The Flow Country

The peatlands of Caithness and Sutherland

R A Lindsay, D J Charman, F Everingham, R M O'Reilly, M A Palmer, T A Rowell and D A Stroud

Edited by D A Ratcliffe and P H Oswald

Please note: This is a section of the full report please visit http://www.jncc.gov.uk/page-4281
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Annex

1 Vegetation and small-scale patterning

As part of the programme for the NCC's revision of its guidelines for the selection of biological Sites of Special Scientific Interest, a number of sites, taken from the main areas of peatland distribution in Britain, were selected for detailed survey between 1982 and 1985. The survey methods were designed to identify geographical trends in both mire surface pattern and vegetation and to determine whether any relationships existed between these two features. As part of this survey, seven sites in Caithness and Sutherland were examined.

In order to illustrate the range of detailed surface patterning within and between sites across Caithness and Sutherland and the distribution of vegetation types within these, data from five of the sites are presented here. These transect profiles are merely examples of the range of microtopography

Table 14a

Synoptic table for Dubh Lochs of Shielton. Constancy values are indicated in Roman numerals. High abundance is indicated by an asterisk.
and vegetation patterning, to show how the two interact and to emphasise the way in which pattern and vegetation change from east to west across the two Districts. The full range of variation is much greater than is shown by these examples and should be a major element in determining the scope of a mire protection programme.

**Methods of survey and analysis**

Transect lines were used as the standard sampling method on each site in the hope that the scale of pattern for both vegetation and microtopography would emerge from the study, rather than be imposed by the sampling method. Kershaw (1973) stated that transects with contiguous quadrats are most appropriate for sampling within small-scale environmental gradients. The method had been used to some effect by Godwin & Conway (1939) on Cors Tregaron in Wales. Like Godwin & Conway, the NCC surveyors took 10 cm squares as the basic mapping unit, but these lay contiguously within a transect of 0.5 m x 2 m. Five transects were taken from each site and were placed so as to sample as wide a range of microtopography as possible. The relative abundance of each vegetation type and zone in the microtopography within the transect did not therefore reflect the overall abundance on the site.

Species were recorded on a three-point scale - Dominant, Common, Rare - within each 10 cm square, and the height of each square was noted (±0.5 cm) relative to an arbitrary datum. Stereo-photographs were taken of each transect. The vegetation records were then analysed by using TWINSPLAN (Hill 1979), and the resulting noda were mapped onto a representation of the transect grid. The TWINSPLAN noda were recombined up the hierarchy until the distribution of noda on the transect corresponded with any vegetation pattern discernible on the stereo-photographs; i.e. the final noda existed in a recognisable form in the field. The details of the noda for each site were drawn up into a synoptic table with the use of a computer spreadsheet.

The height data for the transects were then plotted on the transect grid. The range of heights for each nodum and its mode were recorded. The location of the average water table, which is the single most important limiting factor within the microtopography, was taken to be represented by the upper limit of vegetation noda characterised by *Sphagnum*

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**Table 14b**

Synoptic table for Strathy Bog. Constancy values are indicated in Roman numerals. High abundance is indicated by an asterisk.
Table 14c
Synoptic table for Loch Bad a’Choille. Constancy values are indicated in Roman numerals. High abundance is indicated by an asterisk.

cuspidatum, a good indicator of the transition from aquatic to terrestrial conditions in British mires. This upper limit for each site was taken as the factor necessary to correct the arbitrary height data to heights relative to the average water table.

Small-scale vegetation and surface patterns in Caithness and Sutherland

Tables 14a-e provide synoptic results for each of the five sites. Figures 87a-j present the data for each transect as a three-dimensional surface plot, generated by PC-Surfplot, and as a graph of ranges and medians for the vegetation noda. By using the combined information obtained from the synoptic tables and surface plots, the noda were provisionally assigned to associations described by Birse (1984) or Dierssen (1982). In the main surface plot in each figure, the noda or associations are mapped onto the 10 cm squares which make up the transect grid. The smaller surface plot shows the distinction between aquatic and terrestrial conditions within the transect. The graph of ranges and medians combines information from two of the five transects from each site, selected arbitrarily, and distinguishes between the height ranges for any nuda which occurs on both transects. The vertical scale for all such graphs has been standardised for the entire range of transects. The height range of one transect can therefore be compared directly with that of another, though the five height range graphs are also displayed together in Figure 88 to make comparison easier.

