Botanical monitoring of restored lowland wet grassland at Campfield Marsh RSPB Reserve, Cumbria, England

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SUMMARY

Former cattle-grazed grassland and arable land in a nature reserve in northwest England were converted into wet grassland by raising the water level. Over the next five years the vegetation shifted towards target plant communities characteristic of wet grassland.

BACKGROUND

In 1990, 57 ha of land was added to the Royal Society for the Protection of Birds Reserve (RSPB) Campfield Marsh nature reserve, incorporating part of the Bowness Common Site of Special Scientific Interest (SSSI). This site, located on the Solway Estuary in Cumbria, northwest England, is one of the largest raised bogs remaining in the UK and is part of a complex of lowland raised mires on the Solway Plain. Bowness Common still supports some typical bog vegetation including bog rosemary *Andomeda polifolia*, cranberry *Vaccinium oxycoccos* and great sundew *Drosera anglica*. Work has been undertaken to restore the site and re-establish active peat growth. Initially drains were dammed and invasive birch *Betula* scrub removed to help bring the water table back up to the surface of the mire.

To further enhance the site and help to raise and maintain water levels, 23 ha of wet grassland next to the Common has been created. Prior to RSPB ownership, this area was heavily drained and primarily used for cattle grazing, the fields being reseeded periodically with a conventional perennial rye grass *Lolium perenne* mix between 1978 and 1990. One of the fields was barley stubble at the time of acquisition and this was subsequently sown with a rye grass mix with the intention of managing the site to provide winter grazing for barnacle geese *Branta leucopsis* and grey geese *Anser* spp. At this stage these fields were still heavily drained and some fertiliser was also applied up to 1994 when application ceased. In 1995 it was decided to change the emphasis of management and raise the water levels. The idea behind this was to enhance habitat for breeding wading birds such as lapwing *Vanellus vanellus*, common snipe *Gallinago gallinago* and redshank *Tringa totanus*. The process of this reversion and details of results of ongoing botanical monitoring are summarised.

ACTION

Restoration area: Five fields comprising 23 ha of former cattle-grazed, species poor perennial rye-grass dominated grassland and arable cropland were selected to be restored to wet grassland. The fields were situated along the north-western edge of Bowness Common SSSI (National Grid ref: NY210600); on the Campfield Marsh RSPB Reserve (NY200613).

Wet grassland creation: Water levels were raised immediately before the first botanical survey in August 1995, by diverting the main drain that runs along the edge of Bowness Common and installing sluices along its length to manipulate water levels. However, as part of the Countryside Stewardship agreement, two fields, 'A6' and 'B5 & 6', were chain harrowed, hand cast and rolled with a grass mix of meadow fescue *Festuca pratensis*, red rescue *F. rubra*, tall fescue *F. arundinacea*, cock's-foot *Dactylis glomerata* and crested dog's-tail *Cynosurus cristatus*. Currently the fields are cattle-grazed, with the exception of C5 which has been left untouched as a control.

Vegetation surveys: Vegetation surveys were

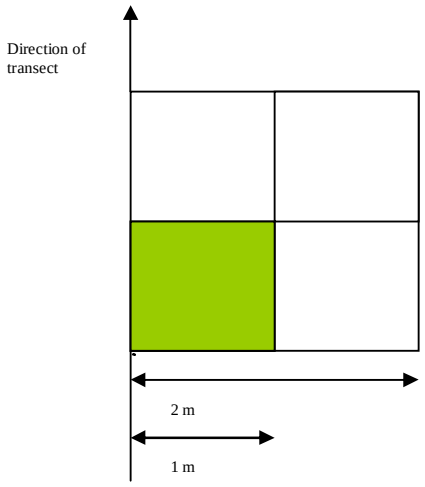

Figure 1. Quadrat design for vegetation surveys.

conducted during 19-22 August 1995 and repeated using the same methodology on 27-30 August 1999 and 26-30 August 2004. Quadrats were placed at set intervals along established transects throughout the different study fields, the size of which determined the number and spacing of quadrats. Each quadrat was aligned with the transect. Percentage cover was recorded in a 1 x 1 m quadrat plus presence and absence in a 2 x 2 m quadrat which the original quadrat was nested within (Figure 1).

Ellenberg's indicator values: Ellenberg's indicator values allow inferences about a particular site to be made by identifying the plants growing there. All the scales except Moisture have values ranging from 1 to 9. Moisture values range from 1 to 12.

In this study Ellenberg's indicator values for moisture (F-values) have been used to analyse the three years botanical survey data to date, to give a quantitative assessment of the different field responses to the habitat management. These F-values were calculated by finding the individual F-value for each plant species, weighting it according to its percentage cover (derived from the quadrat sampling) and averaging across the field. A direct comparison between the years of the five species showing the greatest percentage cover was also carried out.

