ENVIRONMENTALLY SENSITIVE AREAS IN NORTHERN IRELAND

BIOLOGICAL MONITORING REPORT

Year two 1994

Monitoring Team

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SUMMARY

1.   Northern Ireland has five Environmentally Sensitive Areas, covering 20% of the agricultural land of the province. In October 1992, a long-term monitoring programme was established by the Department of Agriculture for Northern Ireland (DANI). The aim of the monitoring programme is to evaluate the impact of designation of Environmentally Sensitive Areas on biological components of the environment and their management and impact on the landscape. Initial baseline monitoring has provided descriptions of species communities within the ESAs' habitats which are targeted for protection. Prior to this, little or no detailed information on many of these plant or invertebrate communities existed for NI.

2.   Woodlands are a widely recognised wildlife resource, particularly in the Antrim Coast, Glens and Rathlin ESA. A woodland monitoring programme was undertaken in the West Fermanagh and Erne Lakeland ESA in 1993 and extended to the Antrim Coast, Glens and Rathlin ESA in May 1994. This involved recording plant, ground beetle and spider species, and site management information.

3.   Heathlands are increasingly under threat due to peat-cutting, over-grazing and land reclamation. Heather moorland is the target habitat in the Sperrins and Slieve Gullion ESAs, which were designated in April 1994. Heather baseline monitoring was initiated in these ESAs in July 1994, recording plant, ground beetle and spider species and relevant site information.

4.   Hazel scrub was dominant in the Antrim Coast, Glens and Rathlin ESA, with blackthorn thickets more common in the West Fermanagh and Erne Lakeland ESA- Rowan *(Sorbus aucuparia),* sycamore *(Acer pseudoplatanus),* willow *(Salix* spp.) and bracken *(Pteridium aquilinum)* were more common in the Antrim Coast, Glens and Rathlin ESA.

5.   The majority of the West Fermanagh and Erne Lakeland ESA monitored woods were grazed (90%), compared with only 36% of the Antrim Coast, Glens and Rathlin ESA woods. Woods which showed no evidence of recent grazing had more tree regeneration than grazed woods, with the exception of birch *(Betula* spp.) and holly *(Ilex aquifolium).* Younger stands of trees were present in the West Fermanagh and Erne Lakeland ESA woods than in the Antrim Coast, Glens and Rathlin ESA woods.

6.   The most common species in the Antrim Coast, Glens and Rathlin ESA woods were sycamore, hawthorn *(Crataegus monogyna),* ash *(Fraxinus excelsior),* bramble *(Rubus fruticosus* agg.), wood anemone *(Anemone nemorosa),* herb robert *(Geranium robertianum),* bluebell *(Hyacinthoides non-*

scripta), wood sorrel *(Oxalis acetosella),* primrose *(Primula vulgaris),* lesser celandine *(Ranunculus ficaria),* common dog violet *(Viola riviniana)* and bracken.

7.   The Antrim Coast, Glens and Rathlin ESA woods were classified into four major vegetation types using TWINSPAN. The two dominant woodland types were primarily hazel scrub, with the type assigned the descriptive name 'mixed species wet scrub', the most common, and with the highest plant species diversity. The other hazel scrub type 'mixed species scrub' were more associated with upland regions, characterised by the presence of rowan. The 'overgrown woodland' type was dominated by bracken and brambles, while the species-poor woodlands were characterised by competitive-ruderal grass species.

8.   There was little evidence of any recent woodland management. The introduction of the ESA scheme will implement specific farm woodland management plans, therefore helping conserve this important and neglected wildlife resource.

9.   Heather monitoring has now been carried Out on all Northern Irelands' ESAs. Rathlin Island ESA heather sites had the greatest species diversity, with significantly more plant and ground beetle species per site than in any other ESA.

10.   Sheep grazing is dominant on most heathland in ESAs, except in the West Fermanagh and Erne Lakeland ESA and Rathlin Island, where cattle are more common. Grazing was least prevalent in the Slieve Gullion ESA. Evidence of burning as a form of heather management was only present on one monitored site in the Sperrins ESA. Peat cuffing was most common in the Sperrins ESA.

11.   Four major heather vegetation types were recognised from TWINSPAN, with over half (60%) of monitored heather sites classified as wet heath, with the indicator species cross-leaved heath *(Erica tetralix).* This group was subdivided into two types, characterised as typical wet heath and grassy wet heath with bilberry. Dry heath with the indicator species bell heather *(Erica cinerea)* accounted for 40% of monitored sites, with the two main types, typical dry heath and grassy dry heath with bilberry.

12.   Typical wet heath, with bog cotton *(Eriophorum* spp.), bog asphodel *(Narthecium ossifragium)* and deer grass *(Scirpus cespitosus)* was the most common type, representing the majority of sites from the Sperrins, Antrim Coast and Glens and the West Fermanagh and Erne Lakeland ESAs. The smallest plant and invertebrate species diversity was recorded in these sites. The grassy wet heath type with

bilberry *(Vaccinium myrtillus)* and sweet vernal grass *(Anthoxanthum odoratum)* was most common in the Sperrins ESA and the West Fermanagh and Erne Lakeland ESA.

13.   The typical dry heath type characterised by presence of gorse *(Ulex europaeus)* and tormentil *(Potentilla erecta)* described the majority of the Mournes and Slieve Croob ESA, and half of Rathlin and Slieve Gullion monitored heather sites. Grassy dry heath with bilberry and sweet vernal grass accounted for 21% of heather sites and had the highest species diversity of plant and ground beetles.

14.   The Sperrins and Slieve Gullion ESAs are primarily heather regions. To enable more detailed analyses of change over time, separate, more detailed classifications of their vegetation were performed.

15.   The classification of the ground beetle species identified from heather sites throughout NI ESAs revealed five distinct groups, with particular habitat associations.

16.   Two ground beetle species of particular note are *Carabus nitens* and *Cymindis vaporariorum.* *C. nitens* is in decline throughout Ireland, however has been found in the West Fermanagh and Erne Lakeland, Antrim Coast and Glens and in the Sperrins ESAs, on wet heath sites. The small ground beetle species *Cymindis vaporariorum* was found only on one site on Rathlin Island. This species is restricted to coastal areas within Ireland and may prove an indicator species for dry, submontane heath habitats.

17.   The introduction of the ESA scheme has highlighted the need to protect internationally important habitats. The key to such protection lies in the adoption of successful management programmes, such as those implemented by the ESA scheme. The baseline heather monitoring programme highlights the importance of plant and invertebrate communities. No active heather management existed on the majority of farms monitored. This stresses the importance of the ESA scheme, where on joining a heather regeneration plan will be drawn up and will involve controlled burning or flailing where appropriate.

18.   In 1995 monitoring will concentrate on landscape features with some biological resampling.

CONTENTS

1.0.   INTRODUCTION

The Environmentally Sensitive Areas Scheme was introduced by the Department of Agriculture for Northern Ireland (DANI) "to help safeguard areas of the countryside where the landscape, wildlife or historic interest is of particular importance and where that interest would benefit through farmers continuing with, or engaging in, environmentally sensitive farming practices" (DANI 1994).

Northern Ireland has five Environmentally Sensitive Areas, covering 20% of the agricultural land area of the province (Figure 1). The Mournes and Slieve Croob ESA (29,000 hectares), renowned for its outstanding landscape typified by small fields bounded by stone walls and hedges, was first designated in May 1988 and extended in 1993. The Glens of Antrim, with its traditional farming landscape, including "ladder field patterns" and semi-natural woodland, was designated in July 1989, extended and renamed the Antrim Coast, Glens and Rathlin in 1993 (34,600ha). The West Fermanagh and Erne Lakeland ESA (57,400ha), which includes a wide variety of semi-natural habitats (for example, hay meadows, wet pastures and limestone grasslands) was designated in 1993. In April 1994, the Sperrins ESA (87,000ha), and Slieve Gullion ESA (13,800ha), two areas of extensive heather moorland, were launched.

In October 1992, a detailed long-term monitoring programme was established by the Department of Agriculture in Northern Ireland, to evaluate the impact of designation of Environmentally Sensitive Areas. The initial aim of the monitoring programme was to provide baseline data on the wildlife value of a range of sites from target habitats within the ESA boundary. If this data was obtained from participating and not participating farms, it could be used to subsequently assess biological change. It was decided to record plant, bird, ground beetle and spider species. Beetles and spiders were chosen as these groups have been shown to respond more quickly to changes in their environment than plant species, but do not themselves represent the main constituent of the habitat and therefore can only supplement flora recording.

During 1993 the monitoring programme was established in the West Fermanagh and Erne Lakeland ESA. Details of the 1993 ESA biological monitoring and a summary of the baseline

data on plant, bird, ground beetle and spider species, prior to the impact of ESA management prescriptions, are given in the Environmentally Sensitive Areas in Northern Ireland, Biological Monitoring Report Year One - 1993.

Heathlands, which are dominated by *Calluna vulgaris,* are a non-natural ecosystem maintained by fire and low intensity grazing management and are located along the western seaboard of Europe. Over a period of approximately 30 years most plants undergo a cyclical succession as the heather plant passes through four definable growth-phases. Although botanical diversity tends to be low in heathlands (2.2 - 4.5% of the British flora), the diversity of some invertebrate groups is high (15.3% and 20.4% of the recorded British ground beetle and spider fauna respectively; Usher 1992).

Heather baseline monitoring in the Sperrins and Slieve Gullion was initiated in July 1994. This has resulted in establishment of Heather monitoring sites throughout all of Northern Ireland's ESAs. An ESA demonstration farm unit is to be established at the Department of Agriculture Hill Farm at Glenwherry, Co. Antrim, and has been incorporated into the heather monitoring programme.

Semi-natural woodlands are often found in close association with escarpments and form an important constituent of the Antrim Coast, Glens and Rathlin ESA landscape. The dominant tree is usually hazel (Cooper 1984). Most woods in Co. Antrim are small and fragmented, as Graham (1981), found that 86% of privately owned woods were less than 5ha. Woodlands have been recognised as a valuable wildlife resource, and are one of the habitats monitored within the West Fermanagh and Erne Lakeland ESA. A woodland monitoring programme was extended to the Antrim Coast, Glens and Rathlin ESA in May 1994.

In addition, a random selection of Wet grasslands and Hay meadows which were originally surveyed in 1992, as part of a pilot monitoring survey in the West Fermanagh and Erne Lakeland ESA were resurveyed in June 1994.
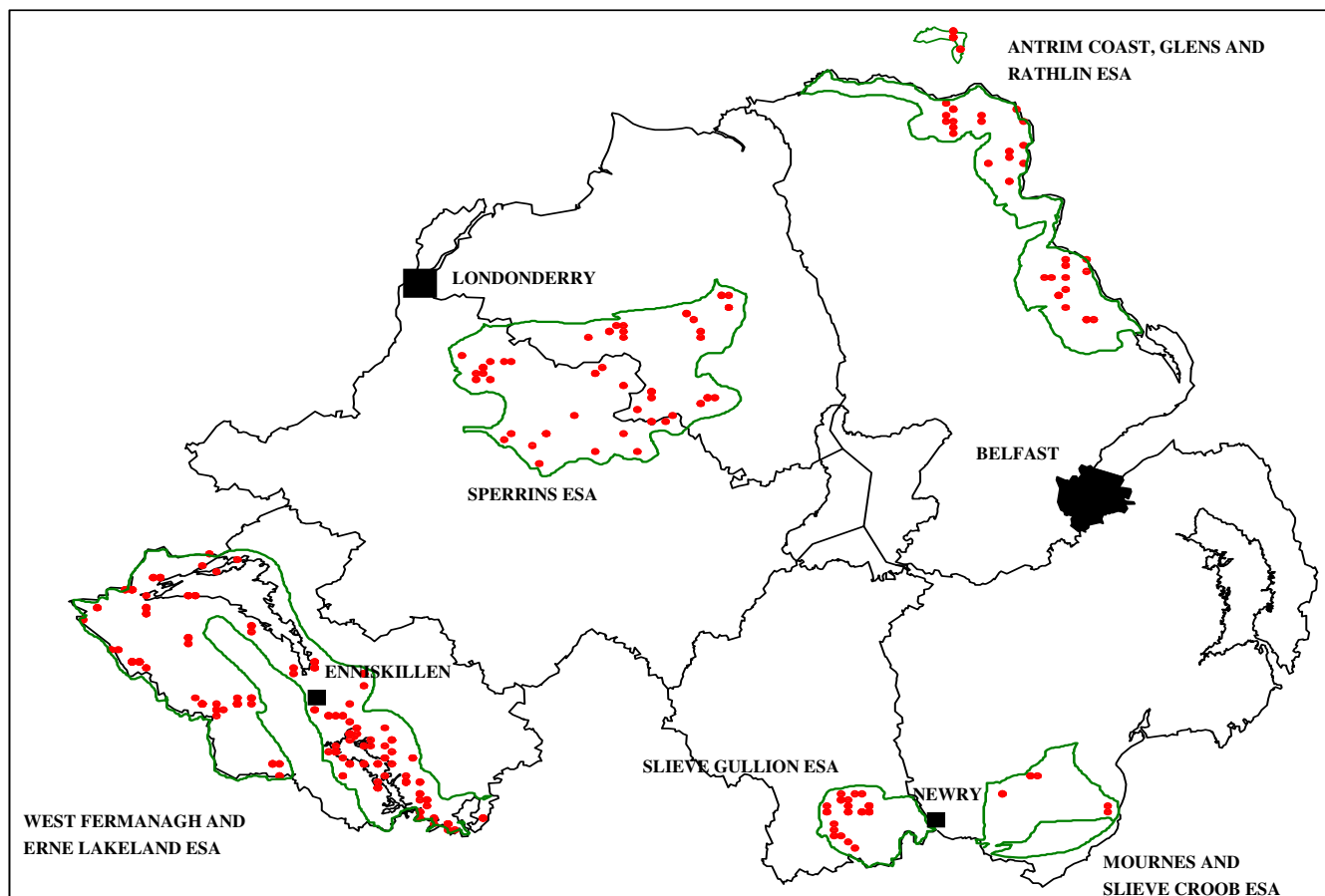
Figure 1. Map of Environmentally Sensitive Areas in Northern Ireland showing location of biological monitoring sites (1993 and 1994)

2.0.   METHODOLOGY

2.1. Field sampling programme

The sampling programme adopted in Year One (1993) of the ESA monitoring programme was used to select all 1994 monitoring sites. Within each respective ESA, DANI Group Staff, prepared lists of farmers who were likely to participate in the scheme, and those unlikely to join. Farms to be monitored were randomly selected from these lists. Grid references of habitat sites monitored are listed in Appendix 1.

2.1.1. Habitat types

Heather monitoring within the Sperrins ESA, and Slieve Gullion ESA constituted the majority of the 1994 monitoring programme. Rathlin ESA was also monitored, independently of the Antrim Coast and Glens, as it is an island and it already has been noted for harbouring rare plant and invertebrate species. Results for the Rathlin ESA heather sites were therefore treated as an individual ESA, separate from the Antrim Coast and Glens. Woodland monitoring was undertaken in the Antrim Coast, Glens and Rathlin ESA. All habitat types monitored, and the number of plant, invertebrate sites and monitoring dates are given in Table 1.

Table 1. The number of plant and invertebrate sites monitored in target habitats in 1994.

ESA	Habitat	Monitoring date- 1994	Number of plant sites	Number of invertebrate sites
Antrim Coast & Glens	Woodland	May	28	14
Rathlin	Heather	June	8	4
West Fermanagh & Erne Lakeland (resurvey)	Hay meadow	June	6	4
" "	Wet grasslands	June	9	2
West Fermanagh & Erne Lakeland - Cuilcagh	Heather	August	4	-
	Limestone grassland	August	2	-
Slieve Gullion	Heather	July	31	19
Sperrins	Heather	August	55	42
Department of Agriculture NI Glenwherry Hill Farm (ESA demonstration unit)	Heather	September	15	-

2.2. Biological Monitoring

2.2.1. Botanical Monitoring

Plant nomenclature follows Clapham, Tutin and Warburg (1987), mosses and liverworts follow Watson (1981). The monitoring techniques used are listed below.

<u>Woodlands</u>: The method used broadly follows that adopted by the ITE (Bunce 1982). A standardised quadrat size of 14 x 14m, consisting of three nested quadrats ($14m^2$, $7m^2$ $2m^2$) was used. Plant species (including ferns, mosses and lichens) and their percentage cover were recorded in the $2m^2$ quadrat. Additional species were noted in the outer quadrats. Girths of trees and shrubs (at 1.2m) were recorded, together with general site information, for example, grazing and woodland management.

<u>Heather</u>: A 60m linear transect was marked by a randomly placed 1m metal stake. Four permanent quadrats were located every 15m. Metal tubes (2.5cm x 15cm) were used as permanent quadrat markers and these were firmly placed below ground level. These quadrats will be relocated using a metal detector. A detailed list of plant species and their percentage cover was recorded from a nested 1 x 1m quadrat. Any additional species were recorded in the outer 2 x 2m quadrat. Grazing by animals was recorded, together with the average mean height of heather within the 1x1m quadrat.

2.2.2. Invertebrate monitoring

During three, four week periods between April and October 1994 ground beetles and spiders were sampled at a sub-sample of plant sites as detailed in Table 1. A stratified random sample of hay meadows and wet pastures, from each major vegetation type (for example species-rich meadows) were re-sampled to compare annual fluctuations in species numbers.

At each site five pitfall traps (polythene containers 9cm wide and 20cm deep) were part filled with ethylene glycol to prevent the escape and deterioration of specimens before collection. Traps were placed 2m apart in a line through the centre of each site. At the end of each sampling period traps were emptied and removed. At the beginning of the next sampling period traps were replaced and refilled with a fresh ethylene glycol solution. The contents from all 5 traps were pooled for each sampling site and frozen at -5^oC until sorting.

All adult ground beetles taken in the traps were identified to species using Lindroth (1974). Species identifications were confirmed by Dr. Roy Anderson, (Agriculture and Environmental Research Division, Department of Agriculture for Northern Ireland).

2.2.3. Bird monitoring

Bird monitoring continued in the West Fermanagh and Erne Lakeland ESA, consisting of three monitoring dates, February, June and December. Details of methodology are given in the Biological monitoring report, Year One, (1994).

2.2.4. Soil sampling

Two soil samples were taken along each monitored transect. Soil was taken from outside the quadrat using a soil auger core (15cm deep x 3 cm diameter). The samples were placed in polythene bags, labelled, sealed and kept cool until they were returned to the laboratory and air-dried at room temperature. Once dried, the samples were dry-sieved through a 2mm sieve. Soil chemical analyses, pH, available phosphorus, exchangeable potassium and magnesium were determined according to Allen, Grimshaw and Roland (1986). The percentage total organic matter and moisture content were recorded for the Heather soil samples from the Sperrins, Slieve Gullion and Rathlin ESAs.

2.3. Data Analyses

All plant and invertebrate data were stored on Recorder database package. TWINSPAN (Hill, 1979) was used to describe the habitats in terms of their major vegetation types and species groups. TABLEFIT (Hill 1993), was performed on all habitat sites to assign each site, objectively to a National Vegetation Classification (NVC) type (Rodwell 1991ab) with a goodness of fit value. The C-S-R plant strategy theory (Grime, Hodgson & Hunt 1988) was applied to plant species. One-way ANOVA and t-tests were performed using the statistical package SPSS. These methods helped to describe the plant composition of sites, compare vegetation types and may help indicate changes in the long term monitoring programme.

3.0. RESULTS

3.1. WOODLANDS

3.1.1. Habitat Descriptions

The habitat variables recorded from the West Fermanagh and Erne Lakeland ESA and the Antrim Coast, Glens and Rathlin ESA Woodlands are listed in Table 2. Blackthorn thickets were more common in the West Fermanagh and Erne Lakeland ESA, with hazel scrub more dominant in the Antrim Coast and Glens ESA. Bramble was common in woods in both ESAs, with wild herb clumps and bracken being more common in the Antrim Coast and Glens ESA.

A small percentage of woods in both ESAs showed evidence of past management, usually coppicing for firewood. The majority of woods monitored in the West Fermanagh and Erne Lakeland ESA (90%) were grazed. Only 36% of the Antrim Coast, Glens and Rathlin ESA woods showing evidence of current grazing. Tree and shrub regeneration in woodlands was more common in the West Fermanagh and Erne Lakeland woods.

3.1.2. Tree girth

The girth distribution for the common tree and shrub species found in the West Fermanagh and Erne Lakeland ESA and the Antrim Coast and Glens ESA are illustrated in Appendix 2a and 2b. More young alder, blackthorn, hawthorn and holly trees (girth class:1-10cm) were present in the West Fermanagh and Erne Lakeland ESA than in the Antrim Coast, Glens and Rathlin ESA. Generally tree and shrub species in Fermanagh ESA had smaller mean girth values than in the Antrim ESA (Table 3). This may indicate that the West Fermanagh and Erne Lakeland woods comprise of younger stands of trees, or simply reflect different growing conditions. Trees such as rowan, sycamore and willow were more common in the Antrim Coast, Glens and Rathlin ESA.

The effect of grazing on tree regeneration in the Antrim Coast, Glens and Rathlin ESA was investigated by comparing the girth distribution of the common trees, Figure 2. Woods which showed no evidence of grazing had more trees present in the smallest girth classes (1-10cm),

indicating higher regeneration rates for all the common tree species, with the exception of birch and holly.

Table 2 Habitat variables of Woodlands monitored in the West Fermanagh and Erne Lakeland ESA and the Antrim Coast, Glens and Rathlin ESA.

Habitat variable	% of Woods monitored in each ESA	
	West Fermanagh and Erne Lakeland ESA (n=20)	Antrim Coast, Glens and Rathlin ESA (n=28)
General wood description		
Blackthorn thicket	20	11
Hazel scrub	20	32
Mixed scrub	10	21
Mature wood	25	25
Alder wood	25	4
New wood	-	7
Ground cover		
Bramble clump	20	21
Nettle	-	4
Wild herb clump	25	50
Umbelifer clump	5	4
Bracken	-	36
Moss bank	30	7
Fern bank	-	4
Grass bank	-	14
Management features		
Coppiced	25	4
Single tree coppiced	5	18
Old stumps	10	11
Grazed wood	90	36
Mean area	0.85(0.13) ha	0.95 (0.18) ha
Tree and shrub regeneration		
Alder	25	7
Ash	40	29
Beech	5	14
Birch	10	-
Blackthorn	10	4
Hawthorn	15	11
Hazel	20	11
Holly	40	14
Oak	5	4
Horse Chestnut	5	-
Sycamore	5	21
Willow	5	11
Rowan	7	-
Fallen branches	55	54
Fallen uprooted	25	21
Log rotten	20	4
Fallen branch >10cm	10	29
Stumps >10cm	15	7
Bryophytes base of trees	30	64

Habitat variable	% of Woods monitored in each ESA	
	West Fermanagh and Erne Lakeland ESA (n=20)	Antrim Coast, Glens and Rathlin ESA (n=28)
Bryophytes on trunk	60	57
Bryophytes on branch	15	25
Lichens on trunk	25	11
Lichen on branch	25	11
Ferns	5	4
Ivy	50	7
Macrofungi	-	4
Stones <5cm	-	4
Rocks 5-50cm	30	39
Boulders >50	15	32
Rock ledge	-	4
Bryophyte on rock	-	4
Pond <1m	5	-
Pond >20m	35	-
Stream/river slow	5	7
Stream/river fast	10	39
Aquatic vegetation	-	4
Spring	-	14
Glade <12m	30	46
Glade >12m	10	-
Path <5m	15	14
Track	30	-
Dry stone wall	-	14
Ruined wall	-	4
Embankment	-	4
Hedge	10	-
Rubbish	10	18
Fence	-	46
Animals		
Birds	75	61
Sheep	5	21
Cattle	50	4
Horse	10	-
Rabbit	10	7
Badger	-	7
Squirrel	-	4
Goats	5	-

Table 3. The Mean girth of tree and shrub species found in the West Fermanagh and Erne Lakeland ESA and the Antrim Coast, Glens and Rathlin ESA woodlands (14m x 14m quadrats)

	West Fermanagh and Erne Lakeland ESA Woods		Antrim Coast, Glens and Rathlin ESA Woods	
Tree / shrub species	**Mean girth** (cm) (±se)	Number of trees	**Mean girth** (cm) (±se)	Number of trees
Alder	**18** (0.7)	391	**38** (2.8)	108
Ash	**31** (2.9)	151	**28** (3.2)	127
Beech	**26** (6.1)	25	**59** (5.1)	93
Birch	**23** (2.3)	77	**50** (4.6)	48
Blackthorn	**8** (0.7)	62	**10** (1.4)	28
Crab Apple	**23** (0.0)	1	-	-
Dog Rose	**6** (0.8)	5	**9** (0.9)	5
Elder	**24** (0.0)	1	**12** (0.0)	1
Elm	**102** (0.0)	1	**18** (6.0)	9
Fuschia	-	-	**6** (1.5)	2
Hawthorn	**22** (1.6)	114	**25** (2.3)	51
Hazel	**21** (0.9)	221	**21** (0.5)	504
Horse Chestnut	**196** (28.8)	4	-	-
Larch	**82** (17.5)	6	**99** (15.1)	7
Laurel	**3** (0.6)	6	-	-
Lime	**39** (19.1)	4	-	-
Norway Spruce	-	-	**22** (13.4)	13
Oak	**18** (2.4)	42	**69** (9.3)	33
Popular	-	-	**4** (0.0)	1
Rowan	**8** (6.6)	2	**31** (4.9)	30
Scots Pine	-	-	**151** (0.0)	1
Sycamore	**26** (21.1)	9	**72** (7.3)	70
Wild Cherry	**26** (4.5)	2	**3** (0.3)	4
Wild Currant	-	-	**9** (0.0)	1
Willow	**21** (2.9)	60	**36** (2.9)	89
Yew	**7** (2.5)	2	-	-

Figure 2. Comparison of the girth distribution for the common tree species found in grazed woods and woods where no grazing has occurred, in the Antrim Coast, Glens and Rathlin ESA. (NG= woods not grazed; G= grazed woods)

ALDER

ASH
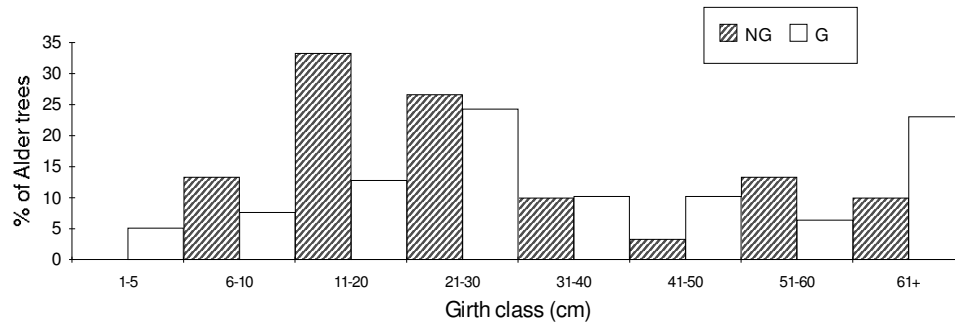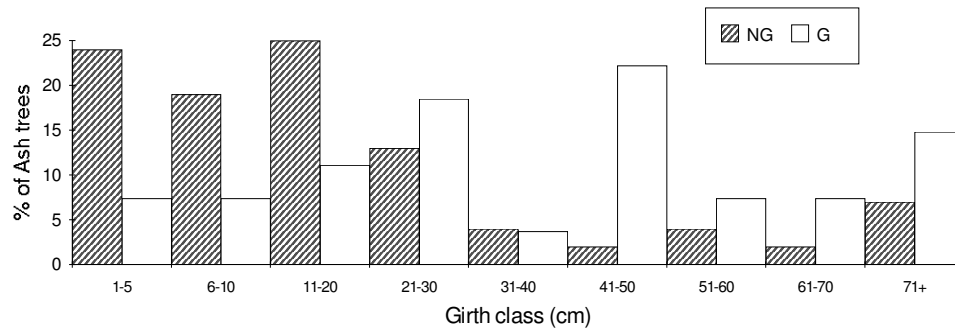
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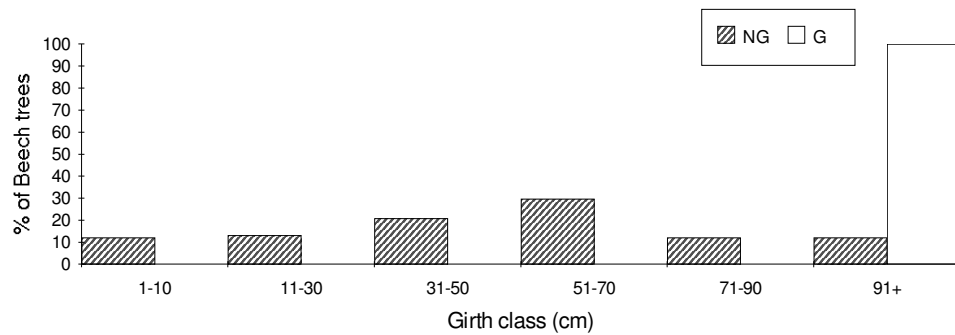
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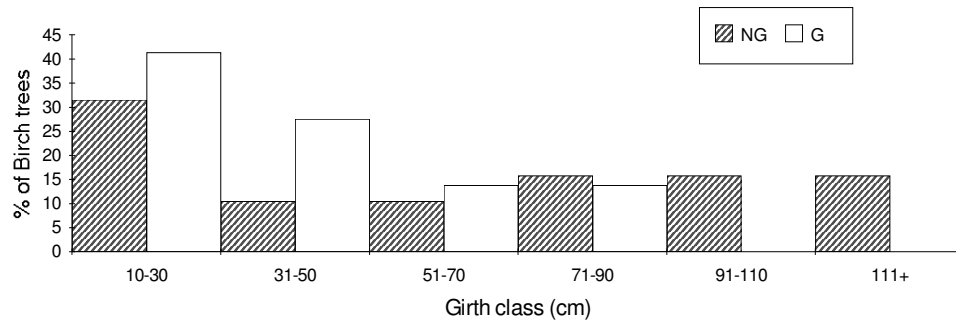
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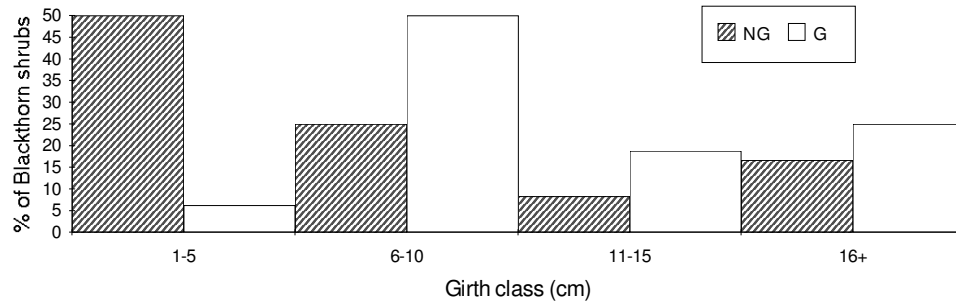
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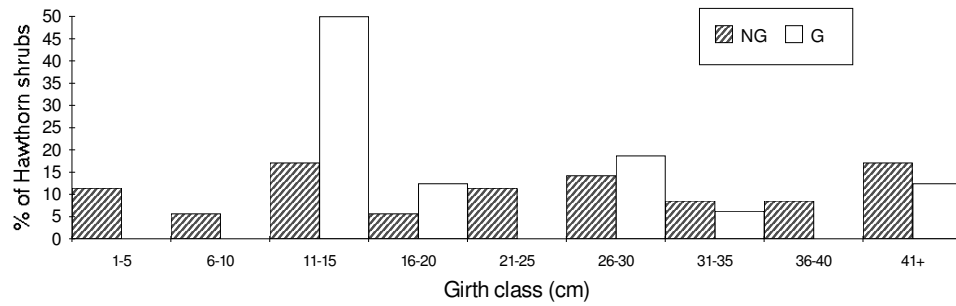
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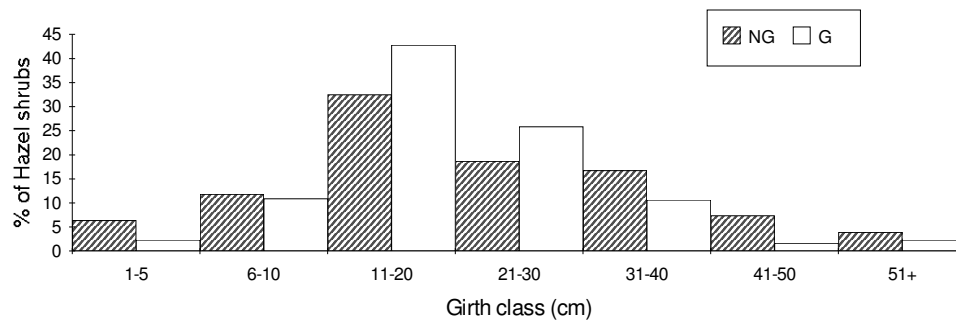
HOLLY

