Deadwood fencing used to protect broadleaved trees from deer browsing in the Cairngorms, Scotland

Tom Bradfer-Lawrence* & Shaila Rao
The National Trust for Scotland, Mar Lodge Estate, Braemar, Aberdeenshire, AB35 5YJ

* Corresponding author: tlawrence@nts.org.uk

SUMMARY

At a site on Mar Lodge Estate, Scotland, a number of broadleaved trees were planted during the early 1990s. After fifteen years these trees were still barely higher than the tree tubes protecting them due to heavy browsing by deer. In 2004 a series of small exclosures were constructed around some of the trees using timber felled from a nearby conifer plantation. Fences were constructed with logs, which proved to be longer-lasting and sturdier than the woody debris used for protection elsewhere. The trees inside the exclosures are significantly higher than those which remain unfenced, and the ground vegetation has responded well. Deadwood fences have a number of benefits over traditional deer fencing: posing no threat to woodland grouse, having a lower visual impact in the landscape, and providing additional habitats for wildlife.

BACKGROUND

Mar Lodge Estate, Scotland, covers over 29,000 hectares and includes a range of habitats, from Caledonian pinewood in the glens (valleys) to montane heath on the mountain summits. Most of the estate is designated for nature conservation, and the current owner, the National Trust for Scotland, is committed to restoring and conserving the habitats under its care. When the charity purchased Mar Lodge Estate it was recognised that the very high density of red deer *Cervus elaphus* was having a detrimental impact on the habitat quality and a policy of reducing the deer population has been pursued (Rao 2011). Implementation of this policy is focussed on the northern and eastern part of the estate, where the core pinewood areas are situated. This area is termed the 'Regeneration zone' and covers nearly 12,500 hectares. The red deer population in this area was reduced from 800 in 2003 to 45 in early 2012.

Some years prior to the purchase of the estate, the previous owners planted a small area of broadleaved trees on the edge of a plantation in Glen Quoich. The mixture of birch *Betula pubescens*, rowan *Sorbus aucuparia* and alder *Alnus glutinosa*, were guarded with 120cm high tree tubes but were otherwise unprotected. Despite the substantial deer reduction that was taking place on the estate, these broadleaved trees were still being browsed so that they were barely higher than the tree tubes (Figure 1a). The proximity of these trees to the cover provided by the edge of the plantation means that this area is heavily used by deer, and the trees were likely to remain badly browsed even once the deer population was reduced.

It is recognised that some of the Mar Lodge Estate pinewoods, and in particular the plantations, lack the broadleaf component, which is found in semi-natural habitats (Taylor 2012). Therefore the National Trust for Scotland is keen to encourage and protect this small area of broadleaved trees in Glen Quoich, but is committed to avoiding the use of deer fencing whenever possible to reduce woodland grouse fence collision mortality, improve wild land quality and encourage public access (National Trust for Scotland 2012). Therefore an alternative to the standard post-and-stock net deer fence was required.

There is considerable interest in different fencing designs and other methods of protection that might negate the disadvantages associated with conventional fencing (Goddard et al. 2001; Casabon & Pothier 2007). The potential for utilising brash and woody debris to protect trees has been recognised (e.g. Mayle 1999; Graham et al 2010). However use is generally limited to

Figure 1a. Deadwood fence construction in 2004. Note the trees are barely above the height of the tree tubes.

Figure 1b. Close-up of the deadwood fence construction in 2012. Note the good growth of ling heather and blaeberry in the fore-ground.

Figure 1c. One of the deadwood fences in 2012, a weathered structure which is less visually intrusive than a conventional post-and-stock net deer fence.

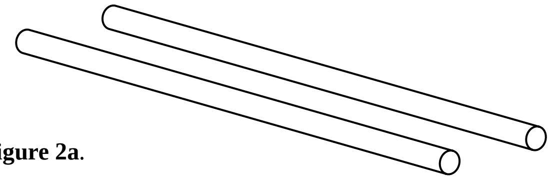
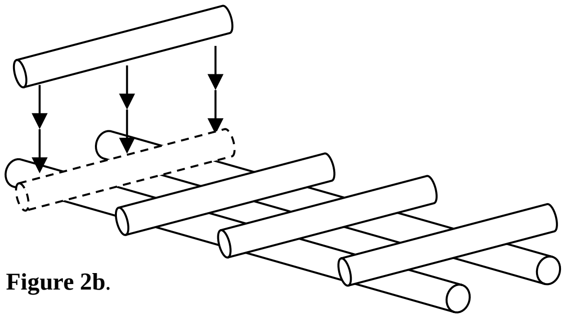


Figure 2a.



