ENVIRONMENTALLY SENSITIVE AREAS IN NORTHERN IRELAND

Re-monitoring of –

The Mournes and Slieve Croob
The Antrim Coast Glens and Rathlin
The Sperrins
Slieve Gullion

Biological evaluation of the ESA scheme between 1994 and 2000

CONTENTS

1. INTRODUCTION

The Environmentally Sensitive Areas (ESA) Scheme was introduced by the Department of Agriculture and Rural Development (DARD) 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. The scheme was introduced in 1988 and has continuously expanded to the present level of 20% of the land area of Northern Ireland. The five designated areas are:

The Mournes & Slieve Croob ESA
The Antrim Coast, Glens & Rathlin ESA
The West Fermanagh & Erne Lakeland ESA
The Sperrins ESA
The Slieve Gullion ESA

A ten year agreement plan has been set up with various tiers of management prescriptions. Payments are area based and are paid annually in arrears. Payments vary according to the level of participation.

1.1. Monitoring

A long-term monitoring programme was established in 1992 by DARD to determine if the ESA scheme is fulfilling its objectives. Biological and landscape monitoring programmes have been established in all ESAs. A baseline biological monitoring programme in the West Fermanagh and Erne Lakeland ESA was completed in 1993 (Hegarty *et al*. 1994) and baseline surveys of the other four ESAs were completed in 1994 (Hegarty *et al*. 1995). These surveys provided baseline data on the wildlife value of a range of sites from target habitats within the ESAs. Plant species, and invertebrates (ground beetles and spiders) were monitored.

Monitoring plant species is the most widely used method of assessing ecological changes in the environment. Vegetation is the key to the entire ecosystem and plant diversity may often be correlated with animal diversity (Osborne 1982). Therefore

monitoring the plant species diversity is indicative of the wildlife value of the habitat. Recording detailed changes at the plant species level is widely used to examine long term ecological changes, such as the relationship between plant composition and agricultural management (Hopkins & Wainwright, 1989).

Ground beetles and spiders were monitored as they are habitat specific, easily trapped in pitfall traps and are good indicators of biological change (Kirby, 1992). The wealth of information on the ecological requirements of individual ground beetle species (Lindroth 1974) has proven useful in environmental quality assessment (Eyre & Rushton 1989; Rushton *et al.* 1989; Gardner 1991).

Invertebrate monitoring in association with plant species provides a comprehensive indicator of the biodiversity of a habitat. Species lists of ground beetles and spiders have been compiled for each target habitat. Rare and threatened species have been found within the ESAs and their status and distribution documented (Hegarty *et al.* 1994, 1995). These species will act as performance indicator species in assessing the effectiveness of the ESA scheme.

All the Northern Ireland ESAs were re-monitored three years after baseline monitoring, in a partial survey to allow an initial appraisal of the effectiveness of the scheme and to facilitate modification of prescriptions if necessary. The West Fermanagh and Erne Lakeland ESA was partially re-monitored in 1996, three years after baseline biological monitoring and a complete re-monitoring exercise was completed in 1999 (Cameron *et al*. 2000). This permitted a more precise evaluation of the scheme over a longer time period during which the effects of management prescriptions have had a greater opportunity to become apparent. A complete re-monitoring of all of the other ESAs was carried out in 2000. This report compares plant and invertebrate species composition as indicators of biodiversity and habitat condition on heather moorland in the Mournes & Slieve Croob ESA, the Sperrins ESA, the Slieve Gullion ESA and heather moorland and woodland in the Antrim Coast, Glens & Rathlin ESA. Although the Antrim Coast, Glens & Rathlin form one ESA, Rathlin Island has been considered separately due to the distinct composition and character of the flora and fauna.

1.2. Heather Management Study

Moorland has been traditionally managed by rotational burning of small patches of older heather to create a mosaic of uneven aged stands. A combination of mature heather and young developing heather has been shown to be the most desirable combination for production and for species conservation (Gimingham 1985). Older stands provide shelter for sheep and cover for grouse and other ground nesting birds whilst young shoots are the most palatable and nutritious. Uneven phased stands have been shown to have greater invertebrate species diversity due to the greater range of structure and ages (Coulson 1992).

More recently, flailing has been used as a management tool with the same objectives as burning. There is little history of controlled heather management in Northern Ireland. In 1997, therefore, botanical monitoring was carried out on a number of heather sites that had recently been either burned or flailed. These sites were re-monitored in 1998 and again in 2000 and the resulting plant species data provides the basis for a comparative study. The study aims to provide information on the suitability and effectiveness of these management practices in Northern Ireland.

2. METHODS

2.1. Re-monitoring field sampling programme

A total of 108 heather moorland and 28 woodland sites were surveyed in 1994 and re-surveyed in 2000 and data compared between years. Farms monitored in 2000 were divided into two groups, those who had entered into an ESA agreement, ESA "participants" and those who had not entered an ESA agreement at the time of re-monitoring, "non-participants".

Table 1. Number of sites re-monitored for each habitat in 2000 on heather moorland and woodland in each of the ESAs.

ESA	Habitat	Number of sites re-monitored		% of baseline sites re-monitored
		Plants	Invertebrates	
Antrim Coast & Glens	Heather moorland	8	4	100
	Woodland	28	14	100
Rathlin	Heather moorland	8	4	100
Mournes & Slieve Croob	Heather moorland	7	4	100
Slieve Gullion	Heather moorland	30	18	100
Sperrins	Heather moorland	55	42	100

2.2. Botanical monitoring

Plant monitoring was carried out between April and September 2000, with sites being visited once during this period. Woodlands were surveyed during May and heather moorland in July, August and September. Permanent quadrats initially recorded in 1994, were re-monitored at the same month of the year as during the baseline monitoring. All ESA and heather management sites were subsequently plotted using a Garmin 12 XL Global Positioning System to aid future re-location. Plant nomenclature follows Stace (1997) mosses and liverworts follow Watson (1981). Details of specific habitat monitoring techniques are listed below.

2.2.1. Heather moorland

At baseline monitoring in 1994, a 60m transect was measured across the site from a randomly placed 1m metal stake and four permanent quadrats were marked out at 15m intervals (MAFF, 1987). Small sections of metal tubing were used as quadrat markers and these were firmly located below ground level, preventing damage to any animals or farm machinery. These quadrats were relocated in 2000 using a metal detector and a detailed field map. All plant species (including bryophytes) within a 1x1m quadrat were recorded, along with estimates of percentage cover for each species. The presence of additional species in the surrounding 2m x 2m quadrat was recorded. Records were also made of the mean heather height, dead heather, bare ground and dung.

2.2.2. Woodland

Permanent 14x14m quadrats were relocated using maps and 1m metal poles that had been placed in each corner and at the centre of the quadrat. Plant species were recorded in the central 2mx2m quadrat, along with their estimated percentage cover. Additional species in the outer 14x14m quadrat were listed. Diameters of trees and shrubs (at 1.2m stem height) were recorded, together with site information on grazing and management details.

2.2.3. Heather management study

Burned and flailed heather sites in Co. Antrim, Co. Tyrone and Co. Londonderry were re-monitored in August and September 2000. Transects were relocated at each site using 8 figure grid references of marker poles, placed at baseline monitoring. Four quadrats were recorded along each 60m transect line. Plant species cover (including bryophytes) was recorded within a 1x1m quadrat and any additional species in the surrounding 2x2m quadrat were listed. Unmanaged controls were re-monitored on adjacent heather areas in each case. The mean heather height in each quadrat was also recorded, together with bare ground, dead heather and dung.

2.3. Invertebrate monitoring

Ground beetles and spiders were sampled during three, four-week periods between April and October 2000. This was achieved at each site using five pitfall traps (polythene containers 9cm wide and 20cm deep) part filled with ethylene glycol to prevent the escape and deterioration of specimens before collection. Pitfall traps are the most efficient method of collecting invertebrate samples and produce more species than any other method (Coulson & Butterfield 1985). They also collect animals throughout the time they are in place and so are less labour intensive for the number of species trapped. Traps were placed 20 m 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^{o}C 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 Science, Department of Agriculture and Rural Development). All adult spiders were identified to species using Roberts (1985). Species identifications were confirmed by Dr. Peter Merrett (British Arachnological Society).

2.4. Data storage

2.4.1. Recorder database

All invertebrate records were stored on the relational database **Recorder** and have been transferred to CEDaR (Centre for Environmental Data and Recording). Recorder facilitates this transfer and provides summary lists and tables compatible with multivariate analysis packages.

2.4.2. MS Access and MS Excel

Plant records were stored on MS Access database and statistical tests on plant data were carried out within this package. MS Excel was used for manipulation and statistical analysis of invertebrate data.

2.5. Data analysis

Habitat diversity was measured by a combination of plant and invertebrate species richness, plant strategy theory CSR groups (Grime *et al* 1988) and similarity indices. Diversity indices were calculated for carabid beetle and spider populations.

2.5.1. Species richness

Species richness, the total number of species found on a habitat, is the most widely adopted measure of diversity (Magurran, 1983). To monitor the success of the ESA scheme in maintaining or enhancing the diversity of a habitat, plant and invertebrate species numbers, frequency and abundance on ESA participant and non-participant farms were compared.

Changes in species richness over time on habitats on ESA participant and non-participant farms were determined by statistically comparing (paired t-test) the mean number of species per site in 1994 with the mean number of species on the same site in 2000 for ESA participant and non-participant farms. Numbers of higher plant species, i.e. excluding mosses, liverworts, lichens and fungi, were also compared.

Plant frequency was determined by the percentage of sites for each habitat that a plant species occurred on. Mean abundance was the mean percentage cover of a plant species within the 1x1m quadrat (or 2x2m quadrat for woodlands).

2.5.2. Plant strategy theory

Plant strategy theory (Grime *et al* 1988) defines plant species in terms of ruderals (R), competitors (C), stress-tolerators (S), or intermediates. Each type occurs under different environmental conditions. Ruderals are annual weeds, typical of improved grassland and disturbed habitats. Competitors are typically fast growing species, found on highly productive grassland and live under the threat of competitive exclusion. Stress-tolerators are found where an environmental factor is limiting productivity, i.e. low nutrient soils and soils liable to water-logging. Many stress-tolerator species are vulnerable to intensive agricultural practices, such as fertiliser application and drainage. By examining the frequency and composition of indicator

species and plant species with known ecological requirements and C-S-R plant strategies, indications on the effect of the management practices may be inferred.

The vegetation of each monitored habitat can be described in terms of the relative proportions of species in each of the CSR groups. These proportions were compared between 1994 and 2000 for ESA participant farms and non-participant farms

2.5.3. Sørensen similarity index

This similarity index gives a measure of the level of change in the species composition of a sample and can be used to determine the level of change in species on ESA participant and non-participant farms between baseline and re-survey.

The similarity between 1994 and 2000 for each site has been calculated for carabid beetles and spiders using the Sørensen Index (I):

$$I = 2j / [a+b] \times 100$$

This is expressed as a percentage where:-

a is the number of species recorded in 1994

b is the number of species recorded in 2000

j is the number of species occurring in both years.

This index makes no distinction between the presence of a species represented by the recording of a single specimen or by the recording of a large number of individuals (Coulson & Butterfield, 1985).

2.5.4. Diversity indices for carabid beetles and spiders

An indication of species diversity at each site was given by alpha of the log series distribution of species abundance data. Alpha diversity is an index which allows comparison of diversity between sites and takes account of both abundance and numbers of species. Alpha species diversity was calculated for carabid beetles and spiders for each site. Alpha was estimated by maximum likelihood in:-

$$S = \alpha \ln (1 + N/\alpha)$$

Where:- S is the species total and N is the total individuals of all species at each site (Southwood 1978).

3. RESULTS

3.1. HEATHER MOORLAND

3.1.1. Antrim Coast and Glens

Plant species diversity between 1994 and 2000

By 2000 all surveyed sites in the Antrim Coast and Glens were participants in the ESA scheme. When all sites were compared between 1994 and 2000 it was found that there was a significant increase in the mean number of plant species recorded per site (Table 2). When the complement of higher plant species (i.e. excluding mosses, liverworts, lichens and fungi) was analysed the mean number had increased between years although this was not significant. The total number of species recorded overall increased from 82 to 111 this increase was mainly due to an increase in the number of bryophytes recorded in 2000.

Table 2. Plant species diversity in 1994 and 2000 on heather moorland in the Antrim Coast & Glens.

	ESA status	n	1994		2000		p
			Mean	se	Mean	se	
Mean no. of plant species per site	Participant	8	23.9	3.8	33.4	4.4	**
	Non-participant	0	-		-		
Mean no. of higher plants per site	Participant	8	15.1	3.7	17.9	4.2	NS
	Non-participant	0	-		-		

(NS = non-significant, * = $p<0.05$, ** = $p<0.01$)

Plant species frequency and abundance

Plant frequency species lists have been determined for 1994 and 2000 (Appendix 1). The most frequent species recorded in 2000 on the Antrim coast and Glens heather moorland sites were heather (*Calluna vulgaris*), common cotton grass (*Eriophorum angustifolium*), bell heather (*Erica cinerea*), tormentil (*Potentilla erecta*) and mosses e.g. *Hypnum* spp., *Pleurozium schreberi* and *Dicranum scoparium*.

In 2000 a total of 111 species were recorded, 50 of these had not been recorded in 1994, including 25 bryophyte and lichen species. 'New' species included some typical heathland species such as crowberry (*Empetrum nigrum*), green-ribbed sedge (*Carex binervis*), pill sedge (*Carex pilulifera*), lesser twayblade (*Listera cordata*) and heath grass (*Danthonia decumbens*). There were also some grassland plants recorded such as meadow grasses (*Poa* spp.), pearlwort (*Sagina procumbens*) and meadow buttercup (*Ranunculus acris*). This was due to heavy grazing on one of the lower lying sites leading to a mosaic of heath and grassland. However some undesirable species were also 'lost' since 1994, including perennial ryegrass (*Lolium perenne*) and ragwort (*Senecio jacobea*). Bare ground was present on all of the sites in 1994 and 2000.

The frequency of mat grass (*Nardus stricta*) had increased between years from 25% to 63% another indication of continued heavy grazing on some sites. The frequency of purple moor grass (*Molinia caerulea*) and deer grass (*Trichophorum cespitosum*) both decreased. Sundew (*Drosera rotundifolia*) was found on two sites in 1994 but not in 2000.

The only higher plant species that showed a significant change in abundance between years was tormentil (*Potentilla erecta*) which decreased from 6% to 2% ($p<0.05$). Heather (*Calluna vulgaris*) cover showed a slight increase from 42% to 48%. The mean cover of sedges (*Carex* spp.) and bog mosses (*Sphagnum* spp.) also increased, again not significantly.

Plant species proportions in the CSR strategy groups

There was little change in the proportions of species in each of the CSR groups on the ESA participant sites in the Antrim Coast and Glens. The proportion of stress-tolerating species remained stable at 42% between 1994 and 2000. There was a higher proportion of ruderal species than in heather moorland sites in the other ESAs, indicating a greater degree of disturbance.

Carabid beetle species diversity

The number of carabid beetle individuals captured on Antrim Coast and Glens heather moorland on participant farms showed no significant change between 1994 and 2000. By 2000 all sampled heathland sites in the Antrim Coast & Glens were ESA participants.

The mean number of carabid beetle species per site increased significantly on participant farms (Table 3). Similarity in carabid beetle species captured between 1994 and 2000 on participant farms was 64%. Species diversity indices showed no significant change between years. Diversity indices did not change significantly between years.

Table 3. Carabid beetle species richness and diversity in 1994 and 2000 on heather moorland in the Antrim Coast & Glens.

	ESA status	n	1994		2000		p
			Mean	Se	Mean	se	
Mean number of carabid species per site	Participant	4	10	1.5	16	2.2	*
	Non-participant	-	-	-	-	-	-
Mean carabid diversity per site	Participant	4	4.0	0.5	4.4	0.8	NS
	Non-participant	-	-	-	-	-	-

(NS = not significant * = $p<0.05$ ** = $p<0.01$)

Spider species diversity

All sites sampled were from ESA participants. The number of spider individuals showed no significant change whilst the number of total spider species increased by 15% (Table 4). Similarity in spider species captured between 1994 and 2000 was 73%.

Table 4. Spider species richness and diversity in 1994 and 2000 on heather moorland sites in the Antrim Coast & Glens.

	ESA status	n	1994		2000		P
			Mean	se	Mean	se	
Mean number of spider species per site	Participant	4	18	2.8	23	2.7	**
	Non-participant	0	-	-	-	-	-
Mean spider diversity per site	Participant	4	9.56	1.2	8.31	0.9	NS
	Non-participant	0	-	-	-	-	-

(NS = not significant * = $p<0.05$ ** = $p<0.01$)

There was no change in spider species composition between years on participant sites (Appendix 3). Of 15 spider species not captured on this habitat in 1994, *Euryopis flavomaculata* is a new county record for Co. Antrim from a participant site.

3.1.2. Rathlin Island

Plant species diversity between 1994 and 2000 for ESA participants and non-participants

Sites on Rathlin continued to have greater species diversity in terms of mean numbers of species than heather moorland on any of the other ESAs. There were no significant changes in mean numbers of plant species or higher plants per site between 1994 and 2000 for ESA participants or non-participants (Table 5). The total number of recorded species increased on participant sites from 91 to 94, whereas they decreased on non-participant heath from 48 to 38.

Table 5. Plant species diversity in 1994 and 2000 on heather moorland on Rathlin

	ESA status	n	1994		2000		P
			Mean	se	Mean	se	
Mean no. of plant species per site	Participant	6	38.0	3.2	39.2	5.1	NS
	Non-participant	2	31.0	2.0	30.1	1.0	NS
Mean no. of higher plants per site	Participant	6	29.7	2.9	26.7	4.0	NS
	Non-participant	2	20.0	1.0	19.0	0.0	NS

(NS = non-significant, * = $p<0.05$, ** = $p<0.01$)

Plant species frequency and abundance

Plant frequency species lists have been determined for 1994 and 2000 (Appendix 1). The most frequent species recorded on heath sites on Rathlin in 2000 include heather (*Calluna vulgaris*), bell heather (*Erica cinerea*), western gorse (*Ulex gallii*), carnation sedge (*Carex panicea*), lousewort (*Pedicularis sylvatica*) and devil's bit scabious (*Succisa pratensis*).

There were 20 higher plant species found on participant heathland in 2000 that had not been recorded in 1994. These were generally species not specific to heathland but to unimproved grassland, e.g. cat's ear (*Hypochaeris radicata*), selfheal (*Prunella vulgaris*) and early hair-grass (*Aira praecox*). Creeping willow (*Salix repens*) was not previously recorded but occurred on five out of six participant sites in 2000. A total of 26 higher plant species listed in 1994 were not re-recorded. These included heathland species such as crowberry (*Empetrum nigrum*), sundew (*Drosera rotundifolia*), hare's

tail cotton grass (*Eriophorum vaginatum*), wavy hair-grass (*Deschampsia flexuosa*) and bilberry (*Vaccinium myrtilis*). However several of the 'lost' species were grassland herbs, e.g. daisy (*Bellis perennis*), creeping buttercup (*Ranunculus repens*) and dandelion (*Taraxacum* spp.).

Species increasing in occurrence on participant sites include bent grasses (*Agrostis* spp.), heath grass (*Danthonia decumbens*) and the sedges *Carex pilulifera* and *C.binervis*. The frequency of the moss species, *Campylopus introflexus* and *Leucobryum glaucum*, had also increased notably. Several species indicative of wet peat including cotton grasses (*Eriophorum* spp.), purple moor grass (*Molinia caerulea*), heath rush (*Juncus squarrosus*) and deer grass (*Trichophorum cespitosum*) had all declined in frequency since 1994.

