Biosecurity New Zealand
Tiakitanga Pūtaiao Aotearoa

MPI 18607 Project Report

Building engagement and social licence: Survey of individuals impacted by myrtle rust

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Executive summary

The problem

In 2017 the Ministry for Primary Industries (MPI) commissioned research into myrtle rust (*Austropuccinia psidii*) to address critical knowledge gaps in social, cultural and scientific knowledge relating to the management of myrtle rust in NZ, as identified by the Strategic Science Advisory Group (SSAG). A priority research theme identified as part of this process was 'building engagement and social licence'. The overall outcome of this research is an improved understanding of the impacts of myrtle rust and response activities to help guide agencies and other decision makers involved in incursion response and long-term management of myrtle rust.

The Ministry for Primary Industries (MPI) has identified the need to understand public acceptance of current and future management options to inform decisions on research, management and communications as being critical for short and long-term management of myrtle rust.

Research aims and approach

This project, which forms part of the Theme "Building engagement and social licence" research, sought to understand public experience and acceptance of response operations and management options to inform future decisions on research, management and communication of biosecurity incursions. Understanding impacts of myrtle rust in different regions, will help build capacity to engage motivated networks and co-develop guidelines for effective partnerships and assessment of social licence for both incursion response and long-term management operations.

This report meets the third project milestone, surveying interested and impacted individuals to complement other research activities.

Activities undertaken to achieve these aims:

- An online survey to gather quantitative data on perceptions of risk associated with myrtle rust, its impacts and management options to understand issues of social acceptability.
- A survey report outlining perceptions, attitudes, and values in a regional context relevant to myrtle rust to complement other research activities conducted as part of Theme "Building engagement and social licence".

This report

This report describes results and analysis of the social license survey conducted as part of MPI project 18607, Theme "Building engagement and social licence" – engagement and social licence. It provides an overview of the design, data collection and analysis and should be read in conjunction with other Theme "Building engagement and social licence" reports. The survey has been conducted with individuals impacted across different regions affected by myrtle rust including properties with restricted property (RP) notices and callers to the Biosecurity New Zealand Government 0800 number hotline.

Key results

The results provided within this report based on a survey of affected property owners and concerned individuals include:

a. A preliminary understanding of information needs and response;

b. Social licence concerns associated with response operations;

c. An initial identification of acceptability of management options;

d. An appreciation of different values associated with myrtle rust;

e. A prioritisation of different risks associated with myrtle rust; and

f. A set of five personas associated with different responses to myrtle rust.

People are concerned about biosecurity and prepared to make sacrifices for the greater good. Many indicated a strong sense of doing everything possible to control the outbreak of the disease. However,

attention needs to be paid to how response operations are run, and particularly how people are engaged throughout the response period.

The research concluded that while people were less concerned about the timeframe of response, (most thought it was quick) the lack of a clear and consistent message from response agencies and MPI, coupled with at times inconsistent response action drew public concern. Information provided was not consistent across time.

Many of the social licence to operate concerns raised in other strands of Theme “Building engagement and social licence” research were met according to respondents, such as respect for privacy, being treated with fairness, being treated with respect. There were some areas of disagreement including on whether what they cared most about was protected, whether it was easy to raise issues or concerns, and whether their concerns were taken seriously.

There was a general acceptance of 16 potential response actions, however with a graduated acceptance for different options. At the higher level of acceptance, was the gathering of seed for conservation purposes at the top and for testing and analysing for resistance as second top. At the lower levels of acceptance was the restricted planting of myrtle plants on private property (lowest) and in public areas (second lowest).

The acceptability of potential response actions or management options are shown to be aligned with different personas, reflecting a values-based identity along with demographic characteristics. These personas provide a potential reference for designing and developing communication and engagement strategies, as well as guiding likely support for different management options.

Quadruple bottom line (QBL) value sets and factor analysis provided a reliable set of value-based data that orients different value perspective across six factors capturing social, cultural, socio-cultural, environmental, environmental equity, and economic value items. Whilst this extends beyond four value bases (Donovan 2008), it does contain them. Based on these data sets we have generated a map of graduated value orientations for the population sampled residing across all regions of New Zealand.

Implications of results for the client

This report provides mostly quantitative evidence for social licence conditions as well as different values orientation associated with various response actions, with underpinning qualitative statements from survey respondents about positive and negative aspects of the response. Acceptability of different management options has been aligned with different personas (identities based on demographic and value-based data gathered). This evidence should be considered in the context of the qualitative evidence collected as part of other Theme “Building engagement and social licence” research, particularly for developing capacities for building social licence and engagement.

The following recommendations are covered in more detail in the full report.

- Understand the range and importance of different values relevant to myrtle rust and other potential biosecurity operations, and how they influence management actions across different responses to develop appropriate communication and engagement strategies
- Use personas to characterise different types of audiences and develop appropriate measures and messages for engaging them by focussing on their values and what concerns might influence SLO
- Understand how SLO concerns influence impacted communities and use this knowledge as a basis for developing operational plans and engagement of communities that are interested or impacted by short, mid, and long term response operations.
- Support management teams and strategic response operations including long term management in interpreting these results to design and development community engagement and partnerships.

Whilst there is a strong support for incursion response and good evidence of social licence there are some concerns that relate directly to the expectations and maintenance of interest in biosecurity.

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1 Project background

To better understand myrtle rust and limit its impact in New Zealand, the Ministry for Primary Industries commissioned a comprehensive research programme in 2017 with more than 20 projects valued at over $3.7 million. Projects in this programme were completed by June 2019.

The projects covered research in the following themes:

- Theme 1 - Understanding the pathogen, hosts, and environmental influence.
- Theme 2 – Building engagement and social licence: Improved understanding of public perceptions and behaviours to allow better decisions about investment, improved design of pathway control strategies and maintain social license for use of management tools.
- Theme 3 – Te Ao Māori: Greater understanding of Te Ao Māori implications of myrtle rust in order to support more effective investments, and improved use of Mātauranga, specific Māori knowledge, and kaupapa Māori approaches in management regimes.
- Theme 4 – Improving management tools and approaches: Improved diagnostic and surveillance speed, accuracy and cost-effectiveness, supporting eradication efforts and enabling scaling up of surveillance efforts for a given resource. More effective treatment toolkits to avoid emergences of MR resistance to treatments and to enable disease control over increasingly large scales that will lead to reduced or avoided impacts.
- Theme 5 - Evaluating impacts and responses: Improved understanding of environmental, economic, social and cultural, impacts to inform risk assessment and management and to communicate implications to decision/makers and stakeholders.

This report is part of the MPI commissioned research under contract MPI18607 which addressed research questions within Theme 2, 4 and 5.

Text in the report may refer to other research programmes carried out under the respective theme titles.

2 Introduction

Following the detection of myrtle rust (*Austropuccinia psidii*) into New Zealand in April 2017, the Ministry for Primary Industries (MPI), the agency responsible for biosecurity incursions, and the Department of Conservation (DOC), with the help of local iwi, the nursery industry, and local authorities, ran a year-long operation to attempt to contain and control myrtle rust and determine the extent of its spread (MPI, 2018). Since mid-May 2017 more than 5,000 myrtle plants have been removed and destroyed, and more than 95,000 myrtle plants inspected (MPI, 2018). However, in April 2018, MPI decided that eradication was not possible and announced that it was moving from incursion response into long-term management.

In October 2017 MPI commissioned research into myrtle rust to address critical knowledge gaps in social, cultural and scientific knowledge relating to the management of myrtle rust in NZ, as identified by the Strategic Science Advisory Group (SSAG) (MPI 2017a). 'Building engagement and social licence' was identified as one of the priority research areas. The intended outcome of this research was to improve understanding of the impacts of myrtle rust social licence to operate (SLO) and related engagement activities to help guide agencies and other decision makers involved in incursion response and long-term management of myrtle rust.

As at 6 April 2018, myrtle rust had been detected on 547 properties across 9 regions: Northland (4 properties), Auckland (82), Waikato (61), Bay of Plenty (123), Taupō (5), Taranaki (233), Manawatu (3), Wellington (34), Tasman (2). By this time, more than 540 properties were known to have been infected by the fungal disease since it was first detected on mainland New Zealand in May 2017. Since then, more than 5,000 myrtle plants had been securely removed and destroyed, and more than 95,000 myrtle plants inspected as part of the official incursion response which came to an end in April 2018 (MPI, 2018).

As part of Theme "Building engagement and social licence" a survey was conducted for mapping community perspectives from those who were interested in or impacted by myrtle rust. The survey was developed by the researchers (report authors) in consultation with key stakeholders to ensure data collected could inform engagement and social licence aspects of biosecurity operations.

The survey was conducted with people who called the '0800' hotline to report or request information about myrtle rust and those whose properties were restricted during response operations. The survey was administered by AsureQuality from October to November 2018, six months after the MPI decision to transition to long term management of the disease.

Regional-based data were collected for mapping perceptions, attitudes and values to complement the data collected from other Theme "Building engagement and social licence" activities including a case study based in Taranaki, a set of interviews with motivated individuals involved in the response, and development of rubrics (performance assessment and management tools) for social license and partnerships. Existing survey data and findings addressing biosecurity and pest management options from previous research reviewed did not deal specifically with myrtle rust, e.g., DOC and MPI surveys (McDonald, 2017; Colmar Brunton, 2018).

This strand of Theme "Building engagement and social licence" research was conducted to address this gap in knowledge. Three steps were taken.

1. Design of a survey instrument (questions and delivery method) with input from key stakeholders to respond to areas of interest (AsureQuality and MPI were engaged for this).
2. Survey implemented across all impacted regions and also captured respondents from other regions who had made calls to the '0800' number. This covered regions where the response efforts were both triggered by MPI, and also those that had not yet been triggered.
3. Analysing survey results to address key questions posed by stakeholders and other inputs from our Theme "Building engagement and social licence" researchers where applicable (this process included quantitative and qualitative analysis).

2.1 Developing and using personas

Personas are abstractions of groups of real target audiences who share common characteristics and needs (Pruitt & Adlin 2006). By identifying their distinct preferences or needs, they begin to

reveal what is personally meaningful to individuals in each group. Personas can help biosecurity teams to create different communication and engagement designs for different kinds of people and to design for a specific somebody, rather than a generic everybody.

Several New Zealand studies have used market segments (related concepts are sometimes termed personas or typologies) to help understand and engage with the public around incursion response or biosecurity issues. For example, a study by McDonald et al (2017) found four main public perspectives around biological pest control technologies; and a Colmar-Brunton (2018) study used a personality type matrix to evaluate attitudes to biosecurity. Personas have been used in marketing over the past decade to help design products with a specified target market segment in mind, ensuring suitability of products for the market segment, and in a similar way, government messaging around public issues such as biosecurity can benefit from such design using targeted persona groups.

Our study is tailored for myrtle rust, and we have built personas using an approach based around identifying generic values statements (Donovan, 2008) along with myrtle rust response specific statements, and then checking the data for alignment to demographic characteristics of respondents. Several prior studies have shown the value in managing either action or communication by segmenting the population based on character type. In the past, marketing segments were usually specified from combination sets of demographic values (mixes of ethnicity, income, age, residence, etc), however, modern evidence suggests decisions and attitudes are more strongly driven instead by personal values (i.e. psychographics), with demographics as mediators.

Instead of using matrices and cluster analysis techniques, our personas were primarily devised through Q-Sort methodology around value statements, and then further tested with ANOVA to find mediating demographic variables that helped to differentiate each persona type.

2.2 Outputs

The survey has gathered data on aspects of the response including social licence of the response operations; the ranking of importance of potential impacts; and acceptability of possible response actions. Further statistical analysis was conducted to include factor assessment on value statements across the quadruple bottom line (QBL) resulting in six values clusters and collated with demographic data and management actions to generate five personas or characterisation of identities across the survey responses.

This report summarises key areas of prioritisation, acceptability of various management options, values impacted by myrtle rust, and social licence to operate concerns. Linear regression analysis conducted across the values statements to show that females care more about environmental, social and cultural values than males, and that Maori care more about values than Asians (except for economic values).

A set of personas generated based on 43 values statements showed a majority associated with persona 4. Significant differences found between means of personas for certain possible response actions provide a guide for strategic response development. Persona 5 is less accepting of response actions than other personas.

2.3 Outcomes

The overall outcome of the project is an improved understanding of the impacts of myrtle rust and response activities to help guide agencies and other decision makers involved in incursion response and long term management of myrtle rust.

Specific outcomes arising from this research strand are:

(i) Improved understanding of impacts and perceptions of response operations and their effectiveness for managing social aspects of myrtle rust
(ii) Supporting those involved in long term management operations with understanding of values and their alignments in different regions
(iii) Understanding of different audiences (and their acceptance of management options) improving the ability to provide targeted messaging through accounting for different values of community members affected by myrtle rust management.

3 Materials and methods

A survey instrument was designed by Scion and Manaaki Whenua Landcare Research researchers with input from practitioners involved in responses operations and stakeholder engagement from AsureQuality and Ministry of Primary Industries. The survey was pilot tested on other researchers not involved in pest incursion and management before being finalised. Database entries of call centre callers and those with restricted property (RP) notifications were surveyed. The survey was administered by AsureQuality with two reminders sent to maximise the response rate.

Table 1: Summary of areas of question covered by the survey

Section 1	Communication	Quality of communication and engagement between the regulatory authority and community, including initial contact, timeframes, response action and information provision
Section 2	Social licence	Aspects of response operations dealing with social licence, e.g., fairness, privacy, respect, concerns
	Acceptability	Level of acceptability for potential response actions or interventions to control myrtle rust
	Impacts	Potential impacts of myrtle rust on values and outcomes that are important to the community
	Risk	Perception of the community to potential risks posed by myrtle rust
	Values	Values in general, important for the community – reflecting areas of social, cultural, environmental and economic impacts - that are worthy of protection
Section 3	Demographics	Demographic data including age, gender, education, and ethnicity

The survey was partitioned into three sections and concluded with collection of demographic data for analytical purposes. The first section was designed to help participants recall the events and collected data on information provision and its adequacy prior to and after initial contact was made with the individual. Who initiated contact, responses timeframes and actions were also asked about.

The next section dealt with social licence aspects of response operations, the acceptability of possible response (including longer term management) actions, potential impacts of myrtle rust on values, and ranking the importance of 12 potential impact risks. This section also captured participants levels of agreement with different value statements across the quadruple bottom line (social, cultural, environmental and economic) of impacts and response.

Finally, demographic data was collected on where people resided, their ethnicity, gender, age and education, which we present first to show the characteristics of respondents and highlight bias in the data compared with the overall New Zealand population.

Income data was gathered to help construct the persona types but otherwise not reported.

4 Results and discussion

A pool of potential respondents from the listings of restricted properties (RP) (n=160) and call centre (n=1788) data were contacted by email inviting them to respond to the survey. A total of 451 (451/1948) responses were received (23% response rate) from the combined pools, 38 (38/160) of which were from those subject to a RP notification (24% response rate).

Table 2: Interest in myrtle rust

Answer Choices	*Responses*	
I am a member of the public with interest in, or affected by, the myrtle rust response operation	328	73.54%
I am a member of an industry group that has been, or could be affected by myrtle rust	36	8.07%
I am a government employee who is involved in the myrtle rust response operation	22	4.93%
I am a member of a community group (School; reserve committee; neighbourhood group)	18	4.04%
I am a member of an interest group that is, or is likely to be, affected (garden group; conservation group)	24	5.38%
Other (please specify)	78	17.49%

Almost three quarters of respondents were members of the public with an interest in or affected by the myrtle rust response operations (74%). Others identified their interest in myrtle rust as a member of an industry groups (8%), a government employee involved in the response (5%), a member of a community groups such as a school or reserve committee (5%), or a member of an interest group such as a conservation or garden group (5%).

