Peatland spider communities and land management on a scottish island

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Introduction

Islay, a west coast Scottish island on the furthest extremity of the Celtic fringe, has a sub-Atlantic, hyper-oceanic climate providing a high number of rainfall days in the year. Boyd (1983) describes the vast areas of the island covered by mor soils with wet and blanket mire communities. On the basis of international comparison, Scotland contains relatively extensive peatlands with marked concentrations in the north and west; giving a 10.4% area cover of peatland (Gore, 1983). These extensive peatland areas are receiving the largest threat from changes in agriculture, forestry and drainage which risks alterations in microtopography composition and, as Coulson (1988) and Butterfield (1989) have shown, in the invertebrate populations. A study was conducted on Islay of the peatbog spider communities in relation to the land management, with six sites and 155 pitfall traps providing the data. The paper summarises investigations into the diversity and composition of the spider fauna in areas with management systems and stock densities.

Site Descriptions

Each of the six sites is described in the following paragraphs and summarised in Table 1.

Glac na Criche (C)
Glac na Criche is extensively grazed by sheep, and has been affected by a past management practice of heather burning. There are also a series of drainage channels taking rain-water away from the site and lowering the water table. The main vegetation composition is *Calluna-Eriophorum-Trichophorum* complex with the oceanic element of *Pleurozium shreberi* and the presence of *Erica cinerea*, usually associated with drier conditions.

Lag na Criche (L)
This area of blanket peatland is owned and managed by the R.S.P.B. specifically for the breeding bird populations. There is grazing from wild deer populations and drainage channels for nearby pasture fields. The high stands of *Calluna-Molinia* contrast the low *Sphagnum-Pleurozium* carpets.

Ardnahoe (A)
This site is surrounded by scrub birch dominated woodland and is heavily grazed by sheep and red deer stock. The area is protected from the heather burning of surrounding land by the small wooded band producing high stands of *Calluna-Molinia* and low *Sphagnum-Pleurozium shreberi-Polytrichum commune* carpets.

Am Mala, Killinallan (K)
This estate land is managed primarily for red deer stock. Past burning and grazing, by the large number of deer stock has meant that the dominant vegetation is *Molinia* with *Eriophorum*, and *Sphagnum*.

Eilean na Muice Duibhe, Duich Moss (D)
This site is a National Nature Reserve protected as a winter roosting site for Greenland White-fronted geese and is affected little from grazing or drainage. It is a *Sphagnum* bog with a vegetation complex of *Sphagnum-Calluna-Cladonia*.

Glenegedale (G)
Glenegedale is an area of blanket peat managed for the red deer stock but also has peatcutting banks. The site is drained and grazed with a vegetation complex of *Calluna-Molinia-Sphagnum* with *Erica cinerea*.

Table 1. Summary of Site Attributes

Site	Altitude (m)	% Soil Moisture	Mean Veg. Height (mm)	St.Dev Height	Veg.Sp. Diversity
C	50	86.12	13.38	4.59	4.57
L	20	85.76	34.33	20.13	3.04
A	80	87.76	33.96	20.57	3.76
K	40	91.82	17.35	8.96	4.06
D	40	92.67	16.37	8.07	6.74
G	90	88.55	18.50	9.00	4.85

Peatland Spider Results

A one year study (June 1988 to July 1989) was made of the spider communities of six sites on Islay using 155 pitfall traps, containing ethylene-glycol and detergent, giving 127 species from 9208 individuals. Luff (1975) demonstrated the inefficiencies of plastic pitfall traps however Curtis (1980) has shown there is a significantly higher catch from traps filled with a preservative/killing fluid.

Table 2 summarises the dominant species found as a total for all sites and for each of the six sites. Most of the spider species recorded were common across all six sites however some were indicative of certain sites e.g. *Gonatium rubens*, *Lepthyphantes mengei*, *Monocephalus fuscipes* and *Agyneta olivacea* found as dominant species of Lag na Criche (Site L).

