

# **ENVIRONMENTALLY SENSITIVE AREAS IN NORTHERN IRELAND**

**Re-monitoring of the  
West Fermanagh & Erne Lakeland**

**Biological evaluation of the ESA scheme  
between 1993 and 1999**

## MONITORING TEAM

The ESA monitoring programme in Northern Ireland is funded by the Department of Agriculture and Rural Development (DARD) through its Science Service and carried out by Queen's University, Belfast (QUB).

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## SUMMARY

1. To determine the effectiveness of the ESA scheme in maintaining or enhancing the wildlife diversity of habitats in the West Fermanagh & Erne Lakeland ESA since 1993, a re-monitoring programme was undertaken in 1999. Habitats were monitored on farms under an ESA agreement and farms that had not entered an ESA agreement at the time of re-monitoring.
2. Habitat diversity was measured by a combination of plant and invertebrate species richness, plant species groups, vegetation types, the relative proportions of species in each of the plant strategy theory groups (Grime *et al.* 1988) and the frequency and distribution of invertebrate indicator species. Comparison was made over time to determine changes in biodiversity with respect to participation in the ESA scheme.
3. The re-monitoring programme indicates that after six years the plant and invertebrate species diversity of all habitats under an ESA agreement is being maintained. Species diversity is also being maintained on non-participant farms. There were indications of enhancement of species diversity on ESA participant farms. A lack of change in overall species number is not necessarily a failure of the scheme to deliver positive enhancements, as in many cases the range of species on target habitats has changed to include more desirable species from a conservation point of view. This has often been accompanied by a loss of undesirable “weed” species.
4. Hay meadows on participant farms showed an increase in typical hay meadow species and a decrease in weedy species such as ragwort (*Senecio jacobea*) and creeping thistle (*Cirsium arvense*). The number of Carabid beetle species increased significantly on hay meadows on participant farms and decreased on non-participant farms. *Carabus clatratus*, identified as an indicator species, increased on participant hay meadows and decreased on non-participant hay meadows between years. The spider *Araneus quadratus*, captured on a hay meadow, is a new record for Co. Fermanagh.

5. Only two sampled limestone grassland sites remain outside the ESA scheme. This indicates the success of the scheme in terms of uptake but presents problems for monitoring. The total number of plant species recorded on limestone grassland increased (by 22%) on participant farms and decreased (by 14%) on non-participant farms. Two new spider county records were found on limestone grassland, one from a participant farm (*Clubiona neglecta*) and one from a non-participant farm (*Peponocranium ludicrum*).
6. There was a notable decrease in the frequency of several grass species on heather moorland. In particular, matt grass (*Nardus stricta*) had declined on participant farms indicating an improvement in the quality of the heather moorland. *Carabus nitens* identified as an indicator species on heather moorland in 1993 maintained its presence on participant farms but was not re-recorded on non-participant farms. Two spider species, *Ero furcata* and *Metopobactrus prominulus*, captured on participant farms on heather moorland are new county records for Fermanagh.
7. The species diversity of unimproved grassland on participant and non-participant sites had not significantly changed between 1993 and 1999, indicating that species diversity had been maintained. Unimproved grassland had a relatively high proportion of stress-tolerant species, similar to that found in hay meadows and wet grasslands, indicating that this is an important habitat in terms of biodiversity.
8. The mean number of plant species recorded in woodland on ESA participant sites and non-participant sites did not change significantly between 1993 and 1999. There was a decrease in grazing due to fencing of woodland, which may have led to the change in frequency and abundance of certain species. Oak seedlings (*Quercus sp.*) and blackthorn (*Prunus spinosa*) increased in woodland on participant farms. The mean cover of bramble (*Rubus fruticosus*) increased in participant woods whereas it decreased in non-participant sites. An increase in oak seedlings is positive although blackthorn and bramble can shade out ground species leading to a decline in species diversity. Of three new spiders captured on this habitat, *Erigonella ignobilis* has not been recently recorded in N. Ireland.

9. The monitoring programme has indicated that after six years the species diversity is being maintained on habitats on ESA participant farms. There are indications of enhancement on habitats such as hay meadows where there has been an increase in the high quality stress-tolerator species on participant farms. There are also positive indicators on heather moorland with an increase in species number on ESA participant farms and a decrease in undesirable species such as mat grass (*Nardus stricta*) probably due to reduced grazing pressure. Possible areas of concern are an increase in blackthorn (*Prunus spinosa*) and bramble (*Rubus fruticosus*) in woodland and an increase in soft rush (*Juncus effusus*) on hay meadows and wet grasslands. These may have implications for management and will be further investigated in future monitoring exercises.

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## **1.0. 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 Mourne and Slieve Croob ESA

The Antrim Coast, Glens and Rathlin ESA

The West Fermanagh and 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.

## **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 (McAdam *et al.* Department of Applied Plant Science, Queens University/ DARD).

A baseline biological monitoring programme in the West Fermanagh and Erne Lakeland ESA was completed in 1993 (Hegarty *et al.* 1994). This survey provided baseline data on the wildlife value of a range of sites from target habitats within the ESA boundary. 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 (Ehanno 1976; 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; Leader-Williams *et al.* 1987). The Institute of Terrestrial Ecology (ITE) National Survey of Britain (Bunce *et al.* 1992) indicates that the increase in the use of fertilisers and slurry and silage cutting has resulted in the loss of species diversity in grassland and hedgerows, in favour of species which respond to soils with high nutrient status, therefore decreasing many indigenous grasses and plant species.

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) have 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.

The habitats monitored in the West Fermanagh and Erne Lakeland ESA were:-

- Woodland
- Heather moorland
- Hay meadow
- Wet grassland
- Unimproved grassland
- Limestone grassland

All the Northern Ireland ESAs were re-monitored three years after baseline monitoring, in a partial survey to allow an initial appraisal of the scheme's effectiveness 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.

A complete re-monitoring exercise has now been completed in the West Fermanagh and Erne Lakeland ESA in 1999 and data compared to the baseline data (1993). This permits a more precise evaluation of the scheme over a longer time period during which management prescriptions have had a greater opportunity to become apparent.

## 2.0. METHODS

### 2.1. Re-monitoring field sampling programme

A total of 188 sites were surveyed in 1993. Of these sites 175 (93%) were re-surveyed in 1999 (Table 1). Sites not re-surveyed were hay meadows that had been cut or wet grasslands that were flooded making survey impossible. Permission to re-survey was refused in one instance (on a non-ESA participant farm).

Data were compared between 1993 and 1999 for the 175 sites surveyed in both years.

Farms monitored in 1999 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 1996 in the West Fermanagh and Erne Lakeland ESA

<b>Habitat</b>	<b>Number of sites re-monitored</b>		<b>% of baseline sites re-monitored</b>	
	<b>Plants</b>	<b>Invertebrates</b>	<b>Plants</b>	<b>Invertebrates</b>
Hay meadow	45	15	98	94
Wet grassland	47	12	94	92
Limestone grassland	15	5	100	100
Unimproved grassland	20	13	100	81
Heather moorland	19	8	90	100
Woodland	15	4	75	100

### 2.2. Botanical monitoring

Plant monitoring was carried out between April and September 1999, with sites being visited once during this period. Woodlands were surveyed during May, hay meadows in June, wet grasslands in July, other grasslands in July and August and heathlands monitored in August and September. Monitoring was carried out at the same season of the year as during the baseline monitoring. Permanent quadrats initially recorded in 1993 were re-monitored. Plant nomenclature follows Clapham, Tutin and Moore (1987), mosses and liverworts follow Watson (1981). Details of specific habitat monitoring techniques are listed below.

Grasslands: Initially in 1993, a diagonal transect was measured across the field and five permanent equidistant 2 x 2m quadrats were marked out (MAFF 1987). Metal tubing was used

as permanent quadrat markers and these were firmly located below ground level, preventing damage to any animals or farm machinery. These quadrats were relocated using a metal detector and a detailed field map. Sites A detailed list of the plant species (including bryophytes) and their percentage cover was estimated within a nested 1 x 1m quadrat. Any additional species were recorded in the outer 2 x 2m quadrat. Sites were plotted using a Garmin 12 XL Geographical Positioning System to aid future re-location.

Heathland and limestone grassland: The sites were marked by a 1m tall metal stake and permanent quadrats were re-located at 4 equidistant points along a 60m transect. Sites were re-located and the standardised 2 x 2m nested quadrats were used in these habitats and species recorded as above.

Woodland: Standardised permanent quadrats size of 14 x 14m, consisting of three nested quadrats (14m<sup>2</sup>, 7m<sup>2</sup> and 2m<sup>2</sup>). Plant species (including ferns, mosses and lichens) and their percentage cover was recorded in the 2m<sup>2</sup> quadrat. Additional species were noted in the outer quadrats. Diameters of trees and shrubs (at 1.2m from ground level) were recorded, together with site information on grazing and management details.

### **2.3. Invertebrate monitoring**

Ground beetles and spiders were sampled during three, four-week periods between April and October 1993. This was achieved at each site using five pitfall traps (polythene containers 9 cm wide and 20 cm 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°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. Damian McFerran (Ulster Museum).

## **2.4. Soil sampling**

Two soil samples were taken along the field diagonal transect, during the botanical monitoring programme. Soil was taken from outside the quadrat using a soil auger (15cm deep x 3cm diameter). Samples were placed in polythene bags, labelled, sealed and kept cool until they were returned to the laboratory and air-dried at room temperature. Once dried, the samples were dry-sieved through a 2mm sieve. Soil chemical analyses, pH, available phosphorus, exchangeable potassium and magnesium were determined according to Allen (1974).

## **2.5. Data storage**

### **2.5.1. 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.

### **2.5.2. 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 statistics on invertebrate data.

## **2.6. 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.

### **2.6.1. 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 1993 with the mean number of species on the same site in 1999 for ESA participant and non-participant farms. Numbers of higher plant species i.e. herb and shrub species excluding grasses, sedges, rushes and ferns 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).

### **2.6.2. 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 1993 and 1999 for ESA participant farms and non-participant farms

### **2.6.3. 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 1993 and 1999 for each site has been calculated for plants, carabid beetles and spiders using the Sørensen Index:

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

This is expressed as a percentage where:-  
 $a$  is the number of species recorded in 1993  
 $b$  is the number of species recorded in 1999  
 $j$  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).

### **2.6.4. 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 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).

## 3.0. RESULTS

### 3.1. Hay meadows

#### 3.1.1. Plant species diversity between 1993 and 1999 for ESA participants and non-participants

##### Plant species richness

To investigate any changes over time the species diversity of hay meadows between 1993 and 1999 was compared regardless of participation in the ESA scheme. There were no significant differences in the mean number of plant species per 4m<sup>2</sup> quadrat or the mean number of higher plants between years.

There were no significant differences between 1993 and 1999 in the mean number of all plant species recorded per 4m<sup>2</sup> quadrat on ESA participant or non-participant farms (Table 2). This suggests that the species diversity of hay meadows is being maintained.

The total number of plant species recorded on hay meadows changed by 1% (from 130 to 131) on ESA participant farms and by 2% (from 128 to 131) on non-participant farms. The similarity in plant species sampled between 1993 and 1999 was 72% for participants and 64% for non-participants.

Table 2. Plant species diversity in 1993 and 1999 on hay meadows in the West Fermanagh & Erne Lakeland ESA.

	ESA status	n	1993		1999		P
			Mean	se	Mean	se	
Mean number of plant species per 4m <sup>2</sup> quadrat	Participant	24	34	1.7	34	2.2	NS
	Non-participant	21	34	1.7	37	2.0	NS
Mean number of higher plant species per 4m <sup>2</sup> quadrat	Participant	24	19	1.2	17	1.2	NS
	Non-participant	21	18	1.1	18	1.1	NS
NS = not significant    * = P<0.05    ** = P<0.01							



### **Plant species frequency and abundance**

Plant frequency species lists for hay meadows on ESA participant and non-participants farms for each year have been compiled (Appendix 1).

The most frequent species recorded in all hay meadows monitored in 1999 (>80% of sites) were sweet vernal grass (*Anthoxanthum odoratum*), Yorkshire fog (*Holcus lanatus*), meadow buttercup (*Ranunculus acris*), white clover (*Trifolium repens*), lady's smock (*Cardamine pratensis*), rough-stalked meadow grass (*Poa trivialis*), creeping buttercup (*Ranunculus repens*) and common sorrel (*Rumex acetosa*).

Some species indicative of high quality grassland such as glaucous sedge (*Carex flacca*), selfheal (*Prunella vulgaris*), common quaking grass (*Briza media*), red clover (*Trifolium pratense*) and ragged robin (*Lynchnis flos-cuculi*) increased in frequency on participant hay meadows between 1993 and 1999. This may indicate an enhancement of the species diversity of some sites. Other species with an increase in frequency on participant farms include creeping buttercup (*Ranunculus repens*), floating sweet-grass (*Glyceria fluitans*), smooth-stalked meadow grass (*Poa pratensis*) and common bent (*Agrostis capillaris*). Certain weed species such as ragwort (*Senecio jacobea*) and creeping thistle (*Cirsium arvense*) had become less frequent.

There was a significant increase in the mean abundance per 1x1m quadrat of soft rush (*Juncus effusus*) on participant and non-participant farms between 1993 and 1999. The increase in rush cover from 2.1% to 7.6% may have resulted from changed management practises. There was a significant increase in mean abundance of ryegrass (*Lolium perenne*) on participant farms from 2% to 5% ( $p<0.05$ ). This is partly due to the fact that at least one hay meadow has been re-seeded since 1993.

### **Plant species composition in the plant strategy CSR groups**

There were no significant differences in the relative proportions of CSR species groups between 1993 and 1999 for hay meadows on participant or non-participant farms. The percentage of stress-tolerators on participant farms decreased slightly from 28% in 1993 to 25% in 1999. This is likely to be due to the fact that in the hay meadow that had been re-seeded since 1993 the proportion of stress-tolerant species fell from 31% to 6%.

### Soil nutrient status

Phosphorus levels and pH decreased in hay meadows on both participant and non-participant farms whilst potassium increased slightly on participant farms (Appendix 4).

### 3.1.2. Carabid beetle species diversity between ESA participants and non-participants from 1993 to 1999.

The number of Carabid beetle individuals captured on hay meadows on participant farms and on non-participant farms showed no significant change. The number of Carabid beetle species increased by 26% on participant farms (Table 3). The diversity index for Carabid species also increased for participant hay meadows. Similarity in Carabid beetle species captured between 1993 and 1999 was 80% for participants and 71% for non-participants.

Table 3. Carabid beetle species diversity in 1993 and 1999 on hay meadows in the West Fermanagh & Erne Lakeland ESA.

	ESA status	N	1993		1999		P
			Mean	se	Mean	se	
Mean number of Carabid species per site	Participant	6	11	0.5	15	1.4	*
	Non-participant	9	12	1.0	11	0.7	NS
Mean Carabid diversity per site	Participant	6	3.4	0.4	4.8	0.3	**
	Non-participant	9	3.9	0.5	3.9	0.3	NS
NS = not significant    * = P<0.05    ** = P<0.01							

### 3.1.3. Spider species diversity between ESA participants and non-participants from 1993 to 1999.

Numbers of spider individuals and species declined on both participant and non-participant farms due to annual fluctuations in population but spider diversity remained higher on ESA-participant farms (Table 4).

Similarity in spider species captured between 1993 and 1999 was 59% for participants and 53% for non-participants.

Table 4. Spider species richness and diversity in 1993 and 1999 on hay meadows in the West Fermanagh & Erne Lakeland ESA.

	ESA status	n	1993		1999		P
			Mean	se	Mean	se	
Mean number of spider species per site	Participant	6	20	3.1	13	0.9	*
	Non-participant	9	17	1.3	13	0.6	**
Mean spider diversity per site	Participant	6	5.02	1.1	4.45	0.3	NS
	Non-participant	9	4.42	0.3	3.76	0.4	NS
NS = not significant    * = P<0.05    ** = P<0.01							

Of the seven spiders not captured on this habitat in 1993, *Araneus quadratus* is a new County record for Fermanagh.

*Araneus quadratus* (Clerck, 1757) is a large (6-15mm) ‘orb weaving spider’. It is found in late summer / autumn on low bushes, heather and grass. It has been recorded widely throughout the Republic of Ireland and in Northern Ireland it has been recorded in Cos. Down and Tyrone. The present record is from a hay meadow in County Fermanagh (Grid ref: H27313884) captured on 13<sup>th</sup> September, 1999.

## 3.2. Wet grassland

### 3.2.1. Plant species diversity between 1993 and 1999 for ESA participants and non-participants

#### Plant species richness

There was no significant difference between the mean number of species recorded per 4m<sup>2</sup> quadrat in 1993 and 1999 when all sites were compared regardless of participation in the ESA scheme (Table 5).

There were no significant differences in mean number of all plant species or higher plant species recorded per 4m<sup>2</sup> quadrat between 1993 and 1999 on participant or non-participant sites. Hence the species-diversity of wet grassland has been maintained.

Similarity in plant species sampled between 1993 and 1999 was 64% for both participants and non-participants.

Table 5. Plant species diversity in 1993 and 1999 on wet grassland in the West Fermanagh & Erne Lakeland ESA.

	ESA status	N	1993		1999		P
			Mean	Se	Mean	Se	
Mean number of plant species per 4m <sup>2</sup> quadrat	Participant	30	39	1.9	38	1.7	NS
	Non-participant	17	39	2.9	42	2.9	NS
Mean number of higher plant species per 4m <sup>2</sup> quadrat	Participant	30	21	1.3	20	1.2	NS
	Non-participant	17	20	1.8	20	1.7	NS
NS = not significant    * = P<0.05    ** = P<0.01							

#### Plant species frequency and abundance

Plant frequency species lists have been compiled for wet grasslands in 1993 and 1999 (Appendix 1).

The most frequent species recorded in all wet grasslands in 1999 (>80% of sites) were soft rush (*Juncus effusus*), creeping bent (*Agrostis stolonifera*), creeping buttercup (*Ranunculus repens*), white clover (*Trifolium repens*), rough-stalked meadow grass (*Poa trivialis*), meadow buttercup (*Ranunculus acris*), Yorkshire fog (*Holcus lanatus*) and lady's smock (*Cardamine pratensis*).

Species which increased significantly ( $p < 0.05$ ) in frequency on participant farms between 1993 and 1999 were creeping buttercup (*Ranunculus repens*), daisy (*Bellis perennis*), selfheal (*Prunella vulgaris*) and hairy bittercress (*Cardamine hirsuta*). Other species had declined in frequency on participant sites, particularly wetland species such as marsh foxtail (*Alopecurus geniculatus*), bulbous rush (*Juncus bulbosus*), meadowsweet (*Filipendula ulmaria*), meadow fescue (*Festuca pratensis*) and yellow flag (*Iris pseudocorus*). Soft rush (*Juncus effusus*) had increased in frequency on participant farms from 87% to 97%, whereas it had decreased on non-participant farms from 94% to 76%.

There was a significant increase in the mean abundance of soft rush (*Juncus effusus*) on participant sites from 3% in 1993 to 14% in 1999 ( $p < 0.01$ ). The mean abundances of creeping buttercup (*Ranunculus repens*), white clover (*Trifolium repens*) and ryegrass (*Lolium perenne*) had significantly increased but their abundance remained low (<5% cover).

