum vulgare*	IV	+-(3)-6	a,c,e	④
Anthoxanthum odoratum	IV	+-(3)-6			*Campanula rotundifolia*	IV	+-(2)-3	a	④
Briza media	IV	+-(4)-7	a	⑤	*Koeleria macrantha*	III	+-(2)-5	a,f	④
Sesleria caerulea	IV	1-(5)-8	a	⑤	*Polygala vulgaris*	III	+-(2)-4	a	④
Pilosella officinarum	IV	+-(2)-8	a	⑤	*Viola riviniana*	III	+-(2)-4	a	④
Prunella vulgaris	IV	+-(2)-5	a,b,d	④	*Cynosurus cristatus*	III	1-(3)-5		

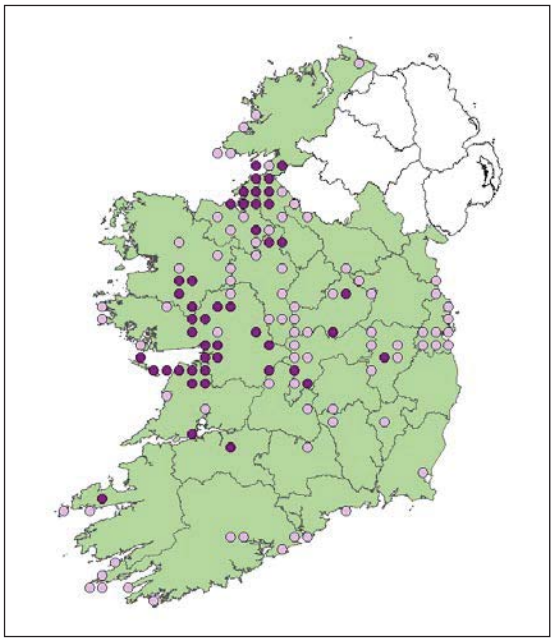


Figure 27: Distribution map community 3a.

Plate 18: Community 3a (relevé 1617/11), Annex I habitat [*]6210 Festuco-Brometalia, Murrooghkilly, East Burren Complex SAC (001926), Clare.

3b *Cynosurus cristatus – Trifolium repens* grassland

This community represents semi-improved swards on relatively well-drained, neutral soils of relatively high fertility. *Lolium perenne*, *Trifolium repens* and *Cerastium fontanum* are all indicative of improved grassland and are very frequent here. Nevertheless, these swards retain significantly more floral diversity than the *Lolium perenne – Trifolium repens* communities typical of more intensely farmed systems such as silage fields. Apart from *L. perenne*, the main grass species are *Cynosurus cristatus*, *Holcus lanatus*, *Festuca rubra*, *Agrostis capillaris* and *Anthoxanthum odoratum*. While the cover of forbs can be quite high, it is largely composed of *Plantago lanceolata* and *Trifolium* spp. with other broadleaved herbs not contributing much cover. These other herbs include a mix of species characteristic of mesotrophic semi-natural grassland, such as *Prunella vulgaris*, *Hypochaeris radicata* and *Centaurea nigra*, and species associated with improved swards and more intensive farming, such as *Bellis perennis*, *Senecio jacobaea*, *Cirsium palustre* and *Cirsium arvense*. This community is found throughout the country in lowland farming landscapes.

Affinities:

Fossitt: GM1 - 0.0% GS1 - 58.3% GS2 - 6.7% GS3 - 0.0% GS4 - 1.7% GA1 - 33.3%

Annex I: 6210 - 6.7% 6230 - 0.0% 6410 - 0.0% 6430 - 0.0% 6510 - 0.0%

NVC: MG6b *Lolium perenne-Cynosurus cristatus* grassland *Anthoxanthum odoratum* sub-com. (76.7%)
MG5a *Cynosurus cristatus-Centaurea nigra* grassland *Lathyrus pratensis* sub-com. (72.8%)
MG6a *Lolium perenne-Cynosurus cristatus* grassland typical sub-com. (69.2%)

EUNIS: E2.11 Unbroken pastures

ZM: Cynosurion cristati

Environmental data:

Number of relevés:	60 (core) 234 (all)		Soil pH:	5.4	(n = 50)
Species richness:	27	(n = 60)	Soil organic content:	16 %	(n = 50)
Forb height:	9 cm	(n = 60)	Soil P:	0.79 mg/g	(n = 41)
Graminoid height:	15 cm	(n = 60)	Ellenberg Light:	7.1	
Forb proportion:	42 %	(n = 60)	Ellenberg Wetness:	5.2	
Altitude:	83 m	(n = 60)	Ellenberg Reaction:	5.7	
Slope:	9 °	(n = 60)	Ellenberg Fertility:	4.7	

Table 44: Synoptic table for core relevés in community 3b.

Species	Freq	Cover	Ind		Indicator	Freq	Cover	Ind	
Lolium perenne	V	2-(4)-7	b,c	④	*Dactylis glomerata*	III	1-(3)-5	b,c	④
Plantago lanceolata	V	+-(4)-7			*Ranunculus repens*	III	+-(2)-5	b,d,e	④
Trifolium repens	V	2-(5)-8	b,d,f	④	*Bellis perennis*	III	1-(2)-5	a,b,d	④
Cynosurus cristatus	V	2-(5)-9	b,c,d	⑤	*Achillea millefolium*	III	+-(2)-5	a,b,d	③
Cerastium fontanum	V	+-(2)-4	b,c,d	④	*Calliergonella cuspidata*	III	+-(2)-4		
Holcus lanatus	V	2-(3)-7	b,c,d	④	*Luzula campestris*	III	+-(2)-6	b,d,e	④
Festuca rubra	IV	2-(4)-6			*Brachythecium rutabulum*	III	+-(2)-5	b,c,d	③
Trifolium pratense	IV	+-(3)-6			*Centaurea nigra*	III	+-(2)-5		
Agrostis capillaris	IV	2-(4)-7	b,d,e	⑤	*Senecio jacobaea*	II	+-(2)-5	a,b,d	③
Anthoxanthum odoratum	IV	1-(3)-7	b,d,e	④	*Lotus corniculatus*	II	1-(2)-5		
Prunella vulgaris	IV	1-(2)-5	a,b,d	④	*Ranunculus acris*	II	+-(2)-4		
Rumex acetosa	IV	+-(2)-5	b,c,e	④	*Cirsium palustre*	II	+-(1)-3	b,d	③
Taraxacum officinalis agg.	IV	+-(2)-5	b,c,d	④	*Cirsium arvense*	II	+-(2)-4	b	③
Rhytidiadelphus squarrosus	IV	1-(2)-5	a,b,d	④	*Kindbergia praelonga*	II	+-(1)-3	b,d,e	③
Hypochaeris radicata	IV	+-(2)-5	b,d,e	④	*Poa trivialis*	II	+-(2)-4	b,c,e	③

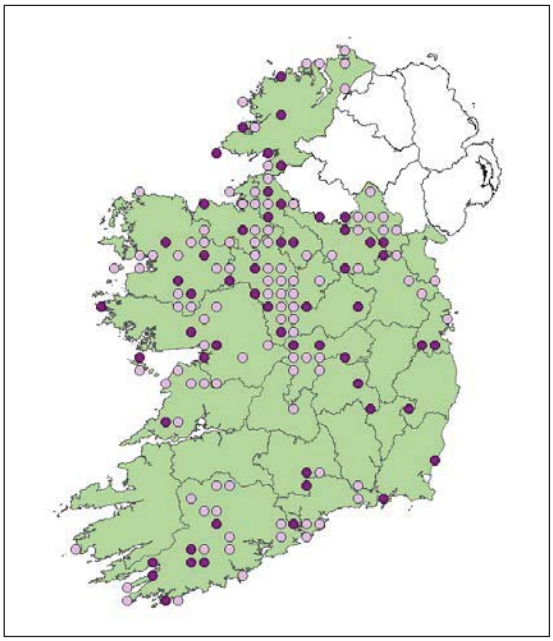


Figure 28: Distribution map community 3b.

Plate 19: Community 3b (relevé 1850/02) Skealoghan, Mayo.

3c *Festuca rubra – Plantago lanceolata* grassland

The *Festuca-Plantago* grassland is chiefly a lowland hay meadow community of mineral soils. The main grass species are *Festuca rubra*, *Dactylis glomerata*, *Holcus lanatus*, *Anthoxanthum odoratum* and *Agrostis stolonifera*. Broadleaved herbs consist primarily of *Plantago lanceolata*, *Trifolium pratense*, *Cerastium fontanum*, *Ranunculus acris*, *Rumex acetosa* and *Centaurea nigra*. It differs from the other main meadow community, 3e *Festuca-Rhinanthus* grassland, by being generally of lower conservation value. Sites tend to be drier and more fertile, *Lolium perenne* is more frequent and *Rhinanthus minor* much less so. The forb component also tends to be lower, but still on average covers half of the ground. The usual presence of *Dactylis glomerata* and the occasional dominance of *Arrhenatherum elatius* can lend the vegetation a coarse and tussocky structure; included here would be swards of abandoned meadows. This community is most frequent across the central part of the country, being only occasional in the south and unrecorded in the south-east.

Affinities:

Fossitt: GM1 - 0.0% GS1 - 18.6% GS2 - 72.9% GS3 - 0.0% GS4 - 2.9% GA1 - 5.7%

Annex I: 6210 - 1.4% 6230 - 0.0% 6410 - 1.4% 6430 - 0.0% 6510 - 37.1%

NVC: MG5a *Cynosurus cristatus-Centaurea nigra* grassland *Lathyrus pratensis* sub-com. (70.6%)
MG6b *Lolium perenne-Cynosurus cristatus* grassland *Anthoxanthum odoratum* sub-com. (67.0%)
MG5b *Cynosurus cristatus-Centaurea nigra* grassland *Galium verum* sub-com. (65.8%)

EUNIS: E2.11 Unbroken pastures

ZM: Cynosurion cristati/Arrhenatherion

Environmental data:

Number of relevés:	70 (core) 188 (all)		Soil pH:	5.8	(*n* = 42)
Species richness:	23	(*n* = 70)	Soil organic content:	19 %	(*n* = 43)
Forb height:	28 cm	(*n* = 70)	Soil P:	0.39 mg/g	(*n* = 34)
Graminoid height:	35 cm	(*n* = 70)	Ellenberg Light:	7.2	
Forb proportion:	50 %	(*n* = 70)	Ellenberg Wetness:	5.1	
Altitude:	67 m	(*n* = 70)	Ellenberg Reaction:	6.2	
Slope:	5 °	(*n* = 70)	Ellenberg Fertility:	4.8	

Table 45: Synoptic table for core relevés in community 3c.

Species	Freq	Cover	Ind		Indicator	Freq	Cover	Ind	
Festuca rubra	V	3-(6)-9	c,e,f	⑤	*Calliergonella cuspidata*	III	+-(2)-5		
Plantago lanceolata	V	+-(5)-9	c,d,e	⑤	*Brachythecium rutabulum*	III	+-(2)-5	b,c,d	③
Trifolium pratense	V	2-(5)-8	c,d,e	⑤	*Lathyrus pratensis*	II	+-(2)-5	c,e	③
Dactylis glomerata	V	+-(4)-7	b,c	④	*Ranunculus repens*	II	+-(3)-5		
Holcus lanatus	V	1-(4)-8	b,c,d	④	*Rhinanthus minor*	II	1-(2)-5		
Cerastium fontanum	V	+-(2)-6	b,c,d	④	*Heracleum sphondylium*	II	+-(3)-5	c,e	③
Trifolium repens	IV	1-(3)-6			*Leucanthemum vulgare*	II	1-(3)-8	a,c,e	④
Ranunculus acris	IV	+-(3)-7	c,d,e	⑤	*Lotus corniculatus*	II	1-(3)-7		
Anthoxanthum odoratum	IV	1-(4)-7			*Prunella vulgaris*	II	1-(2)-8		
Cynosurus cristatus	IV	+-(4)-7	b,c,d	⑤	*Arrhenatherum elatius*	II	+-(3)-7	c	③
Agrostis stolonifera	IV	+-(4)-8	c,f	④	*Achillea millefolium*	II	1-(2)-4		
Rumex acetosa	IV	1-(2)-4	b,c,e	④	*Hypochaeris radicata*	II	+-(2)-5		
Taraxacum officinalis agg.	IV	+-(2)-5	b,c,d	④	*Luzula campestris*	II	+-(2)-3		
Centaurea nigra	III	+-(4)-6	a,c,e	④	*Crepis capillaris*	II	+-(2)-5	b,c,e	③
Lolium perenne	III	+-(3)-7	b,c	④	*Euphrasia officinalis* agg.	II	+-(2)-6	a,c,e	④

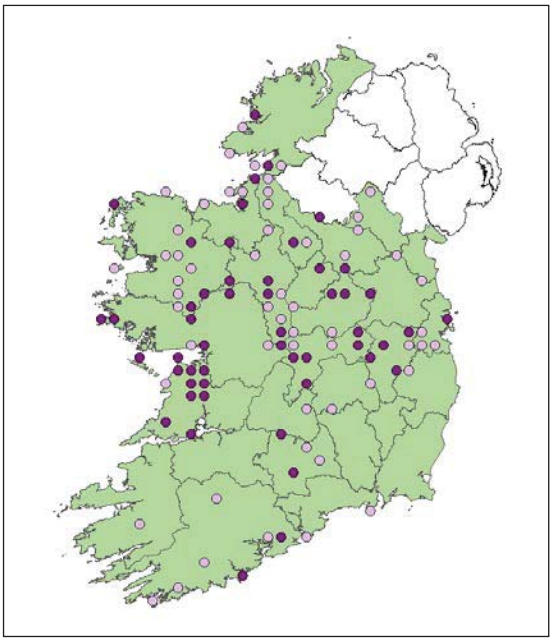


Figure 29: Distribution map community 3c.

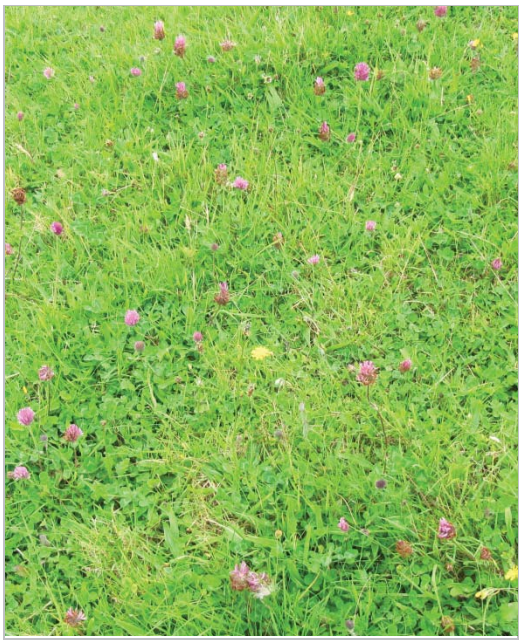


Plate 20: Community 3c (relevé 1908/01), recently mown Annex I habitat 6510 Lowland hay meadows, Sranabol, River Boyne SAC (002299), Meath.

3d *Cynosurus cristatus – Trifolium pratense* grassland

The *Cynosurus-Trifolium* grassland may be regarded as a fairly standard semi-natural pasture community of neutral mineral soils, which lacks any unique indicator species. The main grass species are *Agrostis capillaris* and *Cynosurus cristatus*, with *Holcus lanatus*, *Anthoxanthum odoratum* and *Festuca rubra* also frequent. The broadleaved herbs comprise chiefly *Plantago lanceolata*, *Trifolium repens*, *Prunella vulgaris*, *Trifolium pratense*, *Cerastium fontanum* and *Hypochaeris radicata*. *Rhytidiadelphus squarrosus* is a constant and can be abundant. There are often signs of some agricultural improvement, with *Senecio jacobaea*, *Bellis perennis*, *Lolium perenne* and *Cirsium arvense* being fairly frequent. This community is usually found on sloping ground at mid-range altitudes. It occurs across the country, but is possibly more frequent on the west coast and in the north midlands.

Affinities:

Fossitt: GM1 - 0.0% GS1 - 71.0% GS2 - 10.1% GS3 - 10.1% GS4 - 1.4% GA1 - 7.2%

Annex I: 6210 - 4.3% 6230 - 0.0% 6410 - 0.0% 6430 - 0.0% 6510 - 8.7%

NVC: MG6b *Lolium perenne-Cynosurus cristatus* grassland *Anthoxanthum odoratum* sub-com. (71.3%)
MG5a *Cynosurus cristatus-Centaurea nigra* grassland *Lathyrus pratensis* sub-com. (70.1%)
MG5c *Cynosurus cristatus-Centaurea nigra* grassland *Danthonia decumbens* sub-com. (67.8%)

EUNIS: E2.11 Unbroken pastures

ZM: Cynosurion cristati

Environmental data:

Number of relevés:	69 (core) 153 (all)		Soil pH:	5.0	(*n* = 54)
Species richness:	28	(*n* = 69)	Soil organic content:	18%	(*n* = 53)
Forb height:	11 cm	(*n* = 69)	Soil P:	0.51 mg/g	(*n* = 50)
Graminoid height:	15 cm	(*n* = 69)	Ellenberg Light:	7.1	
Forb proportion:	44 %	(*n* = 69)	Ellenberg Wetness:	5.3	
Altitude:	95 m	(*n* = 69)	Ellenberg Reaction:	5.4	
Slope:	10 °	(*n* = 69)	Ellenberg Fertility:	4.1	

Table 46: Synoptic table for core relevés in community 3d.

Species	Freq	Cover	Ind		Indicator	Freq	Cover	Ind	
Agrostis capillaris	V	2-(5)-8	b,d,e	⑤	*Ranunculus acris*	IV	+-(2)-5	c,d,e	⑤
Cynosurus cristatus	V	2-(5)-8	b,c,d	⑤	*Lotus corniculatus*	III	+-(3)-6	a,d,f	④
Plantago lanceolata	V	2-(5)-7	c,d,e	⑤	*Calliergonella cuspidata*	III	+-(2)-5	a,d,e	③
Holcus lanatus	V	2-(3)-7	b,c,d	④	*Scleropodium purum*	III	+-(2)-6	a,d	⑤
Trifolium repens	V	2-(4)-6	b,d	④	*Leontodon autumnalis*	III	+-(2)-5	b,d,e	③
Prunella vulgaris	V	+-(3)-6	a,b,d	④	*Taraxacum officinalis* agg.	III	+-(2)-3	b,c,d	④
Trifolium pratense	V	+-(3)-6	c,d,e	⑤	*Achillea millefolium*	III	+-(2)-5	a,b,d	③
Cerastium fontanum	V	+-(2)-3	b,c,d	④	*Carex flacca*	III	1-(3)-5	a,d,f	⑤
Hypochaeris radicata	V	+-(3)-6	b,d,e	④	*Senecio jacobaea*	III	+-(2)-3	a,b,d	③
Rhytidiadelphus squarrosus	V	+-(3)-8	a,b,d	④	*Bellis perennis*	III	+-(2)-6	a,b,d	④
Anthoxanthum odoratum	IV	1-(4)-8	b,d,e	④	*Lolium perenne*	III	+-(2)-4		
Festuca rubra	IV	2-(4)-7			*Cirsium palustre*	III	+-(2)-4	b,d	③
Ranunculus repens	IV	+-(2)-4	b,d,e	④	*Luzula campestris*	III	+-(2)-5	b,d,e	④
Rumex acetosa	IV	+-(2)-4			*Dactylis glomerata*	III	+-(2)-4		
Centaurea nigra	IV	+-(3)-5			*Brachythecium rutabulum*	II	+-(2)-5	b,c,d	③

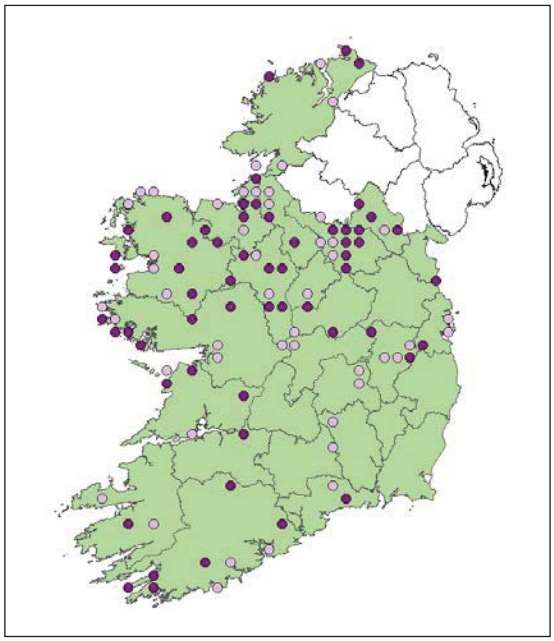


Figure 30: Distribution map community 3d.

Plate 21: Community 3d (relevé 850/11), Letterfine, Leitrim.

3e *Festuca rubra – Rhinanthus minor* grassland

The *Festuca-Rhinanthus* grassland is predominantly a community of lowland hay meadows on mineral soils of rather low fertility. The main grass species are *Anthoxanthum odoratum*, *Festuca rubra*, *Agrostis capillaris*, *Holcus lanatus* and *Cynosurus cristatus*. Forb cover is very high, with *Plantago lanceolata* and *Trifolium pratense* being abundant, while other forbs include *Ranunculus acris*, *Rumex acetosa*, *Lotus corniculatus* and *Leucanthemum vulgare*. The hemi-parasite *Rhinanthus minor* is the chief indicator species for this community, being a constant and fairly common species in this sward. *Filipendula ulmaria* is occasional, occurring on seasonally flooded land. *Lathyrus pratensis* is also occasional and may be found on better quality sites. Generally, there is little sign of improvement, with *Lolium perenne* not being a very frequent species. The bryophyte layer includes *Kindbergia praelonga*, *Calliergonella cuspidata*, *Rhytidiadelphus squarrosus* and *Brachythecium rutabulum* and cover is generally low. This community occurs across the middle of the country, with few examples recorded in the far north (northern Donegal) or in the south (from Kerry across to Wexford).