Figure 1 summarises (a) the differences in spider species diversity and (b) spider species richness throughout the six sites. A significant difference was found in the species diversity of the sites and in the species richness.

Figure 2 represents ordination plots on spider species data showing the relationship and distribution of the sites across the axis. Figure 2 shows a definite split in the six sites classified by the spider species, with sites L (Lag na Criche) and A (Ardnahoe) grouped together; both sites have a high vegetation cover of *Calluna*.

Table 2. Dominant Spider Species

Name	Average 6 sites	Average Spiders per trap/each site C	L	A	K	D	G
Pardosa pullata	7.8	23.7	-	3.3	11.6	6.3	1.9
Alopecosa pulverulenta	4.3	2.8	-	8.2	4.6	4.0	5.3
Centromerita concinna	3.9	12.6	-	2.8	1.3	3.9	2.6
Lepthyphantes zimmermanni	3.4	-	8.2	5.6	-	1.7	1.8
Trochosa terricola	3.4	4.8	-	2.6	6.3	4.3	2.8
Pirata piraticus	3.4	9.3	2.8	1.2	4.8	2.6	-
Pardosa nigriceps	3.1	7.9	2.9	-	2.9	3.4	1.2
Pachygnatha clercki	2.4	2.3	3.0	1.4	3.6	2.5	1.3
Pocadicnemis pumila	2.3	-	7.6	3.6	-	-	-
Gonatium rubens	1.3	-	2.6	-	-	-	-
Walckenaeria acuminata	1.3	-	2.7	-	-	-	1.2
Lepthyphantes mengei	1.2	-	2.4	-	-	-	-
Bolyphantes luteolus	1.2	4.7	-	-	-	-	-
Pachygnatha degeeri	1.1	-	-	-	3.0	-	1.4
Ceratinella brevis	1.0	-	-	1.3	-	1.3	-
Agroeca proxima	0.95	-	-	-	-	2.6	-
Centromerita bicolor	0.95	3.7	-	-	-	-	-
Ceratinalla brevipes	0.75	-	-	-	-	-	1.0
Antistea elegans	0.75	2.9	-	-	-	-	-
Agyneta olivacea	0.73	-	2.6	-	-	-	-
Monocephalus fuscipes	0.55	-	2.4	-	-	-	-
Dicymbium tibiale	0.55	-	-	3.0	-	-	-
Silometapus elegans	0.49	-	-	-	1.5	-	-
Oedothorax gibbosus	0.45	-	-	-	1.8	-	-

Figure 1. Analaysis of variance on spider species data.

(a) Analysis of Variance on Spider Species Diversity by Site

$F = 16.45$ $p < 0.0001$

* = mean (within 95% confidence limits)

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SITE      MEAN      STDEV  -----+---------+---------+---------+-
Gla       7.592     2.171   (---*----)
Lag      14.394     3.066                              (----*---)
Ard      11.438     3.055                    (----*---)
Am        9.931     3.837              (----*----)
Eil      10.427     2.471                 (---*---)
Gle      10.061     2.733               (---*----)
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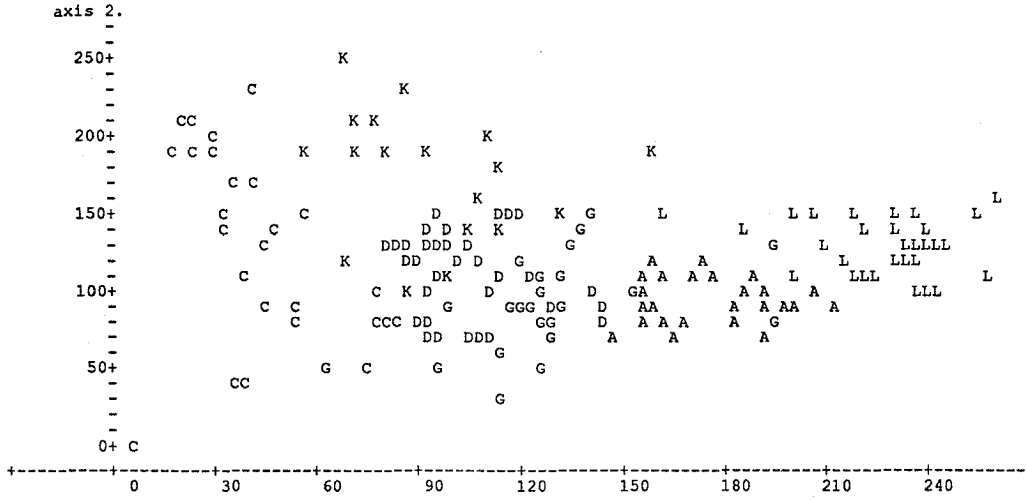
(b) Analysis of Variance on Spider Species Richness by Site