#### **Plant species composition in the plant strategy CSR groups**

Wet grasslands did not differ significantly in their relative proportions of CSR strategy groups between 1993 and 1999 for participant and non-participant farms. There was however, a decrease in the percentage of competitors (16 to 10%) and an increase in ruderals (13 to 18%) on non-participant farms between 1993 and 1999 possibly indicating a greater degree of disturbance on these sites. On participant farms the proportion of stress-tolerators had fallen slightly but not significantly from 23 to 21.

There were no significant differences in soil nutrient status between years on wet grasslands (Appendix 4).

### 3.2.2. Carabid beetle species diversity between ESA participants and non-participants from 1993 to 1999.

The number of Carabid beetle individuals captured on wet grassland on participant farms and on non-participant farms showed no significant change (Table 6). The total number of Carabid beetle species decreased by 14% on participant farms and 44% on non-participant farms. Similarity in Carabid beetle species captured between 1993 and 1999 was 77% for participants and 50% for non-participants.

Table 6. Carabid beetle species diversity from 1993 to 1999 on wet grassland in the West Fermanagh & Erne Lakeland ESA.

	ESA status	n	1993		1999		P
			Mean	se	Mean	Se	
Mean number of Carabid species per site	Participant	10	14	0.6	12	1.1	NS
	Non-participant	2	11	3.5	5	4.5	NS
Mean Carabid diversity per site	Participant	10	4.8	0.3	3.9	0.2	NS
	Non-participant	2	3.4	1.0	2.4	2.4	NS
NS = not significant    * = P<0.05    ** = P<0.01							

### 3.2.3. Spider species diversity between ESA participants and non-participants from 1993 to 1999.

The number of spider individuals showed no significant change. The number of total spider species decreased by 8% on participant farms and by 26% on non-participant farms. Similarity in spider species captured between 1993 and 1999 was 76% for participants and 55% for non-participants. There were no significant changes in spider species richness or diversity from 1993 to 1999 on wet grassland.

### 3.3. Limestone grassland

#### 3.3.1. Plant species diversity between 1993 and 1999 for ESA participants and non-participants

##### Plant species richness

There was no significant difference in the mean number of plant species recorded per 4m<sup>2</sup> quadrat between 1993 and 1999 when all sites were analysed regardless of participation in the ESA scheme (Table 7). However there was a significant decrease in the mean number of higher plants recorded in all limestone grasslands from 24 to 21 species ( $p < 0.05$ ).

There was no change in the mean number of species per quadrat on participant farms between 1993 and 1999, which suggests species diversity is being maintained. The mean number of plant species per quadrat for non-participants fell from 65 to 52. This was not statistically significant as only two limestone grassland sites remain outside the ESA scheme. There was also a decrease in the mean number of higher plants on non-participant sites.

The total number of plant species recorded on limestone grassland increased by 22% on participant farms and decreased by 17% on non-participant farms. Similarity in plant species sampled between 1993 and 1999 was 67% for participants and 57% for non-participants.

Table 7. Plant species diversity in 1993 and 1999 on limestone grassland in the West Fermanagh & Erne Lakeland ESA.

	ESA status	n	1993		1999		P
			Mean	se	Mean	se	
Mean number of plant species per 4m <sup>2</sup> quadrat	Participant	13	44	3.5	44	4.0	NS
	Non-participant	2	65	12	52	0.5	NS
Mean number of higher plant species per 4m <sup>2</sup> quadrat	Participant	13	24	2.4	21	1.9	NS
	Non-participant	2	29	4.5	20	1.0	NS
NS = not significant    * = $P < 0.05$ ** = $P < 0.01$							

### **Plant species frequency and abundance**

Plant frequency species lists have been compiled for limestone grasslands (Appendix 1).

The most frequent species present on limestone grasslands on participant farms (>80% of sites) in 1999 were white clover (*Trifolium repens*), sweet vernal grass (*Anthoxanthum odoratum*), Yorkshire fog (*Holcus lanatus*), crested dog's tail (*Cynosurus cristata*), glaucous sedge (*Carex flacca*), ribwort plantain (*Plantago lanceolata*) and common sorrel (*Rumex acetosa*). There were significant decreases in the mean abundances per 1m quadrat of bugle (*Ajuga reptans*) and blue-moor grass (*Sesleria albicans*) on participant farms ( $p < 0.01$ )

### **Plant species composition in the plant strategy CSR groups**

Limestone grasslands had a relatively high proportion of stress-tolerating species and a low proportion of competitors. There was no significant change in the relative proportions of CSR groups between 1993 and 1999 for participant or non-participants.

### **Soil nutrient status**

The only significant change in soil nutrient status between 1993 and 1999 on limestone grassland was an increase in soil magnesium on participant farms (Appendix 4).

#### **3.3.2. Carabid beetle species diversity between ESA participants and non-participants from 1993 to 1999.**

The number of Carabid beetle individuals captured on limestone grassland on participant farms and non-participant farms showed no significant change. The number of Carabid beetle species increased by 4% on participant farms and by 13% on non-participant farms. Similarity in Carabid beetle species captured between 1993 and 1999 was 77% for participants and 70% for non-participants. There were no significant changes in the mean number of carabid beetle species or diversity per site between 1993 and 1999 on limestone grassland.

#### **3.3.3. Spider species diversity between ESA participants and non-participants from 1993 to 1999.**

The number of spider individuals showed no significant change. Similarity in spider species captured between 1993 and 1999 was 65% for participants and 73% for non-participants. There were no significant changes in spider species richness or diversity from 1993 to 1999 on limestone grassland.



Of eleven new spiders captured in this habitat, two new county records were found; one (*Clubiona neglecta*) from a participant farm and one (*Peponocranium ludicrum*) from a non-participant farm.

***Clubiona neglecta*** (O. P. –Cambridge, 1862) is a ‘foliage spider’ (4-8mm) often situated within a tubular sac (open at both ends) under stones or in rolled up leaves. It is widespread but local and is found in low vegetation on mainly dry habitats. It has been widely recorded in the Republic of Ireland and in Cos. Antrim and Down. The present record is from limestone grassland in County Fermanagh (Grid ref: H12404032) trapped on 15<sup>th</sup> July, 1999.

***Peponocranium ludicrum*** (O. P. –Cambridge, 1861) is a tiny ‘money spider’ (2mm) found on low vegetation and bushes. It is widespread in Britain and can be abundant. It has been found several times throughout Ireland by various recorders. This present record is from limestone grassland in County Fermanagh (Grid ref: H01046166) trapped on 10<sup>th</sup> May, 1999.

### 3.4. Unimproved grassland

#### 3.4.1. Plant species diversity between 1993 and 1999 for ESA participants and non-participants

##### Plant species richness

There were no significant differences in the mean number of species or higher plants recorded per 4m<sup>2</sup> quadrat between 1993 and 1999, when all sites were compared regardless of participation in the ESA scheme.

The species diversity of unimproved grassland on participant and non-participant sites had not significantly changed between 1993 and 1999 (Table 8). Similarity in plant species sampled between 1993 and 1999 was 69% for participants and 55% for non-participants.

Table 8. Plant species diversity in 1993 and 1999 on unimproved grassland in West Fermanagh and Erne Lakeland ESA.

	ESA status	N	1993		1999		P
			Mean	se	Mean	Se	
Mean number of plant species per 4m <sup>2</sup> quadrat	Participant	15	40	1.6	40	2.3	NS
	Non-participant	5	45	2.8	48	4.3	NS
Mean number of higher plant species per 4m <sup>2</sup> quadrat	Participant	15	17	1.0	17	1.3	NS
	Non-participant	5	22	1.3	23	2.7	NS
NS = not significant    * = P<0.05    ** = P<0.01							

##### Plant species frequency and abundance

The plant frequency species list for unimproved grassland have been compiled (Appendix 1).

The most frequent species recorded on unimproved grasslands in 1999 (>80% of sites) were white clover (*Trifolium repens*), Yorkshire fog (*Holcus lanatus*), meadow buttercup (*Ranunculus acris*), creeping buttercup (*Ranunculus repens*), soft rush (*Juncus effusus*), sweet vernal grass (*Anthoxanthum odoratum*), lady's smock (*Cardamine pratensis*) and crested dog's tail (*Cynosurus cristatus*).

Species showing a high increase in frequency on participant farms between years were selfheal (*Prunella vulgaris*), creeping buttercup (*Ranunculus repens*), glaucous sedge (*Carex flacca*) and lady's smock (*Cardamine pratensis*). The presence of common spotted orchid (*Dactylorhiza fuchsii*) had increased from one to two sites. Other species on participant farms including bugle (*Ajuga reptans*), creeping thistle (*Cirsium arvense*), red fescue (*Festuca rubra*) and rough-stalked meadow grass (*Poa trivialis*) were not as frequent in 1999 as in 1993.

Selfheal (*Prunella vulgaris*) and creeping buttercup (*Ranunculus repens*) had a significant increase in mean abundance per 1m<sup>2</sup> quadrat on participant and non-participant sites. ( $p < 0.05$ ). Species with a significant decrease in mean abundance on participant farms were jointed rush (*Juncus acutiflorus*) and rough-stalked meadow grass (*Poa trivialis*).

### **CSR species groups**

Unimproved grassland had a relatively high proportion of stress-tolerators, similar to that found in hay meadows and wet grasslands.

There were no apparent changes in the relative proportion of CSR species between 1993 and 1999 for ESA participants and non-participants. However, there was an increase in the percentage of ruderal species on participant sites from 12% to 16%.

### **Soil nutrient status**

The only significant changes in soil nutrient status between 1993 and 1999 on unimproved grassland were a decrease in phosphorus on non-participant farms and a decrease in magnesium on participant farms (Appendix 4).

#### **3.4.2. Carabid beetle species diversity between ESA participants and non-participants from 1993 to 1999.**

The number of Carabid beetle individuals captured on unimproved grassland on participant farms and on non-participant farms showed no significant change. The number of Carabid beetle species increased by 7% on participant farms and by 25% on non-participant farms. Similarity in Carabid beetle species captured between 1993 and 1999 was 80% for participants and 83% for non-participants. There were no significant changes in the mean number of

carabid beetle species or in species diversity per site between 1993 and 1999 on unimproved grassland.

### 3.4.3. Spider species diversity between ESA participants and non-participants in 1993 and 1999.

The number of spider individuals showed no significant change between years. The number of total spider species decreased by 22% on participant farms and by 30% on non-participant farms (Table 9). Similarity in spider species captured between 1993 and 1999 was 62% for participants and 70% for non-participants.

Table 9. Spider species richness and diversity in 1993 and 1999 on unimproved grassland in the West Fermanagh and Erne Lakeland ESA.

	ESA status	n	1993		1999		P
			Mean	se	Mean	se	
Mean number of spider species per site	Participant	10	21	2.0	15	1.1	**
	Non-participant	3	18	1.2	12	2.6	NS
Mean spider diversity per site	Participant	10	6.71	0.8	4.61	0.5	**
	Non-participant	3	4.98	0.6	3.46	0.4	*
NS = not significant    * = P<0.05    ** = P<0.01							

### 3.5. Heather moorland

#### 3.5.1. Plant species diversity between 1993 and 1999 for ESA participants and non-participants

##### Plant species richness

There was no significant difference in the mean number of plant species or higher plants recorded per 4m<sup>2</sup> quadrat between 1993 and 1999, when all sites were compared regardless of participation in the ESA scheme.

There was an increase in the mean number of plant species recorded per 4m<sup>2</sup> quadrat between 1993 and 1999 on participant farms, although this was not statistically significant, species diversity on heather moorland is being maintained (Table 10).

The total number of plant species recorded on heather moorland increased by 38% on participant farms and decreased by 7% on non-participant farms. Similarity in plant species sampled between 1993 and 1999 was 64% for participants and 56% for non-participants. It should be noted that due to the high uptake of the scheme between 1993 and 1999 only one of the nineteen original heather moorland monitoring sites in the West Fermanagh & Erne Lakeland ESA remains outside the ESA scheme.

Table 10. Plant species diversity from 1993 to 1999 on heather moorland in the West Fermanagh & Erne Lakeland ESA.

	ESA status	n	1993		1999		P
			Mean	se	Mean	se	
Mean number of plant species per 4m <sup>2</sup> quadrat	Participant	18	27	1.5	31	2.9	NS
	Non-participant	1	31	-	33	-	-
Mean number of higher plant species per 4m <sup>2</sup> quadrat	Participant	18	7	0.8	7	0.8	NS
	Non-participant	1	12	-	7	-	-
NS = not significant    * = P<0.05    ** = P<0.01							

### **Plant species frequency and abundance**

Plant frequency species lists have been compiled for heather moorland (Appendix 1).

The frequency of bell heather (*Erica cinerea*) increased on ESA participant sites from 50% in 1993 to 67% in 1999. There was a notable decrease in the frequency of several grass species, in particular matt grass (*Nardus stricta*) had declined from 61% to 28% on participant farms. This may suggest an improvement in the quality of the heather moorland, perhaps due to reduced grazing.

There were very few species with significantly different cover values between 1993 and 1999. However, there was a significant decrease in the mean abundance per 1m<sup>2</sup> quadrat of cross-leaved heath (*Erica tetralix*) on participant sites from 1.6% cover to 0.6% ( $p < 0.05$ ). The mean abundance of the moss *Hypnum jutlandicum* had risen from 0.1% to 3.6% ( $p < 0.05$ ).

### **Plant species composition in the plant strategy CSR groups**

Heather moorland had a higher proportion of stress-tolerators than any other habitat, highlighting the importance of its unique plant species complement.

There was an increase in the proportion of competitors on participant sites from 4% in 1993 to 7% in 1999, perhaps due to lower disturbance, i.e. reduced grazing intensity. On the one remaining non-participant heather moorland site the proportion of competitors rose from 0% to 5% whereas the ruderal species fell from 4% to 0%, also indicating a possible decrease in disturbance.

### **Soil nutrient status**

The only significant change in soil nutrient status between 1993 and 1999 on heather moorland was an increase in soil phosphorus level on participant farms (Appendix 4).

### **3.5.2. Carabid beetle species diversity between ESA participants and non-participants from 1993 to 1999.**

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 by 12% on participant farms and increased by 6% on non-participant farms.

Similarity in Carabid beetle species captured between 1993 and 1999 was 81% for participants and 48% for non-participants. There were no significant changes in the mean number of carabid beetle species per site between 1993 and 1999 on heather moorland.

### **3.5.3. Spider species diversity between ESA participants and non-participants from 1993 to 1999.**

The number of spider individuals showed no significant change. The number of total spider species decreased by 5% on participant farms and by 16% on non-participant farms. Similarity in spider species captured between 1993 and 1999 was 65% for participants and 51% for non-participants. There were no significant changes in spider species richness or diversity from 1993 to 1999 on heather moorland.

Of 14 spiders not captured on this habitat in 1993, two were county records, *Ero furcata* and *Metopobactrus prominulus*, both from participant farms.

*Ero furcata* (Villers, 1789) is a widespread and fairly common ‘pirate spider’ (3mm). It is found on grass, low plants and bushes from August to October. It is widespread and fairly common throughout the British Isles and has been previously recorded in N. Ireland from Cos. Antrim, Down and Londonderry. The present record is from heather moorland in County Fermanagh (Grid ref: H30854555) captured on 10<sup>th</sup> May, 1999.

*Metopobactrus prominulus* (O. P. –Cambridge, 1872) is a small ‘money spider’ (2mm) found in moss and undergrowth. It is locally frequent on chalk grasslands. The only recent Irish records are from Cos. Galway, Kildare and Mayo as well as Antrim, Armagh and Londonderry in the North. The present record is from heather moorland in County Fermanagh (Grid ref: H06804115) captured on 15<sup>th</sup> July, 1999.

### 3.6. Woodland

#### 3.6.1. Plant species diversity between 1993 and 1999 for ESA participants and non-participants

##### Plant species richness

There were no significant differences in the mean number of species or higher plants recorded per 14m<sup>2</sup> quadrat between 1993 and 1999, when all sites were compared regardless of participation in the ESA scheme.

There were no significant differences in the mean number of species or higher plants recorded on ESA participant or non-participant sites between 1993 and 1999 (Table 11).

The similarity of plant species sampled between 1993 and 1999 was 63% for participants and 64% for non-participants.

Table 11. Plant species diversity in 1993 and 1999 on woodland in the West Fermanagh & Erne Lakeland ESA.

	ESA status	n	1993		1999		P
			Mean	Se	Mean	se	
Mean number of plant species per 200m <sup>2</sup> quadrat	Participant	10	43	4.8	38	2.5	NS
	Non-participant	5	51	6.1	43	4.6	NS
Mean number of higher plant species per 200m <sup>2</sup> quadrat	Participant	10	37	4.1	31	1.9	NS
	Non-participant	5	46	5.0	35	3.9	NS
NS = not significant    * = P<0.05    ** = P<0.01							

##### Plant frequency and abundance

The frequency of plant species in the 14x14m quadrat for woods on participant and non-participant sites were compared between 1993 and 1999 (Appendix 1).

The most frequent species in all monitored woodlands in 1999 (>67% of sites) were ash (*Fraxinus excelsior*), hawthorn (*Crataegus monogyna*), bramble (*Rubus fruticosus*), ivy (*Hedera helix*), herb robert (*Geranium robertianum*), germander speedwell (*Veronica chamaedrys*), dandelion (*Taraxacum* agg.) and dog violet (*Viola riviniana*).



Two participant sites had signs of cattle grazing noted in 1999. Only one of the non-participant sites had any grazing noted and this was by horses. Eight of the re-monitored woods had signs of cattle noted in 1993 (one had goats grazing), with six of these being participants. In general there has been a decrease in grazing due to fencing of woodland, which may have led to the change in frequency and abundance of certain species.

Oak (*Quercus sp.*) and blackthorn (*Prunus spinosa*) increased in frequency on participant farms, perhaps indicating some regeneration of certain woody species. The presence of bracken (*Pteridium aquilinum*) had decreased from 40% to 10% of participant sites.

There were no significant changes in the mean abundance of any plant species per 4m<sup>2</sup> quadrat between 1993 and 1999 on participant or non-participant sites. The mean cover of bramble (*Rubus fruticosus*) has increased in participant woods from 1.5% to 6.8%, whereas in non-participant sites it has decreased from 5% to 2%, however these differences were not statistically significant but may be indicative of a future trend.

#### **Plant species composition in the plant strategy CSR groups**

There was a relatively high proportion of stress-tolerators in woodland ground flora, such as primrose (*Primula vulgaris*) and pignut (*Conopodium majus*).

On participant sites the proportion of stress-tolerators had fallen from 25% to 22%, whereas the proportion of ruderal species had increased from 9% to 13%.

There were no significant differences in soil nutrient status between years in woodland (Appendix 4).

#### **3.6.2. Carabid beetle species diversity between ESA participants and non-participants from 1993 to 1999.**

The number of Carabid beetle individuals captured in woodland on participant farms showed no significant change whilst the numbers of individuals on non-participant farms increased significantly. There were no significant changes in the mean number of carabid beetle species per site between 1993 and 1999 in woodland.

