



▲ Lowland neutral grassland • © SNH

4. Semi-Natural Grasslands: Neutral, Calcareous and Acid Grassland Broad Habitats

Summary

- The area of Acid Grassland increased by 8% in Scotland between 1998 and 2007 but no significant changes were detected in the areas of Neutral and Calcareous Grassland during this period.
- Plant species richness decreased by around 17% in Neutral Grassland in Scotland since 1998. Species losses included Bird and Butterfly larvae Food Plants.
- Competitive plant species increased at the expense of species of open ground in Neutral Grassland in Scotland between 1998 and 2007.
- Plant species associated with wetter conditions increased in Neutral Grassland in Scotland since 1998.
- Plant species richness decreased in Acid Grassland in Scotland between 1998 and 2007. Losses of species between 1998 and 2007 included Bird and Butterfly larvae Food Plants.
- Competitive plant species associated with wetter conditions increased, while species of open ground decreased in Acid Grassland in Scotland between 1998 and 2007.
- The mean pH of soils (0-15cm) in Neutral Grassland and Acid Grassland did not change in Scotland between 1998 and 2007. There were significant increases in mean pH (0-15cm) in both Broad Habitats across the period 1978 to 2007.
- No significant change was detected in the mean carbon concentration in soils (0-15cm) in Neutral Grassland in Scotland between 1998 and 2007, but for soils (0-15cm) in Acid Grassland, there was a significant decrease in Scotland during the same period.



▲ Surveyor at work, acid grassland • © CEH

4.1 Introduction¹

In Scotland the majority of grasslands fall into the category of semi-natural grasslands. Two thirds of the area of semi-natural grassland is Acid Grassland typical of upland areas with thin soils and agriculturally unproductive grass species, located mainly in the True Uplands (EZ6) and the Intermediate Uplands and Islands (EZ5). Neutral grassland is less extensive in Scotland where it comprises approximately one third of the total area of semi-natural grassland and is mainly found in the Lowlands (EZ4). The Calcareous Grassland Broad Habitat is scarce in Scotland and is only found to any notable extent in the Intermediate Uplands and Islands (EZ5).

Acid Grassland in Scotland tends to be extensively managed for livestock production, particularly for beef and lamb, on land which is unsuitable for any other kind of production. In contrast, Neutral Grassland, concentrated in the Lowlands (EZ4) and Calcareous Grassland in the Intermediate Uplands and Islands (EZ5), may have been subject to previous intensive management and reverted to Neutral or Calcareous Grassland after more extensive management or may never have been agriculturally improved by ploughing, re-seeding or the use of inorganic fertilisers. Also included in the Neutral Grassland Broad Habitat are areas of unmanaged grassland which may be characteristic of semi-urban areas or areas adjacent to rivers and streams and other small areas of neglected or unmanaged land which are not associated with livestock production. More narrowly defined BAP Priority Habitats occur within each of these Broad Habitats but Countryside Survey (CS) data are unable to contribute to their assessment in Scotland as it does not adequately sample their restricted extent.

The three Broad Habitats included in this chapter are characteristic of soils with differing pH values in their whole profiles. Neutral Grassland occurs on soils that are neither strongly acid nor lime-rich (pH 5.5-6.5); Calcareous Grassland occurs on lime-rich soils (pH > 6.5) such as chalk; and Acid Grassland occurs on acid soils (pH < 5.5). Much of the Acid Grassland in Scotland occurs in the uplands and so reference is also made to this Broad Habitat and its interactions with other Broad Habitats in *Chapter 7*.

Condition of these habitats is assessed using two plot types, Main plots sample the main extent of these Broad Habitats and Targeted plots sample smaller fragments of these Habitats which may be present adjacent to more intensively managed land e.g. a small area of botanically diverse Neutral Grassland in the corner of an arable field.

4.2 Description of Broad Habitats

The three Broad Habitats covered in this chapter are:

Neutral Grassland: This includes all semi-improved and unimproved grassland occurring on neutral soil. It includes enclosed and managed grassland such as pastures, a range of wet grasslands where the vegetation is dominated by grasses, and tall and unmanaged grassland.

Calcareous Grassland: Consists of vegetation on dry ground with scattered sedges and many calcicoles present. It can be relatively species poor but is often species rich with >50% forb cover. It is found on calcareous soils, usually rendzinas or on chalk or limestone.

Acid Grassland: Fine grasses predominate in generally dry situations e.g. *Agrostis capillaris*, *Festuca ovina* and *Anthoxanthum odoratum* usually on brown podzolic soils or rankers. Species indicative of acid conditions are present and include, e.g. *Galium saxatile*, *Potentilla erecta*, *Pleurozium schreberi* and *Rumex acetosella*. This Broad Habitat also includes moorland grass dominated by *Nardus stricta* and *Molinia caerulea*, which is characteristic of moorlands and lowland heaths on peat or peaty gley soils.

