Management of introduced conifers, Beebys Ridge area, Mt Richmond Forest Park, Nelson

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A B S T R A C T

The Beebys Ridge area of Mt Richmond Forest Park was planted for erosion control with a range of introduced conifers from the 1960s onwards, when road access and helicopter hunting made deer control possible. The introduced conifers have stopped erosion and helped restore soil structure and nutrient cycling, as well as creating a sheltered environment (on formerly bare soils) in which native flora and fauna have better chances for re-establishment. However, the unique area of the Red Hills could be invaded by these conifers, the seed of which could be blown from Beebys Ridge by the prevailing westerly winds. Since the mid-1990s there has been active control of the conifers in order to reduce risk of spread, especially the most vigorously spreading species, lodgepole pine (*Pinus contorta*). Further complete control of wildings of this pine, Douglas fir (*Pseudotsuga menziesii*), and Bishop's pine (*Pinus muricata*) is recommended, with removal of dwarf mountain pine (*Pinus mugo*) only recommended alongside spread-prone areas and where it is not useful as a 'nurse' for reinvasion by shade-tolerant local native species such as *Nothofagus* spp. and *Coprosma* spp.

Keywords: introduced conifers, soil conservation, weed control, lodgepole pine, *Pinus contorta*, Douglas fir, dwarf mountain pine, Beebys Ridge, Red Hills, Mt Richmond Forest Park, Nelson Ecological Region.

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1. Introduction

Beebys Ridge is within Mt Richmond Forest Park. The background history of the Beebys Ridge revegetation operations, including the areas planted and species used (together with maps) is covered in an unpublished report to DOC, Nelson/ Marlborough Conservancy (Ledgard, N.J. 1996: Operational plan for the control and management of introduced conifers in the Red Hills, Gordons Range and Beebys Ridge area of Mt Richmond Forest Park).

1.1 VEGETATION HISTORY OF BEEBYS RIDGE

Prior to the mid 19th century, the northern half of Beebys Ridge (north of the Kikawa faces) was covered with beech forest right over the ridge-top, whilst the southern ridge-top has had a low-stature grassland/herb/small shrub cover for many centuries. Between around 1850 to 1950, burning and grazing (mainly by sheep) opened up the Kikawa faces above Rocky Creek and the present-day clearings on the northern ridge-top, and also modified the vegetation composition of the southern 'grasslands' (e.g. increased the percentage of the less palatable carpet grass *Chionochloa australis*). Grazing by sheep largely ceased after the 1930s, due to declining forage availability and increasing numbers of deer competing for feed. In the late 1950s, strong winds blew burning material from a major fire to the west, over the middle areas of Beebys Ridge, to create many of the clearings on the steep eastern faces dropping into Beebys Creek.

This history of fires created large areas of bare soil surrounded by a vegetation struggling to maintain itself due to high animal numbers (especially deer). Concern about induced erosion prompted a decision to attempt revegetation, and in the mid 1960s a road was constructed from the southern end of the ridge and north for approximately 11 km. The road construction and the advent of deer shooting from helicopters enabled better control of animal numbers, so that revegetation planting could begin in the late 1960s. The main revegetation operational period was between 1971 to 1978, when some hundreds of hectares were planted. Initially a wide range of introduced conifer species was used (including lodgepole pine *Pinus contorta*), but dwarf mountain pine (*P. mugo*) was the predominant species planted.

On Beebys Ridge the main recommendation in the 1996 unpublished report was to remove the lodgepole pine from the middle area, but to leave the larger areas of dwarf mountain pine. Even though this latter species is capable of spreading, it was decided against its immediate removal, as the incidence of wildings and the potential for long-distance spread (to the Red Hills) was much lower than for lodgepole pine, and the areas (and cost) involved were much bigger. This situation is reviewed in the current report, along with the potential spread of other introduced conifers.

1.2 OBJECTIVES

- Review control operations to date on introduced conifers on Beebys Ridge, particularly in relation to potential spread to the Red Hills.
- Recommend future operational actions and priorities to prevent spread of introduced conifers.
- Inspect Wairau Faces, Raglan Range revegetation area, and the extent of spread in the Teetotal block.

2. Methods

A total of three days, 5–7 June 2001, were spent in the field, mainly on Beebys Ridge, with side visits to the Raglan Range revegetation area, the Teetotal Flats and beech/Douglas fir boundary, plus viewing from the road of the Wairau faces below the Red Hills. All this time was spent in the company of Graeme Omlo (Conservation Officer from St Arnaud Area), with one day accompanied by Bruce Waddell (Programme Manager) and Melanie Newfield (Technical Support Officer) from the DOC offices of St Arnaud and Nelson, respectively. Discussions were also held with Colin Clarke, of St Arnaud village, who has considerable knowledge of the botany and cultural history of the Beebys area.

