Creating acid grassland by adding sulphur and re-seeding at Minsmere RSPB Reserve, Suffolk, England

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SUMMARY

Former arable land at Minsmere RSPB Reserve, eastern England, was treated with sulphur, herbicide was applied to control weeds, and seeds were sown in an attempt to create acid grassland. Soil pH was reduced and acid grassland target species dominated the vegetation three years after seeding.

BACKGROUND

This case study describes one of three methods used to try to create acid grassland on former arable land at Minsmere RSPB Reserve in Suffolk, eastern England. The other methods were sheep grazing and natural reversion (Ausden & Kemp 2005a) and addition of sulphur, bracken *Pteridium aquilinum* litter and heather *Calluna vulgaris* cuttings (Ausden & Kemp 2005b).

Prior to the current trial, arable cropping had been undertaken on the field every year between 1990 and 1996 inclusive with the aim of reducing soil fertility, particularly levels of extractable phosphorous (P) and exchangeable calcium (Ca) on the northern reversion block between 1990 and 1996. This period of cropping had no significant effect on soil pH or on extractable Ca and P levels (Marrs *et al*. 1998).

ACTION

Study site: The habitat creation took place on 5.1 ha of a former arable land on the Typical Brown Sands soil of the Suffolk Sandlings at Minsmere RSPB Reserve (National Grid ref: TM 454686), Suffolk, eastern England. The field had been under arable cultivation for at least the previous 150 years.

Soil properties in the field prior to the start of the current trial (mean values) were:

Loss on ignition (% of dry weight) 2.6; pH 7.1; Olsen extractable Phosphorous (µg P/g) 2.0.

Field treatment: The field was ploughed to 15 cm in April 1996, then power harrowed and rolled. In October 1996, vegetation was topped prior to addition of elemental sulphur which was applied at a rate of 2.58 tonnes/ha.

The field was sprayed in September 1999 with glyphosphate herbicide and MCPA (a selective weedkiller for the control of annual and perennial broad-leaved weeds of cereals and grassland) and again in August 2000, with Roundup Bi-active, to kill off vegetation that had established in the interim.

Seed sowing: An acid grassland mix (83% sheep's-fescue *Festuca ovina*, 10% common bent *Agrostis capillaris* and 7% fine-leaved sheep's-fescue *Festuca filiformis* by weight) was sown at a rate of 20 kg/ha in September 2000.

Soil and vegetation monitoring: Soil conditions were determined from 20 randomly located 15 cm deep soil samples extracted each field. Vegetation composition was monitored in 12 (1999 and 2001) or 15 (1997 and 2003) randomly located 1 m x 1 m quadrats within each field (three methods being tested on different fields). The cover of individual plant species within each quadrat was determined using 50 'hits' of a point quadrat. The presence of any additional plant species missed by the point sampling within the quadrat was also recorded. Existing acid grassland adjacent to the reversion fields was also surveyed (using 15 randomly placed quadrats) in order to define the 'target vegetation'.

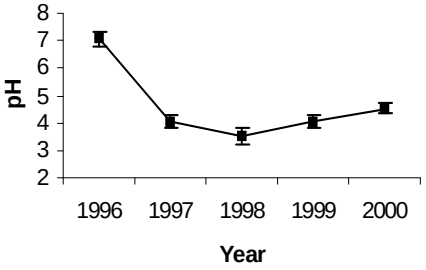


Figure 1. Changes in pH of the upper 15 cm of the soil of the field to which sulphur was applied, Minsmere 1996-2000. Values are means ± one standard error.

CONSEQUENCES

Soil pH: Addition of the sulphur and bracken litter significantly reduced the pH of the upper 15 cm of soil from pH 7 at the start of the field treatment in 1996, to around pH 4.5 in 2000 (Fig. 1).

Vegetation composition: Two measures of vegetation composition were used to assess the success of the habitat creation:

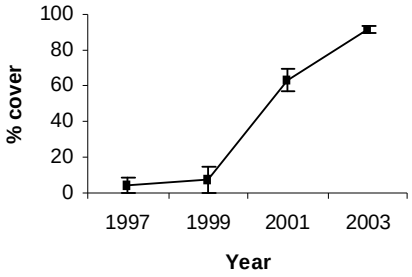
a) The percentage of cover of the species that were found in the 'target acid grassland species'. These were defined as all species found in 15 quadrats recorded on adjacent existing short, rabbit-grazed acid grassland excluding bracken, bramble *Rubus fructicosus* agg. and honeysuckle *Lonicera periclymenum*.

b) The species-richness of these 'target acid grassland species'.