4.3 Area of Semi-Natural Grasslands

- The area of Acid Grassland increased by 8% in Scotland between 1998 and 2007 but no significant changes were detected in the areas of Neutral and Calcareous Grassland during this period.

4.3.1 Neutral Grassland

Neutral Grassland was estimated to cover approximately 461,000 ha in 2007 or approximately 6% of Scotland (*Table 4.1*). Although there was a 6% increase in estimated area between 1998 and 2007, this was not significant on account of the high variability of the results. This increase followed a period of stability between 1990 and 1998 (*Fig. 4.1*). Most Neutral Grassland occurs in the Lowlands (EZ4) where it constitutes 12.2% of the land area. No statistically significant changes were detected in the extent of Neutral Grassland in any of the Environmental Zones but fluctuations in the estimates between 1990 and 2007 (particularly in the EZs where it is less common) indicate high variability in this Broad Habitat over time.

¹ 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)*.

▼ **Table 4.1:** Estimates of the area ('000s ha) and percentage of land area of Neutral Grassland in each Environmental Zone and in Scotland from 1990 to 2007. 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	255	11.3	276	12.2	277	12.2	
EZ5	147	5.8	105	4.1	122	4.8	
EZ6	27	0.8	49	1.5	62	0.8	
Scotland	429	5.4	430	5.4	461	5.8	

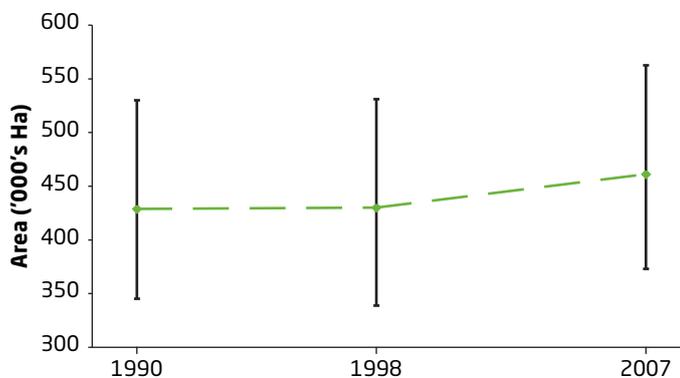
▼ **Table 4.2:** Estimates of the area ('000s ha) and percentage of land area of Calcareous Grassland in each Environmental Zone and in Scotland from 1990 to 2007. Arrows denote significant change ($p < 0.05$) in the direction shown. Note that because of changes in definitions that have been applied 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	0	0	0	0	0	0	
EZ5	36	1.4	28	1.1	26	1	
EZ6	0	0	0	0	0	0	
Scotland	36	0.4	28	0.4	26	0.3	

▼ **Table 4.3:** Estimates of the area ('000s ha) and percentage of land area of Acid Grassland in each Environmental Zone and in Scotland from 1990 to 2007. 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	123	5.5	84	3.8	82	3.7	
EZ5	301	11.8	254	9.9	277	10.8	
EZ6	671	21	573	17.9	624	19.5	↑
Scotland	1095	13.6	911	11.4	983	12.3	↑

▼ **Figure 4.1:** Change in the area of Neutral Grassland across Scotland between 1990 and 2007. 95% Confidence Intervals are shown for each data point. Confidence Intervals on change are not shown.



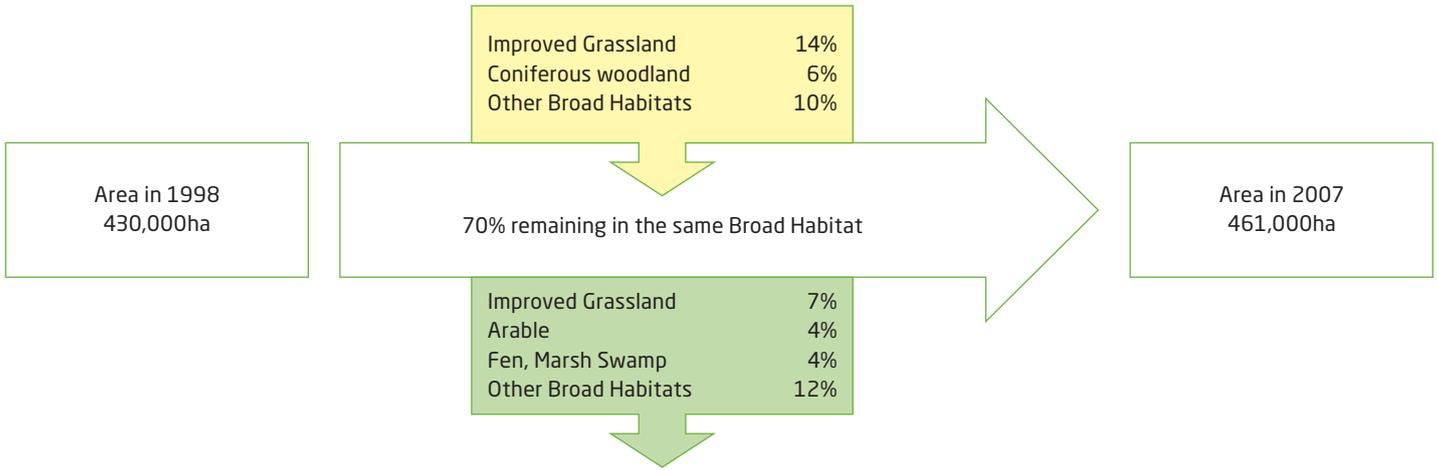
Around 70% of Neutral Grassland polygons remained as that Broad Habitat between 1998 and 2007. Neutral Grassland is a variable Broad Habitat, incorporating a range of different grassland types in different situations and losses and gains to this Broad Habitat included a wide range of different Broad Habitat types (Fig 4.2).