3. Main findings and discussion

3.1 CONSERVATION VALUES

Mt Richmond Forest Park is managed primarily for its soil and water, and indigenous flora/fauna conservation values. The beech forests on and surrounding Beebys Ridge are little different from those existing over much of the Forest Park. However, the flora in the grass/shrubland areas of the southern ridge-top (for about 2 km north and south of Beebys Knob) is unique for its mixture of eastern and western floras, which include a number of relatively rare plants.

The introduced conifers were planted to protect soil and water values on the bare areas created by burning and over-grazing by sheep and deer. On these sites they have stopped erosion and helped restore soil structure and nutrient cycling, as well as creating a sheltered environment (on formerly bare soils) in which native flora and fauna have better chances for re-establishment. These original values are still present, enhanced by a more recently recognised value of increased ability to store carbon.

A unique aspect of Mt Richmond Forest Park is the Red Hills. These are part of the 'Nelson mineral belt' of ultramafic rocks, which are unusual both geologically and topographically. In addition, they support a limited, and in some cases unique, range of plant species. There is a risk that the Red Hills could be invaded by introduced conifers, the seed of which could be blown from Beebys Ridge by the prevailing westerly winds. This threat of conifer invasion on to the Red Hills is probably the greatest concern relative to the impacts of the revegetation plantings on Beebys Ridge.

3.2 MANAGEMENT OF RISK OF SPREAD OF CONIFERS

Since the mid-1990s there has been active control of the conifers in order to reduce risk of spread. As recommended in Ledgard's unpublished report (1996), the prime focus has been removal of the most vigorously spreading species, lodgepole pine. Almost none of the original plantings remain, and regular removal of wildings has meant that the species is well under control. In addition, the few mature Douglas fir (*Pseudotsuga menziesii*) have been removed; this species was targeted because of its shade tolerance and greater ability than the pines to invade regenerating native shrub associations and canopy gaps in beech forests.

The other major spreading conifer is dwarf mountain pine. To date, the area affected by this species and the amount of spread involved is small, allowing for most wildings to be removed. For this reason, together with the greater cost involved in removing this multi-stemmed 'shrub', the species was not given high priority removal status in Ledgard's unpublished report (1996). This pine also poses less risk of distant spread to the Red Hills than lodgepole pine and Douglas fir.

3.3 FUTURE RISK OF SPREAD, AND VALUES THREATENED

3.3.1 Direction of spread

The prevailing and strongest winds come from a westerly direction. The location of seedlings around mature trees on Beebys indicates that most spread is to the north-east. This means that seed could be blown towards the Red Hills from anywhere on the Ridge. There is also evidence that seed has been blown by north-west winds for considerable distances to the south-east. On the southeast-facing slopes below the Red Hills and above the Wairau River (just above the Wash Bridge) there is a scattering of lodgepole pine around 25 years old. A few trees of the same age-class are growing further to the south-east, across the river on the Raglan Range (the species was not planted in this area, and there is no evidence that they have come from revegetation plantings in the Branch River catchment to the south). Also in the 'flight' line between these lodgepole pine occurrences on the Raglan Range and the Wairau faces, and the

possible source in Golden Downs, are sites on the Red Hills and the northern tip of Beebys Ridge, on both of which lodgepole pine wildings of the same age have been found. On these latter two sites, similar-aged wildings of Corsican pine (*Pinus nigra*) and Douglas fir also occur. The possible source of seed is mature plantings of all three species which were present until recently in Golden Downs Forest near the junction of the Blue Glen and Motueka Rivers. If this was the source, seed of lodgepole pine has been blown at least 20 km (to the Raglan Range), whilst seed of Corsican pine and Douglas fir has gone approximately half that distance.

The above indicates that the major seed spread direction from Beebys Ridge is likely to be to the east, in a vector of around 90° from north-east to south-east. Locally, particularly on slopes sheltered from the prevailing wind, where reverse eddies can occur, spread can also be from east to west, but this is usually for less than 100 m.

3.3.2 Local spread

Now that all the mature lodgepole pine and Douglas fir have been removed from Beebys Ridge (except for the small numbers on the northern-most spur above the Motueka Gorge), the main species likely to spread locally is dwarf mountain pine. Although there has not been much spread of the species to date (after 25+ years), there is no doubt that it will increase in the future. The highest numbers of wildings are likely to be found after one 'event' when there is a combination of good seed production followed by favourable seed germination and seedling establishment conditions, allowing a 'wave' of spread to occur. In the majority of years when this combination of favourable circumstances does not occur, far fewer seedlings are likely to appear. In addition to dwarf mountain pine, there will also be much smaller occurrences of Scots pine (*Pinus sylvestris*), and small numbers of Norway spruce (*Picea abies*)—the first wilding of which was observed in June 2001.

