



Manaaki Whenua  
Landcare Research

# Management of wilding conifers in New Zealand: Survey evidence

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## **1 Overview**

Exotic conifers are the backbone of commercial forestry in New Zealand, contributing on the order of \$5 billion to GDP each year. However, invasion by conifers that grow outside plantations, i.e. wilding conifers, is arguably New Zealand's most serious and intractable weed problem. Indeed, wilding conifers currently occupy 1.8 million hectares from Northland to Southland and may invade 20% of the country's total land area by 2050. Such growth in the spread of wilding conifers may profoundly impact our biological heritage, ecosystem services, economy, and cultural values.

As a result, land managers, government agencies and community trusts collectively spend over \$11 million each year managing wilding conifers. These efforts to manage the problem of wilding conifers are bolstered by thousands of land owners across the country who spend their own time and money managing wilding conifers on their land.

In this report, I draw on three surveys – the 2015 and 2017 waves of the Survey of Rural Decision Makers and one supplemental survey that focuses specifically on wilding conifers – to describe land owners' general attitudes toward wilding conifers, the status and source of invasions on respondents' own land, whether wilding conifers are controlled, the methods and costs of control, social attitudes toward different forms of control, land owners' support for novel control technologies and early detection methods, and sources of information and advice. The results clearly show that wilding conifers are perceived to be a serious threat and that individual land owners are a key part of a national strategy for managing wilding conifers across New Zealand.

## **2 The Survey of Rural Decision Makers (2015, 2017)**

The Survey of Rural Decision Makers (Brown 2015, 2017) covers both commercial production and lifestyle farming in all 16 regions in New Zealand. The survey questionnaire was developed with input from central government, regional government, industry groups, New Zealand Crown Research Institutes, and both domestic and international universities. The survey comprises more than 200 questions, including detailed information on ownership and farm structure; land-owner objectives; land use, land-use change, and future expectations regarding land use; land and water management practices; farm profitability; adoption of new technologies; expectations regarding climate change; pest control; farming networks, decision support, and trust; labour and employment; demographics and education; risk preferences; and land-owner values. The survey has been conducted bi-annually since 2013.

The sampling strategy relies primarily on contacting farmers through industry and sector group membership lists, the National Animal Identification and Tracing database, and previous respondents. In 2015, participants were also recruited through the Stats NZ business registry. There were 1,564 complete responses in 2013; 2,834 complete responses in 2015; and 4,488 complete responses in 2017. The sample of commercial farmers in each survey closely approximates the farming population reported in the 2012 agricultural census by geography, industry, and farmer age (Stats New Zealand 2013).

The Survey of Rural Decision Makers is conducted online. One criticism levied against online surveying is lack of accessibility, particularly for rural populations. However, approximately 80% of rural New Zealanders had home access to broadband by 2015 (a figure that is rapidly expanding under the government’s Rural Broadband Initiative). In 2017, the survey took 21 minutes to complete, on average.

In 2015 and 2017, the survey also included questions on experience with and attitudes toward wilding conifers. Specifically, the 2015 survey covered the following questions:

- 1 Whether respondents were aware of wilding conifers in their districts
- 2 Respondents’ personal attitudes toward wilding conifers
- 3 Who respondents believed to be responsible for controlling wilding conifers

The 2017 questionnaire added the following questions to those asked in 2015:

- 4 Whether wilding conifers had become established on respondents’ own land
- 5 Whether wilding conifers are controlled on respondents’ land
- 6 How wilding conifers are controlled on respondents’ land
- 7 Reasons for opting not to control wilding conifers

**2.1 Key results**

Results for the seven questions listed above are reported here. The reporting year and the number of responses is shown in each table.

- 1 To the best of your knowledge, have pine or fir trees that are not on forestry plantations become established in your district?

Awareness of wilding conifers is increasing. In 2015, 25% of respondents reported being aware of wilding conifers becoming established in their districts. By 2017, that figure had increased to 35%.

	Yes	No	Unsure	Responses
<b>2017</b>	34.94	25.93	39.14	4027
<b>2015</b>	25.45	34.13	40.42	1383

- 2 Which of the following best describes your personal attitude toward wilding conifers? (conditional on reporting that pine or fir trees had become established outside of plantations in the district)

More rural land owners became aware of the threat posed by wilding conifers between 2015 and 2017. In 2015, 23% of respondents felt that wilding conifers were more beneficial than harmful. By 2017, views had changed, with only 7% of respondents considering wilding conifers to be beneficial.