4.3.2 Calcareous Grassland

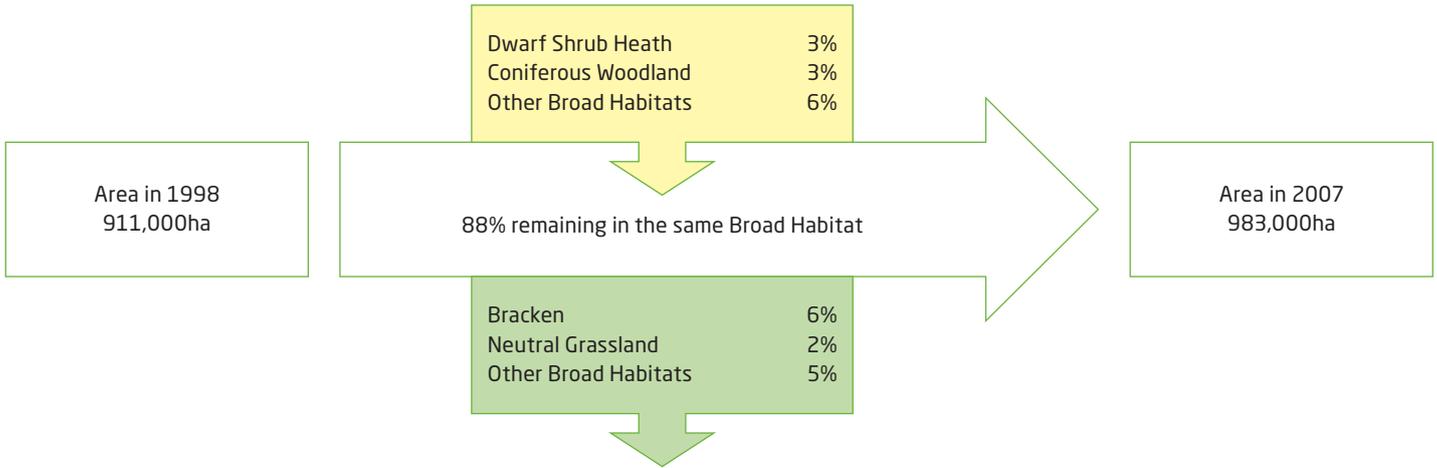
Calcareous Grassland was estimated to cover approximately 26,000 ha (0.3%) of Scotland in 2007 (Table 4.1), the same percentage as for Great Britain. This Broad Habitat is found almost entirely within the Intermediate Uplands and Islands (Table 4.1). Due to the small sample size it is difficult to detect small changes in the area of this Broad Habitat and none has been detected since 1990 in either the Intermediate Uplands and Islands or across Scotland as a whole (Table 4.2).

Over 95% of Calcareous Grassland polygons remained in the same Broad Habitat between 1998 and 2007. There were no notable losses and gains from/to this Broad Habitat.

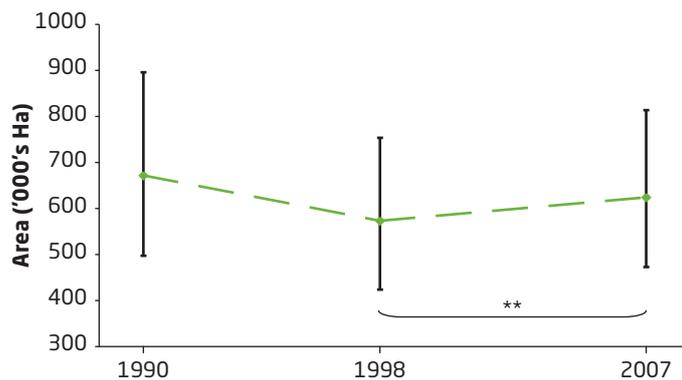
▼ **Figure 4.2:** Movements of land into and out of Neutral Grassland between 1998 and 2007.



▼ **Figure 4.3:** Movements of land into and out of Acid Grassland between 1998 and 2007.