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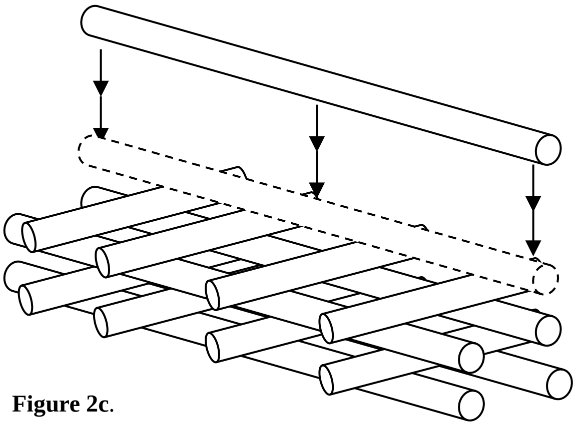

Figure 2c.

Figure 2. Stages of deadwood fence construction; a) two long 'rails' are laid parallel about 1m apart, b) shorter 'sleepers' are laid perpendicular on top of the rails, spanning the gap and creating a second layer, c) the fence is built up in alternating layers of rails and sleepers

taking advantage of existing brash mats. Gill & Fuller (2007) suggest that a "brushwood fence" will discourage deer browsing of coppice for two years, although other authors suggest such an approach will be ineffective (Hodge & Pepper 1998). Using the brash to create a much larger, three metre high barrier was reported to be fairly effective at preventing deer from browsing restocked plantations (RTS Ltd. 2002). However, empirical data regarding the efficacy of this approach is lacking. Moreover, such a large construction has, arguably, greater landscape impacts than conventional deer fences.

ACTION

The site in Glen Quoich provided an opportunity to experiment with an unconventional deer barrier. Management actions on Mar Lodge Estate have included felling the non-native species and diversifying the structure of the conifer plantations, which were established prior to NTS ownership. This has resulted in a large volume of trees felled to waste, providing the raw materials for protecting the broadleaved trees.

In order to create a durable structure that would both withstand the weather conditions and discourage deer, six exclosures were built using deadwood at the site in Glen Quoich during the summer of 2004. Large logs (termed 'rails') around 2.5m long were laid in two concentric rings, about 1m apart, around the group of trees to be protected (Figure 2a). Shorter logs (termed 'sleepers') of around 1.4m long were placed perpendicular to the first set of rails, spanning the gap in a second layer (Figure 2b). Around three or four sleepers were required for each pair of rails, although this was modified to suit the length of the rail and achieve stability. Once these first two layers were complete, further layers of rails and then sleepers were added (Figure 2c). Offsetting the rails, so that the joins occurred at different points in each layer, helped to tie the structure together. When the desired height of the barrier was reached, the top of the fence was finished with a final layer of rails.

To increase the height of the deadwood fence without creating an unstable structure, lengths of brash were then inserted into the top of the fence. Although unlikely to stop a deer from jumping the fence, it was thought that the visual barrier might discourage attempts to do so. Few tools were required to build the fences. Log tongs were useful for lifting the logs, particularly if they were damp or slippery. A chainsaw was used to trim sleepers to the correct length.

The exclosures vary in size, with internal dimensions ranging between 3.2 x 4.0m and 10.7 x 19.6m, the proportions dictated by the size and shape of the groups of trees. The main body of the fences are between 1.0 and 1.4m high, and between 1.0 and 1.7m wide. To reach this height requires around six layers of rails, with five layers of sleepers in between. Thus 2.5m of fence necessitates around twenty-four 2.5m rails and around twenty 1.4m sleepers. The addition of lighter brash sticking from the top provided further height. The logs used for the fencing have a diameter of 10cms or more. Larger logs meant that the fence entailed fewer layers and was sturdier, however there are obvious safety concerns over lifting and transporting the materials over rough ground, and with greater weight the logs might move around and required careful stabilising. The exclosures are in a remote area away from access routes and it is unlikely that visitors to the estate would seek to climb over the fences.

Figure 3. A typical tree from the control group in 2012; still heavily browsed.

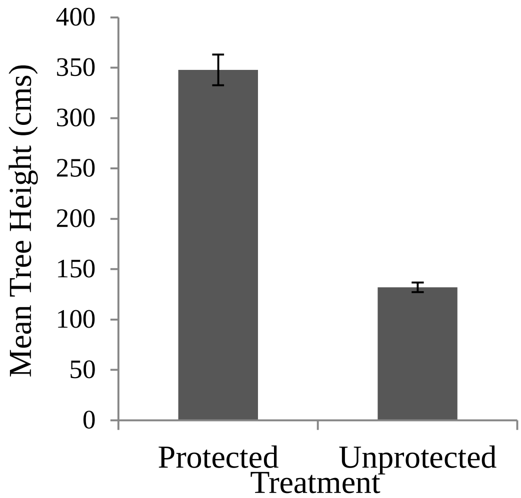

Figure 4. Mean tree height in 2012, showing standard error.

Fifty five trees were included within the deadwood fences and 50 remained unprotected apart from the tree tubes.