	No opinion	More harmful than beneficial		More beneficial than harmful	Responses
<b>2017</b>	14.09	64.84	14.09	6.98	1405
<b>2015</b>	9.94	67.33	Not asked	22.73	352

- 3 Who do you think should have the primary responsibility for controlling wilding conifers in your district? (conditional on reporting that wilding conifers are more harmful than beneficial)

In 2017, most respondents reported that primary responsibility for controlling wilding conifers lay with government (38%) and with land owners who were the source of the wildings (31%). Twenty two percent reported believing that primary responsibility lay primarily with the land owner onto whose land the wildings had spread. Assignments of responsibility for controlling wilding conifers was similar in 2015.

	Land owners (source)	Land owners (destination)	Government	Volunteers	Other	Responses
<b>2017</b>	30.63	21.95	37.65	0.66	9.00	911
<b>2015</b>	37.13	24.89	32.49	1.27	4.22	237

- 4 Have wilding conifers spread onto your land? (conditional on reporting that pine or fir trees had become established outside of plantations in the district)

In 2017, 21% of land owners who were aware of wilding conifers in their districts reported that wilding conifers had spread to their own farms. Five percent of respondents reported being uncertain whether wilding conifers had spread on to their own land.

	Yes	No	Unsure	Responses
<b>2017</b>	20.94	74.20	4.87	1089

- 5 Are wilding conifers controlled in any way on your land? (conditional on reporting that wilding conifers were present on their land and that the wilding conifers are more harmful than beneficial)

Among respondents who reported having wilding conifers on their farms and who considered them to be more harmful than beneficial, 83% reported that they controlled wilding conifers.

	Yes	No	Unsure	Respondents
<b>2017</b>	83.13	15.00	1.88	160

6 How are wilding conifers controlled on your land? (conditional on reporting that wilding conifers are controlled)

Among those controlling wilding conifers on their land, cutting trees (81%) and pulling seedlings (68%) were by far the most common methods of control. Treatment with herbicides (38%) and grazing seedlings by livestock (23%) were less common.

	<b>Livestock grazing</b>	<b>Seedlings pulled</b>	<b>Trees chopped down</b>	<b>Treated with herbicides</b>	<b>Other</b>	<b>Respondents</b>
<b>2017</b>	23.31	67.67	81.20	37.59	4.51	133

7 What are the main reasons that wilding conifers are not controlled on your land? (conditional on reporting that wilding conifers are more harmful than beneficial AND that wilding conifers are not controlled)

In the 2017 Survey of Rural Decision Makers, we observed very few cases in which wilding conifers were present and considered to be problematic and in which they were not controlled. The reason that was most frequently given for not controlling wilding conifers is that it was too time consuming and/or expensive (58%). However, 29% reported that reinvasion was inevitable because their neighbours do not control wilding conifers. Twenty-one percent reported that wilding conifers did not have an economic impact.

	<b>Lack of know how</b>	<b>Too time consuming/expensive</b>	<b>Neighbours don't control</b>	<b>No economic impact</b>	<b>Not interested</b>	<b>Other</b>	<b>Responses</b>
<b>2017</b>	16.67	58.33	29.17	20.83	8.33	20.83	24

### 3 Supplemental survey on wilding conifers (2017)

During winter 2018, a subset of respondents from the 2017 Survey of Rural Decision Makers were invited to complete a supplemental survey that focused specifically on wilding conifers. This supplemental survey included the following topics:

- 8 Whether own land, neighbouring land, or other land in the district had been infested with wilding conifers
- 9 When wilding conifers first appeared on respondents' land?
- 10 Land size
- 11 Where wilding conifers are found on respondents' land
- 12 Main sources of wilding conifers on respondents' land?
- 13 Whether wilding conifers were controlled on respondents' land
- 14 When wilding conifers began to be controlled
- 15 Primary reasons for controlling wilding conifers
- 16 Control methods

- 17 Factors in choosing control methods
- 18 Difficulty of controlling wilding conifers
- 19 Costs of control
- 20 Scenarios affecting management of wilding conifers
- 21 Social attitudes toward controlling wilding conifers on respondents' land
- 22 Social attitudes toward controlling wilding conifers elsewhere
- 23 Support for novel approaches to managing wilding conifers
- 24 Support for early detection methods
- 25 Professional networks for managing wilding conifers?
- 26 Sources of information and advice
- 27 Whether additional information or advice would be beneficial to land owners
- 28 Familiarity with the National Wilding Conifer Control Programme

Some 280 individuals completed the supplemental survey, including 94 respondents who had wilding conifers on their own land.