OAK
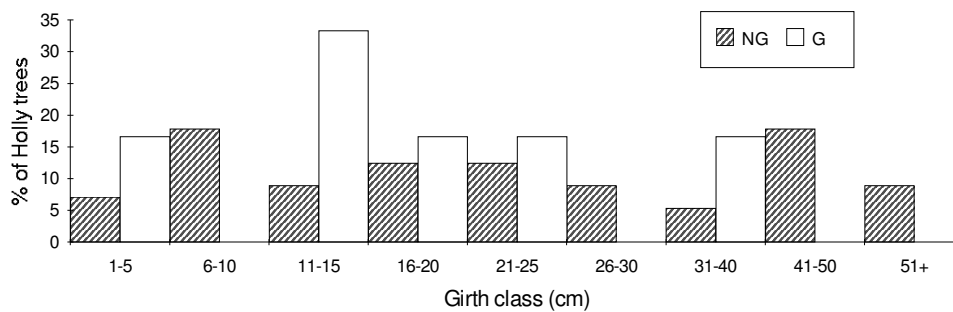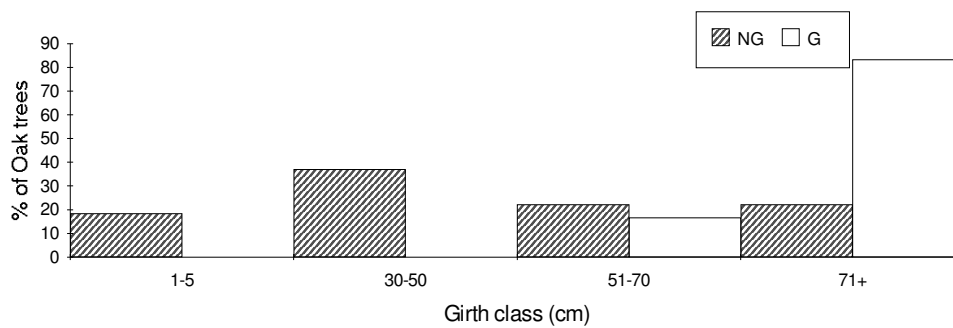
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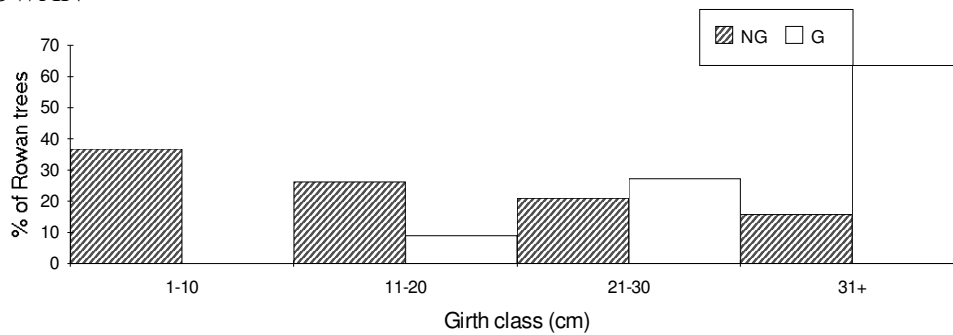
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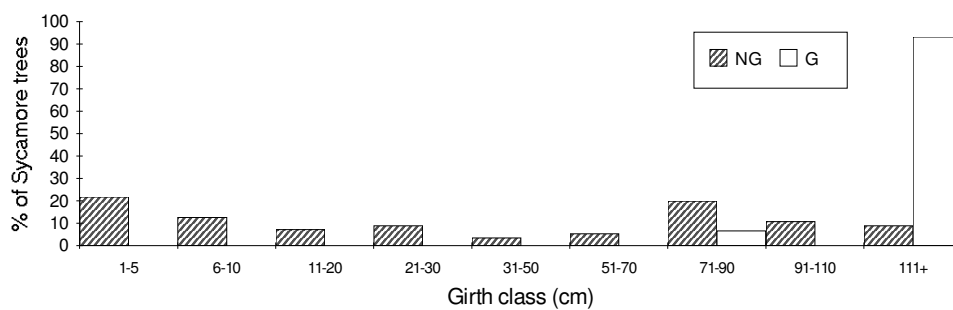
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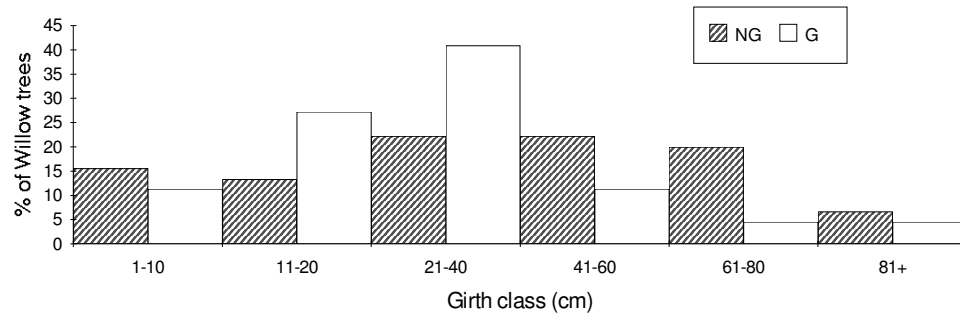
3.1.3. Common plant species of the Antrim Coast, Glens and Rathlin ESA woodlands

The West Fermanagh and Erne Lakeland ESA woodlands results were presented in the Biological Monitoring Report Year One 1994. A list of all 225 species (plants, ferns, mosses, lichens, liverworts) recorded from 28 woodland sites in the Antrim Coast, Glens and Rathlin ESA (14m X14 m quadrats) are given in Appendix 3.

A total of 24 tree and shrub species were recorded, with sycamore (*Acer pseudoplatanus*), hawthorn (*Crataegus monogyna*), ash (*Fraxinus excelsior*) and bramble (*Rubus fruticosus* agg.) present in more than 65% of monitored woods. Wood anemone (*Anemone nemorosa*), herb robert (*Geranium robertianum*), bluebell (*Hyacinthoides non-scripta*), wood sorrel (*Oxalis acetosella*), primrose (*Primula vulgaris*), lesser celandine (*Ranunculus ficaria*), common dog violet (*Viola riviniana*) and bracken (*Pteridium aquilinum*) were the common plant species, found in more than 65% of monitored woods.

3.1.4: Classification of Woodlands

3.1.4.1. National Vegetation Classification - NVC types

Each monitored woodland was issued a specific NVC type using the computer programme TABLEFIT. However all woodlands had goodness of fit values of less than 50, indicating that they should not be assigned to any NVC type.

3.1.4.2. TWINSPAN Woodland Vegetation groups

Peterken (1981) suggests that due to the structural complexity of woods, there is justification for separate independent classifications for the tree and shrub layer and the field layer (ground flora). However for general purpose woodland classifications, such as performed by NVC and ITE (Merkwood), these layers have been combined. TWINSPAN was used to describe the Antrim ESA woodlands, by identifying major representative vegetation types and species groups. Three woodland classifications were performed as detailed below

I   Tree and shrub species in each 14m x14m quadrat (presence/absence)

II.   Ground plant cover in each 2m X 2m quadrat (percentage cover)

III.   All plant species in each 14 x 14m quadrat (Tree/shrub & ground cover: presence/absence).

The woodland classification of the combined woodland layers is the most important, in this context to provide a general broad classification, baseline description of woodlands in the Antrim Coast, Glens and Rathlin ESA. The other independent classifications are listed in Appendix 4, and may prove useful in determining long-term changes in woodland flora. Four major groups of tree and shrub vegetation were recognised (Appendix 4a). Three major ground flora groups were identified (Appendix 4b), with 50% of monitored woods described as having an 'overgrown' field layer flora, dominated by bracken and brambles.

Woodland vegetation groups: (combined layers tree/shrub/ground flora)**:**

Detailed dendrograms of TWINSPAN are given in Appendix 5. The TWINSPAN indicator species are listed and common species are those which occur in more than 88% of group sites. A frequency table of the TWINSPAN classification is given in Table 4. The plant species in Table 4 are arranged in species groups (A-H) and these groups contain species which are commonly found together in the monitored woodlands. Each vegetation group is given a descriptive name and the common tree species found in that group are listed, with the percentage of woods in which they occur.

There were significant differences in woodland types in the mean number of plant species per site for 2x2m and 14x14m quadrats ($p<0.0001$; Table 5) and in soil pH ($p<0.05$; Table 5) and phosphorus ($p<0.001$). Comparisons of the girth distribution of the common tree species between the four woodland vegetation groups is given in Appendix 6. There was no significant difference in the mean number of ground beetle species per site.

Group 1: (n=5; 18%) **Overgrown woodland** (60% Hazel, Hawthorn, Holly, Beech, Sycamore)

The indicator species was bracken (*Pteridium aquilinum*), with bramble (*Rubus fruticosus*) ubiquitous to all sites. Other common species were ivy (*Hedera helix*) and lesser celandine (*Ranunculus ficaria).* Group 1 woods' species were restricted to species groups D, E and F, which contains species indicative of ancient woodland, and species which are tolerant of shady conditions. Species groups G and H, which contain species indicative of more fertile

soils were also represented, to a lesser extent. A total of 65 species were recorded from these woodland sites and had the second lowest mean number of plant species per 14x14m (28 ±1.6).

More hazel regeneration occurs in group 1 than in any other vegetation group, with 21% of hazels having a girth width of less than 5cm.

Group 2: (n=13; 46%) **Mixed species wet scrub** (92% Willow; 85% Hazel; 77% Ash)

Groups 2 and 3 can be described as hazel scrub types, as hazel was the dominant tree species in the tree and shrub layer (Appendix 5). Herb bennett (*Geum urbanum*), bugle (*Ajuga reptans*) and cleaver (*Galium aparine*) were the indicator species of Group 2 woods. The other common species were primrose (*Primula vulgaris*), rough stalked meadow grass (*Poa trivialis*), bracken (*Pteridium aquilinum*), common dog violet (*Viola riviniana*), meadow-sweet (*Filipendula ulmaria*), yellow pimpernel (*Lysimachia nemorum*), and bramble *(Rubus fruticosus).*

Group 2 and Group 3 woods contain a broad range of plant species. Species groups A and B, which contain plants indicative of wet conditions, such as willow (*Salix* spp.), floating sweet grass (*Glyceria fluitans*) and alder (*Alnus glutinosa*) were most prevalent in Group 2 woods. Species group E, which is indicative of shady overgrown conditions is also most common in these woods. Group 2 woods, together with Group 3 woods contain high frequencies of species groups D and F. These are characteristic woodland species, which include species with the C-S-R stress-tolerator strategy, which are sensitive to any small changes in their environment (characteristic of high stress and low disturbance), for example primrose and wood anemone (Table 4). This woodland group had the highest mean number of plant species (58 ±2.7) and a total of 187 species were identified from these woods.

Woods in this group had a significantly higher mean soil pH than Group 3 woods ($p<0.05$),Table 5.

Group 3: (n=8; 29%) **Mixed species scrub** (88% Hazel; 63% Ash; 63% Rowan; 50% Birch; 50% Oak)

The most common species were yorkshire fog (*Holcus lanatus*), yellow pimpernel (*Lysimachia nemorum*), bluebell (*Hyacinthoides non-scripta*), bracken (*Pteridium aquilinum*), common dog violet (*Viola riviniana*), wood sorrel (*Oxalis acetosella*), lesser celandine (*Ranunculus ficaria*), primrose (*Primula vulgaris*), hard fern (*Blechnum spicant*) and the moss *Thuidium tamariscinum*.

Species Group C, which contains species characteristic of upland conditions, such as fox-glove (*Digitalis purpurea*), tormentil (*Potentilla erecta*) and mosses such as *Polytrichum commune* and *Dicranum scoparium,* is most frequent in Group 3 woods (Table 4). These woods had the second highest mean number of plant species per 14x14m quadrat (48 $\pm$3.4). A total of 128 plant species were recorded from these woods.

Group 4: (n=2; 7%) **Species-poor woods** (100% Sycamore/100%Beech)

Perennial rye-grass (*Lolium perenne)* was the indicator species for this group. Creeping bent (*Agrostis stolonifera*), cocksfoot (*Dactylis glomerata*), yorkshire fog (*Holcus lanatus*), rough meadow grass (*Poa trivialis*), nettle (*Urtica dioica*) and meadow foxtail (*Alopecurus pratensis*) were the common species.

All two group 4 wood species are restricted to species groups G and H, which contain species indicative of more fertile soil conditions dock (*Rumex obtusifolius*), dandelion (*Taraxacum officinale*), buttercup (*Ranunculus acris*), and grassland species (Table 4). These species groups contain competitor (C) strategist species (for example nettle (*Urtica dioica*) and cocksfoot (*Dactylis glomerata*)), which have high potential growth rates, exploiting conditions of low stress and low disturbance. Ruderal (R) strategist species, such as dandelion (*Taraxacum officinale*), which are characteristic of low stress and high disturbance conditions, are also common in these species groups. This group had the lowest mean number of plant species per 14x14m quadrat (24 $\pm$1.5) and only 35 plant species were recorded from Group 4 woods.

Sites in this group had the highest mean soil phosphorus content of all groups ($p < 0.05$, Table 5), indicating the higher soil fertility of these woods.

Table 4 :Frequency table of the TWINSPAN classification of the Antrim Coast, Glens and Rathlin Woodlands**.**

The frequency value of each species in each TWINSPAN vegetation type is represented by the Roman numerals I-V: I=1-20%; II=21-40%; III=41-60%; IV=61-80%; V=81-100%. * species with a moderate - high affinity for ancient woodlands (Peterken, 1981)

Plant Species arranged in Species groups A-H	Frequency of species in each TWINSPAN Woodland vegetation Group (1-4) (number of sites)			
	1 (5)	**2** (13)	**3** (8)	**4** (2)
A *Ajuga reptans*	-	IV	I	-
Angelica sylvestris	I	IV	I	-
Ranunculus repens	-	II	I	-
Cardamine hirsuta	-	IV	II	-
Apium nodiflorum	-	II	-	-
Salix aurita	I	V	II	-
Alchemilla glabra	-	-	I	-
Sonchus asper	-	II	-	-
Glyceria fluitans	-	II	-	-
Conocephalum conicum	-	II	-	-
Brachypodium sylvaticum	-	IV	II	-
B *Dryopteris filix-mas*	-	II	II	-
Alopecurus geniculatus	-	III	II	-
Stellaria holostea *	-	III	II	-
Dryopteris dilatata	-	II	II	-
Carex caryophyllea	-	II	II	-
Cardamine pratensis	-	II	II	-
Lysimachia nemorum	-	V	IV	-
Alnus glutinosa	-	II	II	-
Thuidium tamariscinum	-	IV	V	-
Senecio jacobea	-	II	II	-
Lophocolea bidentata	-	III	II	-
C *Juncus effusus*	-	-	III	-
Anthoxanthum odoratum	-	-	IV	-
Sorbus aucuparia	-	-	IV	-
Betula spp.	-	II	III	-
Dicranum scoparium	-	I	III	-
Deschampsia flexuosa	-	II	III	-
Polytrichum commune	-	I	II	-
Pseudoscleropodium purum	-	II	II	-
Potentilla erecta	-	II	II	-
Rhytidiadelphus triquetrus	-	II	II	-
Digitalis purpurea	-	II	III	-
Hypericum perforatum	-	II	III	-
Luzula multiflora	-	I	IV	-
Festuca ovina	-	I	II	-
D *Filipendula ulmaria*	I	V	IV	-
Conopodium majus *	I	IV	IV	-
Viola riviniana *	III	V	V	-
Geranium robertianum	III	V	IV	-
Oxalis acetosella *	II	V	V	-
Circaea lutetiana	I	II	II	-
Corylus avellana	III	V	V	-
Primula vulgaris *	II	V	V	-
Mnium hornum	III	IV	IV	-
Potentilla sterilis *	II	IV	III	-

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Plant Species arranged in Species groups	Frequency of species in each TWINSPAN Woodland vegetation group (1-4) (number of sites)			
	1	**2**	**3**	**4**
	(5)	(13)	(8)	(2)
E *Geum urbanum*	II	V	-	-
Chrysosplenium oppositifolium *	II	V	II	-
Galium aparine	II	IV	I	-
Carex sylvatica *	I	III	-	-
Vicia sepium	I	III	-	-
Pellia epiphylla	II	III	-	-
Brachythecium rutabulum	I	II	-	-
F *Blechnum spicant*	II	IV	-	-
Anemone nemorale *	III	IV	IV	-
Agrostis capillaris	II	II	IV	-
Quercus spp	I	I	III	-
Sanicula europaea	III	III	II	-
Luzula sylvatica *	III	III	II	-
Epilobium montanum	III	IV	II	-
Rumex crispus	II	II	-	-
Isothecium myosuroides	III	IV	II	-
Rosa canina	I	II	I	-
Pteridium aquilinum	V	V	V	-
Ilex aquifolium	III	II	III	-
Hedera helix	V	II	I	-
Lonicera periclymenum	III	III	III	-
Cystopteris fragilis	III	I	III	-
Hyacinthoides non-scripta *	IV	V	V	-
Allium ursinum *	II	II	II	-
Anthriscus sylvestris	I	I	II	-
Eurhynchium praelongum	V	III	II	-
Arum maculatum	II	II	II	-
G *Taraxacum officinale*	-	IV	III	III
Cirsium arvense	-	III	I	III
Holcus lanatus	-	V	IV	V
Rumex acetosa	-	II	III	III
Veronica chamaedrys	I	IV	IV	III
Dactylis glomerata	I	V	IV	V
Agrostis stolonifera	-	V	IV	V
Alopecurus pratensis	-	III	IV	V
Deschampsia cespitosa	-	II	II	III
Poa trivialis	III	V	V	V
Ranunculus acris	I	V	II	V
Fraxinus excelsior	III	IV	IV	III
Hypnum cupressiforme	I	III	II	III
H *Rumex obtusifolius*	I	II	II	III
Acer pseudoplatanus	III	II	IV	V
Crataegus monogyna	III	IV	IV	III
Ranunculus ficaria	V	V	V	III
Rubus fruticosus	V	IV	IV	III
Luzula campestris	-	I	I	III
Festuca rubra	-	II	III	V
Trifolium repens	-	I	I	III
Cerastium fontanum	-	I	II	III
Poa pratensis	-	II	-	V
Fagus sylvatica	III	I	II	V
Urtica dioica	II	II	I	V

Table 5. Mean (+SE) soil properties and number of plant species for each Woodland TWINSPAN vegetation group for the Antrim Coast, Glens and Rathlin ESA Woods.

Woodland TWINSPAN vegetation group (n)	Mean (+standard error) soil properties for each Woodland vegetation group				Mean number of plant species	
	pH	P (mgl^{-1})	K (mgl^{-1})	MG (mgl^{-1})	2x2m	14x14m
1. Overgrown woods (5)	**5.59** (.69)	**32** (17.3)	190 (44.5)	346 (163.7)	**13**(2.5)[a]	**28**(1.6) ab
2 Mixed species wet scrub (13)	**5.94** (.57) [a]	**8** (1.1)[a]	182 (42.3)	422 (75.1)	**26**(1.6)[a]	**58**(2.7)[a]
3 Mixed species scrub (8)	**5.10** (.53)[a]	**6** (1.1)[a]	140 (23.1)	240 (83.1)	**21** (1.6)	**48**(3.4)[b]
4 Species-poor wood (2)	**5.96** (.14)	**62** (27.5)[a]	251 (97.0)	216 (74.0)	**14**(2.5)[a]	**24**(1.5) ab
One-way ANOVA F	3.78	7.22			8.65	19.71
p	0.02	0.001	NS	NS	0.0005	0.0001
df	3,24	3,24			3,24	3,24

Means with the same superscript are significantly different from the mean underlined superscript([a] is significantly different from [a]: Tukey multiple comparison test, P<0.05)

Soil properties: P - Phosphorus   K - Potassium   MG - Magnesium

3.2. Heather moorland

3.2.1. Common plant species

Heather monitoring has now been carried out in all the ESAs. A total of 232 species (plants/ ferns/mosses/lichens) were recorded from a total of 134 monitored sites. The plant species frequency lists for total heather sites and for each ESA are listed in Appendices 7 and 8.

The most common plant species found in more than 60% of heather monitored sites were heather (*Calluna vulgaris*), cross-leaved heath (*Erica tetralix*), tormentil (*Potentilla erecta*), bilberry (*Vaccinium myrtillus*), purple moor grass (*Molinia caerulea*), deer grass (*Scirpus cespitosus*), fine bog cotton (*Eriophorum vaginatum*) and moss species *Dicranum scoparium* and *Hypnum jutlandicum* (Appendix 7).

Species indicative of wet heath, such as cross-leaved heath (*Erica tetralix*), deer grass (*Scripus cespitosus*), broad bog cotton (*Eriophorum angustifolium*), fine bog cotton (*Eriophorum vaginatum*) and moss species *Plagothecium nemorale, Pleurozium schreberi, Rhytidadelphus triquetrus* and *Sphagnum* spp. were most frequent in the Sperrins ESA heather sites (Appendix 8). Dry heath indicator species such as bell heather (*Erica cinerea*) were most common in the Mournes and Slieve Croob, Slieve Gullion and Rathlin ESAs.

Rathlin heather sites had the highest mean number of plant and ground beetle species of all ESAs (Table 6).

3.2.2. Management of Heather sites - livestock grazing and heather burning

A total of 65% of the monitored heather sites in NI ESAs were grazed. The average height of heather on grazed sites was significantly less than sites which showed no recent evidence of grazing (p<0.01, Table 7). Figure 3 illustrates the extent of heather grazing for each ESA. The West Fermanagh and Erne Lakeland ESA sites were most commonly grazed by cattle (64%), while sheep grazing was dominant in the Antrim Coast and Glens (63%), the Mournes and Slieve Croob (71%) and the Sperrins ESAs' monitored sites. Over half of the Slieve Gullion ESAs' monitored heather sites showed no recent signs of livestock grazing.

Evidence of recent heather burning was present on only 5% of monitored sites, with the majority of these caused accidentally and not as a result of positive heather management. The average height of heather on sites which had previously been burned was significantly less than sites where no burning had occurred.

Only 6% of monitored sites had previously been cut for peats, either mechanically or by hand.

Table 6. Mean number ($\pm$standard error) of plant and ground beetle species in each ESA.

ESA	Mean number of all plant species (2x2m)	Number of plant sites	Mean number of ground beetle species per site	Number of invertebrate sites
West Fermanagh and Erne Lakeland	28 (1.6)	25	10 (1.8)	8
Antrim Coast, Glens	**26** (3.7)[a]	8	12 (1.2)	4
Rathlin	**37** (2.6)[a]	8	**19** (0.9)[a]	4
Mournes and Slieve Croob	21 (2.0)[a]	7	**6** (3.0)[a]	2
Slieve Gullion	**30** (1.5)	31	13 (1.1)	18
Sperrins	**28** (0.9)[a]	55	13 (0.8)	42
One-way ANOVA F=	3.79		2.52	
p=	0.005		0.05	
df=	5,115		5,72	

Table 7. Comparison of heather height with grazing, past burning and peat cutting.

Environmental variable	n	Mean height of heather (cm)	Standard error	t-test
GRAZING				
No evidence of grazing	47	**27**	2.4	t=2.63, df=77.26,
Grazing	87	**19**	1.4	**p<0.01**
HEATHER BURNING				
No burning	127	**22**	1.3	t=2.44, df=11.34
Recent burning	7	**16**	2.2	**p<0.05**
PEAT CUTTING				
No recent peat cutting	126	22	1.9	Not significant
Peat cutting	8	20	6.7	

Figure 3. Frequency of Heather Grazing in each of the NI ESAs
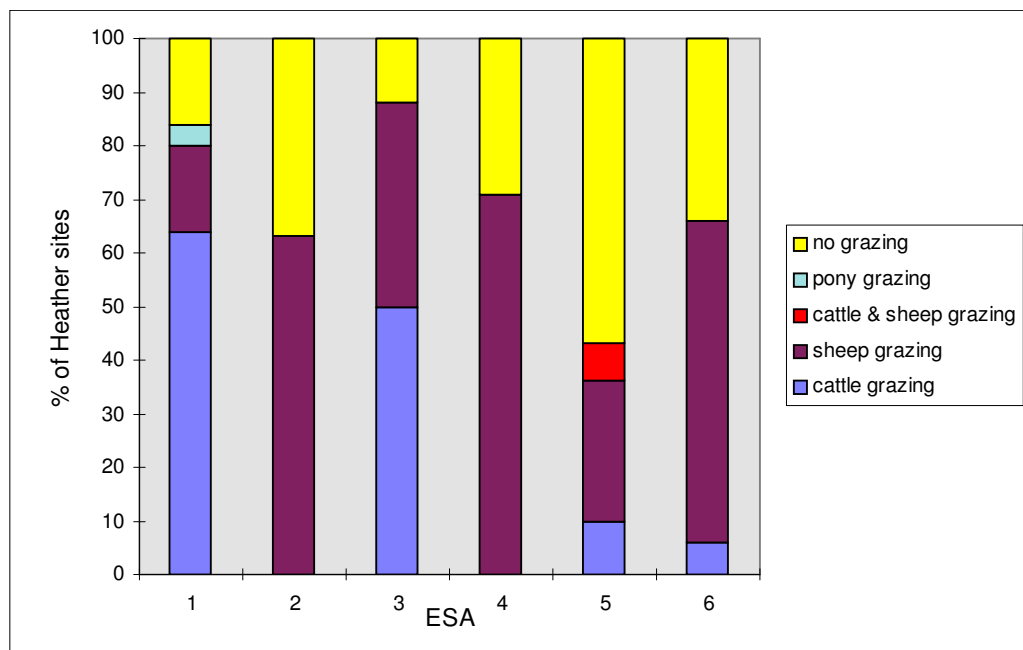
ESAs

1. West Fermanagh and Erne Lakeland

2. Antrim Coast and Glens

3. Rathlin

4. Mournes and Slieve Croob

5. Slieve Gullion

6. Sperrins

3.2.3. Classification of Heather moorland

3.2.3.1. National Vegetation Classification - NVC types

TABLEFIT was used to allocate each heather monitored site a specific NVC type. Only 17% of sites had a very poor association with the NVC type (goodness of fit <49%). The major NVC types of the NI ESAs monitored heather sites are listed in Table 8, with 31% of sites assigned to Mires type M15: *Scripus cespitosus - Erica tetralix* (Scir ces-Eric tet: northern Wet heath), 33% to blanket bog (M17, M19) and 29% of sites were assigned to heath type H10 *Calluna vulgaris - Erica cinerea* (Call vul-Eri cin) heath.

Table 8: NVC Types of monitored NI ESAs' Heather sites.