For those who identified themselves as part of an industry, community or interest group, we asked to nominate that group. Thirty-eight responded and the following groups were named including several schools groups (n=2), contractors (n=1), feijoa grower (n=2), horticulture (n=6), arborist (n=2), guardians (n=1), nursery/ garden (n=6), neighbourhood/ reserve (n=2), restoration (n=2), plantation (n=1), flower (n=1), export (n=1), farm forestry (n=1), science (n=2), parks (n=1), and a zoo (n=1).

For those who had restricted property notices applied, most who responded had the notices applied in Auckland (n = 11), followed by Bay of Plenty (n = 10), Taranaki (n = 8) and Waikato (n=5).

Table 3: Location of restricted property notifications

Answer Choices	*Responses*	
Northland	1	2.63%
Auckland	11	28.95%
Waikato	5	13.16%
Bay of Plenty	10	26.32%
Taranaki	1	2.63%
Manawatu-Wanganui	1	2.63%
Wellington	1	2.63%
Canterbury	1	2.63%

4.1 Demographics

4.1.1 Residence

Most of the respondents came from Auckland (n, %?), although other impacted areas (list and %) and some callers from outside of impacted areas responded to the survey (see Appendix A). A wider regional coverage was achieved making the survey suitable for national analysis.

4.1.2 Ethnicity

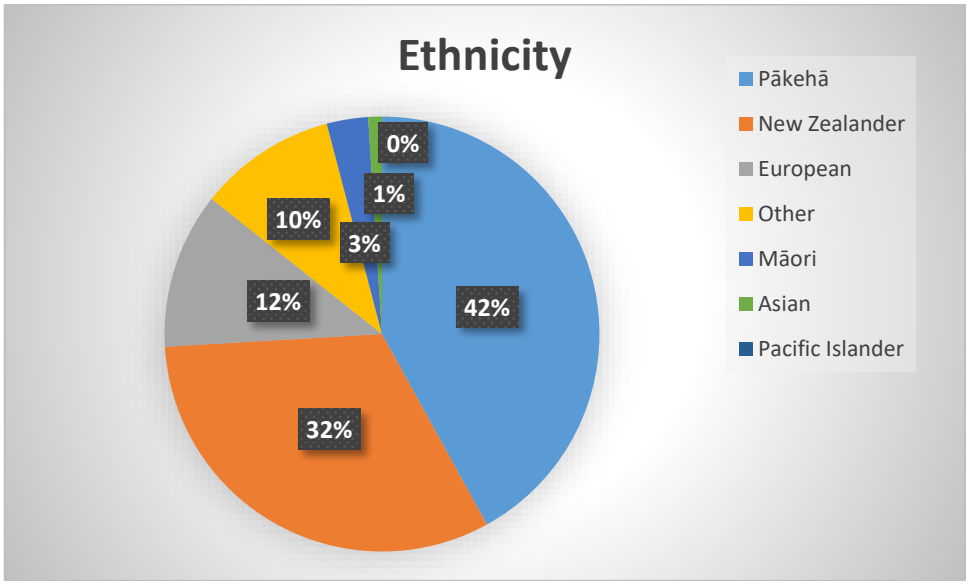


Figure 1: Ethnicity respondents identify most with

Respondents were asked which ethnicity they most identified with. Almost three quarters of the respondents identified mostly as Pakeha (42%) or New Zealanders (32%), whilst a very small proportion identified primarily as Māori (3%), Asian (1%) and Pacific Islander (<1%).

4.1.3 Gender

There were a higher proportion of female to male respondents with 56% female and 42% male and 2% that preferred not to say.

4.1.4 Age

Most respondents were aged between 65 and 74 (29%), with all age groups represented through the survey. A higher proportion of the respondents were aged 55 and over (64%), making the data less representative of a younger demographic.

4.1.5 Education

Predominantly respondents had some university training with a bias in the results toward higher levels of education. Over 33% of respondents had completed a post-graduate course. Very few participants had lower levels of education; only 8% had left school at Year 12-13 and 6% left school at Year 11 or earlier.

The respondents were not representative of the New Zealand population, with a higher level of education, an older age range and comprised more women than the general population (Statistics New Zealand, 2016, see Appendix G). The ratio of ethnicity was also out of balance with the general New Zealand population, with our respondents being a much lower proportion than expected of Maori, Polynesian and Asian respondents, and a much higher proportion of both Pakeha/New Zealander and those of other ethnicities. This is not surprising as the survey was an online survey and only sent to those on the two databases with an email address.

4.1.6 Citizenship

Almost all the respondents were New Zealand citizens (90%) and some were permanent residents (9%). A very small percentage were citizens of another country (1%)

4.2 Initial contact

Most (87%) had contacted a government representative about myrtle rust. Just over 5% were contacted by a government representative. Other responses included contact from friends, local community groups, neighbour, attending field training, google, calling the 0800 number, sending in a photo, industry group, member of the public, regional council, finding suspicious leaf damage, showing a representative from a research institute, facebook, local company or company was contracted, and postal information.

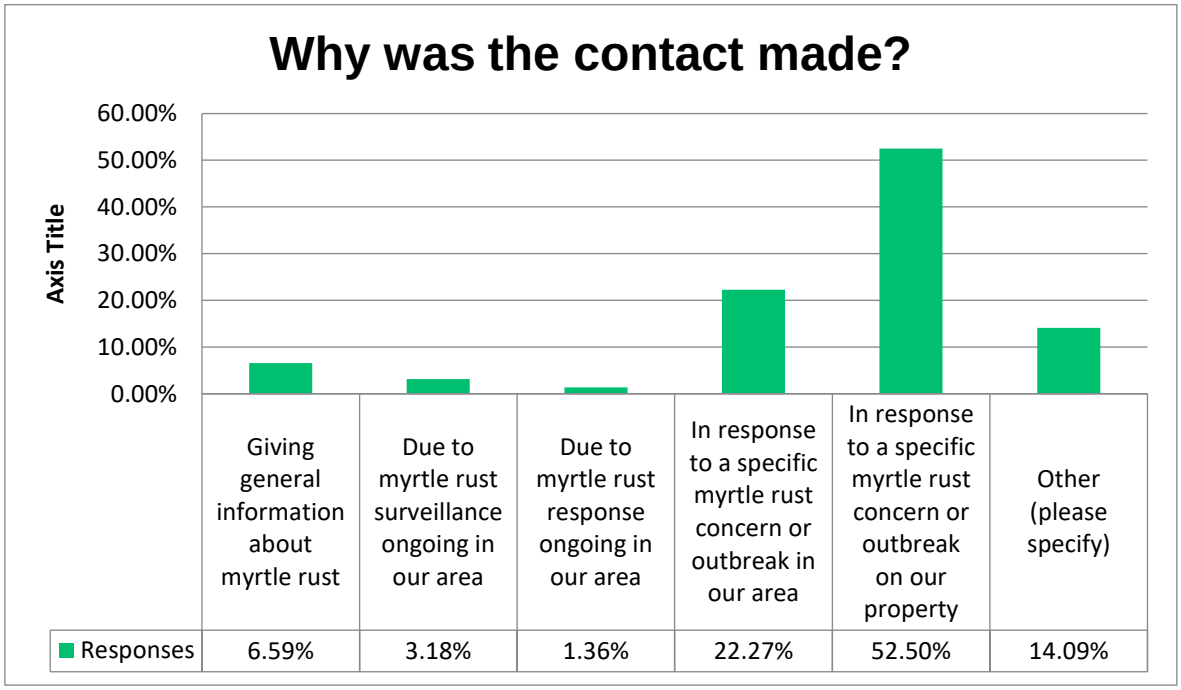


Figure 2: Why contact was made

Most (90%) of the initial contact occurred via phone call or txt message. Almost three quarters of respondents made contact due to a concern or outbreak in their area (22%) or on their property (53%). Ten per cent made contact due to myrtle rust surveillance or response in their area (3%) or seeking general information (7%).

Other reasons offered included finding spore or suspicious signs on plants, purchases made from an infected nursery, wanting to know where it had been tracked locally, seeking support for identifying myrtle rust, concern about local myrtle trees on public/ private land, and to become part of the response team.

4.3 Timeframes (for RPN respondents only)

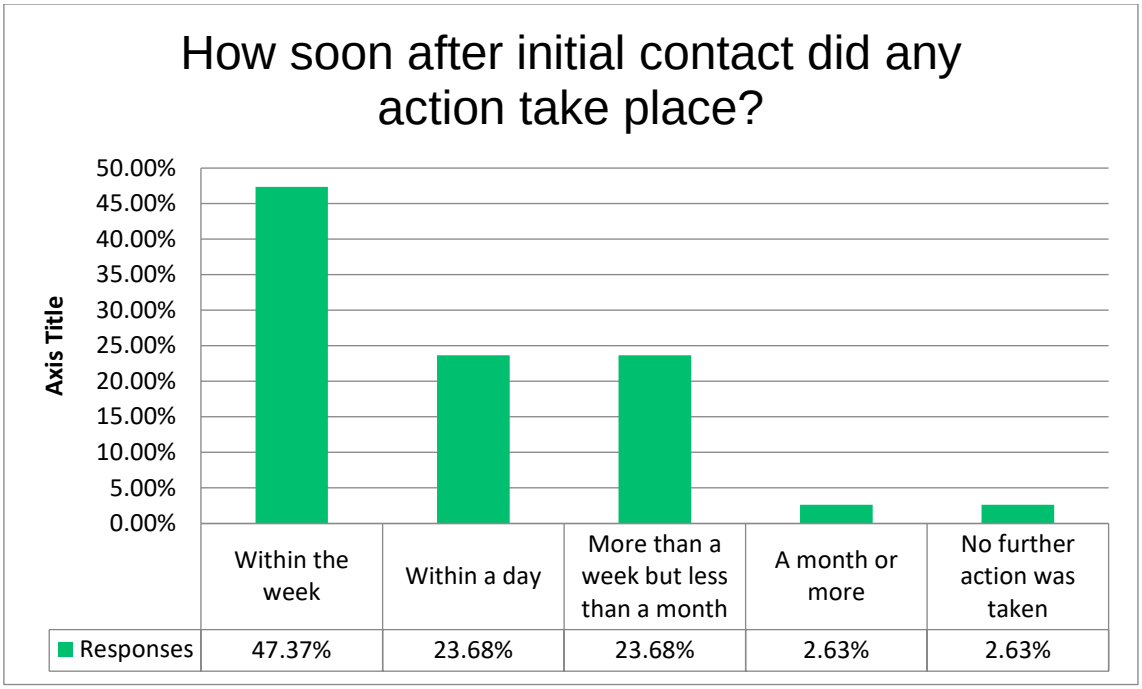


Figure 3: Timeframes from initial contact to action taken

Most action took place within a week (47%) of making initial contact, within a day (24%) or longer than a week but within a month (24%).

A large percentage (82%) of the contact for those receiving a restricted property (RP) notice was multiple times. The average acceptability rating for timeframe of response by those receiving a RP notice was 5.92/ 10, where 0=not at all acceptable to 10=very acceptable

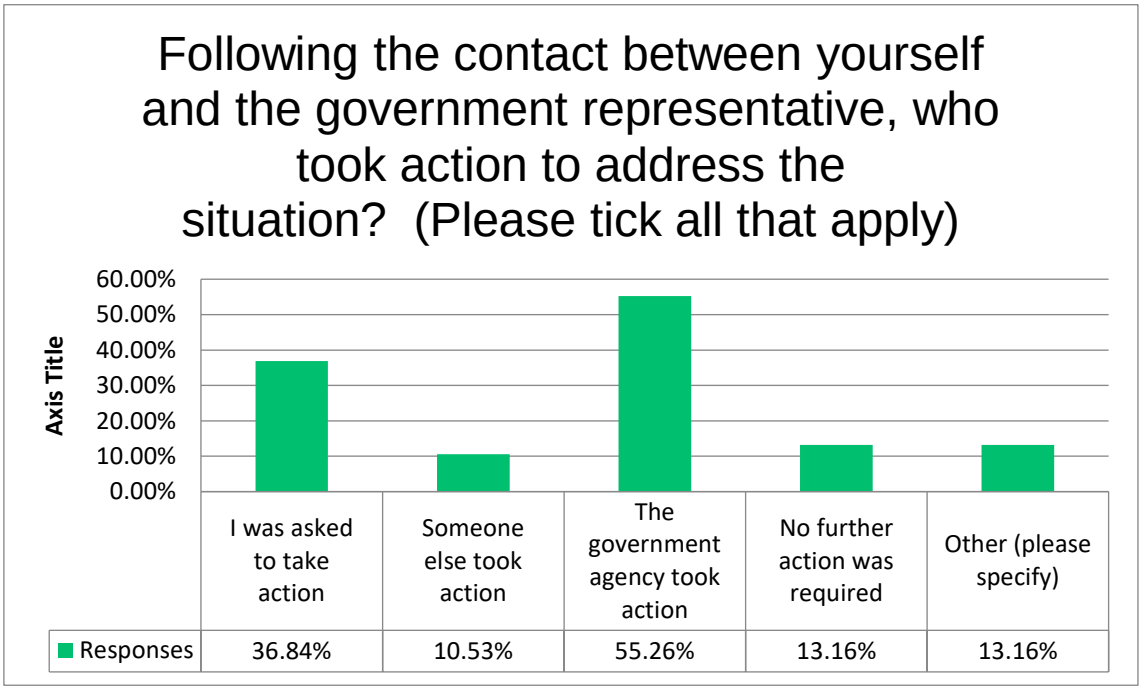


Figure 4: Who took action to address the situation

Most of the action taken was by the government agency (55%), but more than a third of respondents were asked to take action (37%). Just over ten per cent said someone else took action and 13% said that no further action was required.

4.3.1 Qualitative aspects of acceptability of timeframe

Twenty-seven respondents commented on the acceptability of the timeframe, with some of them (n=5) providing positive comments about the timeframe including 'immediately, quick, very quick, prompt, within an hour, good' and so on. Others had mixed responses (n=5) with initially a 'good, excellent' response and then not having any follow up, with plants waiting for removal, and delays in diagnosis. One had a bad experience to start but things did get smoothed over:

(i) No contact for three days after ringing HOTLINE (no field persons working over the weekend)
(ii) *they calmed all my concerns so smoothly and actioned straightaway*

However twice as many (n=10) had less positive experience with having contractors not showing up and having to follow up themselves, problems with quality of operations and then delays for replacement crews. A small number of these were displeased with the delay and lack of urgency.

(i) We initially advised MPI we had plants from a nursery that was later infected and closed down in 2017 - there was zero follow up or preventative actions taken. Once we subsequently discovered myrtle rust at our property and reported it, there were multiple people/agencies, they did not seem to share information - information I had initially reported was not passed on to others. There was no initial sense of urgency

(ii) I identified the myrtle rust myself, phoned the MPI and sent them a digital photo as requested, that was confirmed as positive. After 4 or 5 days i was again contacted and confirmed infestation with information that further contact to be made. Another 4 or 5 days elapsed before another phone call with details of proposed contractor inspection and, isolation and clean up procedure. In the meantime I got sent the legal documentation via email that I needed to respond to. Over a week after reporting the contamination a team arrived at my property entrance.

Others noted inconsistency of information.

(i) An MPI employee who was friends with our immediate neighbour had been checking our trees whenever he was next door. He notified us that he suspected our Ramarama was infected and told us that he would report it and that we didn't need to contact MPI. We heard nothing from MPI for at least a week so then I called the contact number. Was then told I needed to provide photographic evidence which I submitted on 21 Feb 2018. It was then 2 weeks before we were advised of what action we were to take.

(ii) Our report was in the "self management" time so I knew I was on my own, just wanted to know what we planned to do was within the biosecurity laws but the RPN was clear.

Some related to the change in tack moving from eradication to containment.