Dubh Lochs of Shielton

The most easterly of the sites, this shows a clear northern boreal influence in its vegetation. The

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149
Potentilla erecta

Hypnum cupressiforme  IV  I
Racomitrium lanuginosum  III*  I
Cladonia implexa  V*  II  I
Bare peat  III  I  II
Pleurozium schreberi  I
Calluna vulgaris  V*  IV  IV*  I
Sphagnum rubellum  III*  V*  V*  III  I  I
Sphagnum subnitens  II  I  I
Myrica gale  II  II  II  I  I
Erica tetralix  IV*  IV*  III  II  I
Odontoschisma sphagni  II  I  I
Eriophorum vaginatum  I  I  II  I
Drosera rotundifolia  IV*  II  III  I
Molinia caerulea  IV  II  III  II  I  I
Cladonia uncialis  I  I  I
Sphagnum magellanicum  III  V*  IV  III  I
Narthecium ossifragum  II  V*  III
Sphaennum tenellum  III  V*  II  IV*
Cephalozia connivens  I
Trichophorum cespitosum  I  II  II
Pleurozia purpurea  I  III
Sphagnum papillosum  II  V*  IV*  II  I
Eriophorum angustifolium  III  III  IV*  IV*  I
Sphagnum compactum  I
Rhytidiadelphus loreus  III  IV  IV*  III  I
Menyanthes trifoliata  II  II  II  I
Wet bare peat  I
Drosera anglica  I  II  II  I
Sphagnum cuspidatum  I  IV*  V*  V*
Sphagnum auriculatum  I  III*  II
Open water  II  V*
Carex limosa  I  II  II
Amorphous peat  I  II  V*
Molinia litter  I  IV  II
Eleocharis multicaulis  I

Table 14d

Synoptic table for Blar nam Fear Mhora. Constancy values are indicated in Roman numerals. High abundance is indicated by an asterisk.

broad T2 high ridges are dominated by dwarf shrubs, though with a Sphagnum understorey, and a range of hypnoid mosses such as Hylocomium splendens, Rhytidiadelphus loreus and Hypnum cupressiforme can be found within the moss layer. Arctostaphylos uva-ursi occurs on high hummocks and across some high ridge areas towards the margin of the site. This species has been taken as an indicator of continental affinities (Goode & Ratcliffe 1977), but, as it is regarded as a woodland species in Fennoscandia, the relationship is not entirely clear.

The lack of both Molinia caerulea and Racomitrium lanuginosum is an important feature, as is the presence of Eleocharis multicaulis in the Al hollows and deep A3/A4 pools. The site is one of the few for Vaccinium microcarpum in the two Districts.

The extreme height range of the site can be seen in Figures 87a-b, where the wide T2 ridges possess a relatively uniform vegetation cover and the deep watershed pools drop away with very little marginal vegetation.

Strathy River Bog

Described by Pearsall in 1956, this is one of the classic sites of British mire ecology. The small valleyside flow is dominated by crescentic hollows which are much shallower than the deep watershed pools of the Dubh Lochs of Shielton. Figure 87c illustrates a cross-section of such an A2 mud-bottom hollow, in contrast to an Al Sphagnum carpet, whereas Figure 87d demonstrates the gradual transition from T1 low ridge dominated by Sphagnum papillosum down to S. cuspidatum Al carpet. AS. imbricatum T3 hummock is illustrated in Figure 87c.

Arctostaphylos uva-ursi occurs in small amounts, but it is joined by the characteristic shrub of northern boreal mires, Betula nana. Here it is within the central part of its distribution. The site lies near the transition between the Erico-Sphagnetum magellanici and the Pleurozio-Ericetum tetralicis, indicated by the small amounts of Racomitrium lanuginosum and Pleurozia purpurea in the sward.
Hylocomium splendens

I

Sphagnum fuscum

V*

Pleurozium schreberi

II

Empetrum nigrum

V* II V*

Ericophorum vaginatum

III I II I I

Drosera rotundifolia

III II I II

Sphagnum subnitens

II

Rhizidiadelphus loreus

I

Erica tetralix

IV III III III II I

Hylocomium cupressiforme

I I V* I

Racomitrium lanuginosum

I V* I IV* I

Ericophorum angustifolium

II III III III III I

Cladonia uncialis

I I I

Cladonia impexa

I II III I

Sphagnum rubellum

V* II III I

Bare peat

I V* IV* IV* I

Calluna vulgaris

II V* IV* IV* IV* I

Carex pauciflora

I I

Trichophorum cespitosum

I I IV* III IV I IV* I

Narthecium ossifragum

I IV* IV V* V* I III I

Pleurozia purpurea

V* II

Sphagnum tenellum

III II IV IV* I

Mylia anomala

I I

Sphagnum papillosum

I I V* I I

Drosera anglica

I II I III

Wet bare peat

I I V*

Menyanthes trifoliata

I I I I

Carex limosa

I IV I I

Sphagnum cuspidatum

I I II IV III

Sphagnum auriculatum

I III I I

Amorphous peat

I II V* V* V*

Open water

V*

Table 14e

Synoptic table for Allt an Fhaing. Constancy values are indicated in Roman numerals. High abundance is indicated by an asterisk.

