WILDING CONTROL GUIDELINES FOR FARMERS AND LAND MANAGERS

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ABSTRACT

The spread of introduced conifers (wildings) threatens biological conservation, landscape values and pastoral productivity of large areas of montane New Zealand. Considerable resources are spent annually on their control. This paper reviews the background to a guideline manual that has been written to enable farmers and land managers to determine the most practical and cost effective means for wilding control. Wilding size and frequency are used to choose the optimum removal technique from a wilding control 'toolbox'. Methods involve management of the affected site (burning, grazing, fertilising), physical removal (hand pulling, hand tools, ring-barking), power tools (chainsaws and scrub-bars), heavy machinery (mulching, windrowing) and chemicals (foliar spraying, stem poisoning, cut stump application, soil injection). For each technique, implementation recommendations are given, along with comment on the most appropriate tools, audit procedures and safety issues. The wilding website (www.wildingconifers.org.nz) is used for additional detail.

Keywords: wilding conifers, control, manual, guidelines.

INTRODUCTION

Naturally regenerating introduced conifers (wildings) are a problem in many countries, especially in the Southern Hemisphere (Richardson & Higgins 1998). In New Zealand, the spread of wildings threatens the conservation and landscape values, plus the pastoral productivity, of large areas of montane country, particularly in the eastern South Island (Hunter & Douglas 1984; Ledgard 1988). Considerable resources are spent annually on wilding control. In recent years, the Department of Conservation (DOC) has spent 25% of its NZ\$14million weed budget on wilding control (K.W. Briden, DOC, pers. comm.). The Canterbury Regional Council (Environment Canterbury – ECan) lists wildings as a plant pest in their Regional Pest Management Strategy (Environment Canterbury 2001). In 2008, ECan allocated 53% of its plant pest control budget to wilding control (G. Sullivan, ECan, pers. comm.) and rated weed and pest management as the second highest priority after work on water quality and quantity.

Most of the wilding removals by Marlborough, Canterbury and Southland Councils are on private farm land, where the aim is to get owners and managers to take on more responsibility for such work (Bowman 2004). These Councils, plus DOC and representatives of the high country farming community are members of the South Island Wilding Conifer Management Group (SIWCMG), which has 3 years of funding (2006-2009) from the Ministry of Agriculture's Sustainable Farming Fund to run a project entitled 'The prevention, management and control of wilding conifers'. One output of this project is the production of a guideline manual to assist private land owners in choosing and implementing the wilding control technique most appropriate for their circumstances (Ledgard 2009). This paper reviews the background to the control techniques given in the manual.

METHOD

The control manual is designed for easy reference and is published in A5 size, using many images plus text provided in boxes and bullet-point format. It will be free and promoted via local councils, who have strong links with communities involved with the development of formal plans and strategies for weed and pest management and land use generally (Bowman 2004). In its concise and easy-to-read form, the wilding control manual is not suited to contain specific operational detail; for this level of information readers will be directed to the SIWCMG's website (www.wildingconifers.org.nz).

THE MANUAL

Determining appropriate control techniques

The manual uses wilding tree size (approximate diameter and height) and frequency as the first step in determining the most appropriate removal technique (Table 1).

TABLE 1: Classes of wilding tree frequency and size.

Wilding tree frequency	Wilding tree size		
	Small	Medium	Large
Lone wildings or widely scattered individuals	Diameter: <2 cm at base Height: most <0.5 m tall	Diameter: 2–20 cm at 1.4 m Height: most >0.5 m tall	Diameter: >20 cm at 1.4 m Height: often 10+ m tall
Dense trees – often with touching crowns			

Once the wildings have been classified into tree frequency and size, a table is available to indicate the most appropriate removal techniques. For each technique a photo is given along with bullet-pointed recommendations and comments, plus boxes with summary information on safety, tools and audit procedures. In addition to the technique descriptions, the manual contains summary information on the role of helicopters, pre-operational briefings, maintaining control of wildings over the longer term, monitoring success, technique costs, plus the importance of removing all green foliage and early removals before trees reach coning age.