Affinities:

Fossitt: GM1 - 0.0% GS1 - 9.4% GS2 - 87.5% GS3 - 0.0% GS4 - 0.0% GA1 - 3.1%

Annex I: 6210 - 0.0% 6230 - 0.0% 6410 - 0.0% 6430 - 0.0% 6510 - 62.5%

NVC: MG5a *Cynosurus cristatus-Centaurea nigra* grassland *Lathyrus pratensis* sub-com. (70.3%)
MG6b *Lolium perenne-Cynosurus cristatus* grassland *Anthoxanthum odoratum* sub-com. (67.7%)
MG5c *Cynosurus cristatus-Centaurea nigra* grassland *Danthonia decumbens* sub-com. (64.6%)

EUNIS: E2.11 Unbroken pastures

ZM: Cynosurion cristati

Environmental data:

Number of relevés:	64 (core) 112 (all)		Soil pH:	5.2	(n = 30)
Species richness:	24	(n = 64)	Soil organic content:	14 %	(n = 30)
Forb height:	28 cm	(n = 64)	Soil P:	0.39 mg/g	(n = 24)
Graminoid height:	30 cm	(n = 64)	Ellenberg Light:	7.2	
Forb proportion:	58 %	(n = 64)	Ellenberg Wetness:	5.3	
Altitude:	63 m	(n = 64)	Ellenberg Reaction:	5.6	
Slope:	3 °	(n = 64)	Ellenberg Fertility:	4.2	

Table 47: Synoptic table for core relevés in community 3e.

Species	Freq	Cover	Ind		Indicator	Freq	Cover	Ind	
Plantago lanceolata	V	2-(6)-8	c,d,e	⑤	*Calliergonella cuspidata*	III	+-(2)-6	a,d,e	③
Trifolium pratense	V	2-(5)-8	c,d,e	⑤	*Luzula campestris*	III	+-(2)-3	b,d,e	④
Anthoxanthum odoratum	V	2-(5)-8	b,d,e	④	*Lotus corniculatus*	III	+-(3)-6		
Festuca rubra	V	3-(6)-9	c,e,f	⑤	*Taraxacum officinalis* agg.	III	+-(2)-4		
Rhinanthus minor	V	1-(4)-8	e	⑤	*Leucanthemum vulgare*	III	+-(3)-7	a,c,e	④
Ranunculus acris	V	+-(3)-6	c,d,e	⑤	*Ranunculus repens*	III	+-(2)-6	b,d,e	④
Agrostis capillaris	V	2-(5)-8	b,d,e	⑤	*Dactylis glomerata*	II	+-(3)-5		
Holcus lanatus	V	1-(3)-7			*Rhytidiadelphus squarrosus*	II	+-(3)-9		
Rumex acetosa	IV	+-(2)-5	b,c,e	④	*Filipendula ulmaria*	II	+-(2)-5	e	③
Cerastium fontanum	IV	+-(2)-3			*Stellaria graminea*	II	+-(2)-3	c,d,e	③
Cynosurus cristatus	IV	+-(3)-5			*Lathyrus pratensis*	II	+-(2)-3	c,e	③
Trifolium repens	IV	1-(3)-6			*Euphrasia officinalis* agg.	II	2-(4)-7	a,c,e	④
Hypochaeris radicata	III	2-(3)-7	b,d,e	④	*Lolium perenne*	II	+-(2)-5		
Kindbergia praelonga	III	+-(2)-3	b,d,e	③	*Prunella vulgaris*	II	+-(2)-5		
Centaurea nigra	III	+-(3)-6	a,c,e	④	*Brachythecium rutabulum*	II	+-(2)-4		

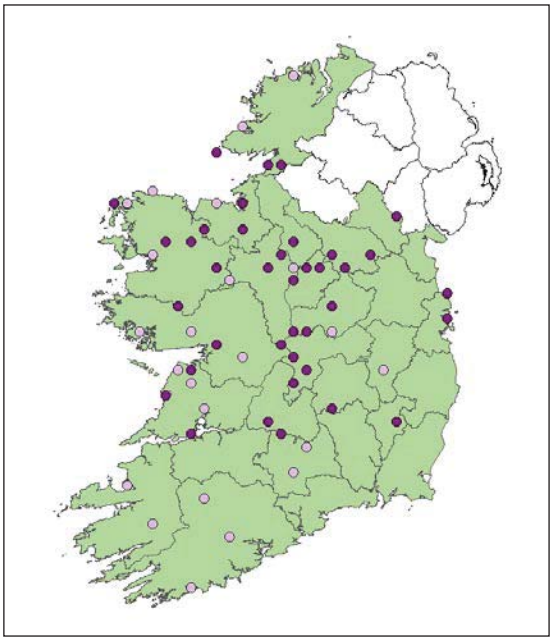


Figure 31: Distribution map community 3e.

Plate 22: Community 3e (relevé 107/05), Annex I habitat 6510 Lowland hay meadows, Clonmacnoise, Shannon Callows SAC (000216), Offaly.

3f *Festuca rubra – Lotus corniculatus* grassland

Included in this rather variable and species-poor community are swards of dry, neutral to base-rich grasslands, compiled here due to the common dominance of *Festuca rubra*. The only other constant species are *Plantago lanceolata*, *Lotus corniculatus* and *Trifolium repens*. Species indicative of calcareous grassland may occur (e.g. *Carex flacca*, *Euphrasia officinalis* agg., *Koeleria macrantha* and *Daucus carota*) but are typically not plentiful. *Festuca-Lotus* grassland comprises two sub-communities. The *Plantago maritima* sub-community (3fi) is a maritime vegetation assemblage, found on clifftops around the coast. The sward is typically very low and tight due to heavy grazing or exposure, and there is a high cover of *Plantago* spp., including *Plantago maritima* and *Plantago coronopus*. Other maritime species encountered include *Armeria maritima* and *Anthyllis vulneraria* but these are less frequent. The *Festuca rubra* sub-community (3fii) lacks these maritime indicators and may occur in a coastal or inland context. It usually occurs as a rank, ungrazed sward in which *Festuca rubra* forms a dense springy mat.

Affinities:

Fossitt: GM1 - 0.0% GS1 - 73.9% GS2 - 10.1% GS3 - 11.6% GS4 - 4.3% GA1 - 0.0%

Annex I: 6210 - 1.4% 6230 - 0.0% 6410 - 1.4% 6430 - 0.0% 6510 - 0.0%

NVC: MC9c *Festuca rubra-Holcus lanatus* maritime grassland *Achillea millefolium* sub-com. (74.4%)
MC9a *Festuca rubra-Holcus lanatus* maritime grassland *Plantago maritima* sub-com. (71.9%)
MC10a *Festuca rubra-Plantago* spp. maritime grassland *Armeria maritima* sub-com. (64.6%)

EUNIS: B3.31 Atlantic sea-cliff communities

ZM: Silenion maritimae/Cynosurion cristati

Environmental data:

Number of relevés:	69 (core) 274 (all)		Soil pH:	5.2	(n = 60)
Species richness:	19	(n = 69)	Soil organic content:	24 %	(n = 59)
Forb height:	10 cm	(n = 69)	Soil P:	0.37 mg/g	(n = 59)
Graminoid height:	13 cm	(n = 69)	Ellenberg Light:	7.6	
Forb proportion:	39 %	(n = 69)	Ellenberg Wetness:	5.2	
Altitude:	34 m	(n = 69)	Ellenberg Reaction:	5.8	
Slope:	10 °	(n = 69)	Ellenberg Fertility:	4.3	

Table 48. Synoptic table for core relevés in community 3f.

Species	Freq	Cover	Ind		Indicator	Freq	Cover	Ind	
Festuca rubra	V	4-(8)-10	c,e,f	⑤	*Leontodon autumnalis*	II	+-(2)-4		
Plantago lanceolata	V	+-(3)-6			*Bellis perennis*	II	+-(2)-6		
Lotus corniculatus	V	+-(4)-7	a,d,f	④	*Euphrasia officinalis* agg.	II	+-(2)-4		
Trifolium repens	V	+-(2)-6	b,d,f	④	*Trifolium pratense*	II	+-(3)-5		
Agrostis stolonifera	III	2-(3)-6	c,f	④	*Anthoxanthum odoratum*	II	2-(3)-7		
Plantago maritima	III	1-(4)-8	a,f	④	*Thymus polytrichus*	II	1-(2)-5		
Holcus lanatus	III	1-(2)-7			*Daucus carota*	II	+-(2)-5	a,c,f	③
Hypochaeris radicata	III	+-(2)-5			*Hypnum cupressiforme*	II	+-(1)-3	f	②
Carex flacca	III	1-(3)-6	a,d,f	⑤	*Rumex acetosa*	II	+-(1)-3		
Cerastium fontanum	III	+-(2)-3			*Achillea millefolium*	I	+-(2)-6		
Potentilla erecta	III	+-(3)-6	a,f	④	*Anthyllis vulneraria*	I	+-(3)-6	a,f	④
Plantago coronopus	III	1-(3)-7	f	④	*Carex viridula*	I	+-(2)-4	d,f	②
Agrostis capillaris	II	1-(3)-5			*Dactylis glomerata*	I	+-(2)-4		
Armeria maritima	II	+-(3)-7	f	④	*Kindbergia praelonga*	I	+-(2)-6		
Koeleria macrantha	II	2-(3)-5	a,f	④	*Centaurea nigra*	I	+-(2)-5		

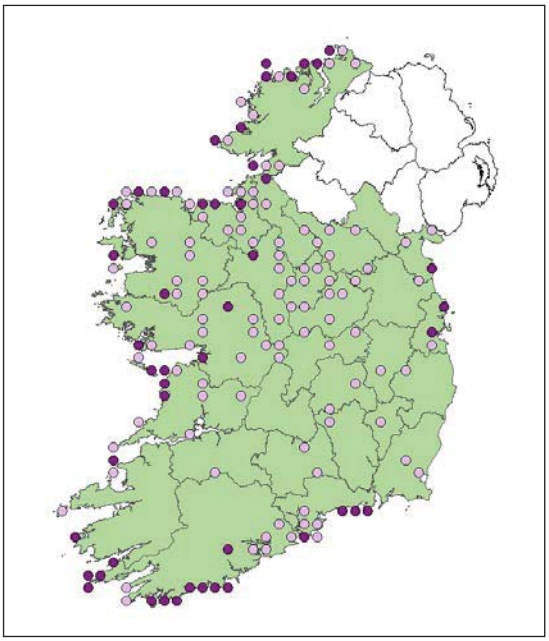


Figure 32: Distribution map community 3f.

Plate 23: Community 3f (relevé 400/03), Roaringwater Bay and Islands SAC (000101), Cape Clear, Cork.

Plate 24: 3a *Briza media – Thymus polytrichus* grassland and Annex I habitat [*]6210 Festuco-Brometalia, Murrooghkilly (Site 1617 view from relevé 2), East Burren Complex SAC (001926), Clare.

Plate 25: 3c *Festuca rubra – Plantago lanceolata* grassland and Annex I habitat 6510 Lowland hay meadows, Glencolumbkille (Site 1696), Clare.

Plate 26: 3d *Cynosurus cristatus – Trifolium pratense* grassland, Knockacullen (Site 534 view from relevé 2), Cork.

Plate 27: 3f *Festuca rubra – Lotus corniculatus* grassland, Glannafeen (Site 481 view from relevé 4), Cork.

4a *Agrostis capillaris – Trifolium repens* grassland

The *Agrostis-Trifolium* grassland is a rather variable semi-improved community of the lower uplands, which occurs mainly on drained mineral soils or gleys. Soil fertility is higher than elsewhere in Group 4, while species richness is lower. The main grass species are *Agrostis capillaris*, *Anthoxanthum odoratum*, *Holcus lanatus* and *Festuca rubra*. Among the forbs, *Trifolium repens* and *Rumex acetosa* are constants, with *Cerastium fontanum, Ranunculus repens* and *Potentilla erecta* also frequent. Of the other species which may occur, some are more characteristic of the uplands (e.g. *Galium saxatile, Luzula multiflora* and *Hylocomium splendens*), while others are more characteristic of lowland dry mesotrophic swards (e.g. *Plantago lanceolata, Cynosurus cristatus, Ranunculus acris* and *Hypochaeris radicata*) or wet grassland (e.g. *Juncus effusus, Juncus acutiflorus/articulatus*). *Lolium perenne, Kindbergia praelonga, Brachythecium rutabulum* and *Poa trivialis* are indicators for this community, through not strong ones. The main component of the bryophyte layer is *Rhytidiadelphus squarrosus*.

Affinities:

Fossitt: GM1 - 0.0% GS1 - 19.0% GS2 - 5.5% GS3 - 30.1% GS4 - 26.4% GA1 - 19.0%

Annex I: 6210 - 0.0% 6230 - 0.6% 6410 - 1.2% 6430 - 0.0% 6510 - 1.2%

NVC: U4b *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland *Holcus lanatus-Trifolium repens* sub-com. (61.0%)
MG6b *Lolium perenne-Cynosurus cristatus* grassland *Anthoxanthum odoratum* sub-com. (59.9%)
U4a *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland typical sub-com. (52.4%)

EUNIS: E1.72 *Agrostis-Festuca* grassland

ZM: Violion caninae

Environmental data:

Number of relevés:	163 (core) 313 (all)		Soil pH:	4.6	(*n* = 145)
Species richness:	17	(*n* = 163)	Soil organic content:	21%	(*n* = 142)
Forb height:	12 cm	(*n* = 161)	Soil P:	0.48 mg/g	(*n* = 139)
Graminoid height:	22 cm	(*n* = 163)	Ellenberg Light:	7.0	
Forb proportion:	22 %	(*n* = 161)	Ellenberg Wetness:	5.9	
Altitude:	132 m	(*n* = 163)	Ellenberg Reaction:	4.6	
Slope:	9 °	(*n* = 163)	Ellenberg Fertility:	3.8	

Table 49: Synoptic table for core relevés in community 4a.

Species	Freq	Cover	Ind		Indicator	Freq	Cover	Ind	
Agrostis capillaris	V	2-(6)-9	a,b,c	⑤	*Cynosurus cristatus*	II	+-(3)-6	a,b	③
Anthoxanthum odoratum	V	1-(5)-9	a,c,d	④	*Ranunculus acris*	II	+-(2)-5	a,c,d	③
Holcus lanatus	V	+-(4)-8	a,c,d	⑤	*Calliergonella cuspidata*	II	+-(2)-5	a,c,d	③
Rhytidiadelphus squarrosus	V	+-(4)-10	a,c,d	④	*Galium saxatile*	II	1-(2)-6		
Trifolium repens	V	+-(4)-8	a,c,d	④	*Hypochaeris radicata*	II	+-(2)-8	a,c,d	③
Rumex acetosa	IV	+-(3)-6	a,c,d	③	*Poa humilis/pratensis*	II	+-(2)-8	a,c,d	②
Festuca rubra	III	2-(4)-8	a,c,d	④	*Kindbergia praelonga*	II	+-(2)-6	a	②
Cerastium fontanum	III	+-(2)-3	a,c	③	*Lolium perenne*	II	1-(3)-7	a	②
Ranunculus repens	III	+-(2)-5	a,c,d	③	*Luzula multiflora*	II	+-(2)-5		
Potentilla erecta	III	+-(2)-7			*Brachythecium rutabulum*	II	+-(2)-5	a	②
Cirsium palustre	II	+-(3)-5	a,c,d	③	*Hylocomium splendens*	II	1-(2)-7		
Scleropodium purum	II	+-(2)-7			*Juncus acutiflorus/articulatus*	I	1-(4)-7		
Plantago lanceolata	II	+-(2)-5	a,c	③	*Taraxacum officinalis* agg.	I	+-(2)-4	a,c,d	②
Juncus effusus	II	+-(4)-8	a,c,d	③	*Prunella vulgaris*	I	+-(2)-5	a,c,d	②
Luzula campestris	II	+-(3)-5	a,b,c	②	*Poa trivialis*	I	+-(2)-4	a	②

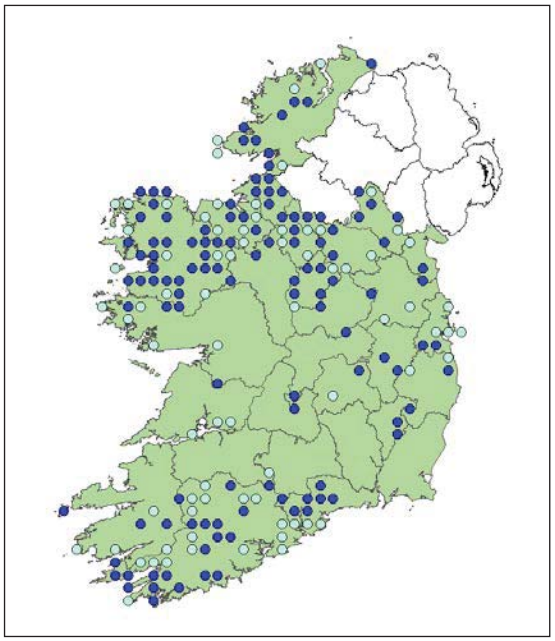


Figure 33: Distribution map community 4a.

Plate 28: Community 4a (relevé 2915/01), Ballymoheen, Tipperary.

4b *Nardus stricta – Festuca ovina* grassland

The *Nardus-Festuca* grassland occurs as a low sward on thin, peaty, infertile soils and is restricted largely to unenclosed, sheep-grazed, steep slopes in the uplands. It occurs at higher altitudes than the other communities in this classification. The main grasses are *Agrostis capillaris*, *Anthoxanthum odoratum*, *Nardus stricta* and *Festuca ovina*, with *Danthonia decumbens* also frequent. *Potentilla erecta* and *Galium saxatile* are constant species, and indeed often the only forbs present apart from *Polygala serpyllifolia*, which is occasional in the sward. There is generally a well-developed bryophyte layer composed of *Hylocomium splendens*, *Rhytidiadelphus squarrosus*, *R. loreus*, *Thuidium tamariscinum/ delicatulum* and *Scleropodium purum*. As these grasslands are derived from, and often in mosaic with, dry heaths, there is frequently some low cover of dwarf shrubs in the form of *Calluna vulgaris* and *Vaccinium myrtillus*. *Carex binervis* is frequent and, in more humid areas, *C. panicea* can be found amongst the sward.

Affinities:

Fossitt: GM1 - 0.0% GS1 - 3.1% GS2 - 0.0% GS3 - 96.3% GS4 - 0.6% GA1 - 0.0%

Annex I: 6210 - 1.9% 6230 - 36.3% 6410 - 0.0% 6430 - 0.0% 6510 - 0.0%

NVC: U5d *Nardus stricta-Galium saxatile* grassland *Calluna vulgaris-Danthonia decumbens* sub-com. (70.1%)

U4d *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland *Luzula multiflora-Rhytidiadelphus loreus* sub-com. (67.8%)

U5a *Nardus stricta-Galium saxatile* grassland species-poor sub-com. (67.1%)

EUNIS: E1.71 *Nardus stricta* swards

ZM: Violion caninae

Environmental data:

Number of relevés:	160 (core) 191 (all)		Soil pH:	4.1	(*n* = 66)
Species richness:	22	(*n* = 160)	Soil organic content:	38 %	(*n* = 67)
Forb height:	6 cm	(*n* = 151)	Soil P:	0.62 mg/g	(*n* = 67)
Graminoid height:	13 cm	(*n* = 151)	Ellenberg Light:	7.1	
Forb proportion:	20 %	(*n* = 151)	Ellenberg Wetness:	6.4	
Altitude:	249 m	(*n* = 160)	Ellenberg Reaction:	4.0	
Slope:	16 °	(*n* = 160)	Ellenberg Fertility:	2.7	

Table 50: Synoptic table for core relevés in community 4b.

Species	Freq	Cover	Ind		Indicator	Freq	Cover	Ind	
Potentilla erecta	V	1-(4)-8	b,c,d	⑤	*Carex pilulifera*	II	+-(2)-4	b,c	③
Agrostis capillaris	V	2-(5)-8	a,b,c	⑤	*Polytrichastrum formosum*	II	+-(2)-5	b,c	②
Galium saxatile	V	+-(3)-8	b,c	④	*Dicranum scoparium*	II	+-(1)-3	b,c	②
Rhytidiadelphus squarrosus	V	+-(4)-7	a,b,d	④	*Holcus lanatus*	II	+-(3)-6		
Hylocomium splendens	V	+-(5)-10	b,c,d	⑤	*Juncus squarrosus*	II	+-(3)-7	b	②
Anthoxanthum odoratum	V	+-(4)-8			*Luzula multiflora*	II	+-(2)-5	b,c,d	③
Nardus stricta	V	+-(4)-9	b,c	④	*Polygala serpyllifolia*	II	+-(2)-4	b,c	②
Festuca ovina	IV	2-(5)-8	b	③	*Agrostis canina/vinealis*	II	2-(3)-6		
Carex binervis	III	+-(3)-5	b,c	③	*Vaccinium myrtillus*	II	+-(2)-5	b	②
Danthonia decumbens	III	+-(3)-6	b,c	③	*Hypnum jutlandicum*	II	1-(3)-6	b	②
Thuidium tamaris./delicatulum	III	+-(3)-7	b,c,d	③	*Festuca vivipara*	I	2-(4)-7	b	②
Rhytidiadelphus loreus	III	+-(3)-7	b	③	*Luzula campestris*	I	2-(3)-5	a,b,c	②
Scleropodium purum	III	+-(2)-4			*Polytrichum commune*	I	+-(4)-7	b,c,d	②
Calluna vulgaris	III	+-(2)-5	b,c	③	*Trifolium repems*	I	+-(2)-3		
Carex panicea	II	1-(3)-6	b,c,d	③	*Breutelia chrysocoma*	I	+-(3)-6	b,c	②

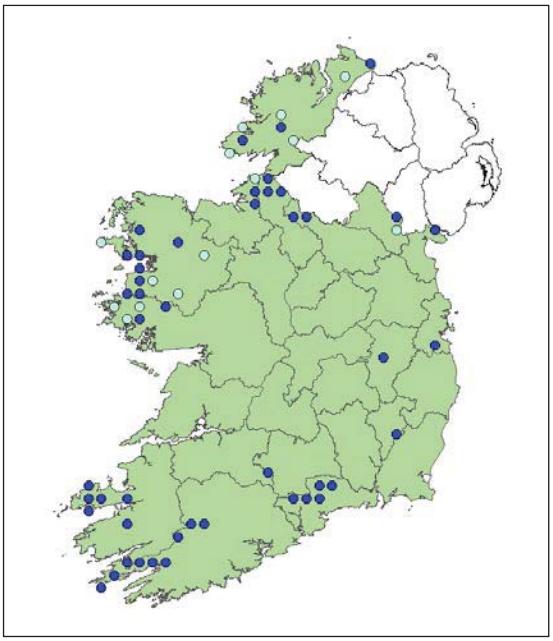


Figure 34: Distribution map community 4b.

Plate 29: Community 4b (relevé 1401/03), Little Curragh, Curragh pNHA (00392), Kildare.

