

Cutting of heather as an alternative to muirburn

1. Introduction

1.1 This note describes the technique of heather cutting and compares its impacts and costs with the more traditional heather management tool of muirburn. Cutting is used here to cover a range of mechanical techniques including cutting, swiping and flailing, with machines which use either blades or chains. Labour available for controlled muirburn has declined considerably since 1945 leading either to uncontrolled burning or to controlled burning over very restricted areas. This applies to areas in both the east and west of Scotland. In some localities in recent years cutting has been used increasingly as a substitute for burning or as an additional tool to help increase the efficiency of fire-controls squads.

1.2 As a heather (*Calluna vulgaris*) plant grows larger and more woody changes occur in its form and in the growth of individual shoots. The changes to both plants and stands are described classically according to four developmental phases: pioneer, building, mature and degenerate. The vigour of heather shoots is greatest during the first two phases while stand productivity is usually greatest when all the heather plants are in the building phase because then the canopy of heather shoots attains maximum coverage and density. (It should be noted that heather vigour is also affected by other factors such as soil conditions and climate.) In dense, even-aged stands each phase typically lasts from 5 to 10 years. In more open, or prostrate, heather stands the heather can continuously regenerate by layering, ie. by producing roots from prostrate stems (see I & A Note: *Heather Layering and its Management Implications*). Prostrate stems tend to be eliminated by shading in tall, dense heather stands.

1.3 Similar general principles apply when using cutting or burning as a management tool. The aim is to break up uniform areas of tall, dense heather

in the late building phase (and certainly before the degenerate phase) in order to increase structural variation in the vegetation. This helps to sustain the full range of habitats needed by the fauna and flora of moorland, and it provides shorter vegetation preferred by grazing livestock. Such management also reduces the average fuel load and makes the distribution of fuel more patchy. Both effects help to reduce the intensity and rate of spread of uncontrolled fires. Good fire control may also require the creation of strategically placed firebreaks. Cutting can be a useful way of creating these.

2. Impacts of cutting

"Age" of stand

2.1 The capacity of heather to recover from cutting or burning depends on two features:

- a bank of dormant seed in the upper few centimetres of the soil, and
- dormant buds at the base of the stem.

2.2 Seedling regeneration is better in burnt plots than in cut plots. In old stands regeneration is almost entirely from seedlings. However, in these stands there is a dense accumulation of plant litter (or dense moss mats) and cutting also produces large amounts of cut trash which are inimical to seed germination and seedling establishment. As a result, regeneration in old stands after cutting is likely to be half as fast as after burning, though even in the latter case regeneration is likely to be very slow and patchy.

2.3 Cutting is therefore less suitable than burning for restructuring and regenerating old stands. It may be useful for creating firebreaks to protect such areas from wildfires.

2.4 Resprouting heather plants grow much more quickly than heather seedlings. Resprouting from

dormant buds on the stem base declines as bushes become larger and more woody. This is for two reasons. First, the density of stems declines through self-thinning, and therefore the number of points at which resprouting can occur also declines. The density of stems in a stand may fall by as much as 60% between five years old and twenty years old. Second, fewer buds seem able to resprout on larger, thicker stems, probably because they eventually become buried in stem wood.

2.5 There is some evidence that more stems resprout after cutting than after burning (as much as 40% more), and shoot extension of resprouts initially may be faster after cutting. After burning, even in relatively young and vigorous stands, fewer than 25% of stems may resprout.

2.6 Cutting is therefore likely to be particularly suitable for stands where resprouting is likely to be the most important form of regeneration, ie. vigorous building or early-mature stands.

Season of cutting

2.7 There are pros and cons to both autumn/early winter and late winter/spring cutting.

- *Regeneration.* Generally better in spring than autumn.
- *Winter survival.* Much better for plants cut in spring than autumn. Autumn cut stems may be exposed to frost and desiccation damage, and autumn germinated seedlings will be exposed to frost heaving before they are strongly established.
- *Machinery access.* Often drier, firmer ground conditions in autumn than in spring.
- *Potential for erosion.* Soils bared over winter by autumn cutting may be at greater risk of erosion.
- *Logistics.* Cutting in autumn can provide firebreaks for later burning (provided the cut trash is removed).

Removal of cut trash

2.8 Stands generally regenerate slightly better after removal of the cut trash. This is most likely in very dense, building to mature phase stands of dominant heather more than 30cm tall. Regenerating plants, particularly seedlings, are less likely to be smothered if the cut trash is removed. This is likely to be most critical in old

stands since regeneration in these is largely from seedlings (see 2.2).