Although not significant, the mean cover of heather and bell heather had increased (by 16% and 11.5% respectively) between years on ESA participant sites. The abundance of carnation sedge (*Carex panicea*) and bog asphodel (*Narthecium ossifragum*) had significantly decreased.

The sample size for non-participant heathland was too small to make any real comparison between years. However on these 2 non-participant sites there had been a significant increase in sedge (*Carex*) cover from 4% to 16% ($p<0.05$), perhaps as a result of continued heavy grazing.

Plant species proportions in the CSR strategy groups

On participant sites the proportion of stress-tolerating species increased slightly from 47% to 51% and the proportion of competitive species decreased from 7% to 2%. The proportion of stress-tolerators on non-participant sites also increased from 67% to 74%. However when actual numbers of species in each CSR group were looked at there were no significant changes in the numbers of stress-tolerators indicating a decrease in species with other life strategies rather than an increase in stress-tolerators.

Carabid beetle species diversity

The number of carabid beetle individuals and species captured on heather moorland on participant farms and on non-participant farms on Rathlin Island showed no significant change (Table 6). There were no significant changes in diversity indices on participant or non-participant sites between 1994 and 2000 on Rathlin Island. Similarity in carabid beetle species captured between 1994 and 2000 was 82% for participants and 85% for non-participants.

Cymindis vaporariorum, recorded as a single specimen on Rathlin in 1994, and in 1997, was not re-recorded in 2000.

Table 6. Carabid beetle species richness and diversity in 1994 and 2000 on heather moorland on Rathlin Island.

	ESA status	n	1994		2000		P
			Mean	se	Mean	se	
Mean number of carabid species per site	Participant	3	19	1.1	16	1.7	NS
	Non-participant	1	18	-	15	-	-
Mean carabid diversity per site	Participant	3	4	0.2	4.4	0.2	NS
	Non-participant	1	3.4	-	3.0	-	-

(NS = not significant * = $p<0.05$ ** = $p<0.01$)

Spider species diversity

There was no significant change in the mean number of spider individuals on participant or non-participant sites on Rathlin Island. Similarity in spider species captured between 1994 and 2000 was 67% for participants and 57% for non-participants. Species richness and diversity did not change significantly between 1994 and 2000 for either participant or non-participant sites. The minor nature of changes in species composition indicated habitat stability on both participant and non-participant sites (Appendix 3).

3.1.3. Mournes & Slieve Croob ESA

Plant species diversity between 1994 and 2000 for ESA participants and non-participants

There were no significant changes in mean numbers of plant species or higher plants per site between 1994 and 2000 for ESA participants or non-participants. The total number of plant species recorded increased from 36 to 40 on ESA participant sites and from 45 to 59 on non-participant sites.

Table 7. Plant species diversity in 1994 and 2000 on heather moorland in the Mournes & Slieve Croob ESA.

	ESA status	n	1994		2000		P
			Mean	se	Mean	se	
Mean no. of plant species per site	Participant	3	21.0	3.2	24.7	1.2	NS
	Non-participant	4	22.0	2.9	25.0	5.9	NS
Mean no. of higher plants per site	Participant	3	14.7	2.3	15.3	0.9	NS
	Non-participant	4	17.8	2.2	17.8	4.0	NS

(NS = non-significant, * = $p<0.05$, ** = $p<0.01$)

Plant species frequency and abundance

Plant frequency species lists have been determined for 1994 and 2000 (Appendix 1). The most frequent species on all heather moorland sites in the Mournes & Slieve Croob ESA in 2000 were bell heather (*Erica cinerea*), purple moor grass (*Molinia caerulea*), bent grasses (*Agrostis* spp.), heather (*Calluna vulgaris*), mat grass (*Nardus stricta*), heath milkwort (*Polygala serpyllifolia*), tormentil (*Potentilla erecta*) and pill sedge (*Carex pilulifera*).

The sample sizes for ESA participants and non-participants were very small (Table 7) so changes in frequency and cover of individual species are difficult to assess. In general there appears to have been an increase in the frequency of certain grass species. 'New' species recorded on participant heath in 2000 include heath grass (*Danthonia decumbens*), sheeps fescue (*Festuca ovina*) and velvet bent grass (*Agrostis canina*).

There was a very low cover of heather (*Calluna vulgaris*) on all sampled Mournes & Slieve Croob ESA sites and there has been a decrease in abundance since 1994, although not significant. On ESA participant sites there was a decrease from 6.3% to 1.4% and on non-participant sites from 9.8% to 2.6%. Bell heather (*Erica cinerea*) also appeared to be declining with a significant decrease from 11.3% to 3.6% on participant sites ($p<0.05$). There has also been an increase in purple moor grass (*Molinia caerulea*) on all sites. These results suggest that it may be necessary to further reduce grazing pressure or cease grazing for a period to allow recovery on sites that were heavily grazed prior to ESA agreement.

Plant species proportions in the CSR strategy groups

There was an increase in the proportion of generalist (CSR) species on ESA participant sites. On non-participant sites there was a increase in stress-tolerant competitors and a decrease in stress-tolerant ruderals, indicating a possible increase in disturbance. There were no ruderal species recorded in 1994 or 2000.

Carabid beetle species diversity

The number of carabid beetle individuals or number of individuals per trap captured on heather moorland in the Mournes & Slieve Croob ESA on participant farms and on non-participant farms showed no change between 1994 and 2000. The diversity index for carabids showed no change on participant or non-participant sites. Similarity in carabid beetle species captured between 1993 and 1999 was 53% for participants and 36% for non-participants.

Table 8. Carabid beetle species richness and diversity in 1994 and 2000 on heather moorland in the Mournes & Slieve Croob ESA.

	ESA status	n	1994		2000		P
			Mean	se	Mean	se	
Mean number of carabid species per site	Participant	1	9	-	10	-	NS
	Non-participant	1	3	-	8	-	NS
Mean carabid diversity per site	Participant	1	5.44	-	2.59	-	NS
	Non-participant	1	2.38	-	2.93	-	NS

(NS = not significant * = $p<0.05$ ** = $p<0.01$)

Spider species diversity

There was no change in number of spider individuals on participant or non-participant sites in the Mournes & Slieve Croob ESA. The total number of spider species increased for both participant and non-participant sites although this was based on one site each. Similarity in spider species captured between 1994 and 2000 was 46% for participants and 34% for non-participants. Species richness and diversity did not change between 1994 and 2000 for either participant or non-participant sites.

Of 25 spider species not previously captured in this ESA, *Neon reticulatus* is a new Northern Ireland record and *Aphileta misera* is a new record for County Down, both from non-participant sites.

3.1.4. Slieve Gullion

Plant species diversity between 1994 and 2000 for ESA participants and non-participants

There were no significant changes in mean numbers of plant species or higher plants per site between 1994 and 2000 for ESA participants or non-participants. The total number of species recorded decreased slightly on participant sites from 127 to 120. On non-participant sites there was an increase from 99 to 105 species recorded.

Table 9. Plant species diversity in 1994 and 2000 on heather moorland in the Slieve Gullion ESA

	ESA status	n	1994		2000		p
			Mean	se	Mean	se	
Mean no. of plant species per site	Participant	13	33.2	1.9	32.5	2.5	NS
	Non-participant	17	26.1	1.8	26.6	2.6	NS
Mean no. of higher plants per site	Participant	13	21.9	1.6	19.8	1.7	NS
	Non-participant	17	18.8	1.3	18.8	1.7	NS

(NS = non-significant, * = $p<0.05$, ** = $p<0.01$)

Plant species frequency and abundance

Plant frequency species lists have been determined for 1994 and 2000 (Appendix 1). The most frequent species on heather moorland in Slieve Gullion were heather (*Calluna vulgaris*), bell heather (*Erica cinerea*), western gorse (*Ulex gallii*), bilberry (*Vaccinium myrtilis*), velvet bent (*Agrostis canina*) and tormentil (*Potentilla erecta*).

On ESA participant sites 16 'new' species were recorded in 2000 including sundew (*Drosera rotundifolia*) and butterwort (*Pinguicula vulgaris*). A further 23 species found in 1994 were not re-recorded in 2000. These include heathland plants such as crowberry (*Empetrum nigrum*) and hare's tail cottongrass (*Eriophorum vaginatum*) as well grassland species such as perennial rye-grass (*Lolium perenne*), ragwort (*Senecio jacobea*) and selfheal (*Prunella vulgaris*).

There were 20 higher plant species recorded in 2000 and not in 1994 on non-participant sites. These were mainly non-heathland agricultural species including

perennial rye-grass (*Lolium perenne*), meadow-grasses (*Poa* spp.), creeping buttercup (*Ranunculus repens*), common sorrel (*Rumex acetosa*) and spear thistle (*Cirsium vulgare*). Most of these new species were found on one site that had been partially reclaimed. The frequency of certain undesirable species had also increased, for example, mouse-ear chickweed (*Cerastium fontanum*) and annual meadow-grass (*Poa annua*).

The abundance of heather (*Calluna vulgaris*) increased significantly on participant sites between 1994 and 2000 from 23.1% to 34.2% ($p<0.05$). There was also a significant decrease in mat grass (*Nardus stricta*), a species indicative of high grazing intensity. Changes in the abundance of *Calluna* and *Nardus* also occurred on non-participant sites but were not significant. The mean cover of western gorse *(Ulex gallii)* increased from 4% to 8% on participant farms.

Plant species proportions in the CSR strategy groups

The proportion of stress-tolerators on non-participant sites fell from 50% to 39% and ruderals and competive-ruderals increased, suggesting increased disturbance. On participant sites the proportions of species in each strategy group were more stable between 1994 and 2000.

Carabid beetle species diversity

The number of carabid beetle individuals and species captured on heather moorland in the Slieve Gullion ESA on participant farms and non-participant farms showed no significant change (Table 10). The species diversity index for carabids decreased on both participant and non-participant farms indicating annual fluctuations and not changes due to differing management practices. Similarity in carabid beetle species captured between 1993 and 1999 was 79% for participants and 75% for non-participants.

Table 10. Carabid beetle species richness and diversity in 1994 and 2000 on heather moorland in the Slieve Gullion ESA.

	ESA status	n	1994		2000		P
			Mean	se	Mean	se	
Mean number of carabid species per site	Participant	9	13	1.5	10	1.5	NS
	Non-participant	9	11	1.5	12	1.9	NS
Mean carabid diversity per site	Participant	9	4.5	0.5	3.6	0.5	NS
	Non-participant	9	4.5	0.5	3.5	0.5	NS

(NS = not significant * = $p<0.05$ ** = $p<0.01$)

Spider species diversity

The number of spider individuals increased significantly ($P<0.01$) by 196% on participant sites. There was no significant change in number of spider individuals on non-participant sites. The total number of spider species increased by 94% on participant sites and by 76% on non-participant sites. Similarity in spider species captured between 1994 and 2000 was 62% for participant sites and 64% for non-participant sites.

Table 11. Spider species richness and diversity in 1994 and 2000 on heather moorland in the Slieve Gullion ESA.

	ESA status	n	1994		2000		P
			Mean	se	Mean	se	
Mean number of spider species per site	Participant	9	9	1.3	25	2.1	***
	Non-participant	8	12	1.1	18	2	NS
Mean spider diversity per site	Participant	9	4.54	0.8	10	0.8	*
	Non-participant	8	6.26	0.9	8.35	1	NS

(NS = not significant * = $p<0.05$ ** = $p<0.01$ *** = $p<0.001$)

Species composition showed no significant change in spider species common to grassland or heathland habitats for both participant and non-participant sites (Appendix 3). Of 44 species not captured in 1994, 3 were county records: *Araneus quadratus, Saaristoa firma* and *Meta mengei*, all from participant sites.

3.1.5. Sperrins

Plant species diversity between 1994 and 2000 for ESA participants and non-participants

Between 1994 and 2000 there was a significant increase in the mean number of plant species recorded on ESA participant heather moorland sites. However there were no changes in the mean number of higher plant species recorded for participants or non-participants. The total number of species recorded decreased slightly on participant sites from 111 to 107. On non-participant sites there was an increase from 74 to 79 species recorded.

Table 12. Plant species diversity from 1994 to 2000 on heather moorland in the Sperrins ESA.

	ESA status	n	1994		2000		P
			Mean	se	Mean	se	
Mean no. of plant species per site	Participant	43	27.6	1.0	32.0	1.3	**
	Non-participant	12	28.3	1.5	30.2	1.7	NS
Mean no. of higher plants per site	Participant	43	13.8	0.8	14.0	0.8	NS
	Non-participant	12	14.8	1.6	14.6	1.5	NS

(NS = non-significant, * = $p<0.05$, ** = $p<0.01$)

Plant species frequency and abundance

Plant frequency species lists have been determined for 1994 and 2000 (Appendix 1). The most frequent species on heather moorland in the Sperrins ESA in 2000 were heather (*Calluna vulgaris*), cotton grasses (*Eriophorum* spp.), cross-leaved heath (*Erica tetralix*), *Sphagnum* spp. and deer grass (*Trichophorum cespitosum*).

On ESA participant sites seven 'new' higher plant species were recorded in 2000 including hard fern (*Blechnum spicant*), heath grass (*Danthonia decumbens*) and devil's bit scabious (*Succisa pratensis*). There were 26 'new' bryophytes and lichens recorded in 2000. Of 25 higher plants not re-recorded in 2000 most were non-heath plants such as ragwort (*Senecio jacobea*), meadow grasses (*Poa* spp.), chickweed (*Stellaria media*) and meadow buttercup (*Ranunculus acris*). However the heath-

specific species cranberry (*Vaccinium oxycoccus*) and heath spotted orchid (*Dactylorhiza maculata*) were 'lost'.

On non-participant heath sites of a total of 79 species recorded in 2000 only four higher plants were newly recorded including heath grass (*Danthonia decumbens*) and bell heather (*Erica cinerea*). Of the nine higher plant species which were 'lost', none were characteristic of heathland.

The mean cover of *Calluna* increased on ESA participant sites between years from 31.9% to 34.1%, although this was not significant. There was however a significant increase in the amount of dead *Calluna* recorded, which is a potential cause for concern. There was a significant increase in the mean cover of *Sphagnum* species from 11.5% to 16.3% ($p<0.05$) and in common cotton grass (*Eriophorum angustifolium*) from 3.9 % to 7.1% ($p<0.01$). The abundance of cross-leaved heath (*Erica tetralix*) decreased significantly on participant and non-participant sites ($p<0.01$ and $p<0.05$ respectively).

Plant species proportions in the CSR strategy groups

There was an increase in the proportion of stress-tolerating species on participant sites from 46% to 54%. This together with a decrease in ruderal species indicates a possible improvement in the quality of these heath sites. However there was still a greater proportion of stress-tolerators recorded on non-participant sites, rising slightly from 61% to 63%.

Carabid beetle species diversity

The number of carabid beetle individuals captured on heather moorland on participant farms and on non-participant farms showed no significant change. The number of carabid beetle species decreased significantly on non-participant but did not decrease significantly on participant farms (Table 13). Diversity indices showed no significant changes between years on participant and non-participant farms.

Similarity in carabid beetle species captured between 1994 and 2000 was 84% for participants and 83% for non-participants.

Carabus nitens, identified as an indicator species in baseline monitoring, decreased in frequency on non-participant sites but maintained its presence on ESA participant sites (Appendix 2).

Table 13. Carabid beetle species richness and diversity in 1994 and 2000 on heather moorland in the Sperrins ESA.

	ESA status	n	1994		2000		P
			Mean	se	Mean	Se	
Mean number of carabid species per site	Participant	34	12	0.8	11	0.8	NS
	Non-participant	8	14	1.8	10	1.6	*
Mean carabid diversity per site	Participant	34	3.6	0.2	3.4	0.2	NS
	Non-participant	8	3.6	0.6	3.2	0.5	NS

(NS = not significant * = $p<0.05$ ** = $p<0.01$)

Spider species diversity

The number of spider individuals increased significantly by 111% ($P<0.001$) on participant sites and by 95% ($P<0.01$) on non-participant sites (Table 14). The total number of spider species increased by 31% on participant sites and by 20% on non-participant sites. Similarity in spider species captured between 1994 and 2000 was 74% for participant sites and 70% for non-participant sites.

Table 14. Spider species richness and diversity in 1994 and 2000 on heather moorland in the Sperrins ESA.

	ESA status	n	1994		2000		p
			Mean	se	Mean	se	
Mean number of spider species per site.	Participant	34	14	1	22	1.1	***
	Non-participant	8	14	1.2	24	2.1	**
Mean spider diversity per site.	Participant	34	7.12	0.6	8.33	0.4	NS
	Non-participant	8	6.52	1	8.76	0.8	NS

(NS = not significant * = $p<0.05$ ** = $p<0.01$ *** = $p<0.001$)

Changes in species composition show an increase the spider species *Antistea elegans* on both participant and non-participant sites (Appendix 3). This is an indicator species of heather moorland. Occurrence of the species increased by 45% on participant sites

and by 33% on non-participant sites. Of 34 species not captured in 1994, 14 were new records.

One species has not been found in Ireland before, *Sintula cornigera.* Three species were new to Northern Ireland, *Bathyphantes setiger, Meioneta beata,* and *Micrargus subaequalis.* Ten species were new county records (Londonderry and Tyrone), *Scotina gracilipes, Taranucnus setosus, Allomengea scopigera, Gongylidiellum latebricola, Hilaira pervicax, Aphileta misera, Rhaebothorax morulus, Metopobactrus prominulus, Theridion bimaculatum,* and *Clubiona reclusa.*

3.2. WOODLAND

3.2.1. Plant species diversity between 1994 and 2000 for ESA participants and non-participants

There were no significant differences in the mean number of plant species recorded per 2x2m or 14x14m quadrat between 1994 and 2000, when all sites were compared regardless of participation in the ESA scheme.

No significant differences in the mean number of species recorded on ESA participant or non-participant sites were observed between 1994 and 2000 (Table 15). However there was a significant decrease in the mean number of higher plant species per 14x14m (and 2x2m) quadrat for ESA participant sites. The total number of plant species (including bryophytes and lichens) recorded for the participant sites also decreased, from 217 to 187 species.

Table 15. Plant species diversity in 1994 and 2000 of woodland in the Antrim Coast, Glens & Rathlin ESA.

	ESA status	n	1994		2000		p
			Mean	se	Mean	se	
Mean number of species per 200m^2	Participant	24	50.6	3.0	46.5	3.0	NS
	Non-participant	4	33.8	5.8	35.8	7.9	NS
Mean number of higher plant species per 200m^2	Participant	24	43.8	3.0	34.9	2.1	***
	Non-participant	4	31.5	5.2	30.3	6.0	NS
Mean number of species per 4m^2	Participant	24	22.1	1.6	22.3	1.8	NS
	Non-participant	4	17.3	2.9	14.5	4.2	NS
Mean no. of higher plant species per 4m^2	Participant	24	18.2	1.4	15.3	1.3	*
	Non-participant	4	15.5	2.3	12.5	3.1	NS

(NS = non significant, * = $p<0.05$, ** = $p<0.01$, *** = $p<0.001$)

Species diversity in woods undergoing different management regimes was also compared between years regardless of participation in the scheme. In 1994, 50% of the woodland sites were grazed, whereas in 2000 only three sites (11%) were actively grazed (by cattle). However a further 10 sites (36%) had signs of sheep entry

suggesting that they were subject to occasional light grazing or browsing. Species numbers on the fourteen sites that were not actively grazed in 1994 or 2000 showed a significant decrease from 15.5 to 12.3 species per $4m^2$ quadrat. This suggests a possible decline in diversity due to lack of grazing over the long-term and may have implications for management recommendation.

Plant frequency and abundance

The frequency of plant species in the 14x14m quadrat for participant and non-participant sites was compared between 1994 and 2000 (Appendix 1).