▼ **Figure 4.4:** Change in the area of Acid Grassland across the True Uplands (EZ6) between 1990 and 2007. Significant changes (** 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.



4.3.3 Acid Grassland

Acid Grassland was estimated to cover approximately 983,000 ha in 2007 or approximately 12% of Scotland (Table 4.1). As for other upland habitats, Scotland is a key stronghold for this Broad Habitat containing over 60% of the stock for Great Britain, most of which is concentrated in the True Uplands (EZ6). The area of Acid Grassland

increased both across Scotland (by 8%) and in the True Uplands (by 9%) between 1998 and 2007 (Table 4.3, Fig. 4.4). There were no significant changes across Scotland or in any of the EZs between 1990 and 1998 despite large apparent differences between estimates. The introduction of new recording categories for Broad Habitats in 1998 may have affected the estimates of changes between 1990 and 1998 in both Neutral and Acid Grassland. The change estimates between 1998 and 2007 are more reliable because the same codes were used in both surveys.

The majority (88%) of Acid Grassland polygons remained in the same Broad Habitat between 1998 and 2007. Areas of land in this Broad Habitat were mainly lost and gained to other upland Broad Habitats (Fig 4.3).

4.4 The Condition of semi-natural grasslands

4.4.1 Changes in Neutral Grassland Broad Habitat

- Plant species richness decreased by around 17% in Neutral Grassland in Scotland since 1998. Species losses included Bird and Butterfly larvae Food Plants.

▼ **Table 4.4:** Change in the characteristics of vegetation in 200m² Main Plots in the Neutral Grassland Broad Habitat across Scotland between 1990 and 2007. Mean values for condition measures in 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)	22.9	24.2	20.0	↓	↓							↓			
No. of Bird Food Species	10.6	10.8	9.5	↓											
No. of Butterfly Food Species	10.4	10.6	9.2	↓											
Grass:Forb Ratio	0.69	0.93	1.12									↑		↑	
Competitor Score	2.67	2.66	2.76	↑	↑								↑		
Stress Tolerator Score	2.36	2.34	2.33												
Ruderal Score	2.92	2.88	2.79	↓	↓							↓	↓		
Light Score	6.95	7.00	6.98					↑							
Fertility Score	4.95	4.92	4.86											↓	
Ellenberg pH Score	5.62	5.57	5.53												
Moisture Score	5.57	5.55	5.67	↑	↑							↑		↑	

▼ **Table 4.5:** Change in the characteristics of vegetation in 2m x 2m Targeted Plots in the Neutral Grassland Broad Habitat across Scotland between 1990 and 2007. Mean values for condition measures in 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)	16.1	14.1	12.2	↓	↓	↓		↓	↓			↓	↓	↓	
No. of Bird Food Species	6.7	5.9	5.0	↓	↓			↓		↓		↓	↓	↓	
No. of Butterfly Food Species	6.9	6.3	5.6	↓		↓		↓				↓	↓	↓	
Grass:Forb Ratio	0.56	1.06	0.87					↑	↑						
Competitor Score	2.79	2.87	2.95	↑					↑			↑	↑		
Stress Tolerator Score	2.45	2.46	2.42												
Ruderal Score	2.70	2.58	2.52					↓	↓			↓	↓		
Light Score	6.87	6.89	6.87												
Fertility Score	4.73	4.73	4.85	↑										↑	
Ellenberg pH Score	5.46	5.38	5.48	↑											
Moisture Score	5.80	5.81	5.87												

- **Competitive plant species increased at the expense of species of open ground in Neutral Grassland in Scotland between 1998 and 2007.**
- **Plant species associated with wetter conditions increased in Neutral Grassland in Scotland since 1998.**

Main Plots: The Species Richness Score in Main Plots in Neutral Grassland across Scotland (**Table 4.4, Fig. 4.5**) decreased between 1998 and 2007 by an average of four species per plot. This decrease was aligned with decreases in both Bird and Butterfly larvae Food Species scores by on average one species per plot. Other changes within Main Plots in Neutral Grassland included an increase in the Competitor Score aligned with decreases in the Ruderal Score, indicating that Neutral Grassland is becoming more

dominated by established competitive species. An increase in the Moisture Score indicates that those competitive species are more suited to wetter conditions than species present in 1998.

Results for the Scottish Lowlands (EZ4), in which the majority of Neutral Grassland is found, are consistent with those for Scotland (**Table 4.4**), but there were no other changes within the other two Environmental Zones between 1998 and 2007.

Many of the changes across the period 1990 to 2007 appeared to be largely due to changes between 1998 and 2007 and are consistent with those changes. Other changes included an increase in the Grass to Forb ratio and a decrease in species associated with fertile conditions in the Intermediate Uplands and Islands between 1990 and 2007.