### 3.1 RESULTS

Results for the questions listed above are reported here.

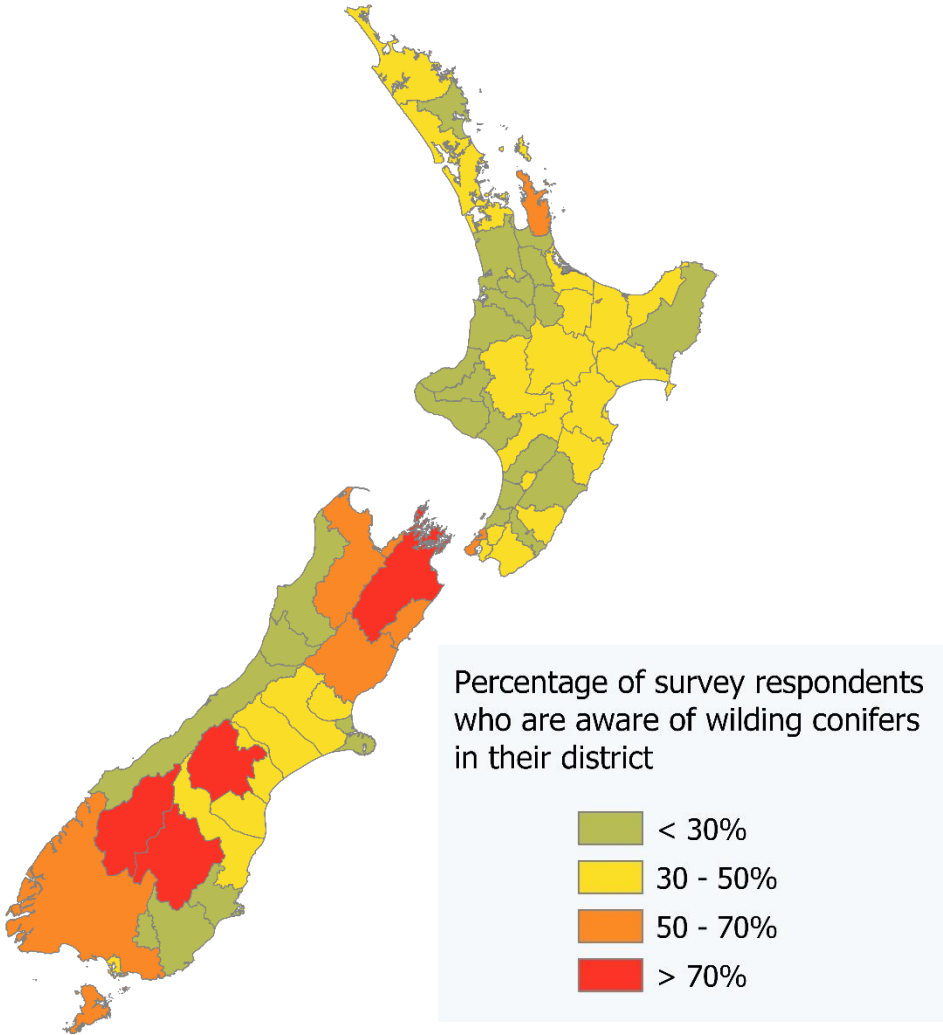
- 8 As far as you are aware, has your land, adjoining properties, or other land in your district ever been affected by wilding conifers?

One-third of survey respondents were aware of wilding conifers on their own land. In addition, one-third of survey respondents were aware of wilding conifers on adjacent land. Taken together, 44% of respondents were aware of wilding conifers on their own land or on adjoining properties. Nearly 60 percent of survey respondents were aware of wilding conifers elsewhere in their districts.

	own land		adjoining land		other land	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
<b>Yes</b>	94	33.57	94	33.57	164	58.57
<b>No</b>	176	62.86	150	53.57	56	20.00
<b>Not sure</b>	10	3.57	36	12.86	60	21.43
<b>Total</b>	<b>280</b>	<b>100</b>	<b>280</b>	<b>100</b>	<b>280</b>	<b>100</b>

The following map shows the share of respondents in each district who report being aware of wilding conifers becoming established in their districts. The highest concentrations of respondents who are aware of wilding conifers are in Marlborough, Mackenzie, Central Otago, and Queenstown Lakes. Other districts in which at least half of respondents reported

being aware of wilding conifers included Thames-Coromandel, Nelson, Tasman, Kaikoura, Hurunui, and Southland.