Hazel (*Corylus avellana*), ash (*Fraxinus excelsior*) and hawthorn (*Crataegus monogyna*) were the most common tree species in all monitored woodlands in 2000. The most frequent ground flora species (>67% of sites) were lesser celandine (*Ranunculus ficaria*), bluebell (*Hyacinthoides non-scripta*), primrose (*Primula vulgaris*), wood sorrel (*Oxalis acetosella*), lady fern (*Athyrium filix-femina*), broad buckler-fern (*Dryopteris dilatata*), yorkshire fog (*Holcus lanatus*) and rough meadow-grass (*Poa trivialis*).

Plant species found in ESA woods in 1994 that were not re-recorded in 2000 include early purple orchid (*Orchis mascula*), lady's mantle (*Alchemilla* sp.), ground ivy (*Glechoma hederacea*), dogs mercury (*Mercuralis perennis*) and common wintergreen (*Pyrola minor*). Other woodland ground flora species have decreased in frequency on participant sites including bugle (*Ajuga reptans*), wood anemone (*Anemone nemorosa*), yellow pimpernel (*Lysimachia nemorum*) and dog violet (*Viola riviniana*). However several important or uncommon species were 'new' records in 2000 on participant sites, e.g. hairy brome (*Bromus ramosus*), wood melick (*Melica uniflora*), hairy woodrush (*Luzula pilosa*), toothwort (*Lathraea squamaria*) and bitter vetch (*Lathyrus montanus*). Undesirable species that were not re-recorded on participant sites or had decreased include weed species such as ragwort (*Senecio jacobea*), mouse-eared chickweed (*Cerastium fontanum*), broadleaved dock (*Rumex obtusifolius*) and dandelion (*Taraxacum* agg.).

There were very few significant changes in the mean abundance of individual plant species in the 2x2m quadrat on participant sites between 1994 and 2000. Most notably

there was a decrease in the amount of bare ground from 9.9% to 2.2% ($p<0.001$). There was a significant decrease in the mean abundance of primrose (*Primula vulgaris*) per $4m^2$ quadrat from 3.1% to 1.5% ($p<0.05$). The abundance of opposite-leaved golden saxifrage (*Chrysosplenium oppsitifolium*) increased from 2.6% to 7.5% ($p<0.05$). There were no significant changes in species abundance on non-participant sites.

In general there was no increase in the percentage cover of grass species, bryophytes or bramble over all the sample sites between 1994 and 2000 although individual sites did show variation between the years. Those sites grazed in 1994 and not grazed in 2000 (n=11) showed a significant decrease in percentage cover of bare ground from 9.9% to 3.3% ($p<0.01$). Percentage grass cover at these sites decreased from 20.8 to 14.8% although this was not significant. Sites not grazed in either year (n=14) also showed a significant decrease in bare ground ($p<0.05$). Grazed sites (n=3) had an increase in grass cover from 51.1% to 63.1% ($p<0.05$).

Plant species proportions in the CSR strategy groups

There was a relatively high proportion of stress-tolerators in woodland ground flora, including species such as primrose (*Primula vulgaris*), sanicle (*Sanicula europaea*), and dog violet (*Viola riviniana*). Between 1994 and 2000 the proportion of stress-tolerating species in participant woods remained stable at 24% whereas the proportion in the non-participant sites had fallen from 22% to 18%. Non-participant sites also showed a notable increase in competitors from 16 to 21%. Participant sites showed a decrease in the proportion of ruderal species from 12% to 8%

3.2.2. Tree regeneration

The presence of seedlings and saplings of tree and shrub species on the sites was compared between 1994 and 2000. Saplings were defined in this case as young trees surviving over a second season of growth and with a girth less than 5cm. Ash and sycamore seedlings were the most frequent. Ash seedlings occurred on eleven sites in 2000, in some cases these were particularly abundant. However only on two of these sites were ash saplings present. A similar situation occurred for sycamore with seedlings at ten sites but only saplings at two of these. No oak seedlings or saplings

were recorded in 1994 or 2000 despite oak being dominant or present in the canopy at five sites.

Sites that were not grazed and showed no signs of any livestock appeared to have good regeneration, many having abundant seedlings and/or saplings, particularly ash. This was with the exception of two sites that were overgrown with bramble and blackthorn. The three grazed sites had no saplings and very few seedlings present.

The mean number of young trees per 200m^2 with a girth of <10cm was calculated for each site in both years. The mean number of young trees had decreased slightly from 5.7 to 4.6 per 200m^2. This may be due to the fact that some trees are now greater than 10cm in diameter due to growth in the past 6 years. However it would also appear on most sites that few saplings are becoming established.

3.2.3. Carabid beetle species diversity

The number of carabid beetle individuals or species captured in woodland on both participant and non-participant farms showed no significant change.(Table 16). There was no change in diversity indices between years for participant or non-participants in woodland in the Antrim Coast Glens & Rathlin ESA. Similarity in carabid beetle species captured between 1993 and 1999 was 71% for participants and 59% for non-participants.

Table 16. Carabid beetle species richness and diversity in 1994 and 2000 on woodland in the Antrim Coast, Glens & Rathlin ESA.

	ESA status	n	1994		2000		P
			Mean	se	Mean	Se	
Mean number of carabid species per site	Participant	12	13	0.8	15	1.1	NS
	Non-participant	2	14	1.0	15	0.5	NS
Mean carabid diversity per site	Participant	12	4.5	0.4	4.2	0.3	NS
	Non-participant	2	4.1	0.4	5.5	1.2	NS

(NS = not significant * = p<0.05 ** = p<0.01)

Pterostichus oblongopunctatus a carabid species not found anywhere else in Northern Ireland maintained its presence in woods in the Antrim Coast, Glens & Rathlin ESA on both participant and non-participant farms. *Laemostenus terricola*, a primarily Mediterranean species, was only found in southern parts of County Down prior to 1970. It has been found increasingly in northern areas during ESA monitoring and may be an indicator of a change in climatic conditions (Appendix 2).

3.2.4. Spider species diversity

There was no significant change in number of spider individuals on participant or non-participant sites. The total number of spider species increased by 13% on participant sites and by 14% on non-participant sites. Similarity in spider species captured between 1994 and 2000 was 75% for participants and 47% for non-participants. Species richness and diversity did not change significantly between 1994 and 2000 for either participant or non-participant sites.

Species composition showed no significant change in spider species common to woodland habitats for both participant and non-participant sites (Appendix 3).

Of 17 spider species not captured in 1994, *Saaristoa firma* is a new record for County Antrim.

3.3. HEATHER MANAGEMENT STUDY

3.3.1. Plant species diversity

Species diversity between 1997 and 2000 for burned and flailed sites

The mean number of plant species and higher plants per site were recorded on burned and flailed sites in 1997 and 2000 (Table 17). Control sites adjacent to the managed areas were also monitored. (NB. There were only six burn controls as there were two transects recorded at two of the burned sites, with the same control used for both). The mean number of species recorded per site between 1997 and 2000 for the burned, flailed and control sites differed significantly. The greatest increase was for the burned sites. However no significant differences in the mean number of higher plant species between 1997 and 2000 were recorded, although there was an increase of two to three species on burned and flailed sites whereas numbers on the controls remained stable. More bryophytes and lichens were recorded in 2000 than in 1997 on burned, flailed and controls. The total number of higher plants recorded overall for burned and flailed sites increased (by four and five species respectively) whereas the controls remained stable.

Table 17. Mean number of plant and higher plant species on heather management sites.

		Mean no. of species per site					Mean no. of higher plants per site					Total no. of species	
Management	n	1997		2000		p	1997		2000		p	1997	2000
		Mean	se	Mean	Se		Mean	se	Mean	se			
Burned	8	22.4	2.2	33.9	1.8	***	12.1	1.0	14.3	1.6	NS	62	77
Burn Control	6	22.2	2.2	27.5	1.6	*	13.3	2.3	13.8	2.0	NS	55	63
Flailed	6	23.2	1.5	30.7	1.8	*	11.2	1.4	14.2	1.9	NS	55	69
Flail Control	6	22.5	2.3	28.0	2.7	*	11.3	2.5	11.2	1.9	NS	53	61

(NS = non-significant, * = $p<0.05$, ** = $p<0.01$, *** = $p<0.001$)

Species diversity between burned and flailed sites and controls in 1997 and 2000

In 1997 there was no significant differences between the mean number of plant species or higher plants in recently burned or flailed sites and their respective controls. In 2000 there were significantly more species recorded on the burned sites than on adjacent controls ($p<0.05$). However, approximately the same number of higher plants per site were recorded, the main difference therefore being in the number of bryophytes between 1997 and 2000. For flailed sites there was no significant difference in species diversity compared to the controls, although there was a greater number of higher plant species recorded than in the controls. There were no significant differences in the mean number of species or higher plants between burned and flailed sites.

3.3.2. Plant frequency and abundance on heather management sites

Burned heather

A total of 77 species were observed on burned heather sites in 2000 compared with 62 species in 1997. New species recorded on burned sites since 1997 include hard fern (*Blechnum spicant*), common bent (*Agrostis capillaris*), sundew (*Drosera rotundifolia*), bulbous rush (*Juncus bulbosus*), lesser twayblade (*Listera cordata*) and sheep's sorrel (*Rumex acetosella*). These species appeared only on one or two sites. Species not re-recorded in 2000 were bracken (*Pteridium aquilinum*) and mouse-eared chickweed (*Cerastium fontanum*).

Species that increased in frequency between years on burned sites include mat grass (*Nardus stricta*), heath rush (*Juncus squarrosus*), deer grass (*Trichophorum cespitosum*) and *Sphagnum* species. The frequency of the moss *Campylopus introflexus* increased from 25% to 100% of burned sites, whereas it did not occur on any of the control sites. *Nardus stricta, Juncus squarrosus* and the moss *Polytrichum commune* occurred on more burned sites than controls. Bare ground was present on all burned sites in 2000 as compared to 50% of control sites. Species notably more frequent on control sites than burned sites were common sedge (*Carex nigra*), bilberry (*Vaccinium myrtilis*) and the moss *Pleurozium schreberi*.

Burning initially creates a new, open habitat with less shade and a greater proportion of bare ground. The mean percentage of bare ground on burned sites was significantly lower in 2000 than in 1997 ($p<0.05$). Only one of the sites showed any increase in bare ground and this was small (2%). There was no longer any significant difference in bare ground cover between burned and control sites (Figure 1b). The mean cover of *Calluna vulgaris* had increased on burned sites from 10% to 30% ($p<0.05$) since 1997, (Figure 1a). However there was still a significant difference in heather cover between burned sites and controls ($p<0.05$). Most of the sites showed an increase in heather cover of 20-30%, with the exception of two sites that only had a slight increase of 2-3%. There were no significant changes in heather cover on control sites.

No change in the abundance of cross-leaved heath (*Erica tetralix*) occurred between 1997 and 2000. Bell heather (*Erica cinerea*) occurred at only one site at which it had increased from 5% to 34%, and was dominant over *Calluna vulgaris.* Both common cotton grass (*Eriophorum angustifolium*) and hare's tail cotton grass (*E. vaginatum*) increased in mean cover by 9% on the burned sites ($p<0.05$).

Overall grass cover on burned sites showed little variation between years (17 to 16%). Grass appeared to have increased on control sites from 17 to 21%, although not significantly and was mainly accounted for by a 40% increase in purple moor grass (*Molinia caerulea*) at one of the controls. Percentage cover of sedges (*Carex* spp.) increased on burned sites from 5 to 17%. Green-ribbed sedge (*Carex binervis*) showed the largest increase, on sites where it occurred. The abundance of deer grass (*Trichophorum cespitosum*) also increased as it was found on four new burned sites since 1994. The mean cover of bilberry (*Vaccinium myrtilis*) increased between 1997 and 2000 on all six of the burned sites where it occurred.

Figure 1a. Mean percentage cover of *Calluna vulgaris* per 1m^2 quadrat on burned, flailed and control sites in 1997 and 2000, after management in 1996.

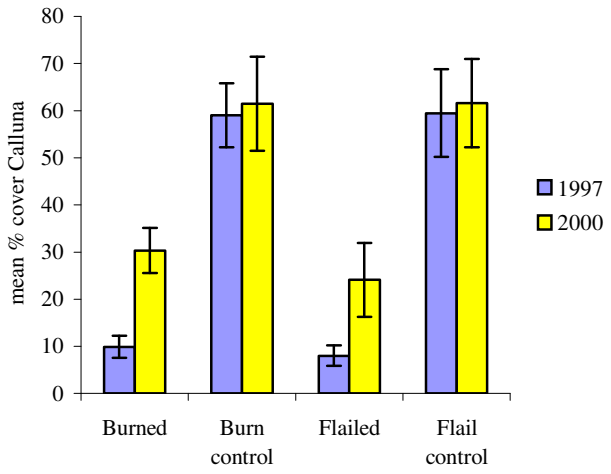
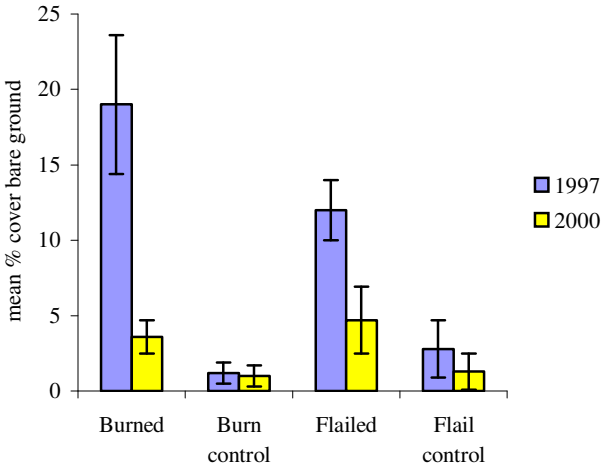


Figure 1b. Mean percentage cover of bare ground per 1m^2 quadrat on burned, flailed and control sites in 1997 and 2000, after management in 1996.



There was no significant difference in bryophyte cover between the burned and control sites in 2000 although the species composition showed some variation. Bryophyte flora associated with pioneer heather is different from that of degenerate stands (Gimingham, 1992). The abundance of the moss species *Campylopus introflexus* increased from 0.1% to 8%. This species is one of the first colonisers of bare peat following burning.

A further site was monitored in 2000 where burning had occurred in 1991. The cover of *Calluna vulgaris* on the burnt area was now slightly higher than that of the control site, 73 % as opposed to 68%. This indicates that regeneration had been successful over 9 years. The condition of the heather was also better, i.e. building phase rather than mature and degenerate.

Flailed heather

A total of 69 species were observed on flailed sites in 2000 compared with 55 species in 1997. Typical heath species newly recorded on flailed sites in 2000 were hard fern (*Blechnum spicant*), bulbous rush (*Juncus bulbosus*), heath rush (*Juncus squarrosus*), heath grass (*Danthonia decumbens*), lousewort (*Pedicularis sylvatica*), milkwort (*Polygala serpyllifolia*), star sedge (*Carex echinata*) and lesser twayblade (*Listera cordata*). Species not re-recorded included birch (*Betula* sp.), Norway spruce (*Picea abies*), tufted hair-grass (*Deschampsia cespitosa*) and Yorkshire fog (*Holcus lanatus*), each of which were found on a single site in 1997.

Species which increased in frequency included grasses: velvet bent (*Agrostis canina*), mat grass (*Nardus stricta*), deer grass (*Trichophorum cespitosum*), sweet vernal grass (*Anthoxanthum odoratum*), as well as bog asphodel (*Narthecium ossifragum*). The occurrence of bare ground decreased from all sites in 1997 to 67% of sites in 2000.

The proportion of bare ground was no longer significantly higher on flailed sites than on control sites as was the case in 1997 (Figure 1b). The proportion of *Calluna vulgaris* however, was still significantly higher on control sites ($p<0.05$). Heather cover on flailed sites increased between 1997 and 2000 from a mean of 8% to 24% (Figure 1a). With the exception of one site there had been increases in heather cover but this varied from 0.5% to 45%. This suggests that heather regeneration following

flailing has been more successful at some sites than others. The cover of *Erica tetralix* also increased from 2% to 4%.

Grass cover increased between 1997 and 2000 from 14 % to 18%, although not significantly. There was a greater percentage cover of grasses on flailed sites than on controls, 18% and 8% respectively. Purple-moor grass (*Molinia caerulea*) decreased in overall abundance as it was lost from three of the sites. The proportion of sedges (*Carex* spp.) increased from 2% to 6%, (not significantly).

There was no significant difference in bryophyte cover between flailed and control sites. At all four flailed sites where hare's tail cotton–grass (*Eriophorum vaginatum*) occurred it increased in cover, overall from 8% to 16% ($p<0.05$).

Comparison of burned and flailed heather

Frequency lists for species found on heather management sites in 2000 have been compiled to permit comparison between treatments (Appendix 4).

There was no significant difference in the mean cover of heather (*Calluna vulgaris*) between burned and flailed sites in 2000, although the burned sites had greater cover (Figure 2). Heather cover is predicted to reach the value prior to management by 2005 for burned sites and 2006/7 for flailed sites, assuming that growth is constant (Figure 2). Burned sites still had a lower bryophyte cover than flailed sites but there was no significant difference as in 1997. Bare ground had decreased considerably for both management types since 1997 and burned sites no longer had higher cover than flailed sites.

The mean height of *Calluna vulgaris* was compared for burned and flailed sites (Figure 3). Increase in heather height appeared to be fairly constant for both treatments over the time period of the study. Heather height was slightly greater on the flailed sites in 2000. This was likely to be due to the fact that burning had removed the heather down to ground level.

Figure 2. *Calluna vulgaris* cover between 1997 and 2000 on heather management sites with predicted increases for burned and flailed sites managed in 1996.

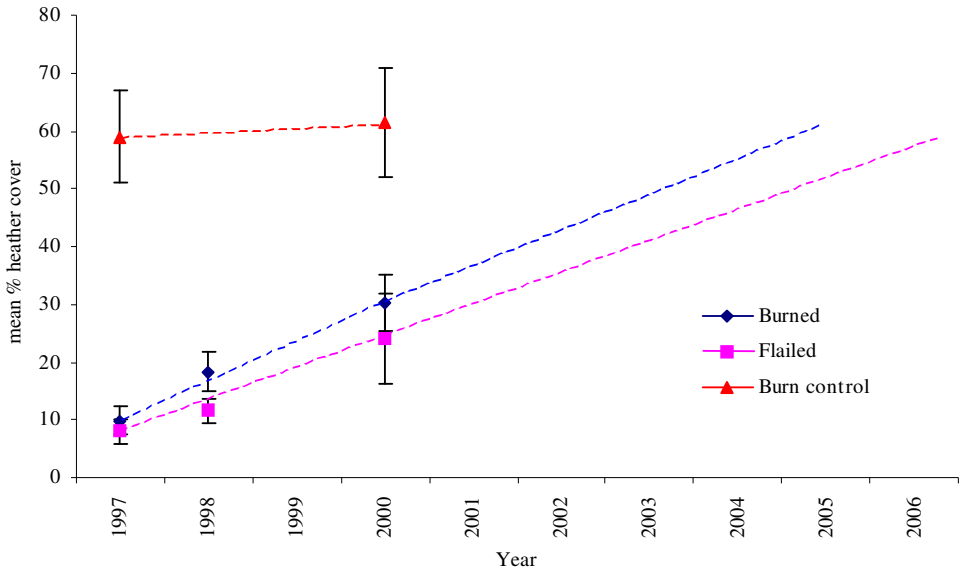
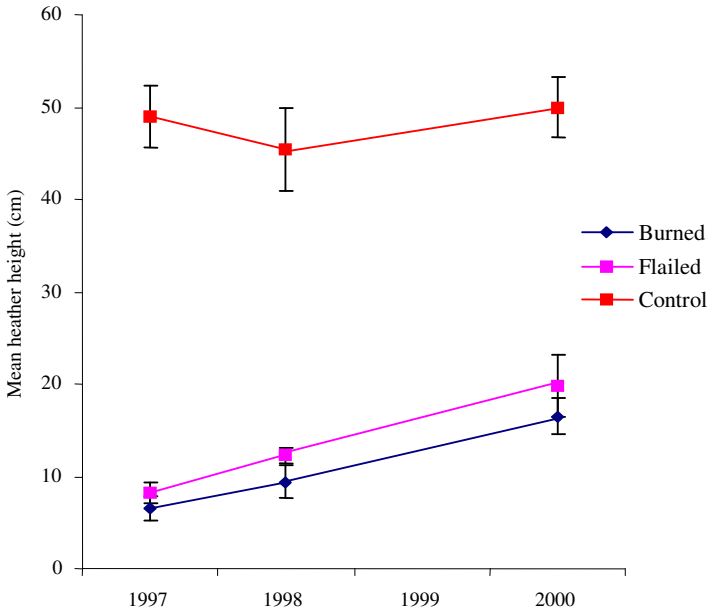


Figure 3. *Calluna vulgaris* height between 1997 and 2000 on heather management sites, managed in 1996.



