



▲ Moorland landscape with muirburn • © Caspian Richards

## 7. Mountain, Moor and Heath

### Summary

- No significant changes were detected in the overall extents of the six Broad Habitats which make up the upland landscape mosaic across Scotland as a whole between 1998 and 2007. There were significant changes in the areas of two of these Broad Habitats in specific Environmental Zones (EZ) within Scotland.
- The area of Bracken Broad Habitat in the Intermediate Uplands and Islands (EZ5) increased by 27% between 1998 and 2007.
- The area of Bog Broad Habitat in the Lowlands (EZ4) decreased by 2.5% between 1998 and 2007.
- A substantial decline of over 113,000ha was detected in the area of Dwarf Shrub Heath between 1990 and 2007 but changes between 1998 and 2007 were not significant.
- No increases were detected in plant species associated with higher nutrient levels (eutrophication) in any of the mountain, moor and heath Broad Habitats between 1998 and 2007.
- Over the period 1990 to 2007, there was a significant decrease of 12% in the mean Species Richness Score in the Dwarf Shrub Heath Broad Habitat from an average of 20.3 to 17.8 plant species per plot. Plant species richness also decreased between 1998 and 2007 (by 23%) in Fen Marsh and Swamp Broad Habitat and by 11% in Bog.
- In Dwarf Shrub Heath and Bog Broad Habitats the cover of grass species relative to forbs increased between 1998 and 2007. Competitive plant species also increased in Bog suggesting deterioration in the condition of Bog Broad Habitat. Competitive species also increased in Bracken.

- In Dwarf Shrub Heath, Bog, and in Fen, Marsh and Swamp, there was no significant change in soil (0-15cm) pH between 1998 and 2007. However, all four Broad Habitats were less acidic in 2007 compared to 1978, due mainly to a pH increase between 1978 and 1998.
- The acidity of soils (0-15cm) in Bracken Broad Habitat has not changed significantly between any of the surveys or across the period as a whole.
- In soils (0-15cm) in Bracken, Dwarf Shrub Heath and Bog Broad Habitats, the carbon concentrations in 2007 were not significantly different from 1978 values.
- In soil (0-15cm) in Fen, Marsh and Swamp Broad Habitat, carbon concentration decreased significantly between 1998 and 2007; the concentration of soil (0-15cm) carbon in 2007 in this Broad Habitat was not significantly different from that of 1978.

## 7.1 Introduction<sup>1</sup>

Six Broad Habitats make up the mosaic of open, unenclosed landscapes in the UK that many people associate with wild land and enjoy as semi-natural, and in some sense, 'unspoilt' mountain, moor and heathland. The majority of these Broad Habitats (75% of the UK extent) are found in Scotland, predominantly in upland areas. Many of these areas, e.g. the Cairngorms, and Loch Lomond and the Trossachs, are also designated as National Parks or National Scenic Areas, Special Protection Areas or Sites/Areas of Special Scientific Interest.

Detailed descriptions of the six Broad Habitats are provided below. Within these six Broad Habitats there are a number of UK BAP Priority Habitats, the most significant of which is Blanket Bog which is particularly extensive in Caithness and Sutherland and the Western Isles. Descriptions of these Priority Habitats are provided in Section 7.5. The UK BAP includes targets to maintain the area and condition of these Priority Habitats for which Scotland is of key importance.

Condition of these habitats is assessed using a range of plot types which has been added to over time (see **Section 1.4.2, UK Report**) to enhance the ability of Countryside Survey (CS) to monitor change in these upland more unenclosed landscapes. Main Plots sample the main extent of these Broad Habitats. Targeted Plots tend to be used in these habitats to sample atypical areas of vegetation (where present) such as particularly wet/dry or rocky areas and areas of Priority habitat not sampled by other plot types. Unenclosed Plots (2 x 2m) were introduced into the survey in 1998 with the specific purpose of providing more information about the habitats of mountain, moor and heath which tend to be quite difficult to map precisely.



▲ Surveyor at work • © NERC

## 7.2 Description of the Broad Habitats

The six Broad Habitats covered in this chapter are:

**Bracken:** areas with a 95-100% cover of bracken plants (CS definition). If cover is less than this the area will be recorded as the underlying vegetation (potentially Acid Grassland) with bracken recorded as a species with a cover value. The Bracken Broad Habitat is included in this Chapter as it is most usually associated with the uplands, although it is found throughout Scotland.

**Dwarf Shrub Heath:** characterised by areas dominated by small shrubby heath species such as heather (*Calluna vulgaris*), Cross-Leaved Heath (*Erica tetralix*) and/or Blaeberry (*Vaccinium myrtillus*). Note that stands of Common or European Gorse, *Ulex europaeus*, are included in Broadleaved, Mixed and Yew Woodland Broad Habitat. Dwarf Shrub Heath is associated with extensive upland areas in Scotland, as well as lowland and coastal regions.

**Bog Broad Habitat:** this includes blanket, raised and valley bogs. It is predominantly found in the uplands where rainfall is high. The water chemistry is nutrient-poor and tends to be acidic and the habitat is dominated by acid-loving plant communities, especially *Sphagnum* mosses.

<sup>1</sup> Note: For further information on the Broad Habitat classification, Vegetation Aggregate Classes or ACs, sampling plots and other Countryside Survey terminology see Chapter 1, UK Report (Methodology).



▲ Upland landscape, Loch Lomond • © Helen M Jones

**Fen, Marsh and Swamp:** includes varied, often small, wetland habitats that are fed by ground or river waters as well as rainfall. The peaty or mineral soils are permanently, seasonally or periodically wet with vegetation dominated by herbs, sedges and rushes rather than grasses.

**Inland Rock:** where it occurs naturally, this is very much a feature of the True Uplands. Natural exposed rock surfaces largely devoid of vegetation form most of this Broad Habitat, alongside smaller areas found in man-made situations such as quarries.

**Montane:** this Broad Habitat covers a very small area of the UK, and is almost entirely confined to Scottish peaks. It includes montane heath and snow bed communities alongside moss and lichen dominated heaths of mountain summits. As a result of its relative rarity and confined distribution, few areas of this Broad Habitat fall within the CS sample.

The Acid Grassland Broad Habitats and mosaics of Acid Grassland, Bracken and Bog make up much of the marginal upland areas of Scotland. The results for Acid Grassland are reported in *Chapter 4*.

## 7.3 Changes in the area of mountain, moor and heath Broad Habitats

- No significant changes were detected in the overall extents of the six Broad Habitats which make up the upland landscape mosaic across Scotland as a whole between 1998 and 2007. There were significant changes in the areas of two of these Broad Habitats in specific Environmental Zones (EZ) within Scotland.
- The area of Bracken Broad Habitat in the Intermediate Uplands and Islands (EZ5) increased by 27% between 1998 and 2007.
- The area of Bog Broad Habitat in the Lowlands (EZ4) decreased by 2.5% between 1998 and 2007.

- A substantial decline of over 113,000ha was detected in the area of Dwarf Shrub Heath between 1990 and 2007 but changes between 1998 and 2007 were not significant.

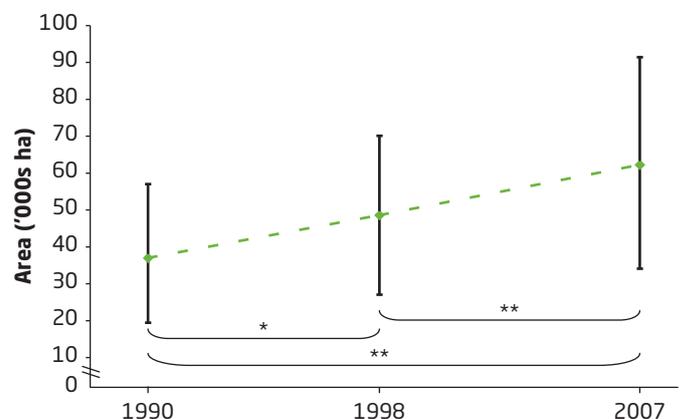
### 7.3.1 Bracken

The estimated area of Bracken Broad Habitat in 2007 was approximately 131,000 ha, which represents 1.6% of the land area (see *Table 7.1*). The area of Bracken changed little in the Lowlands and True Uplands (EZ 4 & 6) but increased by approximately 27% in the Intermediate Uplands and Islands (EZ 5) between 1998 and 2007, following an increase of 32% between 1990 and 1998. This is a variable habitat, and the density of bracken cover determines whether an area is recorded as Bracken Broad Habitat, so the area estimates can be affected by small changes in bracken cover between surveys (e.g. a decrease from 95% to 90% bracken cover would result in a change in the Broad Habitat classification) (*Fig. 7.1*).



▲ Bracken • © SNH

▼ **Figure 7.1:** Change in the area of the Bracken Broad Habitat between 1990 and 2007 in the Intermediate Uplands and Islands (EZ5). Significant changes (\*  $p < 0.05$ , \*\*  $p < 0.01$ ) are shown between the dates bracketed. 95% Confidence Intervals are shown for each data point. Confidence Intervals on change are not shown.