2.9 If trash removal is impractical it is best to produce finely chopped material, as from a double-chop forage harvester or chain swipe. This type of material becomes incorporated into the soil quite quickly. At the SNH farm at Cairnsmore of Fleet, in Galloway, trash produced after using a chain swipe on mixtures of heather and purple moor-grass has been found to disappear within about 14 months. On dry, heather dominant moors in the east of Scotland decomposition rates are likely to be slower. If a forage harvester is used, rates of incorporation can be enhanced by blowing the cut material onto surrounding areas in order to reduce the amount deposited per unit area.

Rates of recovery

2.10 Vigorous heather stands cut in February or late March may recover and flower in the August after cutting. Complete vegetation cover may be re-established after only two to three years where there is vigorous recovery by resprouting. In older stands, composed of thick-stemmed heather, recovery is likely to be much slower.

Forage nutrient value and nutrient cycling

2.11 There is some limited and variable evidence that the concentrations of nitrogen and phosphorous in new heather shoots is lower after cutting than after burning.

2.12 Removal of cut trash will remove mineral nutrients. The depletion of nutrients will be more extreme than after all but the hottest fires. This may be beneficial in areas with high rates of deposition of atmospheric nitrogen pollution where ericaceous plants are likely to become less competitive. This is most likely to apply to lowland heaths, and to upland heaths in the Southern Uplands, south-west central Highlands and the eastern Grampians.

Biodiversity

2.13 Cutting, if carried out between September and the end of March, probably causes less damage than burning to most of the fauna, mosses and liverworts, and those vascular plants which regenerate and spread vegetatively. Plant species which primarily depend on regeneration from seed to maintain their presence will be more

favoured by burning. Juniper bushes, which are killed by fire, can be avoided more easily when cutting than when burning (juniper on heathland is listed in the EC Habitats Directive).

2.14. Contractors are often tempted to cut very broadly rectangular or square patches, sometimes in a chequer board pattern. This is not recommended as it minimises one of the main benefits of cutting and burning which is to maximise the amount of edge between tall and short heather. This is particularly important for red grouse, and it is significant for many other species. Maximising the amount of edge also helps to disperse grazing pressure and reduce the risk of localised overgrazing of the heather. Contractors should clearly understand that patches should vary in size and be elongated or convoluted in shape (but see also 2.16).

2.15 Some practitioners may prefer burning to cutting because they think it is more likely to destroy heather beetle. However, burning cannot easily be used to control heather beetle. The potentially effective times for killing larvae and adults are in May-June or late August-September which are both outside the statutory muirburn period in Scotland. Also, adult beetles are quite capable of evading fire by burrowing into the litter in response to smoke and heat. Cutting may directly kill some larvae and reduce food supplies for those that survive. However, cutting at the time of year when this would be effective would be potentially damaging to ground nesting birds.

Visual and amenity impacts

2.16 Unlike burnt areas, cut patches are not blackened and covered in ash nor does cutting leave tall, charred stems. However, cutting does leave some protruding stems which may be sharp. Cut areas may arguably be more pleasing to the eye and marginally more pleasant to walk over. However, if cutting is carried out during the heather flowering season it may still bring much adverse public comment. The location, size and shape of cut areas should be considered carefully if they are within sight of roads, viewpoints or popular walking areas. Wherever possible the cutting should be supervised to ensure that operators do not produce very artificial looking rectangles or squares. Adverse visual impact can be reduced by cutting narrow strips, meandering along the contours or running across the main sight lines from popular locations, and by bending or scalloping of the edges of strips. Adjacent to

roads or paths a strip or bank of heather will reduce the visual impact of a cut area. If there is a pattern of patches imposed by previous burning activity, patches cut to similar size and shape will be less visually obtrusive.

Other impacts

2.17 Cutting does not produce a smoke nuisance and it can safely be undertaken near to public roads without endangering traffic. It is also a more acceptable and less dangerous technique to use near to habitations and forestry plantations.

2.18 Tractors and cutting equipment can cause damage to earthworks and other archaeological remains. Although intense fires which burn into the soil can also be very damaging, properly controlled fires of low to moderate intensity are less likely to cause damage to buried archaeological interest in moorland situations.

2.19 When assessing the merits of cutting or burning (or doing nothing) the amount of ground damage caused by machinery while gaining access to the working area, as well as while on site, should be considered. Impacts will be greater on wetter ground and for heavier machinery such as loader wagons, forage harvesters with trailers, and balers.

3. Complementary use of cutting and muirburn

3.1 The two techniques are most suitable for different types of ground and for different types of heather stand.

3.2 Cutting is most suitable for:

- easily accessible areas
- flat or gently sloping terrain
- even ground without boulders, ditches or other obstacles for machinery
- large, uniform areas of dense, vigorous heather
- areas of wet heath on firm shallow peat where purple moor-grass is co-dominant with heather.