NVC Type CORINE Type	% of Heather sites (n=134)
M15: *Scripus cespitosus - Erica tetralix* Northern Wet Heath (C31.11)	31%
M17: *Scirpus cespitosus - Eriophorum vaginatum* Lowland blanket bog (C52.1)	16%
M19: *Calluna vulgaris - Eriophorum vaginatum* Upland blanket bog (C52.2)	14%
M18: *Erica tetralix-Sphagnum papillosum* Raised bogs: Bog *Erica - Sphagnum* (C51.115)	1%
M6: *Carex echinata/Sphagnum recurvum/auriculatum* Acidic 'fen': *Carex echinata - Sphagnum* spp. (C54.4)	2%
H10: *Calluna vulgaris - Erica cinerea* heath Submontane heather moor (C31.2256)	29%
H6*: Eriophorum vaginatum - Ulex europaeus* Northern Eric vaga heath (C31.234):	1%
U4: *Nardus stricta - Galium saxatile* Nardo-Galion acid grass (C35.1)	4%
U20: *Pteridium aquilinum-Galium saxatile* Bracken (C31.86)	2%

Key: NVC code: **M** - Mires; **H** - Heath; **U** - Upland

3.2.3.2. TWINSPAN Heather vegetation types

TWINSPAN was used to describe the heather monitored sites in all NI ESAs, by characteristic major vegetation types and species groups based on each sites' plant species and their mean percentage cover (from 4 (1x1m) quadrats). Since the most recently launched ESAs, (the Sperrins and Slieve Gullion) contain the largest areas of heather, separate TWINSPAN analyses were performed to describe these two ESA heather regions in more detail.

I. Total Northern Ireland ESA heather vegetation types

The TWINSPAN division indicator species are listed and other common species which are present in more than 80% of one vegetation type sites. Type 1 and 2 are wet heath types (60% of monitored sites) with the indicator species cross-leaved heath (*Erica tetralix*), while types 3 and 4 are dry heath types with bell heather (*Erica cinerea*) the indicator species (Appendix 5:2a). Broad descriptive names are given to each vegetation type. The frequency value of each plant species in each TWINSPAN vegetation type is listed in Table 8, with plant species which were commonly associated with each other, arranged in species groups (A-G). There were significant differences between vegetation types in mean number of plant species per 2x2m quadrat, number of ground beetle species per site, soil pH, potassium, magnesium, % organic matter and % moisture content (Table 10).

Type 1 (n=55; 41%)**: Typical wet heath**

The indicator species of this type were cross-leaved heath (*Erica tetralix*), bog asphodel (*Narthecium ossifragum*) and deer grass (*Scripus cespitosus*). Other commonly found species were the bog cottons (*Eriophorum angustifolium, Eriophorum vaginatum*), heath rush (*Juncus squarrosus*) and *Sphagnum auriculatum*.

Species groups A and B, characteristic of wet peaty soils are most frequent in sites from heather vegetation types 1 and 2. Species group C contains species common to all heather sites (Table 8). The smallest mean number of plant species and beetle species was recorded from these wet heath sites (Table 9).

Typical wet heath type soils were more acidic than the other types with the exception of vegetation type 2 (grazed wet heath), and had less potassium content. These soils had the highest values for total percentage organic matter and moisture content (Table 10).

The majority of the Sperrins ESA heather sites (64%, Table 11), Antrim Coast, Glens and West Fermanagh and Erne Lakeland ESAs were represented by this wet heath vegetation type 1. This heather type was more associated with wet bogs than other types, being frequently assigned to the NVC Mires types, for example 38% of Type 1 wet heath sites were associated with M17 *Scirpus cespitosus - Eriophorum vaginatum*, lowland blanket bog(Table 12). A small number of these sites (4%) showed signs of previous burning and peat extraction was more common on these sites, with 11% with signs of recent peat cutting.

Type 2 (n=25; 19%)**: Grassy wet heath with bilberry**

Bilberry (*Vaccinium myrtillus*), sweet vernal grass (*Anthoxanthum odoratum*) and *Polytrichum commune* were the indicator species of this vegetation type. Fine bog cotton (*Eriophorum vaginatum*), purple moor grass (*Molinia caerulea*), tormentil (*Potentilla erecta*), deer grass (*Scirpus cespitosus*), *Rhytidiadelphus triquetrus*, *Hylocomium splendens*, and *Sphagnum auriculatum* were the most frequently occurring species.

Species groups D which contain species indicative of grazing such as bilberry (*Vaccinium myrtillus*) and grass species such yorkshire fog (*Holcus lanatus*) are most common to this heather type (Table 9). This group contained the second highest mean number of plant species, significantly more than Type 1.

Soils from Type 2 heather had the same acidic pH value as Type 1 (4.1), and the second highest levels of soil organic matter and moisture content (Table 10).

The majority of these sites were grazed (72%), second only to type 4 (grazed dry heath) sites. Sheep grazing was the most common on this vegetation type (Figure 4). A small number of these sites had evidence of recent peat cutting and past burning (8%).

29% of the Sperrins ESA and 24% of the West Fermanagh and Erne Lakeland ESA heather sites were described as vegetation type 2 (Table 11). Over half of the Type 2 heather sites

were assigned to NVC type M15: *Scirpus cespitosus - Erica tetralix* (Northern wet heath), Table 12.

Type 3 (n=26; 19%)**: Typical dry heath**

The indicator species of the dry heath vegetation type were bell heather (*Erica cinerea*) and gorse (*Ulex europaeus*), with other common species tormentil (*Potentilla erecta*) and purple moor grass (*Molinia caerulea*).

Both heather types 3 and 4 contain few species from species group A and B which are indicative of wet heath conditions (Table 9). Species group G, which contains species indicative of dry heath conditions is most common to this heath type.

Grazing was least common on these heather sites, with 46% of sites showing no recent signs of livestock grazing (Figure 4). No sites showed any evidence of previous peat cutting and only a minority of sites (4%), indicated signs of recent burning.

The majority of the Mournes and Slieve Croob ESA (86%, Table 11), 50% of Rathlin ESA, and 48% of Slieve Gullion ESA sites were represented by this vegetation type. The NVC type H10: *Calluna vulgaris - Erica cinerea*, submontane heather moor was assigned to 50% of dry heath sites (Table 12).

Type 4 (n=28; 21%)**: Grassy dry heath with bilberry**

Bell heather (*Erica cinerea*), bilberry (*Vaccinium myrtillus*) and sweet vernal grass (*Anthoxanthum odoratum*) were the indicator and most common species of this grazed dry heath vegetation type.

Species group D, containing species indicative of grazed heath is frequent in this heath type, as in heath type 2. Also more species from these sites are included in species group F, than any other heath type. These species are indicative of more upland grassland conditions (Table 9). This heather vegetation type had the highest mean number of plant and ground beetle species (Table 10).

Type 4 sites' mean soil values of potassium and magnesium were higher than other heather types and these soils had the lowest values of organic matter and moisture (Table 10).

Type 4 sites were the most commonly grazed of all heather types, with 89% of these heath sites showing recent signs of livestock grazing (Figure 4). There was no evidence of peat cutting on any of these sites. Recent burning has occurred on 7% of type 4 heather sites.

45% of Slieve Gullion sites were classified as vegetation type 4 (Table 11). The majority of these type 4 sites (71%) were assigned to NVC type H10 *Calluna vulgaris - Erica cinerea*, submontane heather moor (Table 12).

Table 9. Frequency table of the TWINSPAN classification of the NI ESAs' Heather sites (134 sites).

The frequency value of each species in each TWINSPAN vegetation type is represented by the Roman numerals I-V: I=1-20%; II=21-40%; III=41-60%; IV=61-80%; V=81-100%.

	Plant Species arranged in Species groups A-G	Frequency of species in each TWINSPAN Heather vegetation type: 1-4 (number of sites)			
		1	**2**	**3**	**4**
		(55)	(25)	(26)	(28)
A	*Plagiochila aspleniodes*	I	I	-	-
	Myrica gale	I	-	-	-
	Drosera rotundifolia	II	II	-	-
	Sphagnum papillosum	III	II	I	I
	Cratoneuron commutatum	I	I	-	-
	Juncus articulatus	I	I	-	-
	Eriophorum angustifolium	V	IV	I	II
	Eriophorum vaginatum	V	V	II	II
	Sphagnum palustre	III	III	I	-
	Sphagnum auriculatum	V	V	I	I
	Nardia scalaris	II	II	I	-
	Sphagnum rubellum	IV	III	I	-
B	*Plagiothecium nemorale*	II	II	I	II
	Lophocolea bidentata	II	III	I	I
	Pleurozium schreberi	III	IV	I	III
	Carex echinata	II	III	I	I
	Sphagnum cuspidatum	II	II	I	-
	Lophozia ventricosa	III	II	I	I
	Dicranum majus	II	I	I	I
	Juncus effusus	I	III	I	I
	Scirpus cespitosus	V	V	III	II
	Cladonia portentosa	III	II	III	III
	Erica tetralix	V	III	III	II
	Narthecium ossifragum	IV	I	II	I
	Cladonia uncialis	III	I	-	I
	Juncus squarrosus	V	IV	II	III
	Polytrichum commune	III	V	II	III
	Rhytidiadelphus triquetrus	III	V	I	III
C	*Aulacomnium palustre*	I	I	I	I
	Cladonia floerkeana	I	I	I	I
	Empetrum nigrum	II	I	I	I
	Hypogymnia physodes	I	I	I	I
	Calluna vulgaris	V	V	V	V
	Pseudoscleropodium purum	II	II	II	II
	Dicranium scoparium	IV	III	IV	IV
	Hypnum jutlandicum	IV	IV	II	III
	Sphagnum subnitens	I	I	I	I
	Juncus acutiflorus	I	I	-	I
	Cladonia pyxidata	III	I	III	I
	Brachythecium rutabulum	I	-	I	I
	Carex pulicaris	I	-	-	I
	Dead Calluna vulgaris	III	III	I	III
	Dicranella heteromalla	II	III	II	I
	Carex flacca	I	III	II	I
	Deschampsia flexuosa	II	IV	II	IV
	Hylocomium splendens	II	V	I	III

Plant Species arranged in Species groups	Frequency of species in each TWINSPAN Heather vegetation type: 1-4 (number of sites)			
	1	**2**	**3**	**4**
	(55)	(25)	(26)	(28)
D *Luzula campestris*	I	III	I	I
Vaccinium myrtillus	III	V	III	V
Thuidium tamariscinum	II	II	I	III
Rhytidiadelphus loreus	I	I	-	I
Agrostis stolonifera	I	II	I	I
Holcus lanatus	I	II	I	I
Sphagnum capillifolium	I	I	I	I
Campylopus introflexus	I	I	I	-
Carex panicea	IV	III	IV	IV
Racomitrium lanuginosum	II	I	II	I
E *Succisa pratensis*	I	I	II	II
Carex pallescens	I	I	II	I
Agrostis capillaris	I	I	I	II
Eurhynchium praelongum	I	I	II	I
Sphagnum compactum	I	I	I	I
Molinia caerulea	IV	V	V	IV
Carex nigra	II	III	II	II
Nardus stricta	II	III	III	III
Potentilla erecta	III	V	V	V
Agrostis canina	I	II	II	II
Blechnum spicant	I	I	I	I
Deschampsia cespitosa	I	I	II	I
F *Rhytidiadelphus squarrosus*	II	II	I	III
Neckera complanata	I	I	-	I
Anthoxanthum odoratum	I	IV	III	V
Galium saxatile	I	III	II	III
Luzula multiflora	I	III	II	III
Carex demissa	I	-	I	I
Festuca rubra	I	II	II	III
Danthonia decumbens	I	I	I	I
Leontodon hispidus	-	-	I	I
Festuca ovina	I	II	II	III
Sesleria albicans	I	I	I	II
Trifolium repens	-	I	I	I
Viola riviniana	-	-	I	I
Rumex acetosa	-	I	I	I
Cerastium fontanum	I	I	I	I
Plantago lanceolata	I	-	I	I
G *Carex pilulifera*	-	I	II	III
Pteridium aquilinum	I	I	I	I
Erica cinerea	II	II	V	IV
Pedicularis sylvatica	I	I	III	II
Carex lasiocarpa	-	-	I	I
Carex disticha	I	-	I	-
Dactylorhiza maculata	I	I	I	I
Carex binervis	I	I	III	II
Ulex europaeus	I	I	V	II
Polygala vulgaris	I	I	I	I
Hypnum cupressiforme	II	III	III	II
Polygala serpyllifolia	I	I	III	I

Table 10. The mean (+SE) values of plant, ground beetle species, and soil properties associated with NI ESA heather monitored sites which were significantly different between vegetation types (One-way ANOVA, p<0.05).

Heather Vegetation type	pH	K (mg/l)	Mg (mg/l)	% Organic matter	%Moisture	Mean no. of plants (2x2m)	Mean no. of beetle species
1.Typical wet heath	4.1^{ab} (.04)	72^a (5.8)	156 (8.8)	90$^{\underline{a}}$ (2.4)	82$^{\underline{a}}$ (2.1)	26^{ab} (0.9)	11^a (0.8)
2 Grassy wet heath with bilberry	4.1^{ab} (.04)	91 (8.9)	129 (9.4)	78 (5.3)$^{a\underline{b}}$	77 (3.2)	31$^{\underline{b}}$ (1.4)	13 (1.2)
3 Typical dry heath	4.4$^{\underline{b}}$ (.06)	117 (22.1)	104 (15.7)^a	77 (14.8)^a	68^a (2.5)	27^a (1.3)	13 (1.2)
4 Grassy dry heath with bilberry	4.4$^{\underline{a}}$ (.06)	150$^{\underline{a}}$ (27.8)	186$^{\underline{a}}$ (39.5)	54^{ab} (3.9)	66^a (2.6)	35$^{\underline{a}}$ (1.5)	16$^{\underline{a}}$ (1.1)
One-way ANOVA F	11.78	5.37	2.85	6.12	8.98	11.61	4.06
p	0.001	0.01	0.05	0.001	0.0001	0.001	0.01
df	3,117	3,117	3,117	3,117		3,130	3,74

Heading above table: Mean (+standard error) of soil properties of each Heather vegetation type

Means with the same superscript are significantly different from the mean underlined superscript($\underline{a}$ is significantly different from ^{a}: Tukey multiple comparison test, P<0.05)

Table 11. Distribution of Heather TWINSPAN vegetation type within each ESA.

ESA	Typical wet heath Type 1 (n=55)	Grassy wet heath with bilberry Type 2 (n=25)	Typical dry heath Type 3 (n=26)	Grassy dry heath with bilberry Type 4 (n=28)
West Fermanagh and Erne Lakeland (n=25)	52	24	4	20
Antrim Coast, Glens (n=8)	63	13	-	24
Rathlin (n=8)	13	-	50	38
Mournes and Slieve Croob (n=7)	14	-	86	-
Slieve Gullion (n=31)	-	7	48	45
Sperrins (n=55)	64	29	-	7

Heading above table: Percentage Frequency of each ESA Heather sites

Table 12. NVC types of each Heather plant TWINSPAN vegetation type sites.

| NVC type (CORINE type) | Percentage Frequency of each TWINSPAN Vegetation Type Heather sites | | | |
| | Typical wet heath | Grassy wet heath with bilberry | Typical dry heath | Grassy dry heath with bilberry |
	Type 1 (n=55)	Type 2 (n=25)	Type 3 (n=26)	Type 4 (n=28)
M15: *Scripus cespitosus - Erica tetralix* Northern Wet Heath (C31.11)	27	52	38	14
M17: *Scirpus cespitosus - Eriophorum vaginatum* Lowland blanket bog (C52.1)	38	4	-	-
M19: *Calluna vulgaris - Eriophorum vaginatum* Upland blanket bog (C52.2)	27	16	-	-
M18: *Erica tetralix-Sphagnum papillosum* Raised bogs: Bog *Erica - Sphagnum* (C51.115)	2	-	-	-
H6: *Eriophorum vaginatum-Ulex europaeus* Northern *Eriophorum vaginatum* heath (C31.234)	-	-	4	-
H10: *Calluna vulgaris - Erica cinerea* **heath** Submontane heather moor (C31.2256)	6	12	50	71
U4: *Festuca ovina-Agrostis capillaris- Galium saxatile* Nardo-Galion acid grass (C35.12)	-	8	4	11
M6: *Carex echinata/Sphagnum recurvum/auriculatum* Acidic 'fen': *Carex echinata - Sphagnum* spp. (C54.4)	-	8	-	-
U20: *Pteridium aquilinum-Galium saxatile* Bracken (C31.86)	-	-	4	4

Key: NVC code: **M** - Mires; **H** - Heath; **U** - Upland

Figure 4. Frequency of Heather Grazing in each of the NI ESAs' Heather Vegetation Types
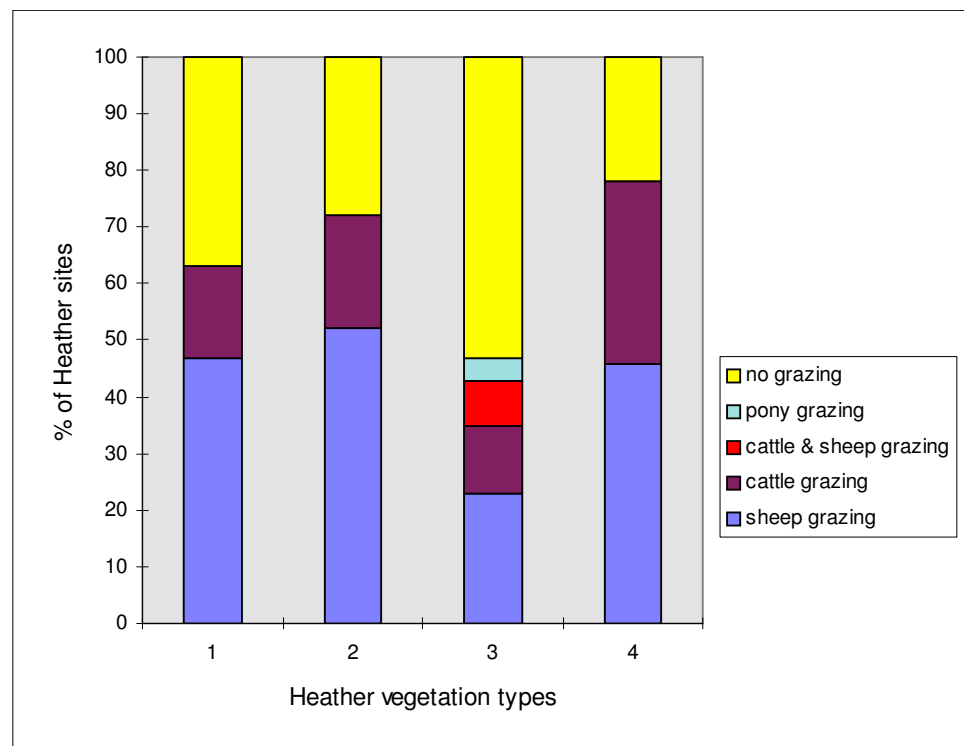
Heather vegetation types

1: Typical wet heath

2: Grassy wet heath with bilberry

3: Typical dry heath

4: Grassy dry heath with bilberry

II. Sperrins ESA Heather vegetation types:

Four major vegetation types were recognised by TWINSPAN of heather sites' plant species and their percentage cover (mean cover for $1m^2$ quadrat per site), Appendix 5 (2b). Vegetation types 1 and 2 are both grassy wet heather types characterised by the indicator species purple moor grass (*Molinia caerulea*), sweet vernal grass (*Anthoxanthum odoratum*), heath bedstraw (*Galium saxatile*) and the moss species *Hylocomium splendens*, accounting for 36% of the monitored Sperrins heather sites. Vegetation types 3 and 4, are wet heath types with the indicator species deer grass (*Scirpus cespitosus*), bog asphodel (*Narthecium ossifragum*) and cross-leaved heath (*Erica tetralix*), representing 64% of monitored sites. The TWINSPAN indicator species are listed below and other common species which are present with a frequency of more than 75% in the listed vegetation type. The frequency value of each plant species in each TWINSPAN vegetation type (1-4) is listed in Table 13, with similarly associated plant species arranged in species groups A-G.

There was significant differences between heather types in mean number of plant species (including bryophytes) per site (F=10.91, p<0.0001,df=3,51), mean number of beetle species per site (F=3.27, p<0.05, df=3,34) and in soil potassium (F=6.59, p<0.001, df=3,45), magnesium (F=3.31, p<0.03,df=3,45), % total organic matter (F=8.15, p<0.001, df=3,45) and altitude (F=2.65, p<0.05, df=3,51).

Type 1 (n=6; 11%)**: Grassy heath**

This grassy heath type had the highest number of grazed sites of all the Sperrins heather vegetation types (84%, Figure 5), significantly higher than in vegetation type 3.

The indicator species of group 1 was velvet bent (*Agrostis canina*), with other common species sweet vernal grass (*Anthoxanthum odoratum*), heath rush (*Juncus squarrosus*), purple moor grass (*Molinia caerulea*), dead *Calluna*, star sedge (*Carex echinata*), carnation sedge (*Carex panicea*), heath bedstraw (*Galium saxatile*), many headed woodrush (*Luzula multiflora*), deer grass (*Scirpus cespitosus*). The most frequent moss species were *Sphagnum auriculatum, Dicranum scoparium, Hylocomium splendens, Hypnum jutlandicum, Pleurozium schreberi, Rhytidiadelphus triquetrus*.

Species group A, which contains a range of species including common grassland species, species indicative of drier heath such as lousewort (*Pedicularis sylvatica*) and bell heather (*Erica cinerea*) and rushes (*Juncus articulatus, Juncus acutiflorus*), was primarily restricted to vegetation type 1 sites. Species group E was common to all the Sperrins' types. Species groups F and G which are broadly indicative of wetter peaty soils were less frequent in type 1 and type 2 sites (Table 13). This vegetation type had the highest mean number of plant species per 2x2m quadrat per site (38 $\pm$1.8), significantly different from all other types (p<0.05). A total of 85 plant species were recorded from these sites.

Soils from Type 1 had highest mean potassium levels (115 mg/l $\pm$24.2), significantly different than the soils from Types 3 and 4 (p<0.05) and the significantly lowest mean soil % organic matter content (58% $\pm$7.9; p<0.05)

Sites from this type had the highest mean number of beetle species per site (16 $\pm$2.4 (n=5)), significantly different from Type 4 (p<0.05).

The majority of Type 1 sites (83%) were assigned to NVC type M17 *Scirpus cespitosus-Eriophorum vaginatum* (Lowland blanket bog), with the remainder of sites to NVC type M19 *Calluna vulgaris-Eriophorum vaginatum* (Upland blanket bog).

Type 2 (n=14; 25%)**: Grazed upland wet heath**

The majority of grazed upland wet heath sites, as the name suggests showed evidence of livestock grazing (79%, Figure 5). This heath type contains the most sites (14% of type 2 sites) which have been cut over for peat.

Bilberry (*Vaccinium myrtillus*) was the TWINSPAN indicator species and the most common species were fine bog cotton (*Eriophorum vaginatum*), heath bedstraw (*Galium saxatile*), purple moor grass (*Molinia caerulea*), wavy hairgrass (*Deschampsia flexuosa*) sweet vernal grass (*Anthoxanthum odoratum*), deer grass (*Scripus cespitosus*). *Polytrichum commune, Pleurozium schreberi* and *Rhytidiadelphus triquetrus* were the commonest moss species.

Species groups B, C and D which contain upland grassland species, sedges and species indicative of grazed heath, were most prevalent in Type 2 sites (Table 13). This heath type

had the second highest mean number of plant species per site (30 $\pm$1.7), significantly higher than type 4 sites (p<0.05). A total of 85 plant species were recorded.

Type 2 sites had the highest mean altitude (257m $\pm$13.1) of all the Sperrins' vegetation types.

The NVC types M17 Scir ces-Erio vag (Lowland blanket bog) represented 43% of Type 2 sites. 14% were assigned to NVC type M19 *Calluna vulgaris-Eriophorum vaginatum* (Upland blanket bog). A further 7% of sites were classified as M15 *Scirpus cespitosus-Erica tetralix* (Northern Wet heath). Other sites were split between NVC type H10 *Calluna vulgaris-Erica cinerea* (21%) and U5 (U2,4,5) Nardo-Galion grassland (14%).

Type 3 (n=23; 42%)**: Blanket bog**

The indicator species of type 3 heather sites were bilberry (*Vaccinium myrtillus*), tormentil (*Potentilla erecta*), *Polytrichum commune, Pleurozium schreberi* and *Plagiothecium nemorale.* The other common species were cross-leaved heath (*Erica tetralix*), bog cotton (*Eriophorum spp.*), deer grass (*Scripus cespitosus*), *Sphagnum auriculatum* and *Dicranum scoparium*.

The species groups F and G were most common in heath types 3 and 4, these species are indicative of wetter peaty soils, for example broad bog cotton (*Eriophorum angustifolium*), and *Sphagnum* spp. (Table 13). This vegetation type had the second lowest mean number of plant species per site (28 $\pm$1.1), with a total of 83 plant species identified.

The majority of sites (87%) were associated with blanket bog NVC types M17 and M19 (57%:M19 *Calluna vulgaris-Eriophorum vaginatum* (Upland blanket bog), 30% M17 *Scirpus cespitosus-Eriophorum vaginatum* (Lowland blanket bog). NVC type M15 *Scirpus cespitosus-Erica tetralix* (Northern Wet heath) accounted for 35% of sites.

All the Sperrins heather sites which showed evidence of past burning were classified as vegetation type 3 (13% of type 3 sites). A small number of type 3 sites (4%) had been cut-over for peat.

Type 4 (n=12; 22%): **Lowland Wet heath**

Deer grass (*Scripus cespitosus*), bog asphodel (*Narthecium ossifragum*) and bog cotton (*Eriophorum* spp.) were the indicator species for this wet heath type. Cross-leaved heath (*Erica tetralix*) an*d Sphagnum* spp. were also frequent species.

Species group F and G, with species characteristic of very wet peaty soils were most frequent in Type 4 heath sites (Table 13). These sites had the smallest mean number of plant species per site (23 $\pm$1.3) and only 63 plant species were recorded from all sites.

This vegetation type soils had the lowest mean levels of potassium (54mg/l $\pm$8.0). and the highest mean levels of magnesium (177 mg/l $\pm$18.2), significantly higher than Type1 ($p<0.05$) and the highest mean % soil organic matter (94% $\pm$1.9). These sites had the lowest mean altitude (207m $\pm$17.2).

The lowest mean number of beetle species per site was recorded from Type 4 sites (9 $\pm$1.4 (n=10)).

The majority of Type 4 sites (67%) were associated with M15 *Scirpus cespitosus-Erica tetralix* (Northern Wet heath), with 8% of sites assigned to NVC type M18 *Erica tetralix-Sphagnum papillosum* (Raised bogs). The other sites were represented by M19 *Calluna vulgaris-Eriophorum vaginatum* (Upland blanket bog). A minority of these monitored type 4 sites (8%) had been cut-over for peat.

Table 13. Frequency table of the TWINSPAN classification of the Sperrins ESA Heather sites (55 sites).

The frequency value of each species in each TWINSPAN vegetation type is represented by the Roman numerals I-V: I=1-20%; II=21-40%; III=41-60%; IV=61-80%; V=81-100%.