4c *Agrostis capillaris – Festuca rubra* grassland

The *Agrostis-Festuca* grassland is chiefly a community of the lower uplands, intermediate in nature between the higher upland swards of 4b *Nardus-Festuca* grassland and the semi-improved swards of 4a *Agrostis-Trifolium* grassland. The soils vary from upland peats to gleys and drained mineral earths. The constant grasses are *Agrostis capillaris*, *Festuca rubra* and *Holcus lanatus*, while *Nardus stricta* is frequent. *Potentilla erecta*, *Trifolium repens* and *Galium saxatile* are the main broadleaved herbs, with *Succisa pratensis* sometimes abundant. The bryophyte layer is fairly well developed and contains *Hylocomium splendens*, *Rhytidiadelphus squarrosus*, *Scleropodium purum* and *Thuidium tamariscinum/ delicatulum*. Some sites have a measure of calcareous influence evidenced by the occurrence of *Carex flacca* and *Lotus corniculatus*. *Molinia caerulea* is also a component at some sites. This community has a distinct distribution, being recorded most frequently in the north-west from Mayo up to Donegal. It is the most species-rich grassland in this group and, as with community 4b, the more diverse swards are of particular conservation value.

Affinities:

Fossitt: GM1 - 0.0% GS1 - 9.6% GS2 - 0.0% GS3 - 70.2% GS4 - 19.3% GA1 - 0.9%

Annex I: 6210 - 3.5% 6230 - 21.1% 6410 - 5.3% 6430 - 0.0% 6510 - 0.0%

NVC: U5c *Nardus stricta-Galium saxatile* grassland *Carex panicea-Viola riviniana* sub-com. (62.3%)
U4d *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland *Luzula multiflora-Rhytidiadelphus loreus* sub-com. (59.3%)
U4a *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland typical sub-com. (58.5%)

EUNIS: E1.71 *Nardus stricta* swards

ZM: Violion caninae

Environmental data:

Number of relevés:	114 (core) 216 (all)		Soil pH:	4.6	(n = 71)
Species richness:	27	(n = 114)	Soil organic content:	27 %	(n = 68)
Forb height:	11 cm	(n = 111)	Soil P:	0.27 mg/g	(n = 68)
Graminoid height:	19 cm	(n = 111)	Ellenberg Light:	7.3	
Forb proportion:	31 %	(n = 111)	Ellenberg Wetness:	6.4	
Altitude:	148 m	(n = 114)	Ellenberg Reaction:	4.6	
Slope:	14°	(n = 114)	Ellenberg Fertility:	3.1	

Table 51: Synoptic table for core relevés in community 4c.

Species	Freq	Cover	Ind		Indicator	Freq	Cover	Ind	
Potentilla erecta	V	1-(4)-8	b,c,d	⑤	*Carex flacca*	III	+-(3)-5	c	③
Hylocomium splendens	V	1-(5)-9	b,c,d	⑤	*Cirsium palustre*	III	+-(3)-5	a,c,d	③
Anthoxanthum odoratum	V	2-(5)-8	a,c,d	④	*Thuidium tamaris./delicatulum*	III	+-(2)-7	b,c,d	③
Rhytidiadelphus squarrosus	V	+-(3)-7			*Carex binervis*	III	+-(3)-5	b,c	③
Agrostis capillaris	V	1-(5)-8	a,b,c	⑤	*Prunella vulgaris*	III	+-(2)-4	a,c,d	②
Festuca rubra	V	1-(5)-9	a,c,d	④	*Danthonia decumbens*	II	+-(2)-4	b,c	③
Scleropodium purum	V	+-(3)-7	c,d	④	*Calliergonella cuspidata*	II	+-(2)-5	a,c,d	③
Holcus lanatus	V	+-(3)-5	a,c,d	⑤	*Lotus corniculatus*	II	+-(2)-5	c	②
Trifolium repens	IV	+-(3)-7	a,c,d	④	*Juncus effusus*	II	+-(2)-7	a,c,d	③
Galium saxatile	IV	+-(3)-6	b,c	④	*Cynosurus cristatus*	II	+-(3)-5	a,c	③
Succisa pratensis	III	+-(3)-8	c,d	④	*Calluna vulgaris*	II	+-(2)-5	b,c	③
Nardus stricta	III	+-(4)-7	b,c	④	*Hypochaeris radicata*	II	+-(2)-5	a,c,d	③
Carex panicea	III	+-(3)-7	b,c,d	③	*Agrostis canina/vinealis*	II	2-(3)-5		
Luzula multiflora	III	+-(2)-4	b,c,d	③	*Molinia caerulea*	II	1-(4)-9	c,d	②
Plantago lanceolata	III	+-(3)-5	a,c	③	*Viola riviniana*	II	+-(2)-3	b,c	②

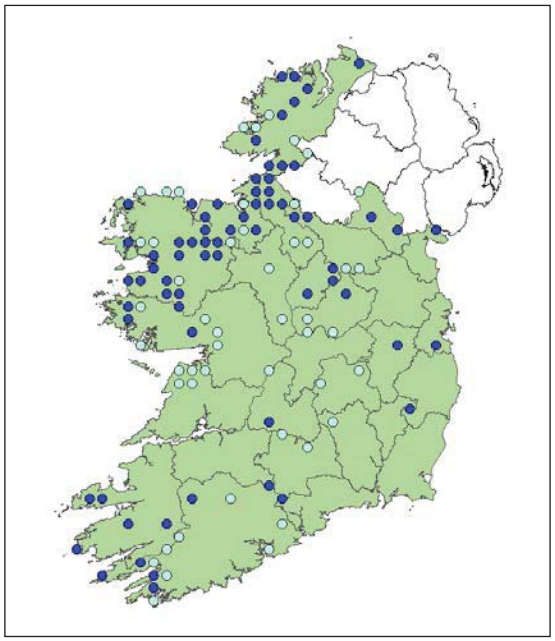


Figure 35: Distribution map community 4c.

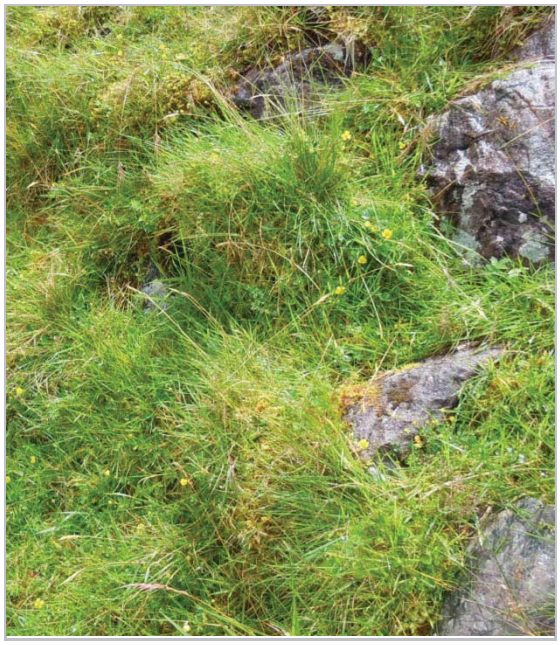


Plate 30: Community 4c (relevé 2401/04), Annex I habitat *6230 *Nardus* grassland, Mount Brandon SAC (000375), Ballinloghig, Kerry.

4d *Agrostis canina/vinealis – Carex echinata* grassland

The *Agrostis-Carex* grassland is a wet or humid sward of infertile, acidic, organic gleys and basin peats. It is somewhat intermediate between the upland grasslands of Group 4 and the peaty, wet grasslands of Group 1. The constant graminoids are *Anthoxanthum odoratum*, *Holcus lanatus*, *Luzula multiflora*, *Juncus acutiflorus/articulatus*, *Agrostis canina/vinealis* and *Carex echinata.* The latter three taxa alongside *Carex nigra* and *C. leporina* are indicators for this community within this group. The only constant forb is *Potentilla erecta*, with *Succisa pratensis* and *Trifolium repens* frequent. There is a good bryophyte layer, with *Rhytidiadelphus squarrosus* usually abundant and accompanied by *Hylcomium splendens* and *Scleropodium purum.* Both *Molinia caerulea* and *Nardus stricta* can occasionally occur. This is a regionally distinct community found most frequently in Leitrim and the surrounding counties.

Affinities:

Fossitt: GM1 - 0.0% GS1 - 0.0% GS2 - 0.0% GS3 - 19.3% GS4 - 78.5% GA1 - 2.2%

Annex I: 6210 - 0.0% 6230 - 3.7% 6410 - 14.8% 6430 - 0.0% 6510 - 0.0%

NVC: M25b *Molinia caerulea-Potentilla erecta* mire *Anthoxanthum odoratum* sub-com. (57.1%)
U4d *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland *Luzula multiflora-Rhytidiadelphus loreus* sub-com. (57.0%)
U5c *Nardus stricta-Galium saxatile* grassland *Carex panicea-Viola riviniana* sub-com. (56.3%)

EUNIS: E3.51 *Molinia* meadows and related communities

ZM: Junco-Molinion

Environmental data:

Number of relevés:	135 (core) 209 (all)		Soil pH:	4.2	(*n* = 109)
Species richness:	21	(*n* = 135)	Soil organic content:	33 %	(*n* = 92)
Forb height:	16 cm	(*n* = 133)	Soil P:	0.52 mg/g	(*n* = 92)
Graminoid height:	30 cm	(*n* = 135)	Ellenberg Light:	7.6	
Forb proportion:	27 %	(*n* = 133)	Ellenberg Wetness:	7.2	
Altitude:	106 m	(*n* = 135)	Ellenberg Reaction:	4.1	
Slope:	5 °	(*n* = 135)	Ellenberg Fertility:	2.7	

Table 52: Synoptic table for core relevés in community 4d.

Species	Freq	Cover	Ind		Indicator	Freq	Cover	Ind	
Rhytidiadelphus squarrosus	V	1-(6)-10	a,c,d	④	*Juncus effusus*	III	+-(3)-8	a,c,d	③
Anthoxanthum odoratum	V	2-(5)-8	a,c,d	④	*Festuca rubra*	III	2-(3)-7	a,c,d	④
Holcus lanatus	V	1-(3)-9	a,c,d	⑤	*Calliergonella cuspidata*	II	+-(2)-5	a,c,d	③
Potentilla erecta	V	+-(4)-7	b,c,d	⑤	*Hypochaeris radicata*	II	+-(2)-7	a,c,d	③
Agrostis canina/vinealis	V	2-(5)-8	d	⑤	*Agrostis stolonifera*	II	+-(3)-7	c,d	②
Juncus acutiflorus/articulatus	IV	+-(4)-8	d	④	*Thuidium tamaris./delicatulum*	II	+-(2)-4	b,c,d	③
Sclerpodium purum	IV	+-(3)-8	c,d	④	*Rumex acetosa*	II	+-(2)-4	a,c,d	③
Luzula multiflora	IV	+-(2)-6	b,c,d	③	*Cirsium palustre*	II	+-(2)-4	a,c,d	③
Hylocomium splendens	IV	+-(4)-8	b,c,d	⑤	*Nardus stricta*	II	2-(3)-6		
Carex echinata	IV	+-(3)-7	d	③	*Pedicularis sylvatica*	II	+-(2)-4	c,d	②
Carex nigra	III	+-(3)-6	d	③	*Ranunculus acris*	II	+-(2)-5	a,c,d	③
Succisa pratensis	III	+-(4)-7	c,d	④	*Molinia caerulea*	II	1-(4)-8	c,d	②
Trifolium repens	III	+-(3)-7	a,c,d	④	*Lophocolea bidentata*	II	+-(2)-4	a,c,d	②
Agrostis capillaris	III	+-(3)-7			*Carex leporina*	II	+-(2)-7	d	②
Carex panicea	III	+-(3)-5	b,c,d	③	*Galium saxatile*	II	+-(2)-6		

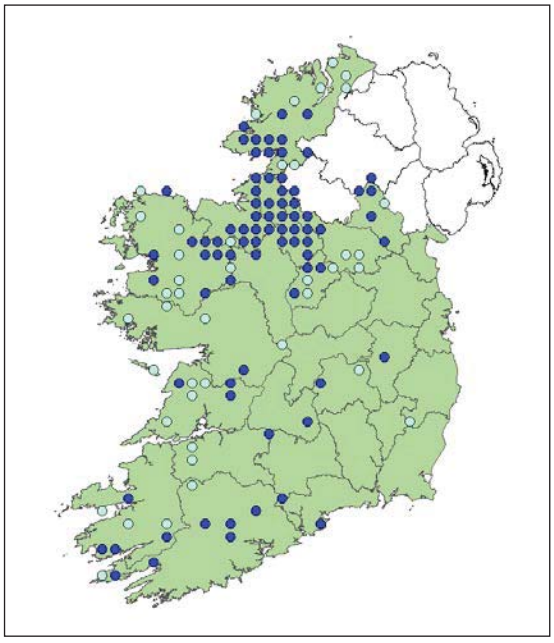


Figure 36: Distribution map community 4d.

Plate 31: Community 4d (relevé 836/05), Annex I habitat *6230 *Nardus* grassland, Shass, Leitrim.

Plate 32: 4a *Agrostis capillaris* – *Trifolium repens* grassland, Kiltimon (Site 3106 view from relevé 1), Wicklow.

Plate 33: 4b *Nardus stricta* – *Festuca ovina* grassland, The Curragh (Site 1400 view from relevé 16), Curragh pNHA (00392), Kildare.

Plate 34: 4c *Agrostis capillaris* – *Festuca rubra* grassland, Rosbarnagh Island (Site 1875 view from relevé 3), Clew Bay Complex SAC (001482), Mayo.

Plate 35: 4d *Agrostis canina/vinealis* – *Carex echinata* grassland, Greenan (Site 1519 view from relevé 5), Bricklieve Mountains and Keishcorran SAC (001656), Sligo.

Grassland butterflies. Left column: *Euphydras aurinia, Inachis io, Argynnis aglaja, Argynnis paphia.* Right column: *Vanessa cardui, Lyacaena phlaes, Polyommatus icarus, Parage aegeria, Pieris napi.*

4. Discussion

The Irish semi-natural grasslands survey (ISGS) has addressed data deficiencies that arose through the lack of a large-scale national semi-natural grasslands survey. The six years of the ISGS resulted in the botanical survey and mapping of 1,192 grassland sites covering 23,188.1 ha of Ireland, representing 0.3% of the national area. A total of 4,544 grassland relevés were recorded. There is now up-to-date information on the relative distribution of the five Fossitt (2000) grassland / marsh habitats and five Annex I grassland habitats, at least in a lowland context. The survey found that wet grassland (GS4 under the Fossitt (2000) habitat classification system) was the most extensive semi-natural habitat, covering 55% of the surveyed area. The north-west to south-east gradient of wet grassland frequency presented in the results is in agreement with the west-east gradient of rainfall across the country (Met Éireann 2013). The main management activity carried out in the surveyed grasslands was grazing, with 91% of sites having some form of grazing. The most frequent grazers were cattle, found in 72% of sites. This finding was also in line with CSO farm data that found specialist beef farming was the most common farming type (CSO 2012). The degree of coincidence between ISGS sites and NPWS conservation sites was examined and it was found that 26% of the area surveyed during the ISGS was within an NHA or pNHA, 20% of the area was within an SAC, and 14% of the area was within an SPA.

The conservation scoring system utilised in this report highlighted the best grassland sites in the country (Table 13). Site 2704 Aughinish, Limerick, received the highest overall score because of its diversity of grassland habitats, including two Annex I grassland habitats, the presence of notable species such as *Sanguisorba officinalis*, and other key criteria. This site is partly within an SAC, although some areas of Annex I habitat in the site are not. Several of the top-ranked sites, however, are completely outside an SAC, while others lack the protection of any NPWS conservation designation. Table 53 below shows the sites ranked in the top 50 nationally that are not within an SAC.

These 21 sites all contain Annex I grassland habitats, and three – 1324 Newbridge Demesne, Dublin, 1502 Edenbaum, Sligo and 2329 Killure More, Galway – contain notable plant species. All 21 sites score well for the quality of the plant species present; most are also large and comprise contiguous swathes of semi-natural grassland. Site 2329 Killure More, Galway contains a large *Orchis morio* population growing on a calcareous esker (which is not within the NHA) that runs along the adjacent bog. Site 1697 Cream Point, Clare, in addition to its Annex I grassland habitats, also contained a population of marsh fritillary butterfly at the time of survey (approximately 15 individuals were observed), a species listed on Annex II of the EU Habitats Directive.

These sites are all worthy of inclusion within an SAC by virtue of the Annex I grassland habitats and species they support. It is a recommendation of this report that they should, as a minimum, be brought within an NHA (in some cases, the boundary of an adjacent NHA could be adjusted to include the site), and if possible brought within an SAC, for which the Annex I grassland habitat should be listed as a qualifying interest. It should be noted that the Phoenix Park is in State ownership (Office of Public Works) and Newbridge Demesne is owned by Fingal County Council. Site 999 Glen Lough is partly owned by NPWS.

Table 53: The 21 ISGS sites ranked in the top 50 that are not within an SAC. NHA/pNHA number is shown where an overlap with an ISGS site of more than 400m² occurs.

Site no.	Site name	County	NHA/pNHA	% score	Rank
850	Letterfine	Leitrim		57.9	=6
825	Ballynaboll	Leitrim		56.8	=8
1067	Manragh Upper	Cavan		54.7	=11
712	Coolberrin	Monaghan		53.7	=11
1502	Edenbaum	Sligo	002435	52.6	=14
2329	Killure More	Galway	000254	50.5	=19
815	Sheemore	Leitrim	001421	49.5	=22
1272	Garvanagh	Donegal	002068	49.5	=22
823	Fawnlion	Leitrim		47.4	=28
849	Corderry	Leitrim	001920	47.4	=28
893	Gleneige	Leitrim	002435	47.4	=28
890	Kilroosk	Leitrim		46.3	=34
1827	Cogaula	Mayo		45.3	=37
1315	Phoenix Park	Dublin		44.2	=40
1324	Newbridge Demesne	Dublin		44.2	=40
1401	Little Curragh	Kildare	000392	44.2	=40
1532	Formoyle	Sligo		44.2	=40
1697	Cream Point	Clare		44.2	=40
999	Glen Lough	Longford/Westmeath	001687	43.2	=50
1402	Dunlavin Marshes	Kildare	001772	43.2	=50
1546	Culdaly	Sligo		43.2	=50

4.1 Annex I grasslands in Ireland

In Ireland, much of the mapping for the delineation of SAC boundaries took place in the 1990s, at a time when the definition of the Annex I habitats at both national and European level was still being developed. The situation with regard to the extent and definition of Annex I grasslands in Ireland is now much clearer, following six years of grassland survey work. Annex I grassland habitats comprised 5% of the total survey area of the ISGS. It is evident from the results of the present report that some areas in SACs that were described as Annex I grassland can no longer be regarded as such. However, it is also clear that there are many areas of Annex I habitat existing outside of the current SAC network (Tables 19 and 21), perhaps even in better condition than those within the SAC boundary, albeit lacking the statutory protection that being within an SAC is intended to provide. This is demonstrated by the fact that 63 of the 135 primary areas of Annex I habitat identified (Table 29) are not located within an SAC.

Annex I habitats are, by definition, rare habitats on a European scale. However, the frequency varies between Member States, with some habitats present almost entirely within a single country or biogeographical region, while others, such as [*]6210 Festuco-Brometalia (including the non-priority 6210 and the priority *6210 orchid-rich variant of the habitat), are found throughout the EU. Regardless of their frequency, however, each Member State has a responsibility to protect and maintain at favourable conservation status a representative proportion of their national resource of each Annex I habitat. In Ireland, the data from the ISGS show that [*]6210 is the most abundant of our Annex I grassland habitats, covering 548.4 ha of the area surveyed, which represents 44% of the

Annex I habitat recorded during the IGSS. The 6210 habitat includes areas that are transitional to scrub, although such areas rarely include the priority *6210 (Calaciura & Spinelli 2008). Throughout ISGS fieldwork and for this report, however, a more narrow interpretation was followed in which only grassland was included within this Annex I habitat: scrubbing-over areas were not mapped if scrub exceeded the Fossitt (2000) cut-off of 25% scrub.

The production of a list of primary Annex I grassland sites (Table 29) as a focus for future monitoring is a useful output of the ISGS that should pay dividends in the future. When resources are limited, the ability to target conservation efforts at a smaller number of sites of proven quality means that the most efficient use can be made of those resources. The end result should be an Annex I habitat that is in *Favourable* conservation status – which is the desired outcome of the monitoring and management of all Annex I habitats in the EU.

Forty-seven percent of the 137 [*]6210 areas recorded during the ISGS are potentially the priority orchid-rich variant, *6210. The difficulty of identifying *6210 habitat has already been alluded to by Dwyer *et al*. (2007), who referred to the ephemeral nature of orchid populations. This situation was observed during the ISGS when one site, 1616 Keelhilla, Clare, was revisited exactly one year after an impressive display of *Ophrys apifera* and *Ophrys insectifera* was recorded during the ISGS, and few or no orchids were found. The danger of identifying some sites as the orchid-rich priority habitat *6210 and others as the non-priority 6210 is that the latter may actually be orchid-rich sites that were going through a 'rest period' in orchid flowering. The approach for the monitoring and management of the two variants of this habitat could be precautionary and all-inclusive, with all [*]6210 sites treated as potential orchid-rich *6210 sites and managed accordingly; or a 'wait-and-see' approach could be adopted, with *6210 sites only being identified after successive years of monitoring. The danger of the latter approach is that important orchid sites are more vulnerable to scrub encroachment and abandonment because of negative effects on orchid seed germination (Calaciura & Spinelli 2008), and such sites could be lost because of inappropriate management before their true importance was realised.

Whatever approach is taken, the decision was taken by the authors of this report to produce a preliminary list of sites containing Annex I habitat that fulfilled the criteria for definition as the priority orchid-rich *6210 variant from the data recorded during the ISGS (Table 31). These 64 sites should in no way be taken as the final list of *6210 sites in Ireland: many others of those identified as containing [*]6210 habitat in this report may, after a period of monitoring, be found to fulfil the criteria for *6210 and be added to the list, while other sites not surveyed during the ISGS may also be added in the future.

In 2013, National Conservation Assessments (NCAs) were completed for all of Ireland's Annex I habitats, including the five Annex I grassland habitats reported in this Irish Wildlife Manual (NPWS 2013). Table 54 shows the assessment results for each of the individual parameters and overall condition assessment of each of the five habitats. The results presented in this report show that, although the overall assessments were *Unfavourable – Bad* for all Annex I grassland habitats, the reality was that a proportion of the Annex I areas did achieve *Favourable* status. The best of these was *6230 *Nardus* grassland: 42% of areas received a *Favourable* assessment (Table 28). 6430 Hydrophilous tall herb swamp communities were next, with 41% of areas achieving *Favourable* conservation status. Of the 21 areas of 6510 Lowland hay meadows that were assessed across area, structure and functions, and future prospects, 29% received a *Favourable* assessment, while 28% of the 99 areas of 6210 Festuco-

Brometalia that could be given an overall assessment were *Favourable*. The habitat to perform worst, both in terms of the percentage receiving a *Favourable* assessment and the percentage receiving the poorest, *Unfavourable – Bad*, assessment, was 6410 *Molinia* meadows: only 11% of the 73 areas assessed were *Favourable*, while a substantial 77% of 6410 areas received the poorest assessment.