A definition and derivation of Ellenberg values and a list of Ellenberg scores for British plant species are available to download at http://www.ceh.ac.uk/products_services/publications/online/ecofact/volume2a.htm.

CONSEQUENCES

The mean F-value across the whole site has increased each year indicating a shift to plant communities' characteristic of wetter conditions (Figure 2). There was a significant increase from 1995 to 1999 (very close to 0.05 confidence limits) but no significant increase was seen from 1999 to 2004. A comparison between each of the three survey years of the five plant species showing the highest percentage cover in each of the five fields is given in Appendix 1. A field by field summary is given below; the grassland types are described using the National Vegetation Classification system (Rodwell 1991 *et seq*).

Field A6: In field A6 there was a strongly significant increase in F-value from 1995 to 1999. However, from 1999 to 2004 the F-value decreased slightly, but this was not significant. Overall, from 1995 to 2004 the F-value has increased significantly. The vegetation has smoothly changed from a near text book definition of MG7 type improved mesotrophic grassland (rye-grass ley) in 1995, to an MG13 *Agrostis stolonifera - Alopecurus geniculatus* (creeping bent - marsh foxtail) lowland wet grassland type in 2004. Clearly, since 1995, the sward has become much less homogenous and although in 2004 *Lolium perenne* was still the third most abundant species in A6, its cover has dropped from an average of 84.6% in 1995 to just 4.47% in 2004. It is not felt that the analysis of the Ellenberg's values for moisture in this case does justice to a sharp

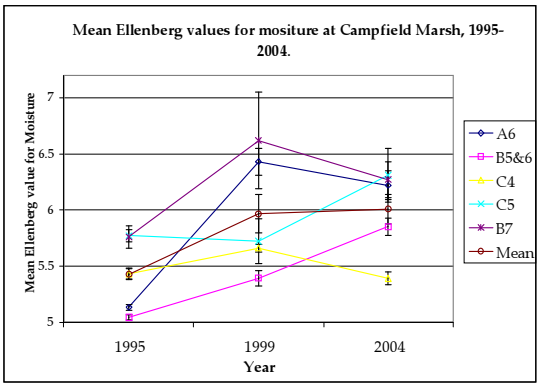

Figure 2. Mean Ellenberg values for moisture at Campfield Marsh in survey years 1995, 1999 and 2004, showing the highest percentage cover in each of the five fields (A6, B5&6, C4, C5, B7).

transition to lowland wet grassland from improved grassland.

Field B5 & 6: The only field to have significant increases in F-value from 1995 to 1999, 1999 to 2004 and 1995 to 2004 was field B5 & 6. This is not however reflected in the species composition. Although *Lolium perenne* now occurs at far lower levels (6.35%), the overall species composition is of dry, neutral grassland, along the lines of the NVC community MG6. The presence of soft rush *Juncus effusus* contradicts this however, and may be the reason for the increased Ellenberg value.

Field C4: This field became significantly wetter from 1995 to 1999 but significantly drier from 1999 to 2004. However, from 1995 to 2004 the values show no significant change and this can be seen in how close the mean Ellenberg values are. This field appears to have changed very little between 1995 and 2004 regarding its vegetation structure. The five most frequent species remain fairly constant with similar frequencies. The field could best be described as having changed from MG7 to MG6.

Field C5: C5, the un-grazed control field, became slightly drier, though not significantly so, between 1995 and 1999. Between 1999 and 2004, the field became wetter but again not significantly. However, from 1995 to 2004 the field became significantly wetter. This field showed some rather stark and chaotic changes in its vegetation composition between the three survey visits. In 2004, no NVC community could be readily assigned to it, as the vegetation was a mosaic of wet and dry species. Further monitoring of this field is required. In 2004 *J. effusus* was becoming dominant and will probably completely dominate the area if left unmanaged.

Field B7: This field became significantly wetter between 1995 and 1999. From 1999 to 2004 the F-value decreased, becoming drier but not significantly so. Overall, from 1995 to 2004, the F-value has increased significantly. However, once again the changes in the Ellenberg values do not reflect the changes in the vegetation observed. The field has changed from a MG6 grassland type to a MG13 grassland type, which is heavily dominated by *J. effusus* in many areas. This field should be monitored again in the future as the *Juncus* may become completely dominant.

The Ellenberg values now range from the driest, being C4 at 5.39 (±0.058), to the wettest being C5 at 6.31 (±0.24).

Breeding waders: As a result of restoration to wet grassland, breeding snipe and lapwing have recolonised and over the reserve as a whole breeding curlew *Numenius arquata* densities are 5.5 pairs/km², representing one of the highest recorded UK breeding densities.

Acknowledgement: Vegetation surveys in 1995 and 1999 were conducted by Andrew Henderson.