### **3.6.3. Spider species diversity between ESA participants and non-participants in 1993 and 1999.**

The number of spider individuals showed no significant change. The number of total spider species decreased by 28% on participant farms and by 47% on non-participant farms. Similarity in spider species captured between 1993 and 1999 was 51% for participants and 60% for non-participants. There were no significant changes in spider species richness or diversity from 1993 to 1999 in woodland. Of three new spiders captured on this habitat, *Erigonella ignobilis* was a new N. Ireland record.

*Erigonella ignobilis* (O. P. –Cambridge, 1871) is a small (1.5mm) ‘money spider’ of damp and marshy sites, often near woods. It is widespread but infrequent and adults are found in spring or early summer. The only modern Irish record was a find by Locket (1974) in Co. Galway (van Helsdingen 1996). This present record is from woodland in County Fermanagh (Grid ref: H26453288) captured on 11<sup>th</sup> May, 1999.

## 4.0. DISCUSSION

The initial aim of the re-monitoring programme was to determine if the habitat diversity changed over the six years regardless of participation in the ESA scheme. Significant changes were a decrease in the numbers of higher plants on limestone grassland and a decrease in the numbers of spider individuals and species. Significant spider decreases were on hay meadows and in woodland. Spider populations are susceptible to annual fluctuations and decreases in populations were on both participant and non-participant farms.

There were no significant differences between 1993 and 1999 in the mean number of plant species recorded in hay meadows on ESA participant or non-participant farms suggesting that the species diversity of hay meadows is being maintained. Some species indicative of high quality grassland increased in frequency on participant hay meadows between 1993 and 1999. Weed species such as ragwort (*Senecio jacobea*) and creeping thistle (*Cirsium arvense*) had become less frequent. These factors indicate an enhancement of the species diversity and habitat quality of some ESA participant sites. A significant increase in the mean abundance of soft rush (*Juncus effusus*) on hay meadows on both participant and non-participant farms may merit further investigation. An increase in the mean abundance of ryegrass (*Lolium perenne*) on participant farms was due to one hay meadow being re-seeded since 1993.

The number of Carabid beetle species increased significantly on participant farms and decreased on non-participant farms. *Carabus clatratus* identified as habitat quality indicator species increased on participant hay meadows and decreased on non-participant hay meadows between years. Numbers of spider species and individuals fell between years on both participant and non-participant hay meadows but there was no significant decrease in diversity indices for this habitat. Of seven new spiders captured on hay meadows, *Araneus quadratus* is a new record for Co. Fermanagh.

There were no significant differences in mean number of all plant species or higher plant species recorded between 1993 and 1999 on participant or non-participant wet grasslands indicating that the species-diversity of wet grassland has been maintained. A decrease in the percentage of competitor species and an increase in ruderal species on non-participant farms between 1993 and 1999 indicated a greater degree of disturbance on these sites. As on hay meadows there were significant increases in soft rush (*Juncus effusus*) on wet grasslands.

The diversity index for carabids indicated a significant decrease on participant farms although there was no significant decrease in mean number of carabid species per site. *Carabus clatratus* was present on more participant sites in 1999 than in 1993. There were no significant changes in spider species richness or diversity from 1993 to 1999 on wet grassland.

There was no change in the mean number of species on limestone grassland on participant farms, which suggests that species diversity is being maintained. The mean number of plant species decreased on non-participants sites. However, this was not significant as due to the high uptake of the scheme between baseline and re-survey only two sampled limestone grassland sites remain outside the ESA scheme. The total number of plant species recorded on limestone grassland increased on participant farms and decreased on non-participant farms. Limestone grasslands supported a high proportion of stress tolerant species indicative of habitat quality. There were no significant changes in the mean number of carabid beetle or spider species between 1993 and 1999 on limestone grassland, a further indication that species diversity is being maintained on this habitat. Two new spider county records were found; one from a participant farm (*Clubiona neglecta*) and one from a non-participant farm (*Peponocranium ludicrum*).

An increase in the mean number of plant species recorded between 1993 and 1999 on heather moorland on participant farms, although this was not statistically significant, indicated that species diversity on heather moorland is being maintained. The total number of plant species recorded on this habitat increased by 38% on participant farms by 7% on non-participant farms. The frequency of bell heather (*Erica cinerea*) increased on ESA participant sites between 1993 and 1999 and there was a notable decrease in the frequency of several grass species, in particular matt grass (*Nardus stricta*) on participant farms. This suggests an improvement in the quality of the heather moorland, probably due to reduced grazing intensity. On non-participant sites the proportion of competitor species increased whereas ruderal species decreased also indicating a possible decrease in disturbance.

There were no significant changes in the mean number of carabid beetle species per site or in carabid diversity indices between 1993 and 1999 on heather moorland. *Carabus nitens* identified as an indicator species on heather moorland in 1993 maintained its presence on participant farms but was not re-recorded on non-participant farms. There were no significant changes in spider species richness or diversity from 1993 to 1999 on heather moorland. Of

fourteen new species of spider captured since baseline monitoring on this habitat, two were county records, *Ero furcata* and *Metopobactrus prominulus*, both from participant farms.

The species diversity of unimproved grassland on participant and non-participant sites had not significantly changed between 1993 and 1999 indicating that species diversity had been maintained. Unimproved grassland had a relatively high proportion of stress-tolerators, similar to that found in hay meadows and wet grasslands indicating the importance of this habitat in terms of conservation.

The mean number of plant species recorded in woodland on ESA participant sites and non-participant sites did not change significantly between 1993 and 1999. There was a decrease in grazing due to fencing of woodland, which may have led to the change in frequency and abundance of certain species. Oak seedlings (*Quercus* sp.) and blackthorn (*Prunus spinosa*) increased in woodland on participant farms. An increase in oak seedlings is positive although blackthorn can shade out ground species leading to a decline in species diversity. The mean cover of bramble (*Rubus fruticosus*) has increased in participant woods whereas it decreased in non-participant sites. A decrease in grazing pressure due to woodland fencing may allow a shrub layer to develop which in turn exerts a shading effect on ground flora. Woodland represents a highly complex and diverse habitat therefore management and conservation objectives should be considered for each particular site based on past management and future conservation and management objectives. The conservation value of woodland can be determined by many factors such as degree of naturalness, rarity within a region, or species compliment. It is however generally accepted that woods with greater numbers of species tend to be of greatest conservation value. A range of structural and age stands incorporating mature trees and dead wood as well as natural glades are acknowledged as beneficial in encouraging biodiversity (Peterken 1981).

There were no significant changes in the mean number of carabid beetle species per site between 1993 and 1999 in woodland. The number of spider individuals showed no significant change. Of three new spiders captured on this habitat, *Erigonella ignobilis* has not been recorded recently in N. Ireland.

The monitoring programme has indicated that after six years the species diversity is being maintained on habitats on ESA participant farms. There are indications of enhancement on

habitats such as hay meadows where there has been an increase in the high quality stress-tolerator species on participant farms. There are also positive indicators on heather moorland with an increase in species number on ESA participant farms and a decrease in undesirable species such as mat grass (*Nardus stricta*) probably due to reduced grazing pressure. Possible areas of concern are an increase in blackthorn (*Prunus spinosa*) and bramble (*Rubus fruticosus*) in woodland and an increase in soft rush (*Juncus effusus*) on hay meadows and wet grasslands. These may have implications for management and will be further investigated in future monitoring exercises.

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### Abstracts

Cameron, A., Campbell, J. & McAdam, J.H. (1999) Monitoring of Environmentally Sensitive Areas in Northern Ireland- A Review. *Irish Botanists Meeting* 1999. Queens University of Belfast 29<sup>th</sup> –31st March 1999.

Cameron, A., Flexen, M., Johnston, R. J., Mc Adam, J. H. (1999). Bugs and Biodiversity. Bugs for the new millenium conference. Ulster Museum 27<sup>th</sup> - 28<sup>th</sup> November 1999.

Cameron, A., Flexen, M., Johnston, R. J., Mc Adam, J. H. (2000). Biological monitoring of Cuilcagh Mountain. *Irish Botanists Meeting* 2000. University College Cork. 18<sup>th</sup> – 20<sup>th</sup> April 2000.

Cameron, A., Flexen, M., Johnston, R. J., Mc Adam, J. H. (in press). Monitoring Agri-environment Schemes in Northern Ireland. Joint workshop on Agri-environment and the location of livestock systems in Europe. Soto Real, Madrid.

Campbell, J. Cameron, A. & McAdam, J.H. (1999). The effects of burning and flailing on heathland regeneration in Northern Ireland. *Irish Botanists Meeting* 1999. Queens University of Belfast 29<sup>th</sup> –31st March 1999

Campbell, J. Cameron, A. & McAdam, J.H. (1999) Heather moorland management within ESAs in Northern Ireland, conservation versus production. *Agricultural Research Forum* (25<sup>th</sup> annual research meeting of Irish Grassland and Animal Production Association). University College Dublin, 25<sup>th</sup> -26<sup>th</sup> March 1999.

Campbell, J. Cameron, A. & McAdam, J.H. (1999) A comparison of the effects of burning and flailing on the regeneration of heathland in Northern Ireland. *Uplands: Problems, pressures and solutions*. University of Durham, 19<sup>th</sup> – 21<sup>st</sup> April 1999.

### Papers

Johnston, R.J. & Cameron, A. (in press) County Records of Spiders in Northern Ireland. *Irish Naturalists' Journal*

### Books

Anderson, R., McFerran, D.M. & Cameron, A. (2000). *The Ground Beetles of Northern Ireland (Coleoptera-Carabidae)*. Atlases of the Northern Ireland flora and fauna, Vol. 1. Ulster Museum. National Museums and Galleries of Northern Ireland.

### Reports

Cameron, A., Flexen, M., Johnston, R. J., Mc Adam, J. H. (2000). *Biological Monitoring of Cuilcagh Mountain – Baseline Report* 1999.

## **7.0. APPENDICES**

- 1. Percentage frequency of plant species recorded on ESA participant and non-participant farms on each habitat in the West Fermanagh & Erne Lakeland ESA in 1993 and 1999.**
- 2. Percentage frequency of Carabid beetle species captured on ESA participant and non-participant farms on each habitat in the West Fermanagh & Erne Lakeland ESA in 1993 and 1999.**
- 3. Percentage frequency of spider species captured on ESA participant and non-participant farms on each habitat in the West Fermanagh & Erne Lakeland ESA in 1993 and 1999.**
- 4. Mean soil data from each habitat in the West Fermanagh & Erne Lakeland ESA, with statistical significance between 1993 and 1999 (paired t – test).**

**Appendix 1. Percentage frequency of plant species recorded on ESA participant and non-participant farms on each habitat in the West Fermanagh & Erne Lakeland ESA in 1993 and 1999.**

HAY MEADOW	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=24	1999 n=24	1993 n=21	1999 n=21
<i>Acer pseudoplatanus</i>		4		
<i>Achillea millefolium</i>		4		
<i>Achillea ptarmica</i>	4	4	5	5
<i>Agrostis canina</i>	29	46	24	52
<i>Agrostis capillaris</i>	17	46	29	81
<i>Agrostis gigantea</i>				5
<i>Agrostis stolonifera</i>	67	42	67	52
<i>Ajuga reptans</i>	58	38	57	33
<i>Alopecurus geniculatus</i>	50	33	57	10
<i>Alopecurus pratensis</i>	63	58	76	76
<i>Amblystegium serpens</i>				5
<i>Anagallis arvensis</i>			5	
<i>Angelica sylvestris</i>	8	13	14	10
<i>Anthoxanthum odoratum</i>	100	88	100	100
<i>Anthriscus sylvestris</i>	4			
<i>Arrhenatherum elatius</i>		17	5	14
<i>Bellis perennis</i>	71	75	33	62
<i>Berula erecta</i>	4		14	
<i>Brachypodium sylvaticum</i>	29	25	5	10
<i>Brachythecium rivulare</i>				14
<i>Brachythecium rutabulum</i>		8	5	24
<i>Briza media</i>	4	13		10
<i>Bromus commutatus</i>		4		5
<i>Bromus hordeaceus</i>	8		14	
<i>Bromus mollis</i>		4		
<i>Bromus ramosus</i>	4			
<i>Caltha palustris</i>	29	13	19	19
<i>Cardamine flexuosa</i>		8		14
<i>Cardamine hirsuta</i>	8		24	5
<i>Cardamine pratensis</i>	75	96	76	90
<i>Carex binervis</i>	13	4	19	5
<i>Carex caryophylla</i>				14
<i>Carex demissa</i>		8		10
<i>Carex distans</i>	4	4		5
<i>Carex echinata</i>	21	8	24	29
<i>Carex flacca</i>	21	42	33	62
<i>Carex hirta</i>	17	25	5	29
<i>Carex laevigata</i>				5
<i>Carex lasiocarpa</i>	4		10	
<i>Carex nigra</i>	50	50	52	62
<i>Carex ovalis</i>	17	33	43	48
<i>Carex pallescens</i>	4		10	
<i>Carex panicea</i>	38	17	52	43
<i>Carex pendula</i>	4		5	
<i>Carex pulicaris</i>				19
<i>Carex remota</i>	4			
<i>Carex rostrata</i>	4	4	10	10

HAY MEADOW continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=24	n=24	n=21	n=21
<i>Carex vesicaria</i>	4		5	
<i>Carex viridula</i>				5
<i>Centaurea nigra</i>	29	25	52	29
<i>Cerastium fontanum</i>	88	71	76	76
<i>Chenopodium album</i>			5	
<i>Cirsium arvense</i>	25	4	19	5
<i>Cirsium dissectum</i>		17		14
<i>Cirsium oleraceum</i>	4		5	
<i>Cirsium palustre</i>			10	
<i>Cirsium vulgare</i>	4			5
<i>Cladonia portentosa</i>	8		5	
<i>Climacium dendroides</i>		4		5
<i>Conopodium majus</i>			5	5
<i>Cratoneuron commutatum</i>	8			
<i>Cynosurus cristatus</i>	71	71	86	86
<i>Dactylis glomerata</i>	17	21	14	24
<i>Dactylorhiza fuchsii</i>	17	17	19	14
<i>Dactylorhiza maculata</i>			5	
<i>Deschampsia cespitosa</i>			5	5
<i>Deschampsia flexuosa</i>			5	
<i>Digitalis purpurea</i>			5	
<i>Elymus repens</i>	4			
<i>Epilobium angustifolium</i>		4		
<i>Epilobium palustre</i>	17	8	5	
<i>Equisetum arvense</i>	25	8	29	24
<i>Equisetum fluviatile</i>		4		
<i>Equisetum palustre</i>			5	
<i>Eriophorum angustifolium</i>				5
<i>Erucastrum gallicum</i>	8		14	
<i>Eurhynchium praelongum</i>	4	8		5
<i>Festuca arundinacea</i>			10	10
<i>Festuca ovina</i>			5	
<i>Festuca pratensis</i>	79	21	76	29
<i>Festuca rubra</i>	75	42	71	38
<i>Filipendula ulmaria</i>	63	58	71	67
<i>Fraxinus excelsior</i>				5
<i>Galium aparine</i>	4	13		24
<i>Galium palustre</i>	13	4	19	10
<i>Galium saxatile</i>	13	4	19	
<i>Galium verum</i>	8	4	5	
<i>Geum rivale</i>			10	
<i>Geum urbanum</i>	4			
<i>Glyceria fluitans</i>	8	38	24	14
<i>Heracleum sphondylium</i>	4			
<i>Holcus lanatus</i>	100	100	95	95
<i>Holcus mollis</i>	4	25		14
<i>Hylocomium splendens</i>	13	4	10	19
<i>Hypericum humifusum</i>	4			
<i>Hypericum perforatum</i>			5	
<i>Hypnum cupressiforme</i>	8	21	19	14
<i>Hypnum jutlandicum</i>	8			5

HAY MEADOW continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=24	1999 n=24	1993 n=21	1999 n=21
<i>Hypochaeris radicata</i>		38	5	29
<i>Isolepis setacea</i>				5
<i>Juncus acutiflorus</i>	71	25	67	43
<i>Juncus articulatus</i>	17	46	57	48
<i>Juncus bufonius</i>	8	8	19	
<i>Juncus bulbosus</i>		8		10
<i>Juncus conglomeratus</i>		8		
<i>Juncus effusus</i>	75	71	62	71
<i>Juncus inflexus</i>				10
<i>Lamium purpureum</i>			5	
<i>Lathyrus palustris</i>			5	
<i>Lathyrus pratensis</i>	29	29	57	43
<i>Lathyrus sylvestris</i>			5	
<i>Leontodon autumnalis</i>	50	13	29	10
<i>Leontodon hispidus</i>	21			
<i>Leucanthemum vulgare</i>	13	8		
<i>Linum catharticum</i>	4		5	
<i>Listera cordata</i>		4		
<i>Listera ovata</i>	4			
<i>Lolium multiflorum</i>				5
<i>Lolium perenne</i>	67	54	52	57
<i>Lophocolea bidentata</i>		4		5
<i>Lophocolea heterophylla</i>				5
<i>Lotus corniculatus</i>	8	8	5	5
<i>Luzula campestris</i>	42	38	43	33
<i>Luzula multiflora</i>	38	8	29	19
<i>Luzula sylvatica</i>		4		
<i>Lychnis flos-cuculi</i>	54	71	48	52
<i>Lysimachia nemorum</i>		8		
<i>Lysimachia nummularia</i>			5	
<i>Medicago lupulina</i>	8	17		10
<i>Melica nutans</i>	4			
<i>Melica uniflora</i>	8			
<i>Mentha aquatica</i>	4		10	
<i>Mnium hornum</i>	8		10	
<i>Molinia caerulea</i>			5	10
<i>Montia fontana</i>	17	13	5	
<i>Mycena alcalina</i>	4			
<i>Myosotis arvensis</i>	46	58	10	43
<i>Myosotis scorpioides</i>		4		
<i>Nardus stricta</i>	13	4	5	
<i>Orchis mascula</i>	8	8	5	
<i>Pedicularis sylvatica</i>			5	14
<i>Pellia epiphylla</i>		4		5
<i>Peltigera canina</i>		4		5
<i>Phleum pratense</i>	25	29	48	24
<i>Pilosella officinarum</i>		4		
<i>Plagiomnium elatum</i>		4		
<i>Plagiomnium undulatum</i>		8		10
<i>Plantago lanceolata</i>	63	46	76	76
<i>Plantago media</i>	13	8	14	19