Loch Bad a’ Choille

This site is an example of the mire type identified as ladder fen and described in Chapter 9. The hollows are typical mud-bottom ones, with dominant bare peat and a scatter of aquatic Sphagna, but the slight minerotrophic element in the site is indicated by the presence of Potamogeton polygonifolius. Similarly, the ridges indicate an enhanced level of enrichment by the presence of Carex dioica and, to a lesser extent, C. pauciflora, Molinia caerulea and Pinguicula vulgaris.

The relative abundance of Molinia, Pleurozia purpurea and Racomitrium lanuginosum confirms the ridge communities as facies of the Pleurozio-Ericetum tetralsicus, though some ladder fen ridges are more closely related to the Campylio-Caricetum dioicae.

The relatively small-scale relief, typically consisting of no more than T2, T1 and A2 (high ridge, low ridge and mud-bottom), is clearly seen on the surface plots and the graphs of height ranges (Figures 87c-f).

Blar nam Fear Mhora

This is the most westerly of the examples, lying within the line of the Moine Thrust mountains and 10 km east of Lochinver, a major west coast fishing port. The small-scale relief of this site is in complete contrast to the microtopography of the Dubh Lochs of Shielton, although the immediate appearance of many of the A2/A3 pools is very similar to that in parts of the Dubh Lochs. The wide, open water pools are in fact relatively shallow, as indicated by Figure 87h. The dense mixture of detritus and Molinia litter produces a matrix which, though not capable of supporting the weight of a man, can form a firm base into which species such as Carex limosa, Eleocharis multicaulis and Rhynchospora alba can root. This type of pool bottom is common in hyperoceanic areas, and the influence of accumulated Molinia litter within pools on the Silver Flowe is discussed by Goodet(1970).

The presence of Potentilla erecta, Molinia caerulea, Pleurozia purpurea and Rhynchospora alba, together with hummocks of Racomitrium
Figure 87 Surface plots for sites listed in Tables 13a-e indicating - (a) distribution of individual vegetation associations within the 2 m x 50 cm transects, together with (b) the location of the average water table through the transect, and (c) the median and range of heights for each association. Associations which occur in two transects on the same site are indicated as separate records in the graph of heights (c). Surface and water table plots generated by Surfplot.

Figure 87a

lanuginosum not linked to erosion or damage, typifies the mire vegetation of western Sutherland, contrasting strongly with that of eastern Caithness. Indeed, the vegetation is more closely related to that found in the Hebrides (Goode & Lindsay 1979; Lindsay et al. 1983) or western Ireland (Boatman 1960).

Allt an Fhaing

This site is included to demonstrate some of the effects of damage and erosion on vegetation and microtopography. It lies on the flood plain of the Allt an Fhaing and has a surface pattern consisting largely of erosion features, though some small areas remain relatively intact.

The highest level in the pattern is occupied by Sphagnum fuscum hummocks. Though regarded as important features because S. fuscum is fast becoming an endangered species in Britain, such hummocks are typically the slowest part of the original surface pattern to be lost when erosion produces a lowering of the average water table. This is because hummock species are more adapted to long drought periods and can therefore tolerate the effects of drawdown in the water table more easily.
Figure 87b

Dubh Lochs of Shielton Transect 4

Nodum

Related communities described in existing literature

C  D3

Erico-Sphagnum papilloi, Typical subassociation, Typical variant, Subvariant with Empetrum nigrum

D  D1

Erico-Sphagnum papilloi, Typical subassociation, Typical variant, Typical subvariant

Author

Birse

Birse
Figure 87c

Strathy Bog Transect 2

<table>
<thead>
<tr>
<th>Code</th>
<th>Location</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>S6</td>
<td><em>Eriophorum angustifolium</em>, Subassociation with <em>Sphagnum cuspidatum</em></td>
</tr>
<tr>
<td>D</td>
<td>S5</td>
<td><em>Eriophorum angustifolium</em>, Subassociation with <em>Sphagnum cuspidatum</em></td>
</tr>
<tr>
<td>F</td>
<td>S4</td>
<td><em>Eriophorum angustifolium</em>, Subassociation with <em>Sphagnum cuspidatum</em></td>
</tr>
<tr>
<td>H</td>
<td>S1</td>
<td><em>Erico-Sphagnetum magellanici</em>, Typical subassociation, Phase with <em>Sphagnum imbricatum</em>, Typical variant</td>
</tr>
</tbody>
</table>