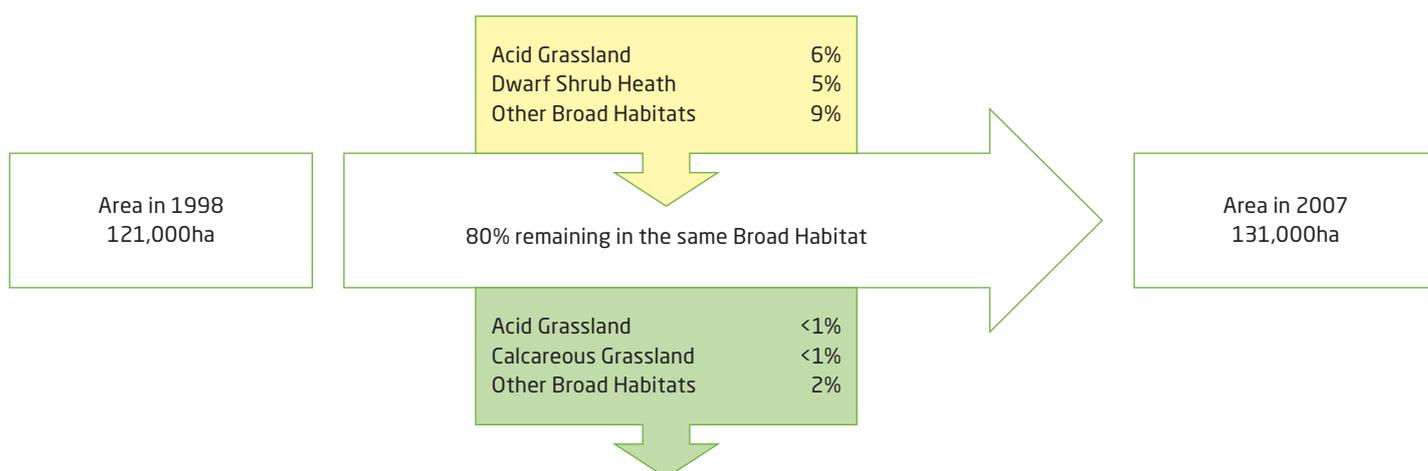
▼ **Table 7.1:** Estimated area ('000s ha) and percentage of land area of the Bracken Broad Habitat in each Environmental Zone and across Scotland from 1990 to 2007. Arrows denote significant change ( $p < 0.05$ ) in the direction shown.

	1990		1998		2007		Direction of significant changes 1998-2007
	Area ('000s ha)	%	Area ('000s ha)	%	Area ('000s ha)	%	
EZ4	21	1.0	25	1.1	23	1.0	
EZ5	37	1.4	49	1.9	62	2.4	↑
EZ6	49	1.5	47	1.5	46	1.4	
Scotland	107	1.3	121	1.5	131	1.6	

▼ **Table 7.2:** Estimated area ('000s ha) and percentage of land area of Dwarf Shrub Heath Broad Habitat in each Environmental Zone and across Scotland from 1990 to 2007. Where present, arrows denote significant change ( $p < 0.05$ ) in the direction shown. Note that because of changes in definitions that have been applied retrospectively, the estimates from 1990 are not in all cases directly comparable with later surveys.

	1990		1998		2007		Direction of significant changes 1998-2007
	Area ('000s ha)	%	Area ('000s ha)	%	Area ('000s ha)	%	
EZ4	77	3.4	71	3.2	68	3.1	
EZ5	236	9.2	208	8.1	207	8.1	
EZ6	695	21.7	633	19.8	619	19.3	
Scotland	1007	12.6	912	11.4	894	11.1	

▼ **Figure 7.2:** Movements of land into and out of Bracken between 1998 and 2007.



▲ Moorland • © Sandra Marks

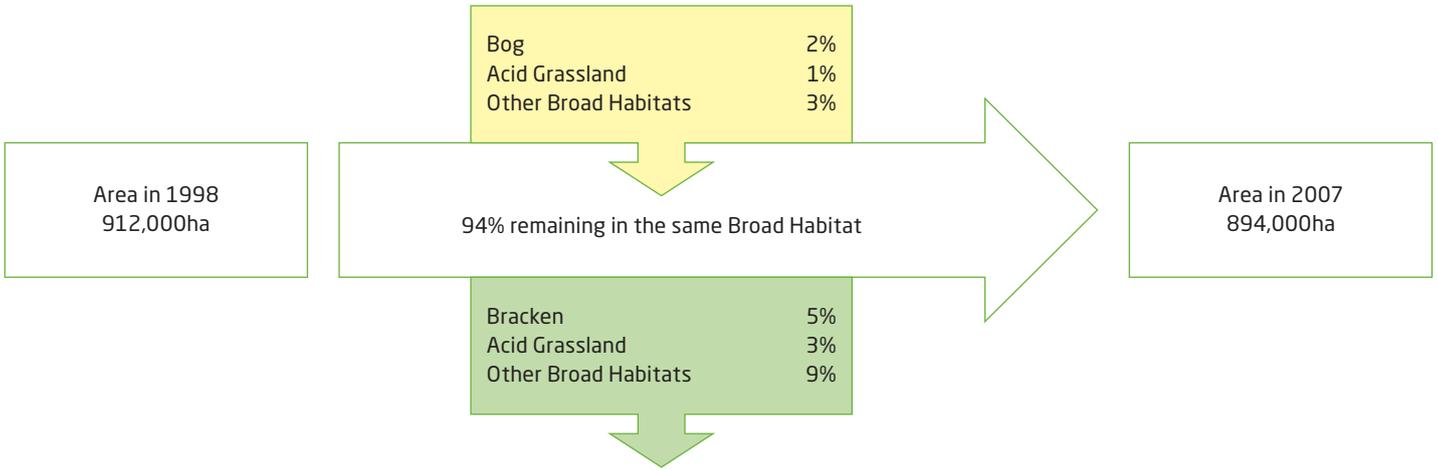
Approximately 80% of the polygons in the Bracken Broad Habitat in 2007 had been Bracken in 1998. Areas of Bracken were both lost to and gained from other Broad Habitats between 1998 and 2007 (Figure 7.2).

### 7.3.2 Dwarf Shrub Heath

The estimated area of Dwarf Shrub Heath Broad Habitat in 2007 was 894,000ha, representing over 65% of the total area of this habitat in the UK (Table 7.2). Dwarf Shrub Heath covered approximately 11% of Scotland and around 19% of the True Uplands (EZ6). Little change was detected in the extent of this habitat between 1998 and 2007 but there was a decrease of 113,000ha across the period 1990 to 2007 for the whole of Scotland.

Ninety four percent of polygons in Dwarf Shrub Heath in 2007 were also in Dwarf Shrub Heath in 1998. Changes are shown in Figure 7.3.

▼ **Figure 7.3:** Movements of land into and out of Dwarf Shrub Heath between 1998 and 2007.



▼ **Table 7.3:** Estimates of the area ('000s ha) and percentage of land area of Bog Broad Habitat in each Environmental Zone and across Scotland from 1990 to 2007 are shown. Arrows denote significant change ( $p < 0.05$ ) in the direction shown. Note that because of changes in definitions that have been applied retrospectively, the estimates from 1990 are not in all cases directly comparable with later surveys.

	1990		1998		2007		Direction of significant changes 1998-2007
	Area ('000s ha)	%	Area ('000s ha)	%	Area ('000s ha)	%	
EZ4	158	7.1	160	7.2	156	7.0	↓
EZ5	832	32.6	872	34.1	890	34.8	
EZ6	932	29.1	1006	31.4	998	31.2	
Scotland	1922	24.0	2039	25.5	2044	25.6	



▲ Bog pool • © SNH

### 7.3.3 Bog

The estimated area of Bog Broad Habitat in 2007 was 2,044,000 ha, which represents over 85% of the total UK stock. In Scotland, Bog makes up 26% of the land area (**Table 7.3**). No change was detected in the estimated area of Bog across Scotland as a whole between 1998 and 2007, but there was a decrease of 2.5% in the Lowlands (EZ4).

The overall area of Bog has remained relatively constant; 97% of the stock in 2007 was also Bog in 1998 (**Figure 7.4**).