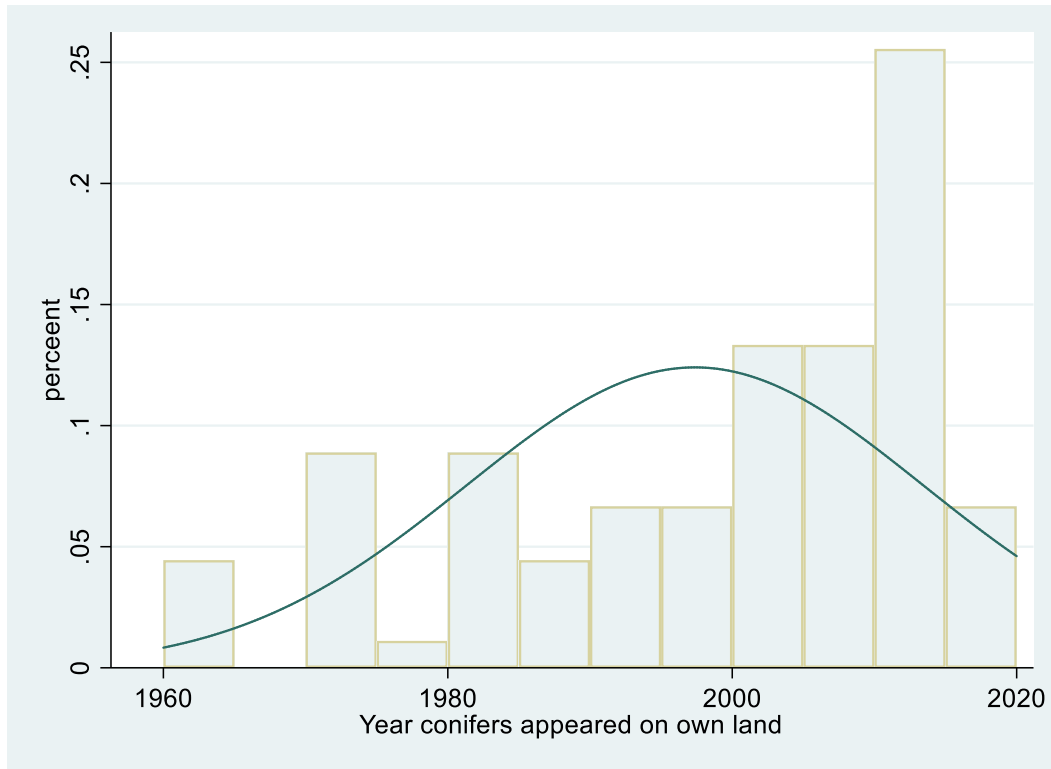


**Figure 1. Data Source: LINZ. Crown copyright reserved.**

9 As far as you are aware, approximately when did wilding conifers first appear on your land?

Nearly 5% of respondents who reported having wilding conifers on their own land recalled them being present as long ago as 1960. However, more than half of respondents were aware of wilding conifers being on their properties only since 2000 (the mean is between 1995 and 2000). The numbers of respondents noticing infestations on their land increased dramatically since the late 1980s.





10 Approximately what size is your land?

A quarter of respondents had significant land holdings of at least 50 hectares, including at least 10% with extensive holdings (>500 hectares). Most respondents had smaller properties (<50 hectares), including least 25% with lifestyle blocks (<5 hectares).

11 Where can wilding conifers currently be found on your land? And at what density?

Bush and hill country were the two most common land types among respondents with wilding conifers on their own land. Density was highest in high country and tussock/grasslands. Wilding conifers were least common in coastal areas and in pasture.

	high country		hill country		pasture		tussock/ grass		bush		wetlands		coastal	
what density	N	%	N	%	N	%	N	%	N	%	N	%	N	%
<b>Not present</b>			5	12.2	6	30.0	1	8.3	4	7.8	3	13.6	4	80.0
<b>Scattered</b>	6	66.7	33	80.5	14	70.0	9	75.0	43	84.3	18	81.8	1	20.0
<b>Moderately dense</b>	1	11.1	2	4.9			2	16.7	4	7.8	1	4.6		
<b>Extremely dense</b>	2	22.2	1	2.4										
<b>Total</b>	9	100	41	100	20	100	12	100	51	100	22	100	5	100

12 As far as you are aware, what is (or was) the main source of wilding conifers on your land?

Of land owners with wilding conifers on their land, 34% reported that these trees spread from commercial forests, whether on their own land or on others' land. A further 20% reported that their wilding conifers originated from farm shelterbelts, and 23% percent reported that their wilding conifers from individual trees and amenity plantings.