$F = 18.95 \quad p < 0.0001$

* = mean (within 95% confidence limits)

SITE	MEAN	STDEV	-----+---------+---------+---------+-
Gla	22.200	4.425	(----*---)
Lag	25.633	4.923	(---*---)
Ard	21.240	4.265	(---*---)
Am	21.550	5.125	(----*----)
Eil	17.367	3.102	(--*---)
Gle	15.880	3.655	(----*---)

Figure 2. Ordination plot based on detrended correspondence analysis of spider data. Points labelled to indicate sites; note the clear trend from C (Glac na Criche) to K (Am Mala), then D (Eilean na Muice Duibhe) mixed with G (Glenegedale), to A (Ardnahoe) and finally L (Lag na Criche). This trend reflects difference in the conditions at the sites relatable in part to management.



Site Comparison and Discussion

Management is seen as having two classes of effects. Operations such as drainage, burning, grazing and cutting largely influence the relative abundances of native species. Changing land use, such as afforestation or agricultural improvement, drastically alters the species complement and hence many ecosystem functions (Usher & Gardner 1988).

Tables 1 and 2 show clearly the differences in community assemblages of spiders and environmental parameters for the six peatland sites. Glac na Criche has a low vegetation cover, due to grazing pressure and heather burning, and lower soil moisture providing habitat for large numbers of Lycosids (Table 2) giving a high spider species richness value (Figure 1(a)) but low species diversity (Figure 1(b)). Figure 2 shows Glac na Criche (C) separating out on its own in the ordination.

In contrast Lag na Criche, which is managed by the R.S.P.B. for the breeding bird population with restricted grazing, has a high vegetation cover of *Calluna vulgaris* with low moss carpets and lower soil moisture providing conditions for both the surface active Lycosids and the web-spinning Linyphiids. This has produced a high spider species richness and high species diversity value (Figure 1 (a), (b)). Ardnahoe, which has a high vegetation cover of *Calluna* and moss carpets due to protection from heather burning by a small stretch of woodland, also has higher spider species diversity and richness values and has been grouped with Lag na Criche in the ordination plots (A & L) (Figure 2).

Eilean na Muice Duibhe is the wettest of the six sites, protected as a National Nature Reserve and receiving minimum impact from grazing or drainage, allowing the water table to remain high therefore maintaining the wet peatland vegetation dominated by *Sphagnum*. Am Mala also maintains a high soil moisture content but the vegetation composition has been affected by grazing pressures and past burning. Glenegedale vegetation composition is affected by drainage, grazing and peat extraction but maintains a similar vegetation height cover and spider species diversity as Am Mala and Eilean na Muice Duibhe (Table 1; Figure 1(a)). Figure 2 shows the grouping together of the three sites (D, K and G)in the ordination. Figure 1(b) shows similar species richness values for Eilean na Muice Duibhe and Glenegedale but Am Mala species richness is higher due mainly to the proportion of single species found.

Changes in land use practices through intensive agriculture, drainage, grazing, burning and also afforestation, affect the soil conditions and the vegetation composition threatening the survival of peatland species (Usher & Gardner 1988). The data summarised in Tables 1 & 2 and in Figures 1 & 2 show the differences in the spider community assemblages attributed to changes in the vegetation microtopography produced by direct or indirect management practices.

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