Fourteen techniques are covered, and these are arranged into five categories (Table 2). Most control operations involve a combination of these removal methods (Woods 2004). A review of each of the recommended techniques is presented below.

TABLE 2: Categories and techniques for wilding removal.

Wilding control category	Wilding control techniques
Site management	Burning, grazing and fertilising
Hand removal	Pulling, tools, ring-barking
Power tools	Chainsaw, scrub-bar
Machine	Mulcher, digger/dozer
Chemical	Foliar, cut-stump, stem poisoning, soil injection

Site management

Burning is an important element of wilding tree control in South Africa (Richardson & Higgins 1998). It has not been used frequently in New Zealand, apart from the North Island Central Plateau where it has been used successfully on contorta pine (*Pinus contorta*), both on its own, and in conjunction with crushing and spraying prior to burning (Ledgard 2001). It can be the cheapest means of removing small wildings and possibly

stands of medium-sized trees, but it can destroy non-target plants and create a seedbed for weed invasion. Burning often requires official consent, and should be undertaken only by experienced teams.

Although mostly unintentional, grazing is the commonest means of wilding control in New Zealand. Even low numbers of sheep can significantly reduce wilding density (Benecke 1967; Cattaneo 2002), and sheep have been shown to be more effective than cattle (Gibson 1988). Grazing by rabbits is most effective on very young seedlings (Davis et al. 1996; Ledgard 2004). Once wilding plants are more than 2 years old, they are usually too woody for complete removal and grazing will only reduce growth (Crozier & Ledgard 2002). Grazing could be used more strategically for wilding control (Ledgard & Norton 2008) and is most effective when combined with fertilisers and pasture improvement.

Commonly used nitrogen and phosphate pasture fertilisers stimulate the growth of weeds (often grasses), and this increases competition for light and moisture, which has been shown to reduce wilding emergence from sown seed by 28-70% (Ledgard 2006). In improved (fertilised) and ungrazed pasture, no contorta pine seedlings survived more than 18 months, whereas in unimproved grasslands seedling survival was 94-100% (Benecke 1967; Davis et al. 1996). Fertilisers generally favour the growth of introduced plants, which may reduce numbers of resident native plants of smaller stature.

Hand removal

Hand pulling is suitable only for small seedlings up to 50 cm tall (Woods 2004), and even those more than 30 cm tall can be difficult to remove. Hand pulling is simple and hence suitable for volunteers, who usually combine this with the use of hand tools.

The most common hand tools are loppers, small saws (jack-knife and fixed blade) and small axes (Woods 2004). These are most useful for unskilled volunteers to remove small trees (<2 m tall and/or <5 cm diameter at their base). The golden rule is that all green foliage must be removed from the cut stump (Environment Canterbury 2005). Any live foliage left will enable the tree to recover, making it much harder to remove next time around.

Ring-barking can be done with bark peelers, which can be quick and effective on young trees with smooth bark (G. Brann, Te Puke, pers. comm.). Chainsaws are more commonly used, but ring-barking with this method often gives variable results due to incomplete severage of stem conductive tissues (R. Grose, DOC, Blenheim, pers. comm.). For this reason it is not recommended as a reliable tree killing technique.

Power tools

Chainsaws are the most common means of removing medium to large trees (Woods 2004), but for safety reasons this technique is not recommended for amateurs. The technique can involve carrying considerable weight, e.g., chainsaw, fuel and safety gear, as well as a small hand axe or tomahawk, which is needed for removing green foliage close to ground level where there is a risk of blunting the chain's teeth on rocks and soil.