(i) I had 6 plants infected with myrtle rust. I notified MPI on 19/02/18 and it took until 22/02/18 for any MPI staff to turn up. And then they only inspected and photographed. No plants were bagged, contained, isolated, etc. More spread could have occurred. However, by this stage I think MPI was just about to give up on trying to stop it's spread in Taranaki.

(ii) It was during the period when the media focus was changing from eradication to "containment" and I expected the response to be more urgent like next day a team comes around to take the bush away and to inspect the rest of our property at least

Many (n=9) had neutral responses with no expectations, not much communication, no further action needed, had forgotten about it or could not recall.

4.4 Response taken (RP notification respondents)

For those receiving restricted property notifications, most had infected plants removed from the property (68%), fewer were given management advice (53%) and fewer again had suspected plant tested or monitored (42%). Twenty-one percent had healthy plants removed or tested or monitored,

and eighteen percent had health plants treated as a precaution. Eight percent had infected plants treated by not removed.

Table 4: Actions that took place on RPs

Answer Choices	*Responses*	
No action was taken	5	13.16%
Management advice was provided	20	52.63%
Suspected plants were tested or monitored	16	42.11%
Healthy plants were tested or monitored	8	21.05%
Healthy plants were treated as a precaution	7	18.42%
Infected plants were treated but not removed	3	7.89%
Infected plants were removed	26	68.42%
Healthy plants were removed	8	21.05%
Other (please specify)	4	10.53%

4.4.1 Qualitative aspects around acceptability of response

In addition to asking about the actions that occurred we asked for more details to describe what happened. We also asked how acceptable those actions were on a scale from 0-10 where 0=not at all acceptable and 10=very acceptable. The average rating for acceptability of the response taken was 6.13/10.

We then asked people to comment on the reasons for the acceptable/unacceptable response.

Respondents' reasons for the acceptability/ unacceptability of the response varied with ten positive comments, eight neutral, and 18 negative comments. Positive comments were generally reflective of the importance of responding, understanding 'the necessity to try and contain this disease', 'didn't feel doing nothing was an option', and 'to try and stop the spread of spores'. Others were generally 'happy with the collection process', 'response was quick and acceptable', 'found MPI emergency phone very helpful' and 'they replied, replying was worth it, very satisfactory', and 'the person was amicable'.

Negative comments were related to the lack of follow up including not being able to get waste removed', being 'left to chase up what was happening', and 'being left with bags that they hadn't picked up'. Others were concerned about the competency of operators

(i) *Was obvious to us that MPI had completely lost control of the spread of Myrtle Rust. Slow response/action advice times. Strong winds would have been spreading the fungal spores. Under-resourced as using off-season meat inspectors from Napier area as Myrtle Rust spotters.*

While some were happy with the response decisions, others thought there were flaws in judgment which increased the risk of myrtle rust contamination.

(i) *Wheelie bins were provided for some properties, random tests took place, badly infected plants were to be removed but never were as residents in the street threatened to sue MPI, so MPI gave up and it was all a waste of time and money.*

(ii) *Total spraying of home, gardens, all other nursery stock with contaminated tank and no knowledge of the chemical and its certified uses.*

(iii) *No effort by MPI staff to isolate, contain or remove plant material during inspection. No instructions received on best way to remove material into bags until after job was done and MPI had remove the bags.*

Some were also concerned about the lack of follow up to collect contaminated materials or to provide advice.

(i) *I wasn't informed that I could place the green-waste in black plastic bags and leave them in the sun until after I had already filled a number of provided wool sacks and they had informed me that they wouldn't be picking them up any longer.*

(ii) *I can't afford to dispose of these woolsacks so will have to manually empty them on my property again (the waste from the infected tree has already been removed).*

(iii) *I have had no follow up to confirm whether the section is now infection free.*

On the positive side people were unfussed or generally happy with the way the operations were conducted. The importance of acting on the disease and processes of collection and disposal were welcome. Positive responses also included the amicable nature of personnel and the speed with which they operated.

(i) *We were the first outbreak in Auckland and we understood the necessity to try and contain this disease.*

(ii) *From the advise I was given, there was no known treatment for the plants and I didn't feel doing nothing was an option. For me the plants were only a few years old so it wasn't a big deal to remove them.*

(iii) The trees were clearly infected and needed to be removed to try and stop spread of spores.

(iv) I was happy with the collection process.

(v) I was given plastic bags to dispose of all rubbish and these were collected at my bidding. Other suspected plants were tested in the property (Feijoa etc) and I found MPI emergency phone very helpful.

(vi) Response was quick and acceptable

(vii) The survey and removal of plants was well carried out albeit by different teams on different days

(viii) I sent it in and they replied, replying was worth it, very satisfactory

(ix) Well its now obvious that the disease is not containable so the approach is the sensible one

(x) They were clear and concise. The personal was amicable.

However, people that were neither particularly troubled or supportive of the operations did have concerns about the uncertainty in the process, the delay in taking plants away, and a lack of information from individual property level interactions.

(i) There seemed to be a considerable amount of uncertainty in the process

(ii) The time frame was extended over a couple of months because of trouble getting containers and trucks to take the plants away

(iii) my neighbourhood was inspected I seemed to be the only one affected

(iv) If you mean initially, everything was dealt with swiftly and professionally. It was when I came to remove plants that the process stalled because of lack of info from the person I was dealing with

(v) The response was good apart from it not being easy to get waste removed.

4.5 Information provision

Respondents with RP notices were asked about what information they received for various actions including verbal, written or both (Table 4). This information included management advice (n=19), testing and monitoring healthy (n=7) or suspected plants (n=14), treating healthy (n=6) or infected plants (n=1), and removing healthy (n=7) or infected plants (n=22). Most information given related to infected plants being removed or management advice. Information was also given around testing or monitoring suspected plants.

Table 5: Verbal and written information given about various actions taken

	Written information only (something to read)	Verbal information only (spoken)	Both written and verbal information	No information given	Total
No action was taken	3	1	1	0	5
Management advice was provided	2	1	16	0	19
Suspected plants were tested or monitored	1	4	9	0	14
Healthy plants were tested or monitored	1	2	3	1	7
Healthy plants were treated as a precaution	0	3	3	0	6
Infected plants were treated but not removed	0	0	1	0	1
Infected plants were removed	3	4	15	0	22
Healthy plants were removed	0	2	4	1	7
[Insert text from Other]	2	2	0	0	4

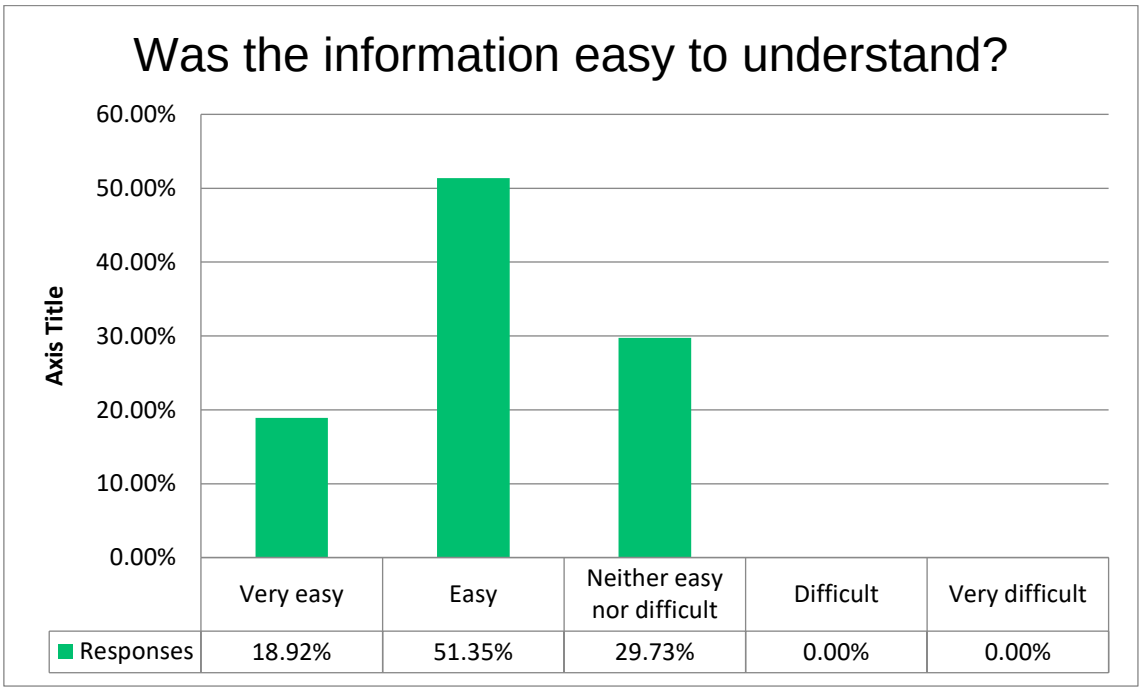


Figure 5: Ease of understanding information provided

Most of the respondents found the information provided easy (51%) or very easy (19%) to understand. The remainder found it neither easy or difficult (30%).

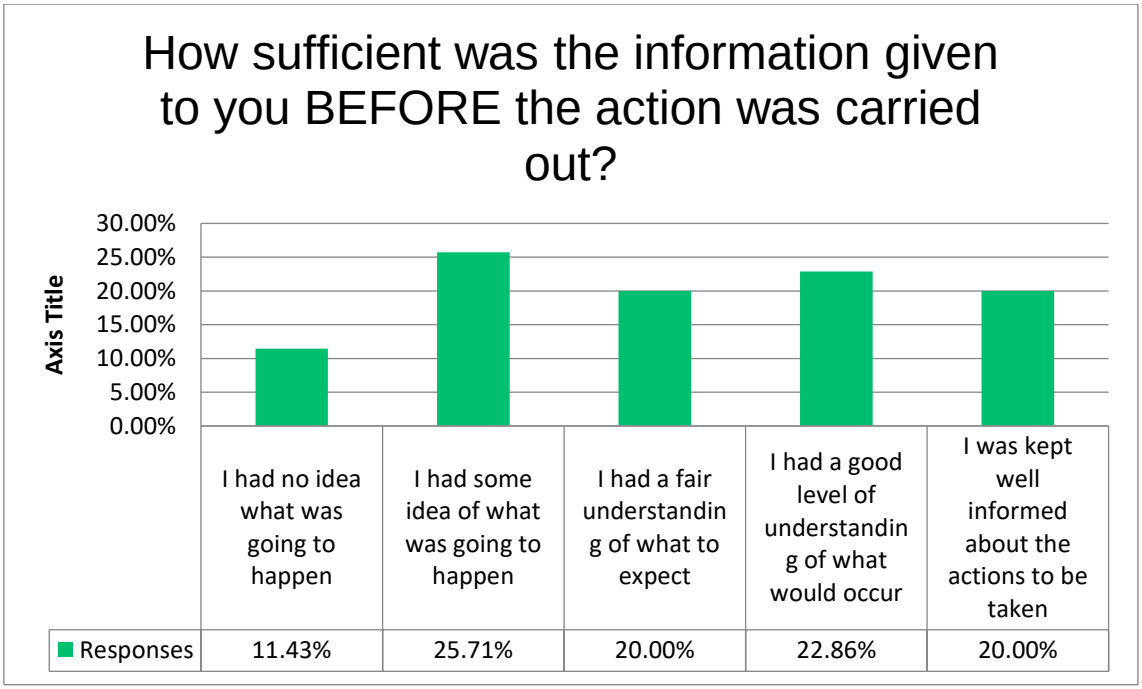


Figure 6: Sufficiency of information prior to action

Most respondents had a fair (20%), good (23%) or well informed (20%) understanding about the actions before they were carried out. More than one quarter only had some idea (26%) and some had no idea (11%) of what was going to happen.

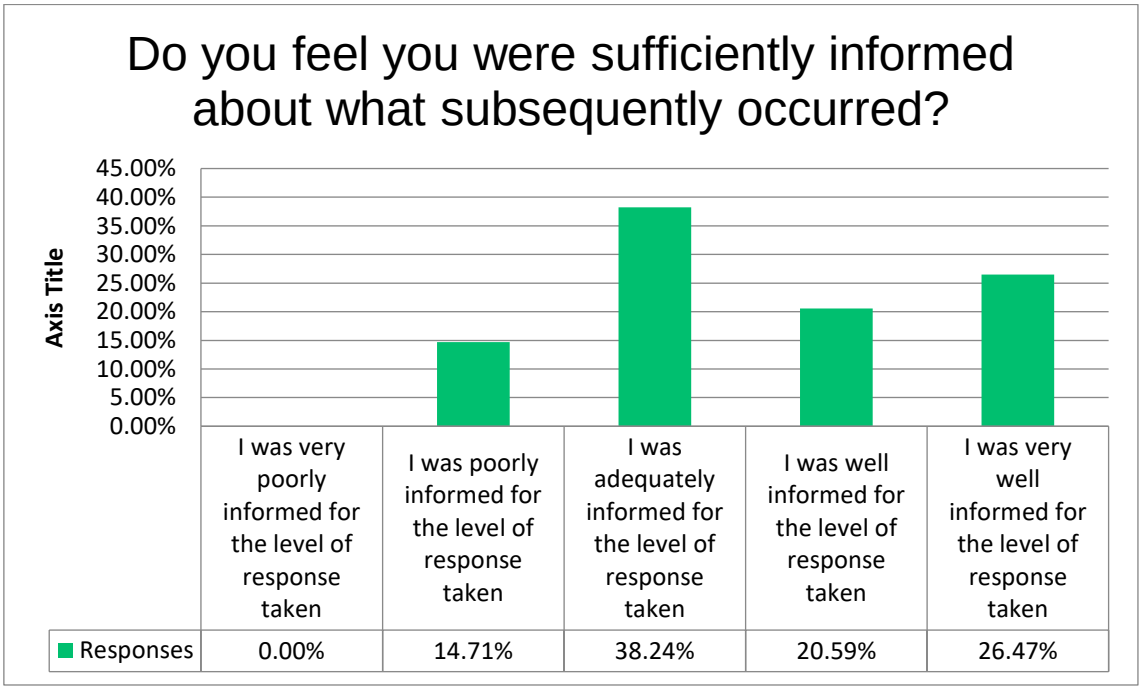


Figure 7: Sufficiency of information after action

Most respondents felt adequately (38%), well (21%) or very well informed (26%) for the level of response taken. However, some (15%) said that they were poorly informed for the level of response taken.

4.5.1 Qualitative aspects around acceptability of information

Respondents were asked 'what else might have been good to know about the action, in hindsight. Twenty-two responded. More information was needed on the actions they could have taken, aspects of change in the process, a lack of confidence in the response teams or consistency of operations, time delays in advice or quality of advice given and no ongoing activity beyond the

response operations. On the positive side, respondents already felt they had the competence to act and some also had sympathy for the response teams.

Specific actions that they could have personally taken, e.g.,

(i) *It would have been good to know that I could have used copper spray to reduce the likelihood of spreading the spores.*

(ii) *It would have been good to know that I could have put the green waste in plastic bags in the sun to sterilise it."*

Aspects of changes in process from what they were led to expect, e.g.,

(i) *"It would have been good to know that they weren't committing to pick up all the wool sacks that they delivered.*

(ii) *A quicker response - was 4 weeks from our initial contact until infected material removed from site*

(iii) *It would have been interesting to know why all interest in my property suddenly declined. Did money run out? Why were we not informed by a group email about closure of the initial phase - if that was the reason MPI no longer stayed in contact.*

(iv) *Only in that it took two days to get back to us (which was an appropriate timeframe) but I wasn't sure what actions (if any) needed to be taken in the meantime. I.e. Should I not have my garden bin collected (which was right under the tree in question).*

No information necessary as had existing competence and action already undertaken, e.g.,

(i) *I am happy - I am a botanist with experience in biosecurity. I knew how to get info and what to do. Needed MPI/restricted place notice just to know what was legal and not legal. We were always going to be super precautionary and do more than required.*

(ii) *We knew of the MR situation... we had a monitoring program already in place due to the number of trees we have on site ... we also had a spray program underway to try and prevent MR and it's spread*

Sympathy for the workload and activities of official response, e.g.,

(i) *As I say the situation was literally changing when we noticed what we thought was the rust so I'm happy MPI did their best. They were completely overloaded at that point and changing the focus*

Lack of confidence in the knowledge of response teams, e.g.,

(ii) *I did not believe that the response team we're taking only the infected plants out with in a hedge row leaving a few staggered plants to remain. I instructed the team to take all. As it turned out the other plant in that species all became infected.*

(iii) *There was a reluctance by the team to confirm wider extent of the problem in the locality even though I had alerted them in the first place.*

Lack of confidence in the consistency of response operations, e.g.