Plant Species arranged in Species groups A-G		Frequency of species in each TWINSPAN Heather vegetation type: 1-4(number of sites)			
		1	**2**	**3**	**4**
		(6)	(14)	(23)	(12)
A	*Agrostis stolonifera*	II	I	I	-
	Pedicularis sylvatica	II	-	I	-
	Carex binervis	II	-	I	-
	Mnium hornum	I	-	-	-
	Stellaria media	I	-	-	-
	Sonchus asper	I	-	-	-
	Cirsium arvense	I	-	-	-
	Epilobium montanum	I	-	-	-
	Holcus lanatus	II	-	-	-
	Poa trivialis	II	I	I	-
	Carex rostrata	I	-	-	-
	Brachythecium rutabulum	I	-	-	-
	Erica cinerea	I	-	-	-
	Ranunculus acris	I	-	-	-
	Carex demissa	I	-	-	-
	Agrostis canina	V	I	I	-
	Juncus articulatus	I	I	-	-
	Cerastium fontanum	II	I	-	-
	Juncus acutiflorus	I	I	-	-
B	*Festuca ovina*	I	I	-	-
	Carex flacca	II	II	I	-
	Festuca rubra	I	I	-	-
	Carex pilulifera	II	II	-	-
	Thuidium tamariscinum	III	II	I	-
	Anthoxanthum odoratum	V	IV	I	-
	Juncus effusus	II	II	-	-
	Galium saxatile	IV	IV	-	I
	Gentianella campestris	-	I	-	-
	Rumex acetosa	-	I	-	-
	Luzula campestris	-	II	I	-
C	*Juncus bulbosus*	II	I	I	-
	Diplophyllum albicans	I	I	-	I
	Nardus stricta	IV	III	II	-
	Agrostis capillaris	I	I	-	I
	Luzula multiflora	IV	III	I	-
	Deschampsia flexuosa	IV	IV	II	I
	Sphagnum subnitens	-	I	I	-
	Deschampsia cespitosa	I	II	I	II
	Carex nigra	III	II	I	I
	Hylocomium splendens	IV	V	II	-
	Rhytidiadelphus triquetrus	V	V	IV	III
D	*Poa nemoralis*	I	-	I	-
	Rhytidiadelphus squarrosus	II	II	II	I
	Potentilla erecta	V	IV	IV	I
	Carex echinata	V	II	II	-
	Lophocolea bidentata	III	III	III	I
	Pleurozium schreberi	V	V	IV	II

Plant Species arranged in Species groups	Frequency of species in each TWINSPAN Heather vegetation type: 1-4(number of sites)			
	1	**2**	**3**	**4**
	(6)	(14)	(23)	(12)
Molinia caerulea	V	V	IV	II
Juncus squarrosus	V	III	III	I
Polytrichum commune	V	IV	IV	I
Juncus bufonius	-	I	I	-
Sphagnum compactum	-	I	I	-
Rhytidiadelphus loreus	-	I	I	-
Vaccinium myrtillus	III	V	IV	I
E *Hypnum cupressiforme*	-	III	II	III
Sorbus aucuparia	I	-	-	I
Pseudoscleropodium purum	-	III	I	III
Carex panicea	IV	III	II	III
Hypogymnia physodes	I	I	I	I
Plagothecium nemorale	IV	III	IV	I
Calluna vulgaris	V	V	V	V
Dead Calluna vulgaris	V	III	IV	IV
Sphagnum auriculatum	V	IV	V	V
Dicranum scoparium	IV	III	IV	IV
Sphagnum palustre	I	III	III	III
Eriophorum vaginatum	III	V	V	V
Polygala serpyllifolia	II	-	I	I
Dicranella heteromalla	III	II	III	I
Hypnum jutlandicum	V	IV	IV	III
Lophozia ventricosa	III	II	IV	II
Sphagnum cuspidatum	-	II	II	-
Aulacomnium palustre	III	-	II	-
Dicranum majus	I	I	II	II
Cladonia floerkeana	-	I	I	I
F *Nardia scalaris*	I	I	III	II
Erica tetralix	IV	IV	V	V
Eriophorum angustifolium	III	IV	V	V
Campylopus introflexus	I	-	I	I
Sphagnum papillosum	II	I	III	IV
Sphagnum rubellum	-	III	IV	IV
Cladonia portentosa	-	II	III	IV
Scirpus cespitosus	V	IV	V	V
Drosera rotundifolia	-	-	I	II
Narthecium ossifragum	-	I	II	V
G *Cladonia pyxidata*	II	-	II	III
Racomitrium lanuginosum	-	-	I	III
Cladonia uncialis	I	-	I	III
Myrica gale	-	-	-	I
Betula spp.	-	-	-	I
Vaccinium oxycoccus	-	-	-	I
Mycena spp.	-	-	-	I
Empetrum nigrum	-	I	II	II
Plagiomnium undulatum	-	-	I	-
Pellia epiphylla	-	-	I	-
Eurhynchium praelongum	-	-	I	-
Listera cordata	-	-	I	-
Pices abies	-	-	I	-
Cystopteris fragilis	-	-	I	-

Figure 5. Frequency of Heather Grazing in each of the Sperrins ESA Heather Vegetation Types.
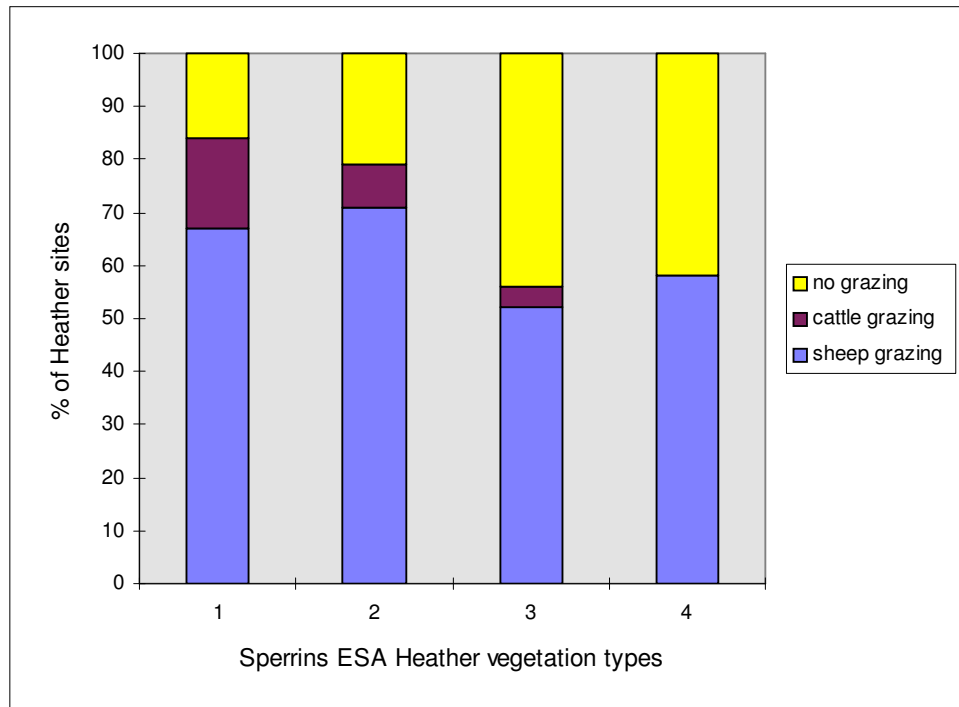
Sperrins ESA Heather vegetation types

1: Grassy heath
2: Grazed upland wet heath
3: Blanket bog
4. Lowland wet heath

III. Slieve Gullion ESA Heather vegetation types:

Following classification of heather sites' plant species and percentage cover (mean cover for $1m^2$ quadrat per site). by TWINSPAN five major vegetation types were recognised (Appendix 5: 2c). The initial TWINSPAN division split Type 5 wet heath from all the other vegetation types which were all broadly dry heather vegetation types, with the indicator species bell heather (*Erica cinerea*). The TWINSPAN indicator species of each type are listed below, with other common species which are present with a frequency of more than 80% in the listed vegetation type. The frequency value of each plant species in each TWINSPAN vegetation type is listed in Table 14, with the plant species arranged in species groups A-H. Heather (*Calluna vulgaris*), tormentil (*Potentilla erecta*) and purple moor grass (*Molinia caerulea*) were ubiquitous to all monitored sites. Bell heather (*Erica cinerea*) was also common to all monitored sites with the exception of Type 5 heather sites.

There were no significant differences in mean soil properties or beetle species numbers. between types. However, significant differences were found between heather vegetation types in the mean number of plant species per site (F=4.51, p<0.01, df 4,26).

Type 1 (n=4; 13%): Upland grassy dry heath

The indicator species of this type were pale sedge (*Carex pallescens*) and *Rhytidiadelphus squarrosus*. Sweet vernal grass (*Anthoxanthum odoratum*), many headed woodrush (*Luzula multiflora*), fescue grasses (*Festuca spp.*), heath bedstraw (*Galium saxatile*) and *Hypnum spp.* were other common species.

Species groups B and C, which contain a number of upland grassland species were most common in this heather type (Table 14). A total of 64 plant species (including bryophytes) was identified from these sites (per $2m^{2)}$, with the second highest mean number species per site (35 $\pm$2.3).

Heather sites described by this vegetation type were found at significantly higher altitudes (mean altitude=273m $\pm$23.0) than the other vegetation types (p<0.05). Grazing was most prominent in this vegetation type, with all sites showing signs of recent/current grazing (Figure 6). All the sites were grazed by sheep.

Half of Type 1 sites correspond to NVC type H10 *Calluna vulgaris-Erica cinerea* (Submontane heather moor), while the other sites are associated with the Nardo-Galion acid grassland NVC type U2, U4 and U5 (U2:*Deschampsia cespitosa*; U4: *Festuca ovina-Agrostis capillaris-Galium saxatile*;U5:*Nardus stricta-Galium saxatile*)

Type 2 (n=6; 19%)**: Gorse/Bracken dominated dry heath**

Gorse (*Ulex europaeus*) was the primary indicator species of this group. Other common species were bilberry (*Vaccinum myrtillus*), sweet vernal grass (*Anthoxanthum odoratum*), fescue grasses (*Festuca spp.*), tufted hair grass (*Deschampsia cespitosa*), pill sedge (*Carex pilulifera*). The most frequently occurring moss species are *Dicranum scoparium* and *Hypnum cupressiforme.* Dead heather was most frequent in this vegetation type.

Species groups D and E, representing species found commonly with bracken and gorse, respectively, and dry heath indicator species were frequently found in Type 2 sites (Table 14). Heather sites from vegetation type 2 had the highest mean number of plant species per $2m^2$ (37 $\pm$3.3), significantly higher than Types 3 and 5 ($p<0.05$). A total of 92 plant species were recorded.

Grazing was common in most of these type 2 sites (67%, Figure 6), with both sheep and cattle grazing recorded. A small number of sites (17%) showed signs of recent burning.

The NVC type M17 *Scirpus cespitosus-Erica tetralix* (Lowland blanket bog) represented 33% of Type 2 sites, with the NVC type H10 *Calluna vulgaris-Erica cinerea* (Submontane heather moor) describing a further 33% of sites. This was the only vegetation type to have a site which was described by NVC type U20 *Pteridium aquilinum-Galium saxatile*, a bracken field.

Type 3 (n=12; 39%)**: Dry/wet (intermediate) heath**

Type 3 indicator species were purple moor grass (*Molinia caerulea*), lichens (Cladonia pyxidata) and the moss *Dicranum heteromalla.* Gorse (*Ulex europaeus*),. Green ribbed sedge (*Carex binervis*) and the moss *Hypnum cupressiforme* was commonly found associated with this heather type.

Species groups D and E, characteristic of dry heath were prevalent in Type 3 sites. Species groups G and H, which contains species indicative of wet heath, such as cross-leaved heath (*Erica tetralix*) and *Sphagnum* spp. were more frequent in this group type. However it should be noted that all species in species group G occur in less than 41% of Type 3 sites (Table 14). These sites had the second lowest mean number of species per site (26 $\pm$1.6) with a total of 87 plant species recorded from all sites.

The majority of these heather sites (83%) showed no recent evidence of grazing, Figure 6.

Over half of Type 3 sites (58%) were associated with NVC type H10 *Calluna vulgaris-Erica cinerea* (Submontane heather moor). A further 33% of sites were characterised by NVC type M17 *Scirpus cespitosus-Erica tetralix* (Lowland blanket bog) and 8% by NVC type H6 *Eriophorum vaginatum-Ulex europaeus* (Northern Eric vag heath).

Type 4 (n=7; 23%)**: Grassy dry heath**

Wavy hair grass *(Deschampsia flexuosa)*, sweet vernal grass (*Anthoxanthum odoratum*) and bilberry (*Vaccinium myrtillus***)** were the indicator species of this heath type. The other most frequently occurring species was the moss *Hypnum jutlandicum.*

Type 4 sites contained high frequencies of species belonging to group E (Table 13), which are dry heath indicator species and species group F, comprising many grassland species and indicative of more calcareous soil conditions, such as blue moor grass (*Sesleria albicans*) and common milkwort (*Polygala vulgaris*). A total of 85 plant species were recorded from these sites, with a mean number of 31 $\pm$ 3.5) plant species per site.

All these sites were associated with NVC type H10 *Calluna vulgaris-Erica cinerea* (Submontane heather moor), and 43% showed signs of recent grazing (Figure 6). A small number of Type 4 sites (14%) had been burned in the recent past.

Type 5 (n=2; 7%)**:Wet heath**

The common species of this group were common sedge (*Carex nigra*), broad bog cotton (*Eriophorum angustifolium*), bilberry (*Vaccinium myrtillus*) and *Polytrichum commune.*

This type contained only two sites and their plant species dominated species group H, which contain species indicative of wet peaty soils (for example *Sphagnum* spp.). These sites had the smallest mean number of plant species per heather site (18 ±4.0), with a total of 28 species identified from these sites. None of these sites were grazed, but one site had been burned accidentally in the past year.

Type 5 heather sites were all assigned to NVC type H6 *Eriophorum vaginatum-Ulex europaeus* (Northern Eric vaga heath).

Table 14. Frequency table of the TWINSPAN classification of Slieve Gullion ESA Heather sites (31 sites).

The frequency value of each species in each TWINSPAN vegetation type is represented by the Roman numerals I-V: I=1-20%; II=21-40%; III=41-60%; IV=61-80%; V=81-100%.

	Plant Species arranged in Species groups A-H	Frequency of species in each TWINSPAN Heather vegetation type: 1-5(number of sites)				
		1 (4)	**2** (6)	**3** (12)	**4** (7)	**5** (2)
A	*Potentilla erecta*	V	V	V	V	V
	Vaccinium myrtillus	IV	V	III	V	V
	Polytrichum commune	III	III	I	III	V
	Dead Calluna vulgaris	III	IV	I	I	III
B	*Anthoxanthum odoratum*	V	V	I	V	III
	Molinia caerulea	V	V	V	V	V
	Luzula multiflora	V	IV	I	-	-
	Carex hostiana	-	I	-	-	-
	Danthonia decumbens	III	II	I	-	-
	Lotus corniculatus	-	I	-	-	-
	Nepeta cataria	-	I	-	-	-
	Rhytidiadelphus squarrosus	V	III	I	-	-
	Thuidium tamariscinum	IV	I	-	-	-
	Sorbus aucuparia	II	I	-	-	-
	Lophocolea bidentata	III	-	-	-	-
	Mycena spp.	III	-	-	-	-
	Trifolium repens	II	I	-	-	
	Teucrium scorodonia	-	II	I	-	-
	Lophozia ventricosa	-	II	-	-	-
	Salix cinerea	-	I	-	-	-
	Nardia scalaris	-	II	-	-	-
C	*Nardus stricta*	IV	III	II	II	-
	Festuca rubra	V	V	I	III	-
	Carex nigra	III	III	II	I	-
	Festuca ovina	V	V	-	III	-
	Viola riviniana	II	II	-	I	-
	Rumex acetosa	-	II	-	I	-
	Galium saxatile	V	III	I	II	-
	Leontodon hispidus	-	III	-	I	-
	Carex pallescens	IV	-	I	-	-
	Holcus lanatus	III	II	I	-	-
D	*Dicranum scoparium*	IV	V	III	I	-
	Pteridium aquilinum	-	IV	I	III	-
	Carex pilulifera	III	V	III	I	-
	Polygala serpyllifolia	III	III	III	-	-
	Cladonia subcervicornis	-	I	I	-	-
	Hypnum cupressiforme	V	V	IV	II	-
	Diplophyllum albicans	-	I	I	-	-
	Cladonia pyxidata	II	III	III	-	-
	Dicranella heteromalla	II	II	III	-	-
	Eurhynchium praelongum	III	III	II	III	-
	Hypnum jutlandicum	V	IV	III	V	-
	Hylocomium splendens	III	I	I	III	-
	Rhytidiadelphus triquetrus	III	-	I	III	-
	Sphagnum subnitens	II	-	I	-	-

Plant Species arranged in Species groups		Frequency of species in each TWINSPAN Heather vegetation type: 1-5(number of sites)				
		1 (4)	**2** (6)	**3** (12)	**4** (7)	**5** (2)
E	*Ulex europaeus*	II	V	V	III	-
	Carex binervis	III	III	IV	II	-
	Deschampsia flexuosa	II	II	I	V	-
	Erica cinerea	V	V	V	V	-
	Pedicularis sylvatica	II	III	III	IV	-
	Carex demissa	-	I	I	I	-
	Succisa pratense	II	I	I	I	-
	Calluna vulgaris	V	V	V	V	V
F	*Agrostis capillaris*	-	I	I	III	-
	Racomitrium lanuginosum	-	I	II	III	-
	Agrostis canina	-	-	II	III	-
	Cladonia portentosa	II	-	II	II	-
	Carex lasiocarpa	-	-	I	II	-
	Rhytidiadelphus loreus	-	-	-	II	-
	Brachythecium rutabulum	-	-	I	I	-
	Pseudoscleropodium purum	-	-	I	III	-
	Plagiothecium denticulatum	-	-	-	I	-
	Luzula campestris	-	-	-	II	-
	Carex flacca	-	-	II	III	-
	Sesleria albicans	-	-	-	IV	-
	Polygala vulgaris	-	-	I	III	-
	Hypericum perforatum	-	-	-	I	-
	Epilobium hirsutum	-	-	-	I	-
	Euphrasia spp.	-	-	-	I	-
	Plantago lanceolata	-	-	-	I	-
	Galium verum	-	-	-	I	-
	Hypochoeris radicata	-	-	-	I	-
	Pleurozium schreberi	-	-	-	III	-
	Marsupella emarginata	-	-	I	I	V
	Aulacomnuim palustre	-	I	I	-	-
G	*Erica tetralix*	-	-	III	I	-
	Sphagnum cuspidatum	-	I	II	I	-
	Narthecium ossifragum	-	-	II	I	-
	Eriophorum vaginatum	-	-	II	-	-
	Cladonia floerkeana	-	-	II	-	-
	Sphagnum compactum	-	-	I	-	-
	Sphagnum papillosum	-	-	I	-	-
	Sphagnum capillifolium	-	-	I	-	-
	Sphagnum rubellum	-	-	II	-	-
	Campylopus introflexus	-	-	I	-	-
	Hypericum pulchrum	-	-	I	-	-
	Rubus fruticosus	-	-	I	-	-
H	*Scirpus cespitosus*	-	II	III	II	III
	Juncus squarrosus	-	I	III	-	III
	Carex panicea	II	III	IV	II	III
	Agrostis stolonifera	II	-	I	III	III
	Sphagnum palustre	-	-	I	-	III
	Deschampsia cespitosa	-	IV	III	III	III
	Blechnum spicant	-	-	I	I	III
	Sphagnum auriculatum	-	I	I	-	III
	Eriophorum angustifolium	-	-	I	I	V
	Juncus effusus	-	-	-	-	III
	Carex rostrata	-	-	-	-	III

Figure 6. Frequency of Heather Grazing in each of the Slieve Gullion Heather Vegetation Types
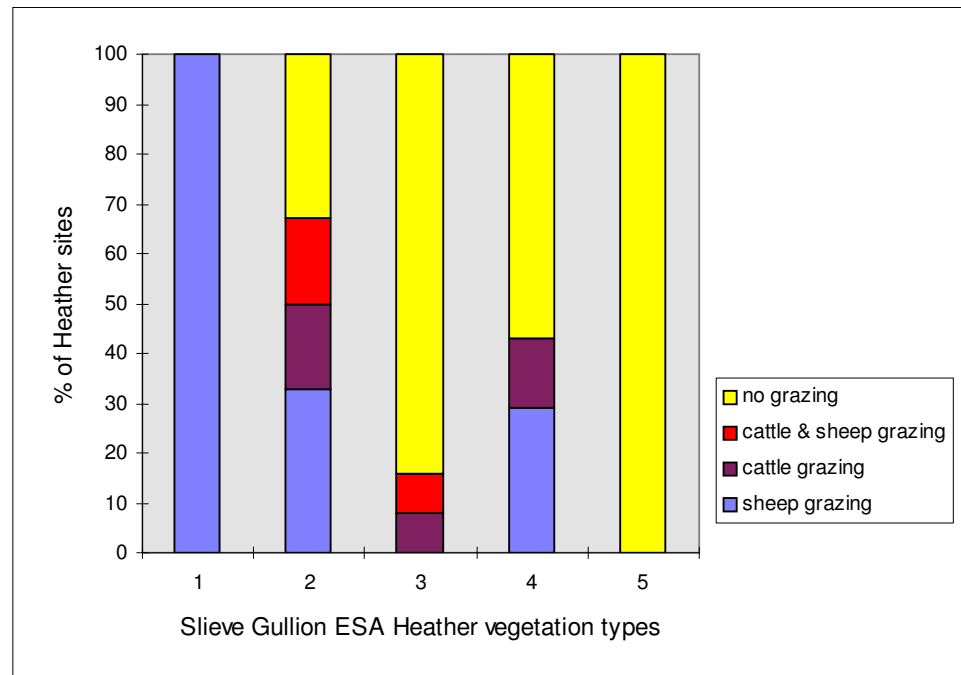
Slieve Gullion ESA Heather vegetation types

1: Upland grassy dry heath

2: Gorse/bracken dominated heath

3: Dry/wet (intermediate) heath

4: Grassy dry heath

5: Wet heath

3.2.4. Invertebrate monitoring in Heather moorland

3.2.4.1. Ground Beetle Species

Between April and October 1994 a total of 11,527 ground beetles of fifty-four species were recorded from seventy-eight heather moorland sites throughout all Environmentally Sensitive Areas (Table 6). Of the species recorded, *Nebria salina*, *Pterostichus rhaeticus*, *Carabus granulatus* and *C. arvensis* accounted for 49% of the total catch. The greatest mean number of ground beetle and plant species per site were recorded from Rathlin Island (group 1 - Table 14).

I. Classification of ground beetle species

A classification of ground beetles trapped on heather moorland sites (using TWINSPAN) revealed five major groups (Figure 7). Preliminary investigation suggested that the two extremes, namely Groups 1 and 5, were dry and wet heath respectively (Table 15). Further examination of the groups showed that the greatest mean number of ground beetle and plant species per site were recorded in Group 4 and Group 1 respectively. Furthermore, those sites contained within Group 1, typically those from the Slieve Gullion ESA and Rathlin Is., were found at the lowest altitudes (Table 16).

Investigation of the peat cores obtained from all study sites subsequently revealed that sites within Group 1 were significantly less acidic than all other groups. Potassium concentration was significantly higher in group 1 than in Groups 3 and 5. However, the mean % moisture associated with Group 1 was shown to be lower than in all other groups, and significantly lower than in Group 5 (Table 17). Application of NVC further suggests that there are interpretable habitat types associated with each of the ground beetle groups (Table 18).

3.2.4.2 Spiders

Spider species are currently being identified.

Figure 7. Dendrogram showing groups and indicator species from TWINSPAN classification of ground beetles throughout all heathland sites in NI ESAs.

Group 1   **Group 2**   **Group 3**   **Group 4**   **Group 5**
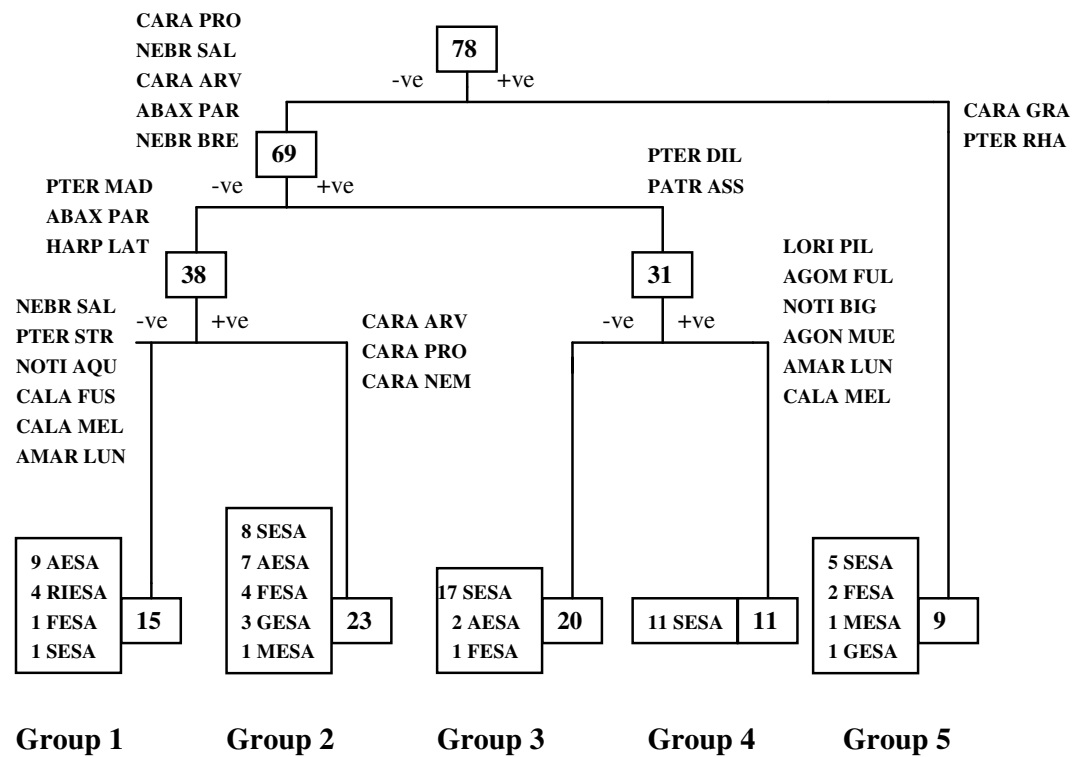
KEY
FESA - WEST FERMANAGH AND ERNE LAKELAND ESA
MESA - MOURNES AND SLIEVE CROOB ESA
GESA - ANTRIM COAST AND GLENS
RIESA - RATHLIN ISLAND
SESA - SPERRINS ESA
RESA - SLIEVE GULLION ESA

Table 15. Species list and number of ground beetles captured in pitfall traps and the number of site occurrences.

Species and Authority	Total number trapped	Site occurrence
Abax parallelepipedus (Piller and Mitter 1783)	|767	53
Agonum fuliginosum (Panzer,1809)	|65	20
Agonum muelleri (Herbst,1784)	|13	9
Amara aenea (Degeer,1774)	|3	2
Amara communis (Panzer,1797)	|4	3
Amara lunicollis Schioedte,1837	|31	12
Amara ovata (F.,1792)	|3	2
Amara plebeja (Gyllenhal,1810)	|3	3
Bembidion aeneum Germar,1824	|1	1
Bembidion bruxellense Wesmael,1835	|1	1
Bembidion lampros (Herbst,1784)	|17	11
Bradycellus harpalinus (Serville,1821)	|2	2
Bradycellus verbasci (Duftschmid,1812)	|1	1
Calathus fuscipes (Goeze,1777)	|92	18
Calathus melanocephalus (L.,1758)	|96	18
Carabus arvensis Herbst,1784	|946	52
Carabus clatratus L.,1761	|1	1
Carabus glabratus Paykull,1790	|71	10
Carabus granulatus L.,1758	|1095	54
Carabus nemoralis Mueller,1764	|435	44
Carabus nitens L.,1758	|49	14
Carabus problematicus Herbst,1786	|740	61
Cychrus caraboides (L.,1758)	|20	14
Cymindis vaporariorum (L.,1758)	|1	1
Elaphrus cupreus Duftschmid,1812	|4	3
Harpalus latus (L.,1758)	|64	19
Harpalus rufipes (Degeer,1774)	|3	2
Laemostenus terricola (Herbst,1784)	|1	1
Leistus fulvibarbis Dejean,1826	|1	1
Leistus rufescens (F.,1775)	|48	16
Loricera pilicornis (F.,1775)	|77	25
Nebria brevicollis (F.,1792)	|974	43
Nebria salina Fairmaire et Laboulbene, 1854	|1896	46
Notiophilus aquaticus (L.,1758)	|56	24
Notiophilus biguttatus (F.,1779)	|22	12
Notiophilus germinyi Fauvel,1863	|2	2
Notiophilus palustris (Duftschmid,1812)	|40	21
Olisthopus rotundatus (Paykull,1790)	|43	18
Patrobus assimilis Chaudoir,1844	|40	17
Pterostichus adstrictus Eschscholtz,1823	|26	2
Pterostichus anthracinus (Panzer,1795)	|2	1
Pterostichus diligens (Sturm,1824)	|233	45
Pterostichus madidus (F.,1775)	|418	30
Pterostichus melanarius (Illiger,1798)	|560	57
Pterostichus minor (Gyllenhal,1827)	|2	2
Pterostichus niger (Schaller,1783)	|741	63
Pterostichus nigrita (Paykull,1790)	|39	7
Pterostichus rhaeticus Heer	|1693	62
Pterostichus strenuus (Panzer,1796)	|65	30
Pterostichus vernalis (Panzer,1795)	|4	3
Pterostichus versicolor (Sturm,1824)	|11	3
Synuchus nivalis (Panzer,1797)	|2	2
Trechus obtusus Erichson,1837	|1	1
Trichocellus cognatus (Gyllenhal,1827)	|2	1

Total number of sites : 78
Total number of species : 54
Total number of individuals trapped : 11,527

Table 16. Heather vegetation types associated with each Beetle TWINSPAN group sites.

Heather vegetation types		Percentage of ground beetle group sites				
Description	Indicator species	1 (n=15)	2 (n=23)	3 (n=20)	4 (n=11)	5 (n=9)
Typical wet heath	1. SCIR CES NART OSS ERIC TET ERIO SPP SPHA SPP JUNC SQU	6.7	26.1	65.0	54.5	88.9
Grassy wet heath with bilberry	2. VACC MYR ANTH ODO POLY COM MOLI CAE ERIO VAG	6.7	30.4	15.0	36.4	11.1
Typical dry heath	3. ERIC CIN ULEX EUR MOLI CAE POTE ERE	46.7	26.1	10.0	-	-
Grassy dry heath with bilberry	4. ERIC CIN VACC MYR ANTH ODO POTE ERE	40.0	17.4	10.0	9.1	-

Table 17. Mean values of Ground beetle and plant species and mean altitude associated with NI ESAs' Heather Sites.

Heather Ground beetle end-group (df=, 4,73)	Mean (±standard error)			
	Ground beetle species ($F=29.47$, $P<0.001$)	Plant species ($F=7.41$, $P<0.001$)	Altitude (m) ($F(4,73)=4.81$, $P<0.01$)	Number of sites in each group
1	17 (0.7) **b**	35 (1.9) **a**	168 (19.7) [a]	15
2	11 (0.6)[ab]**c**	27 (1.6) [a]	220 (11.3)	23
3	10 (0.7) [ab]**d**	28 (1.6) [a]**c**	226 (14.2)	20
4	18 (1.2) **a**	31 (1.6) **b**	259 (12.9) **a**	11
5	6 (0.9) [abcd]	20 (1.5) [abc]	170 (22.6) [a]	9

Means with the same superscript are significantly different from the mean underlined superscript
(**a** is significantly different from [a]: Tukey multiple comparison test, $P<0.05$)

Table 18. Mean values of soil properties associated with Heather Ground beetle TWINSPAN endgroups.

Heather Ground beetle endgroup (df=4,66)	Mean (+standard error) values of Heather sites' soil properties (one-way ANOVA)					
	pH (F=11.02, P<0.001)	Phosphorous (mg/l)	Potassium (mg/l) (F=3.63, P<0.01)	Magnesium (mg/l)	% Organic	% Moisture (F=2.56 P<0.05)
1 (n=12)	4.6 (0.11) **a**	7 (1.3)	156(40.6) **a**	180 (48.9)	63 (5.6)	69 (3.2) [a]
2 (n=22)	4.2 (0.06) [a]	6 (0.6)	97 (8.6)	114 (14.0)	92 (15.9)	77(2.3)
3 (n=20)	4.1 (0.04) [a]	7 (0.6)	71 (9.4) [a]	148 (13.8)	80 (5.4)	77 (2.9)
4 (n=9)	4.0 (0.04) [a]	8 (0.8)	86 (15.5)	140 (14.9)	79 (7.7)	77 (5.1)
5 (n=8)	4.1 (0.07) [a]	5 (0.6)	57 (10.7) [a]	150 (23.5)	96 (0.5)	90 (1.1) **a**

Means with the same superscript are significantly different from the mean underlined superscript (**a** is significantly different from [a]: Tukey multiple comparison test, P<0.05)

Table 19. NVC types of each Beetle TWINSPAN group sites.