Table 54: NCA overall condition assessment results.

Annex I habitat	Range	Area	Structure & Functions	Future Prospects	*Overall*
[*]6210	F	B	B	B	*B*
*6230	F	B	B	B	*B*
6410	F	B	B	B	*B*
6430	F	I	B	B	*B*
6510	B	B	B	B	*B*

The assessment of a habitat as *Unfavourable – Bad*, however, need not signal its imminent extinction. Even 48 of the 135 primary areas of Annex I habitat received *Unfavourable – Bad* assessments for structure and functions (although it should be noted that these were stops that narrowly failed rather than ones that failed severely on criteria). Annex I habitat areas that have good structure and functions but which perform poorly in the future prospects assessment, for example, because of poor management or lack of management, should be targeted for immediate attention to ensure that unsuitable management practices are halted before they lead to a deterioration of the habitat's structure and functions. Consequences such as loss of typical species from the habitat are likely to be more difficult to address than correcting an inappropriate grazing regime.

A review of the surveyed Annex I grassland habitats with respect to SAC boundaries shows that many counties have large areas of Annex I grassland that lie outside of an SAC (Table 19). While the SAC network is only meant to protect a representative sample of the Annex I habitats in an EU Member State, some account should also be taken of the habitat in the local context. Some counties, such as Laois and Kildare, have only a small proportion, or none, of their Annex I grassland habitat within either an SAC or NHA.

It is strongly recommended that the 135 primary areas of Annex I grassland habitat identified in Table 29 be brought completely within the boundary of an NPWS conservation site, if not already within one. In many cases, these primary areas do exist within an SAC, but the Annex I grassland is omitted from the list of qualifying interests for the SAC: such omissions should be rectified so that the grasslands are listed and therefore afforded the full protection of the law. It is further recommended that the 135 primary areas be managed and monitored to ensure that management is contributing to the maintenance or enhancement of the habitats so that they remain in, or reach, favourable condition.

4.1.1 Occurrence of other Annex I grassland habitats in Ireland

There are two Annex I grassland habitats that occur in the UK that were previously thought not to occur in Ireland. These are habitats 6150 Siliceous alpine and boreal grasslands, and 6170 Alpine and subalpine calcareous grasslands. While the ISGS undertook limited surveying in the uplands, it is still

appropriate and useful to comment here on the potential occurrence of these mountain grassland communities in Ireland.

Both the ISGS and the NSUH have recorded calcareous grassland relevés with cushions of *Silene acaulis* in the Dartry Mountains. While neither Ireland nor the UK is covered by the regional subtypes listed for habitat 6170 in the Annex I habitats interpretation manual (Anon. 2007), this vegetation appears to conform to the CG12 *Festuca ovina – Alchemilla alpina – Silene acaulis* dwarf-herb community of the NVC (Rodwell 1992) and this is specifically listed as a corresponding category in the manual. Consequently, the NSUH recorded habitat 6170 in this area (Perrin *et al.* 2013b). The recording of this highly localised habitat is facilitated by the 3aii *Briza media – Thymus polytrichus* grassland *Silene acaulis* sub-community in the ISGS vegetation classification.

Habitat 6150 has also been recorded in an Irish context by the NSUH (e.g. Perrin *et al.* 2013b), on summits and ridges at high altitude. It is, however, scarcely a grassland habitat, being best defined as an assemblage of exposed, level ground with genuine arctic-alpine species (e.g. *Carex bigelowii*, *Cetraria islandica*, *Salix herbacea* or *Diphasiastrum alpinum*) but little or no dwarf shrub cover, and usually takes the form of a sedge-moss community. It usually occurs in a fragmented and marginal form, but extensive areas have been observed, for example near the summit of Lugnaquilla, Wicklow. This community appears to conform to the U7 *Nardus stricta – Carex bigelowii* grass heath and the U10 *Carex bigelowii – Racomitrium lanuginosum* moss heath communities of the NVC (Rodwell 1992) and these are specifically listed as corresponding categories for habitat 6150 in the interpretation manual (Anon. 2007).

A third Annex I grassland habitat, 6520 Mountain hay meadows, occurs in the UK, although with a highly restricted distribution. The interpretation manual (Anon. 2007) states that this habitat occurs mainly above 600 m, but the corresponding NVC community, MG3 *Anthoxanthum odoratum – Geranium sylvaticum* grassland, occurs between 200 m and 400 m in the UK (Rodwell 1992). During the ISGS, hay meadow relevés were only recorded at two sites above 200 m, at site 1300 Glenasmole Valley, Dublin (200-230 m) and at site 2908 Reafadda, Tipperary (290-300 m). At neither site was the sward particularly distinctive from more lowland examples of habitat 6510, therefore there is no evidence that habitat 6520 occurs in Ireland.

4.2 The ISGS classification and Annex I grassland indicator species

Following the production of the vegetation classification system that appears in this manual, it is clear that there is a strong correspondence between 3a *Briza media – Thymus polytrichus* grassland and [*]6210 (96.6% of core relevés in the community were judged to be [*]6210), and between 1c *Molinia caerulea – Succisa pratensis* grassland and 6410 (72.0% of core relevés were judged to be 6410). This is also a strong association between 4c *Agrostis capillaris – Festuca rubra* grassland and *6230 (70.2% of core relevés were 6230), and between 3e *Festuca rubra – Rhinanthus minor* grassland and 6510 (62.5% of core 3e relevés were 6510). The association between 3e grassland and 6510 may even be stronger, as areas that were not managed as traditional hay meadows were not usually deemed to be the Annex I habitat, but there could be relevés within the 3e grassland that are very similar to those classed as 6510, but which are not managed as hay meadows. The synoptic tables presented in the vegetation classification may therefore be consulted to select additional typical species for these three Annex I habitats. It should be borne in mind, however, that any such augmented lists may not distinguish as

well as before between closely related Annex I habitats, such as [*]6210 and 6510, due to the occurrence of some species (e.g., *Leucanthemum vulgare* and *Trifolium pratense*) in more than one of the synoptic tables associated with Annex I habitats; and due to the inclusion of broad-spectrum species such as *Festuca rubra* and *Cynosurus cristatus*, which commonly occur in several of the Annex I grassland habitats and which were not cited as indicator species for this reason.

4.3 Comparison between the ISGS and Fossitt (2000) classifications

Fossitt (2000) was the main habitat classification system used when mapping habitats throughout the ISGS. During the survey, and later in the wake of producing the vegetation classification system described in this Irish Wildlife Manual, a number of inadequacies in the system became clear. Firstly, and very obviously, GS1 consists of two clearly distinct subtypes, with calcareous grassland represented by 3a *Briza media – Thymus polytrichus* grassland, and neutral dry grassland mainly represented by 3b *Cynosurus cristatus – Trifolium repens* grassland and 3d *Cynosurus cristatus – Trifolium pratense* grassland. This deficiency has already been tackled by Smith *et al.* (2011), who recommend the use of qualifier codes ('C' for calcareous and 'N' for neutral) when recording GS1. Also, GS1 and GS2 are closely related, with relevés from both categories being concentrated in Group 3 of the vegetation classification. They do seem to form genuinely separate communities, however, and are not differentiated solely on management (pasturage or hay meadow). GS2 was interpreted during the ISGS most often as mown swards, the rather more tussocky habitat described in Fossitt (2000) being rarely encountered. Swards from the tops of maritime cliffs found in the 3e *Festuca rubra – Lotus corniculatus* grassland community were mainly classified as GS1, for want of a better category; Fossitt (2000) does not have a specific category for maritime grassland.

GS3 relevés were classified mainly in Group 4 of the vegetation classification, which is relatively well-defined with several vascular and bryophyte indicator species. GS4 is diverse in terms of community types (although generally less so in terms of species richness), with Groups 1 and 2 both displaying high affinity for GS4. Group 1 chiefly comprises peaty examples, while Group 2 has more mesotrophic wet swards. Again, this division is broadly reflected in the qualifier codes suggested by Smith *et al.* (2011), 'O' for oligotrophic and 'B' for base-rich. Although, Fossitt (2000) states that vegetation with high cover of *Molinia caerulea* should not be included under GS4, in practice there is usually nowhere else in the classification to place these swards when in a lowland landscape. In the uplands, such swards may represent degraded wet heaths.

The main affinities of GM1 are with 1b *Agrostis stolonifera – Filipendula ulmaria* marsh-grassland and 2a *Agrostis stolonifera – Ranunculus repens* marsh-grassland. It is a rather difficult category to apply in the field since, in the continuum of vegetation, it occupies a rather narrow band, chiefly between GS4 on the one side and FS2 on the other. Due to the transitional nature of GM1 to FS2, it is difficult to fully define GM1 without a comprehensive survey and analysis of tall-herb swamp.

Semi-improved grassland habitats were treated differently when surveyed and mapped for the ISGS. When applying the Fossitt (2000) system strictly, GS1 includes both semi-natural and semi-improved variants of calcareous and neutral grassland. None of the other grassland categories include semi-improved habitats. The decision was taken at the start of the ISGS to utilise the qualifier 'i' to denote semi-improved variants of grassland habitats, even in the case of GS1. Thus GS1 denotes semi-natural calcareous or neutral grassland only, while GSi1 denotes a semi-improved variant. A similar

approach was taken for GS(i)2, GS(i)3 and GS(i)4. There was no semi-improved notation for marsh, as no semi-improved variants of this habitat were found. The need for a semi-improved category in the Fossitt (2000) classification system has been voiced (Sullivan *et al*. 2010). However, a single category would not encompass the variation that the ISGS has found exists in semi-improved vegetation. Despite the fact that the lines between semi-improved habitats are somewhat blurred, as they have frequently been subject to management practices such as fertiliser application, liming and drainage which tends to lessen the differences between their semi-natural counterparts, there are usually enough indications of the original semi-natural habitat to assign the habitat to one of the four semi-improved categories utilised during the ISGS. These categories were found in the course of ISGS fieldwork to be satisfactory and were used throughout the survey. Furthermore, it is useful to be able to identify, through the specific GSi category, the original semi-natural habitat from which it developed. The recommendation of this study is that the use of the 'i' qualifier be continued in further grassland studies in Ireland to denote and map semi-improved grassland habitats. Should a strict adherence to Fossitt (2000) still be required, the approach taken by the ISGS could be followed, in which all GSi habitats (including GSi1) were mapped under Fossitt (2000) as GA1, with the GSi code retained in a separate field in the attributes table of the GIS shapefile.

Swamp communities on the fringes of lakeshores were particularly difficult to classify under Fossitt (2000). Frequently these had a low sward of species such as *Equisetum fluviatile*, *Eleocharis palustris*, *Hydrocotyle vulgaris* and occasionally other low herbs such as *Menyanthes trifoliata*. Such a community is not described in Fossitt (2000) as it is neither rich in tall herbs nor dominated by reeds or sedges, but the context defines it as swamp rather than transition mire. It is suggested that another swamp category, such as FS3 Low-herb swamp, be added to the Fossitt (2000) classification to take this group into account.

It is recommended that future grassland mapping in Ireland is undertaken using the 19 vegetation communities defined within this Irish Wildlife Manual.

4.4 Comparison between the ISGS and other Annex I grassland surveys in Ireland

In 2006, Dwyer *et al*. (2007) undertook the task of monitoring priority (*6210 and *6230) Annex I grassland habitats in SACs throughout Ireland. Subsequent visits to some of these monitored sites were made during the ISGS. However, a direct comparison between the two studies is not possible as the assessment criteria used in 2006 were different from those used for the ISGS, and full relevés were not recorded by Dwyer *et al.* (2007) so retrospective application of the latest criteria was not possible. Also, the definition of the habitats had been refined for the ISGS, and it was found that some of the areas surveyed in 2006 did not conform to the latest definition of 6210, or occasionally were calcareous fen, which shares many common indicator species with *6210. In site 1300, Glenasmole Valley, part of the area mapped in 2006 as *6210 was classified during the ISGS as 6510 because the area was mown for hay. Similar indicator species can occur in *6210 and 6510, and it may be the management as much as the species complement that dictates which of the two Annex I habitats it is assigned to.

In a number of cases, only part of the 2006 area could be resurveyed for the ISGS due to time constraints or access difficulties; this was particularly the case on Inishmore, one of the Aran Islands,

where large areas of *6210 were surveyed in 2006, but only a small area of GS1 was visited for the ISGS, none of it fulfilling the criteria for the Annex I habitat. There is no doubt that [*]6210 habitat is present on Inishmore, either alone or in mosaic with limestone pavement, but none of these areas were mapped during the ISGS. Future monitoring should encompass the larger areas of *6210 mapped for the 2006 survey by Dwyer *et al*. (2007).

Fewer of the *6230 sites surveyed by Dwyer *et al*. (2006) were revisited due to the change in remit that omitted upland SACs from the ISGS's survey area. It may be more appropriate for these areas to be revisited during the on-going National Survey of Upland Habitats, and for any further data on the sites to be added to the database for that project.

The recently completed limestone pavement survey (Wilson & Fernández 2013) included an assessment of [*]6210 habitat in the context of limestone pavement. An overall assessment of *Unfavourable – Inadequate* was given to [*]6210 at the conclusion of the limestone pavement study, which differs from the assessment of *Unfavourable – Bad* given by the ISGS. It is important to note the specificity of the limestone pavement assessment, which uses slightly different criteria for 6210 than the ISGS, and which should only be applied in this context.

4.5 Comparison between the ISGS and other classification systems (NVC and Zürich-Montpellier alliances)

The top percentage scores calculated using MAVIS to examine the similarity between ISGS communities and sub-communities of the British National Vegetation Classification (NVC; Rodwell 1991 *et seq.*) varied from 52.8% to 76.7%, with a mean of 64.0%. Without figures from a comparative British dataset, it is not possible to assess the figures objectively. Intuitively, however, they appear to be rather low, as one would expect when attempting to classify data with a system from a different country that has a greater floral diversity. While the ISGS did not include data from Northern Ireland, if these figures are seen as representative of the grasslands of the island of Ireland, one could speculate about the applicability of the NVC in Northern Ireland and conclude that it is generally unsuitable. In addition, there was some variability in the score across the ISGS vegetation classification groups as follows: Group 1 = 56.1%, Group 2 = 66.6%, Group 3 = 70.0%, Group 4 = 62.6%. This suggests that while the dry calcareous and neutral grassland communities of Group 3 had reasonably good correspondence with the NVC, the oligotrophic wet grasslands of Group 1 are more distinct from their British counterparts.

With 19 grassland communities, the ISGS classification defines considerably fewer grassland types than the NVC. This is not surprising, as Ireland probably has less variation in environmental conditions than Britain, as well as a relatively depauperate flora. Indeed, the range of NVC communities representing top percentage scores is actually rather small. Four of the ISGS wet grassland communities relate to M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture, and three to MG10 *Holcus lanatus-Juncus effusus* rush-pasture. Four of the neutral communities in Group 3 of the ISGS vegetation classification relate to MG5 *Cynosurus cristatus-Centaurea nigra* grassland or the semi-improved MG6 *Lolium perenne-Cynsorus cristatus* grassland.

The range of Zürich-Montpellier grassland alliances for Ireland is rather small, with only nine listed in Table 32. However, it is possible that there are individual relevés or small numbers of samples within

the ISGS dataset that correspond to other alliances or NVC communities, but they simply were not distinctive enough to warrant their own ISGS category.

4.6 Grasslands as habitat for fauna

The ISGS gathered data on wild fauna species seen during the surveys. As Figure 11 showed, a number of species listed in the EU Habitats Directive, such as frog and hare (both Annex V species), were recorded frequently in grassland sites. Also recorded on eight occasions was the Annex II species marsh fritillary, whose main food plant, *Succisa pratensis*, is common and often abundant in [*]6210 and 6410 Annex I grasslands. There were occasional records of other Habitats Directive-listed species, such as otter (Annex II) and pine marten (Annex V), which utilise grasslands as secondary habitat.

Birds too were recorded, including chough from 43 sites, peregrine from three sites and corncrake from two sites; all three species are listed on Annex I of the EU Birds Directive. During the ISGS, corncrake was recorded only from Donegal, including Tory Island, one of the last strongholds of this species for whom grasslands are of prime importance as a nesting and foraging habitat.

Insects from other groups such as butterflies and dragonflies were frequently recorded during the ISGS, with great abundance and diversity noted at several sites. Anthills were frequently a feature of undisturbed grasslands, particularly in [*]6210. The diversity of the vegetation communities, particularly in Annex I grassland habitats, gives rise to diversity in other taxonomic groups as a natural consequence.

4.7 Threats to Irish semi-natural grasslands

Survey of sites for the ISGS involved field visits to sites and, where possible, landowners were consulted about the management of the grassland habitats. However, this information was not always obtained directly from landowners and on some visits had to be inferred from visual cues seen on the day. It would be expected that management practices that were not obvious on the day of the survey were not recorded. Also, a single visit to a site would not be sufficient to make surveyors aware of changes in site management over the years, such as conversion of land from semi-natural to improved grassland, unless the landowner was consulted. The single biggest threat to Irish semi-natural grassland is agricultural intensification – changing species-rich, semi-natural grassland to more agriculturally productive, species-poor swards by the application of fertiliser, herbicides and other chemicals, and by ploughing and reseeding; and yet, loss of habitat by this means might not be obvious during a survey, unless the change had taken place since the aerial photograph was taken. This emphasises the importance, particularly for Annex I grasslands, of repeated visits to sites, particularly the primary sites listed in Table 29, so that survey information will provide more than just a single snapshot in time. Consultation with landowners and NPWS rangers about land management and recent land-use changes provides an enhanced picture of the nature of a site's management regime over the years, and is likely to provide a better understanding of the best way to conserve the habitat in the context of the current management regime.

While intensification is a serious threat to Irish semi-natural grasslands, almost as serious is the decline in farming in Ireland which has led to the abandonment of substantial areas of farmed land, particularly in the west and north-west. The term 'semi-natural', in the context of grassland, implies that it has been altered by human agricultural activities such as grazing or mowing, with minimal input of fertilisers, thus maintaining a suite of native species. However, if anthropogenic management is abandoned, the vegetation is once again subject to scrub invasion, and semi-natural grassland communities succeed to natural scrub communities (Calaciura & Spinelli 2008). Abandonment of farming systems was seen as a severe problem during the ISGS, with large tracts of rank, unmanaged fields observed, (particularly of wet grassland) many with encroaching scrub. Land that has been abandoned becomes too rank even for many bird and insect species to frequent it, as they tend to prefer more open habitats with better structural and species diversity than a rank sward provides. Rank swards tend to become reduced in plant species diversity to just a few coarse, competitive species such as *Arrhenatherum elatius* and *Dactylis glomerata*, or *Juncus effusus* in wetter areas. The longer the rank swards are allowed to prevail, the more seeds of less competitive species will lose their viability in the seed bank; this means that long-abandoned swards will be more difficult to restore by natural means. There is also the danger that such marginal land will be converted to other land-uses, such as forestry. Land abandonment is an important issue that needs to be tackled quickly if large areas of semi-natural grassland are not to be lost permanently.

In the context of land abandonment, measures that were introduced to improve the conservation status of farmland appear to have brought their own, unexpected problems. For example, ISGS surveyors on several occasions spoke to REPS landowners who had put aside areas of grassland as habitat for wildlife, with birds often listed as the beneficiary, as specified under their REPS plan. In most cases, these areas had become rank, closed and often scrub-encroached, and were unlikely to provide suitable habitat for the birds for which they were set aside; this was far from being the desired outcome of the measure. The results of Copland & O'Halloran (2011) reinforce these observations, with REPS shown to have no significant impact on bird species diversity or individual species densities and numbers. Therefore, these measures need to be redesigned, perhaps by allowing late mowing of these areas on an annual basis. Owners of land within SACs also seem to be in some confusion as to what management practices they can and cannot carry out within the SAC; all too often, such landowners do nothing by default, in case they inadvertently do something that will later transpire to be in contravention of Irish or European wildlife law. In these cases, the end result is the same as abandonment: rank, closed swards of low species diversity. There were several instances observed during the ISGS of Annex I habitats being under threat in this way from well-intentioned landowners. It is imperative that all owners of land within an SAC, particularly those who manage Annex I grassland habitat, should be made aware that the management practices that they carried out pre-designation, and which have maintained the Annex I habitat in the past, should be continued, not stopped.

It is a recommendation of this survey that, for the 72 primary areas of Annex I grassland with a proportion of their area mapped within an SAC, a comprehensive management plan should be drawn up in consultation with the landowner as a matter of urgency. It would be expected that a number of these areas already have management plans under existing agri-environment schemes, such as the NPWS Farm Plan Scheme or the Burren Farming for Conservation Programme, and the data from this Irish Wildlife Manual and the associated deliverables such as the GIS habitat map should be incorporated into these plans.

4.8 ISGS links to national and EU policy

All Member States of the EU must ensure that their Rural Development Programmes (RDPs) prioritise the identification, support and maintenance of high nature value (HNV) farmland, and that they monitor any changes to the area of land covered by HNV farming (Sullivan *et al.* 2010). The EU's Common Agricultural Policy (CAP), which has recently been reformed, is of direct relevance to Irish semi-natural grasslands in that conservation of HNV farmland outside of protected areas such as SACs depends mainly on programmes such as agri-environment and less-favoured-area schemes that operate under the CAP (EEA 2004).

All of the grasslands surveyed in the course of the ISGS – and indeed, all semi-natural grasslands under GS and GM in the Fossitt (2000) classification system – can be regarded as High Nature Value (HNV) grasslands; Annex I grasslands are a sub-set of HNV grasslands. As most of the grassland surveyed during the ISGS was located within farming systems, these may all be described as HNV farms; most would be classed as Type 1 HNV farmland, which is defined as that which has a high proportion of semi-natural vegetation (EEA 2004). The list in Appendix 5 of HNV plant species that indicate high quality grassland is a useful aid to help identify HNV grassland in farmland, particularly where funding for the maintenance of HNV farmland is being sought under the CAP. This species list is not a definitive list, but it does help to provide a framework in which such non-Annex grasslands can be evaluated. The conservation scoring table presented in Table 13 is a relatively simple system that can be adapted to score a non-ISGS area of grassland and, if desired, to rank it in relation to ISGS sites. The fact that the score is expressed as a percentage of a maximum score means that subsequent non-ISGS sites can be ranked using the same system, even if data are not available for all criteria.