3.3.3. Plant species in CSR strategy groups

Flailing or burning as a means of heather management involves the removal of vegetation to allow regeneration to take place. The decrease in the proportion of stress-tolerators recorded in 1997 within the burned and flailed categories was therefore not unexpected. The proportion of stress-tolerators on flailed sites was still lower than controls, although it has increased since 1997. In 2000 there was a higher proportion of stress-tolerant ruderals in the burned and flailed sites than in the controls. This indicates that disturbance caused by heather management has a continuing effect on vegetation after four years.

The removal of plant material which occurs with burning is more comprehensive than with flailing, leaving more bare ground. This is a possible reason for the higher proportion of competitors on burned sites in 1997. However the proportion of competitive species in burned and flailed sites has decreased since 1997, with none found on flailed sites in 2000.

Table 18. Relative proportions of each CSR category for each of the management types in 2000.

Management category	**Total CSR species**	**Proportion of plant species falling into each CSR strategy group (%)**						
		C	**R**	**S**	**CR**	**SC**	**SR**	**CSR**
Burned	30	3.3	-	60.0	-	16.7	13.3	6.7
Burn control	27	3.7	-	63.0	-	18.5	3.7	11.1
Flailed	30	-	-	66.7	-	16.7	10.0	6.7
Flail control	23	-	-	73.9	-	17.4	-	8.7

4. DISCUSSION

ANTRIM COAST AND GLENS

Species diversity has been maintained between 1994 and 2000 in the Antrim Coast and Glens ESA. There was an increase in species diversity in terms of the number of species recorded and a slight increase in heather cover. The proportion of stress-tolerator plant species i.e. the species most vulnerable to environmental change also remained stable on participant sites. Possible areas for concern were an increase in grassland species and mat grass *Nardus stricta* on sites that had been previously heavily grazed. Increases in these species are usually due to grazing pressure. Further decreases in stocking rate may be beneficial on sites that were heavily grazed prior to ESA agreement. Another positive indicator of success of the ESA scheme was an increase in the number of carabid beetle and spider species on participant farms in this ESA.

RATHLIN ISLAND

Sites on Rathlin had greater plant and invertebrate species diversity in terms of mean numbers of species per unit area than the other ESAs. There were no significant changes in mean numbers of plant, higher plant or carabid beetle and spider species between 1994 and 2000 for ESA participants or non-participants indicating that species diversity is being maintained on heather moorland sites on Rathlin. There were differences in plant species composition between years as the proportion of stress-tolerating species increased slightly (5%) and the proportion of competitive species decreased by the same amount both positive indicators of the effects of the Scheme. Although not statistically significant, the mean cover of heather and bell heather increased between years on ESA participant sites. The heather is very short on Rathlin due to suppression by climatic factors, so effects of grazing on *Calluna* height are difficult to determine.

MOURNES AND SLIEVE CROOB ESA

There were no significant changes in mean numbers of plant, higher plants carabid beetle or spider species between years for ESA participants or non-participants indicating that species diversity has been maintained. The total number of plant

species recorded increased slightly. Dwarf shrub cover was low on the Mournes & Slieve Croob ESA sites, and has decreased between 1994 and 2000. Heather (*Calluna vulgaris*) cover on participant and non-participant sites has not increased within the existing heath/grassland mosaics however it should be noted that the sample size was too small to determine if there was any statistical significance. There has also been an increase in purple moor grass (*Molinia caerulea*) on all sites. There was a slight decrease in the proportion of stress-tolerators and an increase in the proportion of generalist (CSR) species on participant sites.

These results are indicative of high grazing intensity, leading to a general increase in grass species and a decline in ericaceous species. There is also evidence of previous uncontrolled burning at some sites, which may have been a contributory factor. Monitored sites in the Mournes & Slieve Croob ESA were mainly heavily grazed prior to ESA agreement and heather cover was extremely low at baseline monitoring (6-10%). As in the Antrim Coast and Glens, further decreases in stocking rate may be beneficial on sites such as this.

The spider species *Neon reticulatus* was recorded in the Mournes & Slieve Croob ESA and is a new record for Northern Ireland.

SLIEVE GULLION

The plant species diversity of heather moorland on Slieve Gullion for ESA participant or non-participant sites was maintained between 1994 and 2000. There were no significant changes in mean numbers of plants per site or the total number of species recorded. There were indications of positive change in plant species composition on ESA participant sites as most of the species not re-recorded in 2000 were characteristic of nutrient rich grassland i.e. perennial rye-grass (*Lolium perenne*) and ragwort (*Senecio jacobea*). New species recorded on non-participant sites in 2000 were mainly non-heathland species indicating a reduction of habitat quality for non-participant heather moorland.

Heather cover increased significantly on ESA participant sites. Together with a significant decrease in mat grass (*Nardus stricta*) indicating a reduction of grazing pressure on sites under ESA agreement. The cover of western gorse (*Ulex gallii*) also

increased, suggesting a possible spread due to low grazing intensity. Another species likely to increase on dry heathland sites in Slieve Gullion in the absence of grazing is bracken (*Pteridium aquilinum*). Although not apparent from the current re-monitoring, the spread of bracken is a potential cause for concern as it can lead to shading out of heather and other species.

There was no significant change in the numbers of carabid species or species composition in the Slieve Gullion ESA although numbers of spider species increased significantly on ESA participant farms.

SPERRINS

The overall plant and invertebrate species diversity of heather moorland in the Sperrins on both participant and non-participant sites was maintained between 1994 and 2000. There were some indications of an increase in diversity and improvement in habitat quality on ESA participant sites with a significant increase in the mean number of plant species, a slight increase in the proportion of stress-tolerating species and a decrease in ruderal species. Increases in species number were due to bryophytes and lichens, possibly caused by a reduction of trampling by stock. There was also a significant increase in the mean cover of *Sphagnum* species and a slight increase in *Calluna* on participant sites, further indications of improved habitat quality. The Sperrins ESA had lower species diversity in terms of mean numbers of higher plants per site than the other ESAs as most of the sites were on blanket bog which has a naturally lower species compliment.

On both ESA participant and non-participant sites most of the higher plants not re-recorded in 2000 were non-heath species characteristic of fertile grassland indicating improvements in the species composition of the heather moorland. There were very few 'new' species recorded suggesting overall habitat stability and possible improvement.

The carabid beetle species *Carabus nitens,* identified as an indicator species during baseline monitoring, decreased in frequency on non-participant sites. Numbers of spider species and individuals increased significantly on both participant and non-participant farms in the Sperrins and this increase was greater on participant farms.

The spider *Sintula cornigera* was recorded in the Sperrins in 2000 and is a new Irish species record. Three other spider species recorded in the Sperrins *Micrargus subaequalis , Meioneta beata and Bathyphantes setiger* are new records for Northern Ireland.

A potential cause for concern in the Sperrins was a significant increase in the amount of dead *Calluna* recorded. One possible cause of this is damage caused by the heather beetle (*Lochmaea suturalis*), the larvae of which feed on young heather shoots, a heavy outbreak causing plants to suffer water stress, turn orange-brown and die (MacDonald, 1990). This species was trapped in large numbers at some sites and will be particularly noted in future monitoring. High incidences of heather beetle attack have been recently observed in England and Scotland. The Heather Trust recommends that no remedial action is necessary other than good heather management. (www.heathertrust.co.uk/newssupp.htm).

WOODLAND - ANTRIM COAST, GLENS & RATHLIN ESA.

The main objective of the ESA woodland prescription of fencing to exclude livestock is to increase tree regeneration. The aim is also to increase or maintain the plant species diversity of the ground flora. The results of the monitoring programme have shown a decrease in the number of plant species in ESA participant woodland sites between 1994 and 2000. The mean number of plant species recorded (excluding bryophytes and lichens) decreased significantly between the years. Although certain woodland indicator species may have disappeared or declined from some sites, other ecologically important species were newly recorded in 2000. The small size and fragmented nature of many of the woodland sites is also likely to make colonisation by new species very slow. Several of the species not re-recorded on participant sites were non-desirable in conservation terms which is a positive indictor. Reduction of grazing pressure may be allowing aggressive plant species to become dominant these then shade out smaller or less competitive species. There may also be a shading effect from increased shrub growth in the under-storey since grazing exclusion. Some grazing and trampling by livestock may therefore have a positive effect in maintaining species diversity as it keeps a check on certain species such as bramble and coarse grasses.

A significant decrease in bare ground cover was recorded between 1994 and 2000 probably due to the absence of trampling and poaching by livestock on most participant sites. There was an increase in the abundance of opposite-leaved golden saxifrage (*Chrysosplenium oppositifolium*) which is an indicator of wet soils and absent from heavily disturbed vegetation. The abundance of primrose (*Primula vulgaris*) decreased, possibly as a result of competition from other species. In general there was a decrease in grass cover on sites that were grazed in 1994 but not in 2000. Other studies have shown a general increase in cover of woody species at the expense of grasses and herbs when woodland is fenced (Latham & Blackstock, 1998).

The proportion of ruderal species decreased on participant sites indicating a reduction in disturbance. There was also a decrease in the proportion of desirable stress-tolerating species and an increase in undesirable competitor species on non-participant sites. Observations on presence and abundance of seedlings and saplings suggest that although there was successful seedling recruitment at several sites these were not often surviving to sapling stage. This may be due to competition from more aggressive plant species in the field layer or increased shading by shrub cover following grazing exclusion. A level of ground disturbance by livestock may be important for the regeneration of certain tree species as it reduces competition and creates niches for seedling establishment (Pigott, 1983). There was also a lack of canopy gaps where trees can become established. Ash and sycamore were the most frequent regenerating tree species in ungrazed sites. No oak regeneration was observed. There was a small decrease in numbers of young trees with girths less than 10cm recorded between 1994 and 2000. Hazel regeneration was not measured due to its coppiced nature but at most sites there appeared to be some regeneration with abundant young shoots from the stool. The small number of actively grazed sites means that no real comparison can be made with ungrazed woodlands. (Although fenced a number of sites were subject to occasional light grazing by sheep that had managed to get in.) Studies on regeneration in broad-leaved woodland in Scottish ESAs have shown that seedling and sapling numbers may be more strongly influenced by natural variations of climate and seed production than by stock exclosure (Henderson *et al*, 1997).

The woodland sites in the Antrim Coast, Glens & Rathlin ESA vary considerably from semi-natural woodland and scrub to species-poor broad-leaved plantation. They have different structures, species composition, past management regimes and environmental conditions. It is difficult therefore to generalise about the effects of excluding livestock as several factors as well as grazing interact to determine species diversity and tree regeneration. The variability between woodland sites in the Antrim Coast, Glens & Rathlin ESA means that ideally site-specific management plans should be implemented for successful enhancement of biodiversity and natural regeneration. Low levels of grazing by large herbivores provides a greater diversity in vegetation structure and species composition than either overgrazing or the absence of grazing in fenced woods (Mitchell and Kirby, 1990). For example the Forestry Commission recommend a stocking density of 0.5 sheep per ha for upland mixed ashwoods in order to improve regeneration, ground flora and structure (Mayle, 1999). Most studies on the effects of livestock exclusion on broad-leaved woodland have been over long time periods, for example up to 26 years (Piggott, 1983). In general, conclusions are that permanent complete exclusion is not necessary to ensure regeneration. Longer term monitoring should determine the success of woodland exclosure in the Antrim Coast, Glens & Rathlin ESA although effects will vary between individual sites.

HEATHER MANAGEMENT STUDY

Monitoring was carried out to assess the suitability of burning and flailing as heather management techniques in Northern Ireland. Species diversity and composition were compared on flailed and burned sites, and respective controls, between 1997 and 2000. In 2000 there were no significant differences in the number of plant species (not including bryophytes and lichens) recorded between burned or flailed and the controls. Thus regeneration and recolonisation of the heathland appears to have been successful in both cases. As expected, bare ground significantly decreased as the abundance of heather and other colonising species increased. The species composition of burned and flailed sites and the controls were very similar although the abundance of certain species still varied four years after management. Burning of dry heath is known to cause an increase in grasses, whereas on wetter peat purple moor-grass, deer-grass and cotton-grasses often increase. These species may be encouraged by

burning as their growing points are underground or protected by the tussocky growth form. In general this was the case for the sites in this study, although sample size was limited. Burning or flailing of the drier sites led to an increase in bent grasses and sedges. Wet heath and blanket bog sites showed an increase in cotton-grasses, in particular *Eriophorum vaginatum*.

The effects of burning and flailing on the regrowth of *Calluna vulgaris* were examined. An initial comparison in 1998, 2 years following management found that regeneration was occurring more rapidly on burned than flailed sites. This trend appears to be continuing as a slightly higher cover of *Calluna vulgaris* was found on burned sites in 2000. Other experimental studies comparing the effectiveness of cutting to burning have found that flailed sites had a time lag of 1 year in achieving a particular cover value (Cotton and Hale, 1994). In the present study, if the increase in heather cover remains constant it will have recovered to that of controls by 2005/6, i.e. 9 or 10 years after management. This was the case with the site that had been burned in 1991

Several factors play a part in the regeneration of heather, which has led to management being more successful at some sites than others. The heather management sites included dry heath, wet heath and blanket bog vegetation. The effects of burning or flailing are likely to be different depending on the vegetation type and soils. The age of stand before burning or cutting will affect the regeneration of heather. In this study all sites had mature heather, in some cases degenerate. Old bushes are less likely to regenerate from stem base (MacDonald, 1990). The flailing process left behind some mature bushes and lower stems. Heather stands also have the capacity to recover from damage by regeneration from seed. For seed germination to be successful the underlying peat surface needs to be exposed. This may be an explanation for the higher regeneration of heather by burning rather than flailing, as burning removes more litter and the ground layer of mosses.

A major factor in determining the effects of management on heather is the interaction with grazing. Levels of grazing within the study varied considerably. Some sites were under ESA agreement and had relatively low levels of grazing, with winter exclusion of livestock. Other sites were under higher and more constant grazing pressure, which

has possibly had a limiting effect on heather regrowth. Sheep will preferentially graze areas that have been recently burned or flailed where heather is shorter than surrounding mature bushes (Grant, 1968). In this study only fairly small patches of heather were burnt or flailed leading to overgrazing on some sites. Heather regeneration was less successful at sites where high grazing pressure was apparent due to sheep being attracted to these areas. A system such as that used in Scotland where a proportion of the area is burned every year should alleviate this problem and create the desired mosaic of differing ages of heather stand.

CONCLUSIONS

In general species diversity has been maintained on heather moorland in the Antrim Coast, Glens & Rathlin ESA, Slieve Gullion ESA and the Sperrins ESA. There are indications of positive effects of the scheme such as increases in heather cover on ESA participant sites and increases in bryophytes indicating reduced trampling by stock. There were negative indicators on non-participant sites such as increases in grass species and indicators of heavy grazing such as mat grass *Nardus stricta*. Some sites in the Mournes & Slieve Croob ESA that had been grazed heavily (6-10% heather) have shown little improvement and it may be that further reducing stock on areas such as this will be necessary to initiate recovery.

In the Sperrins there has been a loss of grass species on participant farms and an increase in *Calluna, Sphagnum* spp. and stress-tolerator species, all indications of a decrease in grazing pressure and an improvement in habitat condition. There has also been an increase in dead heather in the Sperrins. This is of potential concern as it may lead to long-term loss of heather cover even if positive grazing management has been implemented. One possible cause of this is damage caused by the heather beetle (*Lochmaea suturalis*). A large number of adult heather beetles were caught in the pitfall traps at some sites. It may therefore be worthwhile in future heather monitoring to investigate the possibility that large numbers of this species in some localities are causing serious damage to *Calluna.*

Reduced grazing pressure has had a positive influence on heathland vegetation in the Slieve Gullion ESA with an increase in *Calluna* and a decrease in grassland species.

Western gorse has also increased probably as a result of decreased trampling although it should be noted that in this area a decrease in stocking levels may lead to increases in bracken in certain areas.

The effects of grazing exclusion on woodlands in the Antrim Coast Glens & Rathlin ESA are as yet unclear. Changes in woodland occur over an extended period of time and at present there are both and negative effects of grazing exclusion. Due to the diverse nature of the woods in this ESA ideally site specific management plans should be implemented for each wood. Previous studies suggest that permanent complete grazing exclusion is not necessary to ensure woodland regeneration.

Examination of the effects of burning and flailing for heather moorland management indicated that heather regenerated more rapidly after burning but both methods gave satisfactory results and could be used depending on prevailing circumstances. A rotational system of burning part of the moor each year should be adopted to maintain the desired mosaic of uneven heather stands and prevent congregation and overgrazing by sheep on recently burned patches.

The ESA scheme has been in operation in its present form for eight years and there is evidence to suggest that it has been instrumental in the maintenance and enhancement of target habitats. Monitoring has also determined that on some areas, such as severely degraded heath and woodland, modifications to the ESA prescriptions may prove beneficial.