(i) *Would have helped not changing staff so often lots got lost and had to repeat same things over and over again*

(ii) *Everyone who came had a different response as to what would happen, complete shambles.*

Time delays in advice given or quality of advice given, e.g.,

(i) *advice which allowed for prompt disposal it was about three weeks from discovery to disposal*

(ii) *to have info on how long the removal was going to take and how we cope with the aftermath*

Advice about ongoing activity beyond the response operations, e.g.,

(i) *If the RPN would be lifted after the plants had been removed.*

(ii) *In hindsight because the disease was unable to be contained we could have kept our crop and tried to control through sprays. We weren't told how long compensation would take. Now over a year.*

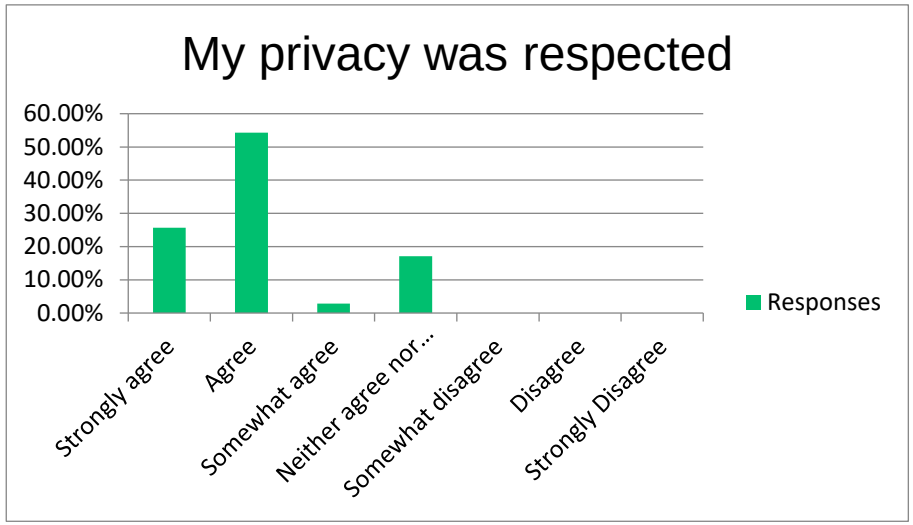
4.6 Response operations – social licence

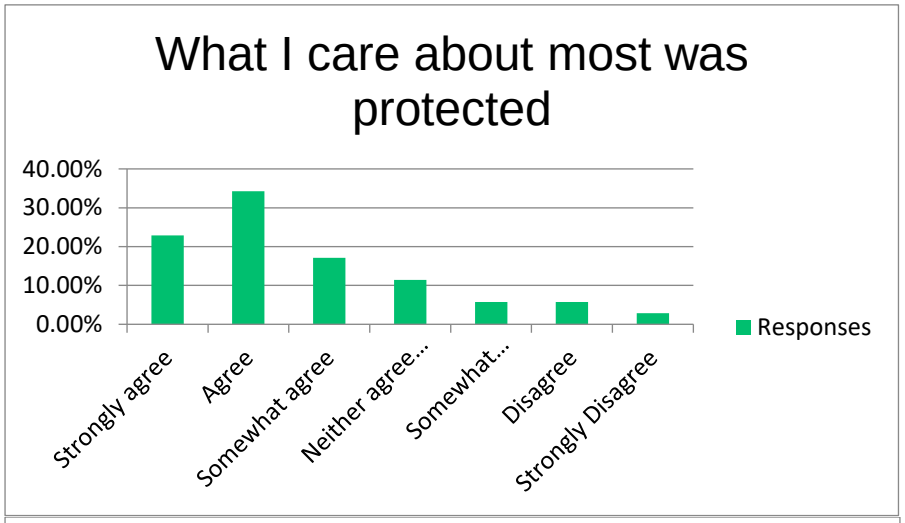
Restricted property respondents (N=36) were asked for their level of agreement with nine statements related to social licence to operate about privacy, fairness, what was cared for being

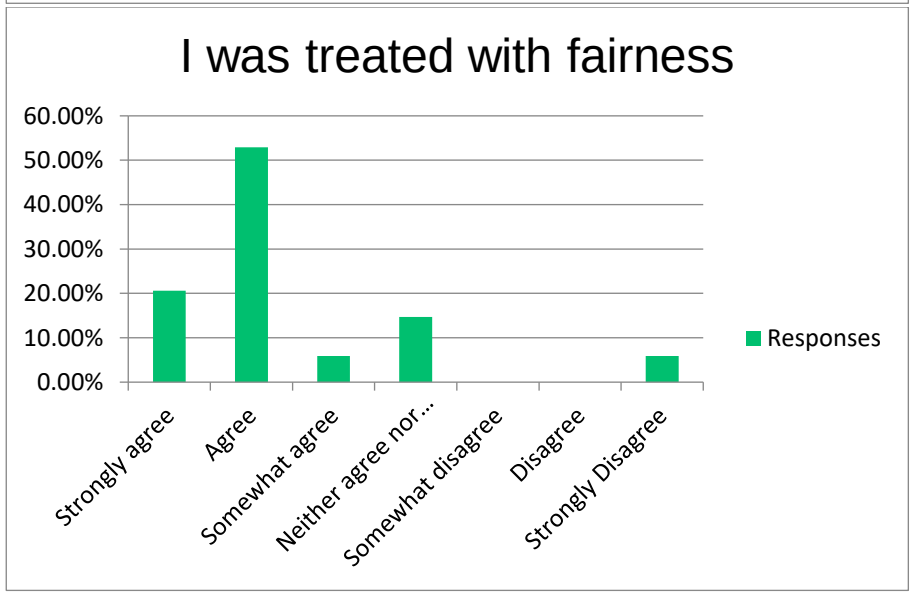
protected, ease of raising issues or concerns, knowing who to contact, retaining relations with neighbours, being treated with respect, being treated in a similar manner to others, and concerns being taken seriously.

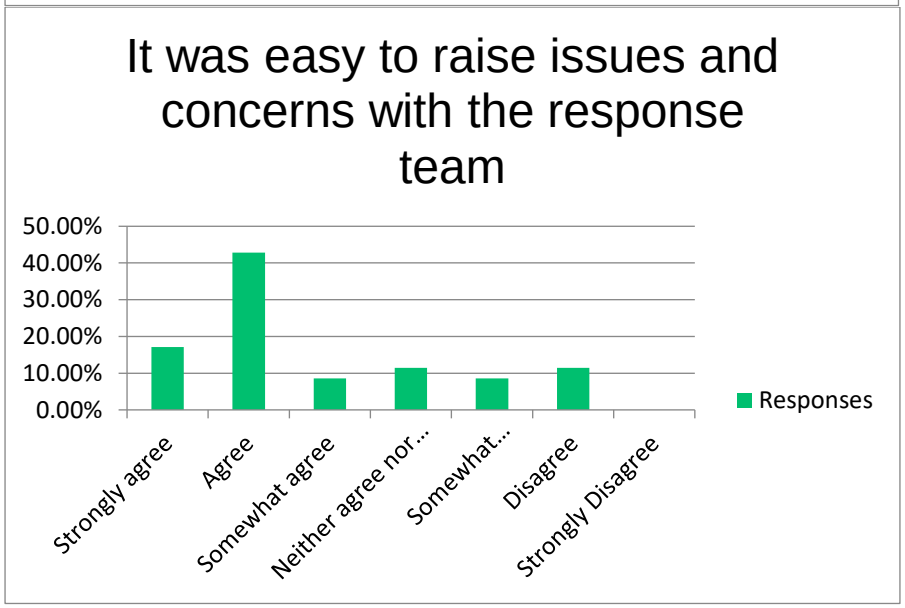
Participants did not seem to have any concerns with privacy not being respected with all respondents in agreeance (83%) or neutral (17%). Almost all also agreed with being treated with fairness (79%) with some strongly disagreeing (6%) or neutral (15%). Most also knew who to contact to make concerns known (76%), with some disagreeing (12%), and some also disagreeing with being treated with respect (9%). There was more disagreement however on whether what they cared most about was protected (15%), whether it was easy to raise issues and concerns (20%), and whether concerns were taken seriously (15%).

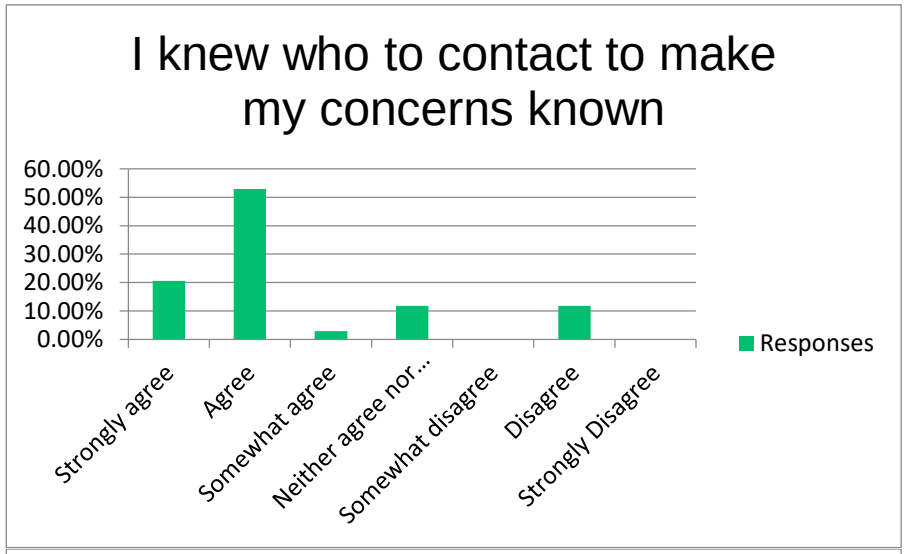
Many participants were unsure of whether relations were maintained with neighbours (40%) or whether they were treated similarly as others (49%).

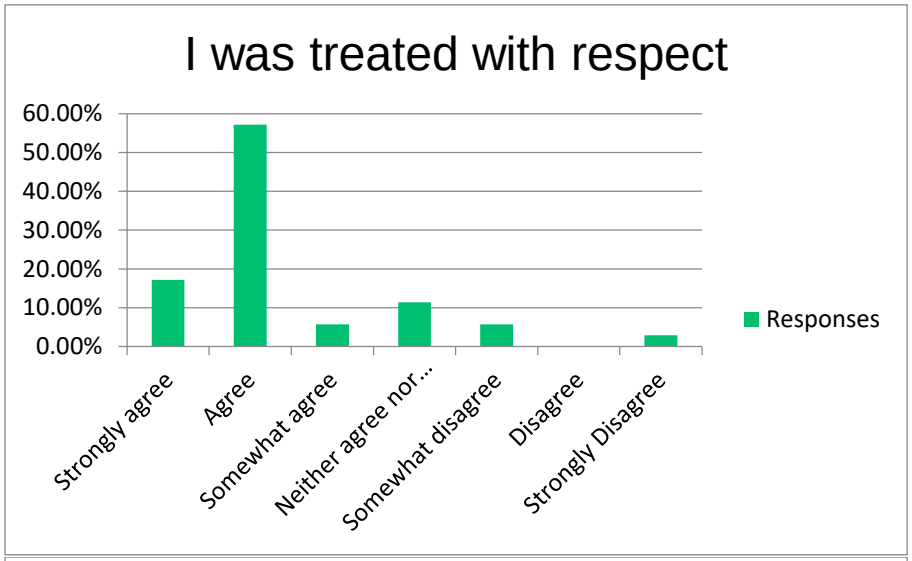

My privacy was respected
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Strongly agree
Agree
Somewhat agree
Neither agree nor...
Somewhat disagree
Disagree
Strongly Disagree
Responses

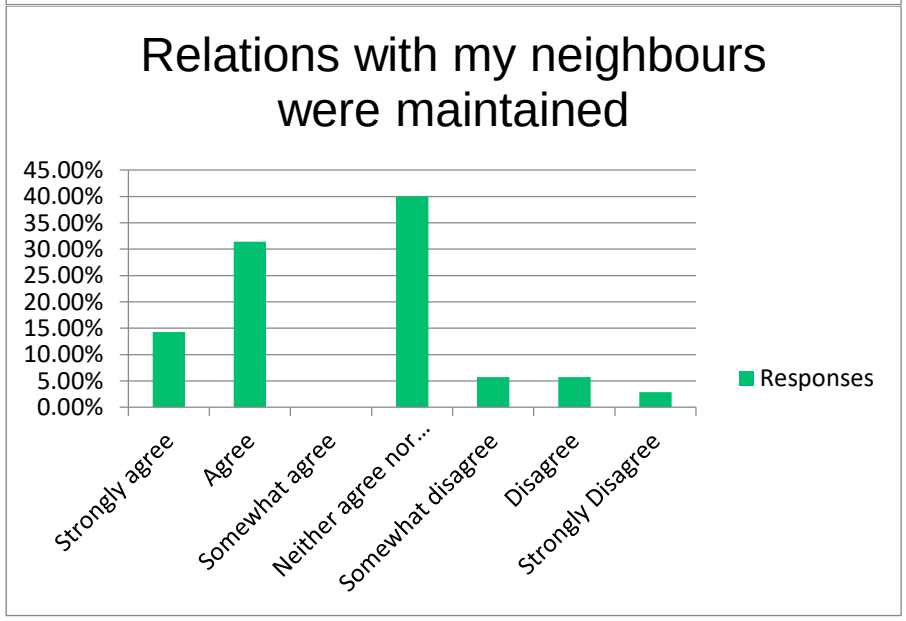

What I care about most was protected
40.00%
30.00%
20.00%
10.00%
0.00%
Strongly agree
Agree
Somewhat agree
Neither agree...
Somewhat...
Disagree
Strongly Disagree
Responses


I was treated with fairness
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Strongly agree
Agree
Somewhat agree
Neither agree nor...
Somewhat disagree
Disagree
Strongly Disagree
Responses


It was easy to raise issues and concerns with the response team
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Strongly agree
Agree
Somewhat agree
Neither agree nor...
Somewhat...
Disagree
Strongly Disagree
Responses


I knew who to contact to make my concerns known
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Strongly agree
Agree
Somewhat agree
Neither agree nor...
Somewhat disagree
Disagree
Strongly Disagree
Responses


I was treated with respect
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Strongly agree
Agree
Somewhat agree
Neither agree nor...
Somewhat disagree
Disagree
Strongly Disagree
Responses


Relations with my neighbours were maintained
45.00%
40.00%
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
Strongly agree
Agree
Somewhat agree
Neither agree nor...
Somewhat disagree
Disagree
Strongly Disagree
Responses

