WILDING CONIFER MONITORING

A ground plot method to monitor management success

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INFORMATION SHEET

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Wilding Conifer Monitoring

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Introduction

Background

The extent and severity of wilding conifer infestations (both with or without management) need to be monitored. This monitoring helps with development of a national strategy and helps stakeholders and managers of wilding infested (or threatened land) acquire data on the issue. Specifically, monitoring of wilding conifers can enable land managers to understand the dynamics and the impact of their management actions better to make improved management decisions where needed.

Monitoring enables stakeholders to document the change that their management has made across their "patch" and links this to their overall goals and objectives. The ability to do this in a quantitative and thorough way allows managers to gain confidence from supporters and funding bodies and can be used as leverage for further funding. Furthermore monitoring data will allow risk analysis and cost calculations based on the trend data that monitoring can supply.
Well-planned monitoring that includes the systematic collection (design), the recording (field protocol) and analysis of observations over time will provide the best possible information to check if the intended outcome of a management program is being achieved or if a historic state has changed to the better or worse independent of intervention or not. Monitoring is essential at very early stages of an expected or already occurring invasion. The decision to employ weed management or control has to start from a known baseline to take the right management steps. This requires the knowledge of the current extend and the current and potential impact of occurring weed invasion. The ongoing capturing of the development of this situation – monitoring - enables us to estimate the future development, also critical for prioritisation of management efforts.

In the planning and design phase of monitoring the aims and objectives of the management programme need to be considered. For example, monitoring of additional indicators might be required to document the recovery of native vegetation following wilding removal if the protection and enhancement of indigenous biodiversity is a management goal. Similarly, the recovery of vegetation for grazing purposes should be documented over time if a return to productive grazing land is the objective.

Any monitoring procedure should be easily repeatable and objective, so that it could be done by different people over time. The objective of this protocol is to provide a method of how wilding conifer management and its impact in management areas can be monitored. Our proposed approach is a simple way to collect in a easy and repeatable fashion

comparable data over time. We aim provide a basic approach that allows the collection of additional data to support reporting.

Purpose

This monitoring protocol outlines a method for estimating wilding conifer numbers and severity (cover) to assess the success of wilding control in a specific area. The method is based on sampling wilding conifer populations by permanent ground plots.
Basically, the protocol describes how many monitoring plots are to be used and how they should be located and sampled. The required norms and standards of sampling design considerations and field work involved.

Scope of protocol

The protocol describes how a ground based standardised wilding conifer monitoring programme should be set up to provide management agencies with sound estimates of wilding conifer densities and their change over time in a local wilding control area. It does not address issues such as occupational safety and health, public relations, behaviour or ethics of those doing the monitoring.

Estimates of the number of wilding conifers and associated statistics may be used as performance criteria for control contracts but these criteria are not prescribed in this protocol. Management agencies may increase the sensitivity of their monitoring by means of stratification or increasing sampling intensity using more plots.

Layout of protocol

The protocol is divided into three parts:
Design: Determining the objectives and requirements of management agencies and the resulting monitoring programme. This involves the stratification and defining the areas with wilding conifer control, deciding on the number of plots and selecting the location of plots.
Field work: Locating plots, marking and outlining plots and making a record of recommended measurements according to prescribed standards.
Information management: This involves collation, analysis of data and interpretation of results.

Design of a local wilding conifer monitoring programme

Define the management area boundary

The management area needs to be defined in which wilding conifer numbers and the severity of infestation in relation to control is assessed. We refer to a management area as the area that is treated in similar fashion and at the same time or intervals, e.g. an area cleared of wildings by hand pulling in 2012. Defining the boundaries for such an area can be done using property boundaries (if management area is restricted to this property) or by drawing the boundaries of the management area (e.g. extent of area where control will or has been carried out). GPS readings or contract plans of control activities can also be used to define such areas. Calculate the total area for the management area as the basis for the calculation of plot numbers in an area.

Define possible strata and their boundaries

Defining a management area based on a control method is itself a stratification that should increase precision of the estimation of wilding conifer numbers or to check specifically if the control is successful. Such a stratification accounts for multiple conditions as many decisions on control methods are made depending on site conditions (e.g. vegetation, topography) and form of the wilding conifer infestation (e.g. dense older stands or young and sparse).