### 7.3.4 Fen, Marsh and Swamp

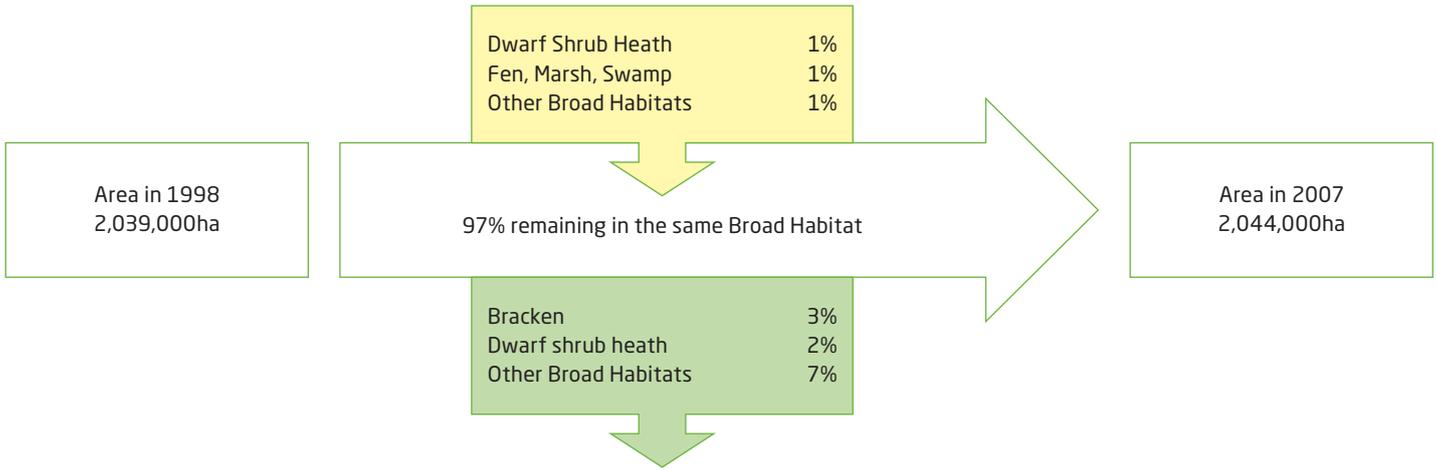
The estimated area of Fen, Marsh and Swamp Broad Habitat in 2007 was 238,000 ha, which represents approximately 54% of the UK stock. No change was detected in the area of Fen, Marsh and Swamp between 1998 and 2007.

Approximately 90% of the polygons in Fen, Marsh and Swamp in 2007 were also Fen, Marsh and Swamp in 1998 (**Figure 7.5**).



▲ Upland landscape with acid grassland • © Helen M Jones

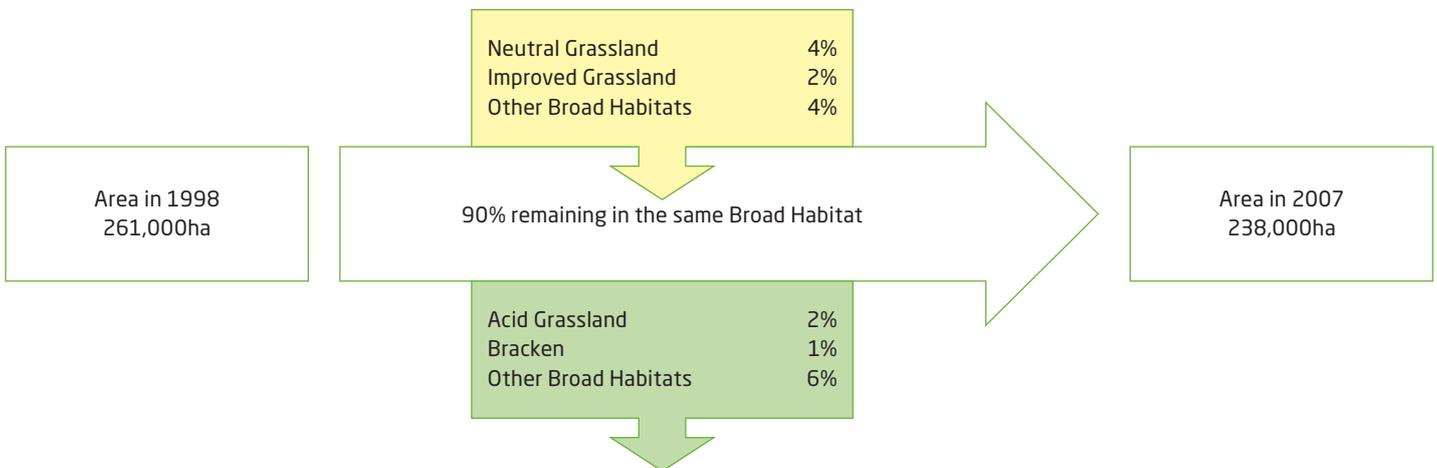
▼ **Figure 7.4:** Movements of land into and out of Bog between 1998 and 2007.



▼ **Table 7.4:** Estimated area ('000s ha) and percentage of land area of Fen, Marsh and Swamp Broad Habitat in each Environmental Zone and across Scotland from 1990 to 2007. Where present, arrows denote significant change ( $p < 0.05$ ) in the direction shown. Note that because of changes in definitions that have been applied retrospectively, the estimates from 1990 are not in all cases directly comparable with later Surveys.

	1990		1998		2007		Direction of significant changes 1998-2007
	Area ('000s ha)	%	Area ('000s ha)	%	Area ('000s ha)	%	
EZ4	58	2.6	72	3.2	71	3.2	
EZ5	151	5.9	109	4.3	95	3.7	
EZ6	80	2.5	80	2.5	72	2.2	
Scotland	289	3.6	261	3.3	238	3.0	

▼ **Figure 7.5:** Movements of land into and out of Fen, Marsh, Swamp between 1998 and 2007.



### 7.3.5 Inland Rock

The area of Inland Rock Broad Habitat in 2007 was estimated at 84,000ha which represents 1% of the Scottish land area, and 94% of the stock of this Broad Habitat in the UK. The majority (70%) of this Broad Habitat is concentrated in the True Uplands (EZ 6). No changes in the area of Inland Rock Broad Habitat were detected between 1990 and 2007 (**Table 2.1 [in National Picture Chapter]**). The only flows in this habitat were those between Inland Rock and Urban areas reflecting changes in features such as quarries.

### 7.3.6 Montane

All Montane Broad Habitat in the UK occurs in the True Uplands (EZ6) where the estimated 38,000ha in 2007 (0.5% of the Scottish land area) constituted approximately 90% of the UK total area for this Broad Habitat. No changes in the area of Broad Habitat were detected between 1990 and 2007 (**Table 1.1 [in National Picture Chapter]**). Non-significant changes between 1990 and 1998/2007 values are likely to reflect methodological and definitional improvements in the survey, rather than changes in the extent of Montane Broad Habitat.

▼ **Table 7.5:** Change in the characteristics of vegetation in 200m<sup>2</sup> Main Plots in the Bracken Broad Habitat across Scotland between 1990 and 2007. Mean values for 1998 and 2007 are presented. Arrows denote significant change ( $p < 0.05$ ) in the direction shown. The condition measures are described in **Box 1.3, UK Report**.

Vegetation Condition Measures	Mean values (Scotland)			Direction of significant changes 1998 - 2007				Direction of significant changes 1990 - 1998				Direction of significant changes 1990 - 2007			
	1990	1998	2007	S	EZ4	EZ5	EZ6	S	EZ4	EZ5	EZ6	S	EZ4	EZ5	EZ6
Species Richness (No. of Species)	19.3	22.8	20.2												
No. of Bird Food Species	4.7	5.8	5.2												
No. of Butterfly Food Species	8.5	9.1	7.9												
Grass:Forb Ratio	0.06	0.96	0.42	↓		↓		↑		↑					
Competitor Score	2.48	2.37	2.49	↑											
Stress Tolerator Score	3.25	3.39	3.26												
Ruderal Score	1.80	1.79	1.72												
Light Score	6.72	6.70	6.73												
Fertility Score	3.34	3.20	3.25												
Ellenberg pH Score	3.81	3.75	3.81												
Moisture Score	6.22	6.02	6.19	↑				↓							

## 7.4 The condition of mountain, moor and heath Broad Habitats

- No increases were detected in plant species associated with higher nutrient levels (eutrophication) in any of the mountain, moor and heath Broad Habitats between 1998 and 2007.
- Over the period 1990 to 2007, there was a significant decrease of 12% in the mean Species Richness Score in the Dwarf Shrub Heath Broad Habitat from an average of 20.3 to 17.8 plant species per plot. Plant species richness also decreased between 1998 and 2007 (by 23%) in Fen Marsh and Swamp Broad Habitat and by 11% in Bog.
- In Dwarf Shrub Heath and Bog Broad Habitats the cover of grass species relative to forbs increased between 1998 and 2007. Competitive plant species increased in Bog suggesting deterioration in condition.

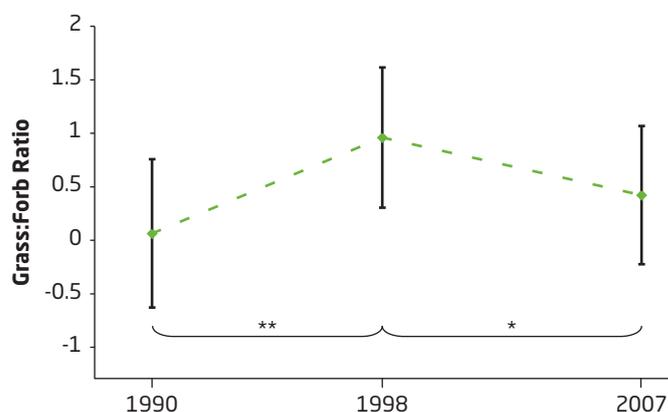
### 7.4.1 Changes in the Bracken Broad Habitat

**Main and Unenclosed Plots:** No changes were detected in the Species Richness of 200m<sup>2</sup> Main Plots in Bracken across the period 1990 to 2007 (Table 7.5).