What values are likely to be threatened by local spread? On the eastern faces, local spread will fill in the unplanted gaps as well as those amongst the existing trees. As these areas were largely bare prior to planting, and the wildings will not invade the surrounding beech forest (with the possible exception of Douglas fir), there are no significant values threatened. Indeed, the conifer 'nurse' cover should encourage the reinvasion of more shade-tolerant local native species, such as beech (*Nothofagus* spp.) and *Coprosma* spp. As the pines are most unlikely to succeed under a 'closed' canopy themselves, it is much more likely that a native cover will have replaced them in 100 years time, especially if encouraged to do so. Therefore, the removal of the conifers on these eastern faces may not justify the cost.

On the more open ridge-top, there is more room for local spread, particularly of the dominant planted species, dwarf mountain pine. Even though there are no significant indigenous values on the northern half of Beebys Ridge, the areas of dwarf mountain pine are small, and they should not be too hard to remove. Similarly, removing the small numbers of lodgepole pine and Douglas fir on the ridge-top at the very north end of Beebys should not be too hard.

However, the situation is different on the southern half of the ridge. Here, the floral values of the ridge-top grass/shrublands are high, and there is a real risk of

invasion and eventual dominance by wildings coming from the dwarf mountain pine plantings upwind on the Kikawa faces. Removing these trees would be very expensive, and there has been little spread to date. Therefore, a 'watching brief' is recommended, with the removal option to be considered more seriously only if (or when) a spread event occurs.

3.3.3 Distant spread

The main concern here is spread to the Red Hills, 5 km to the east of Beebys Ridge. Of the species planted on Beebys, lodgepole pine and Douglas fir represent the major threat of distant spread. The only area left with mature trees of these species is the northernmost portion of the ridge above the Motueka Gorge. Above 1200 m (the trig is at 1377 m), there are few conifers. However, the site is a typical 'take-off' site for seed dispersal in the Red Hills direction, and some of the trees present are coning, so they should be removed as soon as possible. Unfortunately, below 1200 m to the west the incidence of conifers is much greater (also present is dwarf mountain pine), and the likelihood of spread onto the ridge-top and possibly further is very real. However, the cost of removal on these mid slopes would be high, so, as with the pines on the Kikawa faces to the south, a watching brief is recommended.

Further south on Beebys Ridge, the main risk of distant spread lies with the dwarf mountain pine planted on the ridge-top and the exposed western faces. If the small areas in the ridge-top clearings are removed, the only trees remaining will be those on the Kikawa faces. The risk of seed spreading to the Red Hills from these is not considered high—certainly not as high as for lodgepole pine and Douglas fir. The reason for this is dwarf mountain pine's slightly heavier and less aerodynamic seed, and their shrubby tree stature (leading to lower seed release heights and lower wind speeds in amongst the canopy). Therefore, the 'watching brief' role mentioned above is still valid, at least until evidence of greater distant spread risk is apparent.

3.4 ASSISTING REINVASION BY NATIVE SPECIES

As indicated above, the cover afforded by the conifers on sites which were formerly bare of any vegetation offers opportunities for the reinvasion of native plant species. This could occur naturally but would be slow, due to limited seed sources and the limitations for regeneration at the higher altitudes. Near the top of the Ridge, evidence of good beech seedling establishment alongside intact forest margins is scarce. This is probably due to limited seedfall (much of which could be consumed by mice), browsing of young seedlings (particularly by hares), and the generally harsh environment for seedling germination and establishment—which is normal at such altitudes.

Native reinvasion could be assisted by direct sowing amongst the conifers of pure seed, or duff (containing seed) collected from under mature local forest or shrub. Dwarf mountain pine is a good nurse tree for such seeding, as it does not grow tall or too dense, and tends to 'collapse' and open up as it matures. Healthy seedlings of beech and especially *Coprosma* (*C. pseudocuneata*?) are already evident within some of the older planted stands.

If funds permit, strategic thinning or the use of chemical sprays to kill the conifers could be tried to determine their effect on native seedling establishment.

3.5 RED HILLS FACES ABOVE THE WAIRAU RIVER

The Red Hills faces above the Wairau River were only viewed from the main road (SH 83), from where a widely spaced scattering of lodgepole pine was observed. These were growing amongst a thick cover of manuka (upper slopes) and kanuka (lower slopes), and a few had a second generation of wildings alongside (fringe spread). As indicated above, their age (20–25 years) and widespread location leads one to suspect that they may well have come from mature stands some distance away (probably Golden Downs Forest). The uppermost reaches of the faces have already been cleared of wildings, and those lower down have been targeted for the near future.