The EU's 2020 Biodiversity Strategy has six main targets, of which the first three are directly relevant to the ISGS: the full implementation of EU nature legislation; better protection and restoration of ecosystems and the services they provide, and greater use of green infrastructure; and more sustainable agriculture and forestry (European Commission 2011). The ISGS has contributed to Ireland's knowledge of Annex I habitats, and so contributes to the implementation of the EU Habitats Directive, which together with the EU Birds Directive form EU nature legislation. The data gathered by the ISGS have already been used to inform the recent NCAs submitted to the EU. The issue of protection and restoration of ecosystems and their services is inextricably linked with knowledge of what ecosystems are present. Data gathered on Annex I habitats – their distribution and species – will help to identify what sites are most in need of protection. The plant species data, together with additional fauna data that were gathered during the course of the survey, have provided extensive information on Ireland's grassland ecosystems. The fact that the majority of the sites surveyed during the ISGS exist within a farm system is relevant to Target 3 of the strategy, which relates to sustainable agriculture. The semi-natural grasslands surveyed during the ISGS will only persist if they continue to be farmed on a non-intensive basis. A follow-on benefit of non-intensive agriculture is that it helps to achieve Ireland's water quality targets under the Water Framework Directive.

Ireland's National Biodiversity Plan 2011-2020 also includes a number of targets to be reached, and these underpin the seven key objectives of the Plan (DAHG 2011). Objective 2 relates to strengthening the knowledge base for conservation, management and the sustainable use of biodiversity, while Objective 4 refers to the conservation and restoration of biodiversity and ecosystem services in the

wider countryside. Objective 6 concerns issues relating to the management of protected areas and legally protected species. Steps towards the achievement of all three of these objectives have been made by the ISGS through the mapping and documentation of the habitats and species present in semi-natural grasslands, by the significant contribution made towards the vegetation classification system for Ireland referred to in Action 3.2 of the Plan, and by the identification, characterisation and assessment of Annex I grassland habitats throughout Ireland, including a monitoring protocol which can be used in future monitoring programmes to assess trends in conservation status.

Therefore the ISGS has contributed both at a local, Irish level and at a European level to the fundamental aspirations of national and EU biodiversity policy.

4.9 Using the ISGS datasets

The review of relevés and reclassification of some habitats at the end of the project has resulted in a mismatch between the updated data as recorded in the Access, Turboveg and GIS datasets, and those presented in the individual annual county reports from 2007 to 2010 (Devaney *et al.* 2013; Martin *et al.* 2013 were written after the review and are therefore not impacted upon). When reading the annual county reports, it is therefore important to remember that those reports reflect results as they were calculated or assessed at the time they were written.

For any further analysis based on the ISGS datasets, only the final version of the Access database, Turboveg database and GIS shapefiles from the ISGS (2007-2012) should be used. Earlier versions of the databases and shapefiles submitted with the annual county reports 2007 to 2010 contain the data as they were recorded at the time. The final versions of the datasets submitted with this Irish Wildlife Manual comprise the data after a final round of in-depth data screening, checks, standardisation, changes and updates have been implemented.

4.10 Recommendations for future work on grasslands and related habitats

4.10.1 Methodology recommendations

In carrying out any future studies on Irish grasslands, including habitat mapping, it is recommended that full relevés be recorded wherever possible. This facilitates comparisons between studies, and also allows revision to mapping in the event that relevé data are later reviewed and the original habitat assignment is found to be incorrect. The inclusion of robust relevé data gives added value to any habitat mapping study. They were also found to be useful in recent NCA reporting when deciding whether mapped habitats were Annex I or not.

The ISGS used the Domin scale (Kent & Coker 1992) for recording vegetation cover data. However, it is recommended that percentage cover be used in future for monitoring (see the Monitoring Methods Manual in Appendix 2), and that its use also be considered for routine recording of relevé data. There are two advantages to this: there is no need to convert Domin values to a mid-point scale for statistical analysis; and it is a more sensitive method of recording cover, which is better for detecting change if

some areas were to be resurveyed later. The disadvantage is that using a percentage cover scale could result in slightly longer recording times; however, this would be expected to improve with practice, and it is the experience of the authors that recording cover in this way is not significantly longer than using the Domin scale.

4.10.2 Future studies

The ISGS has ensured that a cohesive methodology for the survey of semi-natural grasslands in Ireland has been put in place. Such a methodology could be adapted for other similar habitat groups in the future, and this would facilitate comparisons between habitat groupings. For example, there were a number of transitional plant communities encountered that were difficult to classify under Fossitt (2000), or that were transitional to grassland and therefore not studied. Despite the best efforts of science to classify them, vegetation communities exist as a continuum rather than as discrete entities. It would be useful if additional surveys were to be conducted on habitats that were at the extremes of the remit for the ISGS, such as fen meadows and tall-herb swamps. This would aid in the delineation between grassland habitats and the closely related non-grasssland habitats that exist, especially in the wetlands of Ireland.

The remit of the ISGS was widened in 2011 to include PF fen/flush habitats if they conformed to the Annex I grassland habitat 6410. Examples of this habitat may therefore have been excluded in the earlier years of the project. Any subsequent surveys of the 6410 habitat should include the broader definition of the habitat. If a national fen survey is undertaken, any such oversights of 6410 fen meadows should be remedied.

Because the focus of the ISGS was semi-natural rather than semi-improved grassland habitats, only 7% of the relevés recorded were semi-improved, which may be insufficient to classify all of the variation that exists in Ireland's semi-improved vegetation communities. Two semi-improved grassland communities were identified based on ISGS relevés: one of wet grassland, 2c *Holcus lanatus – Lolium perenne* grassland, and one of dry grassland, 3b *Cynosurus cristatus – Trifolium repens* grassland. Were extra datasets of semi-improved grassland habitats to be included, such groups could be identified and would add to the semi-natural grassland classification system presented in this Irish Wildlife Manual.

The vegetation classification presented here is based strictly on grassland relevés. Inclusion of data from semi-improved relevés, fens and swamps could result in a broader classification scheme with a wider range of use. The inclusion of data from Northern Ireland would be especially useful, so as to obtain an all-Ireland classification system.

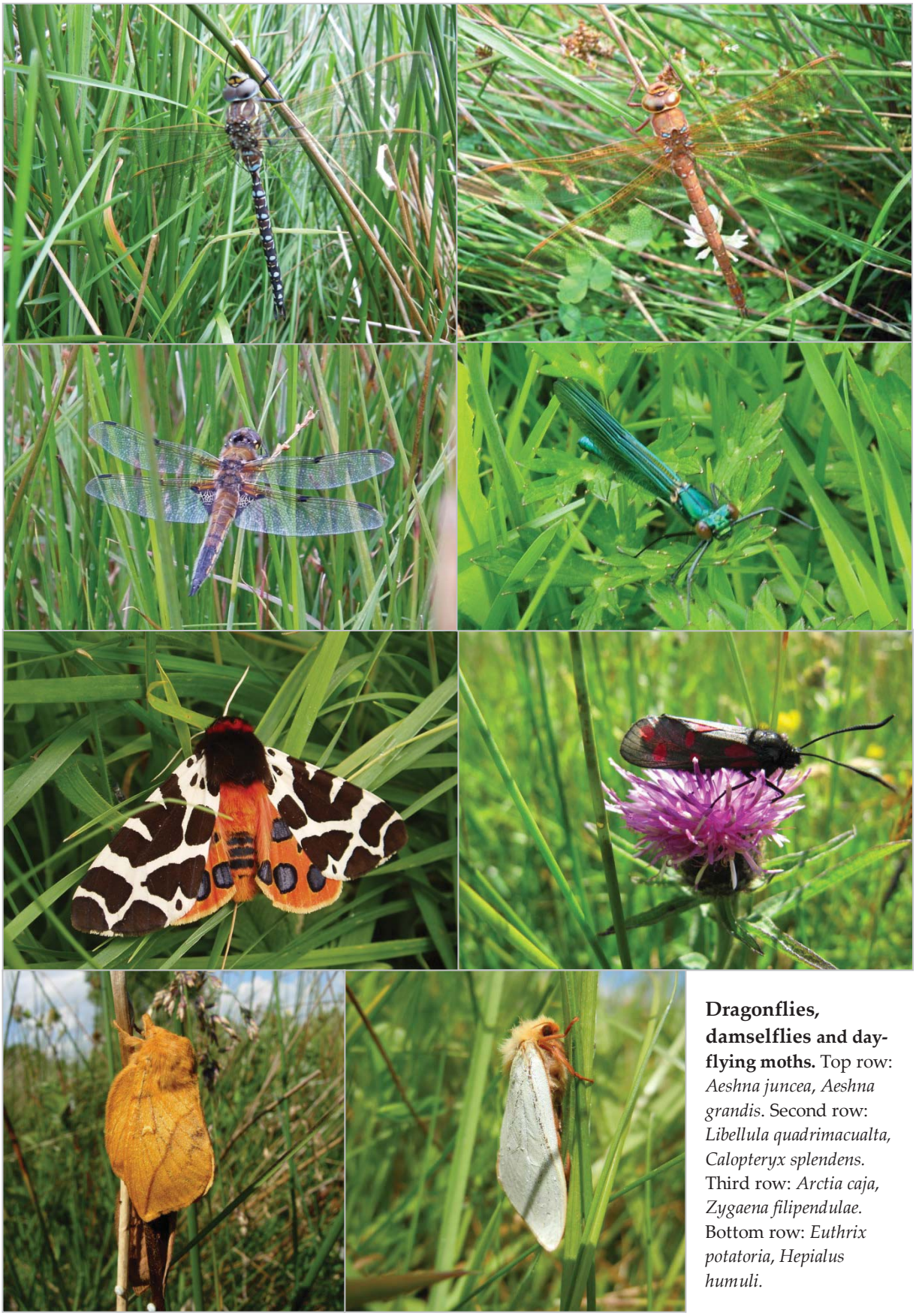
4.11 Concluding remarks: The legacy of the ISGS

Now that the ISGS has been completed, there exists a clearer picture of the main semi-natural grassland habitats in Ireland, both their extent and their relative distribution; this includes Ireland's five main Annex I grassland habitats, for which there is now baseline information with which future monitoring studies can be compared. The comprehensive habitat maps, both in .pdf format and as digitised ArcMap shapefiles, that accompany this report will provide a useful resource for land managers and for conservationists alike. Future students of Irish grassland have been provided with a workable survey methodology that has been tested and refined over several field seasons, which can be used in their research, together with a large dataset of relevés that is available for analysis.

Our most important grassland habitats have been defined, described and mapped, providing a focus for future conservation work. The Monitoring Methods Manual that forms part of this Irish Wildlife Manual (Appendix 2) will facilitate the monitoring of our most important grassland habitats to provide the best assurance of their long-term survival, while allowing their sustainable management in a farmed landscape.

The vegetation classification that this survey has made possible – based as it is on a dataset of 4,477 relevés – will be of immeasurable use to ecological practitioners seeking to characterise and map grassland habitats more fully in the future. The current Fossitt (2000) classification system is still suitable where less detailed mapping is sufficient. However, a more detailed treatment of habitat complexity is frequently required, and such studies will be facilitated by the ISGS vegetation classification. This is particularly true of wet grassland habitats, which currently come under just two grassland/marsh categories in Fossitt (2000); the new system of nine wet grassland habitats has helped to elucidate some of the complexity of these communities.

The ISGS, over its six year duration, resulted in the collection of 208,871 individual plant taxonomic records, and data on 1,240 taxa. A secondary output is additional distribution data on some of the animal, bird and insect species that frequent Irish grasslands, including species listed in Annex II, IV and V of the EU Habitats Directive, and Annex I of the EU Birds Directive. Internal and adjacent grassland and non-grassland habitats have been documented, as has the occurrence of cultural features such as lazy beds that might not otherwise be documented elsewhere. In documenting our grassland resource, what this survey has done most effectively is highlight the sheer diversity – in terms of species, ecosystems and landscape – of Ireland's semi-natural grassland habitats.



Dragonflies, damselflies and day-flying moths. Top row: *Aeshna juncea*, *Aeshna grandis*. Second row: *Libellula quadrimacualta*, *Calopteryx splendens*. Third row: *Arctia caja*, *Zygaena filipendulae*. Bottom row: *Euthrix potatoria*, *Hepialus humuli*.

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Appendix 1: Assessment criteria for the five Annex I grassland habitats surveyed during the ISGS

Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (6210); important orchid sites (*6210)

Criteria		Scale of assessment
Vegetation composition		
1	Total number of positive indicator species present ≥ 7	Relevé
2	Number of high quality species present ≥ 2	Relevé
3	Cover of non-native species ≤ 1%	Relevé
4	Cover of the following negative indicator species: *Arrhenatherum elatius, Cirsium arvense, Cirsium vulgare, Dactylis glomerata, Lolium perenne, Rumex crispus, Rumex obtusifolius, Senecio jacobaea, Trifolium repens, Urtica dioica,* individually ≤ 10%	Relevé
5	Cover of the above negative indicator species collectively ≤ 20%	Relevé
6	Cover of scrub, bracken, heath (woody species except *Juniperus communis, Rosa spinosissima, Dryas octopetala* and *Helianthemum oelandicum)*† ≤ 5%	Relevé
Vegetation structure		
7	Forb component of forb : graminoid ratio 40-90%	Relevé
8	Proportion of the sward between 5-40 cm tall ≥ 30%	Relevé
9	Litter cover ≤ 25%	Relevé
Physical structure		
10	Cover of bare soil ≤ 10%	Relevé
11	Area of the habitat showing signs of serious grazing or disturbance < 20 m²	Local vicinity

High Quality Positive Indicator Species	Positive Indicator Species
Antennaria dioica	*Arabis hirsuta*
Anthyllis vulneraria	*Brachypodium pinnatum*
Asperula cynanchica	*Bromopsis erecta*
Blackstonia perfoliata	*Carex flacca*
Briza media	*Ctenidium molluscum*
Campanula rotundifolia	*Daucus carota*
Carex caryophyllea	*Galium verum*
Carlina vulgaris	*Helictotrichon pubescens*
Centaurea scabiosa	*Homalothecium lutescens*
Filipendula vulgaris	*Leontodon hispidus / L. saxatilis* (count as one)
Gentiana verna	*Lotus corniculatus*
Gentianella amarella/campestris	*Origanum vulgare*
Geranium sanguineum	*Pilosella officinarum*
Knautia arvensis	*Ranunculus bulbosus*
Koeleria macrantha	*Sesleria caerulea*
Linum catharticum	*Thymus polytrichus*
Primula veris	*Trisetum flavescens*
Sanguisorba minor	
Orchid species (count individual orchid species separately)	

†If *J. communis, R. spinosissima* or *D. octopetala* exceed 25% cover, transition to another Annex I community should be considered, e.g., 5130 Juniper formations, 4030 European dry heaths, 4060 Alpine and Boreal heaths.

If the 6210 grassland has a population of any orchid species other than the relatively common *Dactylorhiza fuchsii* and *Dactylorhiza maculata* it should be considered for the orchid-rich priority habitat *6210. The following uncommon orchid species have been recorded in this Annex I habitat: *Anacamptis pyramidalis, Coeloglossum viride, Dactylorhiza fuchsii* v. *okellyi, Epipactis palustris, Gymnadenia conopsea, Listera ovata, Neotinea maculata, Ophrys apifera, Ophrys insectifera, Orchis mascula, Orchis morio, Platanthera bifolia, Platanthera chlorantha.* An assessment of the number of individuals within orchid populations should be made.

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

Criteria		Scale of assessment
Vegetation composition		
1†	Number of high quality and general positive indicator species present ≥ 7	Relevé
2a	Calcareous sub-community: Number of high quality species present ≥ 2 **OR**	Relevé
2b	Non-calcareous sub-community: Number of high quality species present ≥ 1	Relevé
3	Species richness ≥ 25	Relevé
4	Cover of non-native species ≤ 1%	Relevé
5	Cover of the following negative indicator species: *Arrhenatherum elatius, Bellis perennis, Cirsium arvense, Cirsium vulgare, Dactylis glomerata, Eriophorum angustifolium, Eriophorum vaginatum, Holcus lanatus, Juncus effusus, Lolium perenne, Narthecium ossifragum, Ranunculus repens, Rumex crispus, Rumex obtusifolius, Senecio jacobaea, Trifolium repens, Urtica dioica,* individually ≤ 10%	Relevé
6	Cover of the above negative indicator species collectively ≤ 20%	Relevé
7	Cover of *Sphagnum* species ≤ 10%	Relevé
8	Cover of *Polytrichum* species ≤ 25%	Relevé
9	Cover of scrub, bracken and heath (woody species) ≤ 5%	Relevé
Vegetation structure		
10	Forb component of forb : graminoid ratio 20-90%	Relevé
11	Proportion of the sward between 5-50 cm tall ≥ 25%	Relevé
12	Litter cover ≤ 20%	Relevé
Physical structure		
13	Cover of bare soil ≤ 10%	Relevé
14	Area of the habitat showing signs of serious grazing or disturbance < 20 m²	Local vicinity

a. Calcareous sub-community High Quality Species	**b. Non-calcareous sub-community High Quality Species**	**General Indicator Species**
Alchemilla glabra	*Breutelia chrysocoma*	*Agrostis capillaris*
Antennaria dioica	*Carex caryophyllea*	*Anthoxanthum odoratum*
Campanula rotundifolia	*Carex pilulifera*	*Carex binervis*
Conopodium majus	*Danthonia decumbens*	*Festuca ovina*
Ctenidium molluscum	*Lathyrus linifolius*	*Galium saxatile*
Linum catharticum	*Pseudorchis albida*	*Hylocomium splendens*
Lotus corniculatus	*Viola canina*	*Luzula multiflora / L. campestris* (count *Luzula* spp. as one)
Lysimachia nemorum	*Viola riviniana*	*Nardus stricta*
Primula vulgaris		*Polygala serpyllifolia*
Prunella vulgaris		*Potentilla erecta*
Thymus polytrichus		*Rhytidiadelphus loreus*
		Rhytidiadelphus squarrosus
		Veronica officinalis

†Total number of positive species = "a" & general indicator species OR "b" & general indicator species NOT "a" & "b" & general indicator species

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

NOTE: This Annex I habitat can occur in both grasslands and fens. This fen meadow community often contains some *Molinia caerulea* and *Cirsium dissectum* within it.

Criteria		Scale of assessment
Vegetation composition		
1	Total number of positive indicator species present ≥ 7	Relevé
2	Number of high quality species present ≥ 1	Relevé
3	Cover of non-native species ≤ 1%	Relevé
4	Cover of the following negative indicator species: *Cirsium arvense, Cirsium vulgare, Glyceria maxima, Lolium perenne, Phalaris arundinacea, Phragmites australis, Rumex crispus, Rumex obtusifolius, Senecio jacobaea, Trifolium repens, Urtica dioica,* individually ≤ 10%	Relevé
5	Cover of the above negative indicator species collectively ≤ 20%	Relevé
6	Cover of *Polytrichum* species ≤ 25%	Relevé
7	Cover of scrub, bracken and heath (woody species) ≤ 5%	Relevé
Vegetation structure		
8	Forb component of forb : graminoid ratio 40-90%	Relevé
9	Proportion of the sward between 10-80 cm tall ≥30%	Relevé
10	Litter cover ≤ 25%	Relevé
Physical structure		
11	Cover of bare soil ≤ 10%	Relevé
12	Area of the habitat showing signs of serious grazing or disturbance < 20 m^2	Local vicinity

High Quality Positive Indicator Species	Positive Indicator Species
Carex pulicaris	*Achillea ptarmica*
Carum verticillatum	*Carex echinata*
Cirsium dissectum	*Carex flacca*
Crepis paludosa	*Carex nigra*
Galium uliginosum	*Carex panicea*
Juncus conglomeratus	*Carex viridula*
Lathyrus palustris	*Equisetum palustre*
Ophioglossum vulgatum	*Filipendula ulmaria*
Viola persicifolia	*Galium palustre*
Orchid species	*Juncus acutiflorus/(J. articulatus)*
(count individual orchid species separately)	*Lotus pedunculatus*
	Luzula multiflora
	Mentha aquatica
	Molinia caerulea
	Ranunculus flammula
	Potentilla anglica
	Potentilla erecta
	Succisa pratensis
	Viola palustris

Note the late leaf emergence for the indicator species *Molinia caerulea* (June onwards)

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

NOTE: These criteria refer to the lowland type adjacent to lakes and rivers; neither the upland community nor the nitrophilous saum community is dealt with here. Tall reed and sedge-dominated swamps should not be included within this Annex I habitat.

Criteria	Scale of assessment
Vegetation composition	
1 Total number of positive indicator species present ≥ 3	Relevé
2 Cover of non-native species ≤ 1%	Relevé
3 Cover of the following negative indicator species: *Glyceria maxima, Phalaris arundinacea, Phragmites australis,* collective cover ≤ 33%	Relevé
4 Cover of scrub, bracken and heath (woody species) ≤ 5%	Relevé
Vegetation structure	
5 Indicator species cover ≥ 40%	Relevé
6 Mode herb height ≥ 50 cm	Relevé
Physical structure	
7 Cover of bare soil ≤ 10%	Relevé
8 Area of the habitat showing signs of serious grazing or disturbance < 20 m²	Local vicinity

Positive indicator species (HQ species not differentiated)	
Alisma lanceolatum	*Iris pseudacorus*
Alisma plantago-aquatica	*Lysimachia vulgaris*
Angelica sylvestris	*Lythrum salicaria*
Calystegia sepium	*Mentha aquatica*
Cicuta virosa	*Myosotis scorpioides*
Crepis paludosa	*Persicaria amphibia*
Epilobium hirsutum	*Rumex hydrolapathum*
Epilobium palustre	*Sium latifolium*
Epilobium parviflorum	*Solanum dulcamara*
Equisetum fluviatile	*Stachys palustris*
Equisetum palustre	*Symphytum officinale*
Eupatorium cannabinum	*Trollius europaeus*
Filipendula ulmaria	*Valeriana officinalis*
Galium palustre	
Hypericum tetrapterum	

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

NOTE: Lowland hay meadows are almost always maintained by annual mowing, or at the very least were historically managed in this way.

