

Addition of sulphur to agricultural fields to restore heathland, Trehill Farm, Pembrokeshire, Wales

Day J.

Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire SG19 2DL, UK

SUMMARY

Former arable fields were treated by removing the topsoil, adding sulphur and applying seed-rich cuttings of heather *Calluna vulgaris*, bell heather *Erica cinerea* and western gorse *Ulex gallii* using a muck spreader. After soil stripping an interesting plant community developed, including some less frequent or rare species. Both heather species and western gorse germinated. Soil pH a year after the sulphur addition was 5.6 where applied at rate of 4t/ha and 4.2 where applied at 8t/ha.

BACKGROUND

The Marloes Peninsula is situated on the Pembrokeshire coast in southwest Wales. On the south side of the peninsula, lies Trehill Farm. Owned by the National Trust, its 247 hectares are farmed commercially. Early potato crops are the agricultural mainstay, supplemented by cereal cropping and winter sheep-grazing.

Historical evidence suggests the landscape was once a patchwork of heathland, flower-rich grassland, scrub and ponds as well as arable crops. The Marloes Coast Project was conceived during discussions with the tenants at Trehill, the objectives being to restore the historic landscape and habitats, especially the heathlands.

ACTION

Experimental fields: The soils of the six former arable fields (totalling 13 ha) selected for heathland restoration at Trehill Farm, had been heavily modified over the years by lime and fertiliser application. A method therefore, had to be found to counteract the high soil pH and nutrient load before trying to re-establish heathland plants such as heather *Calluna vulgaris*, bell heather *Erica cinerea* and western gorse *Ulex gallii*. Work by Liverpool University in the 1990s demonstrated that the acidifying nature of sulphur could be put to use in heathland restoration projects. They found

that spreading around 6 t/ha reduced soil pH from around pH 7 to pH 3. Although the experiments were successful, the technique remained largely theoretical rather than practical as the high cost of sulphur (upwards of £450/t) was prohibitive in anything other than small-scale trials.

Sulphur source: At Chevron-Texaco's Pembroke refinery, as part of the refining process, hundreds of tonnes of liquid sulphur are produced as a by-product (sold on to be used by the chemical industry). Attracted by the nature of the project, Chevron-Texaco donated some sulphur to spread on the fields at Trehill. In July 2004, 66 t of liquid sulphur was discharged onto a banded area of hard standing at the refinery and left to cool and solidify. A combination of vibrating roller and JCB was used to break the sulphur solid into small granules. This was then taken by lorry to the project site.

Sulphur application: In early August sulphur was applied to the fields by a conventional tractor-drawn lime-spreader. Most fields (or parts of) were treated at a rate of 4 t/ha. Those fields (or parts of) with high perennial ryegrass *Lolium perenne* cover or with clay-rich soils received a higher rate of 8 t/ha.

Heather and gorse mulch: All fields where sulphur had been applied were covered with a mulch of heather and gorse cuttings. With no suitable donor site in the immediate vicinity, the cuttings were collected from an area of

commonland undergoing heathland restoration work, 25 km inland.

Collection took place in October 2003 and 2004 to coincide with heather seed ripening. Seed-rich cuttings of ling, bell heather and also western gorse were collected using a tractor with a double-chop forage harvester to cut and shred the material into a 14 tonne trailer drawn alongside the tractor. In all, eighteen trailer loads were taken to be used at Trehill. The cuttings were loaded into a muck spreader using a Manitou with front-loading forks. The muck spreader proved an efficient way of evenly distributing the cuttings across the fields.

Stripping of topsoil: Decades of fertiliser application meant that levels of nitrogen, potassium and phosphorous were too high for plant communities that were the target of the restoration, to flourish in the face of competition from more aggressive species that thrive in nutrient-rich conditions. To reduce soil fertility the topsoil was therefore removed.