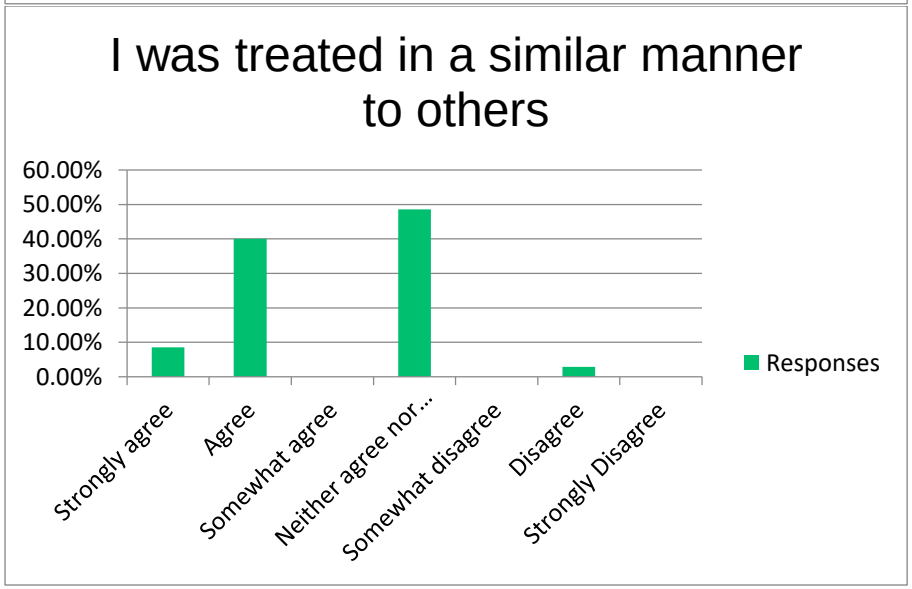

I was treated in a similar manner to others
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Strongly agree
Agree
Somewhat agree
Neither agree nor...
Somewhat disagree
Disagree
Strongly Disagree
Responses

Figure 8: Participants level of agreement with eight areas of SLO

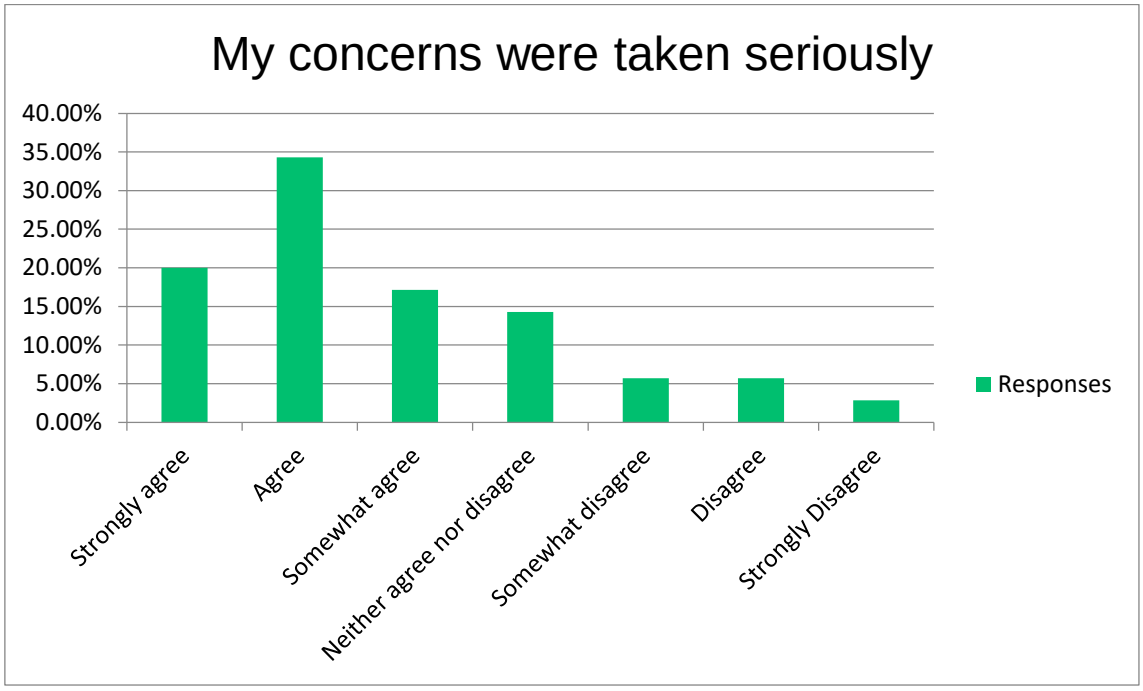


Figure 9: Participants level of agreement with whether or not their concerns were taken seriously

Participants were also asked to comment on what they appreciated most about the official response, with 26 out of 36 responses, as well as what could have been done better, with 23 of 36 repsonses.

Many comments were supportive of the response team including being 'taken seriously', 'quick', 'courteous' and 'friendly' response teams. Several comments were also made about the easy to understand nature of communication and regularity of contact initially, as well as being approachable. Other less positive comments related to a deterioration in communication over time and an unresponsive compensation effort.

Although there were relatively few negative comments (N=9) and some that suggested nothing could be done better, some respondents did offer some suggestions. Concerns about the degree of organisation of operational teams including MPI, e.g.,

(i) *they needed more containers and trucks to be readily available This was not the fault of workers*
(ii) *Have people who knew what they were doing*
(iii) *Operational teams could have been much more organised.*

Issues with communication, particularly following the response, e.g.,
(i) *I raised a concern about whether I should spray my boots after removing plants and response was no. I didnt see an email which said I should. I knew what 'use PPE' on spray bottle meant but others may not.*

Challenges to the consistency of response effort over time with changes, e.g.,
(ii) *Any sense or urgency. Also advice/restrictions on removal of gardening equipment etc was a) over the top and b) pointless as it was so long after the fact. If the plants were surveyed/quarantined when MPI was first notified we had them, further spread could have been avoided*
(iii) *I was extremely disappointed when we had an operation to remove 350 meters of village boundary hedge. MPI had agreed to remove the waste in covered large bins. All costings were completed and budgeted for. Two days prior to starting removal MPI reneged on this at a cost of thousands to our residence. Not happy.*

Some felt that the spread was inevitable and any response effort may have been wasted, e.g.
(i) *Should have donated the money wasted to charity as steps taken have done nothing to stop Myrtle rust as MPI just gave up when it got difficult*

(ii) *As I understand it was an unusual the natural event that MPI or anybody wasn't ever going to stop - unlike many any pest and disease's that are brought and introduced to this country*

One felt stigmatised by the seriousness and visibility of the response, e.g.,

(i) *As we weren't able to tell people in our small rural community what was happening on our premises there were many untrue rumours going on about our facility. Especially when members of the public saw members of the response team in hazardous/contamination suits, it did look like a clandestine lab response.*

4.7 Acceptability of response actions

Participants were asked to rate 16 possible current and future response actions, in terms of their acceptability. Response actions rated included gathering of seed, restricted movement of plant material, use of different types of sprays, and restricted planting in public and private areas.

These responses are shown as stacked in Figure A6, showing how ratings were stacked from 10, totally acceptable, to 0, not acceptable at all.

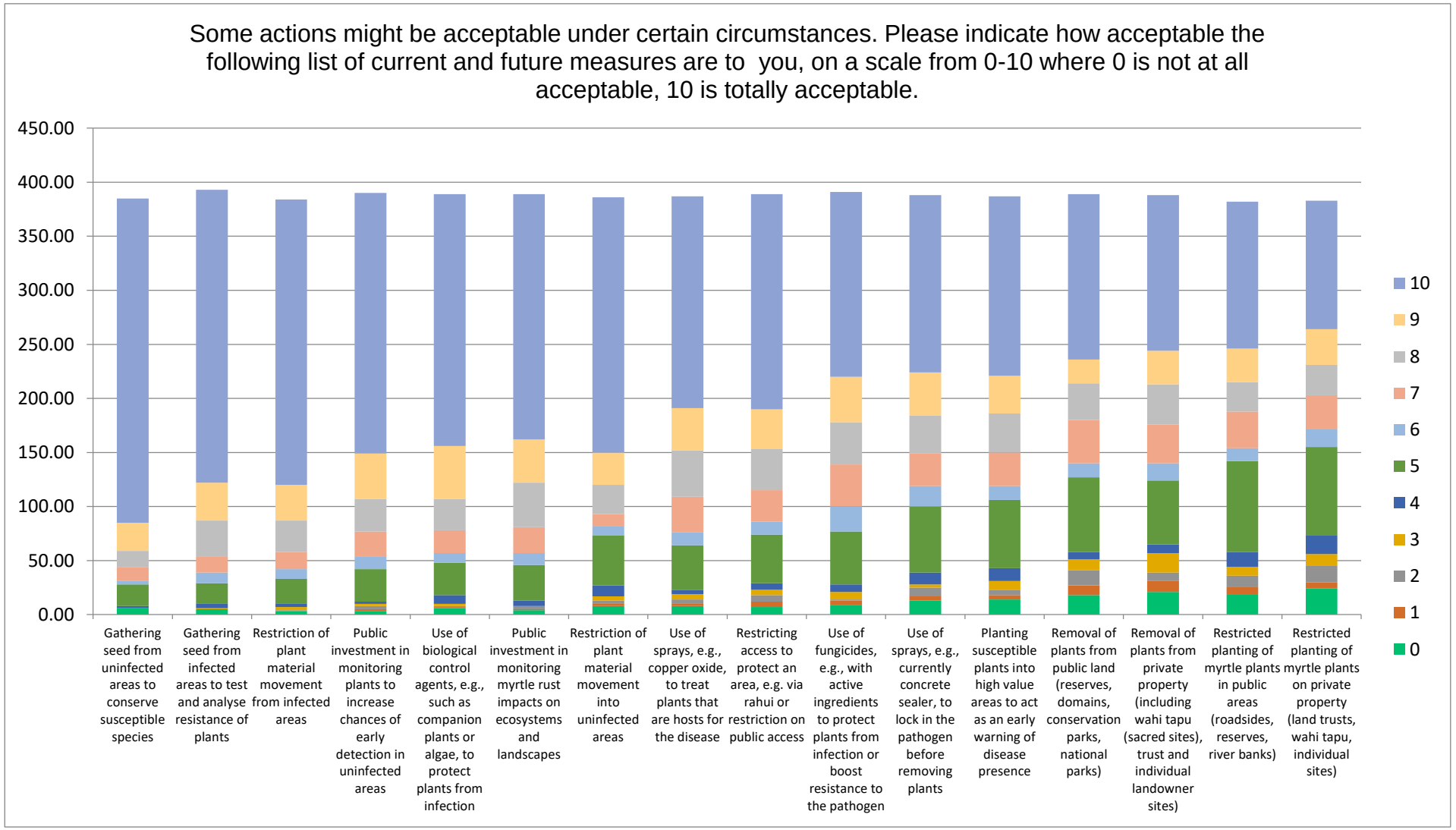


Figure 10: Stacked ratings of acceptability across sixteen potential management actions (Y axis is number of responses stacked according to colour code on right)

The acceptability of response actions were all over the midway or point of neutrality, indicating a general acceptance of response actions. A higher level of acceptance was given to the gathering of seed from both uninfected and infected areas (M=9.31, SD = 1.77; M=9.16, SD =1.79, respectively[1]) with restriction of plant material movement from infected areas also achieving a high level of acceptance (M=9.12, SD=1.80). Investments in monitoring for early detection, and ecosystem protection (M= 8.80, SD =2.00; M=8.80, SD=2.03, respectively), and use of biological control agents (M= 8.80, SD =2.11) also achieve a high level of acceptability.

At the other end of the scale restricted planting of myrtle plants on private property and in public areas is less acceptable, although still seen as acceptable on average. Removal of trees from private property and from public land is also, on average, less acceptable. However, there is a higher range of variability indicated by the standard deviation for the responses at this end of the scale of acceptability compared with the actions seen as more acceptable.

4.7.1 Comments on acceptable/unacceptable actions

Respondents were asked to offer any comments to assist the researchers in interpreting their responses (see Appendix C). Just under one third of the respondents offered comments (N=143) across areas of acceptable and unacceptable actions. Some illustrative comments are summarised.

Many (n=16) indicated that any response was acceptable to protect native species, e.g.,

(ii) *Anything that has to be done to protect our natives should be done.*
(iii) *I believe every effort should be made to protect our myrtle plants by destroying the rust in a safe and eco sensitive way.*
(iv) *I also wonder how , if this disease hit our Manuka hard , would it impact on our ever growing honey industry."*
(v) *Bio-security if of utmost importance to protect our native plants and I feel that we cannot turn a blind eye to its existence so every effort should be made to eradicate it and protect our plant life.*
(vi) *EVERYTHING SHOULD BE DONE TO STOP THE SPREAD OF THE VIRUS AND TO PROTECT OUR NATIVE TREES*

Others (n=6) were concerned about the difficulty or impossibility of eliminating the disease, especially as the disease is airborne, e.g.,

(i) *"Myrtle rust is here it will be very difficult to eliminate*
(ii) *The acceptability of some actions depends on the likelihood of success. Use of sprays and removal of plants seems pointless, or detrimental in other ways, if the spread of myrtle rust cannot be prevented.*
(iii) *"If wind is the main carrier of the infection, then restricting human access to an area probably wouldn't work. Opposite to Kauri dieback.*

Some (n=4) were concerned that they lacked good advice on the management of plants, particularly with using sprays, e.g.

(i) *I'm cautious about use of sprays without knowing more about them eg. how they affect the environment.*
(ii) *I'm not sure about the impact of sprays which is why I went neutral on that, definitely need education on this before deciding*
(iii) *I do have a concern re the use of fungicides in the natural environment. What other fungi are impacted by the drip line around the plant?*

Some (n=9) required more research and knowledge on what could be effective in limited the spread or other measures, e.g.,

(i) *Also, it would be good to know more about all of the strategies possible to limit the spread."*
(ii) *Lack expertise on the efficacy of some of the measures suggested*
(iii) *What I have read about the ability of this rust to disburse in the wind over large areas would mean you should be looking at a strategy of management rather than containment.*

Others (n=2), whilst reluctant to see fungicides or tree removal were supportive if it meant protecting heritage trees, e.g.,

[1] M is the mean and SD is standard deviation

(i) *I hope that removal of plants from public or private land is intended to refer to removing plants that are believed to be infected, rather than total removal of all myrtle species.*
(ii) *Re use of sprays to protect host plants ,I am not in favour but in a infected area may be ok to protect heritage trees.*

A couple (n=2) felt that more context was needed to respond and that actions were needed but within limits, e.g.,
(i) *Restriction of plant material: again I assume 'infected' material. It should be destroyed effectively on site if possible.*
(ii) *Biological control agents and fungicides: yes as long as safe otherwise and no unintended consequences.*

Others (n=7) also felt that the way things had evolved meant a need to change tack and thus some actions were needed under these circumstances, e.g.,
(i) *Removal of plants was good at the start of the outbreak to attempt to contain the outbreak but now I see little value in removal even in areas where rust is not present*
(ii) *It's a tough one to manage (we ended up ripping ours out) and I think it is probably going to be a trial and error scenario for a while. Keep up the good work and even though it might seem people don't care, they love our natives and are thankful for all you have done.*
(iii) *Christchurch has outstanding wetlands with lots of boardwalk access and more being established. Eco-sourced planting is ongoing including lots of rohutu. This is species is very susceptible to MYR and until resistant varieties are found, should not be planted to protect the manuka and kanuka also being planted.*

Some (n=10) positions were contested, e.g., movement controls or restricted access to areas for protection or restricted plantings, e.g.,
(i) *Restriction of access should be much more common. With making access so easy we have allowed a lot of weeds to spread, which I find very sad for our precious unique flora.*
(ii) *Given it is wind borne, restricting public to access to area seems onerous, if people spreading the disease isn't the main way it spreads.*
(iii) *Restrictions wont work anymore most people are moving debri wherever they want..It moves in the wind can't be stopped now*
(iv) *"I see that most plants being of these species are still being sold at garden centres. It should be compulsory to at least advise costumers when purchasing these plant of possible problems they may face which would give them an option to buy more robust plants.*
(v) *As my concern turned out to be inaccurate, I'm not sure what to think. I'm not keen on total abolition of uninfected plants but I favour monitoring possible host plants.*
(vi) *We need to do everything we can to control &/or eliminate the disease but I don't think that it is right to restrict people from planting myrtles on their own land.*
(vii) *With Biological control agents I am a bit less favourable due to potential adverse affects on other aspects of the ecosystem. However I am still positive towards them as I know these agents go through rigorous tests to try to ensure that there are no adverse effects.*
(viii) *"Bio-control through limiting movement is very important.*
(ix) *Chemical control should be undertaken in areas surrounding infected areas to prevent spread. Biological control may back-fire and requires substantial prior research. This may not work in the available time-frame."*
(x) *"I see that most plants being of these species are still being sold at garden centres. It should be compulsory to at least advise costumers when purchasing these plant of possible problems the may face which would give them an option to buy more robust plants.*