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6. APPENDICES

1. **Percentage frequency of plant species recorded on ESA participant and non-participant farms in each ESA in 1994 and 2000.**

2. **Percentage frequency of carabid beetle species captured on ESA participant and non-participant farms in each ESA in 1994 and 2000.**

3. **Percentage frequency of spider species captured on ESA participant and non-participant farms in each ESA in 1994 and 2000.**

4. **Percentage frequency of plant species recorded on heather management sites in 2000.**

Appendix 1. Percentage frequency of plant species recorded on ESA participant and non-participant farms in each ESA in 1994 and 2000

ANTRIM COAST AND GLENS	% FREQUENCY PARTICIPANTS	
HEATHER MOORLAND	1994	2000
PLANT SPECIES	**n=8**	**n=8**
Achillea millefolium	12.5	12.5
Agrostis canina	25	62.5
Agrostis capillaris	75	25
Aira praecox		12.5
Ajuga reptans	12.5	
Anemone nemorosa		12.5
Anthoxanthum odoratum	25	37.5
Atrichum undulatum		25
Aulacomnium palustre		25
Bellis perennis	12.5	12.5
Blechnum spicant	12.5	12.5
Brachythecium rutabulum	37.5	
Breutelia chrysocoma		12.5
Calliergon cuspidatum		12.5
Calluna vulgaris	100	100
Calypogeia muellerana		62.5
Campylopus atrovirens		37.5
Campylopus introflexus		25
Campylopus paradoxus		37.5
Campylopus pyriformis		12.5
Cardamine pratensis	12.5	12.5
Carex binervis		37.5
Carex caryophyllea		12.5
Carex echinata	37.5	25
Carex flacca	12.5	
Carex nigra	25	50
Carex pallescens	25	
Carex panicea	37.5	62.5
Carex pilulifera		37.5
Carex pulicaris		12.5
Carex rostrata	12.5	12.5
Carex viridula		12.5
Cephalozia bicuspidata	12.5	
Cerastium fontanum	12.5	12.5
Cladonia coccifera		25
Cladonia floerkeana	12.5	12.5
Cladonia gracilis		12.5
Cladonia portentosa	50	37.5
Cladonia pyxidata		25
Cladonia subcervicornis	12.5	
Crataegus monogyna	12.5	
Ctenidium molluscum		12.5
Cynosurus cristatus	12.5	12.5
Danthonia decumbens		12.5
Deschampsia cespitosa	25	
Deschampsia flexuosa	50	50
Dicranella heteromalla		12.5
Dicranum majus		25
Dicranum scoparium	50	75
Diplophyllum albicans		12.5
Drosera rotundifolia	25	
Empetrum nigrum		12.5
Erica cinerea	62.5	75
Erica tetralix	75	62.5
Eriophorum angustifolium	62.5	75

ANTRIM COAST AND GLENS continued HEATHER MOORLAND	% FREQUENCY PARTICIPANTS 1994	2000
PLANT SPECIES	**n=8**	**n=8**
Eriophorum vaginatum	87.5	62.5
Euphrasia officinalis agg.	12.5	12.5
Eurhynchium praelongum		25
Festuca ovina	12.5	25
Festuca rubra	12.5	
Galium saxatile	25	25
Holcus lanatus	12.5	12.5
Hylocomium splendens	12.5	37.5
Hypnum cupressiforme	37.5	87.5
Hypnum jutlandicum	37.5	75
Hypochaeris radicata		12.5
Hypogymnia physodes		12.5
Juncus acutiflorus		12.5
Juncus articulatus		12.5
Juncus bulbosus		25
Juncus effusus	12.5	37.5
Juncus squarrosus	12.5	25
Leontodon autumnalis	12.5	12.5
Listera cordata		37.5
Lolium perenne	12.5	
Lophocolea bidentata	12.5	12.5
Lophozia ventricosa	25	25
Lotus corniculatus	12.5	
Luzula campestris	12.5	25
Luzula multiflora		12.5
Lycopodium clavatum	12.5	
Molinia caerulea	87.5	62.5
Mylia anomala		12.5
Nardia scalaris	25	
Nardus stricta	25	62.5
Narthecium ossifragum	25	25
Plagiochila asplenioides	25	
Plagiothecium undulatum	12.5	37.5
Plantago lanceolata	12.5	12.5
Pleurozium schreberi	50	75
Poa annua		12.5
Poa pratensis		12.5
Poa trivialis		12.5
Polygala serpyllifolia	25	25
Polytrichum commune	75	50
Potentilla erecta	75	75
Prunella vulgaris	12.5	12.5
Pseudoscleropodium purum	50	37.5
Racomitrium lanuginosum		12.5
Ranunculus acris		12.5
Ranunculus flammula		12.5
Ranunculus repens	12.5	12.5
Rhizomnium punctatum		12.5
Rhytidiadelphus loreus	25	75
Rhytidiadelphus squarrosus	25	62.5
Rhytidiadelphus triquetrus	50	
Rumex acetosa		12.5
Rumex acetosella	12.5	
Sagina procumbens		12.5
Scapania gracilis		12.5
Senecio jacobea	12.5	
Sphagnum auriculatum	25	25
Sphagnum capillifolium	25	50
Sphagnum compactum	12.5	12.5
Sphagnum cuspidatum	12.5	37.5
Sphagnum fimbriatum		12.5

ANTRIM COAST AND GLENS continued HEATHER MOORLAND	% FREQUENCY PARTICIPANTS 1994	2000
PLANT SPECIES	**n=8**	**n=8**
Sphagnum palustre	37.5	37.5
Sphagnum papillosum	12.5	50
Sphagnum recurvum		25
Sphagnum subnitens	12.5	25
Sphagnum tenellum		37.5
Taraxacum officinale agg.	12.5	12.5
Thuidium tamariscinum	87.5	75
Trichophorum cespitosum	87.5	50
Trifolium repens	12.5	12.5
Tritomaria quinquedentata	12.5	
Ulex europaeus		12.5
Vaccinium myrtillus	50	37.5
Veronica chamaedrys		12.5
Veronica serpyllifolia	12.5	
Viola riviniana	12.5	12.5

MOURNES & SLIEVE CROOB ESA	% FREQUENCY			
	NON-PARTICIPANTS		PARTICIPANTS	
HEATHER MOORLAND	1994	2000	1994	2000
PLANT SPECIES	n=4	n=4	n=3	n=3
Agrostis canina	50	50		100
Agrostis capillaris	75	75	66.7	66.7
Anthoxanthum odoratum		75		
Blechnum spicant	25			
Calluna vulgaris	100	100	100	100
Calypogeia muellerana		25		33.3
Campylopus introflexus		25		33.3
Campylopus paradoxus		50		33.3
Campylopus pyriformis				66.7
Carex acuta			33.3	
Carex binervis		25		
Carex echinata	25	25	33.3	
Carex flacca			33.3	
Carex hirta	25			
Carex nigra		50	33.3	
Carex ovalis	50		33.3	
Carex pallescens	75		66.7	
Carex panicea	75	75	100	66.7
Carex pilulifera		75		100
Carex remota			33.3	
Carex viridula		25		
Cephalozia bicuspidata				66.7
Cirsium palustre		25		
Cladonia fimbriata			33.3	
Cladonia floerkeana			33.3	33.3
Cladonia furcata				33.3
Cladonia portentosa			66.7	33.3
Cladonia pyxidata	75	25		
Cladonia uncialis	25		33.3	
Danthonia decumbens	25	50		100
Deschampsia cespitosa	50		66.7	
Deschampsia flexuosa	25			
Dicranum scoparium	75	75	100	100
Digitalis purpurea		25		
Diplophyllum albicans		50		66.7
Drosera rotundifolia		25		
Eleocharis multicaulis		25		
Erica cinerea	100	100	100	100
Erica tetralix	75	50	100	100
Eriophorum angustifolium	25	25		
Eriophorum vaginatum	25	25	33.3	33.3
Eurhynchium praelongum	50			
Festuca ovina	25	50		100
Festuca pratensis	25			
Galium saxatile	75	50	33.3	66.7
Hylocomium splendens	25	25		
Hypnum cupressiforme		50		66.7
Hypnum jutlandicum		50	66.7	33.3
Hypochaeris radicata		25		
Molinia caerulea	100	100	100	100
Nardus stricta	100	50	100	100
Narthecium ossifragum	25	25		
Odontoschisma sphagni				33.3
Parmelia saxatilis			33.3	
Pedicularis sylvatica	50	25	33.3	33.3
Pinus sp.	25			
Plagiochila asplenioides			33.3	
Plagiothecium undulatum		25		
Pleurozium schreberi		50		66.7
Polygala serpyllifolia	100	100	100	100

MOURNES & SLIEVE CROOB ESA continued HEATHER MOORLAND	% FREQUENCY NON-PARTICIPANTS 1994	2000	PARTICIPANTS 1994	2000
PLANT SPECIES	**n=4**	**n=4**	**n=3**	**n=3**
Polytrichum commune	25	25	66.7	
Polytrichum juniperinum				33.3
Potentilla erecta	100	100	100	100
Pseudoscleropodium purum	25	25	66.7	
Pteridium aquilinum	50	50	33.3	33.3
Racomitrium lanuginosum	50	25	33.3	
Rhododendron ponticum			33.3	33.3
Rhytidiadelphus loreus		25		
Rhytidiadelphus squarrosus				33.3
Scapania gracilis				66.7
Schoenus nigricans	25	25		
Sphagnum auriculatum		25		
Sphagnum capillifolium	25	25		
Sphagnum compactum			33.3	
Sphagnum palustre	25	25		33.3
Sphagnum papillosum		25		33.3
Sphagnum recurvum		25		
Sphagnum subnitens	25	25	33.3	33.3
Sphagnum tenellum		25		
Succisa pratensis		25		
Trichophorum cespitosum	50	50	100	66.7
Ulex gallii	100	75		33.3
Vaccinium myrtillus	25			
Viola riviniana	25	25		

SLIEVE GULLION ESA	% FREQUENCY			
	NON-PARTICIPANTS		PARTICIPANTS	
HEATHER MOORLAND	1994	2000	1994	2000
PLANT SPECIES	n=13	n=13	n=17	n=17
Acer pseudoplatanus		5.9		7.7
Achillea millefolium	5.9			7.7
Agrostis canina	35.3	94.1	46.2	92.3
Agrostis capillaris	17.6	76.5	15.4	46.2
Agrostis stolonifera	29.4	11.8	38.5	
Aira praecox				7.7
Ajuga reptans			7.7	
Anemone nemorosa		5.9		
Anthoxanthum odoratum	88.2	64.7	69.2	53.8
Atrichum undulatum		5.9	7.7	7.7
Aulacomnium palustre	5.9		23.1	
Blechnum spicant	35.3	23.5	15.4	23.1
Brachythecium rutabulum	5.9	11.8	7.7	
Breutelia chrysocoma	5.9		15.4	23.1
Bryum pseudotriquetrum		5.9		
Calliergon cuspidatum		5.9		7.7
Calluna vulgaris	100.0	100.0	100.0	92.3
Calypogeia muellerana		5.9		30.8
Campylopus introflexus	11.8	52.9	7.7	46.2
Campylopus paradoxus		23.5		38.5
Campylopus pyriformis		5.9		
Cardamine pratensis			7.7	7.7
Carex binervis	47.1	76.5	61.5	69.2
Carex echinata	5.9	11.8	7.7	7.7
Carex flacca	17.6		30.8	
Carex hostiana			7.7	
Carex lasiocarpa	11.8		7.7	
Carex nigra	41.2	23.5	30.8	15.4
Carex pallescens	29.4		30.8	
Carex panicea	52.9	35.3	69.2	53.8
Carex pilulifera	47.1	76.5	69.2	84.6
Carex pulicaris	5.9		15.4	7.7
Carex rostrata	5.9	5.9	7.7	
Carex viridula	11.8		15.4	
Cephalozia bicuspidata		5.9		
Cerastium fontanum	11.8	35.3	15.4	23.1
Ceratodon purpureus			7.7	
Cirsium palustre				7.7
Cirsium vulgare		5.9		
Cladonia arbuscula	5.9			
Cladonia coccifera	5.9	5.9	7.7	38.5
Cladonia fimbriata	5.9			
Cladonia floerkeana	5.9		7.7	15.4
Cladonia furcata				7.7
Cladonia gracilis		11.8		7.7
Cladonia portentosa	35.3	23.5	53.8	69.2
Cladonia pyxidata	23.5	11.8	46.2	23.1
Cladonia rangiferina			7.7	
Cladonia squamosa				15.4
Cladonia subcervicornis	5.9		15.4	15.4
Cladonia uncialis			7.7	15.4
Crataegus monogyna		5.9	7.7	
Ctenidium molluscum				7.7
Danthonia decumbens	29.4	23.5	15.4	30.8
Deschampsia cespitosa	47.1		53.8	
Deschampsia flexuosa	47.1	58.8	53.8	30.8
Dicranella heteromalla	35.3		46.2	
Dicranella rufescens	5.9			
Dicranum majus	11.8	5.9	30.8	7.7
Dicranum scoparium	64.7	41.2	76.9	76.9
Diplophyllum albicans	5.9	23.5	7.7	46.2

SLIEVE GULLION ESA continued HEATHER MOORLAND	% FREQUENCY NON-PARTICIPANTS 1994	2000	PARTICIPANTS 1994	2000
PLANT SPECIES	**n=13**	**n=13**	**n=17**	**n=17**
Drosera rotundifolia				7.7
Dryopteris dilatata	5.9			
Empetrum nigrum	5.9		7.7	
Equisetum palustre				7.7
Erica cinerea	94.1	94.1	100.0	100.0
Erica tetralix	29.4	17.6	30.8	23.1
Eriophorum angustifolium	17.6	11.8	7.7	7.7
Eriophorum vaginatum	11.8	5.9	15.4	
Euphrasia officinalis agg.			7.7	7.7
Eurhynchium praelongum	41.2	11.8	46.2	7.7
Festuca ovina	35.3	70.6	61.5	69.2
Festuca rubra	52.9	5.9	46.2	15.4
Galium saxatile	41.2	35.3	53.8	38.5
Grimmia donniana			7.7	
Holcus lanatus	29.4	29.4	15.4	30.8
Holcus mollis		17.6		7.7
Hylocomium splendens	23.5	41.2	30.8	53.8
Hypericum perforatum			15.4	
Hypericum pulchrum		5.9	15.4	23.1
Hypnum cupressiforme	70.6	70.6	69.2	100.0
Hypnum jutlandicum	58.8	52.9	69.2	53.8
Hypochaeris radicata	11.8	11.8	7.7	15.4
Hypogymnia physodes			23.1	23.1
Isopterygium elegans			15.4	
Isothecium myosuroides				15.4
Juncus acutiflorus		5.9	7.7	7.7
Juncus articulatus	5.9			
Juncus bulbosus		11.8		7.7
Juncus effusus	11.8	11.8	7.7	
Juncus squarrosus	47.1	23.5	15.4	38.5
Leontodon autumnalis			7.7	7.7
Leontodon hispidus	17.6		23.1	
Leucobryum glaucum			7.7	
Listera cordata		23.5	7.7	38.5
Lolium perenne		5.9	7.7	
Lonicera periclymenum	5.9		7.7	
Lophocolea bidentata	11.8	23.5	23.1	7.7
Lophozia ventricosa	11.8	5.9	23.1	23.1
Lotus corniculatus			7.7	
Luzula campestris	5.9	23.5	15.4	30.8
Luzula multiflora	35.3	29.4	61.5	15.4
Luzula sylvatica		17.6	7.7	7.7
Mnium hornum	5.9		7.7	
Molinia caerulea	94.1	58.8	92.3	61.5
Montia fontana		5.9		
Mycena sanguinolenta	5.9		15.4	
Nardia scalaris			15.4	
Nardus stricta	17.6	29.4	46.2	46.2
Narthecium ossifragum	17.6	23.5	15.4	15.4
Nepeta cataria			7.7	
Odontoschisma sphagni	5.9			
Pedicularis sylvatica	41.2	23.5	69.2	61.5
Peltigera canina			15.4	
Pilosella officinalis				7.7
Pinguicula vulgaris				7.7
Plagiochila asplenioides			7.7	
Plagiomnium undulatum				7.7
Plagiothecium undulatum			15.4	15.4
Plantago lanceolata	5.9	11.8	7.7	7.7
Pleurozium schreberi	17.6	41.2	38.5	53.8
Poa annua	11.8	41.2		15.4

SLIEVE GULLION ESA continued HEATHER MOORLAND	% FREQUENCY NON-PARTICIPANTS 1994	2000	PARTICIPANTS 1994	2000
PLANT SPECIES	**n=13**	**n=13**	**n=17**	**n=17**
Poa pratensis		23.5		
Poa trivialis		17.6		7.7
Polygala serpyllifolia	52.9	52.9	61.5	69.2
Polytrichum commune	47.1	41.2	38.5	38.5
Polytrichum juniperinum		5.9		15.4
Polytrichum piliferum			7.7	7.7
Potentilla erecta	94.1	100.0	100.0	92.3
Pottia truncata		5.9		
Prunella vulgaris		5.9	7.7	
Pseudoscleropodium purum	17.6	23.5	15.4	46.2
Pteridium aquilinum	35.3	29.4	30.8	15.4
Racomitrium affine				7.7
Racomitrium fasciculare				7.7
Racomitrium heterostichum		5.9		7.7
Racomitrium lanuginosum	29.4	5.9	30.8	
Ranunculus repens		5.9		
Rhizomnium punctatum				7.7
Rhytidiadelphus loreus	5.9	23.5	7.7	7.7
Rhytidiadelphus squarrosus	23.5	52.9	30.8	46.2
Rhytidiadelphus triquetrus	23.5		30.8	7.7
Riccardia multifida				7.7
Rubus fruticosus agg.	5.9	5.9	15.4	15.4
Rumex acetosa		11.8	15.4	15.4
Rumex acetosella			7.7	7.7
Rumex obtusifolius		5.9		
Sagina procumbens		5.9		
Salix aurita				7.7
Salix repens				7.7
Scapania gracilis		11.8		
Selaginella selaginoides				7.7
Senecio jacobea			15.4	
Sesleria caerulea	17.6		23.1	
Sorbus aucuparia	23.5	11.8	15.4	7.7
Sphagnum auriculatum	17.6	11.8	15.4	30.8
Sphagnum capillifolium	5.9	11.8	23.1	15.4
Sphagnum compactum	11.8	11.8	15.4	23.1
Sphagnum cuspidatum	11.8		23.1	7.7
Sphagnum palustre	11.8	17.6	15.4	15.4
Sphagnum papillosum	5.9	17.6	7.7	15.4
Sphagnum recurvum		5.9		
Sphagnum subnitens	5.9	5.9	7.7	23.1
Sphagnum tenellum				15.4
Stellaria uliginosa				7.7
Succisa pratensis	29.4	11.8	23.1	23.1
Teucrium scorodonia	17.6	11.8	23.1	30.8
Thuidium tamariscinum	23.5	29.4	30.8	30.8
Tortella tortuosa			15.4	
Trichophorum cespitosum	52.9	29.4	46.2	30.8
Trifolium repens		5.9	7.7	7.7
Tritomaria quinquedentata			7.7	
Ulex europaeus	5.9	5.9	23.1	30.8
Ulex gallii	70.6	70.6	53.8	76.9
Vaccinium myrtillus	82.4	76.5	84.6	69.2
Veronica officinalis			7.7	7.7
Veronica serpyllifolia			7.7	
Viola riviniana	11.8		15.4	30.8

SPERRINS ESA	% FREQUENCY			
	NON-PARTICIPANTS		PARTICIPANTS	
HEATHER MOORLAND	1994	2000	1994	2000
PLANT SPECIES	n=12	n=12	n=43	n=43
Agrostis canina	33.3	50.0	30.2	44.2
Agrostis capillaris	25.0	33.3	2.3	32.6
Agrostis stolonifera		8.3	9.3	
Alopecurus geniculatus			2.3	
Anthoxanthum odoratum	50.0	50.0	39.5	53.5
Aulacomnium palustre	25.0	25.0	27.9	30.2
Blechnum spicant	8.3	8.3		7.0
Brachythecium rutabulum			2.3	
Breutelia chrysocoma				4.7
Bryum capillare				2.3
Calluna vulgaris	100.0	100.0	100.0	100.0
Calypogeia muellerana		41.7		62.8
Campylopus introflexus	8.3	25.0	16.3	48.8
Campylopus paradoxus		58.3		53.5
Campylopus pyriformis		16.7		7.0
Carex binervis	8.3	8.3	11.6	9.3
Carex echinata	33.3	16.7	32.6	41.9
Carex flacca	25.0		14.0	
Carex lasiocarpa			2.3	
Carex nigra	25.0	33.3	25.6	67.4
Carex pallescens	8.3		2.3	
Carex panicea	50.0	41.7	53.5	27.9
Carex pilulifera	25.0	25.0	11.6	11.6
Carex pulicaris	8.3			
Carex rostrata			2.3	
Cephalozia bicuspidata	8.3		2.3	4.7
Cephalozia connivens				4.7
Cerastium fontanum	16.7		11.6	4.7
Cirsium arvense			2.3	
Cladonia coccifera		8.3	2.3	9.3
Cladonia fimbriata			2.3	2.3
Cladonia floerkeana		8.3	9.3	20.9
Cladonia furcata		16.7		9.3
Cladonia gracilis				7.0
Cladonia portentosa	66.7	75.0	46.5	53.5
Cladonia pyxidata	41.7	8.3	32.6	16.3
Cladonia squamosa				7.0
Cladonia uncialis	41.7	8.3	14.0	2.3
Crataegus monogyna	8.3	8.3	2.3	
Dactylorhiza maculata			2.3	
Danthonia decumbens		8.3		2.3
Deschampsia cespitosa	25.0		20.9	
Deschampsia flexuosa	41.7	66.7	58.1	62.8
Dicranella heteromalla	50.0	8.3	48.8	2.3
Dicranum majus	41.7		27.9	
Dicranum scoparium	75.0	75.0	69.8	81.4
Diplophyllum albicans	8.3	41.7	9.3	44.2
Drosera rotundifolia	16.7	25.0	18.6	11.6
Empetrum nigrum	8.3	8.3	30.2	2.3
Epilobium montanum			2.3	
Epilobium palustre				2.3
Erica cinerea		8.3	9.3	11.6
Erica tetralix	75.0	66.7	88.4	88.4
Eriophorum angustifolium	83.3	100.0	86.0	90.7
Eriophorum vaginatum	100.0	91.7	88.4	90.7
Eurhynchium praelongum			4.7	4.7
Festuca ovina	16.7	41.7	2.3	16.3
Festuca rubra	16.7			2.3
Galium saxatile	33.3	41.7	32.6	37.2
Hedwigia ciliata				2.3
Holcus lanatus			7.0	4.7