Using a JS130 360 degree tracked excavator, the top 20 cm was stripped from 3.5 ha of the heathland restoration fields. The excavator left an uneven soil surface, providing a range of microhabitat features. This was preferred to using a bulldozer, which greatly compacted the soil and left too smooth a finish. Some of the fields had sulphur applied after stripping. The operation took 20 days and cost £17,000.

Restoration of old hedge banks: The soil (about 16,000 m³) was used to restore over a mile of hedge-banks on site, following historical field boundary lines marked on old maps. The banks have been double fenced and allowed to naturally re-vegetate.

CONSEQUENCES

A five-year vegetation and soil chemistry monitoring project by the Institute of Grassland and Environmental Research (IGER) is in place. Some early indications look promising:

Vegetation: A 'look and see' examination (with a quick visual assessment of abundance) in summer 2004 found that many plant species, mostly common arable weeds but some of conservation interest (highlighted with an asterisk*), had grown in areas where soil had been removed:

Commonly occurring species - Annual meadow-grass *Poa annua*, scarlet pimpernel *Anagallis arvensis*, prickly sow-thistle *Sonchus asper*, common mouse-ear *Cerastium fontanum*, lesser swine-cress *Coronopus didymus*, corn spurrey *Spergula arvensis*, groundsel *Senecio vulgaris*, redshank *Polygonum persicaria*, toad rush *Juncus bufonis*, creeping-bent *Agrostis stolonifera*, fumitory *Fumaria* sp., procumbent pearlwort *Sagina procumbens*, shepherd's purse *Capsella bursa-pastoris*, daisy *Bellis perennis*, rape *Brassica napus*, scentless mayweed *Tripleurospermum inodorum*.

Less frequent and rarely occurring species - Lesser spearwort *Ranunculus flammula*, field woundwort *Stachys arvensis*, buck's-horn plantain *Plantago coronopus*, field madder *Sherardia arvensis*, field speedwell *Veronica arvensis*, white clover *Trifolium repens*, creeping buttercup *Ranunculus repens*, hairy bitter-cress *Cardamine hirsuta*, changing forget-me-knot *Myosotis discolor*, field pansy *Viola arvensis*, cat's-ear *Hypochoeris radicata*, ragwort *Senecio jacobaea*, oblong-leaved dock *Rumex obtusifolius*, thyme-leaved speedwell *Veronica serpyllifolia*, cut-leaved crane's-bill *Geranium dissectum*, field penny-cress *Thlaspi arvense*, *corn marigold *Chrysanthemum segetum*, *sharp-leaved fluellen *Kickxia elatine*, *sand spurrey *Spergularia rubra*, black-bindweed *Fallopia convolvulus*, *sheep's-bit *Jasione montana*, *thrift *Armeria maritima*, parsley-piert *Aphanes arvensis*, henbit dead-nettle *Lamium amplexicaule*, cleavers *Galium aparine*, narrow-leaved plantain *Plantago lanceolata*, marsh cudweed *Gnaphalium uliginosum*, soft brome *Bromus hordeaceus*, red bartsia *Odontites vernus*, teasel *Dipsacus fullonius*, common field speedwell *Veronica persica*, willow-herb *Epilobium tetragonum/obscurum*, smooth meadow-grass *Poa pratensis*, bramble *Rubus fruticosus*.

Evidence of dwarf gorse germination was found in early 2004 and heathers (both *Calluna* and *Erica*) by late 2004.

Soil pH: By March 2005, results from pH tests on soil samples showed drops from around pH 7 to 5.6 and 4.2 for each of the respective applications of 4 t/ha and 8 t/ha.

The restored hedge-banks have become important visual and wildlife features in their own right. The work has also benefited the important iron-age fort on the site, and

adjoining wetland by providing better protection against fertiliser and pesticide run-off.

REFERENCES

Sutton M. (2004) Habitat Management News: The Marloes Coast project. *British Wildlife*, 16, 29-30.

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