NVC TYPE	PERCENTAGE FREQUENCY OF EACH BEETLE TWINSPAN GROUP SITES				
	1 (n=15)	2 (n=23)	3 (n=20)	4 (n=11)	5 (n=9)
M15: Scir ces-Eri tet Northern wet heath	27	35	35	18	22
H10: Call vul-Eric cin Submontane heather moor	67	48	5	9	22
M17:Scir ces-Erio vag Lowland blanket bog	6	9	35	18	45
M19:Call vul-Erio vag Upland blanket bog	-	-	25	46	11
U4: Fest ovi-Agro cap-Gali sax Nardo-Galion acid grass	-	4	-	9	-
M18: Eric tet - Spha pap Raised bogs	-	4	-	-	-

4.0.   ASSOCIATED STUDIES

4.1. West Fermanagh and Erne Lakeland ESA general farm management survey

In 1993 a farm management survey was conducted on a random survey (53%) of monitored farms. Socio-economic factors such as farm size, age of farmer and field management data, for example, fertiliser inputs, livestock densities and hay meadow cutting dates were recorded.

The information has been used as part of a MSc research project to assess farmers' attitudes to the ESA designation and the associated ESA management prescriptions. Associations between the field management data and biological data have been made for the hay meadows and wet pastures (McKinney, 1994).

Only 9.4% of the farmers surveyed said they definitely would not join the ESA scheme. Nutrient inputs, cutting dates and stocking rate all had a significant effect on the sward composition of hay meadows. More species-rich hay meadows were found on fields receiving smaller nutrient inputs. Later cutting dates, in July were associated with higher species diversity. More than 74% of the hay meadows surveyed are usually cut in July or afterwards. It was noted that fields cut in June were receiving approximately twice as much nutrient inputs as the other fields.

Stocking rate was found to have a significant effect on the sward composition of wet pastures, with higher stocking rates being associated with species-poor wet pastures. It was noted that 80% of the species-poor wet pastures have been drained and either sprayed or cut for rushes. The period of time which a wet pasture is flooded each year may also have an effect on the species composition of wet pastures.

Currently detailed research (as part of PhD thesis) is being undertaken to investigate the effects of stocking densities (for example, poaching) on botanical composition, invertebrate communities and selected bird wader species (E. Mallon, Department of Applied Plant Sciences, Queens' University , Belfast (DENI & RSPB))

4.2. West Fermanagh and Erne Lakeland ESA Woodland survey

As part of a MSc research project (Monaghan, 1994), a woodland farm survey was carried out on a random selection (70%) of monitored woodlands (1993) in the West Fermanagh and Erne Lakeland ESA. Results from the biological monitoring programme were used in conjunction with details on woodland management, present and past. The ESA scheme management guidelines for woodlands stipulate that woods should be fenced to exclude grazing animals. The aim of this policy is to promote maximum species diversity and regeneration of species. Conclusions from this research indicate that in the surveyed woods, low levels of grazing and timber cutting were compatible with maintaining high diversity, whereas absence of grazing and timber cutting may reduce species, affect vertical structure, promote potential dominants and reduce species diversity.

4.3. Heather management surveys

It is proposed to conduct farm management surveys in the Sperrins and Slieve Gullion ESA, to assess socio-economic factors and current heather management practices. Attitudes to proposed ESA heather management guidelines will be investigated.

5.0. National Vegetation types (NVC) and CORINE types of NI ESA habitats

A summary of the major NVC types and CORINE types of the ESA habitats monitored in 1993 and 1994 main vegetation types, is listed in Appendix 8.

6.0.   DISCUSSION

The baseline monitoring programme in 1994 has helped describe the nature of woodlands in the Antrim Coast, Glens and Rathlin ESA and heather moorland throughout all ESAs in Northern Ireland, in particular, in the most recently launched ESAs, the Sperrins and Slieve Gullion. Prior to this monitoring programme there was very little, if any detailed information available on plant and invertebrate communities in ESA target habitats in Northern Ireland. This stresses the ecological importance of baseline data. Classification of vegetation communities within habitats must be specific to Northern Ireland, as the National Vegetation Classification (Rodwell, 1991) is primarily for use in Great Britain, which has a more extensive flora. The Northern Ireland ESA monitored woodlands were not able to be reliably assigned to any NVC type, so indicating the need for a specific NI woodland classification and description.

Hazel scrub was more common in the Antrim Coast, Glens and Rathlin ESA than in the West Fermanagh and Erne Lakeland ESA, where blackthorn thickets were more abundant. Hazel (*Corylus avellana*), Sycamore (*Acer pseudoplatanus*), hawthorn (*Crataegus monogyna*), ash (*Fraxinus excelsior*) and brambles (*Rubus fruticosus*) were very common in Antrim woods, with ancient woodland indicator plant species such as wood anemone (*Anemone nemorosa*), primrose (*Primula vulgaris*) and bluebell (*Hyacinthoides non-scripta*) present in more than 65% of monitored woodlands. The majority of the West Fermanagh and Erne Lakeland ESA woods were grazed (90%). Only 36% of the monitored Antrim Coast, Glens and Rathlin ESA woods showed signs of current grazing. Woodlands which had been fenced off, or were not grazed by livestock, did show indications of higher regeneration rates for the majority of tree and shrub species, and had more young trees in their stands, with the exception of birch and holly.

Woodland vegetation was classified using TWINSPAN into four major vegetation groups, based on tree/shrub and ground flora data from 14mx14m quadrats from each woodland site. The most common woodland vegetation group, representing 46% of monitored sites, was described as 'mixed species wet scrub', containing many plant species indicative of wet conditions. This group had the highest species diversity and contained many species indicative of ancient woodlands. It should be noted that some primary woodland indicator species in Ireland have been noted occasionally in different habitats (Praeger 1934, Webb

1977), and this has been related to the oceanic nature of the climate (Cooper 1984). However the existence of hazel woods has been documented in the Antrim Plateau, as hazel woods were often listed for sale between 1730 and 1780 (McCracken 1971).

The next most common vegetation group, (29% of monitored woods), was 'mixed species scrub' which had the second highest species diversity, and these woods were found on more upland regions, with trees such as rowan (*Sorbus aucuparia*). These two woodland vegetation groups are both primarily hazel scrub groups as hazel was the dominant tree species in both groups. The overgrown woodland group, which was dominated by bracken (*Pteridium aquilinum*) and brambles (*Rubus fruticosus*) represented 18% of monitored sites, while the species-poor group characterised by predominance of competitive-ruderal grasses only described 2 sites.

This work agrees with findings from a survey of Hazel scrub in North East Ireland by Cooper (1984), where badly drained woods had a relatively higher proportion of regionally rare plant species and higher species diversity. These badly drained woods correspond to the mixed-species wet scrub classification group which had the greatest species diversity in the Antrim Coast, Glens and Rathlin ESA. Woodlands within the Antrim Coast, Glens and Rathlin ESA tended to be small, and the small size of woods may increase the reduction in species diversity and local species extinction, where the woodland becomes overgrown, resulting in canopy closure and reduction in light (Pickett & Thompson, 1978). Trees, such as hazel, which are capable of coppice regeneration have benefited from grazing and coppicing and where this ceases there may be a highly noticeable effect on tree regeneration and canopy composition (Cooper 1984).

Woods, as well as being an important landscape feature, act as essential wildlife reservoirs. Less than 5% of Northern Ireland is covered by broad-leaved trees, and the small size and scattered patterns of existing woods highlights the necessity for their conservation. Currently many of the ESA woodlands harbour a wide species diversity, including many primary woodland indicator plant species. For this species diversity to be maintained, management strategies need to be implemented. Under an ESA farm agreement, any woodlands are fenced off from livestock, so this should benefit tree regeneration in the short term. Woods, especially in the West Fermanagh and Erne Lakeland ESA were noted to be grazed and many are used to over-winter cattle. Fencing off these woodlands should improve the species diversity of these woods. After one-year of entering the ESA scheme, all farms with woods

which are less than 1.0 ha will be issued with a specific long-term ESA woodland management programme, issued by DANI staff. Woodlands which are more than 1ha are referred to DANI Forestry Service for woodland management plans.

Heather moorland is an important component of the landscape within Environmentally Sensitive Areas. The main threats to heather moorland nationally are the changes in land use, mainly by the conversion to arable agriculture, forestry, mechanised peat extraction and urban development. Further habitat degradation has also arisen as a consequence of the cessation of traditional heathland management practices (low intensity grazing and burning). However, in recent years there has been little tradition of heather regeneration within Northern Ireland and in many situations this has led to overgrazed stands of heather which are in need of positive management. The introduction of the Environmentally Sensitive Areas scheme, particularly in the Sperrins and Slieve Gullion, has highlighted the importance of targeting heathlands.

The importance of base-line monitoring of heather throughout all Environmentally Sensitive Areas has helped to define the different types of heathland that exist and has also provided comprehensive evidence of the need for long term management.

Heather monitoring has now been carried out on all Northern Irelands' ESAs. Rathlin Island ESA heather sites had the greatest species diversity, with significantly more plant species and ground beetle species per site. Sheep grazing is dominant in most ESAs, with the exception of the West Fermanagh and Erne Lakeland ESA and Rathlin where cattle are more common. Grazing was least prevalent in the Slieve Gullion ESA, where over half of the monitored sites showed non recent evidence of grazing. Evidence of past burning, was very infrequent with any found usually as a result of accidental burning. Heather burning as a form of heathland management was only recorded on one site in the Sperrins. Half of the sites where peat cutting was evident were present in the Sperrins ESA.

Four major heather vegetation types were recognised from TWINSPAN analysis of all monitored heather sites throughout NI ESAs. Over half (60%) of all NI ESAs heather monitored sites were classified as wet heath, with the indicator species cross-leaved heath (*Erica tetralix*). This group was subdivided into two types, typical wet heath and grassy wet heath with bilberry. The typical wet heath type was the most common (41% of monitored sites), representing the majority of sites from the Sperrins, Antrim Coast and Glens and the West Fermanagh and Erne Lakeland ESAs. Typical wet heath was characterised by the

presence of cross-leaved heath (*Erica tetralix*), bog cotton (*Eriophorum* spp.), bog asphodel *(Narthecium ossifragum*) and deer grass (*Scirpus cespitosus*). The smallest species diversity in both plants and invertebrates was recorded from these sites. This would be expected, as wet heath soil conditions are restrictive (acidic, high moisture and organic matter content) and only a small range of specialised plant species are adapted to live under such conditions, therefore stressing the importance of maintaining wet heath. The grassy wet heath type was characterised by bilberry (*Vaccinium myrtillus*) and sweet vernal grass (*Anthoxanthum odoratum*) and included 29% of the Sperrins ESA sites and 24% of the West Fermanagh and Erne Lakeland ESA sites.

Dry heath, with the indicator species bell heather (*Erica cinerea*) accounted for 40% of monitored heather sites, with two main types, typical dry heath and grassy dry heath with bilberry. The typical dry heath type characterised by the presence of gorse (*Ulex europaeus*) and tormentil (*Potentilla erecta*) described the majority of the Mournes and Slieve Croob ESA sites, and half of Rathlin and Slieve Gullion monitored sites. Grassy dry heath with the indicator species bilberry (*Vaccinium myrtillus*) and sweet vernal grass (*Anthoxanthum odoratum*), accounted for 21% of monitored heather sites. This vegetation type had the highest species diversity of both plant and ground beetle species.

These NI ESA heather vegetation types were closely associated with NVC types. For example 92% of the typical wet heath type were assigned to NVC Mires types M15, M17, and M19, blanket bog and wet heath types. The majority of the dry heath vegetation type (71%) was associated with NVC heath type H10 *Calluna vulgaris - Erica cinerea*.

The Sperrins and Slieve Gullion are primarily heather ESAs and to enable more detailed analysis of change over time, separate classifications of heather vegetation were performed on each of these ESAs in addition to the overall NI heather classification.

The Sperrins ESA heather sites were described by four main vegetation types. The blanket bog type, characterised by cross-leaved heath (*Erica tetralix*), bog cotton (*Eriophorum* spp.), bilberry (*Vaccinium myrtillus*), tormentil (*Potentilla erecta*) and *Sphagnum* spp. was the most common vegetation type representing 42% of monitored sites. The other wet heath type, described as lowland wet heath contained species characteristic of very wet peaty soils and the lowest mean site altitude was recorded for this vegetation type. Lowland wet heath had

the smallest species diversity, for both plants and ground beetle species. Once more the importance of this low species diversity should be stressed, as conservation of heather moorland involves primarily conserving heather moorland species which can only survive in a limited range of conditions, as provided by lowland wet heath. The grazed upland wet heath type was the second most common Sperrins vegetation type, containing plant species indicative of high grazing pressures and upland conditions, as these sites had the highest mean altitude. The grassy heath vegetation type accounted for only 11% of monitored sites, and this type was the most species diverse, in terms of plant and ground beetle species. This may be accounted for by the higher soil nutrient levels, lower organic matter content, and the ability to support a wider range of flora and fauna, more akin to upland grasslands than heathland vegetation. It should be noted that the soil nutrient levels were still very low compared to intensively managed lowland grasslands, as more diversity is generally associated with lower fertility sites.

Slieve Gullion heather sites were described into 5 major vegetation types, with types 1-4 primarily dry heath types and type 5, (representing only 7% of monitored sites) described as wet heath. The heather sites from the Slieve Gullion vegetation types were more similar in their environmental variables, than the Sperrins heather vegetation type sites, as no significant differences were recorded in soil properties, altitude or mean number of ground beetle species per site. The commonest heath type was the dry/wet (intermediate) heath type accounting for 39% of the Slieve Gullion sites. This type contained more species indicative of wet heath conditions than any other vegetation type, as well as characteristic dry heath species. However any wet heath indicator species were always present in less than 41% of the sites monitored. The grassy dry heath type, with wavy hair grass (*Deschampsia flexuosa*), sweet vernal grass (*Anthoxanthum odoratum*) and bilberry (*Vaccinium myrtillus*) described a further 23 % of the Slieve Gullion heather sites. The gorse/bracken dominated dry heath accounted for 19% of monitored sites and had the highest plant species diversity of all types, with the upland grassy heath type having the next highest mean number of plant species per site.

The classification of the ground beetle species has revealed five distinct groups, with subsequent National Vegetation Classification (NVC) suggesting that these groups have particular habitat-type associations.

Two species of particular note are *Carabus nitens* and *Cymindis vaporariorum.* The recently recorded distribution of *C. nitens* would suggest that this species is in decline throughout Ireland. During the present monitoring programme a total of 49 individuals of *C. nitens* were trapped from 14 heather moorland sites from the West Fermanagh and Erne Lakeland (3), Antrim Coast, Glens (1) and Sperrins (10) ESAs. Importantly, this species was not trapped from any other monitored habitat type. Furthermore, *C. nitens* was not recorded from the Mournes and Slieve Croob and Slieve Gullion ESAs and from Rathlin Island. These findings are consistent with the previously recorded distribution of this species in western Europe. Preliminary investigation of the plant species associated with those sites where *C. nitens* was recorded described these sites as being typically "wet heath". Subsequent application of NVC revealed that sites were either blanket bog or Northern wet heath.

The small ground beetle *Cymindis vaporariorum* was recorded from a single site on Rathlin Island. This site, on a south-facing slope with very shallow peaty soil on outcropping basalt, has unrestricted grazing which has resulted in a relatively open, stunted *Calluna* sward. This sites was subsequently classified by NVC as Submontane heather moorland (indicator species,: *Calluna vulgaris/Erica cinerea).* This Rathlin site is at a relatively low altitude and is not particularly close to the exposed coastline. Ground conditions appeared dry but do not equate with the "sandy moraine" identified by Lindroth (1974) as typical of British habitats. Furthermore, as *Cymindis* was not located in any of the other ESAs this tends to support the perceived restriction to coastal areas within Ireland. On Rathlin Is. this species may prove to be a useful indicator species for dry, submontane heath habitats and will receive appropriate attention in future monitoring.

The introduction of the Environmentally Sensitive Areas scheme, particularly in Co. Fermanagh, has highlighted the need to protect internationally important habitats. In those ESAs where heather moorland is an integral part of the landscape there is now a recognition that the management of heather moorland is of increasing importance. Usher (1992) in his discussion of the management and diversity of arthropods in *Calluna* heathland concludes that there is insufficient effort, both nationally and internationally, to conserve the heathlands of Europe. However, the present study highlights the importance for both plant and invertebrate communities that constructive management programmes be considered. After joining the ESA scheme a regeneration plan will be drawn up for any area of heather on the farm and this will involve controlled burning and flailing. Indeed, Hyman and Parsons (1992)

concluded that in order to maintain viable populations of *C. nitens* the management of heathland should aim for a diversity of successional stages, preferably by controlled grazing or by rotational cutting or burning.

7.0.   Proposed monitoring programme 1995

7.1. Landscape monitoring of NI ESAs - 1995

7.1.1. Background

Landscape monitoring involves

1. <u>Landscape Assessment</u> - provides an overview of the landscape character/ value of each ESA, carried out soon after designation. This involves describing patterns and spatial composition of landscape elements which make up the different landscape types across the ESAs.

a.   - land cover -   vegetation /settlements

b.   - linear features

c.   - historical features

This will result in a description of the general landscape, and major landscape types of each of the NI ESAs, a baseline landscape assessment

2<u>. Landscape Monitoring</u> - recording more detailed information on landscape elements which are identified by landscape assessment as significant in determining the landscape type character. The re-survey will record any changes occurring to landscape elements and therefore assess their impact on the overall character and landscape value of the ESA. Landscape monitoring provides the basis for integrated environmental management as it describes the major landscape patterns and reflects the broad ecological and cultural patterns of the ESA and permits refinement of management prescriptions where appropriate. The assessment of the effectiveness of the ESA scheme requires integration of the biological, landscape, historical and management monitoring.

7.1.2. Aim of Landscape ESA monitoring

The aim of landscape monitoring is to assess the impact of the ESA scheme on the character and quality of the landscape. This will involve the following:

1. Applying general principles of landscape ecology to a description of landscape within ESAs.

2. Quantifying the change in quality of field boundaries and other habitats subject to ESA prescriptions and enhancement plans.

3. Integrating biological descriptions of a range of habitats with their spatial distribution in the landscape.

These results will act as a base line for further change within the ESA.

7.1.3. Proposed Methodology

7.1.3.1. Sampling strategy

The Northern Ireland land classification provides a stratified random sampling method for ecological surveys (Cooper 1986). This multivariate land classification technique classified 1 km grid squares into relatively homogeneous units on the basis of map attributes. The major land types within an area can be summarised using the unique spatial distribution of each land class. It is a rational system for stratifying landscapes. This approach was used in the NI landscape ecological surveys of AONBs and Fermanagh (Cooper et al.,1989-1992).

All Northern Ireland ESAs will be monitored: West Fermanagh and Erne Lakeland, Antrim Coast, Glens and Rathlin, Mournes and Slieve Croob, Sperrins and Slieve Gullion. Each ESA consists of a number of major land class groups, and this will form the basis of stratification for the landscape monitoring programme. The land class groups represent relatively homogeneous landscape types. Each major land class group will be sampled in proportion to its land coverage within the ESA. 25ha random squares will be the standard sampling unit, providing a total coverage of 0.5-2% of each ESA. This stratification sampling programme will enable landscape data obtained to be extrapolated to the entire ESA. It provides greater dispersion and representation of samples and potentially greater accuracy and precision of estimates than simple random sampling.

7.1.3.2. Data collection

The 25ha squares will be surveyed in all ESAs from April to September inclusive. The ESA landscape monitoring will record all information below (as recorded in NI Landscape Ecological Surveys - Cooper <u>et al</u>.)

1. Semi-natural vegetation: type, structure, main species, management.
2. Agriculture: crops, animals, farming practice
3. Field boundaries: type, management
4. Topography and ground features

In addition fields and semi-natural vegetation will be initially classified according to guidelines issued by the Department of Agriculture, as used by their Group Staff to classify ESA farms and in relation to ESA habitat management guidelines. In addition more detailed habitat descriptions: using major vegetation types derived from 1993 and 1994 ESA baseline monitoring will be added. These vegetation types will be identified by key indicator species. Historic features and their condition will also be mapped. Additional information such as colour of farm buildings, presence of old farm gates / pillars will be also be recorded, as these are the types of operations targeted for grant aid under enhancement plans.

The data will be entered into the GIS system PC ARC/INFO. This will allow spatial recording and display of the data and will also permit the quantitative analysis following resurvey. The PC ARC/INFO system is particularly favoured because of its capability to incorporate the biological data already collected and the ability in the future, to cope with other datasets (for example, the Northern Ireland soil survey). This will greatly enhance the monitoring exercise. The ARC VIEW system, which is linked to ARC/INFO, will allow sophisticated output and display of the data.

7.2. Invertebrate monitoring

Invertebrate monitoring will continue on sites in the West Fermanagh and Erne Lakeland ESA which were resurveyed in 1994 to account for seasonal fluctuations. Additional invertebrate monitoring will take place on the ESA DANI demonstration farm at Glenwherry, Co. Antrim.

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9.0.   List of publications/presentations

9.1.   Workshops

4-5 October 1994: ESA Monitoring Workshop at Queens University Belfast. Participants from ADAS, SOAF, MLURI, ITE and DANI. Presentations were given on the monitoring programmes on each regions' ESAs (England, Scotland, Wales and Northern Ireland). Monitoring methodology was discussed in detail. A summary report of this workshop is available.

13-14 October 1994. DANI/DOE ESA Workshop. Drumshane Hotel, Lisnarick. Presentations were given on the biological monitoring programme in ESAs.

9.2.   Publications

9.2.1. Poster Abstracts

Cameron, A., McFerran, D., Hegarty, C. & McAdam, J. 1995. Invertebrate monitoring on Environmentally Sensitive Areas in Northern Ireland. Irish Botanists Meeting. Maynooth. April 1995.

Hegarty, C.A., McFerran, D., Mullholland, F. & McAdam, J. 1993. Monitoring of Environmentally Sensitive Areas in Northern Ireland. The 3rd Irish Environmentalists Colloquium. Belfast, January 1993.

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9.2.2. Papers

Anderson, R., McFerran, D.M. & Cameron, A. (in press) A recent Irish record of *Cymindis vaporariorum* (L) (Coleoptera: Carabidae) in Rathlin ESA. *Irish Naturalists Journal*.

Hegarty, C.A., Cooper, A. & McAdam, J. 1994. Factors influencing the plant species composition of hedges - implications for management in Environmentally Sensitive Areas. In: *Field Margins: Integrating Agriculture and Conservation*. Ed. N. Boatman. British Crop Protection Council. Proceedings of a symposium held at the University of Warwick, Coventry. 18-20 April 1994. BCPC Monograph No 58 pp 227-234.

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McFerran, D.M., Hegarty, C.A. & Cameron, A. (1995) Ground beetle (Coleoptera:Carabidae) assemblages associated with heather moorland within Environmentally Sensitive Areas in Northern Ireland. Abstract of the paper presented at the 5th Irish Environmental Researchers Colloquium, Cork 1995.

McFerran, D.M., Hegarty, C.A. & Cameron, A. (in press). Ground beetle (Coleoptera:Carabidae) assemblages associated with heather moorland within Environmentally Sensitive Areas in Northern Ireland. *Biology and the Environment*. Royal Irish Academy. *Biology and the Environment*. Royal Irish Academy.

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10.0.　　　　LIST OF APPENDICES

APPENDIX 1

Lists of 1994 monitored sites' grid references and Recorder codes

I. WOODLAND MONITORING SITES
ANTRIM, GLENS & RATHLIN ESA - MAY 1994

Farm number	Invertebrate site	Recorder code	Woods Grid reference
1		8099 WD1A B01	a: D22753115
2	INV	8100	a: D13943707
3	INV (3a)	8101	a: D14393968 b: D14103964
4	INV	8102	a: D14103676
5	INV	8103	a: D14103583
6	INV	8104	a: D13003830
7	INV	8105	a: D18963745
8	INV	8106	a: D13594067
9	INV	8107	a: D18673874
10	INV	8108	a: D24493354
11	INV	8109	a: D33401462
12	INV (12a, 12b)	8110	a: D30461460 b: D30171195 c: D30181375
13	INV	8111	a: D30560646
14		8112	a: D30590940
15	INV	8113	a: D33541283
16		8114	a: D22502755 b: D22612775
17		8115	a: D19303080
18		8116	a: D22633220
19		8117	a: D23203930
20		8118	a: D22563210
21		8119	a: D245537150
22		8120	a: D24553010

II. HEATHER MONITORING SITES

1. RATHLIN ESA - HEATHER MONITORING SITES - JULY 1994

Farm number	Invertebrate sites	Recorder Code	Site grid references
1	INV (1a)	8143	a: D15254936 b: D15264742
2	INV (2a)	8144	a: D14655146 b: D14755147
3	INV (3a)	8145	a: D14655186 b: D14615186
4	INV (4a)	8146	a: D14095208 b: D14255220

2. SLIEVE GULLION ESA - HEATHER MONITORING SITES - JULY/AUGUST 1994

Farm number	Invertebrate sites	Recorder codes	Site grid references
1	INV	8074	J018224
2	INV	8075	J021235
3	INV	8076	J029234
4		8077	J028228
5		8078	J024232
6		8079	J029231
7	INV	8121	J02122331
8	INV	8122	J02752295
9		8123	J02802287
10		8124	J01252222
11		8125	J01122202
12	INV (12a)	8126	a: H99122269 b: H99192282
13	INV (13a)	8127	a: H99322330 b: H99342315
14	INV	8128	J00311678
15	INV	8129	H98882494
16	INV	8130	H99022488
17	INV	8131	H98942493
18		8132	H99282247
19	INV	8133	J00532541
20		8134	J01682573
21		8135	H98492508
22	INV	8136	H96892355
23	INV (23a)	8137	a: H96932235 b: H96952240
24	INV	8138	H97652030
25	INV	8139	H9767161
26	INV	8140	H97091864
27	INV	8141	H98761801
28		8142	H99481770

3. SPERRINS ESA HEATHER MONITORING SITES - AUGUST 1994

Farm number	Invertebrate sites	Recorder code	Grid reference
1		8080	H544837
2		8081	H562854
3		8082	H504845
4		8083	H482948
5		8084	H475958
6		8085	H645967
7	INV	8147	H46529517
8	INV	8148	H44499884
9		8149	a: H47219697 b: H47259688
10		8150	H51229746
11		8151	H48769765
12	INV (12a)	8152	a: H73118752 b: H74618832
13	INV	8153	H67668550
14	INV	8154	H65688399
15	INV	8155	H63788238
16	INV	8156	H69488292
17	INV (17a)	8157	a: H63659587 b: H63629570
18	INV	8158	H51868551
19	INV (19a)	8159	a: H67089347 b: H67189355
20	INV	8160	H55448023
21	INV	8161	H60248832
22	INV	8162	H50029747
23	INV	8163	C8370188
24	INV (24a)	8164	a: C67360213 b: C67240193
25	INV (25a, b)	8165	a: H71809235 b: H71699220 c: H71619241
26	INV	8166	H71829134
27	INV	8167	H78799017
28	INV (28a)	8168	a: H71698791 b:H71688788
29	INV	8169	H69098986
30	INV (30a)	8170	a: H79539149 b: H79359150
31	INV	8171	H80159109
32	INV	8172	C82280662
33	INV	8173	C81540855
34	INV	8174	C81740804
35	INV	8175	C82520847
36	INV (36a)	8176	a: C78420287 b: C77740471
37	INV (37a)	8177	a: C76420555 b: C76390562
38	INV	8178	C65740241
39	INV	8179	C65840238
40	INV	8180	C67200347
41	INV	8181	C66160346
42	INV	8182	C62070194
43	INV	8183	C82430654
44	INV	8184	H56008541

4. ANTRIM COAST, GLENS AND RATHLIN ESA - MONITORED SITES 1993

Farm	Invertebrate	Recorder code	Grid reference
1	INV a.	8066	a.D339046 b.D33790445 c.D34200455
2	INVq.	8067	a.D295082 b.D29250800
3	INVa	8068	a.D279113 b.D28201125
4	INV	8069	a.D146373

5. MOURNES AND SLIEVE CROOB ESA - MONITORED SITES 1993

Farm	Invertebrate	Recorder code	Grid reference
1	INVa	8070	a.J258285 b.J2572840
2	INV a	8071	a.J217243 b.J21782530
3		8072	J26502850
4		8073	a.J36122250 b.J36192306

Girth distribution for the common tree species found in the West Fermanagh and Erne Lakeland ESA Woodlands (20 woods).