Criteria		Scale of assessment
Vegetation composition		
1	Total number of positive indicator species present ≥ 7	Relevé
2	Number of high quality species present ≥ 1	Relevé
3	Cover of non-native species ≤ 1%	Relevé
4	Cover of the following negative indicator species: *Arrhenatherum elatius, Cirsium arvense, Cirsium vulgare, Dactylis glomerata, Lolium perenne, Rumex crispus, Rumex obtusifolius, Senecio jacobaea, Trifolium repens, Urtica dioica,* individually ≤ 10%	Relevé
5	Cover of the above negative indicator species collectively ≤ 20%	Relevé
6	Cover of scrub, bracken and heath (woody species) ≤ 5%	Relevé
Vegetation structure		
7	Forb component of forb : graminoid ratio 40-90%	Relevé
8	Proportion of the sward between 10-50 cm tall ≥ 50%	Relevé
9	Litter cover ≤ 25%	Relevé
Physical structure		
10	Cover of bare soil ≤ 5%	Relevé
11	Area of the habitat showing signs of serious grazing or disturbance < 20 m²	Local vicinity

High Quality Positive Indicator Species	Positive Indicator Species
Bromus racemosus	*Alopecurus pratensis*
Hordeum secalinum	*Centaurea nigra*
Knautia arvensis	*Crepis capillaris*
Leucanthemum vulgare	*Daucus carota*
Lotus corniculatus	*Filipendula ulmaria*
Pimpinella major	*Heracleum sphondylium*
Rhinanthus minor	*Hypochaeris radicata*
Sanguisorba officinalis	*Lathyrus pratensis*
Tragopogon pratensis	*Leontodon autumnalis*
Orchid species	*Leontodon hispidus*
(count individual orchid species separately)	*Plantago lanceolata*
	Prunella vulgaris
	Ranunculus acris
	Trifolium pratense
	Trisetum flavescens
	Vicia cracca

Appendix 2: Monitoring protocol for Annex I grassland habitats

A2.1 Introduction

This monitoring protocol, based on Wilson and Valverde (2013), is applicable for the following five Annex I grassland habitats:

- Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (6210); important orchid sites (*6210)
- 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 caeruleae) (6410).
- Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430).
- Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*) (6510).

Two grassland habitats in Ireland, the orchid-rich variant of 6210, and *6230, are accorded priority status (i.e. habitats in danger of disappearance and whose natural range falls within the territory of the European Union). For *6230 it should be noted that the National Survey of Upland Habitats (NSUH) is the primary source for data on this habitat. Also only the 6430 community of plains was recorded during the ISGS and the variants of the 6430 habitat found on mountain ledges, and on the margins of wet woodlands (saum community), were not recorded. For assessment criteria and sites for these communities, the recently completed 6430 National Conservation Assessment (NCA) should be consulted. Although the Irish Semi-natural Grassland Survey (ISGS), did comprehensively survey the Annex I habitat 6410, including some areas that were classified as fen, it should be noted that the fen component of the 6410 habitat is underrepresented within the ISGS dataset. Possible 6410 fen sites are listed in Table 1 to contribute to ensuring that this fen component is not underrepresented during monitoring.

A2.2 Selection of sites for monitoring

Field surveys should focus on the primary areas of Annex I habitat listed in Table 29 of the Results section. As there are a significant number of Annex I grassland sites that were not surveyed during the ISGS it is recommended that the 2013 NCA datasets for each of the five Annex I grassland habitats should be consulted before completing a list of monitoring sites. For *6230 and 6430, which have only six and five primary areas respectively of Annex I habitat surveyed during the ISGS, many of the monitoring sites will probably be non-ISGS.

If resources allow the 67 primary areas of Annex I habitat for 6210; including 44 probable *6210 areas, listed in Table 29 should be monitored as these sites incorporate many of the criteria that need to be considered when selecting a group of sites for monitoring, including a good geographical distribution of sites. All 37 areas of 6410 listed in Table 29 should also be monitored, but this list should be extended to include more fen examples of this habitat, as the ISGS sites are primarily grassland. In the absence of a recent comprehensive survey of fen habitats in Ireland Table 1 lists possible 6410 fen areas based on an analysis of the NBDC (National Biodiversity Data Centre) fen relevé dataset. It

should be noted that many of these records are historical and the 6410 habitat may no longer be present.

Table A1: List of possible additional Annex I habitat 6410 fen areas to be included in the monitoring programme with the 37 ISGS primary areas of Annex I habitat 6410. Summary data are presented in this table, for the full dataset consult the 6410 NCA 2013 GIS files held by NPWS.

Data source	Survey year	Relevé No. in NBDC database
O'Criodain, C.(1988). Parvocaricetea in Ireland. Ph.D. Thesis	1988	2047
O'Criodain, C.(1988). Parvocaricetea in Ireland. Ph.D. Thesis	1988	2055
Ivimey Cook, R.B. & Proctor, M.C.F. (1966) The plant communities of the Burren	1959	4357 to 4359
Ivimey Cook, R.B. & Proctor, M.C.F. (1966) The plant communities of the Burren	1959	4361 to 4364
Ivimey Cook, R.B. & Proctor, M.C.F. (1966) The plant communities of the Burren	1959	4367
Ivimey Cook, R.B. & Proctor, M.C.F. (1966) The plant communities of the Burren	1959	4369 and 4370
Ivimey Cook, R.B. & Proctor, M.C.F. (1966) The plant communities of the Burren	1959	4372
Ivimey Cook, R.B. & Proctor, M.C.F. (1966) The plant communities of the Burren	1959	4375 and 4376
Ivimey Cook, R.B. & Proctor, M.C.F. (1966) The plant communities of the Burren	1959	4378
Ivimey Cook, R.B. & Proctor, M.C.F. (1966) The plant communities of the Burren	1959	4381
Ivimey Cook, R.B. & Proctor, M.C.F. (1966) The plant communities of the Burren	1959	4391
Ivimey Cook, R.B. & Proctor, M.C.F. (1966) The plant communities of the Burren	1959	4395
Wetland Survey (Fens) Forest & Wildlife Service 1975-1980	1979	4933
Forest & Wildlife Service - Wetland Survey - Lough Carra 1974 (BSBI)	1974	4947 and 4948
Forest & Wildlife Service - Wetland Survey - Lough Carra 1974 (BSBI)	1974	4961
Forest & Wildlife Service - Wetland Survey - Lough Carra 1974 (BSBI)	1974	4968 to 4970
Forest & Wildlife Service - Wetland Survey - Lough Carra 1974 (BSBI)	1974	4974
Forest & Wildlife Service - Wetland Survey - Lough Carra 1974 (BSBI)	1974	4990
Forest & Wildlife Service - Wetland Survey - Lough Carra 1974 (BSBI)	1974	5000
Forest & Wildlife Service - Wetland Survey - Lough Carra 1974 (BSBI)	1974	5004
Forest & Wildlife Service - Wetland Survey - 1974-1978	1978	5095
O'Connell, M. (1977) The phytosociology and ecology of Scragh Bog. PhD Thesis	1972	5295
O'Connell, M. (1977) The phytosociology and ecology of Scragh Bog. PhD Thesis	1972	5296
Patton, L., Boyle, G., O'Connell, T. (1989) An ecological Survey of Pollardstown Fen	1989	8291
Lockharte, N. (1991) Phytosoc. & ccol. studies of lowland blanket bog flushes	1987	8473
Lockharte, N. (1991) Phytosoc. & ccol. studies of lowland blanket bog flushes	1987	8474
Lockharte, N. (1991) Phytosoc. & ccol. studies of lowland blanket bog flushes	1987	8489
A phytosoc. study of the wetlands of the Lower Corrib Basin, Co.Galway	1986	10067
BSBI survey of Lough Carra carried out in June 1974.	1974	15262
BSBI survey of Lough Carra carried out in June 1974.	1974	15271 and 15272
BSBI survey of Lough Carra carried out in June 1974.	1974	15294 to 15296
BSBI survey of Lough Carra carried out in June 1974.	1974	15300

For 6430 the five primary areas of Annex I habitat listed in Table 29 should be supplemented with the remaining 30 sites where 6430 was recorded during the ISGS. In addition to these 35 ISGS sites any monitoring programme should also include the 6430 habitat found on mountain ledges and on the margins of wet woodlands (saum community).

For 6510 if possible all 20 of the primary areas of Annex I habitat listed in Table 29 should be surveyed during a monitoring programme, plus the additional 17 ISGS sites where 6510 was recorded; including site 1166 where a 6510 area was mapped but no relevé was recorded. To extend the geographical distribution and number of sites an additional 25 ISGS relevés are listed in Table 2 where

6510 was not recorded but the plant community contains many of the typical species for this Annex I habitat.

Table A2: List of 25 possible Annex I habitat 6510 areas to be included in the monitoring programme with the 37 ISGS 6510 sites. Many of the relevés contain the typical species for the 6510 habitat but at the time of the original survey they either did not appear to be managed as a meadow or negative species were prevalent.

ISGS Relevé	Fossitt habitat	Explanatory notes
15_02	GS2	8 typical species. Rank sward, high cover of negative species. Possibly managed as a meadow
81_01	GS1	Looks meadow-like in relevé photo, 7 typical species
210_04	GS1	9 typical species , even sward
482_04	GS3	Sward height very low, uneven sward
497_01	GS1	Looks meadow-like in relevé photo, 7 typical species
506_04	GS4	Damp meadow but this is ok for 6510 (wet to dry sub-types)
604_02	GS2	No notes
800_08	GS2	No notes
856_01	GS4	Fails on sward height but relevé recorded in April
953_05	GS2	Wet variant of meadow
1235_02	GS2	No notes
1508_04	GS4	Damp meadow but this is ok for 6510 (wet to dry sub-types)
1510_02	GS1	9 typical species. Only grazing mentioned for site
1513_04	GS4	Damp meadow but this is ok for 6510 (wet to dry sub-types)
1672_01	GS2	Fails on sward height (but early in season). Looks meadow-like in relevé photo
1672_03	GS1	Looks like sward was recently cut, but synopsis mentions horse grazing. 13 typical species
1675_02	GS1	Looks meadow-like in relevé photo, 7 typical species. Mowing noted
1740_05	GS1	9 typical species. On a slope but looks meadow-like from relevé photo
2018_05	GS2	No notes
2020_02	GS2	No notes
2204_06	GS4	Definitely a damp meadow but this is ok for 6510 (wet to dry sub-types)
2231_02	GS1	Typical species for 6510, no grazers here at time of survey so might be mown
2280_01	GS1	Grazed rather than mown. 12 typical species. Relatively low sward height
2299_01	GS1	10 typical species, looks meadow-like in relevé photo
2408_04	GS4	Possible wet sub-type

For the *6230 habitat all six of the primary areas of Annex I habitat listed in Table 29 should be monitored, the remainder of the sites to be monitored should be chosen from the NSUH dataset, and monitoring should take place in conjunction with other Annex I habitats found in upland areas.

Time and resources will probably dictate that only a subset of all the known sites for each of the five Annex I grassland habitats can be monitored. When selecting the subset of sites for monitoring the following criteria can be considered:

- Proportion of sites within designated sites (SAC, SPA, and NHA), National Parks and Nature Reserves
- Proportion of sites that contain more than one Annex I grassland habitat
- Proportion of sites that were recorded with an overall conservation assessment of *Favourable*, *Unfavourable-Inadequate*, or *Unfavourable-Bad* in the baseline survey
- Proportion of ISGS sites to survey compared to non-ISGS sites (including NSUH dataset)

- Geographic spread of the monitoring sites, and particularly the proportion of sites to be surveyed from the centre of the geographic distribution of the Annex I habitat and from the periphery
- The proportion of monitoring sites that should be allocated for the two priority Annex I grassland habitats *6210 and *6230

Some consideration may also have to be given to the site concept in relation to Annex I grassland habitats. Are all the areas of a particular Annex I grassland within one SAC treated as a site, or are areas of Annex I habitat that are separated by a buffer of less than 500 m considered to be one site? As site is an artificial concept it may prove simpler to monitor defined areas of Annex I habitat. For two of the Annex I grassland habitats, their distribution is centred on certain geographical regions and for this reason monitoring should also focus on these regions:

- For 6210 and *6210, monitoring should focus on the Burren region (Clare and Galway) and the Dartry Mountains (Sligo and Leitrim)
- For 6510, monitoring should focus along the Shannon Callows

For 6510, the two meadow systems (site 1731, Mayo and site 2704, Limerick) where the rare characteristic species *Sanguisorba officinalis* has been recorded should be included within the monitoring scheme for this Annex I habitat.

During the site selection process and the field survey it should be considered that Annex I grassland habitats can exist in mosaics with other non-grassland Annex I habitats. For example, the Annex I grassland habitats 6210 and *6210 can exist with other Annex I habitats such as European dry heaths (4030), Alpine and Boreal heaths (4060), Limestone pavements (8240), and *Juniperus communis* formations on heaths or calcareous grasslands (5130). The same is true for other Annex I grassland habitats, with 6410 found in a mosaic with Alkaline fens (7230) and this situation can also occur for *6230 and 6430. Due to 6510 usually being mown annually, there is unlikely to be a gradation into non-grassland Annex I habitats, but the 6510 grassland can exist in a mosaic with 6410, particularly in the Shannon Callows, and 6210. It is important when monitoring Annex I habitats that 'intermediate' habitats that exist within the mosaic of Annex I habitats are not ignored, or considered to be non-Annex I habitats due to difficulties in classifying them within one Annex I habitat.

A2.3 Field Survey Methods

Field ecologists should work in pairs. Landowners and local NPWS rangers should be contacted before entering a site. The number of monitoring plots to be surveyed at each site should be based on the area of the Annex I habitat being surveyed and calculated using Table 3 in the Methods section. The positioning of each plot should be allocated at random before the site is visited; however, if randomised points are within 4 m of a field boundary they should be reallocated due to the shade effects of hedges and treelines and higher levels of disturbance around field gates. If, when a fieldworker goes to a monitoring plot location, the Annex I habitat cannot be located or the point is subject to localised damage, such as heavy poaching or the positioning of a supplementary feeder, they should record the habitat present at the point and then locate the nearest area of Annex I habitat in which to survey.

A list of all plant species, including bryophytes, within each 2 m x 2 m monitoring plot should be recorded using TurboVegCE software on a handheld GPS minicomputer. For each monitoring plot a 12 figure grid reference (i.e. 6 Easting and 6 Northing) should be obtained using a GPS unit. Altitude, slope and aspect should also be recorded. The full list of data to be recorded for each plot is listed in Appendix 1. Percentage cover of plant species and additional information, such as bare soil, should be recorded at 5% intervals with the following scale applied for cover below 10%; 0.1%, 0.3%, 0.5%, 0.7%, 1%, 3%, 5%, 7%. There should be a photographic record of each plot with one image of the 2 m x 2 m plot and one of the surrounding landscape. Images of impacts, positive, neutral, and negative, should be recorded where possible, together with a 12-figure GPS grid reference if the impact is centred on a specific area. After recording the data within all of the monitoring plots in a site the ecologist should state if the randomly allocated plots were representative of the structure and functions of the Annex I habitat and, if not, how they differ.

Any changes in the area of the Annex I grassland at a site larger than the minimum mapping unit of 400 m^2 should be digitally mapped. Mapping methods are described in more detail in the Methods section and a GPS minicomputer should be used to accurately map the changes in area from the baseline map. Mapping changes should be categorised as actual change or change in interpretation. The latter category should be used where the ecologist conducting the monitoring considers the interpretation of the criteria applied during the baseline survey to be incorrect and that any differences observed are due to interpretation rather than actual change. It should be noted that grassland communities are dynamic and can change naturally due to environmental pressures such as flooding or prolonged drought, or changes in management. For this reason, grassland areas that are adjacent to known areas of Annex I grassland habitats should be briefly viewed and considered for the presence of Annex I grassland habitat.

A2.4 Conservation Status Assessment

The conservation assessment for Annex I habitats is based on three main aspects: area, structure and functions, and future prospects.

A2.4.1 Area

A quantitative assessment of the variation in Annex I habitat extent should be carried out by comparing the area mapped during monitoring to the baseline survey. When assessing changes in area, the rules stated in Evans and Arvela (2011) should be followed: a decline in habitat area within a site of greater than 0% and less than 1% per year should be assessed as *Unfavourable – Inadequate*; a decline greater than 1% per year should be assessed as *Unfavourable – Bad*. It would be expected that most changes in habitat extent would be evident during the field survey.

Area should be given a trend assessment based on changes in extent over time. Available baseline data for a site, such as the ISGS GIS maps, should be utilised when calculating trend. When no previous GIS map is available, all available data sources, such as aerial photographs, hand-drawn maps and information from local NPWS Rangers, should be used to investigate any changes in the extent of the Annex I habitat.

A2.4.2 Structure and functions

Data for the assessment of structure and functions should be gathered through the recording of 2 m x 2 m monitoring plots. For each Annex I habitat, all of the relevant criteria listed in Appendix 1 should be assessed. If one of the individual assessment criteria fails, the overall assessment for the stop will be a fail unless expert opinion judges the overall structure and functions of the habitat to be *Favourable* even though criteria may have failed. In many cases, a failure in the sward height criterion or a near failure in the proportion of broadleaf herbs (e.g. 35-39% is judged to be a near failure when the target is 40% broadleaf cover) does not prevent an overall pass for a plot when all other monitoring criteria pass.

The indicator species listed for each Annex I habitat in Appendix 1 focus on species that are characteristic for a particular Annex I habitat, or indicative of more natural habitats of higher conservation value, such as grassland that has not been improved for agriculture. These lists are intended as a guide to aid fieldworkers in identifying the five Annex I grassland habitats and to recognise grasslands with better structure and functions. Fieldworkers should consider the merits of including additional indicator species for a particular Annex I grassland habitats on a site-by-site basis.

The Annex I habitat at a particular site will be considered *Favourable* if structure and functions are in good condition and no significant deteriorations or pressures are apparent. It will be considered *Unfavourable – Bad* if > 25% of the area is unfavourable as regards its specific structures and functions and it will be considered *Unfavourable – Inadequate* if there is 1- 25% failure (e.g. 1-25% of monitoring stops fail). Each monitoring stop will be representative of a percentage of the Annex I area being assessed, with the ideal being four stops, each representing 25% of the habitat. However, this will not always be the situation on the ground and the percentage of the overall Annex I habitat area that each stop represents should be stated (e.g. stops one to three each represent the habitat condition for 30% of the Annex I area surveyed and stop four represents 10%). Available baseline data for a site, such as the ISGS data, should be utilised when determining if the trend for structure and functions is improving, stable or deteriorating.

A.2.4.3Future prospects

Data for the future prospects assessment should be gathered not only from the monitoring plot data and overall site survey, but also from other relevant sources such as local NPWS Rangers. The future prospects assessment should be viewed as the overall outlook for the site. The assessment should be made by combining habitat knowledge with site-based experience of negative impacts and positive influences on the site. Data recorded during the ISGS should be used for comparative purposes for the next round of assessments. The list of impacts and impact codes should follow Ssymank (2010) and the protocol listed in the Methods section and Appendix 3 should also be followed. Expert judgement can be used to gauge the severity of the impact on the site. The overall status of future prospects should be determined as *Favourable* if the habitat's prospects for its future are excellent / good, and no significant impacts from threats are expected, *Unfavourable – Inadequate* if the habitat's prospects for its future are poor, and *Unfavourable – Bad* if the habitat's prospects are bad, and severe impacts from threats are expected.

A2.4.4 Overall Conservation Assessment

At an individual site level the overall conservation assessment of a site should be assessed using the process outlined in Table 2 of the Methods section. Overall trend for each site should then be discussed where baseline data are available, such as ISGS sites. For the overall NCA for each of the Annex I grassland habitats, the methods proposed in Evans and Arvela (2011) should be followed, with the individual NCAs produced in 2013 acting as a template.

A2.5 Data storage

All monitoring data should be stored within the ISGS Access Database. This database has been set up so that successive rounds of monitoring data can be added to it and to facilitate the transfer of monitoring relevés from Turboveg.

Appendix 3: A guide to assessing future prospects

A3.1 Introduction

This document was created to assist ISGS ecologists assess the future prospects of Annex I grassland habitats as part of the habitat's *first* conservation assessment. Impacts and activities observed during this first phase of monitoring will form the baseline data from which future trend direction can be calculated.

Future prospects relates to the 'viability of a habitat or species in the long-term which depends on the future trends of constitutional parameters' (Ellmauer 2010). In other words, it is the overall outlook for the constitutional parameters - range, area, and structure and functions. In order for an Annex I habitat to gain *Favourable* future prospects the habitat's prospects for its future must be good or even excellent. No significant impact from pressures should be expected and long-term viability is assured. For *Unfavourable-Bad* the Annex I habitat's prospects for its future are bad, with severe impact from pressures expected and long-term viability not assured. *Unfavourable-Inadequate* is any other combination. Long-term is defined as being over the length of two monitoring periods, i.e. 12 years (Ellmauer 2010).

Some of the common influences on future trends include specific or general pressures/threats, and initiated or ongoing conservation measures. The verdict on the outlook for future prospects should therefore be based on an overall assessment of the relative importance of the negative threats/pressures and positive activities observed for the habitat.

Pressures are considered to be factors which are acting on the Annex I habitat now (during the current reporting period), while *threats* are factors expected to act on the Annex I habitat in the future (two reporting periods into the future). Within the 'Assessment and reporting under Article 17 of the Habitats Directive, Explanatory Notes & Guidelines for the period 2007-2012', it is pointed out that theoretical threats should not be listed. Often there is no certainty that any threat will occur in 12 years' time, but it would be expected that some pressures that are scored at the time of monitoring will become threats. Also there are impacts that might not currently be a pressure but might ultimately become a threat. For example, bracken may be adjacent to the Annex I habitat presently but is not a pressure as it has not spread into the habitat. If land management remains the same, however, it is very likely that this will spread into the habitat in 12 years' time and therefore become a threat. In cases such as this, bracken should be recorded as 'neutral effect/0% habitat affected/source outside' and the intensity left blank so its potential as a threat is noted but does not affect its current pressure score.

A3.2 Gathering field data for a future prospects assessment

Ecologists should walk through the Annex I grassland habitat, to identify any activities that are occurring within and adjacent to the habitat which may affect its future prospects. Only activities that are actually observed or known to occur should be listed. Hearsay by locals and best intentions by landowners are not sufficient. Also, only Annex I habitats that are actually surveyed and walked

through should be included in this assessment. For example, a field that might, judging by neighbouring fields and field margins, be 6510 but could not be surveyed as it was mown the day before should not be assessed or mapped as 6510.

The **Annex I habitat code, impact code & description, intensity, effect, % area affected and source** are listed for each activity.

The *minimum* number of data entries is one. If there are no pressures present the impact code "X" should be used. It is important to fill this in to indicate there are no pressures or activities acting on the Annex I habitat, rather than no data entry, which could indicate that the assessment was forgotten.

It is recommended to use the lowest number of possible data entries to adequately describe the situation.