	<b>Freq.</b>	<b>Percent</b>	<b>Cum.</b>
<b>Not sure</b>	17	18.28	18.28
<b>Commercial forest (other than your own)</b>	25	26.88	45.16
<b>Historic plantings undertaken by government on land other than your own</b>	3	3.23	48.39
<b>Shelterbelt (other than your own)</b>	9	9.68	58.06
<b>Amenity plantings and individual trees (other than your own)</b>	8	8.60	66.67
<b>Commercial forest on your land</b>	7	7.53	74.19
<b>Historic plantings undertaken by government on your land</b>	1	1.08	75.27
<b>Shelterbelt on your land</b>	10	10.75	86.02
<b>Amenity plantings or individual trees on your land</b>	13	13.98	100
<b>Total</b>	93	100	

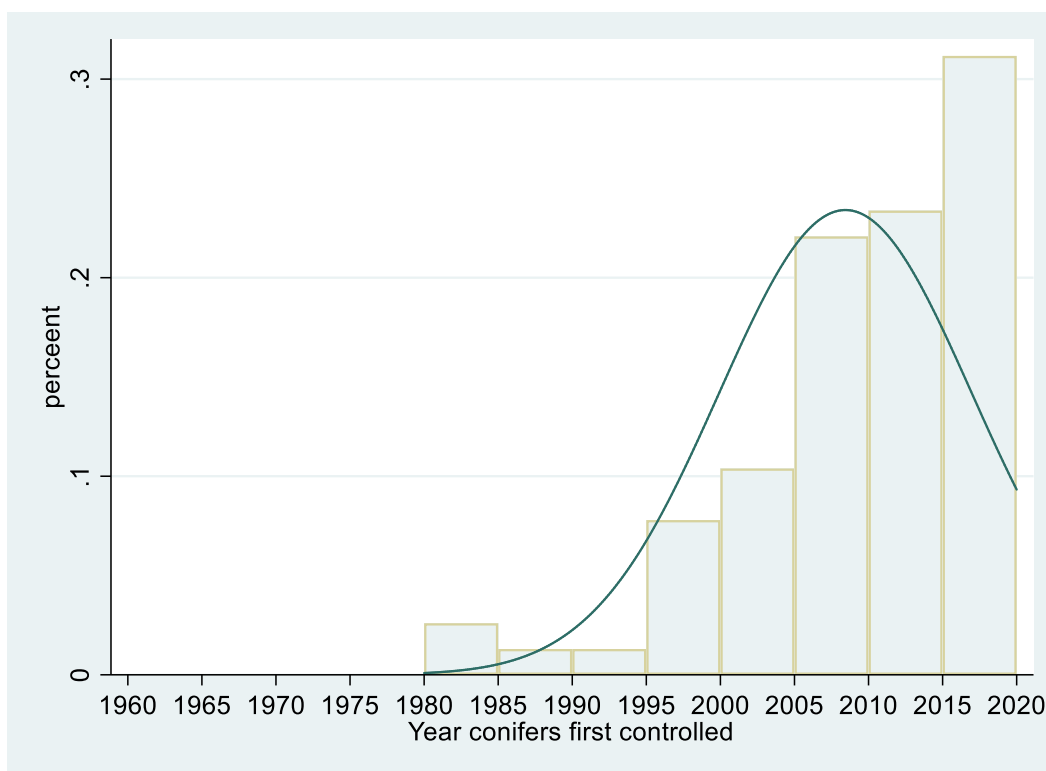
13 Are wilding conifers currently controlled in any way on your land?

Among respondents with wilding conifers on their land, 84% reported that they control them while 16% do not control wilding conifers in any way.

	<b>Freq.</b>	<b>Percent</b>	<b>Cum.</b>
<b>Yes</b>	78	83.87	83.87
<b>No</b>	15	16.13	100
<b>Total</b>	93	100	

14 Approximately when did you begin controlling wilding conifers on your land?

The mean respondent who controls wilding conifers on her/his own land began doing so between 2005 and 2010. Control has increased at an exponential rate since the mid-1980s.



15 What are your *primary reasons* for controlling wilding conifers on your land? (among those who do)

The most important reasons for controlling wilding conifers on respondents' own land were given as "Stewardship of the land/kaitiakitanga" (33%), followed by "Improving or maintaining pastures" (24%), "Protecting native species/habitats" (22%), and "Restoring native landscapes/views" (15%). "Harvesting for firewood" was cited as the least important reason for control by the majority of respondents (66%).