The ratio of grasses to forbs decreased in Main Plots within Bracken across Scotland and in the Intermediate Uplands and Islands (EZ5) between both 1998 and 2007 (Fig. 7.6), and increased between 1990 and 1998. Both the mean Competitor and the mean Moisture Score in these Plots increased significantly across Scotland between 1998 and 2007. The mean Moisture Score result shows a reverse of the downward trend between 1990 and 1998.

To help assess condition of the Broad Habitats in unenclosed areas, extra 2m x 2m plots (see Chapter 1) were surveyed in 1998 and repeated in 2007. The Unenclosed Plots showed that grasses had become less prominent in Bracken habitats across Scotland and in both the Lowlands and Intermediate Uplands and Islands (EZ4 & 5).

▼ **Figure 7.6:** The changes in Grass:Forb ratio in 200m<sup>2</sup> Main Plots in the Bracken Broad Habitat across Scotland, between 1990 and 2007. Significant changes ( $*p < 0.05$ ,  $**p < 0.01$ ) are shown between the dates bracketed. 95% Confidence Intervals are shown for each data point. Confidence Intervals on change are not shown.



**Targeted Plots:** Targeted Plots (2m x 2m) showed decreases in mean Species Richness and plant species used by birds both across Scotland and in the Intermediate Uplands and Islands (EZ5) between 1998 and 2007. Significant decreases were also detected in the mean number of plant species used by butterflies and the mean Ruderal and Light Scores for these Plots in Scotland between 1998 and 2007.

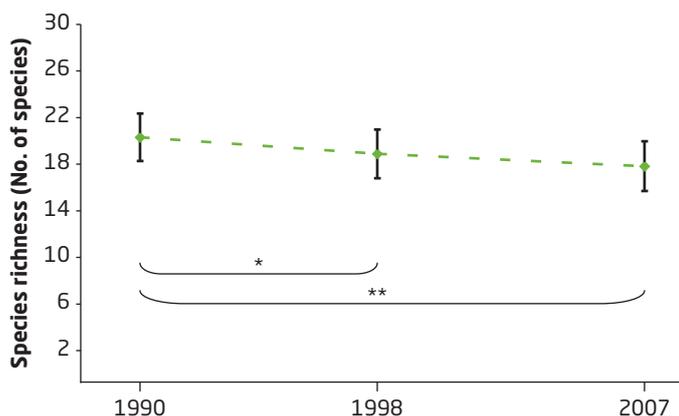


▲ Heather • © SNH

### 7.4.2 Changes in the Dwarf Shrub Heath Broad Habitat

**Main and Unenclosed Plots:** No significant change was detected in mean Species Richness Score in the Main Plots in the Dwarf Shrub Heath Broad Habitat in Scotland between 1998 and 2007, although there was a decrease in the Intermediate Uplands and Islands (EZ 5) (Table 7.6). Over the period 1990 to 2007, there was a decrease of 12% in the mean Species Richness Score in Main Plots across Scotland from an average of 20.3 to 17.8 plant species per plot (Fig 7.7). Plant species used by butterfly caterpillars as food decreased in Main Plots across Scotland from 7.4 species per plot in 1998 to 6.9 in 2007, forming part of a longer-term decrease between 1990 and 2007. An increase in the mean ratio of grasses to forbs in Main Plots in Scotland and the True Uplands (EZ6) where much of this habitat is located may indicate further deterioration in the quality of this Broad Habitat. No significant change in the mean Fertility Score in Main Plots within Dwarf Shrub Heath was detected in Scotland between 1990 and 2007 or between 1998 and 2007. Significant changes in Main Plots at the Environmental Zone level indicate increases in competitive species at the expense of non-competitive species in the Intermediate Uplands and Islands (EZ5) and an increase in moisture tolerant species in the Lowlands (EZ4).

▼ **Figure 7.7:** The changes in mean Species Richness in 200m<sup>2</sup> Main Plots in the Dwarf Shrub Heath Broad Habitat across Scotland between 1990 and 2007. Significant changes (\*p<0.05, \*\*p<0.01) are shown between the dates bracketed. 95% CI are shown for each data point. Confidence Intervals on change are not shown.



Unenclosed Plots in Dwarf Shrub Heath showed small decreases in both Species Richness and in the number of food plants used by butterflies between 1998 and 2007 both across Scotland and in the Intermediate Uplands and Islands (EZ5).

**Targeted Plots:** The Dwarf Shrub Heath Broad Habitat consists of a wide range of sub-habitat types in upland and lowland situations, including some Priority Habitats. These areas within Dwarf Shrub Heath were targeted by CS for their botanical interest using the Targeted Plots (2m x 2m). Examples of these areas would include Dry Acid Grassland Priority Habitat, wet heath, bog and flushes. Targeted Plots in this Broad Habitat showed a decrease across Scotland in Species Richness between 1998 and 2007 from a mean of 13.0 plants per plot to 11.1 (Table 7.7).

A decrease in Species Richness was also found in the Intermediate Uplands and Islands (EZ5). Trends for the period 1990 to 2007 indicate the same pattern with decreases in mean Species Richness and the number of food plants for butterflies across Scotland. Increases in the mean ratio of grasses to forbs and mean Competitor Score for these plots were found across Scotland as a whole and were also significant for the True Uplands (EZ6).

### 7.4.3 Changes in the Bog Broad Habitat

**Main and Unenclosed Plots:** The mean plant Species Richness Score of Main Plots within the Bog Broad Habitat in Scotland decreased by 6% from 19.0 to 17.8 species per plot, between 1998 and 2007, which was also the major component of the decrease between 1990 and 2007 (Fig. 7.8).



▲ Mountain Avens • © SNH

▼ **Table 7.6:** Change in the characteristics of vegetation in 200m<sup>2</sup> Main Plots in the Dwarf Shrub Heath Broad Habitat across Scotland between 1990 and 2007. Mean values for 1998 and 2007 are presented. Arrows denote significant change (p<0.05) in the direction shown. The condition measures are described in **Box 1.3, UK Report**.

Vegetation Condition Measures	Mean values (Scotland)			Direction of significant changes 1998 - 2007				Direction of significant changes 1990 - 1998				Direction of significant changes 1990 - 2007			
	1990	1998	2007	S	EZ4	EZ5	EZ6	S	EZ4	EZ5	EZ6	S	EZ4	EZ5	EZ6
Species Richness (No. of Species)	20.3	18.9	17.8			↓		↓		↓		↓		↓	
No. of Bird Food Species	3.4	3.1	2.9		↓							↓		↓	
No. of Butterfly Food Species	8.0	7.4	6.9	↓		↓		↓		↓		↓		↓	
Grass:Forb Ratio	0.65	0.59	0.81	↑			↑								
Competitor Score	2.15	2.18	2.21			↑						↑		↑	
Stress Tolerator Score	3.68	3.64	3.63			↓									
Ruderal Score	1.50	1.48	1.47		↓										
Light Score	6.95	7.01	7.00					↑			↑	↑		↑	
Fertility Score	2.45	2.39	2.38												
Ellenberg pH Score	3.19	3.15	3.10												
Moisture Score	6.53	6.55	6.60		↑										

▼ **Table 7.7:** Change in the characteristics of vegetation in 2m x2m Targeted Plots in the Dwarf Shrub Heath Broad Habitat in Scotland between 1990 and 2007. Mean values for 1998 and 2007 are presented. Arrows denote significant change (p<0.05) in the direction shown. The condition measures are described in **Box 1.3, UK Report**.

Vegetation Condition Measures	Mean values (Scotland)			Direction of significant changes 1998 - 2007				Direction of significant changes 1990 - 1998				Direction of significant changes 1990 - 2007			
	1990	1998	2007	S	EZ4	EZ5	EZ6	S	EZ4	EZ5	EZ6	S	EZ4	EZ5	EZ6
Species Richness (No. of Species)	13.0	12.2	11.1	↓		↓						↓		↓	
No. of Bird Food Species	2.6	2.4	2.3												
No. of Butterfly Food Species	5.2	4.9	4.5		↓	↓						↓		↓	
Grass:Forb Ratio	0.62	0.94	1.03								↑	↑			↑
Competitor Score	2.23	2.29	2.32								↑	↑			↑
Stress Tolerator Score	3.55	3.51	3.52								↓				
Ruderal Score	1.64	1.61	1.56											↓	
Light Score	6.88	6.93	6.90							↑					
Fertility Score	2.70	2.64	2.60							↓				↓	
Ellenberg pH Score	3.44	3.35	3.33												
Moisture Score	6.39	6.44	6.48												

A decrease in the number of species used by butterfly caterpillars and farmland birds as food and an increase in the proportion of grass species in the Bog Broad Habitat were detected between 1998 and 2007. The proportion of competitive species increased at the expense of ruderal species in Main Plots within the Bog Broad Habitat across Scotland between 1998 and 2007, suggesting a reduction in disturbance. Changes in species are given in **Table 7.9**. These changes may indicate deterioration in the condition of this Broad Habitat, although whilst changes are statistically significant they are not large.