HAY MEADOW continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=24	1999 n=24	1993 n=21	1999 n=21
<i>Pleurozium schreberi</i>		17		29
<i>Poa annua</i>	21	38	19	38
<i>Poa pratensis</i>	13	58	19	81
<i>Poa subcaerulea</i>		4		
<i>Poa trivialis</i>	88	88	76	81
<i>Polygala vulgaris</i>	33		5	
<i>Polygonum amphibum</i>			10	
<i>Polygonum persicaria</i>				24
<i>Polytrichum commune</i>		8		
<i>Potentilla anserina</i>	8	4		5
<i>Potentilla erecta</i>	38	21	14	19
<i>Potentilla palustris</i>		4		10
<i>Potentilla reptans</i>				5
<i>Primula vulgaris</i>	8	4		
<i>Prunella vulgaris</i>	21	46	29	62
<i>Pseudoscleropodium purum</i>				10
<i>Ranunculus acris</i>	92	96	95	100
<i>Ranunculus bulbosus</i>	13		10	
<i>Ranunculus ficaria</i>			10	5
<i>Ranunculus flammula</i>	42	42	29	52
<i>Ranunculus repens</i>	38	92	38	90
<i>Rhinanthus minor</i>			24	14
<i>Rhytidiadelphus loreus</i>		46		38
<i>Rhytidiadelphus squarrosus</i>	21	8	14	14
<i>Rhytidiadelphus triquetrus</i>	50		52	
<i>Rubus fruticosus</i>		4		5
<i>Rumex acetosa</i>	75	96	95	81
<i>Rumex acetosella</i>	8	4	5	29
<i>Rumex crispus</i>	13	21	14	19
<i>Rumex obtusifolius</i>	13	42	10	5
<i>Rumex sanguineus</i>				5
<i>Sagina nodosa</i>	25		5	
<i>Sagina procumbens</i>		13		5
<i>Salix spp_</i>				5
<i>Saponaria officinalis</i>		13		10
<i>Schoenus nigricans</i>	4			
<i>Senecio aquaticus</i>	17	33	43	48
<i>Senecio jacobaea</i>	46	13	43	10
<i>Sonchus asper</i>			5	
<i>Sphagnum auriculatum</i>		4		
<i>Sphagnum cuspidatum</i>				5
<i>Stellaria graminea</i>	50	17	29	5
<i>Stellaria holostea</i>	4	4		10
<i>Stellaria media</i>		4	5	
<i>Stellaria palustris</i>		4		
<i>Succisa pratensis</i>	38	38	43	38
<i>Taraxacum officinale</i>	54	54	62	38
<i>Thuidium tamariscinum</i>	4	13	10	
<i>Tragopogon pratensis</i>	21		24	
<i>Trifolium dubium</i>	8	4	14	

<b>HAY MEADOW continued PLANT SPECIES</b>	<b>% FREQUENCY</b>			
	<b>PARTICIPANTS</b>		<b>NON-PARTICIPANTS</b>	
	<b>1993</b>	<b>1999</b>	<b>1993</b>	<b>1999</b>
	n=24	n=24	n=21	n=21
<i>Trifolium pratense</i>	54	71	76	81
<i>Trifolium repens</i>	96	96	95	86
<i>Urtica dioica</i>	13			
<i>Veronica beccabunga</i>			5	
<i>Veronica chamaedrys</i>		4	5	
<i>Veronica persica</i>	4			
<i>Veronica scutellata</i>	4	13		10
<i>Veronica serpyllifolia</i>	4	8		10
<i>Vicia cracca</i>	4	17	10	19
<i>Vicia sativa</i>	17	4	24	5
<i>Vicia sepium</i>	4			
<i>Viola odorata</i>				5
<b>TOTAL</b>	130	130	128	131

WET GRASSLAND  PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=30	1999 n=30	1993 n=17	1999 n=17
<i>Acer pseudoplatanus</i>			6	
<i>Achillea millefolium</i>		3		
<i>Achillea ptarmica</i>		3		
<i>Agrostis canina</i>	63	53	65	53
<i>Agrostis capillaris</i>	40	43	35	47
<i>Agrostis stolonifera</i>	93	80	76	82
<i>Ajuga reptans</i>	40	20	18	18
<i>Alisma plantago-aquatica</i>	3	7		
<i>Alnus glutinosa</i>		3	6	6
<i>Alopecurus geniculatus</i>	87	40	47	41
<i>Alopecurus pratensis</i>	50	37	47	29
<i>Anagallis arvensis</i>	10		6	
<i>Anagallis tenella</i>	3		12	
<i>Angelica sylvestris</i>		7	6	12
<i>Anthoxanthum odoratum</i>	70	70	65	47
<i>Anthriscus sylvestris</i>	13		6	
<i>Apium nodiflorum</i>	3	7		6
<i>Arrhenatherum elatius</i>			6	12
<i>Bartramia pomiformis</i>		3		
<i>Bellis perennis</i>	20	37	35	47
<i>Berula erecta</i>	3			12
<i>Brachypodium pinnatum</i>	3			
<i>Brachypodium sylvaticum</i>	3	3		
<i>Brachythecium rivulare</i>		3		6
<i>Brachythecium rutabulum</i>		20		29
<i>Briza media</i>	7		12	6
<i>Bromus commutatus</i>		3		
<i>Bromus mollis</i>		3		
<i>Bromus ramosus</i>	3			
<i>Calliargon cuspidatum</i>		17		12
<i>Callitriche stagnalis</i>	3	3		6
<i>Calluna vulgaris</i>			12	12
<i>Caltha palustris</i>	30	27	29	18
<i>Cardamine flexuosa</i>		17		18
<i>Cardamine hirsuta</i>	13	53	35	53
<i>Cardamine pratensis</i>	83	97	53	76
<i>Carex acutiformis</i>	3			
<i>Carex appropinquata</i>			6	
<i>Carex binervis</i>	7	7	12	12
<i>Carex caryophylla</i>		3		6
<i>Carex curta</i>			6	6
<i>Carex demissa</i>		3		6
<i>Carex diandra</i>	3		6	6
<i>Carex distans</i>	3	3	6	
<i>Carex disticha</i>		3		
<i>Carex echinata</i>	7	10	12	18
<i>Carex elata</i>	3			
<i>Carex elongata</i>		3		6
<i>Carex flacca</i>	53	17	47	18
<i>Carex hirta</i>	47	37	24	41



WET GRASSLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=30	n=30	n=17	n=17
<i>Carex laevigata</i>	7		12	
<i>Carex lasiocarpa</i>	23	3	12	
<i>Carex limosa</i>	3			
<i>Carex nigra</i>	63	73	71	71
<i>Carex otrubae</i>		3		
<i>Carex ovalis</i>	20	33	24	24
<i>Carex pallescens</i>	20		29	
<i>Carex panicea</i>	37	53	53	53
<i>Carex paniculata</i>		3		
<i>Carex pendula</i>	7	10		
<i>Carex pilulifera</i>		3		6
<i>Carex pseudocyperus</i>	3			
<i>Carex remota</i>	3			6
<i>Carex riparia</i>	3		6	6
<i>Carex rostrata</i>	13	47	12	18
<i>Carex sylvatica</i>			6	
<i>Carex vesicaria</i>	13	17		12
<i>Carex viridula</i>	3		6	
<i>Centaurea nigra</i>	3	3	18	18
<i>Cerastium fontanum</i>	57	33	71	41
<i>Cicuta virosa</i>				6
<i>Cirsium arvense</i>	30	10	29	6
<i>Cirsium dissectum</i>		10		12
<i>Cirsium oleraceum</i>	7		18	
<i>Cirsium palustre</i>	17	7		18
<i>Cirsium vulgare</i>	7	10	12	18
<i>Cladonia bellidiflora</i>				6
<i>Cladonia pyxidata</i>				6
<i>Cladonia pyxidata</i>				6
<i>Cladonia subulata</i>			6	
<i>Claytonia perfoliata</i>	3			
<i>Climacium dendroides</i>	3	7	12	18
<i>Conopodium majus</i>	3			
<i>Corylus avellana</i>	3			
<i>Cratoneuron commutatum</i>	10		6	
<i>Crepis capillaris</i>	3			
<i>Crocsmia x</i>			6	
<i>Cynosurus cristatus</i>	43	57	59	59
<i>Dactylis glomerata</i>	7	13	12	
<i>Dactylorhiza fuchsii</i>	3		6	
<i>Danthonia decumbens</i>			6	
<i>Daucus carota</i>	3	7	6	6
<i>Deschampsia cespitosa</i>	50	27	35	29
<i>Dicranella heteromalla</i>		3		
<i>Dicranum scoparium</i>		3		6
<i>Drepanocladus uncinatus</i>				6
<i>Drosera rotundifolia</i>				6
<i>Eleocharis palustre</i>				12
<i>Eleocharis uniglumis</i>		3		
<i>Elymus repens</i>	3		12	

WET GRASSLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=30	n=30	n=17	n=17
<i>Epilobium hirsutum</i>	3		6	
<i>Epilobium montanum</i>				6
<i>Epilobium palustre</i>	33	30	18	24
<i>Epilobium parviflorum</i>		3		6
<i>Equisetum arvense</i>	27	7	18	
<i>Equisetum fluviatile</i>		27		12
<i>Equisetum palustre</i>	17	20	6	12
<i>Eriophorum vaginatum</i>			6	
<i>Erucastrum gallicum</i>				6
<i>Eurhynchium praelongum</i>	7	7	18	
<i>Eurhynchium striatum</i>	3			6
<i>Festuca altissima</i>				6
<i>Festuca arundinacea</i>	10		6	12
<i>Festuca ovina</i>		10	12	6
<i>Festuca pratensis</i>	57	23	76	35
<i>Festuca rubra</i>	50	40	71	53
<i>Festuca vivipara</i>			6	
<i>Filipendula ulmaria</i>	70	53	53	47
<i>Fraxinus excelsior</i>			6	
<i>Galium aparine</i>	7	7		6
<i>Galium boreale</i>	10			
<i>Galium palustre</i>	70	63	53	71
<i>Galium saxatile</i>		10		18
<i>Galium uliginosum</i>	33	7	41	
<i>Galium verum</i>	3	3		
<i>Gentiana verna</i>				6
<i>Geranium robertianum</i>				6
<i>Geum rivale</i>	7			
<i>Glyceria fluitans</i>	63	50	35	53
<i>Glyceria maxima</i>	3	3		6
<i>Hedera helix</i>		3		
<i>Holcus lanatus</i>	80	77	82	82
<i>Holcus mollis</i>	7	10	12	6
<i>Hydrocotyle vulgaris</i>	30	47	18	29
<i>Hylocomium splendens</i>		7		24
<i>Hypericum elodes</i>			6	6
<i>Hypericum pulchrum</i>				6
<i>Hypnum cupressiforme</i>	7		18	12
<i>Hypnum jutlandicum</i>	3	3		
<i>Hypochaeris radicata</i>	7		6	
<i>Iris pseudacorus</i>	23	7	12	12
<i>Isolepis setacea</i>		7		18
<i>Juncus acutiflorus</i>	40	33	53	24
<i>Juncus articulatus</i>	47	50	53	71
<i>Juncus bufonius</i>	7	17	24	18
<i>Juncus bulbosus</i>	23	3	24	18
<i>Juncus conglomeratus</i>		23		12
<i>Juncus effusus</i>	87	97	94	76
<i>Juncus inflexus</i>	20	30	29	35
<i>Juncus squarrosus</i>			6	6

WET GRASSLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=30	n=30	n=17	n=17
<i>Knautia arvensis</i>			12	
<i>Lapsana communis</i>		3		
<i>Lathyrus montanus</i>				6
<i>Lathyrus palustris</i>			6	
<i>Lathyrus pratensis</i>	13	13	12	12
<i>Lemna minor</i>		3		
<i>Leontodon autumnalis</i>	37	27	29	12
<i>Leontodon hispidus</i>	7		6	
<i>Leucanthemum vulgare</i>	10			
<i>Lolium multiflorum</i>			6	
<i>Lolium perenne</i>	53	47	47	47
<i>Lophocolea bidentata</i>				6
<i>Lophozia ventricosa</i>	7		12	
<i>Lotus corniculatus</i>	37	7	35	12
<i>Lotus uliginosus</i>		17		12
<i>Luzula campestris</i>	7	7	12	12
<i>Luzula multiflora</i>	20		6	6
<i>Luzula sylvatica</i>			12	
<i>Lychnis flos-cuculi</i>	30	37	18	35
<i>Lysimachia nemorum</i>	20	50	29	59
<i>Lysimachia nummularia</i>	40		35	
<i>Lythrum salicaria</i>		3		6
<i>Medicago lupulina</i>		3		6
<i>Melica nutans</i>	3			
<i>Mentha aquatica</i>	43	43	41	35
<i>Mentha arvensis</i>		10		
<i>Menyanthes trifoliata</i>	17	3		
<i>Mnium hornum</i>	3		6	
<i>Molinia caerulea</i>	3	3	24	12
<i>Montia fontana</i>		7		
<i>Mycena alcalina</i>				6
<i>Myosotis arvensis</i>	10		6	6
<i>Myosotis discolor</i>		3		6
<i>Myosotis laxa</i>		30		18
<i>Myosotis scorpioides</i>	53	40	59	18
<i>Myrica gale</i>	3			
<i>Nardus stricta</i>	7		12	18
<i>Nasturtium officinale</i>				6
<i>Neckera complanata</i>			6	
<i>Oenanthe crocata</i>	20		29	
<i>Oenanthe fistulosa</i>		23		12
<i>Pedicularis sylvatica</i>			12	12
<i>Pellia epiphylla</i>				6
<i>Peltigera canina</i>				12
<i>Persicaria bistorta</i>	7	3	6	6
<i>Phalaris arundinacea</i>	17	10	6	18
<i>Phleum pratense</i>	33	37	12	47
<i>Phragmites australis</i>	10	3		
<i>Pinguicula vulgaris</i>			6	6
<i>Plagiochila asplenoides</i>				6

WET GRASSLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=30	n=30	n=17	n=17
<i>Plagiochila porelloides</i>		3		
<i>Plagiothecium denticulatum</i>	3			6
<i>Plantago lanceolata</i>	13	17	35	47
<i>Plantago major</i>	7	3	12	
<i>Plantago media</i>	3	10	6	
<i>Pleurozium schreberi</i>	7	7	6	
<i>Poa annua</i>	17	17	12	6
<i>Poa pratensis</i>	53	30	47	35
<i>Poa trivialis</i>	93	50	88	53
<i>Polygonum amphibum</i>	30	17	29	6
<i>Polygonum hydropiper</i>		7		6
<i>Polygonum persicaria</i>	7	3		12
<i>Polytrichum commune</i>		3		
<i>Potamogeton sp.</i>	3		12	
<i>Potentilla anserina</i>	57	37	41	29
<i>Potentilla erecta</i>	7	13	18	18
<i>Potentilla palustris</i>	37	50	6	12
<i>Potentilla sterilis</i>		7		
<i>Prunella vulgaris</i>	3	17	18	59
<i>Prunus spinosa</i>			12	12
<i>Pseudoscleropodium purum</i>	10	10		12
<i>Pyrola minor</i>	3			
<i>Ranunculus acris</i>	87	83	94	76
<i>Ranunculus bulbosus</i>	27	3	29	6
<i>Ranunculus ficaria</i>	13	3	6	6
<i>Ranunculus flammula</i>	67	70	53	53
<i>Ranunculus repens</i>	70	97	53	94
<i>Rhododendron ponticum</i>				6
<i>Rhytidiadelphus loreus</i>				6
<i>Rhytidiadelphus squarrosus</i>	57	27	53	29
<i>Rhytidiadelphus triquetrus</i>	7		29	18
<i>Rorippa palustris</i>		3		
<i>Rorippa sylvestris</i>		10		6
<i>Rosa canina</i>	7			
<i>Rubus fruticosus</i>	3		6	12
<i>Rumex acetosa</i>	57	57	53	71
<i>Rumex acetosella</i>	7	3		6
<i>Rumex conglomeratus</i>		27		6
<i>Rumex crispus</i>	43	20	53	24
<i>Rumex hydrolapathum</i>	3	7	18	
<i>Rumex obtusifolius</i>	13	37	12	29
<i>Rumex sanguineus</i>				12
<i>Sagina nodosa</i>	7		12	
<i>Sagina procumbens</i>	23	37		35
<i>Salix aurita</i>	3		18	
<i>Schoenus nigricans</i>			6	
<i>Scirpus cespitosus</i>	10		24	6
<i>Senecio aquaticus</i>	73	70	53	65
<i>Senecio jacobaea</i>	27	20	35	18
<i>Sesleria albicans</i>			12	

WET GRASSLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=30	n=30	n=17	n=17
<i>Sium latifolium</i>		10		12
<i>Sonchus arvensis</i>	3	3		
<i>Sonchus asper</i>				6
<i>Sonchus oleraceus</i>		3		
<i>Sphagnum auriculatum</i>				6
<i>Sphagnum palustre</i>			6	6
<i>Sphagnum squarrosum</i>		3		
<i>Stachys palustris</i>				6
<i>Stellaria graminea</i>	27	17	24	24
<i>Stellaria holostea</i>	7	7	6	6
<i>Stellaria media</i>	13	13	29	12
<i>Stellaria palustris</i>		3		
<i>Stellaria uliginosa</i>		3		12
<i>Succisa pratensis</i>	23	3	35	24
<i>Symphytum tuberosum</i>	3		6	
<i>Taraxacum officinale</i>	37	43	53	29
<i>Thelypteris palustris</i>		3		
<i>Thuidium tamariscinum</i>	7	7	6	29
<i>Tragopogon pratensis</i>	17		18	
<i>Trifolium dubium</i>	3		6	
<i>Trifolium pratense</i>	13	23	18	18
<i>Trifolium repens</i>	97	97	76	88
<i>Triglochin palustris</i>		3		
<i>Typha latifolia</i>		3		
<i>Urtica dioica</i>	7	7	12	12
<i>Vaccinium myrtillus</i>	3			
<i>Valeriana officinalis</i>	10		18	
<i>Veronica anagallis-aquatica</i>		10		6
<i>Veronica beccabunga</i>		17		18
<i>Veronica catenata</i>		3		
<i>Veronica chamaedrys</i>	7			
<i>Veronica persica</i>	10			
<i>Veronica scutellata</i>		20		6
<i>Veronica serpyllifolia</i>			6	
<i>Vicia cracca</i>		3	6	6
<i>Vicia hirsuta</i>	3			
<i>Vicia sativa</i>	3			6
<i>Vicia sepium</i>	7			
<i>Viola hirta</i>	3			
<i>Viola lactea</i>		3		
<i>Viola palustris</i>		7		6
<i>Viola riviniana</i>	3			
<b>TOTAL</b>	<b>178</b>	<b>176</b>	<b>161</b>	<b>182</b>

LIMESTONE GRASSLAND		% FREQUENCY		
PLANT SPECIES	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=13	1999 n=13	1993 n=2	1999 n=2
<i>Achillea millefolium</i>	62	54	100	50
<i>Agrostis canina</i>	15	23	100	100
<i>Agrostis capillaris</i>	54	69	50	100
<i>Agrostis stolonifera</i>	62	54	100	100
<i>Ajuga reptans</i>	77	23	100	
<i>Alchemilla glabra</i>	54	46		
<i>Alopecurus geniculatus</i>	8	8		
<i>Alopecurus pratensis</i>	54	38	50	
<i>Antennaria dioica</i>		8		
<i>Anthoxanthum odoratum</i>	100	85	100	100
<i>Arrhenatherum elatius</i>	46	15		
<i>Bartramia pomiformis</i>		8		
<i>Bellis perennis</i>	85	62		
<i>Blechnum spicant</i>	8		50	
<i>Brachypodium sylvaticum</i>		15		
<i>Brachythecium rivulare</i>		15		
<i>Brachythecium rutabulum</i>		23		
<i>Breutelia chrysocoma</i>	8	15		
<i>Briza media</i>	54	46		
<i>Bromus hordeaceus</i>	8			
<i>Bryum argenteum</i>		8		
<i>Bryum capillare</i>		15		
<i>Calliargus cuspidatum</i>		15	100	
<i>Calluna vulgaris</i>		8	50	50
<i>Campanula rotundifolia</i>		8		
<i>Cardamine hirsuta</i>	8	15		
<i>Cardamine pratensis</i>	38	38	100	50
<i>Carex binervis</i>				100
<i>Carex caryophylla</i>	8	8		50
<i>Carex distans</i>	15		100	
<i>Carex echinata</i>		8	100	100
<i>Carex flacca</i>	38	85	50	100
<i>Carex flava</i>	8			
<i>Carex hirta</i>	15	8		
<i>Carex hostiana</i>			50	
<i>Carex nigra</i>	46	38	100	100
<i>Carex ovalis</i>			100	100
<i>Carex pallescens</i>	31			
<i>Carex panicea</i>	69	46	100	
<i>Carex pendula</i>	15	15	50	
<i>Carex pilulifera</i>				50
<i>Carex pulicaris</i>		8		
<i>Carex rostrata</i>	8			
<i>Carex spicata</i>		8		
<i>Centaurea nigra</i>	23	8		
<i>Cerastium fontanum</i>	77	77	100	50
<i>Cirsium arvense</i>	54	38	100	100
<i>Cirsium dissectum</i>		8		
<i>Cirsium palustre</i>		23		
<i>Cirsium vulgare</i>	31	38		