Least important		Most important
65.8%	Harvesting for firewood	5.1%
5.3%	Stewardship of the land (kaitiakitanga)	33.3%
21.1%	Improving or maintaining pastures	24.4%
2.6%	Protecting native species/habitats	21.8%
5.3%	Restoring native landscapes/views	15.4%

16 Which of the following methods have been used to control conifers on your land? (among those who do)

Among respondents who reported controlling wilding conifers on their own land, most used chainsaws or hand tools (74% without herbicide, 27% with herbicide) or backpack spraying (21%). Some used heavy machinery (12%), or "drill and fill" control methods for larger trees (14%). Smaller shares of respondents used targeted grazing (9%) or aerial herbicide application (4%).

	<b>Yes</b>
Backpack	20.5%
Aerial basal bark spraying	3.8%
Aerial boom spraying	3.8%
Cut stump without herbicides	74.4%
Cut stump with herbicide application	26.9%
Removal with heavy machinery	11.5%
Drill and fill	14.1%
Targeted grazing	9.0%
Changed land use (pasture conversion)	5.1%

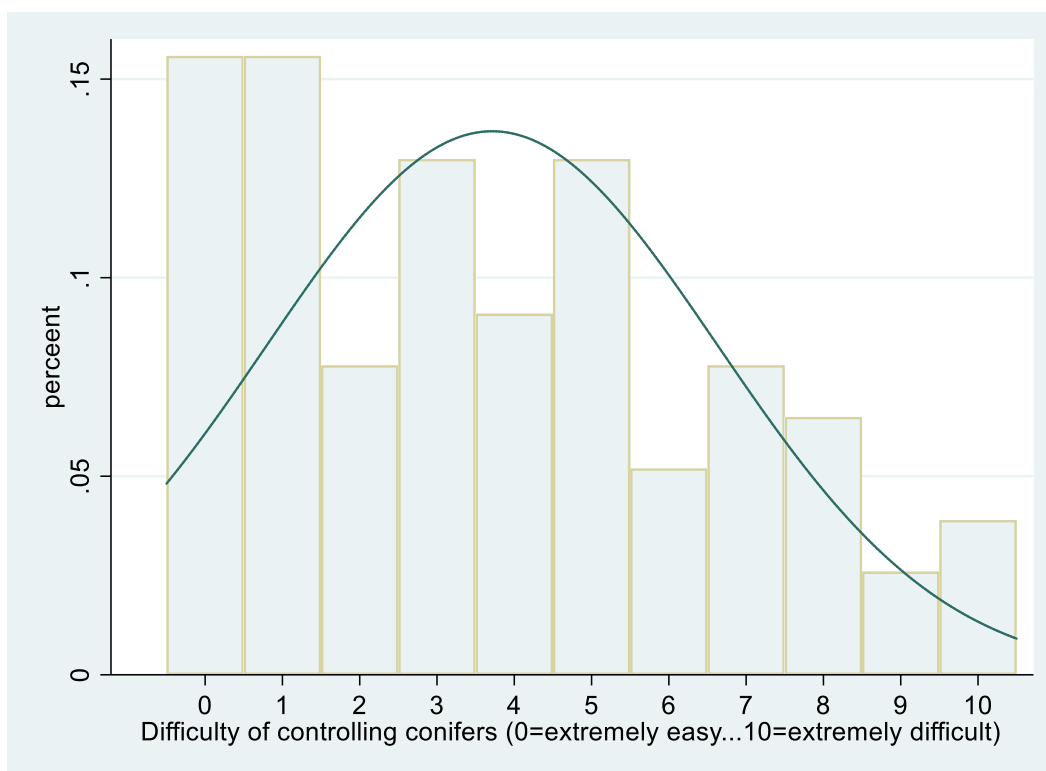
17 How important are the following factors in choosing control methods on your land? (among those who do)

“Overall effectiveness” is reported as the most important criterion for choosing control methods (47%). “Overall cost” is reported as being the least important consideration (51%).

<b>Least important</b>		<b>Most important</b>
5.2%	Overall effectiveness	46.8%
50.6%	Overall cost	13.0%
22.1%	Overall ease and convenience	24.7%
22.1%	Impacts on non-target species	15.6%

18 How difficult is control of wilding conifers on your farm considering both time and financial costs? (among those who do)

Approximately half of respondents who control wilding conifers consider their infestations to be “extremely easy” or “easy” to control. The median respondent reports that wilding conifers are “easy” to control. Only 4% of respondents consider control to be “extremely difficult”.