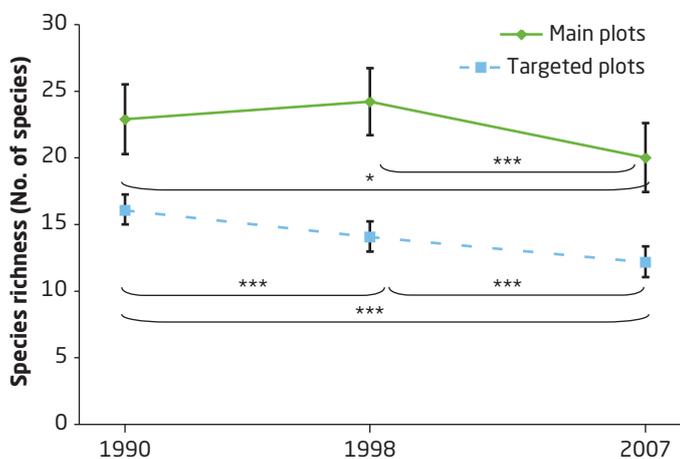
▲ Meadowsweet • © SNH

Targeted Plots: In areas targeted in Countryside Survey for their botanical interest, the plant Species Richness score decreased from 14.1 to 12.2 species per plot in Scotland between 1998 and 2007, following a similar decrease between 1990 and 1998 (Table 4.5, Fig. 4.5). The Targeted Plots may have been located in small patches of Priority Habitat within larger Neutral Grassland areas or within patches of Neutral Grassland within other habitats such as scrub. This increase was consistent with increases in species associated with fertile conditions and a higher pH.

Decreases in the Species Richness Score also occurred within both the Lowlands (EZ4) and the Intermediate Uplands and Islands (EZ5). Decreases in the numbers of Bird Food Species also occurred in the Lowlands (EZ4) and in Butterfly larvae Food Species in the Intermediate Uplands and Islands (EZ5).

There were a number of changes in Targeted Plots between 1990 and 2007 (Table 4.5) many of which were consistent with a) changes between 1998 and 2007 and b) changes in Main Plots.

▼ **Figure 4.5:** Change in the Species Richness score in Main and Targeted Plots in the Neutral Grassland 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.



Other Characteristics of the vegetation of Neutral Grassland:

The changes in the Main and the Targeted Plots are supported by the list of the plant species that increased or decreased the most with only three species showing a significant positive change index (Table 4.6). Decreasing species included both a high proportion of common grasses and some forbs whilst two of the three increasing species are associated with moist conditions.

4.5.2 Changes in Calcareous Grassland Broad Habitat

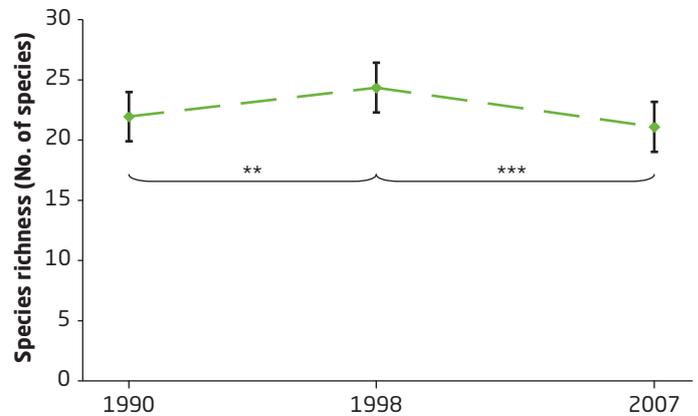
There are too few plots in Calcareous Grassland in Scotland to assess changes in condition.

4.5.3 Changes in Acid Grassland Broad Habitat

- Plant species richness decreased in Acid Grassland in Scotland between 1998 and 2007, particularly in the True Uplands. Losses of species between 1998 and 2007 included Bird and Butterfly larvae food plants.

- Competitive and moisture-preferring plant species increased, while species of open ground decreased in Acid Grassland in Scotland between 1998 and 2007.

▼ **Figure 4.6:** Change in the Species Richness score in 200m² Main Plots in the Acid Grassland Broad Habitat across Scotland between 1990 and 2007. Significant changes (** $p < 0.01$, *** $p < 0.001$) are shown between the dates bracketed. 95% Confidence Intervals are shown for each data point.



Main Plots: The mean plant Species Richness Score recorded in Main Plots in Acid Grassland increased in Scotland between 1990 and 1998 but had decreased by 2007 (Table 4.8), with no overall change across the entire period (Fig. 4.6). The numbers of Butterfly larvae Food Plant species followed the same pattern.

Other changes within Main Plots in Acid Grassland were very similar to those in Neutral Grassland including an increase in the Competitor Score aligned with decreases in the Ruderal Score, and an increase in the Moisture Score. As in Neutral Grassland these changes indicate that Acid Grassland is becoming more dominated by established competitive species which are more suited to wetter conditions than species present in 1998.