LIMESTONE GRASSLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=13	n=13	n=2	n=2
<i>Cladonia portentosa</i>	23	31	50	
<i>Cladonia pyxidata</i>		31		
<i>Cladonia squamosa</i>		15		
<i>Climacium dendroides</i>			50	
<i>Conopodium majus</i>	23	8		
<i>Crataegus monogyna</i>	8			
<i>Cratoneuron commutatum</i>	38	23	50	
<i>Crepis capillaris</i>		15		
<i>Cynosurus cristatus</i>	85	85	100	100
<i>Dactylis glomerata</i>	54	46	100	
<i>Dactylorhiza fuchsii</i>	15	8		
<i>Danthonia decumbens</i>	85	31	100	
<i>Deschampsia cespitosa</i>	23	31		
<i>Deschampsia flexuosa</i>	8			
<i>Dicranum scoparium</i>	8		50	100
<i>Empetrum nigrum</i>	8		100	
<i>Equisetum arvense</i>	8			
<i>Erica cinerea</i>			50	
<i>Euphrasia nemorosa</i>		31		
<i>Euphrasia officinalis</i>	46	15		
<i>Eurhynchium praelongum</i>	54	31	100	
<i>Eurhynchium striatum</i>		8		
<i>Festuca arundinacea</i>			50	
<i>Festuca ovina</i>	69	46	50	100
<i>Festuca pratensis</i>	38	23	100	
<i>Festuca rubra</i>	92	77	100	100
<i>Filipendula ulmaria</i>	8	8		
<i>Fissidens adianthoides</i>		8		
<i>Fragaria vesca</i>		15		
<i>Galium boreale</i>	15			
<i>Galium saxatile</i>	46	8	100	100
<i>Galium sternerii</i>		15		
<i>Galium verum</i>	23			
<i>Geranium robertianum</i>		8		
<i>Glyceria fluitans</i>				50
<i>Gnaphalium uliginosum</i>				50
<i>Helictotrichon pubescens</i>	23			
<i>Holcus lanatus</i>	100	92	100	100
<i>Holcus mollis</i>	23	15		50
<i>Homalothecium lutescens</i>		8		
<i>Homalothecium sericeum</i>		8		
<i>Hyacinthoides non-scripta</i>		8		
<i>Hydrocotyle vulgaris</i>			50	
<i>Hylocomium splendens</i>		31		100
<i>Hypericum perforatum</i>	8	8		
<i>Hypericum pulchrum</i>		15		
<i>Hypnum cupressiforme</i>	23		100	50
<i>Hypnum jutlandicum</i>		8		
<i>Hypochaeris radicata</i>		69		50
<i>Iris pseudacorus</i>			50	

LIMESTONE GRASSLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=13	n=13	n=2	n=2
<i>Isothecium myosuroides</i>	8	8		
<i>Juncus acutiflorus</i>			100	
<i>Juncus articulatus</i>		8		
<i>Juncus bufonius</i>	8		50	
<i>Juncus bulbosus</i>		8	50	100
<i>Juncus effusus</i>	54	54	100	50
<i>Juncus squarrosus</i>	8	8	100	50
<i>Koeleria macrantha</i>		15		
<i>Lathyrus palustris</i>	23			
<i>Lathyrus pratensis</i>	23	15		
<i>Lathyrus sylvestris</i>	23			
<i>Leontodon autumnalis</i>	77	31		
<i>Leontodon hispidus</i>	46	8		
<i>Leucanthemum vulgare</i>	31	8		
<i>Leucobryum glaucum</i>				50
<i>Linum catharticum</i>		31		
<i>Listera ovata</i>	8			
<i>Lolium perenne</i>	62	54		
<i>Lophozia ventricosa</i>	15			
<i>Lotus corniculatus</i>	62	69		
<i>Lotus uliginosus</i>		8		
<i>Luzula campestris</i>	85	54	100	100
<i>Luzula multiflora</i>	31		100	100
<i>Lychnis flos-cuculi</i>	46			
<i>Mnium hornum</i>	15			
<i>Molinia caerulea</i>	31	8	100	50
<i>Montia fontana</i>			100	
<i>Myosotis arvensis</i>	15			
<i>Nardus stricta</i>	15	31	100	50
<i>Neckera complanata</i>	15			
<i>Neckera crispa</i>		38		
<i>Oenanthe crocata</i>			100	
<i>Orchis mascula</i>	15			
<i>Pedicularis sylvatica</i>	15	23	50	100
<i>Peltigera canina</i>		23		50
<i>Phleum pratense</i>		8		
<i>Pilosella officinarum</i>	23	46		
<i>Plagiochila asplenoides</i>		23		
<i>Plagiomnium undulatum</i>	15	31		50
<i>Plagiothecium denticulatum</i>	15			
<i>Plagiothecium nemorale</i>		8		
<i>Plantago lanceolata</i>	92	85		
<i>Plantago major</i>		8		
<i>Plantago media</i>	46	31	100	50
<i>Pleurozium schreberi</i>		15		
<i>Poa annua</i>	46	15	50	100
<i>Poa pratensis</i>		69	50	
<i>Poa subcaerulea</i>		15		
<i>Poa trivialis</i>	77	62	100	100
<i>Polygala serpyllifolia</i>	15			



LIMESTONE GRASSLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=13	n=13	n=2	n=2
<i>Polygala vulgaris</i>	23	23	50	
<i>Polytrichum commune</i>	15	15	100	50
<i>Polytrichum formosum</i>				50
<i>Potentilla anserina</i>			100	
<i>Potentilla erecta</i>	85	69	100	100
<i>Potentilla sterilis</i>		8		
<i>Primula vulgaris</i>	15	8		
<i>Prunella vulgaris</i>	23	69		100
<i>Prunus spinosa</i>	8	8		
<i>Pseudoscleropodium purum</i>	23	23		
<i>Pteridium aquilinum</i>	15	15		
<i>Ranunculus acris</i>	85	77		
<i>Ranunculus bulbosus</i>	23			
<i>Ranunculus ficaria</i>		15		
<i>Ranunculus flammula</i>				50
<i>Ranunculus repens</i>	23	62	100	100
<i>Rhytidiadelphus loreus</i>		15		100
<i>Rhytidiadelphus squarrosus</i>	23	46	100	
<i>Rhytidiadelphus triquetrus</i>	77	38	100	
<i>Rubus fruticosus</i>			50	
<i>Rumex acetosa</i>	69	85	100	100
<i>Rumex acetosella</i>	8	8		100
<i>Rumex crispus</i>	8	8	100	
<i>Rumex obtusifolius</i>	8	15		
<i>Sagina nodosa</i>			100	
<i>Sagina procumbens</i>		8		100
<i>Salix spp_</i>				50
<i>Saponaria officinalis</i>		8		50
<i>Senecio aquaticus</i>	8			
<i>Senecio jacobaea</i>	77	77		
<i>Sesleria albicans</i>	92	23	100	50
<i>Sphagnum auriculatum</i>				50
<i>Sphagnum palustre</i>			50	
<i>Stellaria graminea</i>	62	8	100	
<i>Stellaria holostea</i>	8			
<i>Stellaria media</i>		8		50
<i>Stellaria uliginosa</i>		8		
<i>Succisa pratensis</i>	77	62	50	50
<i>Taraxacum officinale</i>	31	23	100	
<i>Thuidium tamariscinum</i>	8	54	100	
<i>Thymus praecox</i>	62	46	100	
<i>Tortella tortuosa</i>		15		
<i>Trifolium pratense</i>	54	62	100	100
<i>Trifolium repens</i>	92	100	100	100
<i>Ulex europaeus</i>			50	50
<i>Vaccinium myrtillus</i>	8	23		50
<i>Veronica chamaedrys</i>		23		
<i>Veronica officinalis</i>				50
<i>Veronica persica</i>	77	8		
<i>Veronica scutellata</i>		8		50

LIMESTONE GRASSLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=13	1999 n=13	1993 n=2	1999 n=2
<i>Veronica serpyllifolia</i>	8	38	100	50
<i>Viola riviniana</i>	46	46		
TOTAL	122	146	78	65

HEATHER MOORLAND		% FREQUENCY		
PLANT SPECIES	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=18	1999 n=18	1993 n=1	1999 n=1
<i>Agrostis canina</i>		56	100	100
<i>Agrostis capillaris</i>	61	44		100
<i>Agrostis stolonifera</i>	28	6		
<i>Alchemilla glabra</i>		6		
<i>Antennaria dioica</i>		6		
<i>Anthoxanthum odoratum</i>	72	50	100	100
<i>Athyrium filix-femina</i>		11		
<i>Aulacomnium palustre</i>	6	33		
<i>Bellis perennis</i>		6		
<i>Blechnum spicant</i>	6	6		
<i>Brachythecium rutabulum</i>		11		
<i>Breutelia chrysocoma</i>	6	11		
<i>Callitriche stagnalis</i>	11			
<i>Calluna vulgaris</i>	100	100	100	100
<i>Campylopus introflexus</i>		6		
<i>Carex binervis</i>	17	44		100
<i>Carex demissa</i>		11		
<i>Carex distans</i>	11			
<i>Carex echinata</i>	44	67		
<i>Carex elata</i>	6			
<i>Carex elongata</i>	22			
<i>Carex flacca</i>	61	28	100	100
<i>Carex hirta</i>		6		
<i>Carex lasiocarpa</i>	6			
<i>Carex nigra</i>	50	33	100	100
<i>Carex ovalis</i>	11	11		
<i>Carex pallescens</i>	11		100	
<i>Carex panicea</i>	17	67		100
<i>Carex pilulifera</i>		6		100
<i>Carex rostrata</i>	6	6		
<i>Carex vesicaria</i>	22			
<i>Centaurea nigra</i>		6		
<i>Cerastium fontanum</i>	6	11	100	
<i>Cirsium dissectum</i>		6		
<i>Cirsium vulgare</i>		6		
<i>Cladonia fimbriata</i>		6		
<i>Cladonia floerkeana</i>	17	11		
<i>Cladonia gracilis</i>		6		
<i>Cladonia polydactyla</i>		6		
<i>Cladonia portentosa</i>	61	56	100	100
<i>Cladonia pyxidata</i>		17		
<i>Cladonia pyxidata</i>	17			
<i>Cladonia squamosa</i>		6		
<i>Cladonia uncialis</i>	6	6		
<i>Cratoneuron commutatum</i>	17			
<i>Ctenidium cristatus</i>		6		100
<i>Ctenidium molluscum</i>		11		
<i>Cynosurus cristatus</i>		6		
<i>Dactylis glomerata</i>		6		
<i>Dactylorhiza fuchsii</i>	6			

HEATHER MOORLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=18	n=18	n=1	n=1
<i>Danthonia decumbens</i>	11	6		
<i>Deschampsia cespitosa</i>		6		
<i>Deschampsia flexuosa</i>	61	56	100	100
<i>Dicranella heteromalla</i>		6		100
<i>Dicranum scoparium</i>	67	56	100	100
<i>Empetrum nigrum</i>	28			
<i>Erica cinerea</i>	50	67	100	100
<i>Erica tetralix</i>	72	78	100	100
<i>Eriophorum angustifolium</i>	78	67		100
<i>Eriophorum vaginatum</i>	78	67	100	100
<i>Euphrasia micrantha</i>		6		
<i>Euphrasia officinalis</i>	11	6	100	
<i>Eurhynchium praelongum</i>	22	22	100	
<i>Festuca ovina</i>	28	22	100	
<i>Festuca rubra</i>	44	33		
<i>Fissidens adianthoides</i>	17	6		
<i>Galium boreale</i>	6			
<i>Galium saxatile</i>	17	22		
<i>Holcus lanatus</i>	17	22	100	100
<i>Hylocomium splendens</i>	50	28		100
<i>Hypnum cupressiforme</i>	11	22		
<i>Hypnum jutlandicum</i>	28	50		
<i>Hypochaeris radicata</i>	6	11		
<i>Hypogymnia physodes</i>	6			
<i>Juncus acutiflorus</i>	11	11		
<i>Juncus articulatus</i>	6	6		
<i>Juncus bufonius</i>	33	17		
<i>Juncus bulbosus</i>		11		
<i>Juncus effusus</i>	39	44		100
<i>Juncus inflexus</i>		6		
<i>Juncus squarrosus</i>	78	67	100	100
<i>Leontodon hispidus</i>	11	6		
<i>Lophocolea bidentata</i>		11		100
<i>Lophocolea cuspidata</i>		6		
<i>Lophozia ventricosa</i>	17			
<i>Lotus corniculatus</i>		6		
<i>Luzula campestris</i>	33	22	100	
<i>Luzula multiflora</i>		22		100
<i>Luzula sylvatica</i>		6		
<i>Lycopodium clavatum</i>	11	6		
<i>Mnium hornum</i>		17		
<i>Molinia caerulea</i>	94	94	100	100
<i>Myrica gale</i>	11	11		
<i>Nardia scalaris</i>		11		
<i>Nardus stricta</i>	61	28	100	
<i>Narthecium ossifragum</i>	17	11	100	100
<i>Neckera complanata</i>	28			
<i>Neckera crispa</i>		11		
<i>Odontoschisma sphagni</i>		11		
<i>Oxalis acetosella</i>		11		

HEATHER MOORLAND		% FREQUENCY		
continued		PARTICIPANTS	NON-PARTICIPANTS	
PLANT SPECIES	1993	1999	1993	1999
	n=18	n=18	n=1	n=1
<i>Pedicularis sylvatica</i>	11	11	100	
<i>Plagiochila asplenoides</i>	6			
<i>Plagiomnium rostratum</i>	6			
<i>Plagiothecium nemorale</i>		6		
<i>Plantago lanceolata</i>		6		
<i>Plantago media</i>		6		
<i>Pleurozium schreberi</i>	33	6		100
<i>Poa annua</i>		6		
<i>Poa pratensis</i>		6		
<i>Poa subcaerulea</i>		6		
<i>Poa trivialis</i>	11	6		
<i>Pohlia nutans</i>	6			
<i>Polygala serpyllifolia</i>		22		
<i>Polygala vulgaris</i>	17	17	100	
<i>Polypodium vulgare</i>	6	6		
<i>Polystichum aculeatum</i>		6		
<i>Polytrichum commune</i>	56	61		
<i>Potentilla anserina</i>		6		
<i>Potentilla erecta</i>	83	94	100	100
<i>Potentilla sterilis</i>		6		
<i>Primula vulgaris</i>		6		
<i>Prunella vulgaris</i>		6		
<i>Pseudoscleropodium purum</i>	28	44	100	
<i>Pteridium aquilinum</i>	11	11		
<i>Racomitrium lanuginosum</i>		11	100	
<i>Ranunculus acris</i>	6			
<i>Rhytidiadelphus loreus</i>		33		
<i>Rhytidiadelphus squarrosus</i>	67	83		
<i>Rhytidiadelphus triquetrus</i>	28	6		
<i>Rumex acetosa</i>	11	11		
<i>Rumex acetosella</i>	6	6		100
<i>Sagina procumbens</i>		6		
<i>Salix spp_</i>		6		
<i>Scirpus cespitosus</i>	78	67		100
<i>Sesleria albicans</i>	22			
<i>Sphagnum auriculatum</i>	44	56	100	100
<i>Sphagnum capillifolium</i>	28	17		
<i>Sphagnum compactum</i>	11	6		100
<i>Sphagnum cuspidatum</i>	17	17		
<i>Sphagnum palustre</i>	11	22		
<i>Sphagnum papillosum</i>	11	28		
<i>Sphagnum rubellum</i>	44	17		
<i>Sphagnum subnitens</i>	11			
<i>Stellaria graminea</i>	6			
<i>Stellaria media</i>	6	6		
<i>Succisa pratensis</i>	33	50		
<i>Thuidium tamariscinum</i>	39	72	100	
<i>Thymus praecox</i>		6		
<i>Trifolium repens</i>	17	6		
<i>Ulex europaeus</i>			100	

<b>HEATHER MOORLAND</b> <b>continued</b> <b>PLANT SPECIES</b>	<b>% FREQUENCY</b>			
	<b>PARTICIPANTS</b>		<b>NON-PARTICIPANTS</b>	
	<b>1993</b>	<b>1999</b>	<b>1993</b>	<b>1999</b>
	n=18	n=18	n=1	n=1
<i>Vaccinium myrtillus</i>	67	72	100	100
<i>Veronica chamaedrys</i>		6		
<i>Veronica serpyllifolia</i>		6		
<i>Viola riviniana</i>		6		
<b>TOTAL</b>	96	131	31	33

UNIMPROVED GRASSLAND		% FREQUENCY			
PLANT SPECIES	PARTICIPANTS		NON-PARTICIPANTS		
	1993	1999	1993	1999	
	n=15	n=15	n=5	n=5	
<i>Achillea millefolium</i>	13	7	20	20	
<i>Achillea ptarmica</i>				20	
<i>Agrostis canina</i>	60	67	80	60	
<i>Agrostis capillaris</i>	73	73	60	80	
<i>Agrostis stolonifera</i>	80	73	100	80	
<i>Ajuga reptans</i>	73	20	60	20	
<i>Alnus glutinosa</i>	7			20	
<i>Alopecurus geniculatus</i>	13	7		20	
<i>Alopecurus pratensis</i>	33	33	80	20	
<i>Anagallis tenella</i>		7		40	
<i>Anemone nemorosa</i>	7				
<i>Angelica sylvestris</i>				20	
<i>Anthoxanthum odoratum</i>	100	93	100	80	
<i>Arrhenatherum elatius</i>				20	
<i>Bellis perennis</i>	40	33	80	60	
<i>Berula erecta</i>				20	
<i>Brachythecium rutabulum</i>	13	13	40		
<i>Briza media</i>	7			40	
<i>Bryum pallens</i>		7			
<i>Bryum pseudotriquetrum</i>	7				
<i>Calliargon cuspidatum</i>		20		20	
<i>Calluna vulgaris</i>	13	13	20	20	
<i>Caltha palustris</i>	20	7			
<i>Campylopus introflexus</i>		7			
<i>Cardamine flexuosa</i>		20		40	
<i>Cardamine hirsuta</i>	40	33	60		
<i>Cardamine pratensis</i>	73	93	100	80	
<i>Carex binervis</i>	13	20	20	20	
<i>Carex caryophyllea</i>		20		40	
<i>Carex demissa</i>		7		20	
<i>Carex diandra</i>	7				
<i>Carex distans</i>	7	7			
<i>Carex disticha</i>		7			
<i>Carex echinata</i>	40	47	20	20	
<i>Carex elata</i>				20	
<i>Carex elongata</i>	20				
<i>Carex flacca</i>	7	33	40	60	
<i>Carex hirta</i>	20	20	20		
<i>Carex laevigata</i>			20		
<i>Carex lasiocarpa</i>	67				
<i>Carex nigra</i>	73	73	80	60	
<i>Carex ovalis</i>	20	33		20	
<i>Carex pallescens</i>	27		60		
<i>Carex panicea</i>	80	67	100	60	
<i>Carex pendula</i>		20			
<i>Carex pilulifera</i>				40	
<i>Carex pulicaris</i>		13		40	
<i>Carex remota</i>	7				
<i>Carex rostrata</i>	33	7		20	
<i>Carex vesicaria</i>	7	7			