#### 19 Costs of control (among those who do)

In general, control costs were low. The median respondent estimated the direct costs of control to be \$40 per year, consistent with using tools already on hand to control wilding conifers. However, 25% of those who control wilding conifers on their own land reported spending over \$300 annually on chemicals, tools, and contract labour, including 10% who spend over \$2500 annually and 5% who spend over \$10,000 annually.

The median respondent also reported spending 2 person-days annually controlling wilding conifers. Some 75% of respondents who control wilding conifers on their own land spent less than 4 person-days annually controlling them. Ten percent spent more than 14 person-days annually, and 5% spent more than over 25 person-days annually.

#### 20 How would each of the following scenarios change your management of wilding conifers, if at all?

Most respondents appear to view control of wilding conifers as a substitute for others undertaking control rather than as a complement. That is, more respondents reported that they would decrease their control efforts rather than increase their efforts if neighbours increased their efforts. Similarly, if neighbours decreased their control efforts, more respondents report that they would increase their efforts rather than decrease their efforts.

The activities undertaken on neighbouring properties also strongly influenced the level of effort that respondents report being willing to spend on control of wilding conifers. For example, if neighbouring properties converted to pasture, 23% of respondents reported that they would decrease their control efforts. Conversely, if new commercial forests were

established on neighbouring properties, 59% of respondents would increase their control efforts.

	<b>Decrease my control efforts</b>	<b>No change</b>	<b>Increase my control efforts</b>
<b>Neighbouring properties increased control of wilding conifers</b>	25.00	61.84	13.16
<b>Neighbouring properties decreased control of wilding conifers</b>	3.95	59.21	36.84
<b>New commercial forests were established on neighbouring properties</b>	5.26	35.53	59.21
<b>Neighbouring properties converted to pasture</b>	22.67	72.00	5.33
<b>Co-funding became available to contribute to control</b>	9.33	64.00	26.67

21 In your opinion, how does the local community feel about management options for wilding conifers on your land? (among those with wilding conifers on their land)

Respondents who control wilding conifers considered cut-stump methods (with or without herbicide application) to have the broadest social approval. Controllers also perceived the public either supporting or being neutral toward backpack spraying, removal with heavy machinery, "drill and fill" methods, and targeted grazing. In contrast, respondents who control wilding conifers believed that the public is less supportive of aerial basal bark spraying and aerial boom spraying.

	<b>Strong approval</b>	<b>Moderate approval</b>	<b>Neutral</b>	<b>Moderate disapproval</b>	<b>Strong disapproval</b>	<b>Not sure</b>
<b>Backpack</b>	15.07	17.81	21.92	6.85	1.37	36.99
<b>Aerial basal bark spraying</b>	5.48	6.85	10.96	20.55	15.07	41.10
<b>Aerial boom spraying</b>	2.74	1.37	9.59	23.29	21.92	41.10
<b>Cut stump without herbicides</b>	31.51	20.55	15.07	1.37	0.00	31.510
<b>Cut stump with herbicide application</b>	20.55	23.29	15.07	5.48	1.37	34.25
<b>Removal with heavy machinery</b>	9.59	20.55	21.92	6.85	4.11	36.99
<b>Drill and fill</b>	15.07	21.92	19.18	0.00	2.74	41.10
<b>Targeted grazing</b>	21.92	12.33	16.44	4.11	1.37	43.84
<b>Changed land use (pasture conversion)</b>	12.50	15.28	20.83	6.94	4.17	40.28

- 22 In your opinion, how does the local community feel about management options for wilding conifers on land in your district? (among those who do not have wilding conifers on their land)

Perceptions of social acceptability of various control methods among those who do not have wilding conifers on their land were broadly similar to those who control wilding conifers on their land, with cut-stump treatments being preferred, and backpack spraying, removal with heavy machinery, “drill and fill” methods, and targeted grazing also seen as broadly socially permissible. Aerial basal bark spraying and aerial boom spraying were perceived to have the least public support.