In addition, ecologists assessing the Annex I habitat should give their **expert opinion** on the condition of the habitat in relation to its future prospects. Ecologists should state whether they think the future prospects of the Annex I grassland habitat should be *Favourable, Unfavourable-Inadequate* or *Unfavourable-Bad*, with a brief explanation on why (rare species present, local distinctiveness, change in ownership and/or land management, *etc*). In the case of *Unfavourable-Bad*, we strongly recommend that data are available from either the list of activities or from the structure and functions assessment to support this *Unfavourable-Bad* status.

A3.2.1 Items to remember when recording impacts

Annex I habitat

- Fill in the respective codes for each Annex I grassland habitat observed on site
- If there is more than one Annex I grassland habitat on a site, e.g. 6210 and 6410, each must be assessed separately

Impact code

- Use the most detailed code possible, e.g. A04.01.02 rather than A04 or A04.01 and also write the description of the impact as it is very easy to misread/write a code
- Each code should only be used once for a particular Annex I habitat within a site. If, for example, there is positive non-intensive cattle grazing in one part of 6410 within a site but negative non-intensive cattle grazing in another area of 6410 on the same site, the ecologist must assess the overall effect of non-intensive cattle grazing. You may decide that they cancel each other out, thereby having a neutral effect, or that the positives outweigh the negatives or *vice versa*
- If in any doubt about what code to use, write down a brief description of the activity with details on intensity, % area affected, effect and source
- Even activities that have a neutral effect should be recorded as they may have a cumulative impact with other activities or start to have an impact if conditions change
- Mowing, grazing, scrub/heath encroachment, bracken encroachment, drainage ditches, adjacent forest plantations and fertilisation are common activities that have an effect on Annex

I grassland habitats. Refer to Table A3 for codes to use for these. Please note that there are different codes for scrub/heath encroachment and bracken encroachment and these must be listed separately

- Refer to the section "Intensive versus non-intensive" below for clarification on the appropriate codes to use for mowing and grazing activities

Table A3: Common activities recorded on Annex I grassland habitats – impact codes and descriptions

Impact Code	Impact Description
A03.01	Intensive mowing or intensification
A03.02	Non-intensive mowing
A03.03	Abandonment/lack of mowing
A04.01.0X	Intensive grazing (X ranges from 1-5, use most appropriate)
A04.02.0X	Non-intensive grazing (X ranges from 1-5, use most appropriate)
A04.03	Abandonment of pastoral systems, lack of grazing
A08	Fertilisation
B01.0X	Forest planting on open ground (X = 1/2) – use if plantation is *newly planted*
B02	Forest and Plantation management and use – use if plantation is *established*
I02	Problematic native species – use this for bracken encroachment
K02.01	Species composition change (succession) – use this for scrub/heath encroachment
J02.07.01	Water abstraction for agriculture – use this for presence of drainage ditches

Intensity

- Guidelines suggest using a combination of the influence of an impact and the area involved, however we record the area involved separately and therefore when considering intensity, ecologists should only look at the **influence of the impact** on the Annex I habitat
    - High: the impact has a great or immediate influence on the Annex I habitat
    - Medium: the impact has a medium direct or immediate influence on the Annex I habitat
    - Low: the impact has a low direct or immediate influence on the Annex I habitat or an indirect influence
- High intensity suggests that an activity is very serious and concentrated, and often involves doing a great deal in a short time (such as mowing), low intensity suggests an activity is very moderate or slight, while medium intensity suggests an activity is between the two

Source

The majority of impacts tend to occur from within the Annex I habitat (e.g. grazing, mowing, abandonment, drainage ditches). Adjacent forest plantations have an outside source. Scrub and bracken encroachment can either be inside or outside (refer to the example section on how to deal with this)

Effect

- The ecologists must decide whether the activity has a negative, positive or neutral effect on the Annex I habitat, i.e. would the habitat be better or worse off if the activity were removed
- As mentioned above, some activities can have both negative and positive effects but the ecologist must assess the overall effect. Don't be tempted into calling the effect neutral if this scenario occurs unless the negative and positive truly negate each other
- It should be noted that if an activity is of a high intensity, it does not automatically mean the impact is negative. For example, mowing has a high impact on the structure and functions of hay meadows, but if used non-intensively (cut once a year or less for hay) it is an important tool for the continued good management of the grassland habitat and is therefore a positive activity.

% habitat affected

- As it is difficult to give an accurate estimate on the % Annex I habitat influenced by an activity the following ranges are often applied:
    - <1%, 1-25%, 26-50%, 51-75%, 76-99%, 100%
- Pay particular attention to the % area affected by scrub and bracken encroachment

A3.2.2 Intensive versus non-intensive impacts

Intensive farming involves either a large amount of financial or labour investment, which often corresponds with a high application of pesticides or fertilisers on a comparatively small area. Its aim is to produce a high yield from the land available and to maintain a high stocking rate of livestock.

Mowing (A03)

Intensive mowing (A03.01): two cuts per year (or most years – weather dependent), usually for silage or haylage

Non-intensive mowing (A03.02): cut once or less than once per year for hay

Grazing (A04)

Intensive grazing (A04.01): In the majority of cases this will occur in enclosed field systems ('closed-gate field systems') where there is evidence of agricultural improvement and/or high stock numbers, with both leading to high nutrient inputs (due to fertiliser application or excessive dung) and, in the case of high stock numbers, to poaching.

Non-intensive grazing (A04.02): This can occur in unenclosed areas or in enclosed field systems that are very open ('open-gate field systems'), where there are little or no signs of agricultural improvement or high stock numbers.

The ISGS made the distinction between 'open-gate' and 'closed-gate field systems' as Annex I grassland habitats usually occur within at least partially enclosed areas. If grazing which occurs in enclosed field systems were to go under the heading of intensive grazing only, then the vast majority of grazing in Annex I grassland habitats would be intensive by definition. Where Annex I grassland habitats are currently present with grazing as part of the management regime, this grazing probably is non-intensive in the majority of cases. Annex I grassland habitats are very sensitive to grazing pressures, yet require grazing or another form of management to maintain the grassland and halt succession to another habitat (such as scrub), thereby requiring a very delicate balance of grazing intensity. If grazing was intensive, as by the definition above, the Annex I grassland habitat would probably not be present in the first place.

A3.3 Data entry examples

Undergrazing

Undergrazing can be scored in two ways: 'Abandonment of pastoral systems, lack of grazing' (A04.03) or 'non-intensive X grazing' (A04.02.0X). A04.03 should only be used if undergrazing has led to a more tussocky, tall, rank vegetation, usually with high litter cover. In other words, grazing levels are so low that the structure and functions of the habitat are failing. Intensity should generally be either medium or low. A04.03 is also used when the Annex I habitat has been truly abandoned. Intensity in this case is usually high.

A04.04.0X is used when grazing is not sufficient to prevent the spread of scrub or bracken, but the structure and functions of the habitat are still in a *Favourable* condition. Although scrub and bracken encroachment are symptomatic of undergrazing, they have become pressures on the habitat themselves and therefore must be listed separately from grazing. Grazing in this case should be considered to have either a neutral or positive effect as, if it were removed, the situation would be even worse, while encroachment would be listed as a negative effect.

a) A site is undergrazed, but not abandoned, with both scrub and bracken encroachment occurring, but the grassland sward is not rank or tussocky. The following impacts should be listed: Scrub encroachment (K02.01), Bracken encroachment (I02) and Non-intensive grazing (A04.02.0X). **Do not list** Abandonment of pastoral systems, lack of grazing (A04.03)

b) Undergrazing at a site has led to a tussocky, taller rank sward with no evidence of scrub/bracken/heath encroachment. List Abandonment of pastoral systems, lack of grazing (A04.03). A04.03, for this example, refers to undergrazing or insufficient grazing, rather than abandonment.

Mixed grazing regimes or intensities:

c) A small herd of cattle graze within the Annex I habitat. Majority of habitat is grazed adequately with good structure and functions. A small area near the lakeshore is however badly poached due to the waterlogged condition of the soil. In this case the cattle grazing is non-intensive, medium intensity, overall a positive effect, 100% of the habitat, source inside. The positive effects in this case far outweigh the negative.

d) 6230 is found both within an enclosed field system (closed gate) and outside the field system in an unenclosed coastal area. The 6230 within the field system is overgrazed, while the rest is adequately grazed. The 6230 within the field system should go under the intensive sheep grazing code (A04.01.02), with a negative effect at medium or high intensity, and the remainder under non-intensive sheep grazing (A04.02.02) as the management has changed from one area of 6230 to another.

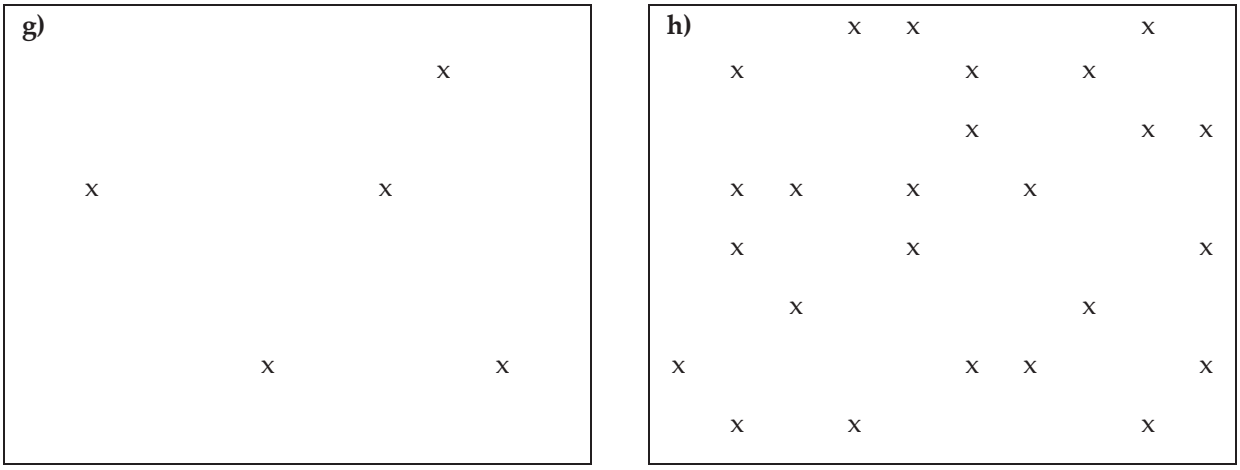
e) If there is non-intensive sheep and cattle grazing on an Annex habitat and both have the same intensity, impact and % area, this impact should be listed under Non-intensive mixed animal grazing (A04.02.05). If they have different impacts or intensities or % area, they should be listed separately under their individual codes.

f) If grazing is non-intensive but the type of grazer is not suitable for the habitat, such as a small herd of cattle grazing where soil is extremely waterlogged causing poaching, this impact should be listed under non-intensive cattle grazing, negative effect, medium or high intensity (depending on severity of poaching). If grazing also has positive effects elsewhere on the habitat, however, the ecologist must decide whether the positives outweigh the negatives.

Encroachment and % area:

g) Scrub encroachment is scattered sparsely throughout the Annex I habitat

h) Scrub encroachment is scattered frequently throughout the Annex I habitat, but with no one area of encroachment of a mappable size

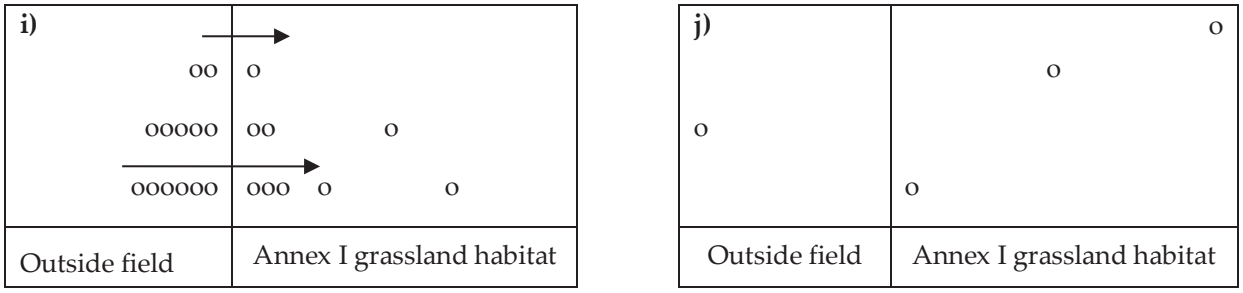


'x' represents individual scrub species, such as *Ulex europaeus* for example

Encroachment and source:

i) Bracken occurs within the Annex I habitat, with high levels in adjacent fields – outside source

j) Bracken occurs within the Annex I habitat, with low levels in adjacent fields – inside source



'o' represents dense bracken

Other:

k) No impacts or activities observed. List "X" No threats or pressures

l) Bracken is adjacent to the Annex I habitat but has not spread into the habitat. It is very likely that this will spread into the habitat in 12 years' time and therefore become a threat. Bracken should be recorded as 'neutral effect/0% habitat affected/source outside' and the intensity left blank so its potential as a threat is noted but does not affect its current pressure score.

See Table A4 below for examples of how to record these impacts in the recommended format.

Table A4: Negative and positive impacts on EU Annex I Habitats. Examples of how to record impacts in the field based on the examples (a – l) outlined above

Annex I habitat	**Impact code / description** e.g. A04.01 intensive grazing	**Intensity**			**Effect**			**% Habitat**	**Source** (inside or outside)
		H	M	Low	-	0	+		
a) 6230	A04.02.02 - non-intensive sheep grazing			✓			✓	76-99 (85%)	Inside
a) 6230	K02.01 – scrub encroachment			✓	✓			1-25 (10%)	Inside
a) 6230	I02 – bracken encroachment			✓	✓			1-25 (5%)	Outside
b) 6410	A04.03 – lack of grazing		✓		✓			100	Inside
c) 6410	A04.02.01 – non-intensive cattle grazing		✓				✓	100	Inside
d) 6230	A04.01.02 – intensive sheep grazing		✓		✓			1-25 (20%)	Inside
d) 6230	A04.02.02 – non-intensive sheep grazing			✓			✓	76-99 (80%)	Inside
e) 6210	A04.02.05 – non-intensive mixed animal grazing (sheep & cattle)		✓				✓	100	Inside
f) 6410	A04.02.01 – non-intensive cattle grazing		✓		✓			100	Inside
g) 6210	K02.01 – scrub encroachment			✓	✓			1-25 (5%)	Inside

h) 6210	K02.01 – scrub encroachment	✓			✓			26-50 (30%)	Inside
i) 6230	I02 – bracken encroachment		✓		✓			1-25 (15%)	Outside
j) 6230	I02 – bracken encroachment			✓	✓			1-25 (5%)	Inside
k) 6430	X – NO IMPACTS								
l) 6210	I02 – bracken encroachment					✓		0%	Outside

Appendix 4: Discussion of methodology

A4.1 Scope of the survey

The ISGS, while it was conducted on a national scale and covered a large area, was nevertheless not comprehensive. Grasslands associated with dune systems were outside of its remit. Some coastal grasslands that were indistinguishable from machair and other dune grasslands (Delaney *et al.* 2013) were omitted, and the survey of maritime grassland may have been somewhat restricted as a result. Turloughs were likewise excluded, so as not to overlap with a survey conducted previously (Kimberley and Waldren in prep.), so no turlough grasslands were included in the survey or the subsequent vegetation analysis. The area within the Burren National Park was, by request from NPWS, largely omitted from the survey owing to the large amount of research work that had already been carried out within its boundary (Parr *et al.* 2009; Wilson and Valverde 2013). Also dating from 2010 was the exclusion of all grasslands within upland SACs from the survey, to avoid overlap with the National Survey of Upland Habitats (NSUH) that commenced in 2009. This was partly addressed by the ISGS resurveying some grasslands identified by the NSUH as Annex I *6230 *Nardus* grassland, particularly in Kerry; and by the inclusion of *6230 and [*]6210 relevés from the NSUH in the vegetation analysis presented in this Irish Wildlife Manual. Because the NSUH is still on-going, there are some counties (such as Wicklow, which would be expected to have *6230) for which such resurveys were not an option as they have not yet been surveyed by the NSUH. For this reason, relevés from upland grassland communities are under-represented within the ISGS dataset.

As the survey methodology evolved and familiarity grew with the Annex I and non-Annex habitats documented in this manual, it was realised that some habitats, while not strictly grassland, nonetheless could be classed as Annex I grassland habitats under the definitions presented in the Interpretation Manual of European Habitats (Anon. 2007). This became an issue in later years of the survey when fen meadows were encountered that corresponded to 6410 *Molinia* meadows, but which were classed under Fossitt (2000) as PF (fen/flush habitats). In earlier years, such fen meadows would have been excluded simply because they did not conform to a Fossitt (2000) grassland category. In later years, however, such habitats were included in the survey, and categorised and mapped as Annex I 6410 and Fossitt category PF1 or PF2.

There was also initially a lack of clarity in relation to the 6430 Hydrophilous tall herb swamp communities Annex I habitat. By definition, under Fossitt (2000) this is an FS2 (tall-herb swamp) community rather than a grassland habitat. The remit of the ISGS was expanded after 2008 to survey 6430 habitats if they were found, and even, at the discretion of the surveyors, to include non-Annex FS2 if encountered in the context of grassland habitats. However, as the definition of the Annex I habitat was unclear, being somewhat nebulous even in the EU interpretation manual of Annex I habitats, the decision on whether or not to survey it was based on incomplete information. Some areas not included in the survey were subsequently deemed to be 6430, including one large area in Co. Galway at Banagher Bridge.

The Annex I habitat 6130 Calaminarian grassland was surveyed to some extent during the ISGS, chiefly in 2008, when a number of old copper mines in Cork and Waterford were surveyed, following the work by David Holyoak in identifying and surveying such sites (Holyoak 2008). However, these

habitats require specialist bryophyte knowledge and are, essentially, bryophyte communities on rock rather than true grassland communities. It was therefore decided, in compiling this national report, that only the five most frequent Annex I grassland communities encountered during the ISGS would be included. The reader is referred to Holyoak (2008) and to the recently issued status report on Irish Annex I habitats for the 2006-2012 reporting period (Anon. 2013) for further information on the 6130 habitat.

A4.2 Review of Fossitt (2000) and Annex I habitat assignments

The ISGS took place over six years and went through a number of changes in remit and resources. The evolution and modifications in the methodology that took place over this time, including some changes in how Annex I habitats were viewed and classified from the early years of the survey to the later years, are outlined in a later section of this appendix.

To correct for any evolving changes in habitat definition, a full review was conducted of the validity of all the original Fossitt (2000) and Annex I grassland habitat assignments at the end of the 2012 field season. This task was a time-consuming but necessary procedure as it reduced variability in the data collected between recorders and by individual recorders over the lifetime of the project. It was particularly important in the case of the Annex I grassland habitats, as the assessment criteria and the definition of each habitat in Ireland underwent multiple refinements. Reassignment of habitats also made it easier to identify and remove outliers (e.g., swamp, wet heath or flush communities) from the dataset before any vegetation analysis was undertaken. It should be noted that, in the majority of cases of reassigned Fossitt (2000) habitat codes, relevés were either recorded in transitional zones between habitats, or in unusual or uncharacteristic examples of grassland. Assigning the most relevant habitat to grassland communities could be difficult when restricted to the five main grassland categories as defined by Fossitt (2000).

One of the largest areas of grassland habitat affected by the habitat review was at the Curragh, Kildare. In the 2010 annual report, this was reported to contain a high proportion of *6230 *Nardus* grassland (O'Neill *et al*. 2010). The review, however, resulted in the acidic grasslands of the Curragh being no longer regarded as the Annex I habitat, due to a lack of species diversity.

A change of view with regard to 6410 also took place. In the early years of the project, fen meadows that were classed under Fossitt (2000) category PF were not surveyed; however, it was subsequently accepted that these frequently conformed to Annex I habitat 6410 *Molinia* meadows and they were surveyed when within or adjacent to grassland sites.

The Annex I habitat 6430 Hydrophilous tall herb communities is a rare habitat that is defined more by its context in the landscape, found along the margins of rivers and lakes, than by a single vegetation community. The recent National Conservation Assessment (NCA) report of 6430 describes three versions of this habitat occurring in Ireland, including one on river floodplains and one on upland ledges (Anon 2013). Vegetationally, these are very different. It was only after the total ISGS dataset was analysed at the end of the project that the final definition of the river plain version of the habitat was defined and applied retrospectively to suitable relevés; the upland ledge community was defined following work carried out during the NSUH.

A4.3 Evolution of methodology

This section outlines the main methodological changes made and provides explanations of why these changes were implemented. Reference is made to the pilot survey (Martin *et al.* 2007) as this was the baseline from which all subsequent ISGS methodology evolved. Changes are catalogued under headings as used during the annual county reports, followed by the appropriate year(s) of the ISGS when changes were made. Please refer to Devaney *et al.* (2013) and Martin *et al.* (2013) for the latest and most detailed methodology used during the ISGS.

A4.3.1 Site selection

Refer to Martin *et al.* (2007) for baseline methodology.

2008

- The target to record a specified number of relevés from sites across counties surveyed, changed to a target to record at least one relevé from a specified number of sites (number provided by NPWS) across counties surveyed in any given year. This change to methodology was made following consultation with NPWS after the pilot survey.

2009

- The method of calculating the number of sites to be selected in each county by combining the size of the county with the amount of agricultural intensification within each county (Lafferty *et al.* 1999) was introduced. Counties with lower levels of agricultural intensification were expected to contain the largest amount of semi-natural grassland. This resulted in more sites selected and greater sampling effort concentrated in less agriculturally productive areas as they were more likely to yield higher quality semi-natural grassland.

2010

- A downward adjustment of potential surveyable area was made by excluding all upland SACs from the ISGS from 2010 onwards to prevent overlap with the National Survey of Upland Habitats (NSUH). The pilot of the NSUH was completed in 2009 (Perrin *et al.* 2009), with the full national survey commencing in 2010. To date the NSUH has surveyed upland SACs in counties Cavan, Donegal, Kerry, Leitrim, Limerick, Louth, Mayo, Sligo, Tipperary and Waterford (Perrin *et al*. 2013a).

2011 and 2012

- Due to a change in site selection methodology in 2010 (see above) where all upland SACs were excluded from the site selection process, the potential for surveying sites containing the Annex I grassland habitat *6230 Species-rich *Nardus* grassland was reduced. Sites identified by the NSUH as containing this Annex I habitat were selected, where applicable, for the remaining counties left to survey in the ISGS. By going back into areas where the NSUH had identified this habitat, extra data could be gathered leading to a more complete dataset in order to assess the conservation status of this habitat as part of the ISGS.