A few (n=3) had issues around compensation, e.g.,
(i) *I had recently replaced pittosporum hedges within my village some only being in ground for 3 months before being ripped out by MPI.*
(ii) *We had 245 Ramaramas pulled at an average cost (small to large) at $25.00 .....$6000+dollars*
(iii) *No compensation."*

A couple (n=2) felt the expense was a waste of taxpayers money, e.g.,
(i) *The myrtle rust seemed to come with a rush of panic.....It was never heard of again till you emailed me twice.....Is it still here and how many people are now getting onto the wagon at great cost to the taxpayer...*

(ii) *If Myrtle rust is windborne then for every identified infected tree there is bound to be many more undetected. I felt many reactions were a case of shutting the stable door after y horse had bolted.*

Others (n=3) of response made specific comments about environmental and cultural impacts, including the duty to include iwi in decision making e.g.,

(i) *Christchurch has outstanding wetlands with lots of boardwalk access and more being established. Eco-sourced planting is ongoing including lots of rohutu. This is species is very susceptible to MYR and until resistant varieties are found, should not be planted to protect the manuka and kanuka also being planted.*
(ii) *I still think alot of the questions answered will only give u a qauntitum measure and that discussions need to be held with Mana tangata of the land assessed as to what access and provisions ate set in place... especially in regards to waahi tapu, and places of cultural significance that the people of place co manage their lands.*
(iii) *as a representative of a ToW settled iwi, we see direct consultation is required, the partnership between iwi/crown (i.e. MPI & DoC) is paramount to protecting our taonga waahi tapu and Taiao. first question of this survey is indicattive of current approach as not 1 of them involved iwi as affected party. As the owners of the native taonga being affected as guaranteed under ToW no action or decision should be made without iwi import at the very top of this decision making process. And should not be determined by a survey of acceptance! Too many of our taonga are now threatened or extinct without our input to allow another process the ability to make impact decisions without consultation is unacceptable.*

One was particularly concerned that greater national coordination of an eradication effort was not maintained,

(i) *Response needed to be a blanket removal and incineration of all myrtles nationwide with a replanting programme to start 2-4 years after all plants removed and incinerated. Or the government needed a plan in place and already done research into how the rust has affected other countries, for example QLD Australia, it's now more than 10 years since they got it and they have naturally resistant plants growing now, it destroyed the myrtle growers for a few years but they are back on their feet now.*

Some (n=4) were concerned about using chemicals, e.g.,

(ii) *It is important that NZ does all that is possible to restrict the spread of this disease, but if we can do it through natural methods and not lots of sprays, would be great.*
(iii) *I am against the use of chemicals as they have an unknown effect on soil health. I'm only an interested individual who happened to purchase plants from infected nursery*
(iv) *"Use of fungicides depends - if pregnant women could be exposed it's a teratogen so needs to have restricted use /public access*

A couple (n=2) resisted the idea of tree removal, particularly on private property, e.g.

(i) *I strongly disagree with the removal of (suspected) myrtle rust affected trees on private property without confirmation from the owners of that private property. I feel this way because feijoa trees were cut down on a friends property, when it was later discovered feijoa is resistant to myrtle rust. I believe unless it is ok'd by the owner, and is proven to be infected (especially fruit trees) trees should be preserved.*
(ii) *I would not be keen to see uninfected trees removed and even where there is already infection it may have already moved on and the trees would be lost without preventing the movement. Unless the chemical use was certain to be effective I would prefer biological efforts.*

A few (n=6) felt that it depended on the circumstances and that they did not have enough information to judge, e.g.,

(i) *I don't fully understand what is implied by the three plant removal and restriction measures. I need more information to comment*
(ii) *I haven't responded to most of these options, through not knowing the science behind containing this disease.*
(iii) *We don't understand the possible consequences of some of these options well enough to make a considered response.*

A couple (n=2) sought prevention rather than treatment, and a high level of resistant to removal of native plants, e.g.

(i) *This is beautiful plants and to remove them from public areas will be a disgrace. Rather treat them to prevent an outbreak again. They are distinctive of NZ and had to be seen by public and their glory enjoyed in many private properties*
(ii) *Instead of just surveillance and lack of action, how about a removal team to act instantly on infected plants. rather than waiting weeks, or as current situation is, doing nothing and letting infected pohutakawa remain in public areas!!*

Others (n=3) felt that actions needed to be more rapid to effective control the spread, e.g.,
(i) *Instead of just surveillance and lack of action, how about a removal team to act instantly on infected plants. rather than waiting weeks, or as current situation is, doing nothing and letting infected pohutakawa remain in public areas!!*
(ii) *There are too many examples of lack of diligence by all parties in not taking expeditious action to prevent incursions, spread and eradication of unwanted plants, animals, diseases and materials in to our environment."*
(iii) *I was disappointed with the lame effort and contact following me notifying concerns. I would like to see HASTE TO INVESTIGATE UPON RECEIVING POSSIBLE SIGHTINGS added to this list above.*

One called but found that there concern was not actually realised as myrtle rust, e.g.,
(i) *There needs to be a Full list & photographs of infections on each tree type affected online. This would save the staff/response team from having their time wasted as was the case in my situation. Our trees were infected with sooty mould, essentially a waste of your time.*

Some (n=3) recommended resistance breeding as an only certain solution, e.g.
(i) *Given the extent of the spread I would imagine that eradication was not possible and that a resistance breeding program along with spraying and MC in highly infected areas would be the best bet.*
(ii) *"1 and 2 do not specify that the plants are infested; just removing plants doesn't allow for the opportunity of finding resistant cultivars. If resistant cultivars are identified then planting of them would be acceptable(#s 3,4).*
(iii) *#8 Could resistant cultivars be moved into uninfected areas?"*

4.8 Ranking of importance - 12 potential impacts

Participants were asked to rank 12 potential impacts of myrtle rust according to their level of priority. The highest priority ranking was the threat of ecosystem collapse and the lowest priority (out of the available options) the loss of personal freedoms. The threat the myrtle rust might spread into new regions was also ranked high whilst no longer being able to plant myrtles in my home garden we second least important.

Table 6: Ranking of 12 potential impacts of myrtle rust

Impact risk item	Mean	Std. Deviation	Ranking
Potential for ecosystem collapse due to loss of myrtle	4.32	3.41	1
That myrtle rust will spread into new regions of New Zealand	4.37	3.36	2
The loss of natural landscape vistas from no mānuka, rātā and pōhutukawa flowers	5.13	3.08	3
Losing native myrtle plants from my local parks, beaches, and domains	5.85	3.12	4
Losing some of our cultural heritage icons like mānuka honey, feijoa jam and pōhutukawa flowers	6.08	3.07	5

The loss of employment for those that work in myrtle-based industries	6.54	2.85	6
No longer being able to buy produce from myrtles (e.g. feijoa, mānuka honey)	6.58	3.14	7
Loss of revenue to local businesses that depend on myrtles	6.92	3.09	8
The impact on the mauri and mana of our native myrtles due to infection	7.40	3.37	9
Loss to Māori businesses that are reliant on myrtles	7.90	2.68	10
No longer being able to plant myrtles in my home garden	8.16	3.44	11
Loss of personal freedoms due to the need to control the spread of myrtle rust	8.74	3.39	12

NB: Highest importance at 1 and lowest importance at 12

Whilst there was a need to obtain a sense of prioritisation, some noted other areas of high importance or priority.

4.8.1 Other priority concerns not listed

Respondents were asked whether there were any other concerns that were not listed; 111 responded to this question (Table 5). A range of concerns were raised and were categorised into concerns about the survey, about the spread or impacts of MR, about the response, lack of awareness or information. Some respondents had concerns in more than one area.

Table 7: Other priority concerns not listed

No comment	55
Concern about MR spread / impacts	12
Comment on MPI/AQ response	11
Lack of public awareness	7
Faster response needed	6
Need more information	4
Too late / impossible	3
Wasting or inefficient use of money	3
Asking question	2
More planting	1
Name another invasive pest	1
Inconsistent information	1
That windborne means no control	1
Lack of research	1
Total high concerns	106*

*Some comments were directly related to the survey and not included

Half of those that responded (55/111) had no comment. Otherwise concern about the spread or impact of myrtle rust was the most commonly raised concern (n=12) and the next most common concern was about the response operation (n=11). The need for a faster response (n=6), the need for more information (n=4) and a lack of public awareness (n=7). A couple of respondents also noted that action came too late (n=3) and that the response was inefficient or a waste of money (n=3). There were also some problems with the survey instrument (n=9).

Concern about spread/ impacts (n=12)

(i) Related to ecosystem loss is the loss of coastal protection provided by myrtle forests particularly in the north.

(ii) Loss of these affected species which are pioneering species and thus pivotal species for regenerating native bush

(iii) Honey industry and the discovery of resistance plants. No active RESEARCH??????

(iv) "The need to act quickly and "nip the problem in the bud" as it were...don't dither about and let it get further out of control, endangering more areas and aspects of our heritage. The

potential to lose our big old pohutukawa forest remnants around the coastline that protect us from erosion, & are important tsunami energy dissipaters/protection.... The old song that says "we don't know what we've got till it's gone" is so true.....can you even bear to imagine what the loss of our wonderful pohutukawa trees would do to the landscape...the same applies to manuka and kanuka, which is also extremely valuable for the specialist honey it provides, as well as it's visual impact."

MPI/ AQ response (n=11)

(i) *Lack of ongoing contact from MPI to visit my premises to advise best detection method or possible actions if further detection*

(ii) *"Yep, came home one night to Neighbours hedge laying on my drive. Rung Asure and was told I wasn't an affected landowner so there no risk of contamination. Took three weeks for our driveway to be cleared. Then I seen them spraying suspected trees with a mist blower! If it is spread in the wind then that seemed a great idea to me! It seemed there was a lack of knowledge on the whole scale of the operation. We couldn't get a contact for anyone to discuss the impacts, we just had people wondering through our property in white suits looking at our plants. They didn't have a contact for us to call and discuss what was happening."*

(iii) *"A unified voice and answer when questions about the safely of treatments (fungicides and concrete sprays etc) are being used, and how that will affect not only us as humans, but also animals and insects (especially bees!!!). I was very disappointed that one MPI staff member would say a specific treatment is fine and would not affect bees, but speak to one other staff member and receive the complete opposite as their truth to that question. Please ensure every staff member is well educated, and if no answer is certain, please say so! Especially if you don't know for certain!"*

4.9 Value statements (relating to myrtle rust response)

Respondents were asked to rate the importance of 27 different statements related to myrtle rust impacts, on a scale from 0 not important to 10 very important (Figure A2).

The distribution of value statements indicates that some areas of value had a higher level of concern with the sampled surveyed. For example, ensuring actions taken or controls used are safe for humans, maintaining the quality of New Zealand's environment, and being able to quickly identify if a tree is infected with myrtle rust rated highly on average (over 9.2/10).

At the other end of the range were value statements indicating less influence such as ensuring continued access to public areas under a control operation (5.5/10), being able to still grow myrtle plants in my house garden following the response operation (5.4/10), and business continuity for growers of myrtle plants during the response operation (6.5/10).

The standard deviation bars show that there is more variability in the least valued aspects than those aspects of high value. The implications could be that messaging around human safety and protecting the quality of the NZ environment could increase the level of commitment for action.

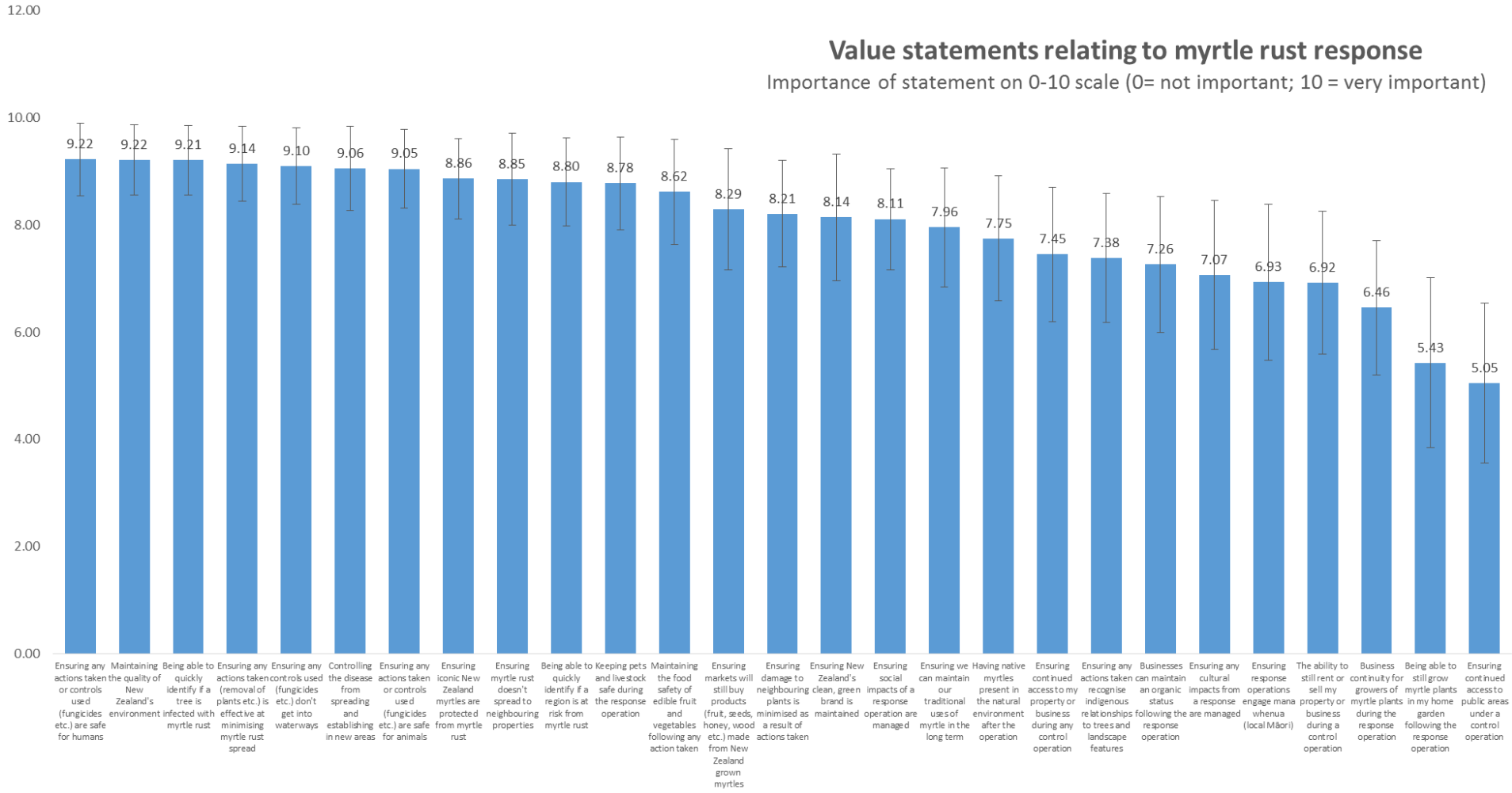


Figure 11: Level of importance of value statements relating to myrtle rust

4.10 Quadruple Bottom Line values in incursion response

In addition to myrtle-rust-specific value statements, respondents were asked to rate the importance of a further set of 16 general values statements. This was to develop and test a quadruple bottom line scale for measuring the importance of values across social, cultural economies and environmental areas with respondents.