Although there is a possibility of further spread from the same source, the current trees indicate that this only happens about once every 50+ years. Therefore the risk is not high. There is a far greater likelihood of spread from the new plantation forests between the base of the slopes and the Wairau River, but the good kanuka/manuka cover means that invasion sites are limited.

3.6 RAGLAN RANGE

One morning was spent driving along the Raglan Range. Much of the top ridge and the bare slopes immediately alongside were revegetated with introduced conifers in the late 1970s and early 1980s. The earliest plantings were at the northern end where the road emerges from the radiata plantations. Here, Douglas fir and dwarf mountain pine are spreading quite vigorously (especially the former species), and where there is not already an intact native cover, many of the downwind slopes will become dominated by wildings in the next 10–20 years. Also present is lodgepole pine regeneration, originating from scattered outlier wildings which arrived from the north-west (Golden Downs) about 25 years ago.

Further along the range the dominant species is dwarf mountain pine, with small areas of Scots pine. The plantings are certainly stabilising the slopes and assisting with soil structure, organic levels and nutrient improvement. In this way, as on Beebys Ridge, they will offer better sites for the invasion of native species over the long term. As yet the incidence of spread is low, but this will undoubtedly increase locally. The high altitude and exposed conditions means that some seed will be carried further afield, but most of the downwind terrain has a good cover of forest or shrubs, and therefore the invasion opportunities are not high.

In recent years, DOC has removed scattered lodgepole pine from the northern slopes beyond the end of the road, between the ridge and the river, and it should not be hard to maintain this area free of introduced conifers. However,

there would be significant costs involved in extending this control further north along the Range, and the current benefits of doing so would be hard to defend.

3.7 TEETOTAL FOREST

One afternoon was spent in this area immediately to the west of St Arnaud. The major purpose of the visit was to look at potential wilding spread from the forests planted in the mid-1980s. The main conifers present are Douglas fir and Bishop's pine (*Pinus muricata*).

Wildings of Douglas fir (up to 5 years old) are growing along the forest margin by the Teetotal Flats, which are leased for grazing. Regular grazing by sheep has allowed few to establish outside the fenced-off forest area. Although late winter frosts on the flat terraces would make wilding survival difficult, more would certainly establish if sheep grazing were to cease. No Bishop's pine wildings were seen on the flats.

Further to the north, the plantations border on to beech forest, which could be invaded by Douglas fir. Wildings up to 3 years old were found along the firebreak border, with some present up to 20 m inside the beech margin. None of these were more than 2 years old, and evidence from elsewhere is that many of these will be ephemeral and unlikely to survive under an intact canopy. However, the incidence of such wildings can only increase, and they could survive in gaps created by breakdown of the beech canopy. Although it is felt that such invasion is likely to be minor and only along the beech/Douglas fir interface, it should be monitored by regular inspections, preferably along permanent transects. Only a few Bishops pine wildings (up to 2 years old) were seen in the firebreak, and this species will not survive in anything other than open environments.

4. Recommendations

Beebys Ridge

- Northern tip. Remove all existing trees above 1200 m. Monitor regularly and remove all wildings every 5 years. Review if/when wilding numbers become excessive.
- Middle section, ridge-top. Remove all dwarf mountain pine plantings on ridge-top (approximate cost $1000/ha), plus wildings - until eliminated.
- Middle section, planted 'clearings' on eastern faces. Not a priority for any removals due to low likelihood of significant spread. Attempt seeding with local native tree / shrub species amongst conifers. Any seeding should be repeated over 3 years, to accommodate seasonal climatic variation. Some aerial spraying of conifers could be attempted to determine consequences relative to vegetation replacement. Monitor the success of any seeding attempts.

- Southern ridge-top/Kikawa faces. Bring conifer limit down to a uniform line. Monitor wilding spread, by carrying out removal sweeps of wildings above this line every 3–5 years. Only consider removal of conifers on Kikawa faces if spread control becomes too costly. If funds permit, attempt some seeding of native species into these conifers.

Wairau faces below Red Hills

- Remove existing conifers and monitor for further spread every 5 years.

Raglan Range

- Maintain a conifer-free area south of the road-end.
- Do not consider removals further north, unless distant spread threatens high conservation values downwind.
- If funds permit, attempt native seeding in amongst planted dwarf mountain pine areas.

Teetotal Forest

- Maintain sheep grazing on Teetotal Flats to control wildings.
- Alongside Douglas fir/beech interface, establish permanent transects in beech forest to monitor Douglas fir seedling numbers, survival and growth.

Operational assistance

- Advise Weyerhauser (Golden Downs Forest) of likelihood of conifer invasion from their forest into Mt Richmond Forest Park. The potential for assistance with wilding prevention and control operations should be explored.

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