SPERRINS ESA continued HEATHER MOORLAND	% FREQUENCY NON-PARTICIPANTS 1994	2000	PARTICIPANTS 1994	2000
PLANT SPECIES	**n=12**	**n=12**	**n=43**	**n=43**
Hylocomium splendens	41.7	58.3	53.5	65.1
Hypnum cupressiforme	50.0	91.7	51.2	86.0
Hypnum jutlandicum	83.3	8.3	72.1	46.5
Hypogymnia physodes	25.0		20.9	4.7
Juncus acutiflorus			4.7	4.7
Juncus articulatus			4.7	
Juncus bufonius			4.7	
Juncus bulbosus	8.3	16.7	7.0	16.3
Juncus effusus	33.3	25.0	14.0	18.6
Juncus squarrosus	75.0	75.0	62.8	60.5
Kurzia pauciflora		8.3	2.3	25.6
Lepidozia reptans				2.3
Leucobryum glaucum		8.3		4.7
Listera cordata	16.7	8.3	11.6	14.0
Lophiostoma bicuspidatum			2.3	
Lophocolea bidentata	25.0	25.0	46.5	51.2
Lophozia ventricosa	41.7	41.7	55.8	48.8
Lotus corniculatus			2.3	
Luzula campestris	25.0	25.0	14.0	11.6
Luzula multiflora	33.3	16.7	34.9	23.3
Mnium hornum			2.3	
Molinia caerulea	83.3	83.3	67.4	62.8
Mycena sanguinolenta			2.3	
Mylia anomala				11.6
Mylia taylorii		16.7		16.3
Myrica gale			2.3	2.3
Nardia scalaris	41.7		37.2	
Nardus stricta	41.7	41.7	27.9	32.6
Narthecium ossifragum	66.7	58.3	46.5	53.5
Nectria peziza			2.3	
Odontoschisma sphagni		25.0		32.6
Parmelia saxatilis			2.3	
Pedicularis sylvatica			7.0	4.7
Pellia epiphylla		8.3	4.7	2.3
Plagiomnium undulatum			7.0	
Plagiothecium undulatum	75.0	58.3	60.5	65.1
Pleurozia purpurea		8.3		
Pleurozium schreberi	75.0	75.0	76.7	83.7
Poa annua		8.3	2.3	2.3
Poa pratensis	8.3		4.7	7.0
Poa trivialis			9.3	
Polygala serpyllifolia	16.7	16.7	14.0	14.0
Polytrichum commune	66.7	58.3	69.8	72.1
Polytrichum juniperinum				11.6
Potentilla erecta	66.7	75.0	60.5	76.7
Prunella vulgaris			2.3	
Pseudoscleropodium purum	33.3	33.3	32.6	18.6
Ptilidium ciliare				2.3
Racomitrium fasciculare				4.7
Racomitrium lanuginosum	16.7	16.7	23.3	4.7
Ranunculus acris			2.3	
Rhytidiadelphus loreus	75.0	75.0	86.0	83.7
Rhytidiadelphus squarrosus	33.3	58.3	34.9	51.2
Riccardia multifida				7.0
Rumex acetosa	8.3			
Scapania gracilis		25.0		16.3
Senecio jacobea			2.3	
Sesleria caerulea			2.3	

SPERRINS ESA continued HEATHER MOORLAND	% FREQUENCY NON-PARTICIPANTS 1994	2000	PARTICIPANTS 1994	2000
PLANT SPECIES	**n=12**	**n=12**	**n=43**	**n=43**
Sonchus asper			2.3	
Sorbus aucuparia			4.7	14.0
Sphagnum auriculatum	91.7	16.7	88.4	11.6
Sphagnum capillifolium	75.0	100.0	60.5	90.7
Sphagnum compactum			4.7	4.7
Sphagnum cuspidatum	25.0	58.3	23.3	69.8
Sphagnum fimbriatum				2.3
Sphagnum magellanicum				2.3
Sphagnum palustre	16.7	16.7	62.8	37.2
Sphagnum papillosum	66.7	75.0	51.2	76.7
Sphagnum recurvum		50.0		48.8
Sphagnum subnitens		50.0	7.0	53.5
Sphagnum tenellum		41.7		48.8
Stellaria media	8.3		2.3	
Stellaria uliginosa			2.3	4.7
Succisa pratensis				2.3
Thuidium tamariscinum	25.0	25.0	18.6	39.5
Tortella tortuosa			2.3	
Trichophorum cespitosum	91.7	75.0	86.0	72.1
Ulex europaeus				2.3
Ulota crispa				2.3
Vaccinium myrtillus	50.0	83.3	62.8	74.4
Vaccinium oxycoccos	8.3	8.3	2.3	
Viola riviniana			2.3	

RATHLIN ISLAND	% FREQUENCY			
	NON-PARTICIPANTS		PARTICIPANTS	
HEATHER MOORLAND	1994	2000	1994	2000
PLANT SPECIES	n=2	n=2	n=6	n=6
Agrostis canina	50.0	100.0	16.7	100.0
Agrostis capillaris				33.3
Aira praecox				16.7
Ajuga reptans			50.0	
Andromeda polifolia			16.7	
Anthoxanthum odoratum	50.0		100.0	66.7
Aulacomnium palustre			16.7	
Bellis perennis			16.7	
Brachythecium rutabulum			16.7	
Breutelia chrysocoma		50.0		16.7
Bryum pseudotriquetrum				33.3
Calliergon cuspidatum				16.7
Calluna vulgaris	100.0	100.0	100.0	100.0
Campylium stellatum				16.7
Campylopus introflexus		50.0		66.7
Campylopus paradoxus		100.0		50.0
Carex binervis	50.0	50.0	33.3	100.0
Carex echinata	50.0		33.3	33.3
Carex flacca		50.0		83.3
Carex hirta			16.7	
Carex hostiana	50.0		16.7	16.7
Carex lasiocarpa	50.0		33.3	
Carex nigra	50.0		66.7	16.7
Carex pallescens			83.3	
Carex panicea	100.0	100.0	100.0	100.0
Carex pilulifera		100.0	33.3	100.0
Carex pulicaris		50.0	33.3	33.3
Carex viridula			33.3	
Cephalozia bicuspidata				16.7
Cerastium fontanum			33.3	33.3
Cirsium palustre				16.7
Cladonia arbuscula			16.7	
Cladonia coccifera				16.7
Cladonia furcata		50.0		
Cladonia gracilis				16.7
Cladonia portentosa	50.0	100.0	66.7	83.3
Cladonia pyxidata	100.0		66.7	
Cladonia rangiferina			16.7	
Cladonia uncialis				16.7
Crataegus monogyna				16.7
Ctenidium molluscum				16.7
Cynosurus cristatus			16.7	16.7
Dactylis glomerata			16.7	
Dactylorhiza maculata	100.0	100.0	83.3	83.3
Danthonia decumbens		50.0	33.3	100.0
Deschampsia flexuosa	50.0		50.0	
Dicranum majus	50.0			16.7
Dicranum scoparium	50.0	100.0	83.3	100.0
Diplophyllum albicans	50.0	50.0		66.7
Drepanocladus revolvens				16.7
Drosera rotundifolia			16.7	
Eleocharis multicaulis				16.7
Empetrum nigrum			66.7	
Epilobium nerteroides				16.7
Erica cinerea	100.0	100.0	100.0	100.0
Erica tetralix	100.0	100.0	50.0	66.7
Eriophorum angustifolium			66.7	16.7
Eriophorum vaginatum	50.0		33.3	
Euphrasia officinalis agg.			50.0	33.3
Eurhynchium praelongum			16.7	
Festuca ovina	50.0	100.0	50.0	66.7

RATHLIN ISLAND continued HEATHER MOORLAND	% FREQUENCY NON-PARTICIPANTS 1994	2000	PARTICIPANTS 1994	2000
PLANT SPECIES	**n=2**	**n=2**	**n=6**	**n=6**
Festuca rubra	50.0		50.0	50.0
Frullania tamarisci		100.0		50.0
Galium saxatile			50.0	16.7
Grimmia donniana	50.0		33.3	
Holcus lanatus			16.7	16.7
Hylocomium splendens	50.0	50.0	83.3	33.3
Hypericum perforatum			16.7	
Hypericum pulchrum				33.3
Hypnum cupressiforme	50.0	100.0	50.0	100.0
Hypnum jutlandicum	100.0		66.7	16.7
Hypochaeris radicata				16.7
Isoetes lacustris	50.0			
Juncus acutiflorus			16.7	16.7
Juncus articulatus			16.7	
Juncus bulbosus		50.0		
Juncus conglomeratus				16.7
Juncus effusus			16.7	
Juncus squarrosus			33.3	
Leontodon autumnalis	100.0		50.0	
Leontodon hispidus			33.3	
Leucobryum glaucum			16.7	83.3
Lophocolea bidentata			16.7	
Lotus corniculatus			16.7	16.7
Luzula campestris				33.3
Luzula multiflora	50.0		50.0	33.3
Lychnis flos-cuculi			16.7	
Molinia caerulea	50.0	100.0	100.0	50.0
Nardus stricta	50.0	100.0	66.7	50.0
Narthecium ossifragum	100.0	50.0	66.7	50.0
Orchis mascula			16.7	
Pedicularis sylvatica	50.0	100.0	83.3	100.0
Peltigera canina	50.0			
Pinguicula vulgaris	50.0			33.3
Plagiothecium undulatum	50.0		16.7	
Plantago lanceolata			50.0	33.3
Pleurozium schreberi	50.0	50.0	16.7	66.7
Poa annua				16.7
Poa trivialis				16.7
Polygala serpyllifolia	50.0	50.0	100.0	83.3
Polygonum aviculare			16.7	
Potentilla erecta	100.0	100.0	100.0	100.0
Prunella vulgaris				33.3
Pseudoscleropodium purum	100.0		33.3	66.7
Pteridium aquilinum			16.7	16.7
Racomitrium affine		50.0		
Racomitrium lanuginosum	50.0	100.0	16.7	16.7
Ranunculus repens			16.7	
Rhytidiadelphus squarrosus			66.7	33.3
Rhytidiadelphus triquetrus	50.0			16.7
Rosa pimpinellifolia			16.7	16.7
Rumex acetosa			33.3	16.7
Sagina procumbens				33.3
Salix repens		50.0		83.3
Scapania gracilis				16.7
Scapania undulata				16.7
Schoenus nigricans			33.3	
Selaginella selaginoides				16.7
Senecio aquaticus				16.7
Sesleria caerulea			50.0	
Sphagnum auriculatum		100.0		33.3
Sphagnum capillifolium			16.7	16.7

RATHLIN ISLAND continued HEATHER MOORLAND	% FREQUENCY NON-PARTICIPANTS 1994	2000	PARTICIPANTS 1994	2000
PLANT SPECIES	**n=2**	**n=2**	**n=6**	**n=6**
Sphagnum compactum	50.0		66.7	33.3
Sphagnum palustre	50.0			
Sphagnum papillosum		50.0	16.7	16.7
Sphagnum subnitens				50.0
Sphagnum tenellum				16.7
Stellaria holostea			16.7	
Succisa pratensis	100.0	100.0	83.3	83.3
Taraxacum officinale agg.			16.7	
Thuidium tamariscinum	100.0			
Thymus polytrichus				16.7
Tortella tortuosa			16.7	
Trichophorum cespitosum	50.0	100.0	50.0	16.7
Trifolium pratense			16.7	
Trifolium repens			16.7	16.7
Ulex gallii	100.0	100.0	100.0	100.0
Vaccinium myrtillus	50.0		50.0	
Viola riviniana			16.7	33.3

ANTRIM COAST AND GLENS	% FREQUENCY			
	NON-PARTICIPANTS		PARTICIPANTS	
WOODLAND	**1994**	**2000**	**1994**	**2000**
PLANT SPECIES	n=4	n=4	n=24	n=24
Acer pseudoplatanus	50	75	46	42
Achillea millefolium	25		4	4
Aegopodium podagraria			4	4
Agrostis canina			13	
Agrostis capillaris		50	50	42
Agrostis stolonifera	10	100	67	75
Ajuga reptans	25	25	42	17
Alchemilla glabra			17	
Allium ursinum			42	38
Alnus glutinosa	25		33	25
Alopecurus geniculatus	25		42	
Alopecurus pratensis	75	25	42	4
Anemone nemorosa	50	50	67	42
Angelica sylvestris	25	50	33	25
Anthoxanthum odoratum			46	50
Anthriscus sylvestris			21	13
Apium nodiflorum			16	4
Arrhenatherum elatius			4	13
Arum maculatum			29	29
Asplenium sp.			4	4
Athyrium filix-femina		25	17	83
Atrichum undulatum		25	8	29
Bellis perennis	25	25	8	
Betula sp.			29	29
Blechnum spicant			71	54
Brachypodium sylvaticum			42	29
Brachythecium plumosum				4
Brachythecium rivulare				4
Brachythecium rutabulum		75	17	75
Bromus ramosus				8
Calliergon cuspidatum				33
Cardamine flexuosa	25	25	42	50
Cardamine pratensis	50		25	21
Carex caryophyllea			25	4
Carex flacca			8	4
Carex hirta			4	4
Carex nigra			17	
Carex pallescens			4	
Carex panicea			8	
Carex pendula			4	4
Carex remota		25		25
Carex sylvatica	25	25	29	25
Carex viridula			4	
Castanea sativa				4
Cerastium fontanum	25	25	17	4
Chamerion angustifolium			4	
Chrysosplenium oppositifolium	50	50	63	63
Circaea lutetiana			29	29
Cirriphyllum piliferum				8
Cirsium arvense	25	25	29	4
Cirsium palustre				4
Climacium dendroides			8	4
Conocephalum conicum			17	29
Conopodium majus	25	25	54	46
Convolvulus arvensis			4	
Corylus avellana	50	50	79	71
Crataegus monogyna	75	75	58	58
Cratoneuron commutatum				4
Crepis paludosa				4
Ctenidium molluscum				8

ANTRIM COAST AND GLENS continued	% FREQUENCY			
	NON-PARTICIPANTS		PARTICIPANTS	
WOODLAND	1994	2000	1994	2000
PLANT SPECIES	n=4	n=4	n=24	n=24
Cynosurus cristatus		25		
Cystopteris fragilis	25		29	
Dactylis glomerata	75	75	71	50
Dactylorhiza fuchsii			8	
Deschampsia cespitosa	25		25	29
Decshampsia flexuosa			29	
Dicranella heteromalla			4	
Dicranoweisia cirrata			4	
Dicranum majus			4	8
Dicranum scoparium			25	8
Digitalis purpurea		25	29	21
Diplophyllum albicans			4	13
Drepanocladus uncinatus			4	8
Dryopteris affinis		25		67
Dryopteris dilatata		50	29	79
Dryopteris filix-mas	50	25	21	13
Elymus repens	25	25	4	
Epilobium montanum	25		50	29
Epilobium obscurum		25		8
Equisetum arvense			13	
Equisetum palustre			4	13
Equisetum sylvaticum			4	
Equisetum telmateia			4	17
Eurhynchium praelongum		50	54	88
Eurhynchium striatum				17
Fagus sylvatica	50	50	29	33
Festuca ovina			17	4
Festuca pratensis			17	
Festuca rubra	50	50	38	25
Filipendula ulmaria	50	50	71	54
Fissendens adianthoides			8	
Fissidens bryoides				4
Fissidens taxifolius			13	25
Fragaria vesca	50		67	
Fraxinus excelsior	75	50	67	63
Fuchsia magellanica			8	4
Galium aparine	50	50	50	54
Galium odoratum			4	4
Galium palustre			8	4
Galium saxatile	25		17	4
Galium verum			8	
Geranium robertianum		50	70	67
Geum rivale				4
Geum urbanum	50	50	50	42
Glyceria fluitans		25	17	4
Hedera helix	25	50	46	42
Heracleum sphondylium	75	50	38	42
Heterocladium heteropterum				4
Holcus lanatus	100	100	71	67
Holcus mollis			4	4
Hookeria lucens				33
Hyacinthoides hispanica				4
Hyacinthoides non-scripta	50	50	88	88
Hylocomium splendens				8
Hypericum androsaemum			4	8
Hypnum cupressiforme	25	75	38	38
Hypnum jutlandicum			8	
Hypochaeris radicata			4	4
Ilex aquifolium			42	38
Iris pseudacorus			8	8

ANTRIM COAST AND GLENS continued	% FREQUENCY			
	NON-PARTICIPANTS		PARTICIPANTS	
WOODLAND	1994	2000	1994	2000
PLANT SPECIES	n=4	n=4	n=24	n=24
Isopterygium elegans				4
Isothecium myosuroides		25	58	63
Isothecium myurum				17
Juncus acutiflorus		25	8	
Juncus bufonius		25	4	
Juncus effusus		25	33	13
Lapsana communis				4
Larix sp.			4	
Lathraea squamaria				4
Lathyrus montanus				8
Lathyrus pratensis		25	8	
Lejeunia cavifolia				4
Lemna minor		25		
Leontodon autumnalis			4	
Linaria vulgaris			8	
Lolium perenne	50	25	4	
Lonicera periclymenum	25		54	58
Lophocolea bidentata		50	42	63
Lophozia ventricosa			13	
Lotus corniculatus			4	4
Luzula campestris	50	25	8	4
Luzula multiflora			29	
Luzula pilosa				25
Luzula sylvatica	25	25	46	33
Lychnis flos-cuculi			8	
Lysimachia nemorum	50	50	67	46
Marchantia polymorpha			4	
Melica uniflora				4
Mentha aquatica			13	4
Mercurialis perennis			4	
Mnium hornum	50	50	67	67
Molinia caerulea			4	
Myosotis arvensis				
Narcissus pseudonarcissus			4	4
Nasturtium officinale				4
Oenanthe croccata			4	
Orchis mascula				4
Oxalis acetosella	25	25	79	75
Pellia epiphylla	25	25	25	63
Peltigera canina			8	17
Phyllitis scolopendrium	25	25		4
Picea sitchensis	25	25	8	
Pinus sylvestris			4	8
Plagiochila asplenioides	25			
Plagiomnium rostratum			4	50
Plagiomnium undulatum		75	17	67
Plagiothecium denticulatum		25		33
Plagiothecium undulatum			8	8
Plantago lanceolata			4	4
Pleurozium schreberi				4
Poa annua		25		
Poa pratensis	75	25	13	4
Poa trivialis	100	100	88	88
Polygala vulgaris	25			
Polypodium vulgare				13
Polygonum persicaria	25			
Polystichum aculeatum				4
Polystichum setiferum		25		21
Polytrichum commune			21	4
Polytrichum formosum				33

ANTRIM COAST AND GLENS continued	% FREQUENCY			
	NON-PARTICIPANTS		PARTICIPANTS	
WOODLAND	1994	2000	1994	2000
PLANT SPECIES	n=4	n=4	n=24	n=24
Populus alba			4	
Potentilla erecta	25		21	4
Potentilla sterilis	50	25	50	50
Primula vulgaris	25	50	83	79
Prunella vulgaris	25		4	
Prunus padus		25	4	8
Prunus spinosa			17	17
Pseudoscleropodium purum			25	21
Pteridium aquilinum	50	25	96	33
Pyrola minor			4	
Quercus rubra				4
Quercus sp.			25	21
Racomitrium heterostichum				4
Ranunculus acris	100	50	58	29
Ranunculus ficaria	75	50	88	92
Ranunculus repens	25	50	25	42
Raphanus raphanistrum			4	
Rhizomnium punctatum				8
Rhynchostegium confertum			4	
Rhytidiadelphus loreus				8
Rhytidiadelphus squarrosus		25	13	42
Rhytidiadelphus triquetrus	25		21	33
Ribes sanguineum			4	
Rosa canina			33	13
Rubus fruticosus agg.	75	75	75	63
Rubus idaeus				4
Rumex acetosa	50	75	8	38
Rumex acetosella	25		38	
Rumex crispus	25		29	
Rumex obtusifolius	25	25	29	17
Rumex sanguineus				25
Sagina procumbens		25		
Salix sp.		25	58	42
Sambucus nigra			4	8
Sanicula europaea			41	38
Scapania gracilis				4
Scapania undulatum				4
Senecio aquaticus			4	4
Senecio jacobea			29	
Sonchus asper			17	
Sorbus aucuparia			33	25
Stachys sylvatica			4	4
Stellaria graminea			8	
Stellaria holostea	50	50	38	33
Stellaria media	25	25	8	8
Stellaria palustris		25		
Succisa pratensis			8	
Symphoricarpos albus			4	4
Symphytum tuberosum			4	
Taraxacum officinale agg.	50	50	67	25
Thamnobryum alopecurum				21
Thuidium tamariscinum	50	50	67	71
Torilis japonica				4
Trifolium repens	25	25	13	4
Ulmus glabra			4	13
Urtica dioica	75	50	29	33
Vaccinium myrtillus			13	4
Valeriana officinalis				8
Veronica beccabunga				4
Veronica chamaedrys	50	50	58	42

ANTRIM COAST AND GLENS continued	% FREQUENCY			
	NON-PARTICIPANTS		PARTICIPANTS	
WOODLAND	1994	2000	1994	2000
PLANT SPECIES	n=4	n=4	n=24	n=24
Veronica hederifolia				4
Veronica montana	25	25	4	42
Veronica persica			4	
Veronica serpyllifolia				4
Vicia sepium	50	50	29	29
Vinca minor			4	
Viola riviniana	25	25	88	67

Appendix 2. Percentage frequency of carabid beetle species captured on ESA participant and non-participant farms in each ESA in 1994 and 2000.