3.3 Burning is most suitable for:

- sloping or broken terrain (but burning very steep slopes should not be attempted)
- uneven ground with boulders and other obstacles for machinery

- late-building, mature or degenerate heather stands (unless cutting firebreaks)
- areas where there is already some structural variation because of past burning or cutting
- dry heaths.

3.4 Wet heaths are difficult to burn safely and without damage to the vegetation and soil. Cutting of wet heath should only be done during dry periods to avoid soil compaction. If *Sphagnum* bog mosses are conspicuously present neither cutting nor burning should be attempted.

3.5 Even if burning is chosen as the main technique for managing heather, cutting can be a useful aid. A double-width swiped strip, 3 to 4m wide, can be quickly cut as a firebreak around an area to be burnt. If the cutting is done immediately before the fire is lit the cut trash provides a wet, soggy mulch which does not readily catch fire. If the cut material is allowed to dry out then it becomes ineffective as a firebreak. Such firebreaks are not infallible and they should only be considered an aid to controlling the pattern of spread of fires. Nevertheless, they can double the efficiency of a burning squad.

3.6 Cutting is also very suitable for creating permanently maintained firebreaks. These are designed to stop or slow down the spread of out-of-control fires and to provide access for fire-fighting. Effective breaks require frequent close-mowing and need to be at least 10m wide. These are unlikely to be practical, or even necessary or desirable, in most upland areas but they may have limited value in helping to protect particularly vulnerable and sensitive features and adjacent forestry plantations.

4. Restriction on carrying out cutting

4.1 Unlike burning there is no statutory restriction on when cutting can be carried out. However, there will be indirect restrictions under the Wildlife & Countryside Act 1981 if carried out during the nesting season of moorland birds. To minimise effects on fauna and flora, cutting should only be carried out from September to the end of March.

4.2 Many earthworks and other archaeological remains will have statutory protection and could be damaged by cutting machinery. The advice of Historic Scotland (Longmore House, Salisbury Place, Edinburgh EH9 1SH, Tel: 0131-668-8600)

must be sought wherever remains are suspected of being present.

5. Collecting cut material for heather restoration work

Seed bearing shoots cut during October to mid-January can be used for heather restoration (see (I & A Note: *Heather Re-establishment on Mechanically Disturbed Areas*). A double-chop forage harvester probably produces the best material but a single-chop type is also suitable. Depending on the amount of seed carried by the donor stand there should be enough material to treat an area from one to three times the size of the donor area.

6. The selection and use of suitable machinery

General considerations

6.1 It is advisable to walk the area prior to cutting to check for stones, the load bearing capacity of the ground and any hidden obstacles or dangers. This will help to determine if the ground is suitable for use of machinery and, if so, what type of machinery might be most appropriate.

Types of cutting equipment and ancillary machinery

6.2 A wide variety of cutting equipment can potentially be used for heather cutting but for extensive use in upland areas a tractor with swipe, flail or forage harvester is required.

6.3 Swipes and flails are more suitable for woody heather and where the ground is rougher. Both use rapidly rotating chins or blades, sweeping horizontally in swipes and vertically in flails. Swipes are designed to ride over irregularities but large stones or tree stumps will cause damage. Forage harvesters and towed flails cope with ground irregularities less well and are likely to experience higher damage rates.

6.4 Suitable types of swipe cut a swathe 1.5-1.8m wide. They should not be set to cut stems any lower than 10cm. If set lower the rootstock may be damaged and there is a greater risk of damage to the blades or chains. If sharp, blades produce a cleaner cut than chains but may become blunted and then produce poor results, particularly in stands of older, more woody

material when two passes may be required. Chain swipes sometimes tear vegetation, or they may flatten stems rather than cutting them, particularly if set too low. However, they mash up the trash better than blades. Chains are not blunted by rocks but breakages may occur where the chains join the rotor. Practitioners disagree about whether blades or chains are more vulnerable to damage.

6.5 Flails produce a cleaner cut than swipes and if used at high rotation rates produce finely fragmented trash. A variety of models are available, cutting swathes up to 2.2m wide. In some models blades are designed to deflect on encountering potentially damaging obstacles. Suction attachments for removing the trash are also obtainable.