Results for the Unenclosed Plots in the Bog Broad Habitat show similar trends to those for the Main Plots, with decreases in Species Richness, Bird and Butterfly larvae Food Plants and a small increase in the ratio of grasses to forbs across Scotland. Both the Fertility Score and Ellenberg pH Score also decreased.



▲ Crowberry • © SNH

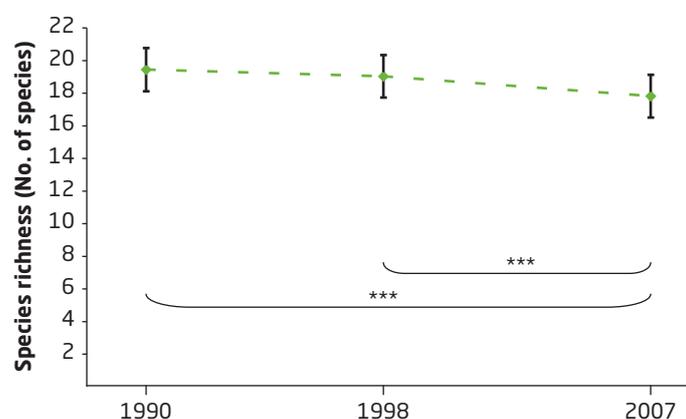
▼ **Table 7.8:** Change in the mean condition characteristics of vegetation in 200m<sup>2</sup> Main Plots in the Bog Broad Habitat in Scotland, between 1990 and 2007. Mean values for 1998 and 2007 are presented. Arrows denote significant change ( $p < 0.05$ ) in the direction shown. The condition measures are described in **Box 1.3, UK Report**.

Vegetation Condition Measures	Mean values (Scotland)			Direction of significant changes 1998 - 2007				Direction of significant changes 1990 - 1998				Direction of significant changes 1990 - 2007			
	1990	1998	2007	S	EZ4	EZ5	EZ6	S	EZ4	EZ5	EZ6	S	EZ4	EZ5	EZ6
Species Richness (No. of Species)	19.4	19.0	17.8	↓	↓	↓				↓		↓		↓	
No. of Bird Food Species	1.9	2.1	1.7	↓		↓	↓								
No. of Butterfly Food Species	7.0	6.7	6.4	↓		↓				↓		↓		↓	
Grass:Forb Ratio	1.11	0.99	1.26	↑		↑	↑								
Competitor Score	2.13	2.12	2.15	↑		↑				↓	↑				
Stress Tolerator Score	3.72	3.70	3.71				↑				↓				
Ruderal Score	1.40	1.42	1.38	↓			↓								
Light Score	7.25	7.30	7.30					↑		↑		↑		↑	
Fertility Score	2.14	2.09	2.04	↓			↓	↓			↓	↓		↓	↓
Ellenberg pH Score	3.10	3.09	3.00	↓		↓	↓					↓		↓	↓
Moisture Score	7.17	7.17	7.19												

▼ **Table 7.9:** The ten plant species showing the largest increases and decreases in the 200m<sup>2</sup> Main Plots in the Bog Broad Habitat across Scotland, between 1998 and 2007. Species at the top of the table show the largest changes. The Change Index was calculated using an adaptation of the method presented in the New Atlas of the British and Irish Flora.

Increasing Species		Change Index	Decreasing Species		Change Index
<i>Carex echinata</i>	Star sedge	0.34	<i>Pinguicula vulgaris</i>	Common butterwort	-0.29
<i>Empetrum nigrum</i>	Crowberry	0.34	<i>Festuca rubra agg</i>	Red fescue	-0.81
<i>Huperzia selago</i>	Fir clubmoss	0.47	<i>Carex panicea</i>	Carnation sedge	-0.13
<i>Euphrasia officinali</i>	Common eyebright	0.35	<i>Pedicularis sylvatica</i>	Lousewort	-0.23
<i>Juncus conglomeratus</i>	Compact rush	0.4	<i>Dactylorhiza sp</i>	Orchid sp.	-0.16
<i>Dryopteris dilatata</i>	Broad buckler fern	0.81	<i>Carex viridula</i>		-0.31
<i>Juncus effusus</i>	Soft rush	0.24	<i>Juncus bulbosus</i>	Bulbous rush	-0.25
<i>Erica tetralix</i>	Cross-leaved heather	0.36	<i>Erica cinerea</i>	Bell heather	-0.03
<i>Salix repens agg.</i>	Creeping willow	0.42	<i>Succisa pratensis</i>	Devilsbit scabious	-0.05
<i>Rhynchospora alba</i>	White beak sedge	0.42	<i>Viola palustris</i>	Marsh violet	-0.22

▼ **Figure 7.8:** The changes in Species Richness in 200m<sup>2</sup> Main Plots in the Bog Broad Habitat across Scotland between 1990 and 2007. Significant changes (\*\*\*)  $p < 0.001$  are shown between the dates bracketed. 95% Confidence Intervals are shown for each data point. Confidence Intervals on change are not shown.



**Targeted Plots:** Small patches of other habitats occur within areas of Bog Broad Habitat including Priority Habitats e.g. Blanket Bog, and also flushes, pools and drier outcrops of Upland Dwarf Shrub Heath. These areas were targeted by CS for their botanical interest using 2m x 2m Targeted Plots.

The mean Species Richness Score per Targeted Plot in the Bog Broad Habitat decreased from 13.1 to 11.6 species across Scotland between 1990 and 2007, and also decreased between 1998 and 2007 (**Table 7.10**). This reduction in the Species Richness Score per plot was similar to that reported for Main Plots randomly sited in the Broad Habitat. There was a simultaneous reduction in number of plant species used by butterfly caterpillars as food. Decreases in mean Species Richness and butterfly food plant species were apparent in the Lowlands and Intermediate Uplands and Islands (EZ 4 & 5) but not in the True Uplands (EZ6) which contains the greatest extent of this Broad Habitat. It should be noted that lowland farmland birds are unlikely to use upland habitats to any great extent and this score is more appropriate for lowland farmed habitats.

▼ **Table 7.10:** Change in the characteristics of vegetation in 2m x2m Targeted Plots in the Bog Broad Habitat across Scotland, between 1990 and 2007. Mean values for 1998 and 2007 are presented. Arrows denote significant change ( $p < 0.05$ ) in the direction shown. The condition measures are described in **Box 1.3, UK Report**.

Vegetation Condition Measures	Mean values (Scotland)			Direction of significant changes 1998 - 2007				Direction of significant changes 1990 - 1998				Direction of significant changes 1990 - 2007			
	1990	1998	2007	S	EZ4	EZ5	EZ6	S	EZ4	EZ5	EZ6	S	EZ4	EZ5	EZ6
Species Richness (No. of Species)	13.1	12.4	11.6	↓	↓	↓		↓	↑	↓		↓		↓	
No. of Bird Food Species	2.0	1.7	1.4	↓	↓	↓	↓	↓		↓		↓		↓	
No. of Butterfly Food Species	4.8	4.5	4.2	↓	↓	↓		↓		↓		↓		↓	
Grass:Forb Ratio	0.71	0.91	0.92												
Competitor Score	2.22	2.24	2.26		↑										
Stress Tolerator Score	3.60	3.55	3.58				↑				↓				
Ruderal Score	1.60	1.59	1.52	↓			↓					↓		↓	
Light Score	7.13	7.20	7.23	↑				↑		↑		↑		↑	↑
Fertility Score	2.47	2.42	2.28	↓		↓	↓					↓		↓	↓
Ellenberg pH Score	3.44	3.37	3.25	↓		↓	↓					↓		↓	
Moisture Score	7.08	7.04	7.17	↑		↑	↑					↑		↑	

▼ **Table 7.11:** Change in the characteristics of vegetation in 200m<sup>2</sup> Main Plots in the Fen, Marsh and Swamp Broad Habitat across Scotland between 1990 and 2007. Mean values for 1998 and 2007 are presented. Arrows denote significant change ( $p < 0.05$ ) in the direction shown. The condition measures are described in **Box 1.3, UK Report**.

Vegetation Condition Measures	Mean values (Scotland)			Direction of significant changes 1998 - 2007				Direction of significant changes 1990 - 1998				Direction of significant changes 1990 - 2007			
	1990	1998	2007	S	EZ4	EZ5	EZ6	S	EZ4	EZ5	EZ6	S	EZ4	EZ5	EZ6
Species Richness (No. of Species)	27.0	28.7	22.2	↓	↓		↓		↑		↑	↓		↓	
No. of Bird Food Species	7.4	7.9	6.2	↓	↓										
No. of Butterfly Food Species	10.2	10.3	8.5	↓	↓							↓	↓		
Grass:Forb Ratio	0.96	0.65	0.68												
Competitor Score	2.40	2.42	2.47												
Stress Tolerator Score	3.15	3.12	3.10												
Ruderal Score	2.09	2.12	2.04												
Light Score	7.03	6.98	6.97												
Fertility Score	3.40	3.43	3.43												
Ellenberg pH Score	4.31	4.32	4.27												
Moisture Score	6.62	6.58	6.57												

The Targeted Plots showed a decrease in the Fertility Score and the Ellenberg pH Score across Scotland between 1998 and 2007 as found in the Main Plots. However, in contrast with the Main Plots, the Targeted Plots showed increases in both the Light and Moisture Scores.