In some situations a high number of small areas with different controls can mean more plots and higher costs of the monitoring and monitoring of such small areas becomes inefficient.

Another possibility is to apply an un-stratified approach and apply sampling across the full "general" management area (e.g. where wilding conifers are controlled by various means). The advantages are that long term sampling will not be hampered by changes of strata over time or by inaccessible areas. The spatial distribution across the management area will need to be well balanced and post-stratification can still be applied to gain precision by eliminating the among strata variance.

Number of plots, size and re-measurement

As a rule the required number of plots in an area will depend on the variability of wilding conifer occurrence in the management area and the difference that we want to detect with a given confidence. Initial monitoring surveys along consistent bearings across a number of wilding control areas indicate that in many infestation areas the variability in wilding numbers is correlated with the mean of wilding conifer numbers. In homogenous management areas a minimum of 10 plots spatially well distributed plots will be sufficient

to detect a control effect of a reduction at least 60% of wilding conifers in this area with a confidence limit of 0.95. This is independent of the size of the management area but we would recommend that for every 100 hectares controlled, a minimum of 10 plots should be installed.

Minimum plot-size is $25m^2$, preferably in the form of circular (radius 2.82m) or square plots (5mx5m) as these are easy to lay out and are a good size to quickly assess tree numbers. Bigger plots generally increase assessment efforts and make installation more difficult, but can improve representativeness.

Permanently installed plots are a powerful way to monitor change (trends through time). Ideally plots should be established before or shortly after a control or management operation to record the initial status. Such a setup can also serve audit purposes. Intervals of measurements should not be greater than 3-5 years.

Monitoring should continue until the collected data shows that management objectives are achieved or indicates the need for further management action (e.g. removal of a new generation of wilding conifers).

Placement of plots

For sampling to be unbiased all site conditions should have a chance of being sampled in a management area. This can be achieved by a randomised grid sampling or by placing plots at equal distance from a random point along a defined bearing. The latter also provides the opportunity to sample along a gradient (e.g. distance from a seed source). Using a systematic sampling approach guarantees consistent sampling intensity across the landscape.

Option 1: For systematic grid sampling across a management area the required grid would require a mesh size of 300m (approximately one plot per 10 hectares)[1]. You can generate a random point within the management area and place the grid in true North/South and West/East direction to ensure the random placement of the grid. Finally you can place individual plots on the centre coordinates of each grid square that is inside the management area.

[1] The created grid can be matched with the nationally randomised systematic 1.5km spaced grid by using the same random starting point (national grid available from author).

Depending on the form of the management area you might not be able to place enough monitoring plots based on the chosen grid. In this case chose a finer grid (e.g.150m mesh size) to achieve the required plot number or use the following option.

Option 2: In some instances monitoring plots need to be placed along a gradient to test the efficiency of certain approaches (e.g. “ring of death”, containing seed rain from stands) on reducing wilding conifer occurrence. In such cases the sampling intensity is slightly higher and the use of systematic plots along a gradient (seed rain from an existing stand) is a viable option. Length of transects should be 300 m with a minimum 30 m spacing between plots.

The placing of monitoring plots along a randomly placed and oriented line across the management area is in some cases a more efficient method as travel effort can be reduced. However the advantage of a balanced spatial placement of plots is lost. Distance of such a monitoring line and distance between plots (not less than 30m) should allow the placement of at least 10 plots per 100 ha.

Long term monitoring

Using permanent plots for the monitoring of wilding conifer management we can focus our measurements on the change over time that the management has on the wilding conifer population without the additional variation if new plot locations were used each time a measurement is scheduled. The change from each plot is used to calculate an overall mean change for the monitored area along with standard error and confidence limits. If managers want to detect small changes in wilding numbers than stated above (less than 60% change) a higher number of plots per area might be necessary.