UNIMPROVED GRASSLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=15	n=15	n=5	n=5
<i>Carex viridula</i>	7		20	
<i>Centaurea nigra</i>	13	7		
<i>Cerastium fontanum</i>	60	53	80	60
<i>Ceratodon purpureus</i>			20	
<i>Cirriphyllum piliferum</i>	20		20	
<i>Cirsium arvense</i>	67	13	60	60
<i>Cirsium dissectum</i>		27		20
<i>Cirsium palustre</i>	27	27		
<i>Cirsium vulgare</i>	33	27	40	20
<i>Cladonia bellidiflora</i>				20
<i>Cladonia polydactyla</i>			20	
<i>Climacium dendroides</i>	13	7		
<i>Conopodium majus</i>		7		20
<i>Cratoneuron commutatum</i>	7			
<i>Cynosurus cristatus</i>	93	80	100	80
<i>Dactylis glomerata</i>	7		20	20
<i>Dactylorhiza fuchsii</i>	7	13		40
<i>Danthonia decumbens</i>		7		20
<i>Deschampsia cespitosa</i>	7			
<i>Deschampsia flexuosa</i>	20			
<i>Dicranella heteromalla</i>		7		
<i>Dicranum scoparium</i>		7	20	20
<i>Elymus repens</i>	7			20
<i>Epilobium montanum</i>				20
<i>Epilobium palustre</i>	20	13		
<i>Equisetum arvense</i>	13			
<i>Equisetum palustre</i>	7	7		
<i>Erica cinerea</i>			20	
<i>Erica tetralix</i>			20	20
<i>Eriophorum angustifolium</i>	7			
<i>Eriophorum vaginatum</i>	7			
<i>Erucastrum gallicum</i>				20
<i>Euphrasia officinalis</i>			20	20
<i>Eurhynchium praelongum</i>	20	7	20	
<i>Eurhynchium striatum</i>				20
<i>Festuca arundinacea</i>		7		
<i>Festuca ovina</i>	20	27		40
<i>Festuca pratensis</i>	13	20		20
<i>Festuca rubra</i>	73	47	100	80
<i>Filipendula ulmaria</i>	20	20	20	
<i>Fraxinus excelsior</i>		7		20
<i>Galium aparine</i>				20
<i>Galium boreale</i>	7		20	
<i>Galium palustre</i>	33	20	20	20
<i>Galium saxatile</i>	7	13		40
<i>Gentiana verna</i>				20
<i>Glyceria fluitans</i>	13	13		
<i>Hedera helix</i>	7		20	
<i>Holcus lanatus</i>	100	100	100	80
<i>Holcus mollis</i>	7	27		20



UNIMPROVED GRASSLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=15	n=15	n=5	n=5
<i>Homalothecium lutescens</i>				20
<i>Hylocomium splendens</i>	20	53	40	20
<i>Hypericum elodes</i>	13			
<i>Hypericum perforatum</i>	7	7		20
<i>Hypnum cupressiforme</i>	53	33	20	20
<i>Hypnum jutlandicum</i>	20	7	40	
<i>Hypochaeris radicata</i>	20	47		80
<i>Hypogymnia physodes</i>				20
<i>Ilex aquifolium</i>			20	
<i>Isolepis setacea</i>		33		20
<i>Juncus acutiflorus</i>	80	33	40	20
<i>Juncus articulatus</i>	47	67	80	20
<i>Juncus bufonius</i>	60	13	20	
<i>Juncus bulbosus</i>		33	20	40
<i>Juncus conglomeratus</i>		20		20
<i>Juncus effusus</i>	93	93	100	80
<i>Juncus inflexus</i>	7	33	20	20
<i>Juncus squarrosus</i>	13	7		
<i>Lathyrus pratensis</i>	27		20	20
<i>Leontodon autumnalis</i>	33	20	40	60
<i>Leontodon hispidus</i>	33	7	60	
<i>Linum catharticum</i>				20
<i>Lolium perenne</i>	27	33	80	40
<i>Lophozia ventricosa</i>	40		40	
<i>Lotus corniculatus</i>	7		20	20
<i>Lotus uliginosus</i>		7		
<i>Luzula campestris</i>	40	47	60	40
<i>Luzula multiflora</i>	13	27		40
<i>Lychnis flos-cuculi</i>	53	60		20
<i>Lysimachia nemorum</i>		13		
<i>Lysimachia nummularia</i>	13		20	
<i>Mentha aquatica</i>			20	20
<i>Mnium hornum</i>	27		60	
<i>Molinia caerulea</i>	13		80	40
<i>Montia fontana</i>		20		20
<i>Myosotis arvensis</i>	7	7		20
<i>Myosotis scorpioides</i>			40	
<i>Myrica gale</i>			20	20
<i>Nardus stricta</i>	33	20		40
<i>Oenanthe crocata</i>				20
<i>Pedicularis sylvatica</i>	7	7		20
<i>Pellia endiviifolia</i>		7		
<i>Pellia epiphylla</i>	20			20
<i>Peltigera canina</i>		20	20	
<i>Persicaria bistorta</i>				20
<i>Phleum pratense</i>	13	20		40
<i>Pilosella officinarum</i>		7		
<i>Pinguicula vulgaris</i>	7			
<i>Plagiochila asplenoides</i>	7			
<i>Plagiomnium undulatum</i>		7	20	40

UNIMPROVED GRASSLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=15	n=15	n=5	n=5
<i>Plagiothecium denticulatum</i>	7			20
<i>Plagiothecium nemorale</i>				20
<i>Plagiothecium undulatum</i>		7		
<i>Plantago lanceolata</i>	60	53	60	80
<i>Plantago media</i>		13	40	20
<i>Pleurozium schreberi</i>	53	27	40	40
<i>Poa annua</i>	7	20	40	40
<i>Poa pratensis</i>	33	40		60
<i>Poa trivialis</i>	80	47	20	100
<i>Polygala vulgaris</i>			20	
<i>Polygonum persicaria</i>	7	7	20	20
<i>Polytrichum commune</i>		13	20	
<i>Potentilla anserina</i>	13	7	40	
<i>Potentilla erecta</i>	60	53	60	60
<i>Potentilla sterilis</i>	7			
<i>Primula vulgaris</i>	7	7		
<i>Prunella vulgaris</i>	13	73	60	80
<i>Pseudoscleropodium purum</i>	27	40	40	20
<i>Pteridium aquilinum</i>	7			
<i>Pyrola minor</i>			40	20
<i>Ranunculus acris</i>	80	100	100	60
<i>Ranunculus ficaria</i>		13		
<i>Ranunculus flammula</i>	73	73	40	60
<i>Ranunculus lingua</i>		7		
<i>Ranunculus repens</i>	53	100	20	80
<i>Rhizomnium punctatum</i>	7			20
<i>Rhododendron ponticum</i>				20
<i>Rhynchosyrium confertum</i>			20	
<i>Rhytidiadelphus loreus</i>	7	13		60
<i>Rhytidiadelphus squarrosus</i>	20	67	80	20
<i>Rhytidiadelphus triquetrus</i>	80	13		
<i>Rosa canina</i>	7			
<i>Rubus fruticosus</i>	7	7		
<i>Rumex acetosa</i>	67	67	80	60
<i>Rumex acetosella</i>		7		
<i>Rumex crispus</i>	7			
<i>Rumex obtusifolius</i>	7	13	20	20
<i>Sagina nodosa</i>	40		20	
<i>Sagina procumbens</i>		47		20
<i>Salix aurita</i>	7			20
<i>Salix repens</i>				20
<i>Salix spp_</i>		7		
<i>Saponaria officinalis</i>		7		40
<i>Schoenus nigricans</i>			40	20
<i>Scirpus cespitosus</i>	27		20	
<i>Senecio aquaticus</i>	27	40	40	40
<i>Senecio jacobaea</i>	60	47	80	
<i>Sesleria albicans</i>	7		20	
<i>Sonchus arvensis</i>		7		
<i>Sonchus asper</i>				20

UNIMPROVED GRASSLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=15	n=15	n=5	n=5
<i>Sonchus oleraceus</i>			80	
<i>Sphagnum auriculatum</i>	13			
<i>Sphagnum capillifolium</i>		7		
<i>Sphagnum palustre</i>	7	13		
<i>Sphagnum papillosum</i>				20
<i>Sphagnum subnitens</i>	7			
<i>Stellaria graminea</i>	27	7	20	
<i>Stellaria media</i>	13	7		20
<i>Stellaria uliginosa</i>		7		
<i>Succisa pratensis</i>	60	53	20	40
<i>Taraxacum officinale</i>	20	20	80	40
<i>Thuidium tamariscinum</i>	47	40	20	
<i>Tragopogon pratensis</i>				20
<i>Trifolium dubium</i>			20	
<i>Trifolium pratense</i>	7	27	60	80
<i>Trifolium repens</i>	87	100	100	80
<i>Urtica dioica</i>		7		
<i>Vaccinium myrtillus</i>			40	
<i>Veronica beccabunga</i>				20
<i>Veronica chamaedrys</i>	7	7		
<i>Veronica scutellata</i>				20
<i>Veronica serpyllifolia</i>		13		40
<i>Vicia sepium</i>	7			
<i>Viola palustris</i>		7		
<i>Viola riviniana</i>	7		20	
TOTAL	141	138	101	131

WOODLAND  PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=10	1999 n=10	1993 n=5	1999 n=5
<i>Acer pseudoplatanus</i>	20	10	40	
<i>Aegopodium podagraria</i>			20	
<i>Aesculus hippocastanum</i>	10	10		
<i>Agrostis capillaris</i>		10		20
<i>Agrostis stolonifera</i>				20
<i>Agrostis canina</i>	10			
<i>Agrostis capillaris</i>	30		20	
<i>Agrostis stolonifera</i>	40		60	
<i>Ajuga reptans</i>	30	10		40
<i>Alchemilla glabra</i>	10			
<i>Allium ursinum</i>	10	10	40	40
<i>Alnus glutinosa</i>	20	20	60	60
<i>Alopecurus geniculatus</i>	40	20	40	20
<i>Alopecurus pratensis</i>	30		20	
<i>Anchusa arvensis</i>			20	
<i>Anemone nemorosa</i>	50	40	40	40
<i>Angelica sylvestris</i>		20	20	40
<i>Anthoxanthum odoratum</i>	20	30	20	40
<i>Anthriscus sylvestris</i>	10	10		20
<i>Arrhenatherum elatius</i>	20			
<i>Arum maculatum</i>	70	40	40	40
<i>Asplenium adiantum-nigrum</i>	10			
<i>Athyrium filix-femina</i>	30	70	20	40
<i>Bellis perennis</i>		20	40	40
<i>Berula erecta</i>	10			20
<i>Betula pubescens</i>	10	20	20	20
<i>Blechnum spicant</i>	40		20	
<i>Brachypodium sylvaticum</i>	20			
<i>Brachythecium rutabulum</i>		10		
<i>Briza media</i>	10		20	
<i>Bromis sterilis</i>			20	
<i>Bromus ramosus</i>		10		
<i>Bromus ramosus</i>	10		40	
<i>Calluna vulgaris</i>		10		
<i>Caltha palustris</i>	10	20	20	40
<i>Capsella bursa-pastoris</i>			20	
<i>Cardamine flexuosa_</i>	30	20	20	60
<i>Cardamine hirsuta</i>	20	10	40	40
<i>Cardamine pratensis</i>		30	20	60
<i>Carex hirta</i>	10		20	
<i>Carex lasiocarpa</i>			20	
<i>Carex binervis</i>	10	10		
<i>Carex caryophyllea</i>		20		
<i>Carex distans</i>			20	
<i>Carex echinata</i>		10		
<i>Carex elata</i>			20	
<i>Carex flacca</i>		10	20	20
<i>Carex nigra</i>	30		20	
<i>Carex pallescens</i>			20	
<i>Carex panicea</i>	20			

WOODLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=10	1999 n=10	1993 n=5	1999 n=5
<i>Carex paniculata</i>		10		
<i>Carex pendula</i>	30			
<i>Carex pilulifera</i>		10		
<i>Carex remota</i>		20	20	20
<i>Carex rostrata</i>		10		
<i>Carex spicata</i>	10			
<i>Carex sylvatica</i>	10	50	20	40
<i>Centaurea nigra</i>		10		
<i>Cerastium fontanum</i>	20	10	40	20
<i>Ceratodon purpureus</i>	20			
<i>Chamerion angustifolium</i>	10	10		
<i>Chrysosplenium oppositifolium</i>	30	40	20	20
<i>Circaea lutetiana</i>	50	50		
<i>Cirsium arvense</i>	10		20	20
<i>Cirsium dissectum</i>		10		
<i>Cirsium palustre</i>	10			
<i>Cirsium vulgare</i>	10	10	40	20
<i>Cladonia fimbriata</i>	20		20	
<i>Cladonia portentosa</i>	10			
<i>Cladonia pyxidata</i>		10		
<i>Climacium dendroides</i>		40	20	60
<i>Conocephalum conicum</i>	10			
<i>Conopodium majus</i>	70	60	60	40
<i>Corylus avellana</i>	60	60	60	40
<i>Crataegus monogyna</i>	80	90	100	80
<i>Cratoneuron commutatum</i>	10		20	
<i>Ctenidium molluscum</i>		10		
<i>Cynosurus cristatus</i>		10	20	20
<i>Cystopteris fragilis</i>	40	40		40
<i>Dactylis glomerata</i>	30		40	
<i>Dactylorhiza fuchsii</i>	10		40	
<i>Deschampsia cespitosa</i>	40	20	60	
<i>Deschampsia flexuosa</i>	10			
<i>Dicranum scoparium</i>		20		
<i>Dryopteris dilatata</i>	50	40	20	20
<i>Dryopteris filix-mas</i>	20	60	40	
<i>Elymus repens</i>			20	
<i>Epilobium hirsutum</i>	10			
<i>Epilobium montanum</i>	20	30	40	20
<i>Epilobium palustre</i>	10	20		
<i>Equisetum arvense</i>	10		20	
<i>Equisetum palustre</i>		10		60
<i>Equisetum sylvaticum</i>			20	
<i>Euonymus europaeus</i>		20		
<i>Eurhynchium praelongum</i>	30		80	
<i>Fagus sylvatica</i>	20	30		
<i>Festuca pratensis</i>	10		40	
<i>Festuca rubra</i>	20		60	20
<i>Filipendula ulmaria</i>	50	40	100	100
<i>Fissidens taxifolius</i>	10			

WOODLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=10	n=10	n=5	n=5
<i>Fragaria vesca</i>	10	50		40
<i>Fraxinus excelsior</i>	80	80	100	40
<i>Galium aparine</i>	70	60	20	80
<i>Galium odoratum</i>		10		20
<i>Galium saxatile</i>	10		20	
<i>Geranium robertianum</i>	70	70	80	80
<i>Geum urbanum</i>	50	40	40	60
<i>Glechoma hederacea</i>			20	
<i>Glyceria fluitans</i>	10	10	40	20
<i>Gymnocarpium dryopteris</i>	20			
<i>Hedera helix</i>	70	90	80	80
<i>Heracleum sphondylium</i>	20	30	60	40
<i>Hieracium sp_</i>	10			
<i>Holcus lanatus</i>	30	30	60	20
<i>Hyacinthoides non-scripta</i>	50	50	60	40
<i>Hylocomium splendens</i>			20	
<i>Hypericum androsaemum</i>				20
<i>Hypericum perforatum</i>	20	10	40	20
<i>Hypnum cupressiforme</i>	30	30		20
<i>Hypnum jutlandicum</i>		10		
<i>Hypnum mammillatum</i>	60		20	
<i>Hypochaeris radicata</i>		10	20	
<i>Ilex aquifolium</i>	70	70	40	40
<i>Iris pseudacorus</i>	10	10		
<i>Isoetes myosuroides</i>	20			
<i>Juncus acutiflorus</i>	10			
<i>Juncus articulatus</i>			20	
<i>Juncus bufonius</i>	20	10	20	
<i>Juncus effusus</i>	30	10	60	20
<i>Juncus inflexus</i>		10	40	
<i>Juncus squarrosus</i>	10			
<i>Lapsana communis</i>			20	
<i>Lapsana communis</i>	10	10		20
<i>Larix decidua</i>	10	10		
<i>Lathyrus pratensis</i>	10			
<i>Leontodon autumnalis</i>	10		20	
<i>Leontodon hispidus</i>	10			
<i>Listera ovata</i>			40	20
<i>Lolium perenne</i>	10	10		
<i>Lonicera periclymenum</i>	50	50	20	20
<i>Lunularia cruciata</i>	10			
<i>Luzula sylvatica</i>	30	10		
<i>Luzula multiflora</i>	30		40	20
<i>Lychnis flos-cuculi</i>	10			
<i>Lysimachia nemorum</i>	30	10	60	40
<i>Malus sylvestris</i>			20	
<i>Melica uniflora</i>	10			20
<i>Mentha aquatica</i>	10		40	
<i>Mentha spicata</i>				20
<i>Mnium hornum</i>	50	40	40	60

WOODLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=10	n=10	n=5	n=5
<i>Mycelis muralis</i>	10			
<i>Myosotis scorpioides</i>				20
<i>Neckera complanata</i>	20		20	
<i>Oenanthe crocata</i>	10		20	
<i>Ophioglossum vulgatum</i>				20
<i>Orchis mascula</i>	30	20	20	20
<i>Oxalis acetosella</i>	60	50	40	20
<i>Pellia epiphylla</i>	10	10	20	40
<i>Peltigera canina</i>	10	20		
<i>Phalaris arundinacea</i>			20	
<i>Phragmites australis</i>		10	20	
<i>Phyllitis scolopendrium</i>	40	20	60	40
<i>Picea sitchensis</i>		10		
<i>Plagiochila asplenoides</i>	10			
<i>Plagiomnium undulatum</i>	10	30		60
<i>Plagiothecium denticulatum</i>	10			
<i>Plagiothecium nemorale</i>	10			
<i>Plagiothecium undulatum</i>		20		20
<i>Plantago media</i>			20	20
<i>Plantago lanceolata</i>	10		40	
<i>Pleurozium schreberi</i>			20	
<i>Poa trivialis</i>	70	20	60	40
<i>Poa annua</i>	10	10	20	20
<i>Poa nemoralis</i>		70		60
<i>Poa pratensis</i>	20		40	
<i>Pohlia nutans</i>	10			
<i>Polygala vulgaris</i>			20	
<i>Polygonum aviculare</i>			20	
<i>Polypodium vulgare</i>	10	30		20
<i>Polytrichum commune</i>		20	20	
<i>Potentilla erecta</i>	20	20	20	40
<i>Potentilla palustris</i>	10	10		
<i>Potentilla reptans</i>	10			
<i>Potentilla sterilis</i>	60		60	
<i>Primula vulgaris</i>	70	40	60	60
<i>Prunella vulgaris</i>		30	60	60
<i>Prunus avium</i>				20
<i>Prunus laurocerasus</i>		10		
<i>Prunus spinosa</i>	20	40	80	60
<i>Pseudoscleropodium purum</i>	20			20
<i>Pteridium aquilinum</i>	40	10	60	
<i>Quercus sp.</i>	10	30		
<i>Ranunculus acris</i>	30	40	80	20
<i>Ranunculus auricomus</i>				20
<i>Ranunculus ficaria</i>	50	80	60	20
<i>Ranunculus flammula</i>	10			
<i>Ranunculus repens</i>		40	60	40
<i>Rhododendron ponticum</i>	10	20		
<i>Rhynchosstegium confertum</i>			20	
<i>Rhytidiadelphus loreus</i>	20	10		20

WOODLAND continued PLANT SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=10	1999 n=10	1993 n=5	1999 n=5
<i>Rhytidiadelphus squarrosus</i>	30		60	
<i>Rhytidiadelphus triquetrus</i>	20	10		20
<i>Robinia pseudoacacia</i>			20	
<i>Rosa canina</i>	20	30	60	80
<i>Rubus fruticosus</i>	90	100	80	80
<i>Rumex acetosa</i>	10	20	20	20
<i>Rumex crispus</i>	50	30	20	20
<i>Rumex obtusifolius</i>	10	10	20	20
<i>Rumex sanguineus</i>		10		40
<i>Salix spp_</i>	30	30	40	60
<i>Sambucus nigra</i>	10	20		40
<i>Sanicula europaea</i>	30	30	20	20
<i>Senecio aquaticus</i>	20			60
<i>Senecio jacobaea</i>	30	20	40	20
<i>Sorbus aucuparia</i>	20	20		
<i>Stachys sylvatica</i>		20		20
<i>Stellaria graminea</i>	10		40	
<i>Stellaria holostea</i>			20	20
<i>Stellaria media</i>		10	20	20
<i>Succisa pratensis</i>	10	20	40	
<i>Taraxacum officinale</i>	50	70	100	100
<i>Taxus baccata</i>	10			
<i>Thuidium tamariscinum</i>	80	70	60	80
<i>Tilia sp_</i>			20	
<i>Tortella tortuosa</i>				20
<i>Tortula muralis</i>				20
<i>Trifolium pratense</i>	20			20
<i>Trifolium repens</i>	20	10	40	20
<i>Ulex europaeus</i>	10	10		
<i>Ulmus sp_</i>	10	10		20
<i>Urtica dioica</i>	40	40	40	60
<i>Valeriana officinalis</i>		10		
<i>Veronica montana</i>	70	10	20	20
<i>Veronica chamaedrys</i>	40	70	80	60
<i>Veronica scutellata</i>				20
<i>Veronica serpyllifolia</i>		10		20
<i>Viburnum opulus</i>	10			
<i>Vicia cracca</i>	10			
<i>Vicia sativa</i>	10	10	40	40
<i>Vicia sepium</i>	40	20	20	
<i>Viola riviniana</i>	80	60	60	80
<i>Viola odorata</i>	10	10		
<b>TOTAL</b>	<b>167</b>	<b>139</b>	<b>138</b>	<b>114</b>



**Appendix 2. Percentage frequency of Carabid beetle species captured on ESA participant and non-participant farms on each habitat in the West Fermanagh & Erne Lakeland ESA in 1993 and 1999.**

CARABID BEETLE SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=6	1999 n=6	1993 n=9	1999 n=9
<i>Abax parallelepipedus</i>			11	11
<i>Agonum assimile</i>		17		11
<i>Agonum fuliginosum</i>	17	67		67
<i>Agonum gracile</i>		17		
<i>Agonum moestum</i>	33			
<i>Agonum muelleri</i>	83	67		78
<i>Agonum piceum</i>			11	
<i>Agonum viduum</i>	50	17		11
<i>Amara communis</i>		33	11	
<i>Amara lunicollis</i>			11	
<i>Amara ovata</i>		17	22	
<i>Bembidion aeneum</i>	33	17	44	11
<i>Bembidion guttula</i>			11	
<i>Calathus melanocephalus</i>	17	17		
<i>Carabus clathratus</i>	33	83	56	44
<i>Carabus granulatus</i>	83	83	89	78
<i>Carabus nemoralis</i>		17	11	
<i>Chlaenius nigricornis</i>	17	33	11	11
<i>Clivina fossor</i>		17	11	11
<i>Cychrus caraboides</i>	17			
<i>Dyschirius globosus</i>			11	
<i>Elaphrus cupreus</i>	83	67	44	78
<i>Harpalus latus</i>			11	
<i>Leistus fulvilabris</i>				11
<i>Loricera pilicornis</i>	67	83	67	100
<i>Nebria brevicollis</i>	100	83	78	89
<i>Nebria salina</i>		17	11	
<i>Notiophilus biguttatum</i>		17		
<i>Pelophila borealis</i>			11	11
<i>Pterostichus anthracinus</i>	33	83	33	67
<i>Pterostichus diligens</i>	50	50	56	78
<i>Pterostichus madidus</i>	33	33	33	
<i>Pterostichus melanarius</i>	50	100	78	56
<i>Pterostichus niger</i>	67	100	67	78
<i>Pterostichus nigrata</i>	100	100	100	100
<i>Pterostichus rhaeticus</i>	67	83	33	22
<i>Pterostichus strenuus</i>	50	83	89	33
<i>Pterostichus vernalis</i>	17	17	33	44
<i>Pterostichus versicolor</i>	33	50	56	33
TOTAL	23	29	29	24

WET GRASSLAND		% FREQUENCY		
CARABID BEETLE SPECIES	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=10	n=10	n=2	n=2
<i>Agonum albipes</i>		10		
<i>Agonum assimile</i>		10		
<i>Agonum fuliginosum</i>	20	60		50
<i>Agonum muelleri</i>	90	90	50	50
<i>Agonum obscurum</i>	20			
<i>Agonum piceum</i>	10			
<i>Agonum viduum</i>	70	60	50	
<i>Amara ovata</i>	10			
<i>Bembidion aeneum</i>	80	40	50	
<i>Bembidion guttula</i>	10			
<i>Bembidion mannerheimi</i>	20			
<i>Bembidion tetracolum</i>	10			
<i>Blethisa multipunctata</i>		10		
<i>Calathus micropterus</i>		10		
<i>Carabus clathratus</i>	20	30	50	
<i>Carabus granulatus</i>	90	100	100	50
<i>Chlaenius nigricornis</i>	50	60		50
<i>Clivina fossor</i>	20	10		
<i>Elaphrus cupreus</i>	80	80		
<i>Leistus fulvilabris</i>	20			
<i>Loricera pilicornis</i>	80	80	50	50
<i>Nebria brevicollis</i>	90	70	100	50
<i>Pelophila borealis</i>	20	20		50
<i>Pterostichus anthracinus</i>	90	80	50	
<i>Pterostichus diligens</i>	90	70	50	50
<i>Pterostichus madidus</i>	50	30	50	
<i>Pterostichus melanarius</i>	20	20		
<i>Pterostichus minor</i>	30		50	
<i>Pterostichus niger</i>	40	80	100	
<i>Pterostichus nigrata</i>	100	100	100	50
<i>Pterostichus strenuus</i>	60	40	100	
<i>Pterostichus vernalis</i>	50	30	50	
<i>Pterostichus versicolor</i>	70	20	50	
TOTAL	29	25	16	9

LIMESTONE GRASSLAND		% FREQUENCY		
CARABID BEETLE SPECIES	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=3	1999 n=3	1993 n=2	1999 n=2
<i>Abax parallelepipedus</i>	67	67	50	100
<i>Agonum fuliginosum</i>		33		
<i>Agonum muelleri</i>	67	67	50	
<i>Amara aenea</i>	33			
<i>Amara aulica</i>	67	33		
<i>Amara communis</i>	33			
<i>Amara lunicollis</i>		33		50
<i>Calathus fuscipes</i>	67	67	50	100
<i>Calathus melanocephalus</i>	33	33		
<i>Carabus clathratus</i>		33		
<i>Carabus granulatus</i>	33	100	100	100
<i>Carabus nemoralis</i>	33	67		50
<i>Carabus problematicus</i>	33	33	50	
<i>Clivina fossor</i>				50
<i>Cychrus caraboides</i>		33		50
<i>Elaphrus cupreus</i>			50	
<i>Harpalus latus</i>	33			
<i>Laemostenus terricola</i>	33			
<i>Loricera pilicornis</i>	67	67	100	50
<i>Nebria brevicollis</i>	100	100	100	100
<i>Nebria salina</i>	67	33	100	50
<i>Notiophilus aquaticus</i>	33	33		
<i>Notiophilus biguttatum</i>		33		
<i>Patrobus assimilis</i>			50	
<i>Pterostichus diligens</i>	67	67		50
<i>Pterostichus madidus</i>	100	67	50	100
<i>Pterostichus melanarius</i>	67	100	100	50
<i>Pterostichus minor</i>	33			
<i>Pterostichus niger</i>		100	50	100
<i>Pterostichus nigrita</i>	100	100	100	100
<i>Pterostichus strenuus</i>	100	67	50	50
<i>Pterostichus vernalis</i>	33	67		50
<i>Pterostichus versicolor</i>	33	67	100	50
TOTAL	24	25	16	18

HEATHER MOORLAND  CARABID BEETLE SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=7	1999 n=7	1993 n=1	1999 n=1
<i>Abax parallelepipedus</i>	43	57	100	100
<i>Agonum fuliginosum</i>	29			
<i>Agonum muelleri</i>	14	14	100	
<i>Amara lunicollis</i>	14	14		
<i>Amara plebeja</i>			100	
<i>Bembidion lampros</i>	29	14		
<i>Bradycellus harpalinus</i>	14			
<i>Calathus fuscipes</i>	14		100	100
<i>Calathus melanocephalus</i>				100
<i>Carabus arvensis</i>	71	43	100	100
<i>Carabus clathratus</i>	14	14		
<i>Carabus granulatus</i>	71	43	100	100
<i>Carabus nemoralis</i>	57	29		
<i>Carabus nitens</i>	29	29	100	
<i>Carabus problematicus</i>	71	43		
<i>Cychrus caraboides</i>	14			
<i>Harpalus latus</i>		14	100	
<i>Loricera pilicornis</i>		14		100
<i>Nebria brevicollis</i>		29	100	100
<i>Nebria salina</i>	43	43		100
<i>Notiophilus aquaticus</i>	14			100
<i>Notiophilus palustris</i>	14			
<i>Olisthopus rotundatus</i>	29	14		
<i>Patrobus assimilis</i>				100
<i>Patrobus atrorufus</i>				100
<i>Pterostichus diligens</i>	43	29		
<i>Pterostichus madidus</i>	57	43	100	
<i>Pterostichus melanarius</i>	43	71	100	
<i>Pterostichus niger</i>	86	100	100	100
<i>Pterostichus nigrita</i>	29	43	100	100
<i>Pterostichus rhaeticus</i>	71	57	100	100
<i>Pterostichus strenuus</i>	29	14		100
<i>Pterostichus vernalis</i>			100	100
<i>Pterostichus versicolor</i>	14	14	100	
<i>Trechus quadristriatus</i>				100
TOTAL	26	23	16	17

UNIMPROVED GRASSLAND		% FREQUENCY		
CARABID BEETLE SPECIES	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=10	1999 n=10	1993 n=3	1999 n=3
<i>Abax parallelepipedus</i>	20	30		33
<i>Agonum assimile</i>		30		
<i>Agonum fuliginosum</i>	50	70		67
<i>Agonum muelleri</i>	90	50	100	100
<i>Agonum obscurum</i>	10	10		
<i>Agonum viduum</i>	20	20		
<i>Amara aulica</i>		10	33	
<i>Amara ovata</i>	10	10		
<i>Bembidion aeneum</i>	20	10		
<i>Bembidion mannerheimi</i>	10			
<i>Bembidion unicolor</i>		10		
<i>Calathus fuscipes</i>		20		
<i>Calathus melanocephalus</i>	10	10	33	33
<i>Carabus clathratus</i>	20		33	33
<i>Carabus granulatus</i>	90	60	100	100
<i>Carabus nemoralis</i>	20			
<i>Carabus problematicus</i>		10		
<i>Chlaenius nigricornis</i>	10	30		
<i>Clivina fossor</i>				33
<i>Elaphrus cupreus</i>	40	60		67
<i>Harpalus latus</i>	10			
<i>Leistus fulvilabris</i>		10		
<i>Loricera pilicornis</i>	80	70		67
<i>Nebria brevicollis</i>	100	90	100	100
<i>Nebria salina</i>	30	20	33	33
<i>Pelophila borealis</i>		10		
<i>Pterostichus anthracinus</i>	50	50	67	100
<i>Pterostichus diligens</i>	50	70	33	67
<i>Pterostichus madidus</i>	70	30	67	33
<i>Pterostichus melanarius</i>	70	60	100	67
<i>Pterostichus minor</i>	20			
<i>Pterostichus niger</i>	80	100	67	100
<i>Pterostichus nigrita</i>	70	70	100	100
<i>Pterostichus rhaeticus</i>	40	40		
<i>Pterostichus strenuus</i>	80	70	100	100
<i>Pterostichus vernalis</i>	20	40	33	100
<i>Pterostichus versicolor</i>	20	50	100	67
TOTAL	29	31	16	20

WOODLAND  CARABID BEETLE SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=1	1999 n=1	1993 n=3	1999 N=3
<i>Abax parallelepipedus</i>			100	67
<i>Agonum albipes</i>				33
<i>Agonum assimile</i>				100
<i>Agonum fuliginosum</i>	100	100	33	100
<i>Agonum gracile</i>				33
<i>Agonum muelleri</i>				33
<i>Bembidion aeneum</i>			33	
<i>Bembidion mannerheimi</i>	100			
<i>Bembidion unicolor</i>				67
<i>Calathus piceus</i>				33
<i>Carabus clathratus</i>	100		33	
<i>Carabus granulatus</i>	100		100	33
<i>Carabus nemoralis</i>			33	
<i>Carabus problematicus</i>			33	67
<i>Cychrus caraboides</i>			33	67
<i>Elaphrus cupreus</i>			67	33
<i>Harpalus latus</i>			33	
<i>Leistus fulvilabris</i>			33	67
<i>Loricera pilicornis</i>			33	67
<i>Nebria brevicollis</i>	100		67	100
<i>Nebria salina</i>			33	
<i>Ocys harpaloides</i>				33
<i>Pterostichus anthracinus</i>	100		33	33
<i>Pterostichus diligens</i>			33	
<i>Pterostichus madidus</i>	100		33	
<i>Pterostichus melanarius</i>	100		67	100
<i>Pterostichus niger</i>	100		67	100
<i>Pterostichus nigrata</i>	100		67	67
<i>Pterostichus strenuus</i>	100		100	100
<i>Trechus obtusus</i>	100		33	100
<i>Trechus quadristriatus</i>				67
TOTAL	12	1	22	23

**Appendix 3. Percentage frequency of spider species captured on ESA participant and non-participant farms on each habitat in the West Fermanagh & Erne Lakeland ESA in 1993 and 1999.**

SPIDER SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=6	1999 n=6	1993 n=9	1999 n=9
<i>Agyneta decora</i>	17		11	
<i>Agyneta olivacea</i>	17			
<i>Alopecosa pulverulenta</i>	17	17	22	
<i>Antistea elegans</i>	33			11
<i>Araeoncus crassiceps</i>	17			
<i>Araeoncus humilis</i>	33		11	
<i>Araneus quadratus</i>				11
<i>Bathyphantes approximatus</i>			11	33
<i>Bathyphantes gracilis</i>	83	83	100	89
<i>Bathyphantes nigrinus</i>			11	
<i>Centromerita bicolor</i>	17	17	33	
<i>Centromerita concinna</i>				11
<i>Clubiona reclusa</i>			11	
<i>Dicymbium nigrum</i>	50	67	78	33
<i>Diplocephalus cristatus</i>	17			
<i>Diplocephalus latifrons</i>	33		11	
<i>Diplocephalus permixtus</i>	83		89	56
<i>Drepanotylus uncatulus</i>	50		11	
<i>Erigone atra</i>	100	100	100	100
<i>Erigone dentipalpis</i>	83	100	89	100
<i>Erigone longipalpis</i>				11
<i>Gnathonarium dentatum</i>	17		22	
<i>Gonatium rubens</i>			11	
<i>Gongylidiellum vivum</i>	67	33	56	44
<i>Hypomma bituberculatum</i>		17	33	
<i>Lepthyphantes angulatus</i>				11
<i>Lepthyphantes ericaeus</i>			11	
<i>Lepthyphantes flavipes</i>			11	
<i>Lepthyphantes tenuis</i>	100	67	78	89
<i>Lepthyphantes zimmermanni</i>	33		56	
<i>Leptorhoptrum robustum</i>	50		56	
<i>Lophomma punctatum</i>	17	83		11
<i>Micrargus herbigradus</i>	17			
<i>Micrargus subaequalis</i>			11	
<i>Microlinyphia pusilla</i>	17			
<i>Monocephalus fuscipes</i>	17	17		
<i>Oedothorax fuscus</i>	100	100	89	100
<i>Oedothorax gibbosus</i>	17			
<i>Oedothorax retusus</i>	67	50	78	
<i>Pachygnatha clerckii</i>	67	83	100	78
<i>Pachygnatha degeeri</i>	100	100	100	100
<i>Pardosa agrestis</i>				11
<i>Pardosa amentata</i>	100	83	89	100
<i>Pardosa palustris</i>	50	50	67	56
<i>Pardosa pullata</i>	83	83	89	100
<i>Pirata piraticus</i>	83	33	44	67

<b>HAY MEADOW continued SPIDER SPECIES</b>	<b>% FREQUENCY</b>			
	<b>PARTICIPANTS</b>		<b>NON-PARTICIPANTS</b>	
	<b>1993</b>	<b>1999</b>	<b>1993</b>	<b>1999</b>
	n=6	n=6	n=9	n=9
<i>Rhaebothorax morulus</i>	17			
<i>Robertus lividus</i>			11	
<i>Saarioa abnormis</i>	17			
<i>Savignya frontata</i>	50		67	
<i>Silometopus elegans</i>	33			
<i>Tiso vagans</i>	17		11	
<i>Trochosa spinipalpis</i>		67		22
<i>Trochosa terricola</i>	100	50	44	11
<i>Walckenaeria acuminata</i>	17			
<i>Walckenaeria nudipalpis</i>				11
<i>Walckenaeria vigilax</i>	17			11
<i>Xysticus cristatus</i>	17		11	11
<i>Xysticus erraticus</i>	17			
<b>TOTAL</b>	43	21	37	27