#### 7.4.4 Changes in the Fen, Marsh and Swamp Broad Habitat

**Main and Unenclosed Plots:** A 23% decrease in the Species Richness Score occurred in Main Plots within Fen, Marsh and Swamp between 1998 and 2007. Between 1990 and 2007 the decrease in Species Richness in this Broad Habitat was 18% (Fig. 7.9). Decreases between 1998 and 2007 appear to be particularly concentrated in the Lowlands (EZ4), where decreases in species richness and plant species for both birds and butterflies are consistent with those across Scotland as a whole.

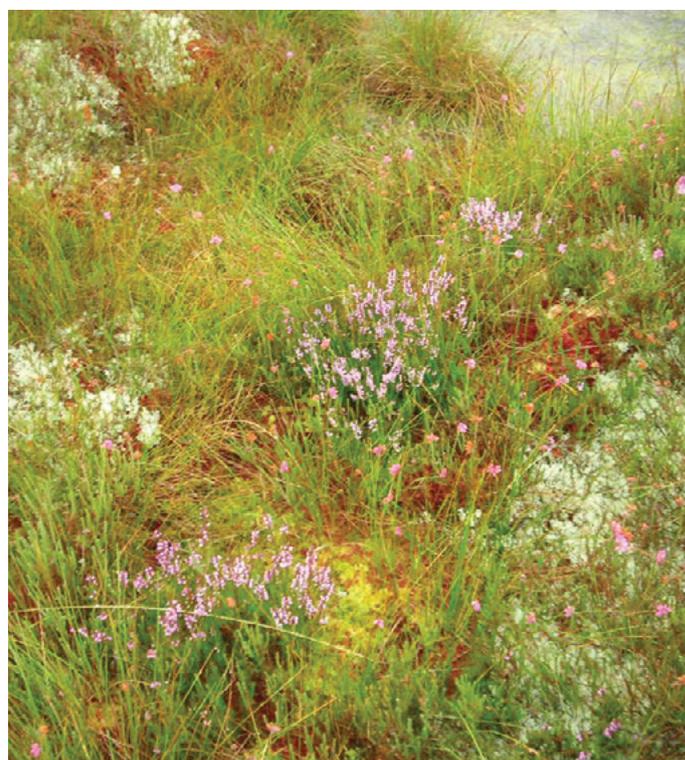
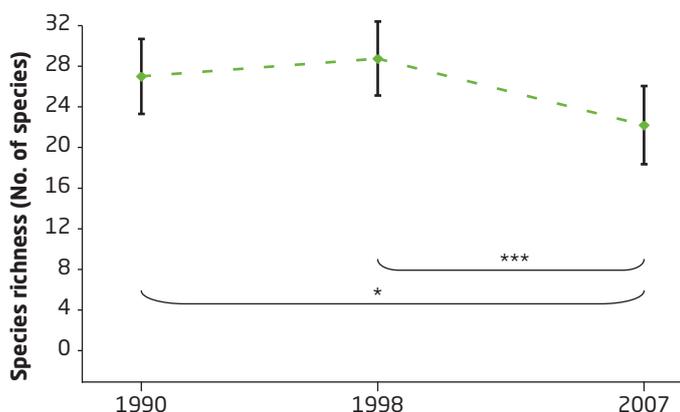
In Unenclosed Plots in Fen, Marsh and Swamp species richness decreased by 10% across Scotland and by 14% in the Intermediate Uplands and Islands (EZ5).

**Targeted Plots:** In common with the results for the Main Plots randomly sited in the Broad Habitat, there was a reduction in the mean Plant Species Richness Score in the Targeted Plots used to sample areas targeted by CS for their botanical interest. Species richness decreased by 14% from a mean of 15.4 to 13.3 plant species per Targeted Plot in Scotland between 1998 and 2007, compared with no significant change (15.9 and 15.4 species) between 1990 and 1998 (Table 7.12). There was a simultaneous decrease in the number of Butterfly larvae Food Plants between 1998 and 2007.

▼ **Table 7.12:** Change in the characteristics of vegetation in 200m<sup>2</sup> Targeted Plots in the Fen, Marsh and Swamp Broad Habitat across Scotland between 1990 and 2007. Mean values for 1998 and 2007 are presented. Arrows denote significant change ( $p < 0.05$ ) in the direction shown. The condition measures are described in **Box 1.3, UK Report**.

Vegetation Condition Measures	Mean values (Scotland)			Direction of significant changes 1998 - 2007				Direction of significant changes 1990 - 1998				Direction of significant changes 1990 - 2007			
	1990	1998	2007	S	EZ4	EZ5	EZ6	S	EZ4	EZ5	EZ6	S	EZ4	EZ5	EZ6
Species Richness (No. of Species)	15.9	15.4	13.3	↓								↓		↓	
No. of Bird Food Species	4.3	4.2	3.9												
No. of Butterfly Food Species	4.93	5.11	4.29	↓											
Grass:Forb Ratio	0.48	0.28	0.40				↑								
Competitor Score	2.54	2.57	2.61												
Stress Tolerator Score	2.90	2.90	2.84												
Ruderal Score	2.25	2.22	2.21												
Light Score	7.05	7.07	7.03			↓									
Fertility Score	3.75	3.72	3.71												
Ellenberg pH Score	4.70	4.62	4.60							↓				↓	
Moisture Score	6.99	6.94	7.01												

▼ **Figure 7.9:** Changes in mean Species Richness Score per 200m<sup>2</sup> Main Plot in Fen, Marsh and Swamp Broad Habitat across Scotland, between 1990 and 2007. Significant changes ( $*p < 0.05$ ,  $***p < 0.001$ ) are shown between the dates bracketed. 95% Confidence Intervals are shown for each data point. Confidence Intervals on change are not shown.



▲ Bog vegetation • © CEH

## 7.5 Priority Habitats of mountain, moor and heath

The UK BAP Priority Habitats<sup>2</sup> are sub-sets of the Broad Habitats. The CS in 2007 is the first time that information on Priority Habitats has been included. Data for 1998 have also been analysed and are given for most Priority Habitats.

The data in this section are provided with a caution. There has been difficulty in separating the data between the Priority Habitats within the Broad Habitats. In particular it has been difficult to differentiate floristically between the Blanket Bog Priority Habitat and the other elements of the Bog and Dwarf Shrub Heath Broad Habitats.

### 7.5.1 Blanket Bog

The 1998 estimate has not been given for the Blanket Bog Priority Habitat due to differences in the definitions used during each survey giving non-comparable results. The area of Blanket Bog in 2007 was estimated at over 1.1 million ha which represents 14% of the area of Scotland (**Table 7.13**) and the vast majority of the area of this Priority Habitat in Great Britain. Blanket Bog is particularly abundant in the Intermediate Uplands and Islands and True Uplands (EZ5 & 6).

▼ **Table 7.13:** Estimated area ('000s ha) and percentage of land area of Blanket Bog Priority Habitat in Scotland in 2007.

Blanket Bog	2007	
	Area ('000s ha)	%
EZ4	84	3.7
EZ5	382	14.9
EZ6	649	20.2
Scotland	1115	14

### 7.5.2 Upland Dwarf Shrub Heath

The area of Upland Dwarf Shrub Heath in 2007 was estimated at 778,000 ha. This Priority Habitat is more abundant in Scotland than in other countries in Great Britain. There was no significant change from the 1998 estimate.

▼ **Table 7.14:** Estimated area ('000s ha) and percentage of land area of Upland Dwarf Shrub Heath Priority Habitat in Scotland from 1998 to 2007. Where present, arrows denote significant change ( $p < 0.05$ ) in the direction shown.

Upland Dwarf Shrub Heath	1998		2007		Direction of significant changes 1998-2007
	Area ('000s ha)	%	Area ('000s ha)	%	
EZ4	35	1.5	36	1.5	
EZ5	160	6.3	160	6.3	
EZ6	595	18.6	582	18.2	
Scotland	790	9.9	778	9.8	

### 7.5.3 Lowland Dwarf Shrub Heath

Lowland Dwarf Shrub Heath covered an estimated area of 41,000ha in 2007. As with Upland Dwarf Shrub Heath this Priority Habitat is more abundant in Scotland than in other countries in Great Britain. There was no significant change from the 1998 estimate.

▼ **Table 7.15:** Estimated area ('000s ha) and percentage of land area of Lowland Dwarf Shrub Heath Priority Habitat in Scotland from 1998 to 2007. Where present, arrows denote significant change ( $p < 0.05$ ) in the direction shown.