ANTRIM COAST & GLENS HEATHER MOORLAND	% FREQUENCY PARTICIPANTS 1994	2000
CARABID BEETLE SPECIES	**n=4**	**n=4**
Abax parallelepipedus	75	75
Agonum fuliginosum	0	25
Amara aenea	0	25
Bembidion lampros	25	0
Calathus melanocephalus	25	50
Calathus piceus	0	50
Carabus arvensis	75	75
Carabus glabratus	0	50
Carabus granulatus	100	75
Carabus nemoralis	75	75
Carabus nitens	25	25
Carabus problematicus	50	75
Cychrus caraboides	0	50
Harpalus latus	0	50
Leistus fulvilabris	25	25
Leistus rufescens	0	50
Loricera pilicornis	0	25
Nebria brevicollis	50	75
Nebria salina	25	50
Notiophilus aquaticus	0	50
Notiophilus biguttatus	25	25
Notiophilus palustris	0	50
Olisthopus rotundatus	50	25
Patrobus assimilis	25	75
Pterostichus diligens	0	50
Pterostichus madidus	75	50
Pterostichus melanarius	50	100
Pterostichus niger	100	0
Pterostichus nigrita	25	100
Pterostichus oblongopunctatus	0	25
Pterostichus rhaeticus	75	50
Pterostichus strenuus	0	25
Pterostichus versicolor	0	25
Synuchus nivalis	0	25
Trechus obtusus	25	0
Trechus quadratus	0	25
TOTAL	20	33

RATHLIN ISLAND	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
HEATHER MOORLAND	1994	2000	1994	2000
CARABID BEETLE SPECIES	**n=3**	**n=3**	**n=1**	**n=1**
Abax parallelepipedus	100	100	100	100
Calathus fuscipes	67	67	100	0
Calathus melanocephalus	100	67	100	100
Carabus arvensis	100	100	100	100
Carabus granulatus	100	100	100	100
Carabus nemoralis	100	100	100	100
Carabus problematicus	100	100	100	100
Cychrus caraboides	33	33	100	100
Cymindis vaporariorum	33	0	0	0
Harpalus latus	67	67	0	0
Harpalus rufipes	33	0	0	0
Laemostenus terricola	33	33	0	0
Leistus rufescens	0	33	100	0
Nebria brevicollis	100	100	0	0
Nebria salina	100	100	100	100
Notiophilus aquaticus	100	33	0	0
Notiophilus biguttatus	33	0	0	0
Notiophilus palustris	33	0	0	0
Olisthopus rotundatus	100	67	100	0
Patrobus assimilis	33	0	100	0
Pterostichus diligens	33	33	100	100
Pterostichus madidus	100	100	100	100
Pterostichus melanarius	100	100	100	100
Pterostichus niger	100	100	100	100
Pterostichus rhaeticus	67	67	100	100
Pterostichus strenuus	67	33	100	100
Synuchus nivalis	67	0	0	0
Trechus obtusus	0	33	0	0
Trechus quadratus	0	33	0	100
TOTAL	26	23	18	15

MOURNES & SLIEVE CROOB ESA HEATHER MOORLAND	% FREQUENCY PARTICIPANTS 1994	PARTICIPANTS 2000	NON-PARTICIPANTS 1994	NON-PARTICIPANTS 2000
CARABID BEETLE SPECIES	**n=1**	**n=1**	**n=1**	**n=1**
Agonum fuliginosum	0	0	100	0
Bembidion lampros	0	100	0	0
Calathus fuscipes	100	100	0	0
Carabus granulatus	0	100	0	0
Carabus problematicus	100	100	0	100
Harpalus latus	100	100	0	100
Nebria salina	100	100	0	100
Notiophilus palustris	100	0	0	0
Olisthopus rotundatus	100	0	0	0
Pterostichus diligens	0	0	100	100
Pterostichus madidus	0	100	0	100
Pterostichus melanarius	100	100	0	0
Pterostichus nigrita	100	0	100	100
Pterostichus rhaeticus	100	0	0	100
Pterostichus strenuus	0	100	0	0
Pterostichus versicolor	0	100	0	100
TOTAL	9	10	3	8

SLIEVE GULLION ESA	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
HEATHER MOORLAND	1994	2000	1994	2000
CARABID BEETLE SPECIES	n=9	n=9	n=9	n=9
Abax parallelepipedus	100	89	100	89
Agonum dorsale	0	11	0	0
Agonum fuliginosum	11	11	0	0
Agonum muelleri	0	11	0	11
Amara communis	22	0	0	0
Amara familiaris	0	0	0	11
Amara lunicollis	44	11	11	22
Amara ovata	11	0	11	11
Amara plebeja	0	0	11	11
Bembidion lampros	22	22	0	11
Bembidion mannerheimi	0	11	0	0
Bradycellus harpalinus	0	0	11	0
Calathus fuscipes	44	11	11	11
Calathus melanocephalus	33	0	33	22
Calathus piceus	0	0	0	11
Carabus arvensis	89	56	89	67
Carabus granulatus	22	11	0	22
Carabus nemoralis	100	89	78	67
Carabus problematicus	89	67	100	100
Cychrus caraboides	56	33	33	33
Harpalus latus	56	67	56	11
Laemostenus terricola	0	0	0	11
Leistus fulvilabris	0	11	0	11
Leistus rufescens	22	22	44	44
Loricera pilicornis	44	11	44	67
Nebria brevicollis	56	56	56	67
Nebria salina	89	33	33	44
Notiophilus aquaticus	56	0	11	33
Notiophilus biguttatus	11	56	11	44
Notiophilus germinyi	11	0	0	0
Notiophilus palustris	44	22	11	0
Olisthopus rotundatus	11	22	22	22
Patrobus assimilis	0	11	0	11
Pterostichus diligens	33	0	22	0
Pterostichus madidus	56	44	44	22
Pterostichus melanarius	67	33	78	56
Pterostichus niger	78	89	78	100
Pterostichus nigrita	0	11	0	0
Pterostichus rhaeticus	33	22	56	56
Pterostichus strenuus	44	22	67	33
Pterostichus vernalis	0	0	0	22
Pterostichus versicolor	0	0	11	0
Trechus obtusus	0	0	0	11
Trechus quadratus	0	0	0	11
TOTAL	29	29	27	34

SPERRINS ESA	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
HEATHER MOORLAND	1994	2000	1994	2000
CARABID BEETLE SPECIES	n=34	n=34	n=8	n=8
Abax parallelepipedus	56	56	63	38
Agonum fuliginosum	35	38	50	25
Agonum marginatum	0	3	0	0
Agonum muelleri	15	9	25	13
Amara aenea	3	0	13	0
Amara communis	3	3	0	0
Amara lunicollis	15	12	13	25
Amara plebeja	3	0	0	0
Bembidion aeneum	3	0	0	0
Bembidion bruxellense	3	0	0	0
Bembidion lampros	15	3	13	13
Bradycellus verbasci	3	0	0	13
Calathus fuscipes	15	12	13	0
Calathus melanocephalus	12	3	25	0
Carabus arvensis	53	50	63	25
Carabus glabratus	21	15	25	25
Carabus granulatus	91	76	88	75
Carabus nemoralis	35	18	50	38
Carabus nitens	15	12	63	25
Carabus problematicus	71	68	88	75
Cychrus caraboides	9	0	0	0
Elaphrus cupreus	6	3	13	0
Harpalus latus	12	15	13	0
Harpalus rufipes	3	0	0	0
Leistus fulvilabris	0	3	0	0
Leistus rufescens	24	26	13	63
Loricera pilicornis	35	41	50	25
Nebria brevicollis	62	65	63	63
Nebria salina	56	41	63	38
Notiophilus aquaticus	35	18	25	25
Notiophilus biguttatus	15	32	25	13
Notiophilus germinyi	3	0	0	0
Notiophilus palustris	29	3	38	0
Olisthopus rotundatus	15	18	13	0
Patrobus assimilis	32	29	38	38
Pterostichus adstrictus	6	6	0	13
Pterostichus anthracinus	0	0	0	13
Pterostichus diligens	79	71	88	75
Pterostichus madidus	24	21	13	13
Pterostichus melanarius	71	65	88	50
Pterostichus niger	76	88	88	88
Pterostichus rhaeticus	97	94	100	100
Pterostichus strenuus	35	12	38	13
Pterostichus vernalis	3	3	13	13
Pterostichus versicolor	0	3	0	0
Synuchus nivalis	0	0	0	13

SPERRINS ESA continued	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
HEATHER MOORLAND	1994	2000	1994	2000
CARABID BEETLE SPECIES	n=34	n=34	n=8	n=8
Trechus obtusus	0	9	0	0
Trechus quadratus	0	3	0	0
Tricocellus cognatus	3	6	0	0
TOTAL	42	39	32	29

ANTRIM COAST & GLENS ESA	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
WOODLAND	1994	2000	1994	2000
CARABID BEETLE SPECIES	**n=12**	**n=12**	**n=2**	**n=2**
Abax parallelepipedus	75	75	50	0
Agonum albibes	25	17	0	0
Agonum assimile	67	33	50	100
Agonum dorsale	8	17	0	0
Agonum fuliginosum	50	50	50	100
Agonum muelleri	17	33	0	0
Agonum obscurum	0	8	0	0
Amara aenea	0	8	0	0
Amara aulica	0	8	0	0
Amara communis	0	0	50	0
Amara familiaris	0	8	0	0
Amara ovata	0	0	50	50
Amara plebeja	8	0	50	0
Badister bipustulatus	8	0	0	0
Badister sodalis	8	0	50	0
Bembidion aeneum	0	0	0	50
Bembidion bruxellense	8	0	0	0
Bembidion harpaloides	8	17	0	0
Bembidion lampros	17	0	0	0
Bembidion mannerheimi	17	0	0	0
Bembidion tetracolum	8	0	50	0
Calathus fuscipes	25	25	50	0
Calathus melanocephalus	8	17	0	0
Calathus micropterus	0	8	0	0
Calathus piceus	67	75	50	0
Carabus glabratus	8	0	0	0
Carabus granulatus	17	25	50	0
Carabus nemoralis	25	0	0	0
Carabus problematicus	0	25	0	0
Clivina fossor	8	17	50	50
Cychrus caraboides	8	75	50	100
Elaphrus cupreus	25	8	0	0
Harpalus latus	0	17	0	0
Harpalus rufipes	8	8	0	0
Laemostenus terricola	0	17	0	0
Leistus fulvilabris	42	58	50	50
Leistus rufescens	33	50	0	0
Loricera pilicornis	92	92	100	100
Nebria brevicollis	92	92	100	100
Nebria salina	8	0	0	50
Notiophilus biguttatus	100	42	50	50
Olisthopus rotundatus	0	8	0	0
Patrobus assimilis	0	8	0	0
Pterostichus adstrictus	8	8	0	50
Pterostichus diligens	8	33	0	0

ANTRIM COAST & GLENS ESA continued WOODLAND	% FREQUENCY PARTICIPANTS 1994	PARTICIPANTS 2000	NON-PARTICIPANTS 1994	NON-PARTICIPANTS 2000
CARABID BEETLE SPECIES	**n=12**	**n=12**	**n=2**	**n=2**
Pterostichus madidus	25	8	50	0
Pterostichus melanarius	92	92	100	100
Pterostichus niger	58	0	100	0
Pterostichus nigrita	42	100	0	100
Pterostichus oblongopunctatus	25	17	100	100
Pterostichus rhaeticus	17	25	0	50
Pterostichus strenuus	75	83	100	100
Pterostichus versicolor	8	0	0	0
Stomis pumicatus	0	17	0	50
Synuchus nivalis	0	17	0	0
Trechus obtusus	8	92	0	100
Trechus quadratus	33	42	0	0
TOTAL	42	42	22	19

Appendix 3. Percentage frequency of spider species captured on ESA participant and non-participant heather moorland and woodland sites in the Antrim Coast, Glens and Rathlin ESA, Sperrins ESA, Slieve Gullion ESA and the Mournes & Slieve Croob ESA.

ANTRIM COAST, GLENS & RATHLIN ESA : HEATHER MOORLAND	% FREQUENCY	
	PARTICIPANTS	
SPIDER SPECIES	1993	1999
	n=4	n=4
Agroeca proxima	50	25
Agyneta decora	25	25
Agyneta olivacea	0	50
Agyneta subtilis	50	50
Allomengea scopigera	50	50
Alopecosa pulverulenta	50	100
Antistea elegans	50	50
Araeoncus crassiceps	0	25
Bathyphantes gracilis	25	25
Centromerita bicolor	25	0
Centromerita concinna	50	50
Centromerus prudens	0	25
Ceratinella brevipes	25	75
Clubiona trivialis	25	0
Dicymbium nigrum	50	50
Diplocephalus latifrons	25	0
Diplocephalus permixtus	25	0
Drassodes cupreus	0	25
Erigone atra	0	50
Erigone dentipalpis	0	75
Erigonella hiemalis	25	0
Euryopis flavomaculata	0	25
Gonatium rubens	75	25
Gongylidiellum vivum	25	25
Haplodrassus signifer	25	50
Lepthyphantes alacris	0	25
Lepthyphantes mengei	50	75
Lepthyphantes obscurus	0	25
Lepthyphantes tenebricola	25	0
Lepthyphantes tenuis	25	25
Lepthyphantes zimmermanni	75	75
Leptotrix hardyi	0	25
Lophomma punctatum	0	25
Micrargus herbigradus	25	25
Oedothorax gibbosus	0	25
Oedothorax retusus	25	50
Oxyptila trux	25	50
Pachygnatha clercki	25	50
Pachygnatha degeeri	75	100
Pardosa nigriceps	50	100
Pardosa pullata	75	100
Pelecopsis parallela	0	25
Pirata piraticus	50	25
Pocadicnemis pumila	25	50

ANTRIM COAST, GLENS & RATHLIN ESA : HEATHER MOORLAND	**% FREQUENCY**	
	PARTICIPANTS	
SPIDER SPECIES	**1993**	**1999**
continued	n=4	n=4
Robertus arundineti	25	0
Robertus lividus	100	100
Saaristoa abnormis	75	25
Scotina gracilipes	25	25
Tapinopa longidens	25	0
Tiso vagans	0	25
Trochosa terricola	100	100
Walckenaeria acuminata	100	100
Walckenaeria clavicornis	25	0
Walckenaeria nudipalpis	25	25
Walckenaeria vigilax	50	25
Xysticus cristatus	0	75
TOTAL	**41**	**47**

RATHLIN ISLAND : HEATHER MOORLAND	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
SPIDER SPECIES	1994	2000	1994	2000
	n=3	n=3	n=1	n=1
Agroeca proxima	67	67	100	0
Agyneta cauta	33	0	0	0
Agyneta decora	33	100	0	0
Agyneta olivacea	0	33	0	0
Agyneta subtilis	100	33	100	0
Allomengea scopigera	33	0	0	0
Alopecosa pulverulenta	100	100	100	100
Antistea elegans	67	33	0	0
Centromerita concinna	67	67	100	100
Ceratinella brevipes	33	67	0	0
Ceratinella brevis	0	33	0	0
Clubiona diversa	0	0	0	100
Dicymbium nigrum	33	100	0	100
Diplocephalus permixtus	33	0	0	100
Dismodicus bifrons	0	33	0	100
Drassodes cupreus	67	67	100	100
Erigone atra	33	33	100	0
Erigone dentipalpis	33	33	0	0
Erigonella hiemalis	33	0	0	0
Gonatium rubens	67	33	100	100
Gongylidiellum vivum	33	0	0	0
Haplodrassus signifer	100	33	0	0
Hypomma bituberculatum	0	0	0	100
Lepthyphantes ericaeus	0	33	0	100
Lepthyphantes mengei	0	67	0	100
Lepthyphantes tenuis	0	33	0	100
Lepthyphantes zimmermanni	33	33	100	100
Lophomma punctatum	0	33	0	0
Meioneta saxatilis	0	0	0	100
Metopobactrus prominulus	33	0	0	0
Micrargus herbigradus	0	0	0	100
Microlinyphia pusilla	33	0	0	0
Monocephalus fuscipes	0	67	0	0
Oedothorax fuscus	0	33	100	0
Oedothorax gibbosus	33	0	0	100
Oedothorax retusus	33	0	100	100
Oxyptila atomaria	33	100	0	0
Oxyptila trux	33	0	100	0
Pachygnatha clercki	33	33	0	0
Pachygnatha degeeri	100	100	100	100
Pardosa nigriceps	100	100	100	100
Pardosa palustris	33	0	0	0
Pardosa pullata	100	100	100	100
Pelecopsis parallela	0	33	0	0
Peponocranium ludicrum	0	67	0	100
Pirata piraticus	33	33	100	0
Pocadicnemis pumila	0	33	100	100
Poeciloneta globosa	33	67	0	0
Robertus arundineti	0	0	0	100