▼ **Table 4.6:** The plant species with the largest increases and decreases in frequency in Main Plots in the Neutral Grassland Broad Habitat across Scotland between 1998 and 2007. Species are ranked according to the difference between the number of plots in which the species was found in 1998 and 2007 as indicated in the column 'No. & Direction'.

Species with increasing frequency		Change Index	No. and Direction	Species with decreasing frequency		Change Index	No. and Direction
<i>Juncus effusus</i>	Soft rush	0.48	6	<i>Poa pratensis sens lat</i>	Smooth meadow grass	-0.61	-17
<i>Trifolium pratense</i>	Red clover	0.46	6	<i>Bellis perennis</i>	Daisy	-0.23	-9
<i>Cirsium palustre</i>	Marsh thistle	0.18	4	<i>Veronica chamaedrys</i>	Germander speedwell	-0.25	-8
				<i>Luzula campestris</i>	Field Wood-rush	-0.21	-8
				<i>Alopecurus pratensis</i>	Meadow foxtail	-0.36	-7
				<i>Poa annua</i>	Annual meadow grass	-0.23	-7
				<i>Lathyrus pratensis</i>	Meadow Vetchling	-0.32	-6
				<i>Agrostis capillaris</i>	Common bent	-0.02	-5
				<i>Ranunculus repens</i>	Creeping buttercup	-0.02	-5
				<i>Agrostis stolonifera</i>	Creeping bent	-0.04	-5

▼ **Table 4.8:** Change in the characteristics of vegetation in 200m² Main Plots in the Acid Grassland Broad Habitat across Scotland between 1990 and 2007. Mean values for condition measures in 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)	21.9	24.3	21.1	↓			↓	↑			↑				
No. of Bird Food Species	5.0	5.4	4.8	↓			↓				↑				
No. of Butterfly Food Species	8.9	9.5	8.3	↓		↓	↓	↑			↑			↓	
Grass:Forb Ratio	1.30	1.21	1.34												
Competitor Score	2.18	2.18	2.24	↑					↓			↑			↑
Stress Tolerator Score	3.51	3.47	3.46						↑		↓				↓
Ruderal Score	1.81	1.86	1.81	↓							↓				
Light Score	6.92	6.97	6.98					↑				↑	↑		
Fertility Score	2.94	2.95	2.93						↓						
Ellenberg pH Score	3.67	3.72	3.71								↑				
Moisture Score	6.41	6.37	6.46	↑		↑									

Patterns of change in the mean plant Species Richness score and Bird and Butterfly larvae Food Species scores in the True Uplands (EZ6) were consistent with those for Scotland, as most of the Acid Grassland occurs in EZ6. Changes in the Intermediate Uplands and Islands since 1998 are also consistent with changes across Scotland as a whole.

The results for the True Uplands indicate that the increase in competitive species since 1998 is at the expense of stress-tolerant species.



▲ Harebell • © SNH

▼ **Table 4.9:** Change in the characteristics of vegetation in 2m x 2m Targeted Plots in the Acid Grassland Broad Habitat across Scotland between 1990 and 2007. Mean values for condition measures in 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)	14.1	15.3	13.2	↓	↓		↓	↑							
No. of Bird Food Species	3.2	3.8	3.4					↑	↑						
No. of Butterfly Food Species	5.8	6.2	5.6	↓	↓		↓								
Grass:Forb Ratio	0.97	1.08	1.13												
Competitor Score	2.20	2.23	2.31	↑	↑							↑	↑		↑
Stress Tolerator Score	3.50	3.45	3.41								↓				↓
Ruderal Score	1.88	1.95	1.92												
Light Score	6.94	6.99	6.95	↓			↓	↑			↑				
Fertility Score	3.05	3.05	3.07												
Ellenberg pH Score	3.93	3.93	3.94												
Moisture Score	6.42	6.39	6.42												

▼ **Table 4.10:** The plant species with the largest increases and decreases in frequency in Main Plots in the Acid Grassland Broad Habitat across Scotland between 1998 and 2007. Species are ranked according to the difference between the number of plots in which the species was found in 1998 and 2007 as indicated in the column 'No. & Direction'.

Species with increasing frequency		Change Index	No. and Direction	Species with decreasing frequency		Change Index	No. and Direction
<i>Carex binervis</i>	Green ribbed sedge	0.31	8	<i>Agrostis capillaris</i>	Common bent	-0.26	-19
<i>Cirsium arvense</i>	Spear thistle	0.24	6	<i>Carex pilulifera</i>	Pill sedge	-0.3	-15
<i>Urtica dioica</i>	Common nettle	0.2	5	<i>Luzula campestris</i>	Field wood-rush	-0.16	-14
<i>Trichophorum caespitosa</i>	Deergrass	0.25	5	<i>Festuca rubra agg.</i>	Red fescue	-0.18	-13
<i>Agrostis canina sens lat.</i>	Velvet bent	0.26	5	<i>Festuca ovina agg</i>	Sheep's fescue	-0.11	-12
<i>Selaginella selaginoides</i>	Lesser clubmoss	0.16	4	<i>Carex viridula</i>		-0.22	-11
<i>Eriophorum vaginatum</i>	Harestail cotton grass	0.19	4	<i>Deschampsia flexuosa</i>	Wavy hair grass	-0.06	-10
<i>Cirsium palustre</i>	Marsh thistle	0.16	3	<i>Galium saxatile</i>	Heath bedstraw	-0.07	-10
<i>Carex echinata</i>	Star sedge	0.19	3	<i>Agrostis stolonifera</i>	Creeping bent	-0.1	-9
<i>Holcus lanatus</i>	Yorkshire fog	0.21	3	<i>Carex pulicaris</i>	Flea sedge	-0.24	-9