	<b>Strong approval</b>	<b>Moderate approval</b>	<b>Neutral</b>	<b>Moderate disapproval</b>	<b>Strong disapproval</b>	<b>Not sure</b>
<b>Backpack</b>	23.81	22.22	22.22	1.59	0.00	30.16
<b>Aerial basal bark spraying</b>	6.45	9.68	16.13	16.13	16.13	35.48
<b>Aerial boom spraying</b>	8.06	9.68	11.29	20.97	19.35	30.65
<b>Cut stump without herbicides</b>	23.81	22.22	15.87	4.76	3.17	30.16
<b>Cut stump with herbicide application</b>	26.98	22.22	15.87	7.94	0.00	26.98
<b>Removal with heavy machinery</b>	8.20	32.79	14.75	6.56	9.84	27.87
<b>Drill and fill</b>	18.03	29.51	14.75	8.20	1.64	27.87
<b>Targeted grazing</b>	16.95	30.51	15.25	1.69	1.69	33.90
<b>Changed land use (pasture conversion)</b>	8.47	27.12	18.64	8.47	5.08	32.20

- 23 Consider the following approaches that have been discussed among the scientific community. To what extent would you support these approaches relative to current approaches used in your district?

Respondents were asked about the extent to which they preferred novel technologies for controlling wilding conifers to current practices. The most widely preferred technologies included “breeding sterile trees for commercial forests” (56% preferred over current practices) and “using genetic technologies to produce sterile trees for commercial forests” (43% preferred over current practices). “New technologies for aerial spraying (e.g. drones)” was preferred to current practices by one-third of respondents and biological controls were preferred by 32%. However, these practices require significantly more discussion: between 26% and 41% of respondents were unsure or wanted additional information about these practices before they evaluated them.

	<b>Less preferred than current management</b>	<b>Same as current management</b>	<b>More preferred than current management</b>	<b>Need more information/ not sure</b>
<b>Breeding sterile trees for commercial forests</b>	7.84	9.80	56.37	25.98
<b>Using genetic technologies to produce sterile trees for commercial forests</b>	19.51	6.83	42.93	30.73
<b>Biological control of wilding conifers outside of commercial farmers</b>	17.16	10.78	31.37	40.69
<b>Controlled burning</b>	55.39	19.61	6.86	18.14
<b>New technologies for aerial spraying (e.g. drones)</b>	20.69	16.26	33.00	30.05

24 Which of the following methods might you support for detecting wilding conifers on your area?

While interest in controlling wilding conifers was high among affected respondents, interest in early detection of wilding conifers was seemingly lower. Fewer than one-quarter of survey respondents supported early detection by imagery captured by drones. Only 14% supported early detection by in-person surveys and 13% supported early detection by satellite.

	<b>Support</b>
<b>ground-based, in person surveys</b>	14.1%
<b>imagery collected by satellite</b>	12.7%
<b>imagery collected by drones</b>	22.7%

25 Have you spoken to friends or neighbours about wilding conifers?

37% of respondents had specifically spoken with (an average of six) friends or neighbours specifically about wilding conifers in the previous year.

26 As far as you are aware, what are the best sources of information and advice regarding management of wilding conifers? Tick all that apply.

The Department of Conservation was identified as being a top source of information by 65% of respondents, ahead of regional councils (57%), the Internet (45%), and district councils (33%). Lesser sources of information include the Ministry for Primary Industries (21%), friends & neighbours (21%), community trusts (20%), rural supply stores (13%) and Federated Farmers (6%).



Variable	Ticked
DOC	65.35%
MPI	21.29%
friends and neighbours	21.29%
regional council	57.43%
district council	32.67%
rural supply store	13.37%
Federated Farmers	6.44%
Internet	45.05%
community trusts/organisations	20.30%

27 Would additional information or advice be helpful for controlling wilding conifers on your land?

36% of respondents reported that additional information or advice would help them to control wilding conifers on their land. Their preferred means of obtaining said information was through written materials/brochures. The least preferred method was through face-to-face advice.

Least preferred		Most preferred
40.8%	Face-to-face advice	21.9%
33.8%	Online tutorials	32.9%
25.4%	Written materials/brochure	45.2%

28 How familiar are you with the National Wilding Conifer Control Programme run through regional councils?

Less than 2% of respondents reported being involved in the National Wilding Conifer Control Programme. Some 44% of respondents had heard of the programme whereas 54% were unaware of the programme.

## 4 Conclusion

Wilding conifers are a national challenge, and individual landowners are integral to a comprehensive solution. Awareness of wilding conifers is increasing, especially among South Island land owners. Most land owners who were aware of wilding conifers on their property reported that they actively managed them, with stewardship/kaitiakitanga cited as the most common reason. Control efforts are significantly influenced by land use and control decisions on neighbouring properties, which highlights the need to address wilding conifers at a community level.

## **5 Acknowledgements**

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