The scrub-bar is a relatively new introduction to wilding control operations, but it is rapidly gaining popularity, due to the ability to remove a wide range of tree sizes – from small seedlings up to trees of 15 cm diameter at their base (P. Willemse, DOC, Twizel, pers. comm.). Another important benefit is that this technique is significantly less physically demanding (no bending), so that more area can be covered per operational hour. A new development is the addition of a spray attachment below the blade, which can apply a chemical to very small seedlings, as well as to the cut-stump in order to kill any remaining green foliage (W. Godfrey, Independent Environmental Contracting Ltd, pers. comm.). A scrub-bar operation, often combined with chainsaws for larger trees, can therefore be very cost-effective, but both tools are recommended for use only by professionals.

Machines

Tractor-driven mulchers or independent mulching machines are most effective on dense stands of trees, and large specialised machines can tackle trees up to 14 years old (Anon. 2005). However, with smaller mulchers, removal of all green foliage can be

difficult if the ground surface is uneven and/or wildings have green foliage at soil level (Paul & Ledgard 2009). Mulchers can also remove desirable non-target plants (often native species) and create an ideal soil surface for new weed invasion.

Traditionally, heavier machines, such as digger/dozer combinations, have been used to remove dense areas of medium to large trees, often pushing them into 'windrows' 20-30 m apart (Hall 1995). Subsequent windrow removal can cause problems, as they are costly to carry away and difficult to burn. In addition, as with mulching, an ideal seedbed for weed reinvasion is created, and the impact on non-target plants, often including native species, is significant.

Chemicals

Trials of chemicals for the control of woody vegetation, including wildings, have been undertaken in New Zealand for decades (Ray & Davenhill 1991). An internal review of the use of herbicides for controlling wilding conifers has been produced by DOC (Raal 2005). This described the state of knowledge for all the chemical control options used for wilding conifers at that time. Chemicals have most often been applied to foliage (e.g. Preest 1985; Crozier 1990), both from the ground and the air, but also to cut-stumps (Crozier et al. 1998), as a stem poison (Woods 2004) and by soil injection at the base of trees (Davenhill & Preest 1974).

The main determinant of success from foliar application has been the degree of foliar coverage obtained during application. Good foliar penetration can be obtained on small trees (up to 2-3 m), but satisfactory foliar coverage is difficult on larger trees and this, combined with differing target species, chemical rates and mixes, has given very variable results from most trials (Raal 2005). Consequently, repeat sprays are often needed to ensure kills, particularly with contact only (non-systemic) sprays. Most commonly used is the contact chemical, diquat, but other systemic herbicides have been tried, including glyphosate, trichlopyr, picloram and metsulfuron, together with a range of added desiccants and surfactants. The variable results to date, combined with largely unknown non-target effects (especially on native plants), mean that simple recommendations cannot yet be given.

Cut stump application is useful where removing all live foliage by cutting stumps at ground level is difficult due to risk of tool damage on soil and stones (Crozier et al. 1988). Chemicals must be applied immediately after cutting, and is best done during the season of active growth. A commercially available product, Vigilant Gel® is effective and safe (Newfield & Ward 2004), but is expensive if used extensively.

Stem poisoning is most useful for large trees in difficult access or rocky terrain, and in bush/shrublands where felling can create light-wells and promote new wilding establishment. A 'bore and fill' method is recommended (Raal 2005) and can give impressively quick results. The most used chemicals are glyphosate and metsulfuron. Recent trials have shown that these are best applied during the growing season into holes (20 mm diameter and 25 mm deep) obliquely angled down through the cambium, and spaced at around 50 mm apart, depending on tree size (N.J. Ledgard, unpubl. data). Dead trees can take over 10 years to completely collapse and during that time they are often unsightly and can be hazardous (falling dead wood) near areas of human use.

The soil injection technique can be the most appropriate for scattered outlier wildings in difficult-to-access areas. The chemical is taken up by the roots after application to the base of the main stem during the active growth period (Davenhill & Preest 1974). A commercially available product, Formula 4®, has been developed, and this stabilises quickly in the soil with little risk of movement off-site (W.P. Chisholm, Landward Management, pers. comm.).