Carrying out field monitoring

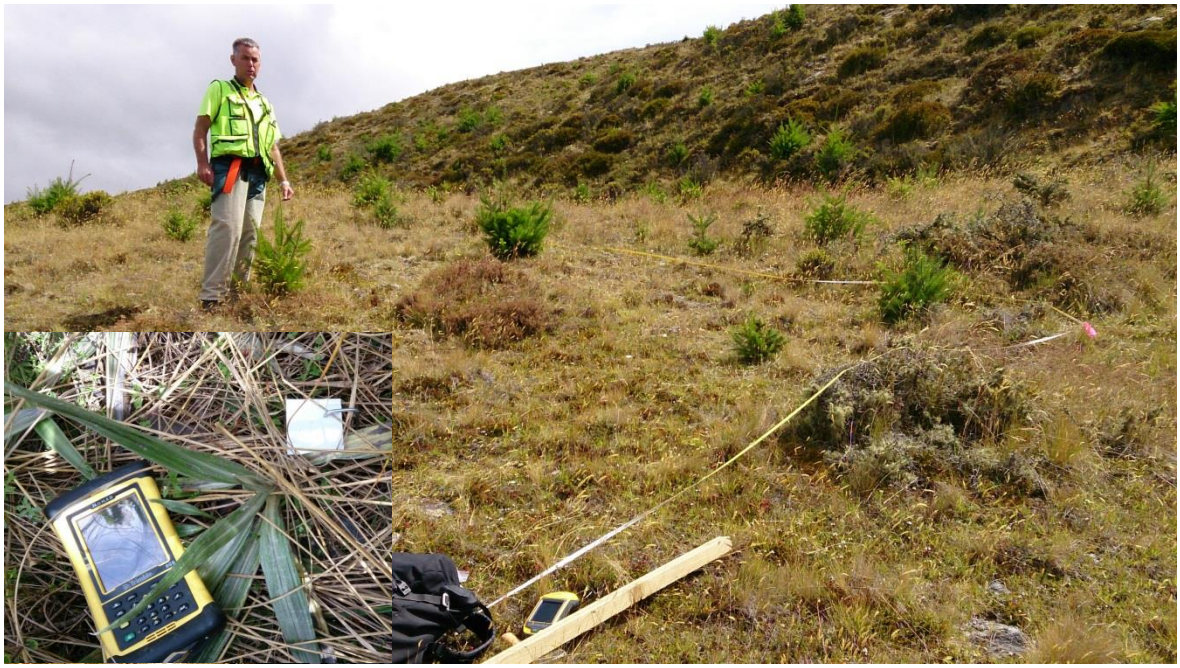
Locating and marking of monitoring plots

Handheld Global Positioning System, such as Garmin and Trimble units, are used to locate the predefined position of plots and to fix the location. For square plots, fix and record the position of a designated corner peg that is clearly marked (e.g. every uphill, right corner) with your GPS unit. For circular plots record position of centre peg. To achieve the best possible fix use the average function or multiple positioning modes and if available post-processing (e.g. Trimble).

At least 2 corners of a square plot should be marked using aluminium pegs to define the placement. If circular plot are used mark the centre point with an aluminium peg. Instead of aluminium or steel, wooden pegs can also be used (H3 treated radiata pine). State the way how plots are marked in the overall description (e.g. diagonal pegs or one side marked; Photo 1.) Use permolat, metal or durable plastic tags to mark plots with a plot number.

If plots are laid out along a defined line marking the start and endpoint with larger pegs (steel or treated timber like 4cmx4cm x130cm) aids the relocation of plots.

Photo 1. Layout of a 5m x 5m plot in short tussock grassland. Inlay shows corner with permolat.



Recording

Assessments inside laid out plots need to include the recording of each wilding tree species present and for each species the count of individual trees grouped in dead and alive and according to their height class (Table 1a)[2]. For each species, record presence of coning trees (counting coning trees or just presence). Estimate relative cover of dead and alive foliage for each wilding species inside a plot according to a cover scale (Table 1b). Additional useful variables that can be recorded for a plot to assess management success will depend on the objective. Recording the presence and cover of indigenous and exotic plant species is useful if the management aim is the restoration of previously present indigenous vegetation types. Recording of the dominant vegetation/surface cover can become useful to understand site preferences of wilding conifers when analysing the dataset. Recording a representative age range by counting whirls for a number of wilding trees of different size classes in a plot assist with interpretation of wilding establishment on sites.