Targeted plots: The results for the Targeted Plots situated in areas of botanical interest within the Acid Grassland Broad Habitat across Scotland as a whole reveal similar trends to those found in the Main Plots, with decreases in both species richness and numbers of Butterfly larvae Food Plants (but not Bird Food Plants) since 1998 (**Table 4.9**). An increase in competitive species in these plots was aligned with an increase in shade tolerant species (decreasing Light Score) between 1998 and 2007.

The same patterns as observed for Scotland as a whole were present to varying extents in both the Lowlands (EZ4) and the True Uplands (EZ6).

As in Main plots, increases in the Species Richness Score between 1990 and 1998 as compared to decreases between 1998 and 2007 resulted in no overall change for the period 1990 to 2007.

Other characteristics of vegetation in Acid Grassland:

The changes in the Main and the Targeted Plots are supported by the lists of increasing and decreasing plant species (**Table 4.10**). Increasing plant species include a number of competitive species, notably *Urtica dioica* and *Cirsium arvense* alongside species associated with moist conditions, whilst decreasing species include many typical of dry acid grassland.

4.6 Changes to the soils (0-15cm) of semi-natural grasslands

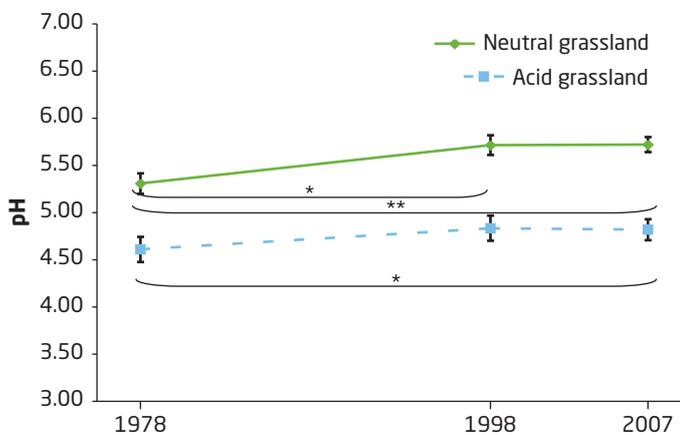
- **The mean pH of soils (0-15cm) in Neutral Grassland and Acid Grassland did not change in Scotland between 1998 and 2007. There were significant increases in mean pH (0-15cm) in both Broad Habitats across the period 1978 to 2007.**

- No significant change was detected in the mean carbon concentration in soils (0-15cm) in Neutral Grassland in Scotland between 1998 and 2007, but for soils (0-15cm) in Acid Grassland, there was a significant decrease in Scotland during the same period.

4.6.1 Neutral Grasslands

Soil (0-15cm) pH: The mean pH of soil (0-15cm) samples in Main Plots within Neutral Grassland in Scotland remained stable between 1998 (5.70) and 2007 (5.73). A lower pH in 1978 (5.31) resulted in significant increases between 1978 and 1998 and overall from 1978 to 2007 (Fig 4.7).

▼ **Figure 4.7:** The change in mean pH of soils (0-15cm) from Neutral and Acid Grasslands in Scotland between 1978 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.



Soil (0-15cm) carbon concentration: There was no significant change in the carbon concentration of soil (0-15cm) in Neutral Grassland in Scotland between 1998 (79.4g/kg) and 2007 (77.5g/kg) or between 1978 (85.7 g/kg) and 1998 or over the entire period 1978 to 2007.

Bulk density and soil (0-15cm) carbon content: The mean bulk density of Neutral Grassland soils (0-15cm) in Scotland was 0.81 g/cm³ (in the top 15cm) which when combined with mean soil (0-15cm) carbon concentration indicated a soil (0-15cm) carbon content of 67.5 t/ha.

4.7.2 Calcareous Grasslands

Too few soil samples were taken from the Calcareous Grassland Main Plots for a statistical analysis to be undertaken for this Broad Habitat.