Lowland Dwarf Shrub Heath	1998		2007		Direction of significant changes 1998-2007
	Area ('000s ha)	%	Area ('000s ha)	%	
EZ4	14	0.6	13	0.6	
EZ5	15	0.6	14	0.6	
EZ6	15	0.5	14	0.5	
Scotland	44	0.6	41	0.5	

### 7.5.4 Purple Moor Grass and Rush Pasture

It was not possible to identify Purple Moor Grass and Rush Pasture from past CS data as there was no comparable classification, so estimates are only provided for 2007. This is a species-rich fen meadow and rush pasture which occurs in poorly drained, high rainfall areas mainly in the south west, particularly concentrated in the Stewarty region of Dumfries and Galloway. It is identified in the field by indicator species such as Wavy St John's Wort (*Hypericum undulatum*), Water Mint (*Mentha aquatica*), Sneezewort (*Achillea ptarmica*), Marsh Horsetail (*Equisetum palustre*) and Cuckoo Flower (*Cardamine pratensis*). The estimated area for Purple Moor Grass Rush Pasture in Scotland for 2007 was 38,000 ha (**Table 7.16**) with the majority being found in the Intermediate Uplands and Islands (EZ5).

▼ **Table 7.16:** Estimated area ('000s ha) and percentage of land area of Purple Moor Grass and Rush Pasture Priority Habitat in Scotland in 2007.

Purple Moor grass and Rush Pasture	2007	
	Area ('000s ha)	%
EZ4	5	0.2
EZ5	25	1
EZ6	8	0.2
Scotland	38	0.5



▲ Upland scene • © Helen M Jones



▲ Vegetation survey on moorland • © CEH

## 7.6 Changes in soils (0-15cm) in mountain moor and heath Broad Habitats

- In Dwarf Shrub Heath, Bog, and in Fen, Marsh and Swamp, there was no significant change in soil (0-15cm) pH between 1998 and 2007. However, all four Broad Habitats were less acidic in 2007 compared to 1978, due mainly to a pH increase between 1978 and 1998.
- The acidity of soils (0-15cm) in Bracken Broad Habitat has not changed significantly between any of the surveys or across the period as a whole.
- In soils (0-15cm) in Bracken, Dwarf Shrub Heath and Bog Broad Habitats, the carbon concentrations in 2007 were not significantly different from 1978 values.
- In soil (0-15cm) in Fen, Marsh and Swamp Broad Habitat, carbon concentration decreased significantly between 1998 and 2007; the concentration of soil (0-15cm) carbon in 2007 in this Broad Habitat was not significantly different compared to 1978.

### 7.6.1 Bracken

**Soil (0-15cm) pH:** Between 1998 and 2007, there was no significant change in the mean pH of soil (0-15cm) samples from Bracken Broad Habitat (4.80, 4.43). No changes were observed between 1978 and 1998 or across the entire survey period.

**Soil (0-15cm) carbon concentration:** No significant change in the mean carbon concentration of soil (0-15cm) was detected in the Bracken Broad Habitat between 1998 and 2007 (196.3 g/kg, 264.4 g/kg). There were no changes between 1978 and 2007 or between 1978 and 1998.

**Bulk density and soil (0-15cm) carbon content:** The mean bulk density of soils (0-15cm) in the Bracken Broad Habitat in 2007 was 0.31 g/cm<sup>3</sup> which when combined with soil (0-15cm) carbon concentration gave a soil (0-15cm) carbon content estimate of 78.6 t C/ha (Table 2.8).

### 7.6.2 Dwarf Shrub Heath

**Soil (0-15cm) pH:** No significant change was detected in the mean pH of soils (0-15cm) within Plots in the Dwarf Shrub Heath Broad Habitat between 1998 and 2007 (4.63, 4.66). The difference in pH between 1978 and 2007 was significant, mainly due to the large rise from pH 4.31 in 1978 to pH 4.63 in 1998.

**Soil (0-15cm) carbon concentration:** No significant change in the mean carbon concentration of soil (0-15cm) was detected in the Dwarf Shrub Broad Habitat between 1998 and 2007 (300.3 g/kg, 285.8 g/kg) or from 1978 to 1998 or from 1978 to 2007 (Table 2.7).

**Bulk density and soil (0-15cm) carbon content:** The mean bulk density of soils (0-15cm) in the Dwarf Shrub Heath Broad Habitat in 2007 was 0.30 g/cm<sup>3</sup> which when combined with soil (0-15cm) carbon concentration gave a soil (0-15cm) carbon content estimate of 81.9 t C/ha (Table 2.8).

### 7.6.3 Bog

**Soil (0-15cm) pH:** No significant change in mean soil (0-15cm) pH was detected in the Bog Broad Habitat between 1998 and 2007 (4.53, 4.59). An overall increase in pH from 1978 to 2007 was significant due mainly to the large significant increase from pH 4.34 in 1978 to pH 4.53 in 1998 (Table 2.7).

**Soil (0-15cm) carbon concentration:** No significant change in the mean soil (0-15cm) carbon concentration in the Bog Broad Habitat was detected between 1998 and 2007 (412.6 g/kg, 398.2 g/kg), although there was a significant increase between 1978 and 1998 (Table 2.7).

**Bulk density and soil (0-15cm) carbon content:** The mean bulk density of soils (0-15cm) in the Bog Broad Habitat in 2007 was 0.17 g/cm<sup>3</sup> which when combined with soil (0-15cm) carbon concentration gave a soil (0-15cm) carbon content estimate of 75.9 t C/ha (Table 2.8). The very large carbon concentration in these soils is offset by the low bulk density, to yield a moderately large carbon content when compared to other Broad Habitats.

### 7.6.4 Fen, Marsh and Swamp

**Soil (0-15cm) pH:** No significant change was detected in the mean pH of soils (0-15 cm) in the Fen, Marsh and Swamp Broad Habitat between 1998 and 2007 (5.25, 5.32). Between 1978 and 2007, the mean value increased significantly from pH 4.57 to pH 5.32, due mainly to the large significant increase between 1978 and 1998.

**Soil (0-15cm) carbon concentration:** A significant decrease was detected in the carbon concentration of soil (0-15cm) in the Fen, Marsh and Swamp Broad Habitat between 1998 and 2007 (243.4 g/kg, 206.9 g/kg). No significant changes were observed from 1978 to 1998 or from 1978 to 2007 (Table 2.7).



▲ Upland landscape with blanket bog • © SNH

**Bulk density and soil (0-15cm) carbon content:** The mean bulk density of soils (0-15cm) in the Fen, Marsh and Swamp Broad Habitat was 0.42 g/cm<sup>3</sup> which when combined with soil (0-15cm) carbon concentration gave a soil (0-15cm) carbon content estimate of 69.8 t C/ha (*Table 2.8*).

## 7.8 Summary and discussion

### 7.8.1 Changes in mountain, moor and heath

Mountain, moor and heath habitats grade into one another and are difficult to define. Often surveyors will choose to interpret these habitats as complex mosaics and assign a proportion to each of the constituent habitats. This complexity, both of the habitats themselves and of their definitions inevitably results in some uncertainty around the estimates of their extent. In order to detect changes in the extents of mountain moor and heath habitats substantial shifts in vegetation would need to have taken place. CS found no ecologically significant changes in the extents of the Broad Habitats described in this chapter between 1998 and 2007 but the data do indicate a longer-term decline in the extent of Dwarf Shrub Heath (1990-2007). The reasons for this decline are not immediately apparent, though factors such as increases in Bracken, particularly in the Intermediate Uplands and Islands and increases in numbers of grazing animals may be important.

The most apparent change in the condition of the Broad Habitats was the decrease in the Species Richness Scores in Dwarf Shrub Heath, Bog and Fen, Marsh and Swamp. In some cases these were aligned with increases in competitive species and grass species but not in all. There was no evidence of increases in nutrient availability associated with eutrophication, between 1998 and 2007. Further analyses would need to be undertaken to understand the implications of a decline in Species Richness Score for habitat condition as decreases may not always indicate a deterioration.

Soil (0-15cm) acidity was reduced in mountain, moor and heath between 1978 and 1998, but further reductions in acidity were not found between 1998 and 2007, despite continuing reductions in levels of sulphur deposition. The composition of vegetation in the Bog Broad Habitat actually showed an increase in species associated with more acidic conditions between 1998 and 2007. Further analysis of soils is ongoing to enable estimation of nutrient status, contaminant levels, soil biotic diversity and soil function and will be reported in November 2009.

### 7.8.2 Bracken

In 2007, the Bracken Broad Habitat covered 131,000 ha, 1.6% of the Scottish land area. Approximately half of the total extent of this Broad Habitat in Great Britain was located in Scotland. Although the overall extent of Bracken did not change significantly between 1998 and 2007, there was an increase in the Intermediate Uplands and Islands (EZ5) both in this period and between 1990 and 1998. Bracken increases were at the expense of a range of upland habitats including Bog, Acid Grassland, Dwarf Shrub Heath and Fen, Marsh and Swamp. The 95% cover threshold that defines the Bracken Broad Habitat means that shifts in and out of this Broad Habitat are likely to result from fluctuations in the cover of bracken in a particular area which may reflect factors such as annual weather conditions or more long-term patterns of vegetation change. The condition of the Bracken Broad Habitat changed little between 1998 and 2007, with only a reversal of the signal for grasses becoming more prominent observed between 1990 and 1998 across Scotland and in the Intermediate Uplands and Islands (EZ5). Soil conditions under the Bracken Broad Habitat have changed little since 1978.