Author:
- Dierssen
Figure 87d

Strathy Bog Transect 4

<table>
<thead>
<tr>
<th>Nodum</th>
<th>Related communities described in existing literature</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td><em>Eriophorum angustifolium</em>, Subassociation with <em>Sphagnum cespitatum</em></td>
<td>Diersen</td>
</tr>
<tr>
<td>C</td>
<td><em>Eriophorum angustifolium</em>, Subassociation with <em>Sphagnum cespitatum</em></td>
<td>Diersen</td>
</tr>
<tr>
<td>E</td>
<td><em>Eriophorum angustifolium</em>, Subassociation with <em>Sphagnum cespitatum</em></td>
<td>Diersen</td>
</tr>
<tr>
<td>O</td>
<td><em>Erico-Sphagnetum magellanicum</em>, Subassociation with <em>Cladonia uncialis</em>, Typical variant</td>
<td>Diersen</td>
</tr>
</tbody>
</table>
Figure 87e

Loch Bad a'Choille Transect 1

Nodum: Related communities described in existing literature

B C6: Caricetum limosae, Typical subassociation

D C7: Enophorum angustifolium, Subassociation with Sphagnum cuspidatum

E C3: Erica-Sphagnetum magellanici, Subassociation with Cladonia uncialis, Phase with Raumtrium lanuginosum

G C4: Pleurozio-Ericetum tetralicis, Facies with Molinia caerulea

Author

Dierssen

Dierssen

Dierssen

Dierssen
Figure 87f

Loch Bad a’Choille Transect 4

<table>
<thead>
<tr>
<th>Nodum</th>
<th>Related communities described in existing literature</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>A C6</td>
<td>Caricetum limosae, Typical subassociation</td>
<td>Diersen</td>
</tr>
<tr>
<td>C C7</td>
<td>Eriophorum angustifolium, Subassociation with Sphagnum cuspidatum</td>
<td>Diersen</td>
</tr>
<tr>
<td>F C5</td>
<td>Erica-Sphagnum papillosi, Typical subassociation, Variant with Molinia caerulea, Typical subvariant</td>
<td>Birse</td>
</tr>
<tr>
<td>H C2</td>
<td>Erica-Sphagnum papillosi, Typical subassociation, Variant with Molinia caerulea, Typical subvariant</td>
<td>Birse</td>
</tr>
<tr>
<td>J C1</td>
<td>Erica-Sphagnum papillosi, Typical subassociation, Variant with Molinia caerulea, Typical subvariant</td>
<td>Birse</td>
</tr>
</tbody>
</table>
**Figure 87g**

Blar nam Fear Mhora Transect 1

<table>
<thead>
<tr>
<th>Nodum</th>
<th>Related communities described in existing literature</th>
<th>Author</th>
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</thead>
<tbody>
<tr>
<td>C</td>
<td>Sphagno tenellii-Rhynchospora albae, Subassociation with <em>Sphagnum auriculatum</em>, Variant with <em>Rhynchospora alba</em></td>
<td>Dierssen</td>
</tr>
<tr>
<td>E</td>
<td>Sphagno tenellii-Rhynchospora albae, Subassociation with <em>Sphagnum tenellium</em>, Variant with <em>Sphagnum papillosum</em></td>
<td>Dierssen</td>
</tr>
<tr>
<td>F</td>
<td>Sphagno tenellii-Rhynchospora albae, Subassociation with <em>Sphagnum tenellium</em>, Variant with <em>Sphagnum papillosum</em></td>
<td>Dierssen</td>
</tr>
<tr>
<td>H</td>
<td>Sphagno tenellii-Rhynchospora albae, Subassociation with <em>Sphagnum tenellium</em>, Variant with <em>Sphagnum papillosum</em></td>
<td>Dierssen</td>
</tr>
<tr>
<td>J</td>
<td>Sphagno tenellii-Rhynchospora albae, Subassociation with <em>Sphagnum papillosum</em>, Facies with <em>Rhynchospora alba</em></td>
<td>Dierssen</td>
</tr>
</tbody>
</table>
Figure 87h