RATHLIN ISLAND : HEATHER MOORLAND	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
SPIDER SPECIES	**1994**	**2000**	**1994**	**2000**
continued	n=3	n=3	n=1	n=1
Robertus lividus	100	33	100	100
Saaristoa abnormis	33	0	100	0
Silometopus elegans	0	0	0	100
Tiso vagans	100	33	0	0
Trichopterna thorelli	67	33	0	100
Trochosa terricola	100	100	100	100
Walckenaeria acuminata	67	67	100	100
Walckenaeria antica	67	0	0	100
Walckenaeria nudipalpis	67	0	0	0
Walckenaeria vigilax	0	67	100	100
Xysticus cristatus	100	100	100	100
Xysticus erraticus	67	33	0	0
TOTAL	**42**	**41**	**22**	**31**

MOURNES & SLIEVE CROOB ESA : HEATHER MOORLAND	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
SPIDER SPECIES	1993	1999	1993	1999
	n=1	n=1	n=1	n=1
Agyneta cauta	0	0	0	100
Agyneta subtilis	0	100	0	0
Alopecosa pulverulenta	0	100	0	0
Antistea elegans	100	0	0	100
Aphileta misera	0	0	0	100
Bolyphantes luteolus	0	100	0	0
Centromerita concinna	0	100	0	100
Clubiona neglecta	0	100	0	0
Dismodicus bifrons	0	0	0	100
Drassodes cupreus	100	100	0	100
Erigone atra	0	100	0	100
Erigone dentipalpis	0	0	0	100
Euryopis flavomaculata	0	100	0	0
Gnathonarium dentatum	0	0	0	100
Gonatium rubens	0	0	0	100
Gongylidiellum vivum	100	0	0	0
Haplodrassus signifer	0	0	0	100
Lepthyphantes mengei	0	100	0	0
Lepthyphantes tenuis	100	100	0	100
Lepthyphantes zimmermanni	100	0	0	100
Neon reticulatus	0	0	0	100
Oedothorax fuscus	0	0	0	100
Oedothorax retusus	0	100	0	0
Pachygnatha clercki	0	0	0	100
Pachygnatha degeeri	100	100	100	100
Pardosa nigriceps	100	100	0	100
Pardosa pullata	100	100	100	100
Pirata piraticus	100	0	100	100
Robertus arundineti	0	0	0	100
Robertus lividus	0	100	0	0
Scotina gracilipes	100	0	0	0
Tiso vagans	0	100	0	0
Trochosa terricola	100	100	100	100
Walckenaeria acuminata	100	100	0	0
Walckenaeria antica	0	100	0	0
Walckenaeria vigilax	0	100	0	0
Xysticus cristatus	100	100	100	100
Xysticus erraticus	0	100	0	100
TOTAL	**13**	**22**	**5**	**24**

SLIEVE GULLION ESA : HEATHER MOORLAND	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
SPIDER SPECIES	1994	2000	1994	2000
	n=9	n=9	n=8	n=8
Agroeca proxima	22	33	13	50
Agyneta cauta	11	33	0	13
Agyneta conigera	0	0	13	0
Agyneta decora	11	44	0	13
Agyneta olivacea	0	11	0	0
Agyneta subtilis	22	100	25	63
Allomengea scopigera	0	0	13	13
Alopecosa pulverulenta	56	44	75	38
Antistea elegans	11	11	13	13
Araneus quadratus	0	11	0	0
Bathyphantes gracilis	11	22	0	13
Bathyphantes parvulus	0	22	0	0
Bolyphantes luteolus	0	0	13	0
Centromerita concinna	0	56	0	25
Ceratinella brevipes	11	44	25	38
Clubiona diversa	0	11	0	0
Clubiona reclusa	0	11	0	0
Clubiona trivialis	11	11	0	0
Cnephalocotes obscurus	0	22	0	0
Dictyna arundinacea	0	0	0	38
Dicymbium nigrum	22	22	25	38
Diplocephalus permixtus	0	0	0	13
Dismodicus bifrons	0	44	0	38
Drassodes cupreus	33	78	25	38
Erigone atra	11	22	25	75
Erigone dentipalpis	11	22	25	38
Erigonella hiemalis	0	44	0	0
Ero furcata	0	11	0	25
Gonatium rubens	33	89	63	75
Gongylidiellum vivum	0	67	25	25
Haplodrassus signifer	44	44	25	38
Hypomma bituberculatum	0	0	0	13
Kaestneria pullata	0	11	0	0
Lepthyphantes alacris	0	11	0	13
Lepthyphantes cristatus	0	11	0	0
Lepthyphantes ericaeus	0	11	0	13
Lepthyphantes mengei	44	89	25	25
Lepthyphantes pallidus	0	11	0	13
Lepthyphantes tenebricola	0	0	0	13
Lepthyphantes tenuis	11	67	13	13
Lepthyphantes zimmermanni	11	78	75	88
Linyphia triangularis	22	0	25	13
Lophomma punctatum	0	11	0	0
Meioneta saxatilis	0	22	0	13
Meta mengei	0	44	0	13
Metopobactrus prominulus	0	0	0	13
Micrargus herbigradus	0	22	0	25
Microlinyphia pusilla	0	22	0	0
Monocephalus fuscipes	0	56	0	38

SLIEVE GULLION ESA : HEATHER MOORLAND	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
SPIDER SPECIES	1994	2000	1994	2000
continued	n=9	n=9	n=8	n=8
Neriene clathrata	0	0	0	13
Neriene montana	0	11	0	0
Nesticus cellulanus	0	0	0	13
Oedothorax fuscus	0	22	13	0
Oedothorax gibbosus	0	22	0	13
Oedothorax retusus	11	22	0	0
Oxyptila atomaria	0	22	0	13
Oxyptila trux	11	56	13	25
Pachygnatha clercki	11	22	25	25
Pachygnatha degeeri	44	100	75	50
Pardosa amentata	11	22	0	13
Pardosa nigriceps	78	78	75	75
Pardosa pullata	100	100	88	75
Pelecopsis mengei	0	22	0	0
Pelecopsis parallela	0	22	0	0
Peponocranium ludicrum	11	22	0	50
Philodromus cespitum	0	0	0	13
Pirata piraticus	22	0	50	13
Pocadicnemis pumila	0	33	0	13
Poeciloneta globosa	0	22	0	13
Robertus lividus	56	67	100	38
Saaristoa abnormis	11	33	38	50
Saaristoa firma	0	11	0	0
Scotina gracilipes	0	11	0	0
Stemonyphantes lineatus	0	11	0	0
Textrix denticulata	0	0	0	13
Theridion impressum	0	11	0	0
Tiso vagans	22	33	25	0
Trochosa terricola	33	100	50	88
Walckenaeria acuminata	22	67	50	63
Walckenaeria antica	33	0	13	13
Walckenaeria nudipalpis	0	11	0	0
Walckenaeria unicornis	0	11	0	38
Walckenaeria vigilax	11	11	0	0
Xysticus cristatus	33	67	25	63
Xysticus erraticus	0	22	0	0
TOTAL	**36**	**70**	**33**	**58**

SPERRINS ESA : HEATHER MOORLAND	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
SPIDER SPECIES	1994	2000	1994	2000
	n=34	n=34	n=8	n=8
Agroeca proxima	18	59	13	63
Agyneta cauta	12	3	0	0
Agyneta conigera	0	3	0	0
Agyneta decora	3	3	0	13
Agyneta olivacea	0	9	0	13
Agyneta subtilis	38	74	38	75
Allomengea scopigera	0	9	0	25
Alopecosa pulverulenta	24	26	13	38
Antistea elegans	53	76	75	100
Aphileta misera	0	15	0	0
Araeoncus crassiceps	9	6	13	25
Bathyphantes gracilis	12	29	0	50
Bathyphantes parvulus	0	9	0	0
Bathyphantes setiger	0	0	0	13
Bolyphantes luteolus	21	21	38	13
Centromerita bicolor	6	0	0	0
Centromerita concinna	59	56	50	63
Centromerus prudens	9	15	0	25
Centromerus sylvaticus	3	0	0	0
Ceratinella brevipes	50	59	25	13
Ceratinella brevis	0	3	0	0
Clubiona diversa	3	18	0	13
Clubiona reclusa	0	3	0	0
Clubiona trivialis	12	9	13	13
Cnephalocotes obscurus	12	12	0	0
Dictyna arundinacea	3	0	0	0
Dicymbium nigrum	50	41	38	50
Dicymbium tibiale	3	0	0	0
Diplocephalus latifrons	0	3	0	0
Diplocephalus permixtus	0	15	0	13
Dismodicus bifrons	0	12	0	0
Drepanotylus uncatus	18	12	38	13
Enoplognatha thoracica	3	0	0	0
Erigone atra	15	32	0	38
Erigone dentipalpis	6	15	25	13
Erigonella hiemalis	6	3	13	0
Ero furcata	0	0	0	25
Gnathonarium dentatum	0	3	0	0
Gonatium rubens	32	56	75	50
Gongylidiellum latebricola	0	9	0	13
Gongylidiellum vivum	15	18	0	25
Haplodrassus signifer	9	6	13	25
Hilaira pervicax	0	9	0	0
Hypomma bituberculatum	9	18	0	13
Hypselistes jacksoni	0	6	13	0
Lepthyphantes alacris	9	29	0	0
Lepthyphantes ericaeus	0	21	0	38
Lepthyphantes flavipes	0	3	0	0

SPERRINS ESA : HEATHER MOORLAND	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
SPIDER SPECIES	**1994**	**2000**	**1994**	**2000**
continued	n=34	n=34	n=8	n=8
Lepthyphantes mengei	15	65	13	50
Lepthyphantes obscurus	6	12	0	0
Lepthyphantes tenebricola	3	3	0	0
Lepthyphantes tenuis	26	24	25	25
Lepthyphantes zimmermanni	35	74	38	88
Leptorhoptrum robustum	0	3	0	0
Lophomma punctatum	35	56	38	13
Meioneta beata	0	0	0	13
Meioneta rurestris	0	0	0	13
Meioneta saxatilis	6	12	0	25
Meta mengei	0	3	0	0
Metopobactrus prominulus	0	0	0	13
Micrargus herbigradus	15	24	13	38
Micrargus subaequalis	0	3	0	0
Microlinyphia pusilla	0	3	0	13
Monocephalus fuscipes	38	50	63	38
Neriene clathrata	0	3	0	0
Oedothorax agrestis	3	0	0	0
Oedothorax fuscus	3	3	13	13
Oedothorax gibbosus	32	56	25	38
Oedothorax retusus	15	35	13	38
Oxyptila trux	35	24	25	13
Pachygnatha clercki	41	53	38	75
Pachygnatha degeeri	41	50	38	38
Pardosa amentata	6	6	13	0
Pardosa nigriceps	15	29	0	50
Pardosa pullata	97	100	88	100
Pelecopsis parallela	0	9	0	0
Peponocranium ludicrum	0	18	0	0
Pirata piraticus	79	79	100	100
Pirata uliginosus	0	6	13	0
Pocadicnemis pumila	6	38	0	13
Poeciloneta globosa	0	0	0	13
Rhaebothorax morulus	0	3	0	0
Robertus arundineti	9	15	0	0
Robertus lividus	71	76	50	88
Saaristoa abnormis	12	35	13	88
Satilatlas britteni	0	0	13	13
Scotina gracilipes	0	6	0	0
Silometopus elegans	0	32	0	75
Sintula cornigera	0	6	0	0
Stemonyphantes lineatus	9	6	13	13
Tapinopa longidens	3	9	0	0
Taranucnus setosus	0	6	0	0
Theridion bimaculatum	0	3	0	0
Tibellus maritimus	3	0	0	13
Tiso vagans	15	9	25	25
Trochosa spinipalpis	3	0	13	0

SPERRINS ESA : HEATHER MOORLAND	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
SPIDER SPECIES	**1994**	**2000**	**1994**	**2000**
continued	n=34	n=34	n=8	n=8
Trochosa terricola	91	100	100	100
Walckenaeria acuminata	47	74	38	88
Walckenaeria antica	12	12	25	38
Walckenaeria clavicornis	35	24	25	13
Walckenaeria cuspidatum	3	3	13	0
Walckenaeria incisa	3	0	13	0
Walckenaeria nudipalpis	18	32	0	13
Walckenaeria unicornis	3	0	0	13
Walckenaeria vigilax	0	29	25	63
Xysticus cristatus	24	50	13	75
TOTAL	**68**	**89**	**46**	**65**

ANTRIM COAST, GLENS & RATHLIN ESA: WOODLAND	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
SPIDER SPECIES	1994	2000	1994	2000
	n=12	n=12	n=2	n=2
Agyneta cauta	8	0	0	0
Agyneta subtilis	8	0	0	50
Alopecosa pulverulenta	17	8	0	0
Amaurobius fenestralis	8	0	0	0
Araeoncus crassiceps	8	0	0	0
Bathyphantes gracilis	33	67	0	100
Bathyphantes nigrinus	33	33	0	100
Centromerita bicolor	8	0	0	50
Centromerus sylvaticus	0	0	100	0
Ceratinella brevipes	8	17	0	0
Clubiona pallidula	0	8	0	0
Dicymbium nigrum	67	50	100	100
Diplocephalus latifrons	67	67	100	0
Diplostyla concolor	33	25	50	50
Drapetisca socialis	0	8	0	0
Erigone atra	17	58	0	50
Erigone dentipalpis	33	33	0	0
Erigone longipalpis	8	0	0	0
Erigonella hiemalis	33	17	0	0
Gonatium rubellum	8	8	50	50
Gonatium rubens	0	8	0	0
Gongylidiellum rufipes	0	8	0	0
Gongylidiellum vivum	0	17	0	100
Haplodrassus signifer	8	0	0	0
Harpactea hombergi	0	0	50	0
Helophora insignis	0	0	50	0
Hilaira excisa	8	8	50	50
Lepthyphantes alacris	17	42	50	50
Lepthyphantes cristatus	8	17	50	0
Lepthyphantes ericaeus	0	25	0	0
Lepthyphantes flavipes	33	58	0	50
Lepthyphantes mengei	17	33	0	0
Lepthyphantes minutus	0	8	0	0
Lepthyphantes pallidus	8	8	0	0
Lepthyphantes tenebricola	83	75	100	50
Lepthyphantes tenuis	50	58	0	50
Lepthyphantes zimmermanni	92	92	100	100
Linyphia hortensis	0	17	50	0
Linyphia triangularis	0	17	0	50
Lophomma punctatum	33	17	0	50
Maso sundevalli	0	0	0	50
Meioneta saxatilis	8	8	0	0
Meta mengei	0	17	0	0
Micrargus herbigradus	17	8	0	0
Micrargus subaequalis	0	8	0	0
Microneta viaria	17	33	0	0
Monocephalus fuscipes	83	67	100	100

ANTRIM COAST, GLENS & RATHLIN ESA: WOODLAND	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
SPIDER SPECIES	1994	2000	1994	2000
continued	n=12	n=12	n=2	n=2
Neriene montana	8	8	0	0
Oedothorax fuscus	0	8	0	0
Oedothorax gibbosus	25	25	0	50
Oedothorax retusus	25	17	0	0
Oxyptila trux	0	8	0	0
Pachygnatha clercki	8	8	50	0
Pachygnatha degeeri	67	58	0	0
Pardosa amentata	33	17	50	0
Pardosa pullata	8	8	0	0
Pirata piraticus	0	0	50	0
Pocadicnemis pumila	17	0	50	0
Robertus lividus	42	50	50	100
Saaristoa abnormis	17	42	50	50
Saaristoa firma	0	0	0	50
Segestria senoculata	8	0	0	0
Silometopus elegans	0	8	0	0
Tiso vagans	8	8	0	0
Trochosa terricola	50	33	0	0
Walckenaeria acuminata	42	58	50	100
Walckenaeria cuspidatum	8	8	0	0
Walckenaeria incisa	0	8	0	0
Walckenaeria nudipalpis	8	8	0	0
Walckenaeria vigilax	0	8	0	50
Xysticus cristatus	8	0	50	0
TOTAL	**49**	**55**	**22**	**25**

Appendix 4. Percentage frequency of plant species recorded on heather management sites in 2000.

PLANT SPECIES	Burned n=8	Burn control n=6	Flailed n=6	Flail control n=6
Agrostis canina	50	50	100	50
Anthoxanthum odoratum	38	50	50	
Aulacomnium palustre	75	17	67	33
Bare ground	100	50	67	33
Blechnum spicant	25		17	17
Breutelia chrysocoma	13	17		17
Calluna vulgaris	100	100	100	100
Calypogeia muellerana	88	50	50	83
Campylopus introflexus	100		17	17
Campylopus paradoxus	88	17	67	50
Campylopus pyriformis	25		17	
Carex binervis	25	33	33	33
Carex echinata	38	17	33	17
Carex nigra	38	83	83	33
Carex panicea	38	33	17	17
Carex pilulifera	38	17	33	33
Cladonia floerkeana	25			
Cladonia portentosa	38	33	33	50
Cladonia pyxidata	38			
Danthonia decumbens		17	17	17
Deschampsia flexuosa	75	83	83	67
Dicranella heteromalla	38			
Dicranum scoparium	88	83	50	83
Diplophyllum albicans	13		33	33
Drosera rotundifolia	25			
Dryopteris dilatata			17	
Empetrum nigrum	25	17	17	17
Erica cinerea	13	17	17	17
Erica tetralix	88	83	83	100
Eriophorum angustifolium	88	83	67	67
Eriophorum vaginatum	88	83	67	67
Eurhynchium praelongum		17	17	
Festuca ovina	13	33	33	33
Festuca rubra	13	17	17	17
Galium saxatile	38	50	33	
Hylocomium splendens	75	67	67	83
Hypnum cupressiforme	100	83	100	67
Hypnum jutlandicum		67	67	67
Juncus acutiflorus		17		
Juncus bulbosus	25		33	
Juncus conglomeratus	13	17		
Juncus effusus	13	17		
Juncus squarrosus	50	17	33	17
Kurzia pauciflora	38	33	17	33
Leucobryum glaucum			17	17
Listera cordata	13	33	33	67
Lophocolea bidentata	38	33	33	50
Lophozia ventricosa	88	50	67	50
Luzula campestris			17	
Luzula multiflora	38	33	50	17
Luzula sylvatica	13	17		
Mnium hornum	13			
Molinia caerulea	63	67	33	50
Mylia anomala	13			
Mylia taylorii		17	17	17
Nardus stricta	38	17	50	33
Narthecium ossifragum	38		33	17
Odontoschisma sphagni	25	33	50	50
Pedicularis sylvatica	13		17	
Plagiothecium undulatum	88	67	50	67

PLANT SPECIES	Burned n=8	Burn control n=6	Flailed n=6	Flail control n=6
Pleurozium schreberi	63	100	100	100
Poa pratensis		17		
Pohlia nutans	25			
Polygala serpyllifolia	25		17	
Polytrichum commune	88	50	100	67
Polytrichum juniperinum	13		33	
Potentilla erecta	75	83	67	50
Pseudoscleropodium purum	13	50	17	17
Rhytidiadelphus loreus	88	83	83	83
Rhytidiadelphus squarrosus	25	50	50	50
Rhytidiadelphus triquetrus		17		
Rumex acetosella	13			
Salix repens		17		17
Scapania gracilis	13	33	33	33
Sphagnum auriculatum	13		17	17
Sphagnum capillifolium	88	67	67	83
Sphagnum compactum	13			
Sphagnum cuspidatum	63		50	50
Sphagnum palustre	50	17	17	33
Sphagnum papillosum	88	33	50	67
Sphagnum recurvum	50	17	67	67
Sphagnum subnitens	63	50	50	50
Sphagnum tenellum	38	33	33	50
Thuidium tamariscinum	25	50	17	17
Trichophorum cespitosum	88	83	50	67
Vaccinium myrtillus	63	83	67	83