▲ Acid grassland with bracken • © Helen M Jones

### 7.8.3 Dwarf Shrub Heath

Dwarf Shrub Heath covered almost 900,000 ha in Scotland in 2007, representing over 70% of the total area of this habitat in the UK. There was no significant change in the extent of this Broad Habitat between 1998 and 2007 but there was a significant downward trend in extent across the period 1990-2007. Shifts away from Dwarf Shrub Heath between 1998 and 2007 were primarily as a result of increases in Bracken and Acid Grassland Broad Habitats.

Decreases in plant Species Richness Scores occurred in all plot types in this Broad Habitat with decreases in the numbers of Butterfly larvae Food Plants constituting part of this decrease in plots. An increase in grass species at the expense of forbs is likely to have contributed to this decline.

Soil (0-15cm) pH changed in Dwarf Shrub Heath Broad Habitat between 1978 and 2007, becoming less acidic (but still within the range of acid soil pH), with the increase mostly between 1978 and 1998. Soil (0-15cm) carbon concentrations have not changed over the past 30 years.



▲ Upland bog • © Caspian Richards

### 7.8.4 Bog

Bog (including Blanket Bog and Lowland Raised Bog) covered approximately 10% of the UK land area in 2007. At over 2 million hectares, the area of bog in Scotland constituted around 85% of the UK total and made up 26% of the Scottish land area. There was no detectable change in the estimated area of Bog as a whole between 1998 and 2007, although there were significant but small decreases in the Lowlands. The extent of the Bog Broad Habitat was very stable between 1998 and 2007, with negligible movements to and from other mountain, moor and heath Broad Habitats.

The plant Species Richness Score in all plots in the Bog Broad Habitat decreased between 1998 and 2007, including food plants for butterfly caterpillars. Grasses and other competitive plants increased, whereas ruderal plants, associated with disturbance decreased. The other vegetation changes were indicative of an overall decreasing nutrient status and increasing acidity.

Changes in the vegetation were not consistent with measurements of soil (0-15cm) pH, which showed a long-term reduction in acidity mainly because of the significant increase in the pH value between 1978 and 1998. Soil (0-15cm) carbon concentration increased in the Bog Broad Habitat between 1978 and 1998, but there was no change between 1998 and 2007, nor was there any significant change over the period as a whole.

### 7.8.5 Fen, Marsh and Swamp

Fen, Marsh and Swamp Broad Habitat covered approximately 1.7% of the area of Great Britain in 2007, with 61% of this habitat (239,000ha, 3.0% of the Scottish land area) occurring in Scotland. Previous problems in defining the Broad Habitat during Field Survey and when processing mapping data have led to revised estimates of status since the CS 2000 report. Estimates now indicate very little change in the extent of this habitat since 1984 and there were no significant changes in the extent of this Broad Habitat between 1990 and 2007. Movements between Fen, Marsh and Swamp and other habitats were small and largely involved Acid and Neutral Grasslands.

Vegetation condition has deteriorated since 1990 in the Fen, Marsh and Swamp Broad Habitat. The total Species Richness Score, as well as the number of plant species used by butterfly caterpillars as food, decreased in all plot types between 1998 and 2007.

A long-term reduction in the acidity of soils (0-15cm) in Fen, Marsh and Swamp Broad Habitat was due mainly to the large pH increase between 1978 and 1998. The carbon concentration of soils (0-15cm) decreased significantly between 1998 and 2007, but there was no significant change over the period as a whole.

## 7.9 Discussion

Mountain, moor and heathland habitats occupy over half of the landscape in Scotland, and comprise 60% of the UK total for these habitats. Associated land-based activities, such as hill farming, game management, tourism and recreation, play a part in Scotland's rural economy. These activities exert, and are influenced by, a variety of environmental, economic, legislative and political pressures, some of which have changed in their prevalence and intensity since the first CS in 1978. Long-term environmental pressures include the effects of climate change, which are likely to affect upland species and habitats. The uplands have also been affected by major changes in the economic environment over the past ten years, particularly following the reform of the Common Agricultural Policy (CAP).

Moor and heathland habitats are the product of centuries of management by muirburn and extensive grazing. These cultural landscapes are important for recreation, tourism and as sporting estates, and are also of international conservation importance for their distinctive assemblages of birds and mammals. Their future depends on well-planned management which seeks to balance a range of sometimes conflicting uses. Identification and maintenance of the most appropriate grazing and burning regimes for achieving desired outcomes is key to maintaining habitats in good condition. Future land use will need to meet multiple objectives appropriate to local conditions, while responding to the ways in which the impacts of grazing and burning interact with changes in climate and deposition of air pollution.

Many areas of mountain, moor and heath are protected under international and national nature conservation designations. The EC Birds and Habitat Directives and the Nature Conservation (Scotland) Act 2004 aim to protect internationally and nationally important rare and threatened habitats and species, which are targeted through designated Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Sites of Special Scientific Interest (SSSIs). Mountain, moor and heath habitats are also targeted through the UK BAP and the Scottish Biodiversity Strategy (SBS), which include specific targets for the restoration and maintenance of Priority Habitats.

Grazing in the uplands is strongly influenced by livestock subsidy mechanisms and other economic factors. Since the Single Farm Payment (SFP) scheme was introduced in 2005 as part of CAP reform, support is no longer based on the number of animals. This has contributed to a steady reduction in the numbers of hill sheep, particularly in the north and west, with Scottish Agricultural Census returns showing reductions in sheep and, to a lesser extent, cattle since 1999. The impact of the decline is complex, due to factors such as local variations and interactions with wild grazers such as deer. Changes to upland farming and grazing will have consequences for habitats and biodiversity resulting from possible undergrazing in some areas.



▲ Muirburn mosaic • © CEH

The increase in Bracken over the last ten years is likely to be related to heavy grazing pressure, as the species-poor grassland that often results is more prone to bracken invasion than heather moorland. Bracken infestation is a problem in many areas of upland Scotland, as it has limited grazing potential, acts as a reservoir for ticks and is associated with loss of biodiversity. Bracken thrives in mild, damp conditions such as those found in the south and west of Scotland, so it is possible that climate change will favour its spread in the future.

Many of the changes that have occurred in upland habitats are closely linked to changes in agricultural practices, which over the past ten years have been influenced by reforms to subsidies and changing market pressures. The importance of an integrated approach to dealing with the many pressures on upland habitats is reflected in the move towards agricultural support schemes which incorporate a wide range of environmental, economic and social outcomes. The effects of climate change are likely to become increasingly evident in the landscape. CS provides a contextual picture by measuring large-scale and long-term changes of widespread habitats in the uplands.



▲ Deer-proof fencing • © Caspian Richards

Air pollution in the form of atmospheric deposition of sulphur and nitrogen has been impacting on upland habitats since the industrial revolution through changes to acidity and nutrient status. Emissions of sulphur dioxide have decreased since the 1970s and reductions in the acidity of upland soils reflect this between 1978 and 1998. On the basis of critical load assessments, upland habitats, and bogs in particular, are considered to be at risk from increasing nutrient levels due to nitrogen deposition. A greater understanding is needed of the interaction between the impacts of nitrogen deposition with grazing and burning impacts. The increase in species associated with acid conditions appears inconsistent with the decrease in soil acidity observed between 1998 and 2007. However, this may be due to time lags in vegetation responses to changes in soils. More detailed analysis may help with understanding the interactions over long timescales that are involved in vegetation changes in upland habitats.



▲ Sheep grazing on heather • © SNH

## Further information

More details of the methodology, analyses and results from Countryside Survey can be found in other companion reports and data resources available for the Countryside Survey website [[www.countrysidesurvey.org.uk](http://www.countrysidesurvey.org.uk)] including:

### Reports:

- UK Headline Messages – *published November 2008*
- UK Results from 2007 – *published November 2008*
- Detailed Northern Ireland Countryside Survey results – *published April 2009*
- England Results from 2007 – *due to be published August 2009*
- Scotland Results from 2007 – *due to be published June 2009*
- Wales Results from 2007 – *due to be published July 2009*
- Ponds – *due to be published July 2009*
- Streams – *October 2009*
- Soils – *November 2009*
- Integrated Assessment – *2010*

### Data resources:

- Web access to **summary data** – a systematic summary of the results used to inform the UK and country level reports – launched in November 2008 and updated in January 2009
- Web access to the **actual data** – data from individual survey squares used to generate all the results presented in Countryside Survey reports from the 2007 survey – licensed access available from June 2009
- The UK Land Cover Map for 2007 – September 2009

The data generated by Countryside Survey will continue to be investigated in conjunction with other information such as climate, pollution and agricultural statistics. It is anticipated that future analysis of Countryside Survey data will lead to many scientific journal articles over the coming years. These investigations will improve understanding about the possible causes of the changes detected in the countryside and, for example, provide an opportunity to explore the results for Priority Habitats in more detail.

## Contacts

For further information on Countryside Survey see

[www.countrysidesurvey.org.uk](http://www.countrysidesurvey.org.uk) or contact:

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The Countryside Survey partnership has endeavoured to ensure that the results presented in this report are quality assured and accurate. Data has been collected to estimate the stock, change, extent and/or quality of the reported parameters. However, the complex nature of the experimental design means that results can not necessarily be extrapolated and/or interpolated beyond their intended use without reference to the original data.



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