We were unable locate a robust and tested QBL scale that could be used as a framework, so created an analysis framework to categorise responses based on generic (i.e. not incursion specific) values. Our framework was based on the value topics for each QBL value (Economic, Environmental, Cultural and Social) from key QBL aspects identified by Donovan (2008) in an Australian study of QBL impacts of research. Items for the four-factor scale were created as value statements (Figure 1) that related to each QBL value derived from the Australian study (Donovan, 2008). There were 16 items in total (4 per value):

Cultural items

- Growing the Māori economy
- Celebrating our heritage as a nation
- Understanding our past and future aspirations as a society
- Maintaining my cultural values and practices

Economic items

- Maintaining a high standard of living
- Maintaining our productive economy
- Maintaining global competitiveness
- Achieving financial freedom

Social items

- Maintaining social bonds with family and friends
- Ensuring an inclusive and diverse society
- Enhancing levels of social equity and justice
- Maintaining personal health and wellbeing

Environmental items

- Protecting New Zealand's biodiversity and our natural environment
- Ensuring an environment that all people can enjoy
- Improving the quality of our water and air
- Reducing my personal consumption of goods and resources

Figure 12: Four value sets of items (statements) representing the quadruple bottom line

A check on each of these four original value scales for reliability (Cronbach Alpha) between the original items from the respondents' data found a high degree of scale reliability relating to each of the QBL categories. A further check on whether they were distinctly measuring scales relating to the four QBL categories (Environmental; Social; Cultural and Economic) was undertaken by running a factor analysis (PCA[2]) on these items. A factor analysis looks for statements aligning on commonalities in response. This factor analysis found 4 distinct groups – however, one of the groups wasn't reliable (Cronbach Alpha of 0.519[3]). The first factor contained a highly reliable factor (Cronbach Alpha = 0.867) that was more aligned with a combined socio-cultural set of items (the responses aligning with that factor based on the agreements with statements were across social and cultural items). The second factor was aligned with environment and equity values (Cronbach Alpha = 0.771). Therefore, we created another two value categories for socio-cultural and environmental equity and rearranged some of the statements to better fit with the Cronbach Alpha reliability check shown by the data.

[2] Principle Component Analysis (PCA) is a method used to reduce dimensionality of large data sets, by transforming a large set of variables into a smaller one that transforms a number of (possibly) correlated variables into a (smaller) number of uncorrelated variables called principle components.

[3] Cronbach Alpha measures for reliability by finding general agreeance between statements but not direct overlap. A measure of 0.7 or more shows general agreeance but if agreeance becomes too high, i.e, closer to 1.0 then the statements can be effectively merged into one (they effectively have the same meaning to people). This is termed highly reliable in principle component analysis (PCA).

Two of the items did not load onto any of the four groups found through the PCA analysis ('Achieving financial freedom', and 'Reducing personal consumption of goods and resources'), showing that contrary to our initial thinking, these were not proxy statements for the economy nor environment, respectively. It appears these two items have correlated value components and are not distinct enough around any QBL category to reflect that value.

Socio-cultural items

- Growing the Māori economy
- Celebrating our heritage as a nation
- Understanding our past and future aspirations as a society
- Maintaining my cultural values and practices
- Maintaining social bonds with family and friends
- Ensuring an inclusive and diverse society
- Enhancing levels of social equity and justice

Environmental equity items

- Enhancing levels of social equity and justice
- Protecting New Zealand's biodiversity and our natural environment
- Maintaining personal health and wellbeing
- Ensuring an environment that all people can enjoy
- Improving the quality of our water and air

Cultural items

- Growing the Māori economy
- Celebrating our heritage as a nation
- Understanding our past and future aspirations as a society
- Maintaining my cultural values and practices

Economic items (revised)

- Maintaining a high standard of living
- Maintaining our productive economy
- Maintaining global competitiveness

Social items (revised)

- Maintaining social bonds with family and friends
- Ensuring an inclusive and diverse society
- Enhancing levels of social equity and justice

Environmental items (revised)

- Protecting New Zealand's biodiversity and our natural environment
- Ensuring an environment that all people can enjoy
- Improving the quality of our water and air
- Maintaining personal health and wellbeing

Figure 13: Six value sets of items (statements) tested using Cronbach Alpha reliability check

The influence of the QBL values sets tested through this inquiry showed that there are strong alignments between six clusters of value (Figure 2) that are distinct but not the same. In this survey, following Donovan 2008, cultural value is wider than simply indigenous, and includes aspects of both heritage and nation-hood as well as valuing continuation of an individuals' distinctive practices/ tikanga handed down through generations. Economic values include standards of living and not just productivity and competitiveness, although financial freedom was not seen as a statemen that aligned with other economic value statements. Environment values relate to the general physical qualities of environment such as biodiversity and water quality. Social values concern inclusion and bonding, and include aspects of equity and justice. The combined value categories found through the PCA show socio-cultural to be about bonding with your heritage and culture, where cultural heritage can be expressed and nurtured through social bonds; while environmental equity expands on the biophysical to include the fairness that everyone can enjoy the environment. Unexpectedly, we note also that health and wellbeing was considered to sit within an environmental set of values rather than social.

To assess the scale of each of the six value categories, the scores from each item loading onto the scale were added for each respondent, and respondents were assigned a primary value category based on their highest scoring category. This revealed that most respondents held either environmental (or environmental equity) values particularly strongly, while very few in the population sampled held strongly to socio-cultural and cultural values:

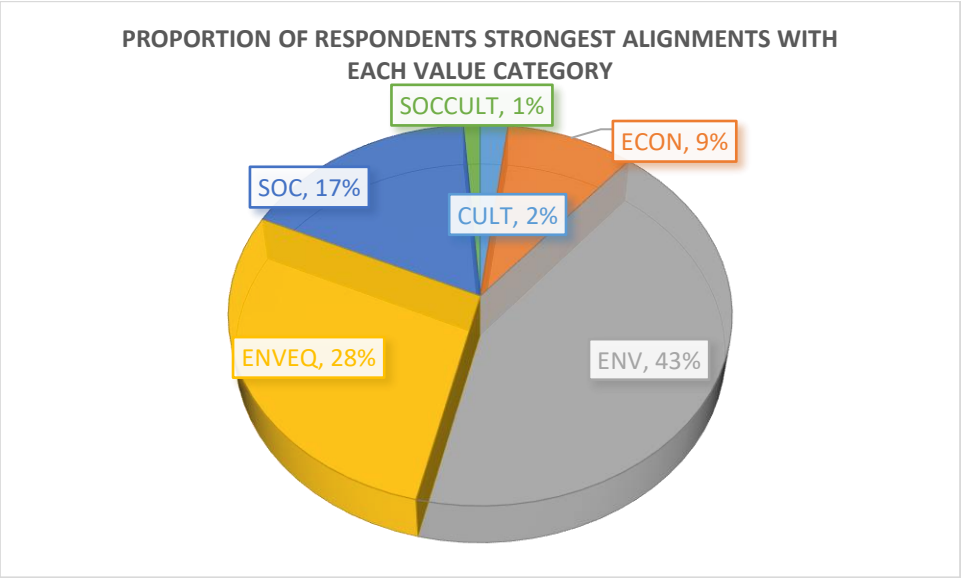


Figure 14: Proportion of respondents' main alignments with each value category

The resulting six QBL scales from this study were then used in regression analysis to assess demographic differences. To reduce the number of demographic responses to a reasonable number of variables for regression, a Multiple correspondence analysis was undertaken (Appendix F).

4.10.1 Regression analysis on values

Linear regression analysis showed that females care more about environmental, social and cultural values than males, and that Maori care more about values than Asians (except for economic values) (Appendix E). However, these results are read with caution as the surveyed sample was not representative of the New Zealand population.

4.10.2 Regional mapping of value sets

We also analysed / regressed the data gathered on values to regions, showing what proportion of respondents from those regions were reflected by their values sets. This enabled us to generate a regional mapping of the six values sets as a proportion of the responses, albeit limited by the number of respondents per region (Figure 3). For example, 119 respondents resided in Auckland whilst only 54 resided in Wellington and there were only two respondents from West Coast and Tasman. Subsequently the maps generated are only illustrative of how such data can be used rather than a comprehensive picture of values for those regions (Figure 4).

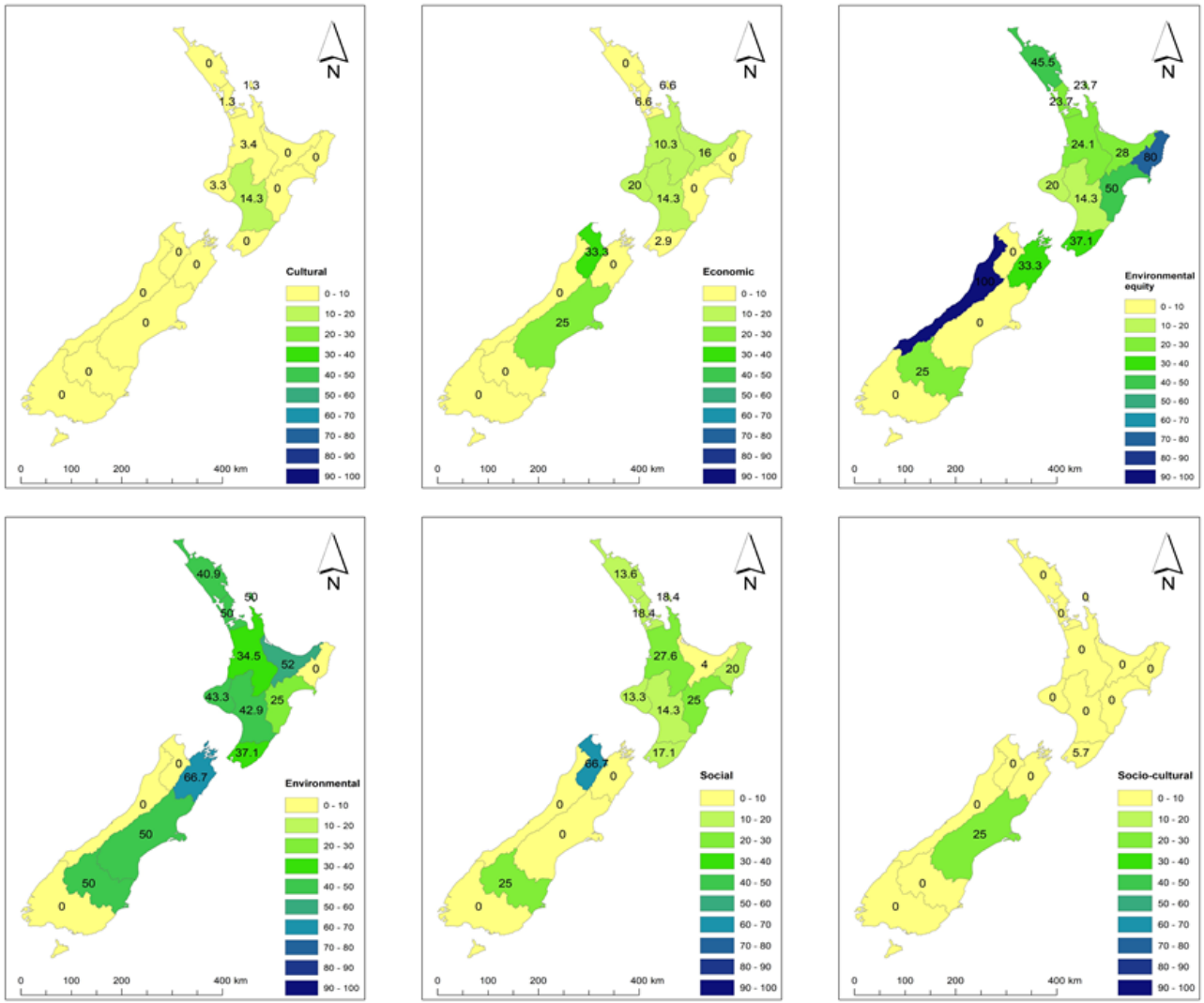


Figure 15: Maps of the distribution of importance of six value sets as expressed across regions where participants resided (not necessarily where myrtle rust was found)

4.11 Persona groups and response actions

Generic values statements were informed from an Australian study (Donovan, 2008) representing QBL areas. The 27 statements relating to important values associated with myrtle rust response (above); along with the 16 generic QBL values were collated into a single values 'set'.

A Q-sort was conducted on the 43 value statements using Ken-Q analysis (n=375 respondents) revealing different persona groups (Appendix F). A Q-sort characterises different types of subjectivity based on the degree of variance between different levels of agreement with statements. Where there is convergence across different individuals in terms of their agreement with a subset of statements a persona group is created. This was then correlated with acceptability of different types of response actions to indicate which response actions may be acceptable to which types of persona.

The following section identifies:

- 5 key personas based on 43 values statements (Majority associated with persona 4)
- Significant differences between means of personas for certain possible response actions (in orange)
- Persona 5 is less accepting of response actions than other personas

4.11.1 Q-sort persona results

Five main personas were found. Personas are based around the values statement (as indicated above), however demographic mediators can tell propensity to have this value. Demographics can indicate whether a person with these demographics is more likely to be in this persona set (because there is a disproportionate number of people in the persona set with this characteristic).

Personas were tested across regions to see if there were any regionally significant differences but there were none. Therefore this persona set (based on the sample surveyed) is potentially not related to any particular location, and therefore should be able to be applied in other outbreak regions throughout New Zealand through any future national response management engagement process.

PERSONA 1:

Had HIGH agreement with following statements:

- Ensuring any actions taken or controls used (fungicides etc.) are safe for animals
- Improving the quality of our water and air
- Keeping pets and livestock safe during the response operation
- Ensuring any actions taken or controls used (fungicides etc.) are safe for humans
- Ensuring myrtle rust doesn't spread to neighbouring properties
- Ensuring any controls used (fungicides etc.) don't get into waterways
- Maintaining social bonds with family and friends
- Ensuring an inclusive and diverse society
- Celebrating our heritage as a nation

Had LOW agreement with following statements:

- Having native myrtles present in the natural environment after the operation
- Being able to still grow myrtle plants in my home garden following the response operation
- Maintaining a high standard of living
- Business continuity for growers of myrtle plants during the response operation
- Ensuring any actions taken recognise indigenous relationships to trees and landscape features
- Maintaining the food safety of edible fruit and vegetables following any action taken
- Ensuring iconic New Zealand myrtles are protected from myrtle rust
- Reducing my personal consumption of goods and resources
- Ensuring continued access to my property or business during any control operation

Demographic indicators
- Pakeha
- Not Asian
- Female
- Secondary school leaver in 6-7 form
- Aged 35-55
- Lower overall income (under $70k pa personal income)

The statements of agreement tend to relate to ensuring the environment and those involved are kept safe as a result of the response operation. The values statements also show a persona that places importance on society. The statements also show lower importance on protecting myrtle species from the disease/ business continuity and protecting the status quo through eradication.

PERSONA 2:

Had HIGH agreement with following statements:
- Maintaining the quality of New Zealand's environment
- Controlling the disease from spreading and establishing in new areas
- Being able to quickly identify if a tree is infected with myrtle rust
- Ensuring any actions taken (removal of plants etc.) is effective at minimising myrtle rust spread
- Protecting New Zealand biodiversity and our natural environment
- Ensuring iconic New Zealand myrtles are protected from myrtle rust
- Maintaining personal health and wellbeing
- Improving the quality of our water and air
- Ensuring myrtle rust doesn't spread to neighbouring properties

Had LOW agreement with following statements:
- Being able to still grow myrtle plants in my home garden following the response operation
- Ensuring continued access to public areas under a control operation
- Ensuring continued access to my property or business during any control operation
- Business continuity for growers of myrtle plants during the response operation
- The ability to still rent or sell my property or business during a control operation
- Growing the Māori economy
- Maintaining a high standard of living
- Maintaining global competitiveness
- Businesses can maintain an organic status following the response operation

Demographic indicators
- Maori or permanent resident
- Female
- Completed university post graduate course
- Higher than $100k pa household income
- $70-100k pa personal income
- 25-34 year age group

The statements of agreement tend to relate to ensuring a quick and effective response, in order to protect the natural environment. These persons were less concerned with personal freedoms and business continuity, as well as access issues, and valued environmental statements highly while placing low importance on economic statements.