ALDER

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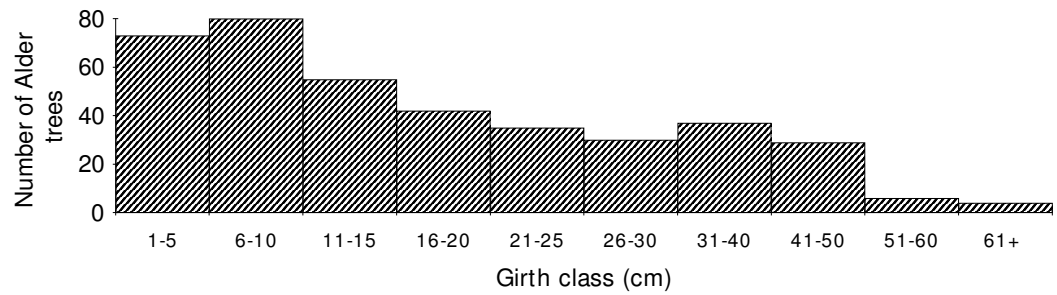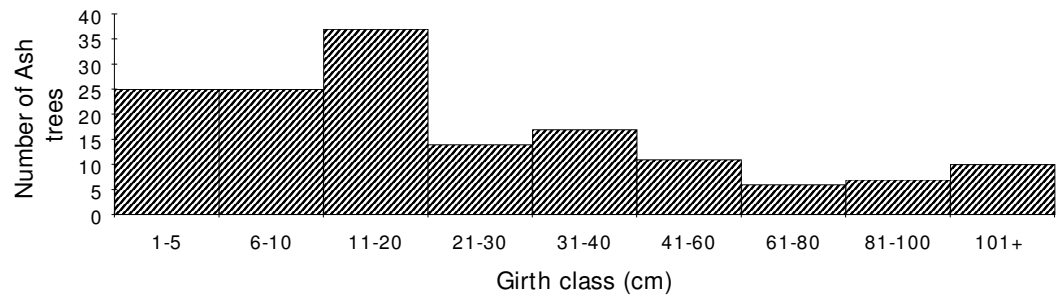
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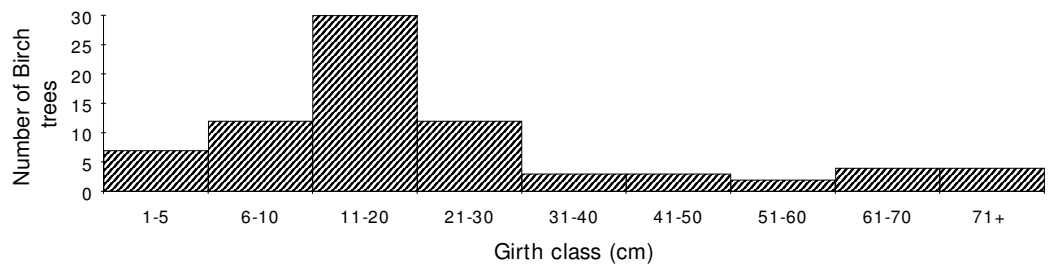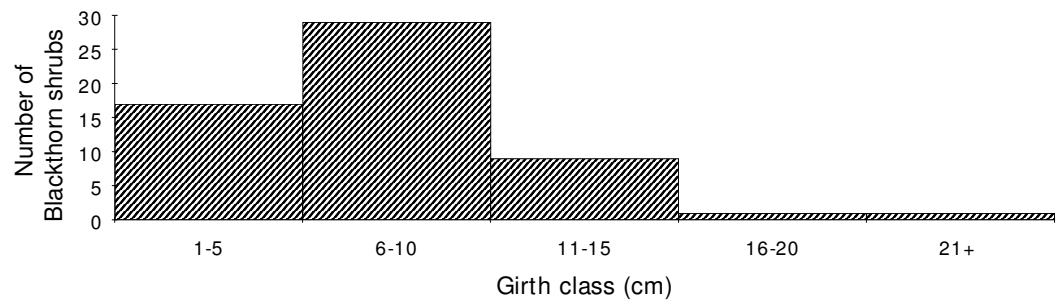
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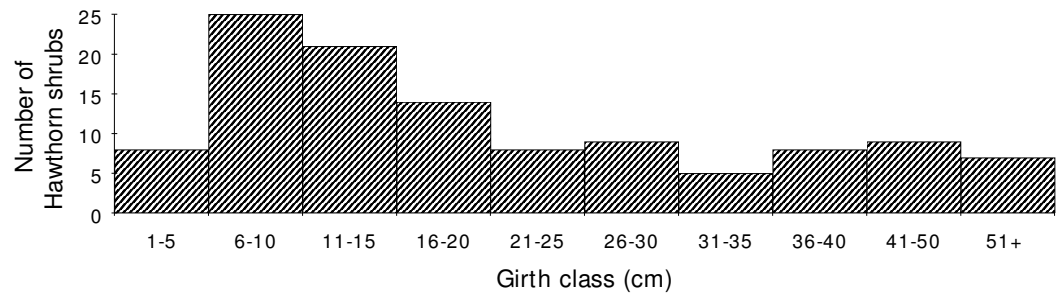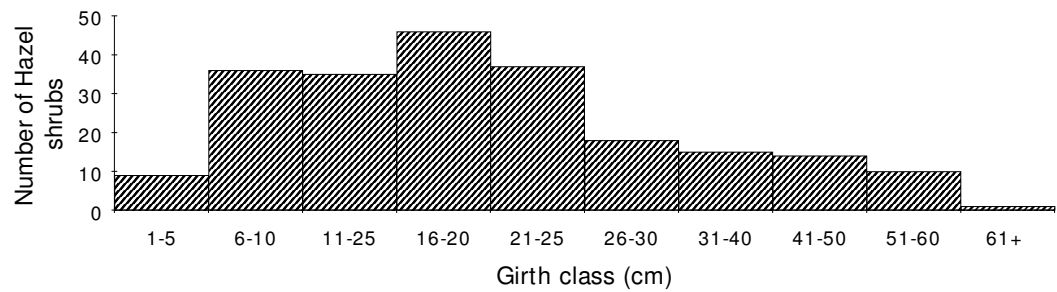
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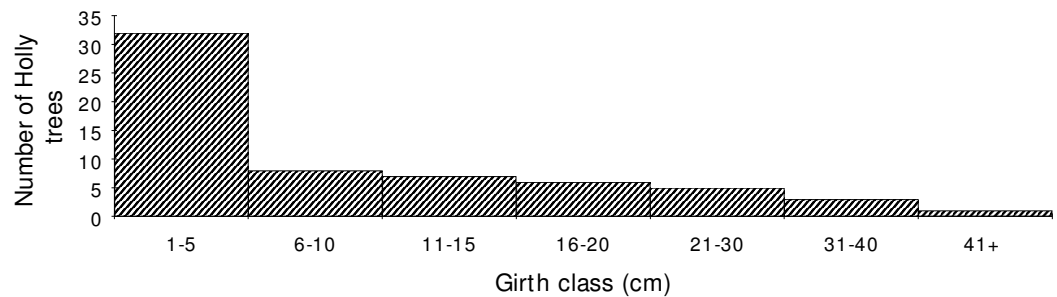
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HOLLY

OAK
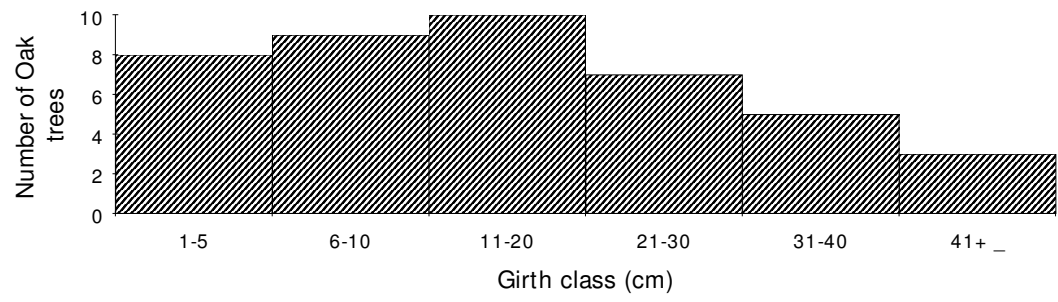
APPENDIX 2B

Girth distribution for the common tree species found in the Antrim Coast, Glens and Rathlin ESA Woodlands (28 monitored woods).

ALDER

ASH

BEECH

BIRCH

BLACKTHORN

HAWTHORN

HAZEL

HOLLY

78

OAK
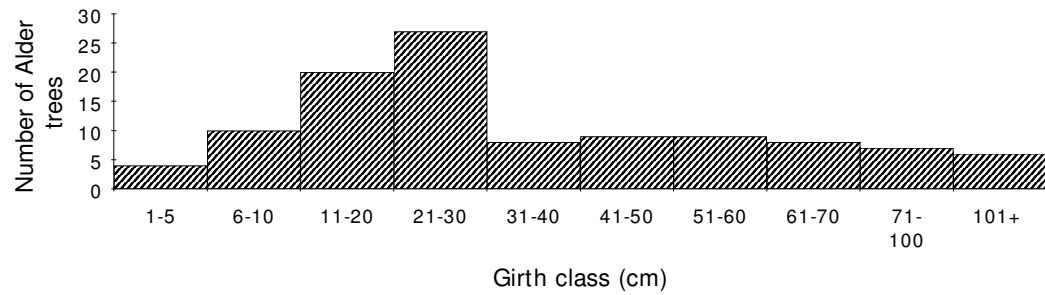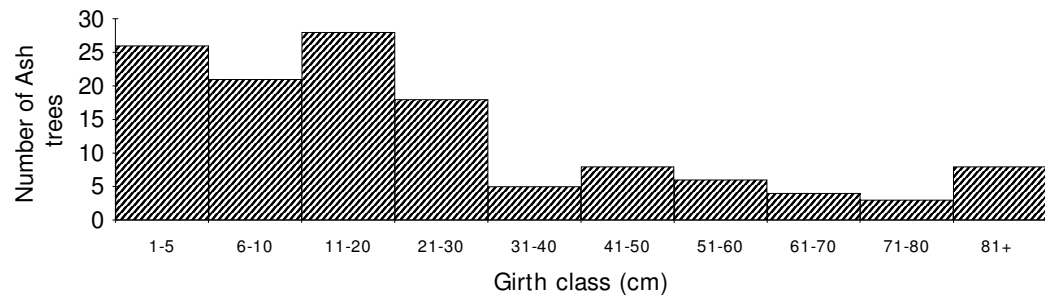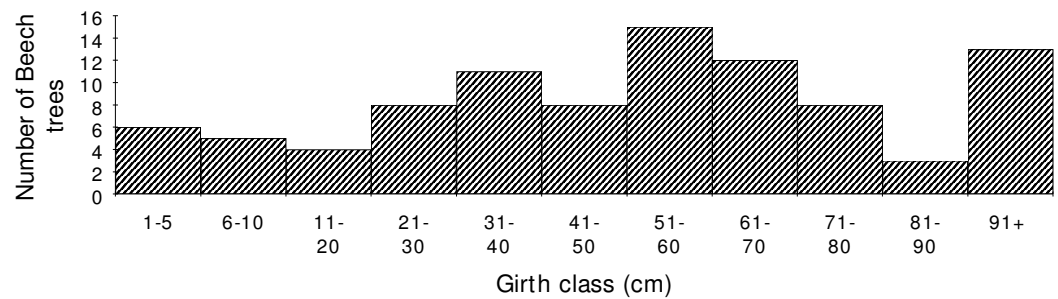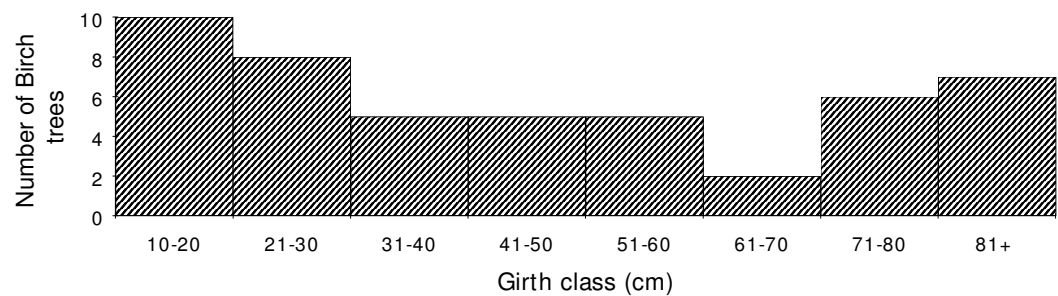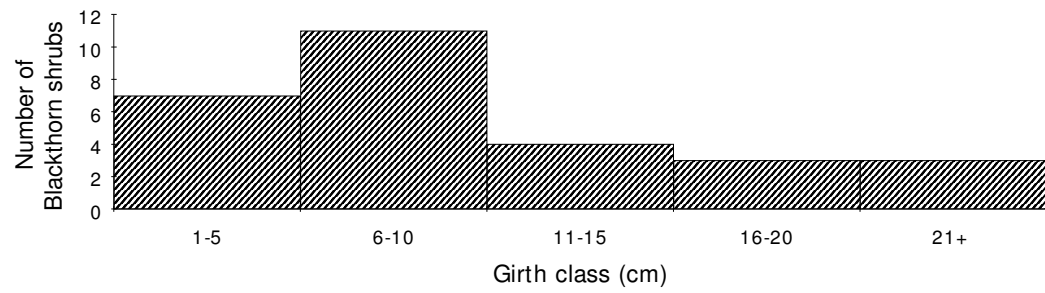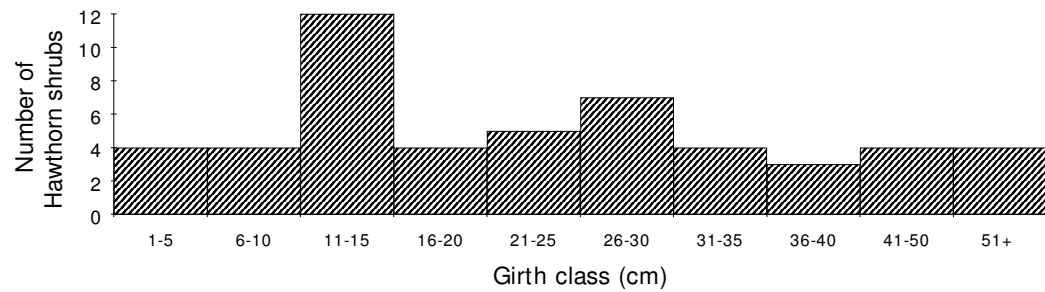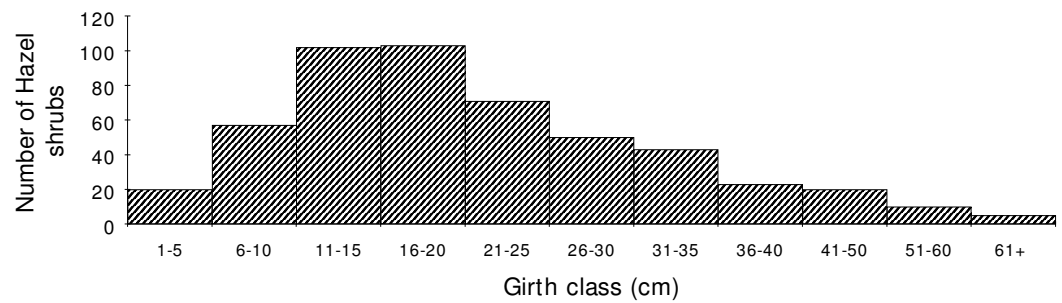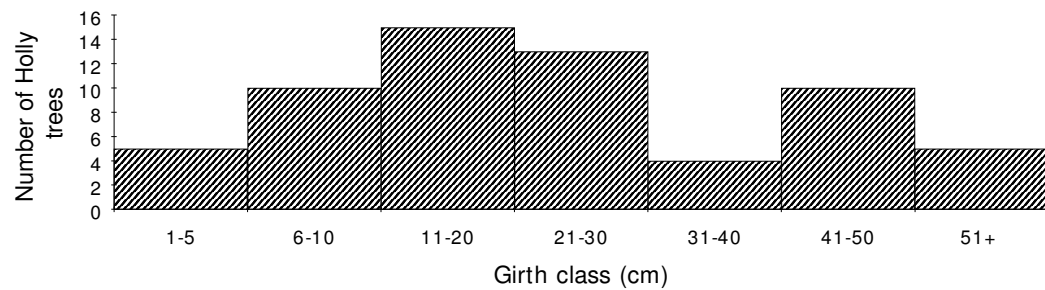
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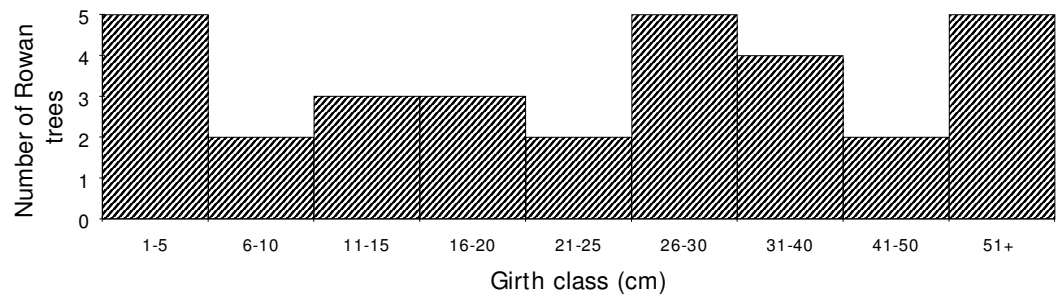
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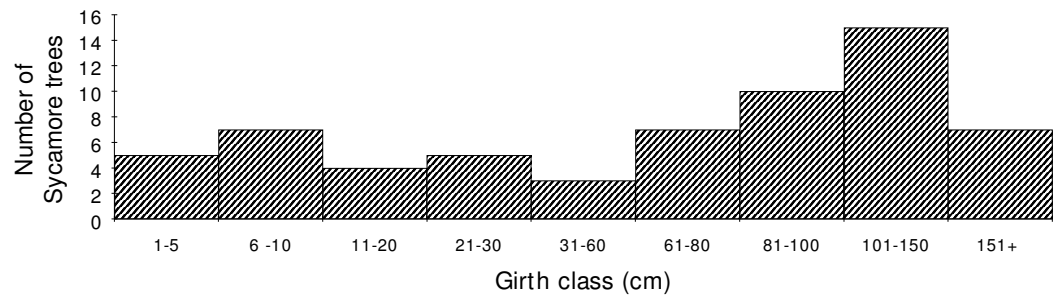
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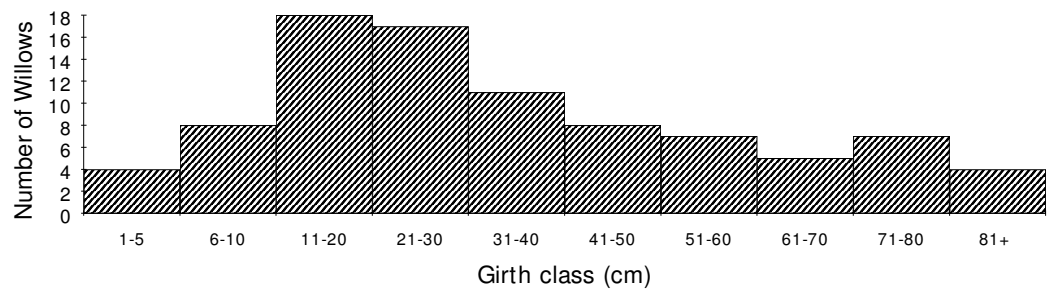
APPENDIX 3

Antrim Coast, Glens and Rathlin ESA Woodlands plant species frequency list (14x14m quadrat). A total of 225 species were recorded from 28 sites. % Frequency = % of Woodland sites in which plant species occurs.

Scientific name	Common name	Frequency %
Tree/shrub		
Acer pseudoplatanus	Sycamore	75
Alnus glutinosa	Alder	29
Betula spp.	Birch	25
Corylus avellana	Hazel	75
Crataegus monogyna	Hawthorn	61
Fagus sylvatica	Beech	32
Fraxinus excelsior	Ash	68
Fuchsia magellanica	Fuchsia	11
Ilex aquifolium	Holly	39
Larix spp.	Larch	4
Pices abies	Norway Spruce	11
Pinus sylvestris	Scots Pine	7
Populas alba	Popular	4
Prunus avium	Wild Cherry	4
Prunus spinosa	Blackthorn	21
Quercus spp	Oak	21
Ribes nigrum	Blackcurrant	4
Rosa canina	Dog Rose	21
Rubus fruticosus agg.	Bramble	75
Salix spp	Willow	57
Sambucus nigra	Common Elder	4
Sorbus aucuparia	Rowan	29
Symphoricarpus rivularis	Snowberry	4
Ulmus spp	Elm	4
Higher plants		
Achillea millefolium	Yarrow	7
Aegopodium podagraria	Ground Elder	4
Ajuga reptans	Bugle	39
Alchemilla glabra	Lady's Mantle	14
Allium ursinum	Wild Garlic	36
Anemone nemorosa	Wood Anemone	68
Angelica sylvestris	Wild Angelica	32
Anthriscus sylvestris	Cow Parsley	18
Apium nodiflorum	Fool's Watercress	14
Arum maculatum	Lords and Ladies/Cuckoo pint	25
Bellis perennis	Daisy	11
Caltha palustris	Marsh Marigold	7
Calystegia sepium	Bindweed	4
Cardamine hirsuta	Hairy Bittercress	36
Cardamine pratensis	Ladys Smock	25
Cerastium fontanum	Common Mouse-ear	18
Chrysosplenium oppositifolium	Opposite-leaved Golden Saxifrage	57
Circaea lutetiana	Enchanter's Nightshade	25
Cirsium arvense	Creeping Thistle	29
Cirsium vulgare	Spear Thistle	4
Conopodium majus	Pignut	54
Dactylorhiza fuchsii	Common Spotted Orchid	7
Digitalis purpurea	Fox-glove	25
Epilobium angustifolium	Rosebay Willowherb	4
Epilobium montanum	Broad-leaved Willowherb	50

Scientific name	Common name	Frequency %
Erica cinerea	Bell Heather	4
Filipendula ulmaria	Meadowsweet	64
Fragaria vesca	Wild Strawberry	11
Galium aparine	Cleaver	46
Galium odoratum	Woodruff	4
Galium palustre	Common Marsh Bedstraw	7
Galium saxatile	Heath Bedstraw	14
Galium verum	Ladys Bedstraw	4
Geranium pratense	Meadow Cranes's Bill	4
Geranium robertianum	Herb Robert	90
Geum urbanum	Herb Bennett	46
Glechoma hederacea	Ground Ivy	4
Hedera helix	Ivy	43
Heracleum sphondylium	Hogweed	39
Hyacinthoides non-scripta	Bluebell	86
Hypericum andriosaemum	Tutsan	4
Hypericum perforatum	Common St John's-wort	25
Hypochoeris radicata	Cats ear	4
Iris pseudacorus	Yellow Iris	11
Isoetes lacustris	Quillwort	4
Lapsana communis	Nipplewort	4
Lathyrus pratensis	Meadow Vetchling	7
Leontodon autumnalis	Autumn Hawkbit	4
Linaria vulgaris	Common Toad flax	7
Lonicera periclymenum	Honeysuckle	46
Lotus corniculatus	Common Bird foots trefoil	4
Lychnis flos-cuculi	Ragged Robin	7
Lysimachia nemorum	Yellow Pimpernel	61
Mentha aquatica	Watermint	11
Mercurialis perennis	Dog's Mercury	2
Myosotis arvensis	Field forget-me-not	2
Narcissus pseudonarcissus	Daffodil	2
Orchis mascula	Early Purple Orchid	11
Oxalis acetosella	Wood Sorrel	79
Plantago lanceolata	Ribwort Plantain	2
Polygala vulgaris	Common Milkwort	2
Polygonum persicaria	Redshank	2
Potentilla erecta	Tormentil	21
Potentilla sterilis	Barren Strawberry	50
Primula vulgaris	Primrose	79
Prunella vulgaris	Self Heal	2
Pyrola minor	Common Wintergreen	2
Ranunculus acris	Meadow buttercup	64
Ranunculus ficaria	Lesser Celandine	86
Ranunculus flammula	Lesser Spearwort	4
Ranunculus repens	Creeping Buttercup	21
Rumex acetosa	Common Sorrel	11
Rumex acetosella	Sheep's Sorrel	36
Rumex crispus	Curled Dock	25
Rumex obtusifolius	Broad leaved Dock	29
Sanicula europaea	Sanicle	39
Senecio aquaticus	Marsh Ragwort	4
Senecio jacobea	Common Ragwort	25
Sonchus asper	Prickly Sow-thistle	14
Stachys sylvatica	Hedge Woundwort	4
Stellaria graminea	Lesser Stitchwort	7
Stellaria holostea	Greater Stitchwort	36
Stellaria media	Common Chickweed	11
Stellaria palustris	Marsh Stitchwort	4

Scientific name	Common name	Frequency %
Succisa pratensis	Devils Bit	7
Symphtum tuberosum	Common Comfrey	4
Taraxacum officinale agg.	Dandelion	61
Trifolium repens	White Clover	14
Urtica dioica	Nettle	32
Vaccinium myrtillus	Bilberry	11
Valeriana officinalis	Valerian	4
Veronica chamaedrys	Germander Speedwell	57
Veronica montana	Wood Speedwell	7
Veronica persica	Common Field Speedwell	4
Vicia sepium	Bush Vetch	29
Viola palustris	Marsh violet	4
Viola riviniana	Common Dog violet	86

Grasses

Agrostis canina	Velvet Bent	11
Agrostis capillaris	Common Bent	50
Agrostis stolonifera	Creeping Bent	68
Alopecurus geniculatus	Marsh Foxtail	36
Alopecurus pratensis	Meadow Foxtail	46
Anthoxanthum odoratum	Sweet vernal grass	39
Arrhenatherum elatius	False-oat grass	4
Brachypodium sylvaticum	Wood False-Brome	36
Bromus hordeacus	Soft Brome	4
Cynosurus cristatus	Crested Dogs-tail	7
Dactylis glomerata	Cocksfoot	71
Deschampsia cespitosa	Wavy hair grass	25
Deschampsia flexuosa	Tufted hair grass	25
Elymus repens	Couch grass	7
Festuca ovina	Sheeps Fescue	14
Festuca pratensis	Meadow Fescue	14
Festuca rubra	Red Fescue	39
Glyceria fluitans	Floating sweet grass	14
Holcus lanatus	Yorkshire fog	71
Holcus mollis	Creeping soft grass	4
Lolium perenne	Perennial Rye grass	7
Molinia caerulea	Purple Moor grass	4
Poa pratensis	Smooth meadow grass	18
Poa trivialis	Rough meadow grass	89

Sedges

Carex caryophyllea	Spring sedge	21
Carex demissa	Common Yellow sedge	4
Carex flacca	Glaucous sedge	7
Carex hirta	Hairy sedge	4
Carex lasiocarpa	Slender sedge	4
Carex nigra	Common sedge	4
Carex pallescens	Pale sedge	4
Carex panicea	Carnation sedge	7
Carex pendula	Pendulous sedge	4
Carex sylvatica	Wood sedge	29

Rushes

Juncus acutiflorus	Sharp flowered rush	7
Juncus articulatus	Jointed rush	4
Juncus bufonius	Toad rush	7
Juncus effusus	Soft rush	29
Juncus inflexus	Hard rush	2
Luzula campestris	Field woodrush	14

Scientific name	Common name	Frequency %
Luzula multiflora	Many headed woodrush	25
Luzula sylvatica	Woodrush	46
Ferns/Horsetails		
Asplenium trichomanes	Maiden hair Spleenwort	4
Athyrium filix-femina	Lady's fern	14
Blechnum spicant	Hard fern	64
Cystopteris fragilis	Brittle Bladder fern	14
Dryopteris dilatata	Broad buckler fern	25
Dryopteris filix-mas	Male fern	21
Equisetum arvense	Common horsetail	11
Equisetum palustre	Water horsetail	4
Equisetum sylvaticum	Wood horsetail	4
Equisetum telmateia	Giant horsetail	7
Phyllitis scolopendrium	Hart's Tongue	7
Polypodium vulgare	Polypoidy	7
Pteridium aquilinum	Bracken	89
Mosses / Lichens/Liverworts		
Atrichum undulatum		11
Brachythecium rutabulum		14
Campylopus introflexus		4
Ceratodon purpureus		4
Cetraria chlorophylla		4
Cladonia coniocraea		4
Cladonia fimbriata		4
Cladonia floerkeana		4
Cladonia polydactyla		4
Cladonia portentosa		7
Climacium dendroides		7
Conocephalum conicum		14
Dicranella heteromalla		4
Dicranum majus		4
Dicranum scoparium		21
Diplophyllum albicans		4
Drepanocladus uncinatus		4
Eurhynchium praelongum		50
Fissidens adianthoides		7
Fissidens taxifolius		11
Hylocomium splendens		4
Hypnum cupressiforme		36
Hypnum jutlandicum		7
Hypogymnia physodes		7
Isothecium myosuroides		54
Lophocolea bidentata		36
Lophozia ventricosa		11
Marchantia polymorpha		7
Metzgeria spp		4
Mnium hornum		75
Nardia scalaris		4
Pellia epiphylla		29
Peltigera canina		7
Plagiochila aspleniodes		4
Plagiomnium rostratum		4
Plagiomnium undulatum		14
Plagiothecium denticulatum		4
Plagiothecium nemorale		4
Plagiothecium undulatum		7
Pohlia nutans		7

Scientific name	Common name	Frequency %
Polytrichum commune		21
Pseudoscleropodium purum		21
Ramalina farinacea		4
Rhynchostegium confertum		4
Rhytidiadelphus squarrosus		11
Rhytidiadelphus triquetrus		21
Scapania nemorea		4
Tetraphis pellucida		4
Thuidium tamariscinum		61

I. Tree and shrub vegetation groups:

The TWINSPAN indicator species of each group are listed and other common species which occur in more than 60% of group sites. There were significant differences in woodland types in the mean number of total plant species per 14x14m quadrat per site (F=9.55, p<0.001).

Group 1: (n=6; 21%) **Scrub**

Blackthorn *(Prunus spinosa)* is the indicator species, with hazel (*Corylus avellana*)*,* willow (*Salix* spp.)*.* and hawthorn (*Crataegus monogyna*) being common. A total of 16 tree and shrub species were recorded from these sites, with a mean total number of plant species per 14x14 m quadrat of 57 ($\pm$3.7), significantly higher than Group 3 sites (p<0.05).

Group 2: (n=5; 18%) **Mixed species wet woods**

The indicator species are alder (*Alnus glutinosa*) and willow (*Salix spp.*) The most common species are hazel (*Corylus avellana*) and ash (*Fraxinus excelsior*). This group had the significantly highest mean number of plant species per 14x14m quadrat (61 $\pm$5.7; p<0.05), with a total of 13 tree and shrub species recorded from all group 2 sites.