Other important considerations

In addition to describing and recommending control techniques, the manual also contains summary information on safety, costs, auditing operations (supervision and quality control), monitoring results and the need for long-term commitment (Ledgard 2001) to maintain control until no further wildings emerge. In addition, the manual discusses the role of helicopters, and emphasises the importance of removing wildings

before they cone, as well as the need to remove all green foliage from cut stumps. These factors are briefly discussed below.

The safety of workers (volunteer and professional) is the first consideration in any removal operation (Woods 2004). The manual addresses this for every technique, and where dangerous tools are required, recommends use only by trained and/or professional individuals or teams.

The costs given in the manual are based on recent wilding control operations undertaken in the South Island high country. They vary widely, from as little as a few dollars/ha for supervising volunteers using hand pulling and hand tools on small seedlings, to tens of thousands of dollars/ha for removing dense, mature stands with contractors and chainsaws. Every control operation will involve more than one removal technique, and the greatest challenge for managers is to quantify the areas most suited to any one means, or mix of means. For this reason, contractors are usually paid on an hourly basis, not on a per block or per hectare rate (Woods 2004).

Good auditing involves supervision and quality control, both of which are essential from the outset (Woods 2004). This starts prior to beginning any removal operation with a briefing that clearly informs on safety practices, demonstrates appropriate control techniques (notably to volunteers), and agrees on accountability standards to ensure that work quality is maintained. For example, if wildings are being removed physically, trees 'missed' (not removed or green foliage still on cut stump) are counted by an independent person at the very start of the operation and at intervals thereafter. If misses account for >1% of total trees, a rework can be required and payment deferred until this is completed. It is similar with chemical removal; full payment may be made only if an acceptable percentage of trees are totally killed. With volunteers, good supervision is essential.

Monitoring of results should be carried out to determine changes in wilding abundance over time as a result of the control operations. The methods used may involve aerial surveillance (although small wildings are difficult to see from the air), ground sampling by means of transects or plots, and/or photo points.

It is important that options for maintaining control in the long term are considered at the start of any control operation. No control operation will remove all wildings in one visit, due to missed small seedlings and delayed seed germination – although the latter rarely occurs after 5 years (Langer 1993). Presuming that there is no new invasion from outside seed sources, at least one (usually two) return visits will be needed to remove remaining wildings. These should be carried out every 3–4 years, but can be extended out to 5 years for later maturing species. Such inspections should be continued until it is clear that new wilding establishment is unlikely.

The maxim 'a stitch in time saves nine' (SITS9) is a good motto for wilding control. Use must be made of the fact that young wildings become very visible some years before they produce cones and seed. Unless these immature wildings are removed before they cone, a new crop of wildings will establish, and the cost of removal increases significantly.

Helicopters allow access to wildings that would be impossible or difficult to access otherwise (Woods 2004). They can be used for aerial spraying or for carrying people with removal equipment to drop-off areas (this is called skid-hopping), or on the end of long strops directly to wilding trees (human sling). These removal techniques can only be carried out by specially trained operators.

In the author's opinion, the failure to remove (or kill with chemicals) all green foliage on cut stumps is the commonest fault occurring during wilding control operations. If green branches or needles are left on the stump, the tree will not die (Environment Canterbury 2005).

The wilding control manual summarises current control techniques and associated operational considerations. As the manual cannot contain all details and these will change with time, the wilding control website (www.wildingconifers.org.nz) is used to supply updates as they become available.

CONCLUSION

The wilding control guideline manual, produced by the South Island Wilding Conifer Management Group, uses a simple, easy-to-read format to summarise the main control techniques and to act as a guide to the most appropriate means for different situations. To the author's knowledge, this is the first control manual to be produced for general public use. It follows the production of a similar manual in 1999, which focuses on wilding prevention (Ledgard & Langer 1999). Together, these two manuals can assist people with properties that are susceptible to, or affected by, wilding invasion, to both practise prevention and, if needed, to undertake timely and cost-effective removals. Only in this way, with all land owners and managers aware of the basic aspects of wilding management, will cost-effective wilding prevention and control become accommodated as an accepted component of everyday land use.

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