WET GRASSLAND  SPIDER SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=10	1999 n=10	1993 n=2	1999 n=2
<i>Allomengea vidua</i>		10		
<i>Alopecosa pulverulenta</i>	20	10	50	
<i>Antistea elegans</i>		10		
<i>Araeoncus crassiceps</i>	10	10		
<i>Bathyphantes approximatus</i>	30	50	50	
<i>Bathyphantes gracilis</i>	80	100	50	100
<i>Bathyphantes nigrinus</i>	10			
<i>Centromerita bicolor</i>	10	10		
<i>Ceratinella brevipes</i>	10			
<i>Clubiona diversa</i>			50	
<i>Clubiona phragmitis</i>		10		
<i>Dicymbium nigrum</i>	40	20	50	
<i>Diplocephalus latifrons</i>	10		50	
<i>Diplocephalus permixtus</i>	40	70	50	
<i>Drepanotylus uncatus</i>	20	50		50
<i>Erigone atra</i>	100	100	100	100
<i>Erigone dentipalpis</i>	100	80	100	100
<i>Erigone longipalpis</i>	40	40	50	50
<i>Gnathonarium dentatum</i>	10	60	100	
<i>Gongylidiellum vivum</i>	20	10		
<i>Haplodrassus signifer</i>	10			
<i>Hypomma bituberculatum</i>	40	40		
<i>Lepthyphantes flavipes</i>			50	
<i>Lepthyphantes tenebricola</i>	10			
<i>Lepthyphantes tenuis</i>	90	80	50	100
<i>Lepthyphantes zimmermanni</i>	10		50	
<i>Leptorhoptrum robustum</i>	40	30		50
<i>Lophomma punctatum</i>	40	60	50	
<i>Monocephalus fuscipes</i>		10		50
<i>Nerienne montana</i>		10		
<i>Oedothorax fuscus</i>	100	100	100	100
<i>Oedothorax gibbosus</i>	40	40	100	50
<i>Oedothorax retusus</i>	30	40		50
<i>Pachygnatha clerckii</i>	90	100	100	50
<i>Pachygnatha degeeri</i>	90	90	100	100
<i>Pardosa amentata</i>	90	100	50	100
<i>Pardosa palustris</i>	30	30		50
<i>Pardosa pullata</i>	90	70	100	50
<i>Pirata hygrophilus</i>			50	
<i>Pirata piraticus</i>	100	90	100	100
<i>Robertus lividus</i>	10			
<i>Savignya frontata</i>	20	10	50	50
<i>Tallusia experta</i>		10		
<i>Tiso vagans</i>	10			50
<i>Trochosa ruricola</i>	10			
<i>Trochosa spinipalpis</i>		10		50
<i>Trochosa terricola</i>	40	10	50	
<i>Walckenaeria acuminata</i>			50	

WET GRASSLAND continued SPIDER SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=10	n=10	n=2	n=2
<i>Walckenaeria vigilax</i>	10			
<i>Xysticus cristatus</i>			50	
TOTAL	38	35	27	20

SPIDER SPECIES	% FREQUENCY			
	PARTICIPANT		NON-PARTICIPANT	
	1993	1999	1993	1999
	n=3	n=3	n=2	n=2
<i>Agroeca proxima</i>	33			
<i>Agyneta cauta</i>	33			
<i>Agyneta decora</i>			100	50
<i>Agyneta olivacea</i>	33			
<i>Agyneta subtilis</i>		33		
<i>Alopecosa pulverulenta</i>	67	67	50	50
<i>Araeoncus humilis</i>	33			
<i>Bathypantes gracilis</i>	33	33	100	100
<i>Centromerita bicolor</i>			50	
<i>Centromerita concinna</i>	33		100	
<i>Clubiona neglecta</i>		33		
<i>Dicymbium nigrum</i>	67	33	100	50
<i>Diplocephalus permixtus</i>	33	33	50	
<i>Dismodicus bifrons</i>		33		
<i>Drassodes cupreus</i>		33		50
<i>Erigone atra</i>	100	67	100	100
<i>Erigone dentipalpis</i>	67	67	100	100
<i>Erigonella hiemalis</i>				50
<i>Gongylidiellum vivum</i>			50	50
<i>Hypomma bituberculatum</i>	33			
<i>Lepthyphantes ericaeus</i>		33		
<i>Lepthyphantes tenuis</i>	67	100	100	100
<i>Lepthyphantes zimmermanni</i>	67	33		
<i>Lophomma punctatum</i>			50	
<i>Monocephalus fuscipes</i>		33	50	50
<i>Oedothorax fuscus</i>	100	67	100	100
<i>Oedothorax gibbosus</i>			50	
<i>Oedothorax retusus</i>	67		100	100
<i>Pachygnatha degeeri</i>	67	100	100	100
<i>Pardosa amentata</i>	67	33	100	50
<i>Pardosa nigriceps</i>	33			
<i>Pardosa palustris</i>	100	100	100	100
<i>Pardosa pullata</i>	100	67	100	100
<i>Peponocranium ludicrum</i>				50
<i>Pirata piraticus</i>	33	33	50	
<i>Pocadicnemis pumila</i>	33			
<i>Savignya frontata</i>	33		100	
<i>Textrix denticulata</i>				50
<i>Tiso vagans</i>	100	67	100	100
<i>Trochosa spinipalpis</i>		33		
<i>Trochosa terricola</i>	100	100	100	50
<i>Walckenaeria acuminata</i>	33	33		
<i>Walckenaeria antica</i>	67			
<i>Walckenaeria vigilax</i>	33			50
<i>Xysticus cristatus</i>	67	33	50	100
<i>Xysticus erraticus</i>				50
TOTAL	30	25	25	24

HEATHER MOORLAND		% FREQUENCY		
SPIDER SPECIES	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=7	n=7	n=1	n=1
<i>Agroeca proxima</i>	14	14		
<i>Allomengea scopigera</i>	14			
<i>Allomengea vidua</i>			100	
<i>Alopecosa pulverulenta</i>	43	86	100	100
<i>Antistea elegans</i>	43	43		
<i>Bathypantes gracilis</i>		14		
<i>Bolyphantes luteolus</i>	14	14		
<i>Centromerita bicolor</i>			100	
<i>Centromerita concinna</i>	29	43	100	100
<i>Ceratinella brevipes</i>	14	14		
<i>Clubiona reclusa</i>	14	14		
<i>Clubiona trivialis</i>		14		
<i>Cnephalocotes obscurus</i>	14			
<i>Dictyna arundinacea</i>		14		
<i>Dicymbium nigrum</i>	14		100	
<i>Diplocephalus permixtus</i>	14			
<i>Erigone atra</i>	43	43		100
<i>Erigone dentipalpis</i>	14	29	100	100
<i>Erigonella hiemalis</i>		14		
<i>Ero furcata</i>		14		
<i>Gonatium rubens</i>		29		
<i>Gongylidiellum vivum</i>	14			100
<i>Haplodrassus signifer</i>	14			
<i>Lepthyphantes alacris</i>	14			
<i>Lepthyphantes flavipes</i>		29		
<i>Lepthyphantes mengei</i>		29		
<i>Lepthyphantes tenebricola</i>	14			
<i>Lepthyphantes tenuis</i>	29	57		100
<i>Lepthyphantes zimmermanni</i>	57	29	100	
<i>Leptorhoptrum robustum</i>	14			
<i>Lophomma punctatum</i>		14		
<i>Metopobactrus prominulus</i>		14		
<i>Monocephalus fuscipes</i>				100
<i>Oedothorax fuscus</i>	14	14	100	100
<i>Oedothorax gibbosus</i>	14		100	
<i>Oedothorax retusus</i>	14		100	
<i>Oxyptila trux</i>	29	14	100	
<i>Pachygnatha clerckii</i>	86	86	100	100
<i>Pachygnatha degeeri</i>	57	86	100	100
<i>Pardosa amentata</i>	14	29		100
<i>Pardosa nigriceps</i>	71	43	100	
<i>Pardosa pullata</i>	100	100	100	100
<i>Pirata piraticus</i>	86	57		
<i>Robertus arundineti</i>	14			
<i>Robertus lividus</i>	57	57	100	
<i>Saarioa abnormis</i>	14	14		
<i>Syedra gracilis</i>	14			
<i>Tallusia experta</i>				100
<i>Tiso vagans</i>		29		

<b>HEATHER MOORLAND</b> <b>continued</b> <b>SPIDER SPECIES</b>	<b>% FREQUENCY</b>			
	<b>PARTICIPANTS</b>		<b>NON-PARTICIPANTS</b>	
	<b>1993</b>	<b>1999</b>	<b>1993</b>	<b>1999</b>
	n=7	n=7	n=1	n=1
<i>Trochosa terricola</i>	100	100	100	100
<i>Walckenaeria acuminata</i>	43	29		100
<i>Walckenaeria clavicornis</i>		14		
<i>Walckenaeria nudipalpis</i>	14		100	
<i>Walckenaeria vigilax</i>	29	14		
<i>Xysticus cristatus</i>	57	57	100	100
<b>TOTAL</b>	39	37	19	16

SPIDER SPECIES	UNIMPROVED GRASSLAND			
	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993 n=10	1999 n=10	1993 n=3	1999 n=3
<i>Agyneta decora</i>		10		33
<i>Allomengea scopigera</i>	20		33	
<i>Allomengea vidua</i>			33	
<i>Alopecosa pulverulenta</i>	50	30		33
<i>Antistea elegans</i>	10	10		
<i>Araeoncus crassiceps</i>		10		
<i>Bathyphantes approximatus</i>	10			
<i>Bathyphantes gracilis</i>	80	100	67	67
<i>Centromerita bicolor</i>	30	30	33	
<i>Centromerita concinna</i>	10			33
<i>Clubiona reclusa</i>		10		
<i>Dicymbium nigrum</i>	70	80	100	33
<i>Diplocephalus permixtus</i>	60	30		33
<i>Drassodes lapidosus</i>	10			
<i>Drepanotylus uncatus</i>	30	10		
<i>Erigone atra</i>	100	100	100	100
<i>Erigone dentipalpis</i>	100	90	100	100
<i>Erigone longipalpis</i>	10			
<i>Gnathonarium dentatum</i>	50	20	33	
<i>Gongylidiellum vivum</i>	50	20	33	
<i>Hypomma bituberculatum</i>	30		33	
<i>Labulla thoracica</i>	10			
<i>Lepthyphantes angulatus</i>	10			
<i>Lepthyphantes tenuis</i>	80	90	67	67
<i>Lepthyphantes zimmermanni</i>	70			
<i>Leptorhoptrum robustum</i>	60	50	67	33
<i>Lophomma punctatum</i>	60	20	33	
<i>Micrargus herbigradus</i>	40	10		
<i>Monocephalus fuscipes</i>	30	20		
<i>Oedothorax fuscus</i>	70	90	100	100
<i>Oedothorax gibbosus</i>	20	10	67	33
<i>Oedothorax retusus</i>	70	60	67	
<i>Pachygnatha clerckii</i>	80	60	67	33
<i>Pachygnatha degeeri</i>	90	90	67	100
<i>Pardosa agrestis</i>			33	
<i>Pardosa amentata</i>	100	70	100	67
<i>Pardosa nigriceps</i>	10		33	
<i>Pardosa palustris</i>	80	40	67	100
<i>Pardosa pullata</i>	100	80	100	67
<i>Pirata piraticus</i>	90	80	67	33
<i>Pocadicnemis pumila</i>			33	
<i>Robertus lividus</i>	30			
<i>Saaristoa abnormis</i>	10			
<i>Savignya frontata</i>	20	10	67	
<i>Tiso vagans</i>	60	30	33	
<i>Trochosa spinipalpis</i>		30		67
<i>Trochosa terricola</i>	80	40	33	33
<i>Walckenaeria acuminata</i>	10	20		
<i>Walckenaeria antica</i>	10			

UNIMPROVED GRASSLAND continued SPIDER SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=10	n=10	n=3	n=3
<i>Walckenaeria nudipalpis</i>	10			
<i>Walckenaeria vigilax</i>	30	30	33	
<i>Xysticus cristatus</i>	50	30	100	67
TOTAL	45	35	30	21

WOODLAND  SPIDER SPECIES	% FREQUENCY			
	PARTICIPANTS		NON-PARTICIPANTS	
	1993	1999	1993	1999
	n=1	n=1	n=3	n=3
<i>Agyneta decora</i>				33
<i>Agyneta subtilis</i>		100		
<i>Allomengea scopigera</i>			33	
<i>Bathypantes gracilis</i>		100	33	100
<i>Bathypantes nigrinus</i>			33	
<i>Ceratinella brevis</i>	100			
<i>Clubiona comta</i>			33	
<i>Clubiona lutescens</i>			33	
<i>Dicymbium nigrum</i>	100		67	
<i>Diplocephalus latifrons</i>	100	100	33	33
<i>Diplocephalus permixtus</i>	100			
<i>Erigone atra</i>	100	100	67	100
<i>Erigone dentipalpis</i>	100		33	67
<i>Erigonella hiemalis</i>			33	
<i>Erigonella ignobilis</i>		100		
<i>Gnathonarium dentatum</i>			33	
<i>Lepthyphantes angulatus</i>			33	
<i>Lepthyphantes cristatus</i>			33	
<i>Lepthyphantes flavipes</i>	100	100	33	67
<i>Lepthyphantes mengei</i>	100		33	
<i>Lepthyphantes obscurus</i>	100			
<i>Lepthyphantes tenebricola</i>	100		33	
<i>Lepthyphantes tenuis</i>		100	67	67
<i>Lepthyphantes zimmermanni</i>	100	100	100	100
<i>Leptorhoptrum robustum</i>			33	33
<i>Lophomma punctatum</i>			33	
<i>Monocephalus fuscipes</i>	100	100		33
<i>Oedothorax fuscus</i>	100	100	33	67
<i>Oedothorax retusus</i>			67	
<i>Pachygnatha clerckii</i>	100	100	100	
<i>Pachygnatha degeeri</i>			33	33
<i>Pardosa amentata</i>	100		67	33
<i>Pardosa nigriceps</i>			33	
<i>Pardosa palustris</i>	100			
<i>Pardosa pullata</i>		100	33	33
<i>Pirata piraticus</i>			33	
<i>Savignya frontata</i>			33	33
<i>Trochosa terricola</i>	100	100	33	33
<i>Walckenaeria acuminata</i>	100			
TOTAL	18	13	30	16



**Appendix 4. Mean soil data from each habitat in the West Fermanagh & Erne Lakeland ESA, with statistical significance between 1993 and 1999 (paired t – test).**

Habitat	ESA status	Test	n	93 mean	93 se	99 mean	99 se	sig.
Hay meadow	Non-participant	pH	11	5.7	0.08	5.3	0.05	***
Hay meadow	Participant	pH	20	5.5	0.11	5.3	0.08	*
Hay meadow	Non-participant	P	11	12.9	0.63	10.0	1.43	*
Hay meadow	Participant	P	20	22.5	3.27	17.4	2.89	**
Hay meadow	Non-participant	Mg	11	134.7	17.97	130.0	9.50	NS
Hay meadow	Participant	Mg	20	137.3	16.82	152.8	17.71	NS
Hay meadow	Non-participant	K	11	90.0	20.10	93.2	10.90	NS
Hay meadow	Participant	K	20	98.6	5.91	116.4	9.14	*
Wet grassland	Non-participant	pH	8	6.2	0.32	6.0	0.31	NS
Wet grassland	Participant	pH	14	5.8	0.23	5.7	0.15	NS
Wet grassland	Non-participant	P	8	10.3	1.76	6.5	1.00	NS
Wet grassland	Participant	P	14	14.3	1.63	14.0	2.01	NS
Wet grassland	Non-participant	Mg	8	159.4	22.34	205.4	30.35	NS
Wet grassland	Participant	Mg	14	176.2	19.41	188.6	26.13	NS
Wet grassland	Non-participant	K	8	107.9	20.00	101.3	25.71	NS
Wet grassland	Participant	K	14	121.3	16.30	133.7	17.20	NS
Limestone grassland	Non-participant	pH	2	4.7	0.49	4.5	0.18	NS
Limestone grassland	Participant	pH	11	5.9	0.31	6.2	0.27	NS
Limestone grassland	Non-participant	P	2	27.5	7.50	11.3	1.25	NS
Limestone grassland	Participant	P	11	16.5	3.97	10.5	2.69	NS
Limestone grassland	Non-participant	Mg	2	204.0	83.00	188.5	35.00	NS
Limestone grassland	Participant	Mg	11	355.0	87.03	650.5	130.95	*
Limestone grassland	Non-participant	K	2	107.5	18.50	173.0	6.50	NS
Limestone grassland	Participant	K	11	133.8	22.83	370.1	152.92	NS
Heather moorland	Non-participant	pH	1	4.4	-	4.3	-	NS
Heather moorland	Participant	pH	17	4.2	0.05	4.1	0.12	NS
Heather moorland	Non-participant	P	1	7.0	-	5.5	-	NS
Heather moorland	Participant	P	17	6.7	0.55	11.2	1.84	*
Heather moorland	Non-participant	Mg	1	82.0	-	149.5	-	NS
Heather moorland	Participant	Mg	17	173.7	13.85	172.6	16.95	NS
Heather moorland	Non-participant	K	1	79.0	-	102.0	-	NS
Heather moorland	Participant	K	17	132.4	32.02	119.8	6.50	NS

continued overleaf

**Appendix 4 continued. Mean soil data from each habitat in the West Fermanagh & Erne Lakeland ESA, with statistical significance between 1993 and 1999 (paired t – test).**

Habitat	ESA status	Test	n	93 mean	93 se	99 mean	99 se	sig.
Unimproved grassland	Non-participant	pH	5	5.6	0.16	5.4	0.29	NS
Unimproved grassland	Participant	pH	13	5.3	0.09	5.4	0.13	NS
Unimproved grassland	Non-participant	P	5	21.8	7.55	13.7	5.77	*
Unimproved grassland	Participant	P	13	13.1	1.17	10.6	1.45	NS
Unimproved grassland	Non-participant	Mg	5	102.6	6.35	135.7	14.73	NS
Unimproved grassland	Participant	Mg	13	144.0	12.97	121.2	13.67	*
Unimproved grassland	Non-participant	K	5	87.2	11.88	110.2	32.59	NS
Unimproved grassland	Participant	K	13	108.2	16.15	98.9	13.96	NS
Woodland	Non-participant	pH	4	6.5	0.10	6.3	0.31	NS
Woodland	Participant	pH	11	6.0	0.22	5.6	0.16	NS
Woodland	Non-participant	P	4	10.3	1.65	8.1	1.56	NS
Woodland	Participant	P	11	9.6	1.55	7.4	1.56	NS
Woodland	Non-participant	Mg	4	240.5	68.92	203.0	65.96	NS
Woodland	Participant	Mg	11	235.5	30.69	231.9	28.35	NS
Woodland	Non-participant	K	4	142.3	39.60	159.3	69.40	NS
Woodland	Participant	K	11	158.2	28.14	137.2	26.01	NS