Group 3; (n=11; 39%) **Mixed species woods**

Sycamore (*Acer pseudoplatanus),* ash (*Fraxinus excelsior*), rowan (*Sorbus aucuparia*) are the indicator species of this group, with hazel (*Corylus avellana*), hawthorn (*Crataegus monogyna*), and holly *(Ilex aquifolium*) common in these woods. A total of 16 tree and shrub species were recorded from Group 3 woods with a mean number of plant species per 14x14m quadrat of 46 ($\pm$3.7).

Group 4 (n=6; 21%). **Mature woods**

The indicator species of group 4 are beech (*Fagus sylvatica*), hazel (*Corylus avellana*) and sycamore (*Acer pseudoplatanus),* with hawthorn (*Crataegus monogyna*) frequently present*.* This group had the lowest mean number of plant species per 14x14m quadrat (29 $\pm$3.6), with a total of 13 tree and shrub species recorded from all sites.

APPENDIX 4b

II. Ground flora vegetation groups:

Common species are those occurring in more than 70% of vegetation group sites. There was a significant difference between vegetation groups in soil pH value (F=4.52, p<0.05), and the number of beetle species per group site (F=8.07, p<0.01).

Group 1: (n=6; 21%): **'Ancient' woodlands**

The indicator species of Group 1 are sweet vernal grass (*Anthoxanthum odoratum*) and wood sorrel (*Oxalis acetosella*). Other common species are bluebell *(Hyacinthoides non-scripta)* and yorkshire fog (*Holcus lanatus*). A mean number of 22 plant species (+2.7) was recorded per 2mx2m quadrat per site with a total of 72 plant species being recorded from all sites. This group sites' had the lowest mean soil pH (5.11 (+0.23); significantly different from Group 2 p<0.05). Only 2 of these sites were recorded for invertebrates with a mean number of 9 beetle species identified, significantly smaller than any of the other woodland groups (p<0.05).

Group 2: (n=8; 29%) **Damp, species-diverse woods**.

Opposite-leaved golden saxifrage (*Chrysosplenium oppositifolium*), rough meadow grass (*Poa trivialis*) and *Hypnum cupressiforme* are the indicator species with creeping bent (*Agrostis stolonifera*), yorkshire fog (*Holcus lanatus*), meadow buttercup (*Ranunculus acris*), lesser celandine (*Ranunculus ficaria*) common to group 2 sites. This group had the highest mean number of plant species per 2x2m quadrat (24 (+3.1)), with a total of 96 species being identified from all sites. The highest mean number of beetle species per site was recorded from Group 2 woods (15 beetles species (+1.2); n=5). These soils were the most alkaline with a mean soil pH value of 6.06 (+0.14).

Group 3 (n=14; 50%) **Overgrown woods**

The indicator species are Beech *(Fagus sylvatica)*, wood sorrel (*Oxalis acetosella*) and fool's watercress (*Apium nodiflorum*), with bracken (*Pteridium aquilinum*) and lesser celandine (*Ranunculus ficaria*) the most common species. A total of 87 plant species were recorded from Group 3 woodland sites (2x2m quadrats), with a mean number per quadrat of 20 (+1.9) and 13 beetle species per site (n=7).

Dendrograms showing end groups and indicator species derived from TWINSPAN of vegetation species cover data on habitats monitored during 1994.

1a. Antrim Coast and Glens ESA Woodlands - Tree and shrub vegetation groups

```
                              ┌────┐
                              │ 28 │
                        -ve   └────┘   +ve
                     ┌───────────┴──────────────────────────┐
                                                            │  Fagu syl
              ┌────┐                                         │
         -ve  │ 22 │  +ve                                    │
       ┌──────┴──────┐                                       │
                     │  Frax exc                             │
                     │  Ilex aqu                             │
                     │  Betu spp                             │
                     │  Acer pse                             │
  Prun spi           │  Sorb auc                             │
       ┌────┐        ┌────┐                                 ┌────┐
       │ 6  │        │ 16 │                                 │ 6  │
       └────┘        └────┘                                 └────┘
       Gp 1             │                                   Gp 4
                        │
            ┌───────────┴───────────┐
   Alnu glu                 Acer pse
                            Frax exc
   Sali spp                 Sorb auc
       ┌────┐                 ┌────┐
       │ 5  │                 │ 11 │
       └────┘                 └────┘
       Gp 2                   Gp 3
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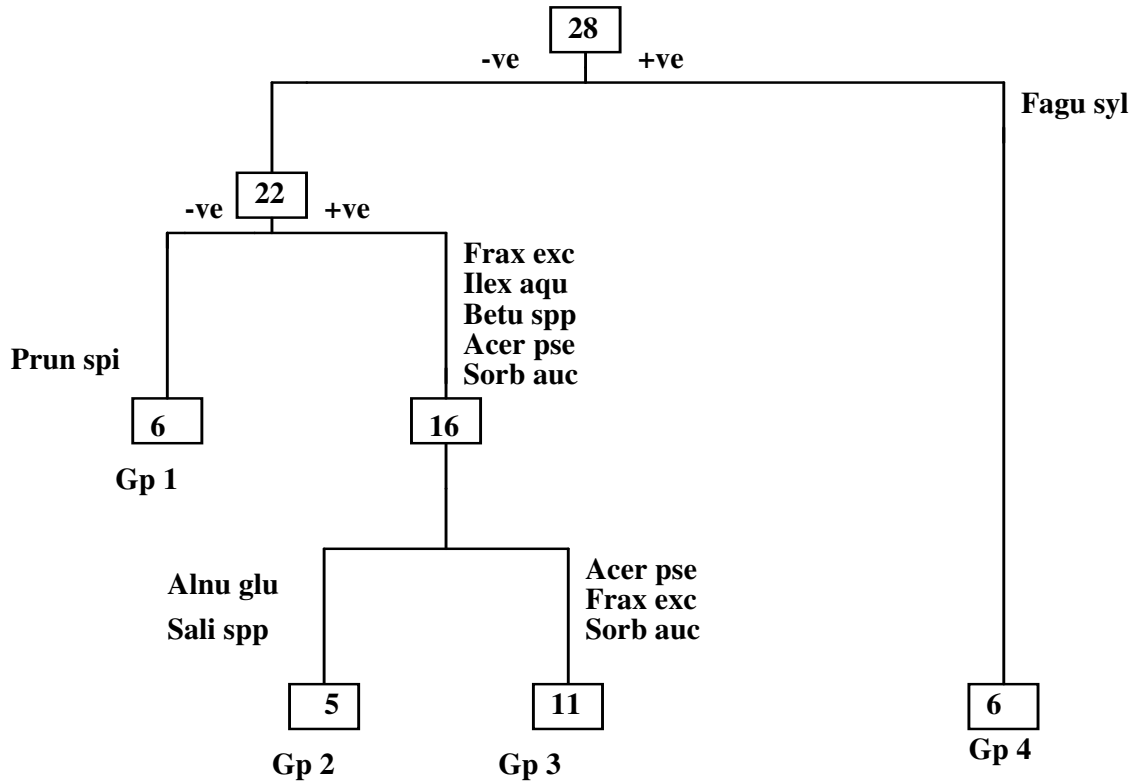
1b. Antrim Coast and Glens ESA Woodlands - Ground flora vegetation groups
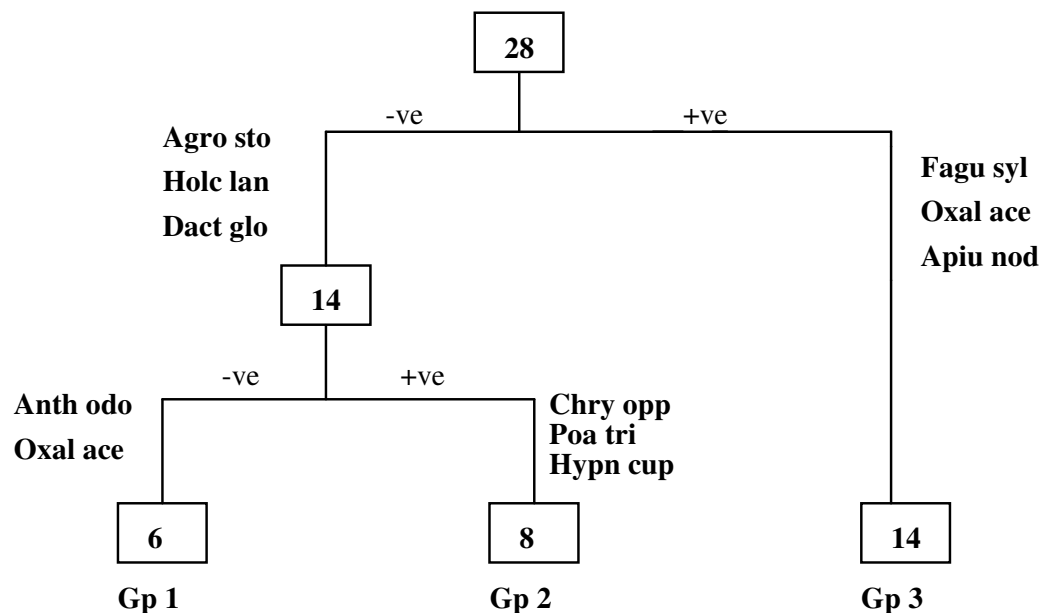
```
                        ┌────┐
                        │ 28 │
                        └────┘
                 -ve              +ve
       ┌──────────┴─────────────────────────┐
  Agro sto                             Fagu syl
  Holc lan                             Oxal ace
  Dact glo                             Apiu nod
       ┌────┐
       │ 14 │
       └────┘
     -ve        +ve
   ┌──┴──────────────┐
  Anth odo      Chry opp
                Poa tri
  Oxal ace      Hypn cup
   ┌────┐        ┌────┐              ┌────┐
   │ 6  │        │ 8  │              │ 14 │
   └────┘        └────┘              └────┘
   Gp 1          Gp 2                Gp 3
```