- Due to resource limitations, the sampling density applied over the final two years of the project had to be reduced to ensure the remaining 14 counties were all included within the study. This resulted in counties where grasslands are more intensively farmed or that have large upland SACs being less intensively surveyed than they would have been during earlier phases of the project.

A4.3.2 General site survey

Refer to Martin *et al.* (2007) for baseline methodology.

2008

- During the pilot survey (Martin *et al.* 2007) wet meadow habitats along the Shannon and other large rivers were included within the Fossitt (2000) dry meadows category (GS2), in order to distinguish them from other wet grassland habitats (GS4). This was found to be unsatisfactory, however, and led to confusion during the interpretation of relevé data. From 2008 onwards, wet meadows habitats were included within the Fossitt (2000) wet grassland category (GS4). The wet meadows which were assigned as dry meadows (GS2) in 2007 were changed to GS4 *post hoc* to conform to this change in methodology.

2010

- In early 2010, the structure of the Access database was completely redesigned. One of the changes involved the removal of certain general site data from the database, and therefore these data were no longer recorded during the site survey. Redundant site data included site topography, boundary transition, grazing levels and encroachment. Topography was still recorded at a relevé level. Grazing levels and encroachment were still recorded when an Annex I grassland habitat was present, as these criteria form part of the structure and functions and future prospects assessments for Annex I grassland habitats. Grazing levels and encroachment were no longer routinely recorded at a site level due to the complexity and variability that was often observed in these criteria at the site level.

A4.3.3 Relevé survey

Refer to Martin *et al.* (2007) for baseline methodology.

2012

- Soil samples were collected from most relevés but only a sub-set of samples, mainly from Annex I relevés, was analysed: the majority were not analysed but instead dried and sent to a storage facility in the Agriculture and Food Science Centre in University College Dublin. This decision was made following consultation with NPWS. It was expected that the results produced from five years of soil analyses was sufficient to run correlation analysis between soil variables (amongst others) and the vegetation communities as outlined in the Results section.

A4.3.4 Assessment of Annex I grassland

Refer to Martin *et al.* (2007) for baseline methodology. For each Annex I grassland habitat, three parameters were scored: area, structure and functions, and future prospects. There was no change to area assessment methodology. Changes made to the structure and functions assessment methodology are outlined first, followed by the changes made to the future prospects assessment methodology. The structure and functions assessment criteria for Annex I grassland habitats were continuously refined throughout the lifetime of the ISGS as each progressive year led to further understanding and knowledge of these habitats. Only broad changes to the criteria will be mentioned below; readers are asked to refer to the individual annual county reports for more detail.

A4.3.4.1 Structure and functions assessment

2008

- The assessment criteria for 6410 *Molinia* meadow on calcareous, peaty or clayey-silt laden soils, 6430 Hydrophilous tall herb fringe communities and 6510 Lowland hay meadows were adapted. New lists of positive indicator species using the data collected during the 2007 ISGS survey, the Interpretation Manual of European Union Habitats (Anon. 2003) and White and Doyle (1982) were compiled. Refer to Martin *et al.* (2008) for more details.

2009

- All assessment criteria were reviewed using the data collected during the 2007 and 2008 ISGS surveys, the Interpretation Manual of European Union Habitats (Anon. 2007) and White and Doyle (1982). The main change to the assessment criteria used during 2009 was to divide the positive indicators species into High Quality (H.Q.) and non-H.Q. indicator species. H.Q. indicator species were almost always species only found in high quality grassland habitats. Five species were also added to the positive indicator species list for *6230 Species-rich *Nardus* grassland and four species added to the positive indicator species list for 6430 Hydrophilous tall herb fringe communities.
  The introduction of H.Q. indicator species helped to clarify the distinction between Annex I grassland and non-Annex I grassland. All Annex I grassland habitats recorded in 2007 and 2008 were reassessed in 2009 using the new assessment criteria. Refer to O'Neill *et al.* (2009) for more details.

2010

- A scale used to determine the number of monitoring stops to record in any given Annex I grassland habitat at a site was introduced in 2010. This change was made to ensure that the variation within Annex I grassland habitats of any size, once above the threshold of 0.04 ha[5], was represented by an adequate amount of monitoring stops. Refer to O'Neill *et al.* (2010) for more details.

[5] Areas of 6430 Hydrophilous tall herb fringe communities < 400 m² were an exception to this rule due to the rarity and deficiency of data on both a national and regional level.

2012

- All assessment criteria were reviewed after the 2012 field season using the data collected during the lifetime of the ISGS (2007-2012), NSUH data (2009-2012), the Interpretation Manual of European Union Habitats (Anon. 2007), Dwyer *et al.* (2007), JNCC (2004), Curtis and McGough (1988) and White and Doyle (1982). Positive indicator species lists for each Annex I grassland habitat were updated based on these data sources, with both addition and removal of species applied. The calcareous and non-calcareous sub-communities for *6230 Species-rich *Nardus* grassland were introduced, as was a species richness criterion for this habitat. The fen meadow community of 6410 *Molinia* meadows was recognised and the negative indicator species list amended to reflect this community.

  Once the final structure and functions criteria for each Annex I grassland habitat were finalised, they were applied *post hoc* to all assessment relevés recorded between 2007 and 2012. Refer to Devaney *et al.* (2013) and Martin *et al.* (2013) for more details. This *post hoc* analysis resulted in areas that had previously been assessed as Annex now considered to be non-Annex and *vice versa*.

A4.3.4.2 Future prospects

2009

- Future prospects were assessed in the field following the methodology set out in 2007 and 2008, but a recent report on the pressures, threats and impacts on Annex I habitats (Ssymank, 2009) led to a subsequent adjustment in the future prospects scores of the Annex I grassland habitats assessed in 2009. The availability of this report led to the amalgamation of some categories and the removal of others. This new methodology could not be fully implemented in 2009, nor applied *post hoc* to the 2007 and 2008 data due to a lack of the required detail recorded for these years. Refer to O'Neill *et al.* (2009) for more details.

2010

- Following on from the release of Ssymank (2009), a subsequent update of this report was released in 2010 (Ssymank, 2010). Pressures, threats and impacts were recorded for each area of Annex I grassland habitat surveyed using the impact codes from Ssymank (2010). Following recommendations made in Ellmauer (2010), the intensity and effect of each impact was recorded, as well as the percentage of the Annex I habitat under this impact and its source. A scoring system was developed to combine the above aspects to get an overall score for each impact and also to get an overall future prospects assessment for the Annex I habitat in question at a site level. Refer to O'Neill *et al.* (2010) for more details.

2011 and 2012

- The source criterion was not used in the future prospects scoring system as introduced in 2010, as the source of the impact was not deemed to be a key issue when assessing the severity of the impact. Expert judgement was also brought in to the 2011 and 2012 future prospects assessment methodology. This was to ensure that the quantitative analysis of the future prospects assessment was a true reflection of the future prospects of the habitat. Refer to Devaney *et al.* (2013) and Martin *et al.* (2013) for more details.

A4.3.5 Ranking of sites using conservation and threat evaluations

Refer to Martin *et al.* (2007) for baseline methodology.

2008

- Archaeological features were removed as a criterion from the conservation score calculation, while the presence of certain negative species indicating habitat disturbance or sward improvement was introduced to the calculation for site threat scores. The grassland plant species diversity, semi-natural grassland habitats and adjacent and internal habitats criteria were all modified slightly. Refer to Martin *et al.* (2008) for more details.

2009

- The criterion within the conservation score calculation on Annex I grassland habitats saw the introduction of primary areas of Annex I grassland, and a new criterion based on high quality indicator species was also added to the calculation. Other criteria were reviewed and modified, with maximum scores adjusted slightly. The threat scores calculation remained the same. Refer to O'Neill *et al.* (2009) for more details.

2010

- Due to changes in the Access database in 2010, grazing and encroachment were no longer routinely recorded at a site level. Due to this, the presence of encroachment and negative grazing could no longer be assessed for every site surveyed and these criteria were therefore removed from the threat scores calculation.

A4.3.6 Vegetation data analysis

Refer to Martin *et al.* (2007) for baseline methodology. As the relevé dataset grew over the lifetime of the ISGS with each successive year, the vegetation data analysis techniques evolved. Refer to the methods section in this Irish Wildlife Manual for a detailed description of both the data preparation and analysis techniques.

2008

- The statistical technique using Ellenberg indicator values was removed from the vegetation data analysis.

2009

- The statistical techniques Multi-response Permutation Procedure (MRPP) and Non-metric Multidimensional Scaling (NMS) were removed from the vegetation data analysis.

2010

- MAVIS was used to calculate mean cover-weighted Ellenberg scores for light, wetness, pH and fertility based on the British and Irish calibrations (Hill *et al.* 1999).

2011 and 2012

The use of FANNY to produce the vegetation classification is a departure from the approach taken in the analysis of the grassland dataset in some of the previous phases of the ISGS (Martin *et al.* 2007, 2008; O'Neill *et al.* 2009, 2010) where hierarchical agglomerative cluster analysis was used as advocated by Perrin *et al.* (2006). Objective testing of various algorithms, however, found FANNY to be the optimal method, at least for this data set, even without the exclusion of intermediate plots. This exclusion process has reduced significantly the amount of data used to define the final communities and as such the full dataset is not, as such, described. However, this process has abstracted from the classification the core communities. While we recognise that variation in vegetation is indeed a continuum and that these intermediates are part of this continuum, abstracting the more distinct noda should, theoretically, have produced a more informative classification which is easier for ecologists to apply in practical situations.

The VEGCLASS function from package VEGCLUST that was used to assign excluded plots to their best matching community is a great facility that could be used to numerically classify any grassland relevé to ISGS community. R and its packages are freeware and readily available on the internet at http://cran.r-project.org/. While R can be intimidating to new user, a fairly simple set of instructions could be disseminated with the necessary ISGS data files to other researchers. Classification of other grassland datasets would have the benefit of potentially filling in apparent gaps in the distribution maps.

The scope of classification is naturally limited by the scope of the dataset which have been discussed above. The main deficiency would appear to the area of upland grasslands which have been much less intensively sampled than lowland swards. Nevertheless, the upland communities defined are likely to encapsulate the majority of variation.

A4.4 Methodology critique

As seen from the "Evolution of the methodology" section, numerous changes were made to the ISGS methodology over its lifetime. Changes were made to help improve the quality of data and the efficiency of data collection and analysis. As with all surveys or projects, a pilot survey is recommended if time and budget constraints allow, in order to test the methodology. It is not surprising that the majority of gross changes to the ISGS methodology occurred in 2008 after the pilot survey, with only refinements made in later years. What follows is a critique of the ISGS methodology with the aim of further improving this methodology for future surveys. Recommendations either adopted during the ISGS, or as an outcome of reviewing the current methodology are highlighted.

A4.4.1 Mapping

The 2005 aerial photographs were utilised when producing base maps with the 2007-2012 boundaries superimposed over them. There was therefore an unavoidable bias towards the 2005 extent when selecting and mapping sites. This bias was amplified as the ISGS progressed because the boundaries became less representative of what was on the ground due to the greater time elapsed since the photographs were taken. Slight differences in features such as thickness of hedges or extent of scrub encroachment may not have been deemed to be significantly different from the base map and may

therefore not have been mapped in the field. It is expected that the majority of these changes are likely to have been smaller than the minimum mapping area. The bias towards the 2005 aerial photographs was unavoidable as they were the most recent aerial photographs available to this project. The situation will be improved with the availability of the new series of aerial photographs, but the problem will reassert itself as the time elapsed since imagery was captured increases. One way to reduce the bias would be to load all photographs onto hand-held digital mappers which superimpose the location of the surveyor on the map; this would enable surveyors to notice more readily any changes in habitat extent, such as an increase or decrease in scrub cover.

A4.4.2 Data collection and management

The term "site" was used throughout the lifetime of the ISGS. These sites were selected from aerial photographs, recommendations and various published resources. Often sites comprised land from several landowners, with different management techniques, landscape features, underlying soil, geology and geography. General site data were recorded at this "site" level so it was often possible to have both appropriate and inadequate management techniques applied within the one site, to record both lowland plain and hill/mountain for site geography, for all three typical grazers (sheep, cattle and horses) to be recorded, and so on. While these data are informative to a point, correlations between these data and grassland habitats cannot be examined as the data were not recorded at this finer level of detail. For example, it would have been much more revealing to record the type and level of encroachment and grazing regime at a relevé scale than at a site level.

Recommendation: Record data such as management, livestock, and geography at a relevé level in order to better utilise these data for any future surveys.

The ISGS switched to handheld Personal Digital Assistants (PDAs) loaded with Turboveg CE version 1.5 for recording site and relevé data from 2010 onwards. Prior to this, paper field sheets were used. While the introduction of PDAs improved time efficiency by cutting down on time spent on data entry, and reduced the amount of error that sometimes crept in when abbreviated species names were used or handwriting was misread, this digital method of recording data is not infallible. PDAs are vulnerable to battery failure and storage card errors. For these reasons paper field sheets were still carried by surveyors, fully charged spare batteries were carried and numerous backups of data to the storage card occurred throughout any one day, with a final backup to a field base computer (off-site computer) at the end of each survey day.

Recommendations: Invest in a rugged handheld computer (such as a Trimble Nomad) for the recording and storage of vegetation data in the field. Quality control of data and standard backup procedures should always be implemented when using this method of recording data.

Habitat maps of sites were drawn in the field using the colour aerial photograph(s) provided as a base map. A handheld GPS was used to accurately map habitat boundaries, particularly when they were

not visible on the aerial photograph. Mapping with a handheld GPS was accompanied by the use of waypoint recording sheets. Waypoints were backed up at the end of each week in the field. For the most part, this was a satisfactory means of mapping habitats in the field. Problems arose when areas which were surveyed had few or no landmarks to help orientate the surveyor, the site had a complicated mixture of habitats or the base map was at too small a scale for the level of mapping required.

Recommendation: Using a rugged handheld computer with integrated GNSS and compatibility with GIS mapping software makes the mapping of habitats in the field more straightforward. Aerial photographs can be uploaded, surveyor's position is visible on screen, as are any waypoints added, making it easier to keep track of areas already mapped. Waypoints are stored as point shapefiles, reducing the need to convert GPS points.

The review and reclassification of some habitats has resulted in a mismatch between the data as recorded in the Access, Turboveg and GIS datasets and that presented in the individual annual county reports from 2007 to 2010 (Devaney *et al.* 2013 and Martin *et al.* 2013 were written after the review and are therefore not impacted upon). When reading the annual county reports it is therefore important to remember that these reports reflect results as they were calculated or assessed at the time of writing.

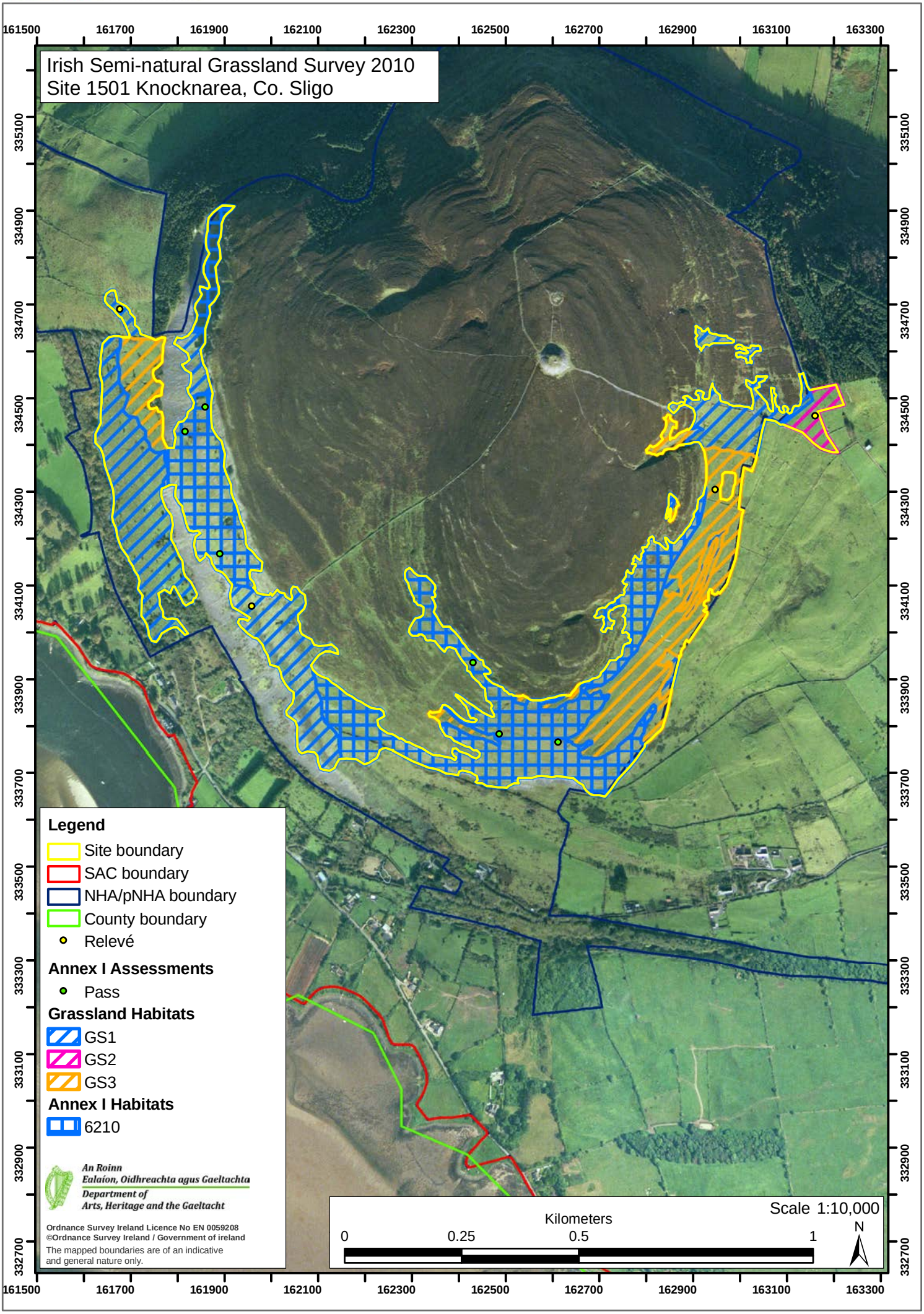
Recommendation: Only the final version of the Access database, Turboveg database and GIS shapefile from the ISGS (2007-2012) should be used for any further data analysis. Earlier versions of the databases or shapefile, and the annual county reports contain the data as it was recorded at the time. The final versions of the datasets comprise the data after a final round of in-depth data screening, checks, standardisation, changes and updates.

Appendix 5: High Nature Value vascular plant species used to assess the conservation value of lowland grasslands

When assessing the HNV status of grasslands, in addition to the species listed below the rare and threatened species listed in Curtis and McGough (1988) can also be utilised. Also in a more upland setting, grassland species such as *Agrostis canina* should be included. Species that are indicative of more herb-rich swamp habitats such as *Epilobium hirsutum* and *Lythrum salicaria* were not included as they can sometimes indicate rank or abandoned grassland If assessing the HNV status of such habitats the list of positive indicator species for the Annex I habitat 6430 (Appendix 1) should be included. Finally, all bryophyte and lichen species recorded within lowland grasslands can indicate HNV habitat.

Vascular plant species	Vascular plant species	Vascular plant species	Vascular plant species
Achillea ptarmica	*Cirsium dissectum*	*Juncus articulatus*	*Pimpinella major*
Agrostis capillaris	*Coeloglossum viride*	*Juncus conglomeratus*	*Plantago lanceolata*
Alchemilla glabra	*Conopodium majus*	*Knautia arvensis*	*Platanthera bifolia*
Alopecurus pratensis	*Crepis capillaris*	*Koeleria macrantha*	*Platanthera chlorantha*
Anacamptis pyramidalis	*Crepis paludosa*	*Lathyrus linifolius*	*Polygala serpyllifolia*
Antennaria dioica	*Dactylorhiza fuchsii*	*Lathyrus palustris*	*Potentilla anglica*
Anthoxanthum odoratum	*Dactylorhiza maculata*	*Lathyrus pratensis*	*Potentilla erecta*
Anthyllis vulneraria	*Danthonia decumbens*	*Leontodon autumnalis*	*Potentilla palustris*
Arabis hirsuta	*Daucus carota*	*Leontodon hispidus*	*Primula veris*
Asperula cynanchica	*Epipactis palustris*	*Leontodon saxatilis*	*Primula vulgaris*
Blackstonia perfoliata	*Equisetum palustre*	*Leucanthemum vulgare*	*Prunella vulgaris*
Brachypodium pinnatum	*Euphrasia* spp.	*Linum catharticum*	*Pseudorchis albida*
Briza media	*Festuca ovina*	*Listera ovata*	*Ranunculus acris*
Bromopsis erecta	*Filipendula ulmaria*	*Lotus corniculatus*	*Ranunculus bulbosus*
Bromus racemosus	*Filipendula vulgaris*	*Lotus pedunculatus*	*Ranunculus flammula*
Caltha palustris	*Galium palustre*	*Luzula campestris*	*Rhinanthus minor*
Campanula rotundifolia	*Galium saxatile*	*Luzula multiflora*	*Sanguisorba minor*
Carex binervis	*Galium uliginosum*	*Lychnis flos-cuculi*	*Sanguisorba officinalis*
Carex caryophyllea	*Galium verum*	*Lysimachia nemorum*	*Sesleria caerulea*
Carex echinata	*Gentiana verna*	*Mentha aquatica*	*Succisa pratensis*
Carex flacca	*Gentianella amarella*	*Molinia caerulea*	*Thymus polytrichus*
Carex nigra	*Gentianella campestris*	*Nardus stricta*	*Tragopogon pratensis*
Carex panicea	*Geranium sanguineum*	*Neotinea maculata*	*Trifolium pratense*
Carex pilulifera	*Gymnadenia conopsea*	*Ophioglossum vulgatum*	*Trisetum flavescens*
Carex pulicaris	*Helictotrichon pubescens*	*Ophrys apifera*	*Veronica officinalis*
Carex viridula	*Heracleum sphondylium*	*Ophrys insectifera*	*Vicia cracca*
Carlina vulgaris	*Hordeum secalinum*	*Orchis mascula*	*Viola canina*
Carum verticillatum	*Hydrocotyle vulgaris*	*Orchis morio*	*Viola palustris*
Centaurea nigra	*Hypochaeris radicata*	*Origanum vulgare*	*Viola persicifolia*
Centaurea scabiosa	*Juncus acutiflorus*	*Pilosella officinarum*	*Viola riviniana*

Appendix 6: Example of an ISGS habitat map



Aerial photo - 2005. Map size - A4