6.6 Forage harvesters give a clean cut and the trash can be collected and carted away in one pass or blown over the cut area. A double-chop type produces finely chopped trash. Single-chop machines produce larger fragments which tend to fall in thicker deposits. If cutting is restricted to relatively narrow strips a large part of the trash can be blown onto adjacent areas, especially if cutting is carried out on a windy day. Double-chop types can blow cut trash further than single-chop types, and depending on the model it should be possible to blow cut material over a distance of 3-5m. It may be difficult to manoeuvre forage harvesters, particularly on uneven or sloping ground, and they are likely to suffer more from damage than flails or swipes. A single-chop forage harvester will cope better with occasional stones.

6.7 Where it is desirable to remove cut trash it may be removed by being blown from a forage harvester into a trailer. Material cut by a swipe or flail can be collected using a self-loading wagon. Loader wagons usually have pickup widths of about 1.6m and cubic capacities from 20m³-36m³ according to model. They work well even on quite rough ground. The blades can be removed to reduce damage as further chopping of the trash is not required. The risks of gathering stones and causing damage can be reduced on stony areas if the trash is first rowed-up using a tractor-moured hay rake. Cut heather can also be baled provided the cut material is not wet. The bales should be made smaller than with hay or straw since cut heather is heavier. The bales can be removed by trailer. There are some limited markets for sale of baled heather.

6.8 For heavy duty flails, swipes and forage harvesters, suitable and robust enough for extensive use in the uplands, a four-wheel drive tractor of at least 80HP (60kW) is desirable. Some practitioners recommend that tractors should be at least 100HP (75kW). Larger four-wheel drive tractors can considerably reduce compaction and traction damage on wetter ground, as well as reducing the risks of the machine becoming bogged.

6.9 There are a number of potential suppliers of suitable machinery. Your local agricultural engineer or agricultural machinery dealer should be able to supply details.

7. Relative work rates and costs

Work rates

7.1 Cutting and muirburn are not directly comparable since burning is much more influenced by weather conditions. In an average year there may be only 5 to 15 suitable days for burning in western areas and 10 to 25 days in eastern areas. Lack of available labour or other work commitments may reduce this further. In principle, in any one year it should be possible to cover a much larger area by cutting than by burning.

7.2 An average work rate for cutting is about 3-4 ha tractor⁻¹ day⁻¹. Where the ground is sloping, uneven, wet, or the heather is very woody, cutting will take longer and work rates may fall to 2 ha tractor⁻¹ day⁻¹. Less than ideal ground conditions will most affect the work rates of heavier and less manoeuvrable equipment.

7.3 Average muirburn work rates are generally about 1 to 2 ha person⁻¹ day⁻¹, for fire-control squads of 3-4 people (burning should not be carried out by lone individuals), burning strips no wider than 30m or small patches each of about a hectare. Lower rates apply to situations where all precautions are taken, such as laying down foam around patches to be burnt as well as using firebreaks. Difficult weather or ground conditions may reduce rates to less than 1 ha person⁻¹ day⁻¹.

Capital costs

7.4 Indicative 1996 capital costs for new cutting equipment (secondhand prices may be much less):

- Swipe or flail £2,000-4,000
- Forage harvester (double-chop) £8,000
- Tractor £30,000-40,000
- Loader wagon £15,000-20,000

7.5 Indicative 1996 capital costs for new burning equipment:

- Protective visor & mask £25 each
- Beaters (may only last 2 seasons) £30
- Lighter £70 each
- Tractor (optional) £30,000-40,000
- Swipe (optional) £2,000-4,000
- Water pump, hoses & nozzles (optional) £1,500-3,500
- Water tank (optional): ATV mounted, towed or stationary, e.g. fibreglass or heavy PVC-coated fabric, c. 1,000-3,000 litres £1,000-3,000

Operational costs

7.6 The following are indicative 1996 costs based on experience from the SNH farm at Cairnsmore of Fleet. They are for burning or cutting small patches of about one hectare each at a rate of about 4 ha tractor⁻¹ day⁻¹ for cutting and about 1 ha person⁻¹ day⁻¹ for burning.

- Cutting using own equipment £25-28 ha⁻¹
- Cutting by contractor approx £100-120 ha⁻¹
- Muirburn using traditional equipment £51-59 ha⁻¹
- Muirburn using cut firebreaks and foam traces £89-100 ha⁻¹

Costs on other sites may differ due to differing ground conditions and rates of work, and variations in contractors' rates. On difficult ground costs could easily double.

8. Further reading

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9. Acknowledgements

Comments were kindly provided by Dr. Nick Michael (English Nature), Tom Wall (English Nature), Sue Rees (North York Moors National Park), Jeremy Roberts (SNH), Brian Arneill (SNH), Rebecca Hughes (SNH), Dr Helen Armstrong (SNH), and Dr Des Thompson (SNH).

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