Blar nam Fear Mhora Transect 3

<table>
<thead>
<tr>
<th>Nodum</th>
<th>Related communities described in existing literature</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Eleocharitetum multicaulis, Subassociation with Sphagnum auriculatum</td>
<td>Dierssen</td>
</tr>
<tr>
<td>B</td>
<td>Sphagno tenelli-Rhynchospora albae, Subassociation with Sphagnum auriculatum, Variant with Rhynchospora alba</td>
<td>Dierssen</td>
</tr>
<tr>
<td>D</td>
<td>Sphagno tenelli-Rhynchospora albae, Subassociation with Sphagnum tenellum, Variant with Sphagnum papillosum</td>
<td>Dierssen</td>
</tr>
<tr>
<td>G</td>
<td>Sphagno tenelli-Rhynchospora albae, Subassociation with Sphagnum tenellum, Variant with Sphagnum papillosum</td>
<td>Dierssen</td>
</tr>
<tr>
<td>K</td>
<td>Sphagno tenelli-Rhynchospora albae, Subassociation with Sphagnum papillosum, Facies with Rhynchospora alba</td>
<td>Dierssen</td>
</tr>
<tr>
<td>L</td>
<td>Pleurozio-Ericetum tetralicis, Subassociation with Raconitrium lanuginosum, Facies with Molinia caerulea</td>
<td>Dierssen</td>
</tr>
</tbody>
</table>
**Figure 87i**

Allt an Fhaing Transect 1

<table>
<thead>
<tr>
<th>Nodum</th>
<th>Related communities described in existing literature</th>
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<tbody>
<tr>
<td>A</td>
<td><em>Eriophorum angustifolium</em>, Subassociation with <em>Sphagnum cuspidatum</em> (<em>AF9 lacks Eriophorum angustifolium</em>)</td>
<td>Dierssen</td>
</tr>
<tr>
<td>B</td>
<td><em>Sphagno tenelli-Rynchosporum albae</em>, Subassociation with <em>Sphagnum tenellum</em>, Variant with <em>Sphagnum papillosum</em> (<em>AF8 lacks Rynchospora alba</em>)</td>
<td>Dierssen</td>
</tr>
<tr>
<td>C</td>
<td><em>Narthecia-Sphagnetum papillosi</em>, Typical subassociation, Typical variant</td>
<td>Dierssen</td>
</tr>
<tr>
<td>D</td>
<td>Pleurozio-Erietum tetralicis, <em>Molinia caerulea fasicies</em>, Subassociation with <em>Racomitrium lanuginosum</em> (<em>AF5 lacks Molinia caerulea</em>)</td>
<td>Dierssen</td>
</tr>
</tbody>
</table>
Figure 87j

Allt an Fhaing Transect 4

<table>
<thead>
<tr>
<th>Node</th>
<th>AF4</th>
<th>Description</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Empetro-Eriophoretum*, Typical subassociation (*AF4 lacks Rubus chamaemorus)</td>
<td>Dierssen</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Empetro-Eriophoretum*, Subassociation with Cladonia arbuscula**, Variant with Raconitrium lanuginosum (*AF2 lacks Rubus chamaemorus, **AF2 lacks Cladonia arbuscula)</td>
<td>Dierssen</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Empetro-Sphagnetum fusci, Subassociation with Sphagnum fuscum, Typical formation with Calluna vulgaris</td>
<td>Dierssen</td>
<td></td>
</tr>
</tbody>
</table>
than species typical of wetter levels in the microtopography (see Chapter 5). In addition, the extremely fibrous nature of hummocks makes them highly resistant to erosive scouring (Hobbs 1986).

*Racomitrium lanuginosum* is present as hummocks and within the T1/T2 ridge, but its relative abundance on this site is more an indication of damage than a reflection of climate. Indeed the level of damage can be seen from the extensive occurrence of noda AF1 and AF2 throughout the T2 zone. Once down from the hummocks, the general mire surface is dominated by these two noda, which are characterised by abundant bare peat and *Trichophorum cespitosum*.

The T1 zone (low ridge) is reduced to a small fringe of vegetation dominated by *Sphagnum tenellum* around the margins of eroding hollows and pools. *S. tenellum* is characteristic of damaged areas in the west. It acts as 'scar tissue' on ground which has been burnt or drained and then resoaked (Lindsay unpublished) and forms a distinct association with *S. cuspidatum* on ground which is eroding but has not reached the deep gully stage. This type of ground has been termed "microbroken" during the survey, because it indicates a microtopography which is broken into an anastomosing network enclosing small ridge-islands but which has not developed the deep gullies and hags of the more typical dendritic erosion complex. The channels of such microbroken ground are characteristically dominated by a *Sphagnum tenellum/S. cuspidatum* mixture which is illustrated by noda AF8 and AF9; the form of this microtopography is well illustrated by Figure 87i.

The wide range of heights displayed by the microtopography at Ailt an Fhaing is typical of an eroding surface, where the ridge zone is left high above the water table and hummocks become hags.
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