```
                              ┌──────┐
                              │  28  │
                      -ve     └──┬───┘    +ve
                   ┌─────────────┴──────────────────────┐
                ┌──┴───┐                                 │  Loli per
                │  26  │                                 │
                └──┬───┘                                 │
                   │          Holc lan                   │
                   │          Lyis nem                   │
        ┌──────────┴─────────┐                           │
        │                 ┌──┴───┐                        │
 Pter aqu              │  21  │                        │
        │                 └──┬───┘                        │
        │       Geum urb      │                           │
        │       Ajug rep      │                           │
        │       Gali apa      │                           │
     ┌──┴──┐   ┌──────┴──┐   ┌──────┐              ┌──────┐
     │  5  │   │   13    │   │  8   │              │  2   │
     └─────┘   └─────────┘   └──────┘              └──────┘
      Gp 1        Gp 2         Gp 3                  Gp 4
```

2a. Total Northern Ireland ESA heather vegetation types

134

Erio vag
Erio ang　　　**-ve**　　　　　**+ve**　　　**Eric cin**
Eric tet　　　　　　　　　　　　　　　　　　**Ulex eur**

80　　　　　　　　　　　　　**54**

Scir ces　　　　**Vacc myr**　　**Ulex eur**　　　　　　　**Anth odo**
Nart oss　　　　**Poly com**　　　　　　　　　　　　　**Rhyt squ**
Eric tet　　　　**Anth odo**　　　　　　　　　　　　　**Vacc myr**
　　　　　　　　　Rhyt tri

55　　　　　　**25**　　　　**26**　　　　　　**28**

Type 1　　　　　**Type 2**　　　**Type 3**　　　　**Type 4**

2b. Sperrins ESA Heather vegetation types

55

Moli cae
Anth odo　　　**-ve**　　　　**+ve**　　　**Scir ces**
Hylo spl　　　　　　　　　　　　　　　　**Nart oss**
Gali sax　　　　　　　　　　　　　　　　**Eric tet**

20　　　　　　　　　　　**35**

　　　　　　　　　　Plag nem
　　　　　　　　　　Pote ere
　　　　　　　　　　Poly com　　　　　　**Scir ces**
Agro can　　　　　　　**Vacc myr**
　　　　　Vacc myr　　**Pleu sch**　　　　**Nart oss**

6　　　　　　**14**　　　　**23**　　　　　　**12**

Type 1　　　　　**Type 2**　　　**Type 3**　　　　**Type 4**
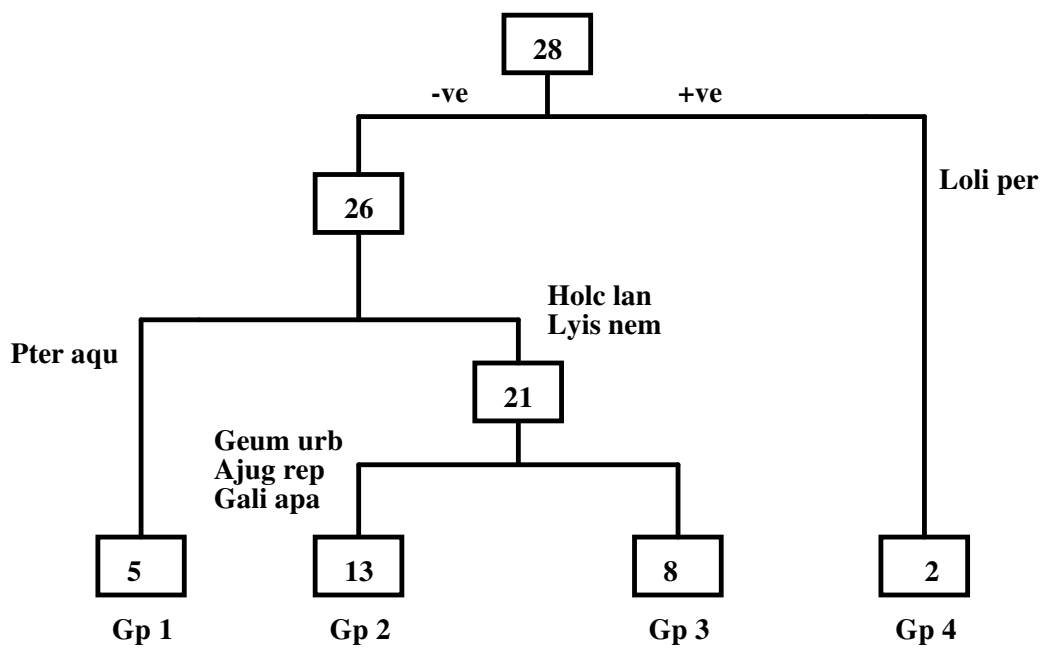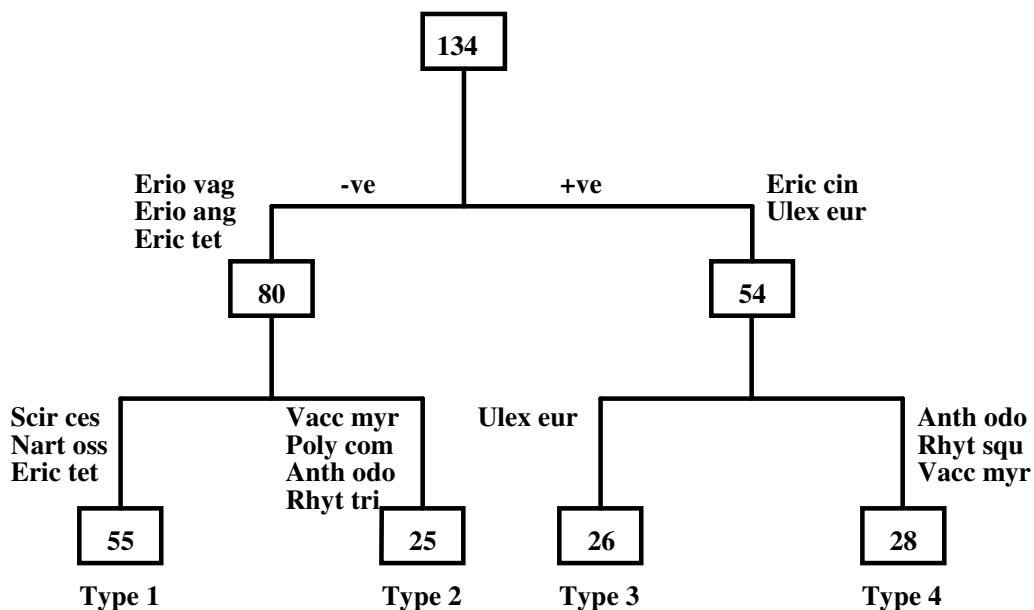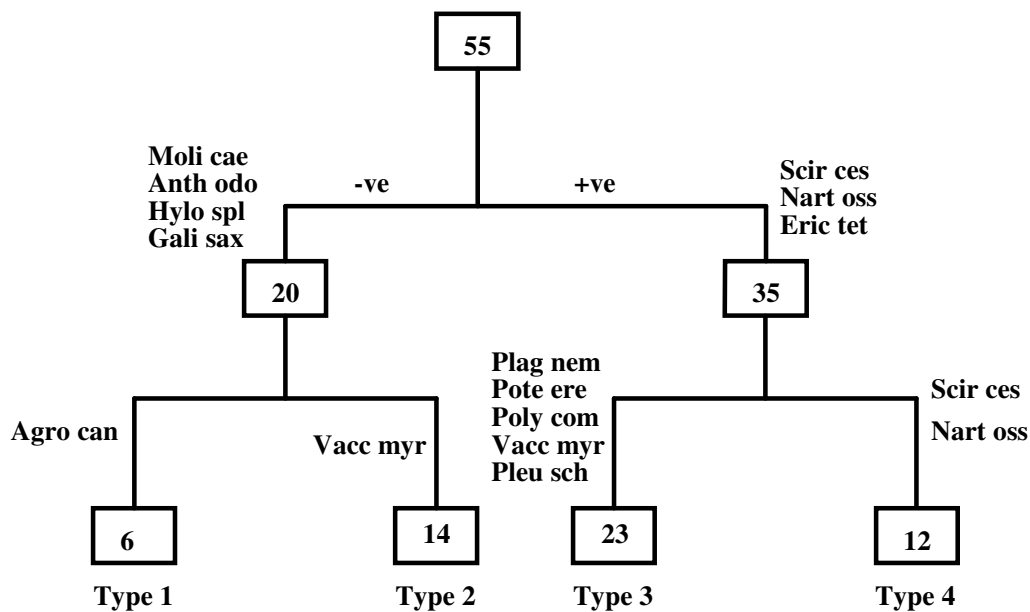
2c. Slieve Gullion ESA Heather vegetation types
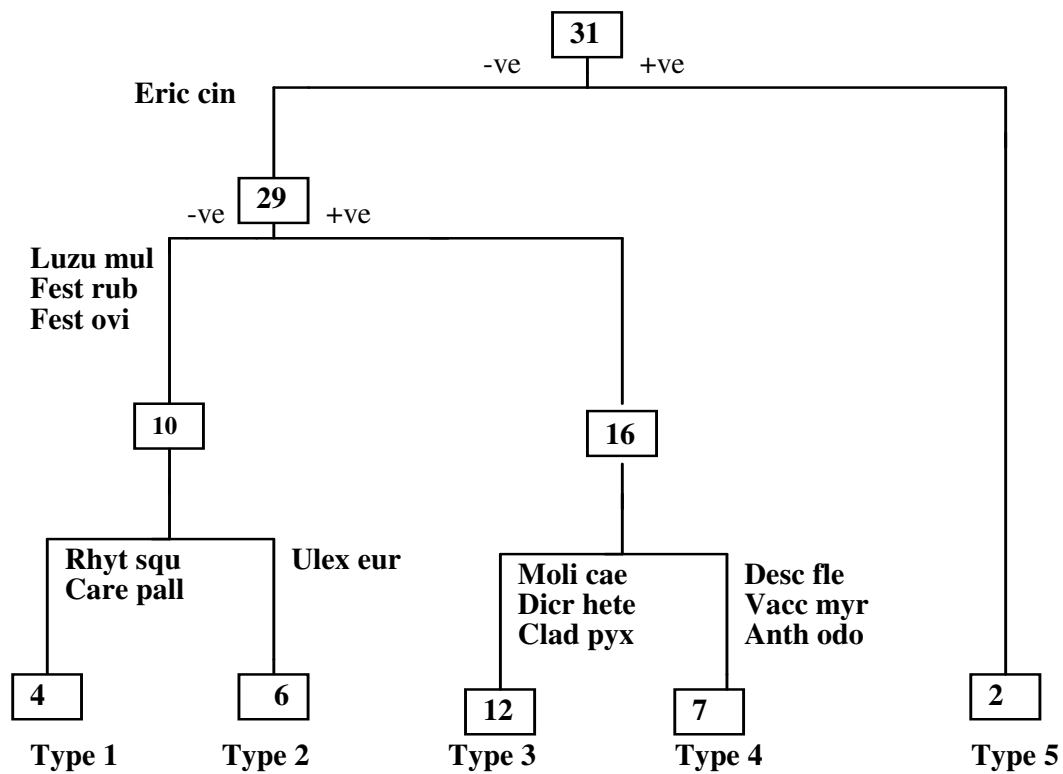
APPENDIX 6

Girth distribution for the common tree species in each of the Woodland TWINSPAN vegetation groups

Tree/shrub species	% of trees in Woodland TWINSPAN group (n=number of trees)			
	Group 1	Group 2	Group 3	Group 4
Alder	(n=2)	(n=77)	(n=29)	
Girth class (cm)				
1-5	-	5	-	-
6-10	-	10	7	-
11-20	-	21	14	-
21-30	50	30	14	-
31-40	-	5	14	-
41-50	-	9	7	-
51-60	50	6	7	-
61+	-	14	34	-
Ash				
Girth class (cm)	(n=31)	(n=57)	(n=26)	(n=13)
1-5	16	16	8	77
6-10	26	16	4	23
11-20	35	28	4	-
21-30	23	9	23	-
31-40	-	7	4	-
41-50	-	5	19	-
51-60	-	5	12	-
61-70	-	4	8	-
71+	-	11	19	-
Beech				
Girth class (cm)	(n=82)		(n=6)	(n=5)
1-10	61	-	100	60
11-30	41	-	-	-
31-50	10	-	-	-
51-70	10	-	-	-
71-90	-	-	-	-
91+	-	-	-	40
Birch				
Girth class (cm)		(n=24)	(n=24)	
10-30	-	50	25	-
31-50	-	33	8	-
51-70	-	8	21	-
71-90	-	8	25	-
91-110	-	-	13	-
111=	-	-	13	-
Blackthorn				
Girth class (cm)		(n=21)	(n=7)	
1-5	-	19	43	-
6-10	-	43	29	-
11-15	-	10	29	-
16+	-	29	-	-
Hawthorn				
Girth class (cm)	(n=5)	(n=32)	(n=13)	(n=1)
1-5	20	6	-	100
6-10	-	6	8	-
11-15	-	16	54	-
16-20	-	13	-	-
21-25	-	13	8	-
26-30	-	16	8	-
31-35	60	6	-	-
36-40	20	6	-	-
41+	-	16	23	-

Tree/shrub species	% of trees in Woodland TWINSPAN group (n=number of trees)			
	Group 1	Group 2	Group 3	Group 4
Hazel				
Girth class (cm)	(n=24)	(n=266)	(n=214)	
1-5	21	2	5	-
6-10	17	7	16	-
11-20	21	35	44	-
21-30	4	26	24	-
31-40	8	17	9	-
41-50	25	5	1	-
51+	4	5	-	-
Holly				
Girth class (cm)	(n=7)	(n=43)	(n=12)	-
1-5	43	5	-	-
6-10	43	2	50	-
11-15	14	9	17	-
16-20	-	19	-	-
21-25	-	14	17	-
26-30	-	12	-	-
31-40	-	9	-	-
41-50	-	21	8	-
51+	-	9	8	-
Oak				
Girth class (cm)	(n=17)	(n=3)	(n=13)	
1-5	-	33	31	-
30-50	59	-	-	-
51-70	29	-	15	-
71+	12	67	54	-
Rowan				
Girth class (cm)		(n=13)	(n=17)	
1-10	-	-	41	
11-20	-	31	12	
21-30	-	31	12	
31+	-	38	35	
Sycamore				
Girth class (cm)	(n=28)	(n=1)	(n=13)	(n=28)
1-5	-	-	8	39
6-10	4	-	8	18
11-20	11	100	-	-
21-30	14	-	8	-
31-50	7	-	-	-
51-70	4	-	15	-
71-90	29	-	31	-
91-110	18	-	8	-
111+	14	-	23	43
Willow				
Girth class (cm)	(n=12)	(n=69)	(n=8)	
1-10	-	16	13	-
11-20	8	23	13	-
21-40	50	29	25	-
41-60	33	13	25	-
61-80	8	14	13	-
81+	-	4	13	-

APPENDIX 7

Heather sites from Northern Irelands' ESAs plant species frequency list (2x2m quadrat).
A total of 232 species were recorded from 134 sites. % Frequency = % of Heather sites in which plant species occurs

Scientific name	Common name	Frequency %
Tree and shrub		
Acer pseudoplatanus	Sycamore	1
Betula spp.	Birch	2
Crataegus monogyna	Hawthorn	3
Cytisus scoparium	Broom	1
Pices abies	Norway Spruce	2
Pinus spp.	Pine	2
Rhododendron ponticum	Rhododendron	1
Rosa canina	Dog rose	1
Salix spp.	Willow	3
Sorbus aucuparia	Rowan	7
Ulex europaeus	Gorse	27
Higher plants		
Achillea millefolium	Yarrow	1
Ajuga reptans	Bugle	4
Anagallis tenella	Bog Pimpernel	2
Bellis perennis	Daisy	2
Calluna vulgaris	Heather	99
	Dead Heather	43
Callitriche stagnalis	Water starwort	1.5
Cardamine pratensis	Ladys Smock	1.5
Cerastium fontanum	Common Mouse-ear	13
Cirsium dissectum	Bog Thistle	1.5
Dactylorhiza fuchsii	Common Spotted Orchid	1
Dactylorhiza maculata	Heath Spotted Orchid	5
Drosera rotundifolia	Sundew	13
Empetrum nigrum	Crowberry	19
Epilobium hirsutum	Greater Willowherb	1.5
Epilobium montanum	Broad-leaved Willowherb	1
Erica cinerea	Bell Heather	49
Erica tetralix	Cross-leaved heath	69
Euphrasia spp.	Eyebright	7
Galium palustre	Marsh Bedstraw	3
Galium saxatile	Heath Bedstraw	32
Galium verum	Lady's Bedstraw	1
Gentianella campestris	Field Gentian	1
Hedera helix	Ivy	1
Hieracium pilosella	Mouse Ear Hawkweed	1
Hypericum perforatum	Common St.John's wort	1.5
Hypericum pulchrum	Slender St John's-wort	3
Hypochoeris radicata	Cats ear	2
Isoetes lacustris	Quillwort	2
Leontodon autumnalis	Autumn Hawkbit	5
Leontodon hispidus	Rough Hawkbit	9
Listera cordata	Lesser Twayblade	2
Listera ovata	Common Twayblade	4
Lonicera periclymenum	Honeysuckle	1.5
Lotus corniculatus	Common Bird foots trefoil	2
Lychnis flos-cuculi	Ragged Robin	1

Scientific name	Common name	Frequency %
Mentha aquatica	Water mint	1
Myrica gale	Bog Myrtle	4
Narthecium ossifragum	Bog Asphodel	37
Orchis mascula	Early Purple Orchid	2
Oxalis acetosella	Wood Sorrel	1
Pedicularis sylvatica	Lousewort	25
Pinguicula vulgaris	Common Butterwort	1.5
Plantago lanceolata	Ribwort Plantain	5
Polygala serpyllifolia	Thyme-leaved Milkwort	23
Polygala vulgaris	Common Milkwort	13
Polygonum aviculare	Knotgrass	1
Potentilla erecta	Tormentil	81
Prunella vulgaris	Self Heal	1
Ranunculus acris	Meadow buttercup	2
Ranunculus repens	Creeping Buttercup	1.5
Rubus fruticosus agg.	Bramble	3
Rumex acetosa	Common Sorrel	7
Rumex acetosella	Sheep's Sorrel	1.5
Senecio jacobea	Common Ragwort	1
Sonchus asper	Prickly Sow-thistle	1
Stellaria alsine	Bog Stitchwort	1.5
Stellaria graminea	Lesser Stitchwort	1
Stellaria holostea	Greater Stitchwort	1
Stellaria media	Common Chickweed	2
Succisa pratensis	Devils Bit	17
Taraxacum officinale.	Dandelion	3
Teucrium scorodonia	Wood sage	5
Thymus praecox	Wild Thyme	1
Trifolium pratense	Red Clover	1
Trifolium repens	White Clover	7
Vaccinium myrtillus	Bilberry	63
Vaccinium oxycoccos	Cranberry	1.5
Veronica chamaedrys	Germander Speedwell	1
Veronica officinalis	Heath Speedwell	1
Veronica persica	Common Field Speedwell	4
Viola palustris	Marsh Violet	1
Viola riviniana	Common Dog violet	7
Grasses		
Agrostis canina	Velvet Bent	28
Agrostis capillaris	Common Bent	22
Agrostis stolonifera	Creeping Bent	13
Alopecurus geniculatus	Marsh Foxtail	1
Anthoxanthum odoratum	Sweet vernal grass	54
Briza media	Common Quaking grass	1
Cynosurus cristatus	Crested Dogs-tail	2
Dactylis glomerata	Cocksfoot	1
Danthonia decumbens	Heath grass	10
Deschampsia cespitosa	Wavy hair grass	25
Deschampsia flexuosa	Tufted hair grass	49
Festuca ovina	Sheep' Fescue	23
Festuca pratensis	Meadow Fescue	1
Festuca rubra	Red Fescue	22
Holcus lanatus	Yorkshire fog	13
Lolium perenne	Perennial Rye grass	1
Molinia caerulea	Purple Moor grass	85
Nardus stricta	Mat grass	43
Poa annua	Annual meadow grass	2
Poa nemoralis	Wood meadow grass	2

Scientific name	Common name	Frequency %
Poa pratensis	Smooth meadow grass	1
Poa trivialis	Rough meadow grass	6
Scirpus cespitosus	Deer grass	74
Sesleria albicans	Blue moor grass	12
Sedges		
Carex binervis	Green-ribbed sedge	23
Carex caryophyllea	Spring sedge	1
Carex curta	White sedge	3
Carex demissa	Common Yellow sedge	9
Carex dioica	Dioecious sedge	1
Carex disticha	Brown sedge	3
Carex echinata	Star sedge	31
Carex flacca	Glaucous sedge	22
Carex hirta	Hairy sedge	2
Carex hostiana	Tawny sedge	2
Carex lasiocarpa	Slender sedge	5
Carex lepidocarpa	Long-stalked Yellow sedge	1
Carex nigra	Common sedge	35
Carex ovalis	Oval sedge	4
Carex pallescens	Pale sedge	22
Carex panicea	Carnation sedge	54
Carex pendula	Pendulous sedge	1
Carex pilulifera	Pill sedge	21
Carex pulicaris	Flea sedge	6
Carex remota	Remote sedge	1
Carex rostrata	Bottle sedge	3
Carex vesicaria	Bladder sedge	4
Rushes		
Eriophorum angustifolium	Broad bog cotton	59
Eriophorum vaginatum	Fine bog cotton	66
Juncus acutiflorus	Sharp flowered rush	5
Juncus articulatus	Jointed rush	6
Juncus bufonius	Toad rush	6
Juncus bulbosus	Bulbous rush	6
Juncus effusus	Soft rush	19
Juncus squarrosus	Heath rush	52
Luzula campestris	Field woodrush	16
Luzula multiflora	Many headed woodrush	31
Luzula sylvatica	Woodrush	1
Schoenus nigricans	Bog rush	3
Ferns		
Blechnum spicant	Hard fern	10
Cystopteris fragilis	Brittle Bladder fern	1
Dryopteris dilatata	Broad Buckler fern	1
Dryopteris filix-mas	Male fern	1
Equisetum palustre	Water horsetail	1
Equisetum telmateia	Giant horsetail	4
Polypodium vulgare	Polyploidy	1
Pteridium aquilinum	Bracken	13
Mosses / Lichens/Liverworts		
Atrichum undulatum		1
Aulacomnuium palustre		16
Brachythecium plumosum		1
Brachythecium rivulare		1
Brachythecium rutabulum		5

Scientific name	Frequency %
Breutelia chrysocoma	4
Bryum pseudotriquetrum	1
Calliergon stramineum	1.5
Campylopus introflexus	10
Cephalozia bicuspidata	1.5
Ceratodon purpureus	1
Cetraria chlorophylla	1
Cladonia arbuscula	1.5
Cladonia coccifera	2
Cladonia coniocraea	2
Cladonia fimbriata	2
Cladonia floerkeana	10
Cladonia gracilis	1
Cladonia portentosa	54
Cladonia polydactyla	2
Cladonia pyxidata	37
Cladonia subcervicornis	2
Cladonia squamosa	1
Cladonia uncialis	12
Cratoneuron commutatum	2
Dicranella heteromalla	31
Dicranella palustris	1
Dicranum majus	19
Dicranum scoparium	72
Diplophyllum albicans	7
Drepanocladus uncinatus	1
Eurhynchium praelongum	17
Fissidens adianthoides	2
Grimmia donniana	2
Grimmia pulvinata	1
Hypnum cupressiforme	43
Hypnum jutlandicum	63
Hylocomium splendens	43
Hypogymnia physodes	12
Isopterygium elegans	1.5
Isothecium myosuroides	2
Kurzia pauciflora	1.5
Lepidozia reptans	1
Leucobryum glaucum	3
Lophocolea cuspidata	1
Lophocolea bidentata	27
Lophozia ventricosa	31
Lycopodium alpinum	3
Marsupella emarginata	2
Mnium hornum	2
Mycena spp	3
Nardia scalaris	19
Neckera complanata	4
Odontoschisma sphagni	1
Parmelia conspersa	1
Parmelia omphalodes	1
Pellia epiphylla	2
Peltigera canina	3
Plagiochila aspleniodes	4
Plagiomnium rostratum	1
Plagiomnium undulatum	2
Plagiothecium denticulatum	1
Plagiothecium nemorale	31
Pleurozium schreberi	51

Scientific name	Frequency %
Pohlia nutans	1
Polytrichum commune	54
Polytrichum piliferum	1
Pseudoscleropodium purum	32
Racomitrium lanuginosum	23
Rhytidiadelphus loreus	5
Rhytidiadelphus squarrosus	37
Rhytidiadelphus triquetrus	49
Sphagnum auriculatum	54
Sphagnum capillifolium	50
Sphagnum compactum	10
Sphagnum cuspidatum	19
Sphagnum palustre	36
Sphagnum papillosum	29
Sphagnum rubellum	40
Sphagnum subnitens	8
Thuidium tamariscinum	27
Tortella tortuosa	3
Tritomaria quinquedentata	1.5

APPENDIX 8

Heather sites from Northern Irelands' ESAs' plant species frequency list. A total of 232 species were recorded from 134 sites (2x2m quadrat). ESAs: **1**: Sperrins (126 species, 55 sites) ; **2**. Slieve Gullion (149 species, 31 sites); **3**.Rathlin (98 species, 8 sites); **4**. Antrim Glens, Coast (82 species, 8 sites); **5**. Mournes (61 species, 7 sites) **6**. West Fermanagh and Erne Lakeland (122 species, 25 sites). % Frequency = % of sites within an ESA in which the plant species occurs.

Scientific name	Common name	% Frequency					
		1	**2**	**3**	**4**	**5**	**6**
Tree and shrub							
Acer pseudoplatanus	Sycamore	-	3	-	-	-	-
Betula spp.	Birch	2	-	-	-	-	-
Crataegus monogyna	Hawthorn	4	3	-	-	-	4
Cytisus scoparius	Broom	-	3	-	-	-	-
Pices abies	Norway Spruce	2	-	-	-	-	-
Pinus spp.	Pine	-	-	-	-	14	-
Rhododendron ponticum	Rhododendron	-	-	-	-	14	-
Rosa canina	Dog Rose	-	-	13	-	-	-
Salix spp.	Willow	4	16	-	-	-	-
Sorbus aucuparia	Rowan	4	23	-	-	-	-
Ulex europaeus	Gorse	-	77	88	-	43	4
Higher plants							
Achillea millefolium	Yarrow	-	-	-	13	-	-
Ajuga reptans	Bugle	-	3	38	25	-	4
Anagallis tenella	Bog Pimpernel	2	-	13	13	-	-
Bellis perennis	Daisy	-	-	25	-	-	-
Calluna vulgaris	Heather	100	100	100	100	86	100
	Dead Heather	69	42	25	-	-	8
Callitriche stagnalis	Water starwort	-	-	-	-	-	8
Cardamine pratensis	Ladys Smock	-	3	-	13	-	-
Cerastium fontanum	Common Mouse-ear	13	16	28	13	-	8
Cirsium arvense	Common Thistle	2	3	-	-	-	-
Dactylorhiza fuchsii	Common Spotted Orchid	-	-	-	-	-	4
Dactylorhiza maculata	Heath Spotted Orchid	2	-	75	-	-	-
Drosera rotundifolia	Sundew	20	-	13	25	-	12
Empetrum nigrum	Crowberry	25	6	50	-	-	24
Epilobium hirsutum	Greater Willowherb	-	6	-	-	-	-
Epilobium montanum	Broad-leaved Willowherb	2	-	-	-	-	-
Erica cinerea	Bell Heather	5	97	89	75	100	44
Erica tetralix	Cross-leaved heath	85	29	63	75	86	80
Euphrasia spp.	Eyebright	-	3	38	-	-	16
Galium palustre	Marsh Bedstraw	-	-	-	-	-	4
Galium saxatile	Heath Bedstraw	35	48	25	25	43	12
Galium verum	Lady's Bedstraw	-	3	-	-	14	-
Gentianella campestris	Field Gentian	2	-	-	-	-	-
Hedera helix	Ivy	2	-	-	-	-	-
Hieracium pilosella	Mouse Ear Hawkweed	-	-	13	-	-	-
Hypericum perforatum	Common St John's-wort	-	10	13	-	-	-
Hypericum pulchrum	Slender St.John's wort	-	6	-	-	-	-
Hypochoeris radicata	Cats ear	-	6	-	-	-	4
Isoetes lacustris	Quillwort	-	-	13	-	-	-
Leontodon autumnalis	Autumn Hawkbit	-	3	50	13	-	-
Leontodon hispidus	Rough Hawkbit	-	23	25	-	14	8
Listera cordata	Lesser Twayblade	4	3	-	-	-	-
Listera ovata	Common Twayblade	9	-	-	-	-	-
Lonicera periclymenum	Honeysuckle	-	6	-	-	-	-
Lotus corniculatus	Common Bird foottrefoil	-	3	13	13	-	-

Scientific name	Common name	1	2	3	4	5	6
				% Frequency			
Lychnis flos-cuculi	Ragged Robin	-	-	13	-	-	-
Lysimachia nemorum	Yellow Pimpernel	-	-	-	-	-	-
Mentha aquatica	Watermint	-	3	-	-	-	-
Myrica gale	Bog Myrtle	2	-	-	-	-	16
Narthecium ossifragum	Bog Asphodel	51	9	75	25	14	36
Orchis mascula	Early Purple Orchid	-	-	26	-	-	-
Oxalis acetosella	Wood Sorrel	-	3	-	-	-	-
Pedicularis sylvatica	Lousewort	5	58	38	-	43	16
Pinguicula vulgaris	Common Butterwort	-	-	-	-	-	4
Plantago lanceolata	Ribwort Plantain	-	3	25	13	-	4
Polygala serpyllifolia	Thyme-leaved Milkwort	15	45	75	-	-	8
Polygala vulgaris	Common Milkwort	2	16	-	25	86	16
Potentilla erecta	Tormentil	64	100	88	88	100	84
Prunella vulgaris	Self Heal	-	-	-	13	-	-
Ranunculus acris	Meadow buttercup	2	3	-	-	-	4
Ranunculus repens	Creeping Buttercup	-	-	-	13	-	-
Rubus fruticosus agg.	Bramble	-	13	-	13	-	-
Rumex acetosa	Common Sorrel	4	10	13	-	-	8
Rumex acetosella	Sheep's Sorrel	-	-	13	-	-	4
Senecio jacobea	Common Ragwort	-	-	-	13	-	-
Sonchus asper	Prickly Sow-thistle	2	-	-	-	-	-
Stellaria alsine	Bog Stitchwort	2	-	13	-	-	-
Stellaria graminea	Lesser Stitchwort	-	-	-	-	-	4
Stellaria holostea	Greater Stitchwort	-	3	-	-	-	-
Stellaria media	Common Chickweed	4	-	-	-	-	4
Succisa pratensis	Devils Bit	-	26	75	-	-	32
Taraxacum officinale	Dandelion	-	3	13	13	-	4
Teucrium scorodonia	Wood Sage	-	19	-	-	-	-
Thymus praecox	Wild Thyme	-	-	13	-	-	-
Trifolium pratense	Red Clover	-	-	13	-	-	-
Trifolium repens	White Clover	-	6	13	13	-	12
Vaccinium myrtillus	Bilberry	62	89	88	50	14	56
Vaccinium oxycoccos	Cranberry	4	-	-	-	-	-
Veronica chamaedrys	Germander Speedwell	-	-	-	13	-	-
Veronica officinalis	Heath Speedwell	-	3	-	-	-	-
Viola palustris	Marsh Violet	2	-	-	-	-	-
Viola riviniana	Common Dog violet	-	16	13	13	14	4
Grasses							
Agrostis canina	Velvet Bent	31	35	25	13	43	16
Agrostis capillaris	Common Bent	7	19	-	63	57	44
Agrostis stolonifera	Creeping Bent	7	29	-	-	-	20
Alopecurus geniculatus	Marsh Foxtail	2		-	-	-	-
Anthoxanthum odoratum	Sweet vernal grass	42	19	88	25	--	64
Briza media	Common Quaking grass	-	-	-	-	-	4
Cynosurus cristatus	Crested Dogs-tail	-	3	13	13	-	-
Dactylis glomerata	Cocksfoot	-	-	13	-	-	-
Danthonia decumbens	Heath grass	-	26	25	-	14	12
Deschampsia cespitosa	Wavy hair grass	22	52	-	13	57	-
Deschampsia flexuosa	Tufted hair grass	56	48	50	-	-	52
Festuca ovina	Sheep' Fescue	-	52	50	13	14	24
Festuca pratensis	Meadow Fescue	5	-	-	-	14	-
Festuca rubra	Red Fescue	4	48	38	13	-	32
Holcus lanatus	Yorkshire fog	5	26	13	13	-	12
Lolium perenne	Perennial Rye grass	-	-	-	13	-	-
Molinia caerulea	Purple Moor grass	71	97	75	100	100	92
Nardus stricta	Mat grass	43	35	63	50	71	60
Poa annua	Annual meadow grass	2	6	-	-	-	-
Poa nemoralis	Wood meadow grass	5	-	-	-	-	-

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Scientific name	Common name	% Frequency					
		1	2	3	4	5	6
Poa pratensis	Smooth meadow grass	-	3	-	-	-	-
Poa trivialis	Rough meadow grass	7	-	-	-	-	12
Scirpus cespitosus	Deer grass	89	48	50	88	71	76
Sesleria albicans	Blue Moor grass	2	23	38	-	-	12
		-					
Sedges							
Carex binervis	Green-ribbed sedge	11	55	25	-	-	20
Carex caryophyllea	Spring sedge	-	-	-	-	-	4
Carex curta	White sedge	-	-	-	-	-	12
Carex dioica	Dioecious sedge	-	-	-	-	14	-
Carex demissa	Common Yellow sedge	2	16	38	-	-	12
Carex disticha	Brown sedge	-	-	-	-	29	8
Carex echinata	Star sedge	36	6	25	38	29	44
Carex flacca	Glaucous sedge	16	23	-	13	14	48
Carex hirta	Hairy sedge	-	3	13	-	14	-
Carex hostiana	Tawny sedge	-	3	13	-	-	-
Carex lasiocarpa	Slender sedge	-	10	25	-	-	4
Carex lepidocarpa	Long-stalked Yellow sedge	-	-	13	-	-	-
Carex nigra	Common sedge	27	35	50	25	14	52
Carex ovalis	Oval sedge	-	-	-	-	57	8
Carex pallescens	Pale sedge	4	32	50	25	71	20
Carex panicea	Carnation sedge	53	58	88	38	86	32
Carex pendula	Pendulous sedge	-	-	-	-	14	-
Carex pilulifera	Pill sedge	15	58	25	-	-	-
Carex pulicaris	Flea sedge	2	6	25	-	-	8
Carex remota	Remote sedge	-	-	-	-	14	-
Carex rostrata	Bottle sedge	2	6	-	-	-	2
Carex vesicaria	Bladder sedge	-	-	-	13	-	12
Rushes							
Eriophorum angustifolium	Broad bog cotton	85	13	50	63	14	76
Eriophorum vaginatum	Fine bog cotton	95	13	38	88	28	84
Juncus acutiflorus	Sharp flowered rush	4	3	13	-	14	8
Juncus articulatus	Jointed rush	4	3	25	-	14	8
Juncus bufonius	Toad rush	4	-	-	-	-	24
Juncus bulbosus	Bulbous rush	9	-	-	-	-	12
Juncus effusus	Soft rush	18	10	-	13	-	40
Juncus squarrosus	Heath rush	65	35	13	13	14	72
Luzula campestris	Field woodrush	18	13	-	-	-	28
Luzula multiflora	Many headed woodrush	35	52	50	-	-	8
Luzula sylvatica	Woodrush	-	3	-	-	-	-
Schoenus nigricans	Bog rush	-	-	-	-	14	-
Ferns							
Blechnum spicant	Hard fern	2	26	-	13	14	8
Cystopteris fragilis	Brittle Bladder fern	2	-	-	-	-	-
Dryopteris dilatata	Broad Buckler fern	-	2	-	-	-	-
Dryopteris filix-mas	Male fern	2	-	-	-	-	-
Equisetum palustre	Water horsetail	-	-	-	-	-	4
Polypodium vulgare	Polyploidy	-	-	-	-	-	4
Pteridium aquilinum	Bracken	-	35	13	-	43	8
Mosses / Lichens/Liverworts							
Atrichum undulatum		-	3	-	-	-	-
Aulacomnium palustre		27	13	13	-	-	8
Brachythecium plumosum		-	3	-	-	-	-
Brachythecium rivulare		-	3	-	-	-	-
Brachythecium rutabulum		2	6	13	38	-	-
Breutelia chrysocoma		2	10	-	-	-	4

Scientific name	% Frequency					
	1	**2**	**3**	**4**	**5**	**6**
Bryum pseudotriquetrum	-	-	-	13	-	-
Calliergon stramineum	2	-	-	13	-	-
Campylopus introflexus	16	10	-	-	-	8
Cephalozia bicuspidata	4	-	-	-	-	-
Ceratodon purpureus	-	3	-	-	-	-
Cetraria chlorophylla	-	-	-	-	14	-
Cladonia arbuscula	-	3	13	-	-	-
Cladonia coccifera	2	6	-	-	-	-
Cladonia coniocraea	-	6	-	13	-	-
Cladonia fimbriata	2	3	-	-	14	-
Cladonia floerkeana	7	13	-	13	-	16
Cladonia gracilis	-	-	-	-	-	4
Cladonia portentosa	53	52	50	50	43	60
Cladonia pyxidata	40	35	63	-	43	28
Cladonia polydactyla	-	3	13	-	-	-
Cladonia subcervicornis	-	6	-	-	-	-
Cladonia squamosa	-	-	-	13	-	-
Cladonia uncialis	22	3	-	-	28	4
Cratoneuron commutatum	-	-	-	-	-	12
Dicranella palustris	-	3	-	-	-	-
Dicranella heteromalla	49	39	-	-	-	12
Dicranum majus	33	19	13	-	-	-
Dicranum scoparium	71	77	75	50	86	68
Diplophyllum albicans	11	6	-	-	-	-
Drepanocladus uncinatus	-	-	-	13	-	-
Eurhynchium praelongum	4	45	-	-	28	20
Fissidens adianthoides	-	-	-	-	-	12
Grimmia donniana	-	3	13	-	-	-
Grimmia pulvinata	-	-	13	-	-	-
Hylocomium splendens	51	26	63	-	-	52
Hypnum cupressiforme	47	71	50	38	-	8
Hypnum jutlandicum	76	68	75	38	-	40
Hypogymnia physodes	22	10	-	-	-	4
Isopterygium elegans	-	6	-	-	-	-
Isothecium myosuroides	2	-	-	-	-	-
Kurzia pauciflora	4	-	-	-	-	-
Lepidozia reptans	2	-	-	-	-	-
Lophocolea cuspidata	2	-	-	-	-	-
Lophocolea bidentata	45	26	13	13	-	4
Lophozia ventricosa	56	13	-	25	-	16
Lycopodium alpinum	-	-	-	13	-	12
Marchantia polymorpha	-	-	-	-	-	-
Marsupella emarginata	2	6	-	-	-	-
Mnium hornum	2	6	-	-	-	-
Mycena spp	2	10	-	-	-	-
Nardia scalaris	38	6	-	13	-	8
Neckera complanata	-	-	-	-	-	20
Odontoschisma sphagni	-	3	-	-	-	-
Parmelia conspersa	-	-	-	-	1	-
Parmelia omphalodes	2	-	-	-	-	-
Pellia epiphylla	5	-	-	-	-	-
Peltigera canina	-	10	13	-	-	-
Plagiochila aspleniodes	2	-	-	38	-	-
Plagiomnium rostratum	-	-	-	-	-	-
Plagiomnium undulatum	5	-	-	-	-	-
Plagiothecium denticulatum	-	3	-	-	-	-
Plagiothecium nemorale	65	6	25	13	-	-
Plagiothecium undulatum	-	-	-	-	-	-
Pleurozium schreberi	78	32	25	50	-	36

Scientific name	**% Frequency**					
	1	**2**	**3**	**4**	**5**	**6**
Pohlia nutans	-	-	-	-	-	4
Polytrichumcommune	-	45	-	75	-	44
Polytrichum piliferum	-	3	-	-	-	-
Pseudoscleropodium purum	33	19	50	50	43	28
Racomitrium lanuginosum	22	29	-	-	43	20
Rhytidiadelphus loreus	4	6	-	13	-	4
Rhytidiadelphus squarrosus	35	32	50	13	-	60
Rhytidiadelphus triquetrus	78	26	-	50	-	36
Sphagnum auriculatum	91	16	-	25	-	60
Sphagnum capillifolium	2	3	-	-	-	20
Sphagnum compactum	4	10	50	13	14	8
Sphagnum cuspidatum	22	19	-	13	-	28
Sphagnum palustre	56	13	13	50	14	28
Sphagnum papillosum	56	6	13	-	-	20
Sphagnum rubellum	62	13	13	13	14	52
Sphagnum subnitens	5	6	-	13	28	12
Thuidium tamariscinum	22	19	25	75	-	40
Tortella tortuosa	2	6	-	-	-	4
Tritomaria quinquedentata	-	-	-	13	-	-

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APPENDIX 9

Summary of major NVC types and CORINE types of ESA Habitats vegetation types (derived from TWINSPAN) using TABLEFIT.

HABITAT VEGETATION TYPE: Description and indicator species (frequency of >70% in vegetation type)	NVC TYPE & CORINE Types (cross-referenced to NVC type)	% of vegetation type with >50% Goodness of Fit with NVC type
HAY MEADOWS (West Fermanagh & Erne Lakeland ESA)		68
1. Species-rich lowland damp meadows *Ranu rep/Phle pra/Anth odo/Junc eff/Care nig/Cyno cri* (n=7)	**29% MG5 Cyno cri-Cent nig; 29% MG8 Cyno cri-Calth pal** 71% Cynosurion pasture (C38.1) 29% Eutrophic humid grassland (C37.2)	29
2. Species-rich meadows *Anth odo/Poa tri/Fest rub/Ranu acr* (n=20)	**65% MG8 Cyno cri-Calt pal 25% M23a Junc eff/acfl-Gal pal** 75% Cynosurion pasture (C38.1) 25% Eutrophic humid grassland (C37.2)	65
3. Species-poor meadows *Plan lan/Cent nig/Cynos cris/Tara agg./Rume ace/Cera fon* (n=8)	**75% MG8 Cyno cri-Calt pal** 83% Cynosurion pasture (C38.1) 17% Eutrophic humid grassland (C37.2)	100
4. Species-poor grazed meadows *Bell per/Aloe pra/Holc lan/Card pra* (n=11)	**55% MG8 Cyno cri-Calt pal** 9% Fertiliser & reseed (C81) 91% Cynosurion pasture (C38.1)	63

WET GRASSLANDS (West Fermanagh & Erne Lakeland ESA)		16
5. Species-poor wet grasslands *Loli per/Poa tri/Rume ace* (n=10)	**30% MG9a Hol lan-Desc ces Poa triv** 60% Eutrophic humid grass (C37.2) 40% Cynosurion pasture (C38.1)	35
6. Species-rich wet grassland *Ment aqu/Gali pal/Lysi num/Ranu fla/Agro sto/Junc eff* (n=33)	**30% MG10 Holc lana-Junc eff 27% M22 Junc subnod-Cirsi palu 22% M23 Junc eff/acfl-Gal palu** 88% Eutrophic humid grassland (C37.2)	12
7. Species -rich grassland *Carex spp./Succ pra/Junc acu/Agro can/Trif rep*(n=7)	**43% M22 Junc subnod-Cirsi palu 28% MG8 Cynos cris-Calt pal** 43% Eutrophic humid grassland (C37.2)	0
HEATHER (All ESAs)		83
8. Typical wet heath *Call vul/Eric tet/Erio spp./Scir cesp/Junc squ/Spha spp.* (n=55)	**38% M17 Scir cesp-Erio vag: 27% M19 Calluna - E vag 27% M15 Scir cesp-Eric tet** 38% Lowland blanket bog(C52.1) 27% Upland blanket bog (C52.2) 27% Northern Wet heath (C31.1)	41
9. Grassy wet heath with bilberry *Vacc myr/Poly com/Anth odo/Moli cae/Erio vag* (n=25)	**52% M15 Scri cesp-Eric tet:** **16% M19 Calluna - E vag** 52% Northern Wet heath (C31.1) 16% Upland blanket bog (C52.2)	72
10a. Typical dry heath *Eric cin/Ulex eur/Moli cae/Pote ere* (n=26)	**50% H10 Calluna-Eric cin 38% M15 Scri cesp-Eric tet:** 50% Submontane heather moor (C31.2256)	85
10b. Grassy dry heath with bilberry *Vacc myr/Pote ere/Anth odo* (n=28)	**71% H10 Calluna-Eric cin**	89

	71% Submontane heather moor (C31.2256)	
LIMESTONE GRASSLANDS (West Fermanagh & Erne Lakeland ESA)		47
11. Limestone grassland *Carex spp/Ajug rep/Cyno cri/Fest rub/Gali sax/Lotu cor/Succ pra* (n=3)	**67% MG3a Anth odo-Ger syl Brom hor** **33% CG10b Fest ovi-Agro cap-Thym Car pul-Car pan** 67% Coarse grass, hay meadow (C38.2) 33% Perennial calc grassland (C34.3)	0
12. Species-rich limestone grassland *Ache mill/Briz med/ Dant dec/Fest rub/Luzu cam/Cyno cri* (n=5)	**100% MG3b Anth odo-Gera syl Briz med** 100% Coarse grass, hay meadow (C38.2)	100
13. Species-poor limestone grassland *Loli per/Agro sto/Moli cae/Bell per/Cyno cri* (n=3)	**67% MG8 Cyno cri-Calt pal** **33% MG6a Loli per-Cyno cri** 100% Cynosurion grassland (C38.1)	66
14. Heavily grazed limestone grasslands *Nard str/Agro can/ Fest ovi/Care nig/Junc eff/Rume ace* (n=4)	**75% U4d Agro-Festuca grass** 75% Dry siliceous grasslands (C35.1) 25% Cynosurion grassland (C38.1)	0
WOODLANDS (West Fermanagh & Erne Lakeland ESA)		10
15. Scrub *Frax exc/Cory ave/Crat mon/Hyac non* (n=10)	**40% W21 Crat mon-Hedera scrub** **30% W8d Fra exc-Ace cam-Mer per Pri vul-Gle hed** 60% Broad-leaved deciduous wood (C41) 40% Thicket, hedge, recolon (C31.8)	10
16. Species-rich woods *Prim vul/Viol riv/Pote ster/Cono maj/Hede hel/Thui tam* (n=5)	**40% W21 Crat mon-Hedera scrub** 60% Broad-leaved deciduous wood (C41) 40% Thicket, hedge, recolon (C31.8)	0
17. Alder woods *Alnu glu/Ranu fla/Ranu acr/Sene aqu/Junc buf* (n=5)	**80% W6 Alnu glu-Urti dio** 80% Alder and sallow swamp (C44.9)	20

UNIMPROVED GRASSLANDS (West Fermanagh & Erne Lakeland ESA)		25
18. Wet unimproved grasslands *Junc art/Ranu rep/Junc eff/Sene aqu/Succ pra/Agro can*	**60% M23 Junc eff/acfl-Gal palu**	20
	60% Eutrophic humid grass (C37.2)	
19. Sedge dominated unimproved grasslands *Carex spp./Ranu acr/Card pra/Cyno cri/Trif rep*	**50% M23 Junc eff/acfl-Gal palu** **33% MG8 Cynos cris-Calth pal**	0
	50% Eutrophic humid grass (C37.2)	
20. Semi-improved grasslands *Loli per/Agro sto/Aloe pra/Ranu acr*	**56% MG8 Cynos cris-Calth pal**	44
	67% Cynosurion pasture (C38.1) 22% Eutrophic humid grassland (C37.2)	
IMPROVED GRASSLANDS (West Fermanagh & Erne Lakeland ESA)		79
21. Species-diverse improved grasslands *Care hir/Glyc flu/Cyno cri/Fest rub* (n=3)	**33% MG8 Cyno cri-Calt pal** **33% MG7b Loli per-Trif rep** **33% MG10 Holc lan-Junc eff**	33
	33 % Fertilised & reseed (C81) 33% Eutrophic humid grassland (C37.24) 33% Cynosurion pasture (C38.1)	
22. Species-poor reseeded grasslands *Trif rep/Rume ace/Loli per* (n=6)	**100% MG11 Fes rub-Agr sto-Pot ans**	83
	100% Eutrophic humid grasslands(C37.2)	
23. Species-poor improved grassland *Sene jac/Rume obt/Loli per/Ranu rep/Bell per/Phle pra* (n=5)	**60% MG11 Fes rub-Agr sto-Pot ans**	100
	80% Eutrophic humid grasslands (C37.2)	

WOODLANDS		
(Antrim Glens, Coast & Rathlin ESA)		0
1. Overgrown woods	**40% W9a Frax exc-Sor auc-Mer per Typical**	0
Pter aqu/Rubu fru/Hede hel/Ranu fic (n=5)		
	60% Ash woods (C41.3)	
2. Mixed species wet scrub	**92% W9b Frax exc-Sor auc-Mer per Crep pal**	0
Salix spp./Cory ave/Frax exc/Prim vul/Viol riv/Fili ulm/Pter aqu/Lysi nem (n=13)		
	100% Ash woods (C41.3)	
3. Mixed species scrub	**63% W9b Frax exc-Sor auc-Mer per Crep pal**	0
	25% W11b Que pet-Bet pub-Oxa ace Blech spp.	
Cory ave/Frax exc /Sorb auc/Hyac non/Pter aqu/Viol riv /Lysi nem(n=8)		
	76% Ash woods (C41.3)	
4. Species-poor woods	**50% MG6a Loli per-Cynos cri Typical**	0
Acer pse/Fagu syl/Loli per/Agro sto/Dact glo/Urti dio (n=2)		
	50% MG9 Hol lan-Des ces	
	50% Cynosurion pasture (C38.1) 50% Eutrophic humid grasslands (C37.2)	

APPENDIX 10

Plates illustrating vegetation types from monitored habitats -
Woodlands and Heather moorland