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Techniques for Heathland Restoration in England

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Introduction

Chapman and Webb (1989) define a heathland as a "plagioclimax community dominated by ericaceous dwarf shrubs". Many European heathlands are dominated by the heather *Calluna vulgaris* (Snow and Marrs 1997). Heathland in north-western Europe expanded 3000-4000 years ago following the clearing of the forests. In England, "between the mid 18th century and 1978," 80% of heathlands were lost (Chapman et al. 1989). The current distribution of heathland ranges from the lowlands to the upland moors of Great Britain (Putwain and Gillham 1990).

The fragmentation of lowland heathland is of greatest concern in southern England (Putwain and Gillham 1990). Lowland heath communities are important to rare faunal species like the Dartford Warbler, *Sylvia undata*, the Sand Lizard, *Lacreta agilis*, and are home to the rare heather species Dorset Heather, *Erica ciliaris* (Bullock and Webb 1995). Recent changes in governmental agricultural policy have created new opportunities to set aside and restore lands for conservation purposes. One of the programs involved is the "Countryside Stewardship" which provides "financial incentives to recreate biotopes of conservation interest, including lowland heath" (Pywell et al. 1994).

Many heathland restorations have been undertaken on old farm fields (Smith et al. 1991), mined lands and lands disturbed in order to bury pipelines, as well as road construction, and the construction of power stations and oil terminals. Other restorations have taken place to replace those heathlands lost to development (Putwain and Gillham 1990). Some of the parties responsible for heathland restoration include English China Clay International and Shell UK Ltd., as well as British Gas and the Central Electricity Generating Board (Putwain and Rae 1988).

This paper will cover the various techniques used in heathland restoration including the transplantation of entire heather turves, the use of heather topsoil, restoration of heathland on old farm fields, the use of heather litter, the harvest of heather shoots, and bracken control as a means of heathland restoration. Each of these techniques has usefulness in particular situations.

Techniques:

Transplantation of Heather Turves

The transplantation of entire heather turves provides immediate restoration of a site. Turves can be cut in 0.75m x 2.3m blocks from a donor site (Putwain and Rae 1988). The depth of the turves depends on the depth of the organic layer. Turves are placed at the recipient site. If weather is favorable the outlook for survival is excellent. This practice is used extensively in Dorset for surface stabilization of mined sites (Putwain et al. 1988).

Turfing does provide immediate restoration of a site as stated earlier, but should only be carried out in areas where large scale disturbance such as mining or industrialization will destroy existing heathland. These areas serve as good donor sites for other locations which are to be restored. Turfing also works well in areas where pipelines are to be laid, but the turves can be stored for no more than two days to prevent desiccation (Putwain and Rae 1988). A drawback to turfing is the transportation cost involved as well as "the high costs of site preparation and supervision of the operation by a skilled ecologist" (Pywell et al. 1995). In 1979 the cost was six pounds British per square meter of turf.

Harvested Heather Topsoil

Harvested heather topsoil is a good source of propagules and organic matter in heathland restorations (Putwain and Rae 1988). Topsoil can be harvested to a maximum depth of 50-60 mm so as to prevent the dilution of *Calluna* and *Erica spp.* seed by having excess soil with no viable seed in it. Ninety percent of the viable seed is found in the upper 50 mm of soil, with 97% of the seed found in the upper 60 mm of the soil profile. Soil can be spread to a depth no greater than 10-15 mm to stimulate maximum germination (Putwain and Rae 1988).

On large scale restorations, introduction heather topsoil has proven to be a viable technique (Putwain and Rae 1988). Test pits are dug in random areas to determine the mean organic layer depth. Once this is accomplished a mechanical tool with a bucket can scrape the topsoil to desired depths. Topsoil is then broken up using a mechanical shredder. This material can be stored for 2-3 months in winter without degeneration of vegetative heather fragments. Seeds in these soils of species such as *Calluna* and *Erica* can be stored for up to 14 months (Putwain and Rae 1988). Maximum soil storage in summer for viable vegetative fragments should not exceed 2-3 weeks. Topsoil can be spread using a manure spreader or dumped on the ground and graded. This material should be spread to a depth of 25 mm which would cover an area 1.5 -2.0 times greater than the donor area to be restored. When heathland topsoil is spread over coarse mineral substrate, fine sand or gravel should be put down first so as to aid in cation exchange and moisture retention. After topsoil is spread, native grasses can be sown to help stabilize the soil initially. Fertilizer and lime can be added to nutrient poor soils and whose pH is between 3.5-3.7 (Putwain and Rae 1988).

Restoration using heathland topsoil is generally successful with most heathland species represented in naturally occurring ratios (Putwain and Gillham 1990). Restoration using harvested topsoil is also cost effective when compared to other techniques like turf transplantation. Heathland soil should only be harvested in areas that are to be disturbed and later reclaimed, e.g.. mining and pipeline laying or permanently lost due to development (Putwain and Gillham 1990). Regeneration is generally fast, with "good cover after three years" and nearly identical species composition (Putwain and Rae 1988).

Heathland Restoration On Abandoned Farm Fields

On many heathland restorations, site preparation must take place before any planting can begin. On abandoned farm fields herbicide can be used to destroy any competing grasses. Once this is accomplished, the soil can be cultivated (Pywell et al. 1994). Another method to prepare an old

farm field for restoration would be to strip the upper 3-5 cm. of turf in order to remove competing species (Smith et al. 1991).