Changes in the flora of the former arable field are shown in Figure 2. The cover of target acid grassland species remained low two years after addition of sulphur. The vegetation had become dominated by non-target perennial 'weed' species, the most abundant of which were black bent *Agrostis gigantea* and creeping thistle *Cirsium arvense*. Therefore, it was decided to seed it with an acid grassland mix in 2000. The three sown acid grass species quickly established and dominated the vegetation three years after seeding: sheep's-fescue/fine-leaved sheep's-fescue 50 + 6 % (these two species were grouped as it was not possible to distinguish non-flowering plants with certainty) and common bent 41 + 6 %.

Table 1 compares the vegetation in the grassland that had developed on the field by 2003 with that on adjacent existing acid grassland. The dominant plant species in the grassland on the field and on the adjacent existing acid grassland in 2003, seven years after the start of the trial, are shown in Table 2. Photo 1 shows the re-seeded field in summer 2004.

a) Target acid grassland species



b) Non-target perennials

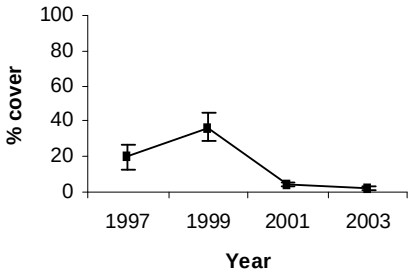


Figure 2a & b. Changes in vegetation cover in the field to which sulphur was applied, Minsmere, 1997-2003. Values are means ± one standard error.

Table 1. Comparison of the vegetation in the field at Minsmere to which sulphur was added and the field re-seeded with that of adjacent existing acid grassland. Values are mean percentage cover in 2003 ± one standard error.

Vegetation	Existing acid grassland	2.6 t/ha S + re-seeded	*t*	*P*
Target acid grassland species (% cover)	85.6 ± 2.5	91.9 + 2.2	2.214	0.035
Target acid grassland species (no. of species/m^2)	5.7 ± 0.7	2.3 + 0.2	5.244	<0.001

Table 2. Dominant plant species in the grassland on the field and on the adjacent existing acid grassland in 2003, seven years after the start of the trial (values are mean % cover ± one standard error).

Existing acid grassland:		
Sheep's sorrel	*Rumex acetosella* agg.	49.9 ± 7.4
Common bent	*Agrostis capillaris*	11.6 ± 4.0
Fine-leaved sheep's-fescue	*Festuca filiformis*	9.0 ± 3.6
Brown bent	*Agrostis vinealis*	4.3 ± 3.6
Field to which sulphur was added and re-seeding took place:		
Sheep's/fine-leaved sheep's-fescue	*Festuca ovina/filiformis*	49.7 ± 5.7
Common bent	*Agrostis capillaris*	41.3 ± 6.0
Squirreltail/rat's-tail fescue	*Vulpia bromides/myuros*	2.8 ± 1.3
Yorkshire-fog	*Holcus lanatus*	1.6 ± 0.9

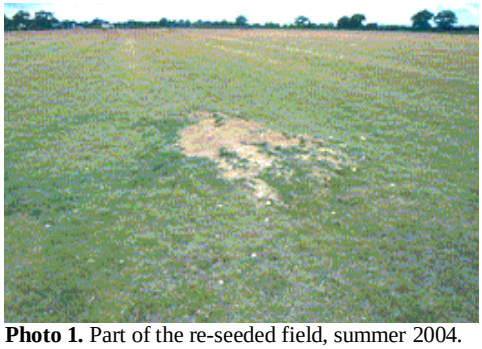


Photo 1. Part of the re-seeded field, summer 2004.

REFERENCES

Ausden M. & Kemp M. (2005a) Creating acid grassland by sheep grazing and natural reversion at Minsmere RSPB Reserve, Suffolk, England. *Conservation Evidence*, 2, 18-20.

Ausden M. & Kemp M. (2005b) Creating acid grassland by adding sulphur, bracken *Pteridium* litter and heather *Calluna* cuttings at Minsmere RSPB Reserve, Suffolk, England. *Conservation Evidence*, 2, 21-23.

Marrs R.H., Snow C.S.R., Owen K.M. & Evans C.E. (1998) Heathland and acid grassland creation on arable soils at Minsmere: identification of potential problems and a test of cropping to impoverish soils. *Biological Conservation*, 85, 69-82.