REFERENCES

Rodwell J.S. (ed) (1991 *et seq*) *British Plant Communities (Volumes 1-5)*. Cambridge University Press, Cambridge, UK.

Appendix 1. Percentage (mean) and standard error (s.e.) of the five major species in the surveys in 1995, 1999, and 2004 per field (A6, B5&6, C4, C5, C7). A6, B5&6 were chain harrowed and seeded. All fields were grazed, except C5, which acted as a control.

Field A6)

Rank	1995	Mean %	s.e.	1999	Mean %	s.e.	2004	Mean %	s.e.
1	*Lolium perenne*	84.6	0.53	*Juncus bufonius*	38.4	7.11	*Agrostis stolonifera*	56.6	7.79
2	*Holcus lanatus*	13.7	2.70	*Poa trivialis*	25.3	6.98	*Alopecurus geniculatus*	14.0	5.01
3	*Trifolium repens*	6.78	1.34	*Lolium perenne*	20.8	6.99	*Lolium perenne*	4.47	3.11
4	*Phleum pratense*	3.387	0.63	*Alopecurus geniculatus*	16.3	5.70	*Trifolium repens*	3.88	1.26
5	*Ranunculus repens*	1.60	0.53	*Ranunculus repens*	9.34	3.33	*Glyceria fluitans*	3.85	2.62

Field B5&6)

Rank	1995	Mean %	s.e.	1999	Mean %	s.e.	2004	Mean %	s.e.
1	*Lolium perenne*	79.3	2.69	*Lolium perenne*	56.3	5.67	*Agrostis capillaris*	20.2	4.87
2	*Trifolium repens*	17.6	2.48	*Trifolium repens*	17.2	3.19	*Trifolium repens*	12.6	3.68
3	*Holcus mollis*	2.12	2.12	*Agrostis capillaris*	14.9	4.42	*Ranunculus repens*	11.8	2.05
4	*Holcus lanatus*	1.42	0.55	*Ranunculus repens*	10.6	2.61	*Juncus effusus*	11.2	4.06
5	*Phleum pratense*	1.32	0.27	*Poa trivialis*	9.95	1.97	*Holcus lanatus*	8.34	1.83

Field C4)

Rank	1995	Mean %	s.e.	1999	Mean %	s.e.	2004	Mean %	s.e.
1	*Lolium perenne*	26.3	3.70	*Anthox-anthum odoratum*	41.9	9.16	*Holcus lanatus*	30.5	2.03
2	*Anthox-anthum odoratum*	15.7	5.10	*Holcus lanatus*	28.7	8.88	*Festuca rubra*	22.8	4.09
3	*Holcus lanatus*	14.3	2.93	*Taraxacum agg.*	24.5	3.62	*Lolium perenne*	11.5	2.85
4	*Agrostis capillaris*	6.83	3.07	*Lolium perenne*	8.33	2.08	*Taraxacum* agg.	8.35	2.03
5	*Holcus mollis*	6.50	3.89	*Holcus mollis*	4.35	2.11	*Anthox-anthum odoratum*	5.68	2.90

Field C5)

Rank	1995	Mean %	s.e.	1999	Mean %	s.e.	2004	Mean %	s.e.
1	*Anthox-anthum odoratum*	65.0	7.96	*Lolium perenne*	27.5	8.05	*Juncus effusus*	55.6	12.1
2	*Taraxacum* agg.	9.88	2.82	*Agrostis capillaris*	20.7	11.2	*Lotus corniculatus*	21.9	10.4
3	*Holcus mollis*	7.50	7.50	*Agrostis canina*	12.9	12.0	*Holcus lanatus*	11.2	4.67
4	*Lolium perenne*	6.50	1.56	*Ranunculus repens*	11.3	5.48	*Rumex acetosa*	7.75	3.04
5	*Agrostis canina*	4.00	2.41	*Taraxacum* agg.	7.75	2.04	*Ranunculus repens*	5.93	3.38

Field B7)

Rank	1995	Mean %	s.e.	1999	Mean %	s.e.	2004	Mean %	s.e.
1	*Holcus lanatus*	45.5	9.47	*Agrostis capillaris*	29.9	11.9	*Agrostis stolonifera*	34.8	12.6
2	*Agrostis capillaris*	15.5	7.39	*Ranunculus repens*	29.1	11.7	*Juncus effusus*	26.4	10.2
3	*Holcus mollis*	5.45	2.52	*Holcus lanatus*	13.8	8.49	*Agrostis capillaris*	13.5	7.70
4	*Phleum pratense*	4.11	1.38	*Agrostis stolonifera*	12.3	7.13	*Anthoxanthum odoratum*	3.91	2.69
5	*Ranunculus repens*	3.46	0.58	*Alopecurus geniculatus*	8.54	7.73	*Epilobium ciliatum*	2.75	1.87