CONSEQUENCES

In the autumn of 2012, eight years after the fences were constructed, the height of the 105 trees was measured to the nearest centimetre.

The trees inside the deadwood fences were substantially taller than those left unprotected. Despite the deer reduction in recent years, the unprotected trees were still heavily browsed and struggling to grow much above the height of the tree tubes (Figure 3). Mean height of the protected trees was 348cm (range 124 to 520cm) and that of the unprotected trees 132cm (range 51 to 205cm) (Figure 4). The data for the protected trees was not normally distributed (Anderson-Darling (AD) test value = 0.844, p = 0.028). This was due to three outliers; trees that were damaged when their tree tubes were pushed over. Constrained by the tree tubes, these three trees have subsequently grown parallel to the ground and not attained their potential heights. With these outliers removed both sets of data were normally distributed (protected trees; AD = 0.67, p = 0.08, unprotected trees; AD = 0.64, p = 0.09). A two sample t-test showed the difference in mean height to be highly significant (t = 13.51, d.f. = 64, p = < 0.001) (Minitab 2010).

In addition to the increased height of the trees, the ground vegetation within the exclosures has also responded to the reduced browsing rates. Although empirical data is lacking there are clear differences in the ground flora due to the fences. Inside the deadwood fences ling heather *Calluna vulgaris* and blaeberry *Vaccinium myrtillus* are the dominant species, whilst the ground flora of the surrounding area is predominantly graminoid, with only a small dwarf shrub component (Figure 1b).

The deadwood fences have proven to be highly durable and have required little maintenance (Figure 1b). During most winters Glen Quoich experiences heavy snow fall, and the deadwood fences have sometimes been damaged. However any such damage is usually only in a few areas and can be quickly repaired. Such incidents can be reduced by ensuring the initial construction is solid. The brash sticking from the top decayed quite rapidly, however this does not appear to be essential to discourage deer from entering the exclosures.

The apparent success of the deadwood fences, despite their moderate dimensions, may stem from their width. Although deer can clear considerable heights they appear reluctant to jump over wider barriers (Goddard et al. 2001). This is borne out by the continuing effectiveness of the deadwood fences, despite the rapid decay of the brash sticking out of the top. Deadwood fences of this design will not be immune to lagomorphs due to the open structure. However, there are only low numbers of mountain hares *Lepus timidus* and no rabbits *Oryctolagus cuniculus* in Glen Quoich, so lagomorph browsing is uncommon here.

Several studies have reported on the use of brash and woody debris in protecting young trees from ungulate browsing. However, most of these are limited to the opportunistic use of material present on the site, and do not involve constructing a barrier. There are mixed reports of the efficacy of such protection, depending on the herbivore density, the palatability of the tree species, and the quantity and structure of the woody debris present on the site (e.g. Ripple & Larsen 2001; Pellerin et al. 2010). Mayle (1999) asserts that brash mats are ineffective against muntjac *Muntiacus reevesi* as they will just push them aside. One of the few descriptions of an actual woody debris 'fence' involved piling brash into a three metre high mound (RTS Ltd. 2002). However, this was with very small diameter material and the barrier had subsided by half its height after only three years (Colin MacBrayne, pers. comm. 2012).

Conventional deer fences have several disadvantages which can make them undesirable in conservation land management; drawbacks which are not a concern with the deadwood fences pioneered in this study. One of the most important issues is the mortality of woodland grouse resulting from deer fence strikes (Baines & Andrew 2003; Baines & Summers 1997). The deadwood fences are likely to pose no such threat to woodland grouse as they are lower in height and should be visible to the birds, unlike the thin wires of conventional fencing.

Deer fences can have considerable impacts in a wild land setting. The deadwood fences have a lower visual impact and appear far less artificial than traditional fencing, particularly once they have weathered (Figure 1c). Moreover, deadwood fences can provide a valuable wildlife habitat which might otherwise be missing from plantation woodlands. Plantations generally lack understorey shrubs and have very low levels of deadwood. Any management which increases structural diversity or the amount of deadwood in these woodlands will offer substantial gains for biodiversity (Muller et al. 2010; Humphrey & Bailey 2012). The deadwood fences offer cover for generalist species, and deadwood niches for specialist species.

Finally, deer fences are costly to erect. Provided that the materials are available on site, deadwood fencing offers a means of protecting small areas against deer without any costs beyond staff time. For a conservation charity with limited funding, deadwood fences also have the advantage that they can be built by volunteer teams rather than requiring skilled staff or contractors as would be the case for post-and-wire fences.

The deadwood fences have been highly effective in discouraging deer browsing, allowing the broadleaved trees to grow considerably in the eight years since the fences were constructed. The fence design described here has proven to be far more durable than other methods using woody debris to protect young trees. This novel technique has several benefits over conventional post-and-stock net deer fencing; posing no threat to woodland grouse, having a lower visual impact in the landscape, and offering additional habitats to wildlife.

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