Abandoned farm field topsoil, when compared to heathland topsoil contains slightly higher concentrations of nutrients, while heathland topsoils generally contained more organic matter than abandoned farm fields (Pywell et al. 1994). Heathland soil pH averaged 3.81 while farmland pH averaged 5.24 due to past liming. Farmland soils did not have defined soil horizons, while heathland soils were humoferric podsols with high definition between organic and mineral horizons. Plowing mixed the organic and mineral soil horizons to plow depth, under which lay a mineral horizon (Pywell et al. 1994).

Heathland restorations can be undertaken on abandoned farmland if organic matter is added (Pywell et al. 1994). Restoration on recently farmed soil may not be possible unless soil fertility and pH is reduced. If this is not accomplished, competing species may overtake heathland species. Leaching and erosion will reduce fertility over time, but regular planting and harvesting of cereal crops may aid in nutrient removal, but may take several years. On soils with high Ca concentrations, the addition of acidifying compounds may be necessary to reduce the pH. The addition of organic matter will also aid in pH reduction and will aid the heather plants (Pywell et al .1994).

Heather Litter as a Propagule Source

According to Putwain and Rae (1988), 30-40 kg. of dry heather litter can be collected by hand to introduce heather propagules. This material is spread over 250-300 square meters with a rate of application of 125g per square meter. Upland heather stands should be 10-15 years old in order to harbor enough litter. Lowland heaths should be 15-25 years old due to lower accumulation rates. Once collected, the litter can be spread at a rate of 1000-1500 kg per hectare. An advantage of this method is that heather litter can be stored for "several years without loss of seed viability." Litter is also simple to broadcast either by hand or by the use of mechanized spreaders. One disadvantage to this restoration technique is that litter may contain high numbers of propagules of "undesirable" species like *Betula spp.* and *Ulex europaeus.*

Harvest of Heather Shoots

Harvesting and scattering of heather shoots is another viable technique in heathland restoration (Pywell et al. 1996). Heather shoots "bearing seed capsules can be cut" and used as a source of heather propagules. An advantage to using harvested heather shoots is that they are a "renewable resource" provided they are harvested in a sustainable manner. During harvest the upper 200-300 mm can be cut off the heathland canopy. This will yield approximately 1.2-3.0 kg per square meter of fresh heather material. Harvesting can be done in winter when the heathland canopy contains the maximum numbers of seed (Pywell et al. 1996). Cultivation of the recipient site will remove competitive grasses initially, and it is believed "the shoots provide(d) protective microsites for the recruitment of some of the large numbers of seeds contained in this material" (Pywell et al. 1995). "Adequate reinstatement of the heathland plant community could be achieved using as little as 0.6 kg per square meter of harvested shoots, and it is possible to

restore between two and five times the area harvested" (Pywell et al. 1996). This method appears to be inexpensive when compared to other methods like turfing.

Bracken Control

In England, bracken fern (*Pteridium aquilinum*) has invaded many heathlands (Snow and Marrs 1997). The control of bracken has become a method of heathland restoration in and of itself. Lowland heath requires low nutrient concentrations and low pH to survive. Bracken stands, due to their deep litter layer contain more nutrients accumulations than heathland without bracken (Snow and Marrs 1997).

Three methods of bracken control were employed by Lowaday and Marrs (1992). The first method was the cutting of bracken fronds. Fronds were cut in the early summer when the fronds were at maximum growth in order to maximize reductions of carbohydrates in the rhizomes. This technique had to be repeated due to bracken recovery. Herbicide application with the herbicide "asulam" was employed as another bracken control method. This method was successful, but had to be repeated in succeeding years to keep frond recovery to a minimum.

Heather itself was used as a bracken inhibitor after bracken was cut or destroyed by herbicides (Lowaday and Marrs 1992). Heather and other grassland species appeared to outcompete as well as inhibit bracken on sites where bracken had invaded. Once bracken was controlled, heather was seeded or the seed bank was used as a source of heather propagules.

The results of the bracken control methods varied (Lowaday and Marrs 1992). Frond cutting did not appear to work well. The bracken recovered when frond cutting ceased. The use of the herbicide "asulam" was successful at first, but successive treatments were necessary. The restoration of heaths as a bracken control method worked best when bracken cutting and heath introduction were combined. Also, it appeared that heathland vegetation somewhat inhibited the recovery of bracken. Bracken control could not be discontinued at any of the sites (Lowaday and Marrs 1992).

Conclusion

"In recent times the area of lowland heath dominated by *Calluna vulgaris* in Britain has been greatly reduced, and it is generally recognised that there is a need to conserve existing heathland, and where possible restore heathland lost" (Snow and Marrs 1997). Important plant and animal species inhabit heathland so they are important areas to conserve and restore. The various heathland restoration techniques all have merit for individual situations, but restoring heather to old farm fields appears to be especially problematic due to low levels of organic matter at the soil surface. Upon studying the heathland restoration techniques in review it was concluded that the addition of heather litter harvested from existing heather stands (Putwain and Rae 1988) could be used as a source of organic matter in concert with the application of harvested heather shoots on old farm fields (Pywell et al. 1996).

The restoration of heathland by the use of turves appears to be an exceptional way to stabilize highly erodible sites, but existing heathland is destroyed in the process. Turves are also prone to

desiccation which makes storage problematic. The high costs of transportation and site preparation make this method prohibitive. Harvested heather topsoil is a very effective means of restoring large areas of heathland. Organic matter and propagules are both present at the same time, but existing heathland is destroyed in the process. This method is best used in reclamation efforts after mining or pipeline laying is completed. Bracken control as a means of heathland restoration is a valid technique, but control by the use of herbicides or frond cutting has to be carried out on a yearly basis. Regardless of which restoration techniques are used, efforts must be made to monitor sites after the initial restoration to ensure that long term goals are met.

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