▲ Neutral grassland • © Lisa Norton

4.7.3 Acid Grasslands

Soil (0-15cm) pH: There was no significant change in the mean pH of soil (0-15cm) samples in the Main Plots within Acid Grasslands in Scotland, between 1998 (4.83) and 2007 (4.82) (Table 2.7, Fig. 4.7). As in Neutral Grassland, a lower pH in 1978 (4.60) resulted in significant increases across the period 1978 to 2007 (except between 1978 and 1998).

Soil (0-15cm) carbon concentration: There was a significant decrease in the mean carbon concentration of soil (0-15cm) in Acid Grasslands in Scotland between 1998 (265.8g/kg) and 2007 (226.2g/kg) (Table 2.7), whereas there was no significant change between 1978 (238.6g/kg) and 1998, or across the period 1978 to 2007.

Bulk density and soil (0-15cm) carbon content: The mean bulk density of soils (0-15cm) in Acid Grassland in Scotland was 0.38 g/cm³ which, when combined with mean soil (0-15cm) carbon concentration indicated a soil (0-15cm) carbon content of 80.3 t/ha (Table 2.8).

4.8 Summary and Discussion

4.8.1 Summary - Changes in Semi-Natural Grasslands

Increases in the area of semi-natural grasslands in Scotland resulted from increases in Acid Grassland. There were no other significant changes in extent in semi-natural grassland Broad Habitats.

Plant species richness has decreased since 1998 in Main Plots in semi-natural grasslands and since 1990 in Targeted Plots in Neutral Grassland, with increases in the numbers of competitive species and species associated with wetter conditions. Soil pH increased in both Acid and Neutral Grassland between 1978 and 2007, but there were no significant changes in carbon concentration across the same period. Further analysis is ongoing to enable estimation of soil nutrient status, contaminant levels, soil biotic diversity and soil function and will be reported in November 2009. It was not possible to assess changes in condition or soils in Calcareous Grassland due to small sample sizes.



▲ Acid grassland, Glencoe • © SNH

4.8.2 Discussion

The variety of semi-natural grassland communities in Scotland has arisen through the combined effects of soil type, climatic conditions, drainage and centuries of land management, including grazing by sheep and deer.

The changes observed in vegetation condition in the 2007 results are consistent with what would be expected under reduced grazing and cutting, if combined with wetter conditions and higher soil pH. The increase in taller, more competitive species is likely to have suppressed smaller species, subsequently reducing species richness. Losses from Neutral Grassland to Fen, Marsh and Swamp may be partly due to reduced drainage maintenance in wetter grassland areas.

The unique and diverse assemblages of plants associated with Calcareous Grassland and its scarcity in Scotland means this habitat is of considerable importance for biodiversity. Due to small sample size, CS is only able to provide estimates of changes in extent, but it appears that the decrease seen between 1990 and 1998, due mainly to conversion to intensively managed pasture, has not continued.

In the uplands, a major threat to semi-natural grasslands is inappropriate grazing by cattle, deer and, in particular, sheep. In some areas, overgrazing is an issue, whereas in others, undergrazing occurs (see also [Chapter 7](#)). Agricultural Census data show that livestock numbers, particularly for sheep, have declined since 1999, largely as a result of farmers downsizing or leaving the

industry. The decline is complex but seems to have increased after agricultural payments were decoupled from numbers of animals². Other factors may be involved, such as the increases in deer abundance which may occur where livestock grazing is reduced. Further investigation is needed to improve understanding of the interactions between different grazing animals and the impact they have on habitats and biodiversity.

Other threats to semi-natural grasslands include eutrophication from airborne pollutants and supplementary livestock feeding, which favours species associated with more fertile conditions over less competitive species. Some sites may also be at risk from more localised pollution, such as ground water contamination and herbicide or fertiliser application.

The UK Biodiversity Action Plan (BAP) includes Habitat Action Plans (HAPs) which include maintenance, restoration and re-establishment targets for five types of lowland grassland in Scotland. In addition, many semi-natural grassland areas are protected under statutory nature conservation designations, e.g. as Sites of Special Scientific Interest. Agri-environment measures have been one of the main policy initiatives for delivery of biodiversity objectives in semi-natural grasslands since 1987.

Schemes with measures targeted at semi-natural grasslands included Environmentally Sensitive Areas (ESAs) and Rural Stewardship. Such schemes aimed to encourage the maintenance of semi-natural grasslands of existing high biodiversity value. Under the Scotland Rural Development Programme (SRDP), introduced in 2007, there are various outcome-focused options available to enhance as well as maintain species-rich unimproved grassland, or grasslands previously degraded by agricultural improvement or neglect. However, it will be some years before it is possible to assess the impact of these.

It may be that unimproved grasslands will increase in extent in future decades, as maintenance of improved grasslands in marginal areas becomes less financially viable. Appropriate grazing management would still be required, as in the long-term ungrazed grasslands will turn into scrub and woodland.



▲ Species-rich grassland • © SNH

² *Farming's Retreat from the Hills*, SAC Rural Policy Centre, 2008

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] 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.

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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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