Table 1: Height class (tiers) and relative cover scale for recording wilding conifer numbers and cover of wilding conifers and present vegetation.

a) Height classes (tiers) for wilding conifers		b) Relative cover scale for wilding conifer/ vegetation cover	
Tier 1a*	<0.1m	1	≤1%
Tier 1	<0.5m	2	≤5%
Tier 2	≥0.5m-1.3m	3	6% ≤ 25%
Tier 3	≥1.3m-2.5m	4	26% ≤ 50%
Tier 4	≥2.5m-5m	5	51% ≤ 75%
Tier 5	≥5m	6	76% - 100%

*Tier 1a might be additionally added (optional) to identify very recent emergence of wilding conifers

Every dataset of a plot should include the geo-reference (e.g. Lat/Long, MapGrid, NZTM) of the plot corner/centre, the used plot area (in m^2), the name of field assessor and the date of plot measurement.

[2] In some cases the number of seedlings (<50cm) might be too high to count efficiently on $25m^2$. In such cases counts for this height class can be carried out in a subplot (0.5m x 0.5m) located at the marked and geo-referenced corner.

Information Management

Reporting requirements

Collection, recording, collation and analysis of data from monitoring surveys should be carried out in an ordered way to ensure that all relevant information can be reported in an easily understood way.

Data from surveys can be send to Scion in a predefined format to allow the use of developed analysis routines. A spreadsheet with the predefined format can be downloaded from the wildingconifer website (www.wildingconifers.org.nz) . Data standards are given in table 2.

Retain all raw data records in case of disputes regarding analyses and their interpretation

Analysis

By following the steps below, the indicator “average wilding conifers density” (trees per hectare) for a management area can be calculated for each measurement period.

1) Count for each plot the total numbers of wilding conifers.
2) Sum the number of total counts per plot.
3) Divide sum of wildings counted in all plots by the sum of area of all plots (m^2) sampled and multiply by 10.000.
4) Calculate the standard error by using the standard deviation of the mean / square root of the number of plots.
5) Compare multiple measurements at the same plots over time for significant changes over time or compare different management areas in regards of their success.

Other indicators like height class distribution, % coning and mean relative cover can also be calculated.
With multiple measurements (particularly before and after control operations) the effect of wilding management in an area can be quantified (effective reduction of wilding numbers or re-invasion of a site or improvement of indigenous vegetation cover). The monitoring of a site by permanent plots should include at least one re-measure in three to five years after control. This will give stakeholders and supporters of wilding conifer programmes higher confidence in the control efforts and allow managers to plan and redirect efforts if results demands changes in how wildings are controlled in an area.

Data standards

Table 2: Recommended variables to record during field monitoring

Variable	Type	Entry	Comments
Wilding conifer species	Categorical (text)	Pine; Douglas-fir; Larch; unknown; none or detailed species.	Multiple entries allowed
Plot Area	Numerical	Size of plot in m^2	$25m^2$ or width and length of plot
Tree counts per plot	Numerical	Counts	Split in dead and live and by tier
Height tiers	Numerical (Class)	1a = ≤ 0.1m 1 = ≤ 0.5m 2 = > 0.5 m – 1.3m 3 = > 1.3 m – 2.5m 4 = > 2.5 m – 5 m 5 = > 5 m	# of wilding conifers found in this height tier
Vegetation (species or species group level)	Text	Species name	scientific nomenclature should be used
Wilding conifer or vegetation cover (%)	Numerical (Class)	1 = <1% 2 = 1-5% 3 = 6-25% 4 = 26-50% 5 = 51-75% 6 = 76-100%	Either as true % or as classes
Coning (by species)	Categorical (text)	Yes/no	
Geo-reference	Numerical (NZGD2000 Transverse Mercator)	Easting 7digits Northing 7digits	
Line bearing	Numerical	Degrees (magnetic)	Also usable to define plot orientation
Observer	Text	Name of observer	
Date	Date	DD/MM/YYYY	