PERSONA 3:

Had HIGH agreement with following statements:
- Being able to quickly identify if a tree is infected with myrtle rust
- Maintaining personal health and wellbeing
- Ensuring any actions taken or controls used (fungicides etc.) are safe for humans
- Ensuring any actions taken (removal of plants etc.) is effective at minimising myrtle rust spread
- Controlling the disease from spreading and establishing in new areas

- Maintaining the food safety of edible fruit and vegetables following any action taken
- Maintaining the quality of New Zealand's environment
- Ensuring any controls used (fungicides etc.) don't get into waterways
- Keeping pets and livestock safe during the response operation

Had LOW agreement with following statements:
- Ensuring any cultural impacts from a response are managed
- Ensuring response operations engage mana whenua (local Māori)
- Being able to still grow myrtle plants in my home garden following the response operation
- Ensuring any actions taken recognise indigenous relationships to trees and landscape features
- Growing the Māori economy
- Reducing my personal consumption of goods and resources
- Understanding our past and future aspirations as a society
- Maintaining my cultural values and practices
- Ensuring continued access to public areas under a control operation

Demographic indicators
- Asian or permanent resident
- Economic values
- Completed secondary school to form 5
- Aged 18-24 or 75-84
- $40-70k pa personal income

The statements of agreement tend to relate to ensuring a safe and effective response, without damage to environment. These persons were not concerned with indigenous cultural impact, heritage or engagement.

PERSONA 4:

Had HIGH agreement with following statements:
- Ensuring any controls used (fungicides etc.) don't get into waterways
- Ensuring any actions taken or controls used (fungicides etc.) are safe for humans
- Being able to quickly identify if a tree is infected with myrtle rust
- Maintaining the quality of New Zealand's environment
- Controlling the disease from spreading and establishing in new areas
- Ensuring any actions taken (removal of plants etc.) is effective at minimising myrtle rust spread
- Ensuring any actions taken or controls used (fungicides etc.) are safe for animals
- Keeping pets and livestock safe during the response operation
- Maintaining the food safety of edible fruit and vegetables following any action taken

Had LOW agreement with following statements:
- Maintaining a high standard of living
- Growing the Māori economy
- Maintaining my cultural values and practices
- Maintaining global competitiveness
- Reducing my personal consumption of goods and resources
- Ensuring continued access to public areas under a control operation
- Celebrating our heritage as a nation
- Understanding our past and future aspirations as a society
- Achieving financial freedom

Demographic indicators
- NZ citizen
- Identified as New Zealander or Pakeha
- Completed some university or wananga training
- Neither very young nor very old
- Lower than $40kpa household income

- Lower than $40kpa personal income

The statements of agreement tend to relate to ensuring a safe response, particularly for animals, and environment, and also that any action taken is effective. These persons were not as concerned with economy or cultural values (possibly as they don't have the income to achieve high living standard and financial freedom?).

PERSONA 5:

Had HIGH agreement with following statements:
- Ensuring any actions taken or controls used (fungicides etc.) are safe for humans
- Improving the quality of our water and air
- Ensuring any actions taken or controls used (fungicides etc.) are safe for animals
- Keeping pets and livestock safe during the response operation
- Having native myrtles present in the natural environment after the operation
- Maintaining the food safety of edible fruit and vegetables following any action taken
- Maintaining the quality of New Zealand's environment
- Ensuring any actions taken recognise indigenous relationships to trees and landscape features
- Protecting New Zealand biodiversity and our natural environment

Had LOW agreement with following statements:
- Maintaining global competitiveness
- Ensuring continued access to public areas under a control operation
- Growing the Māori economy
- Ensuring myrtle rust doesn't spread to neighbouring properties
- Ensuring continued access to my property or business during any control operation
- Reducing my personal consumption of goods and resources
- Controlling the disease from spreading and establishing in new areas
- Maintaining my cultural values and practices
- Being able to quickly identify if a region is at risk from myrtle rust

Demographic indicators
- Pakeha or NZ citizen
- Less likely to be Maori or Asian
- Completed secondary school to 6-7 form
- Middle aged (25-65yrs)

The statements indicate importance in ensuring tools used are safe for those affected, as well as an importance placed on native species, biodiversity and indigenous relationships with native species. This persona places less importance on ensuring the disease is contained geographically. This persona places an emphasis on the quality of response (long term biodiversity outcome of indigenous flora) over the timeframe, containment or personal accessibility aspects.

4.11.2 Using personas

While a persona is usually presented as a document or list, it is more than just a product or a deliverable – it is a way to communicate and summarise research-based audience trends and patterns to the wider design and operations team (Flaherty 2018). It is this fundamental understanding of users of the data expressed as personas that is important for communication and engagement design and implementation.

A persona represents a segment of audience members who exhibit similar behaviors in relating to biosecurity communication and engagement initiatives. By identifying their distinct preferences or needs, they help us understand what is personally meaningful to each target group. These, in turn, can be used to inform strategies towards more personalised solutions. They reveal emotional tendencies and triggers, as well as desired communication and engagement environments.

According to Cooper, "Personas consolidate archetypical descriptions of user behaviour patterns into representative profiles, to humanise design focus, test scenarios, and aid design communication" (2004). The power of the narration that typifies this method allows us to create a

story that introduces our communication and engagement packages in the everyday life of the imagined stakeholder. The process for creating personas does vary and they have been found to be most useful in supporting the discussion across different perspectives of them and how they can be used (Vincent and Blandford, 2014). Creating personas can help teams set goals, and envisage problems and potential issues in communication and engagement approaches.

However, teams only benefit from the use of personas if they buy into the concept, and are actively involved in their development and use. A first step is to involve the key players in reviewing and adapt the indicative personas for use in their own settings (Howard 2015). If the design team is going to use them they need to believe in them, feel some buy-in, and have ownership over them. In this way they provide a way to get all members of the wider design team on the same page. When all members share the same understanding of their target audiences, then building consensus on key design issues becomes easier as well.

Similarly, teams may require training in their use. They are not just A4 handouts, but need to be taken off the paper and actually be seen to be in the minds and decision-making processes of the design team (De Boer 2010). In this way they will be referenced in a wide range of discussions and decision-making processes as a matter of course. Guidance in their use can help teams both appreciate their value, and model the different ways that they can be formally used within projects (Miaskiewicz & Kozar 2011, Goltz 2014). Personas are not just useful to design a communication strategy for a group of people. They provide a way to model, summarize and communicate research about key audiences. The use of personas can structure a conversation that builds empathy with different audiences – helping the team to describe research results and highlight patterns in the types of people that they wish to engage. They can also be used to help make and defend design decisions, providing a mechanism to illustrate the team's reasoning for their communication and design decisions.

To make the most out of personas they need to be used throughout the whole communication and engagement strategy, and not just the design phase. They can help in prototyping and getting user feedback during early phases of the campaign. Above all they help anthropomorphize research findings (Goltz 2014) and help teams work in a more mindful way, keeping potential end users at the centre of the design process.

4.12 Discussion

The results of a survey of affected property owners and concerned individuals are discussed below in relation to the research aims, identifying areas of importance.

4.12.1 Initial contact made and timeliness of response

Most of the contact made was by respondents to the 0800 number with around three quarters of them reporting a concern in their area (22%) or in response to an outbreak on their property (53%). Of those who were contacted by the authorities, most (82%) were contacted multiple times. The timeframes were generally seen as good, except for those receiving RP notices who, on average rated the timeframe as 5.92/ 10 (0=not at all acceptable to 10=very acceptable). Comments provided indicated that people did describe the response positively (n=5), but twice as many (n=10) had negative comments about the timeliness of response.

Similarly, in relation to the response taken, the average rating for acceptability of the response taken was 6.13/ 10. Positive comments reflected the importance of responding, and necessity of trying to stop the spread of myrtle rust. Ten positive comments were given, eight neutral and 18 negative comments. Negative comments related to inconsistency or a lack of follow up and some concern about the competency of operators. Some were concerned about the uncertainty of the process or getting waste removed.

While there were a full range of views on the timeliness of response and its acceptability to respondents, this averaged out slightly above neutral in terms of acceptability. The acceptability of the response came out with a higher average level of acceptability. Comments provided indicate that more had negative experiences.

4.12.2 A preliminary understanding of information needs and response

More information was needed on the actions they could have taken, aspects of change in the process, a lack of confidence in the response teams or consistency of operations, time delays in advice or quality of advice given and no ongoing activity beyond the response operations. On the positive side, respondents already felt they had the competence to act and some also had sympathy for the response teams.

Whilst most expressed agreeance with the statements associated with social license to operate (SLO), there were some areas of disagreement including on whether what they cared most about was protected, whether it was easy to raise issues or concerns, and whether their concerns were taken seriously. Some also disagreed with being treated with respect. Many respondents were unsure on whether relations were maintained with neighbours or if they had been treated similarly to others.

When asked about what they appreciated most, 26 replied with comments about friendliness and courtesy, quick response and being taken seriously. The ease of understanding the communication, regularity of contact initially, and being approachable were also appreciated. Less positive comments related to a deterioration in communication over time and an unresponsive compensation effort. Furthermore, relatively few negative comments were given in response to what could have been done better. Some issues noted were the degree of organisation of response teams, poor follow-up communication, changes to response or consistency of effort, inevitability of the spread and wasted effort.

4.12.3 An initial identification of acceptability of management options

Analysis of respondents' responses showed a general acceptance of 16 listed response actions, however with a graduated acceptance for different options. At the higher level of acceptance, was the gathering of seed for conservation purposes at the top and for testing and analysing for resistance as second top. At the lower levels of acceptance was the restricted planting of myrtle plants on private property (lowest) and in public areas (second lowest). A graduated range of options in between showed comparability between different actions. For example, copper sprays were more acceptable (average rating 8/16) than fungicides (10/16); restriction of plant material movement from infected areas was more acceptable (3/16) than restriction of plant material movement into uninfected areas (7/16). Public investment in monitoring plants to increase early detection (4/16) and public investment in monitoring myrtle rust impacts (6/16), and use of biological control agents (5/16) were all higher than use of sprays.

Comments were invited on management options to help understand participants responses. About one third of respondents made comments (N=143) some of which were supportive of the actions, others needed more context, some provided alternative recommendations, some commented on the response operations; and some gave critical feedback on the survey. Many indicated that any response was acceptable (n=16), yet other commented on the difficulty or impossibility of eliminating the disease (n=6). Others were concerned about the lack of good advice (n=4) and the need for more research and knowledge on effective actions (n=9).

4.12.4 A prioritisation of different risks associated with myrtle rust

Out of the 12 areas of potential impact a weighted average indicated that most respondents rated the potential for ecosystem collapse due to loss of myrtles as the highest priority. The loss of personal freedoms due to the need to control the spread of myrtle rust was of lowest priority. This forced ranking displays an interesting contrast with findings from other strands of Theme "Building engagement and social licence" research, where evidence shows that peoples' experience of the incursion impact on personal freedom did matter (Stronge et al 2019). Two possible explanations for this are that what matters to people in the abstract differs from what matters to them in the real; or that how response operations were conducted affected what they found to be acceptable.

4.12.5 An appreciation of different values associated with myrtle rust

Respondents rating of the importance of statement relating different values (social, economic, cultural and environmental) to myrtle rust impacts, indicated a higher level of concern with ensuring human safety, maintaining the quality of the NZ environment and being able to quickly determine whether or not a tree is infected. Things that respondents (on average) felt were less important were ensuring continued access to public areas, being able to grow myrtle plants in their home

garden following the response operation and business continuity for growers of myrtle plants during the response operations.

While there are limitations with these results due to the bias in the sample of impacted and interested individuals, and also due to the questioning around the response operation rather than for issues of long term management, there are implications for the development of communication and engagement strategies. For example, messaging around human safety and protecting the quality of the NZ environment could increase the level of commitment for action. However, this would need to be tested with a wider and more representative sample of New Zealanders. This research provides an instrument for doing so.

4.12.6 Generic scales for mapping values across the QBL

Further to the myrtle-rust-specific value statements we asked respondents to rate their level of importance of 16 generic values statements. This provided a set of data that could be tested against a Chronbach Alpha reliability measure. Our examination of the data showed not four but six sets of values statements as items that could derive a principle component analysis of cultural, social, socio-cultural, economic, environmental and environmental equity values. We were thus able to demonstrate how such a tool could be used to map the diversity of values orientation with each of the six values sets geographically across regions. While our sample was limited, this tool could be applied more widely to better understand values and their diversity for developing communication, management and research strategies on myrtle rust.

4.12.7 A set of five personas associated with different responses to myrtle rust.

A set of five personas associated with different responses to myrtle rust were generated using the generic values statement (n=27) and those relating to myrtle rust specifically (n=16). A q-sort, characterising different types of subjectivity based on the degree of variance between different levels of agreement with statements, enabled us to create different persona groups. The q-sort used the combined 43 value-based statements to generate areas of convergence between different individuals in terms of their agreement with a subset of statements. The five personas generated could then be traced with respondents' demographic data and their acceptability of response actions to provide a means of differentiating between personas.

The five characteristic personas relating aspects of actions with values and demographic data becomes a tool for response agencies and their stakeholders to develop communication and engagement strategies that can specifically target certain groups and set of values. Alternatively, they can be used to design and develop appropriate management options that best meet the concerns of different persona types. Personas have been used in marketing over the past decade to help design products with a specified target market segment in mind, ensuring suitability of products for the market segment, and in a similar way, government messaging around public issues such as biosecurity can benefit from such design using targeted persona groups.

By identifying their distinct preferences or needs, personas can reveal what is personally meaningful to individuals in each group. Personas can help biosecurity teams to create different communication and engagement designs and management options for different kinds of people and to design for a specific somebody, rather than a generic everybody. However, the added value of developing personas is in the processes of identifying these key characteristics so that products developed (messages and engagement approaches) are well aligned with the values of that group. They can then become part of management teams thinking in being able to engage with a diversity of values and concerns. The use of personas can structure a conversation that builds empathy with different audiences – helping the team to describe research results and highlight patterns in the types of people that they wish to engage.

5 Conclusions and recommendations

5.1 Conclusions

People are concerned about biosecurity and prepared to make sacrifices for the greater good. Many indicated a strong sense of doing everything possible to control the outbreak of the disease. However, attention needs to be paid to how response operations are run, and particularly how people are engaged throughout the response period.

The research concluded that while people were less concerned about the timeframe of response, (most thought it was quick) the lack of a clear and consistent message from response agencies and MPI, coupled with at times inconsistent response action drew public concern. Information provided was not consistent across time.

Two main conclusions are drawn from this analysis.

Firstly, a lack of clear command about what action was to be being taken/ should be taken by people personally, in conjunction with inaccurate or inconsistent messaging, may have led to a perception of incompetency within the response actions. While there was an appreciation that agencies tried to engage with honesty and transparency to each case, there were some concerns about the effect of changing operations as the situation unfolded and the extent of myrtle rust presence became apparent. Some responses suggest that the agency was not well prepared for engaging people beyond response operations or to help them to expect changes. A minority of views indicated that the efforts to control the spread of the disease were futile and that resources were over-extended beyond reason.

Secondly, the way MPI engages needs to be managed, particularly where public expectations around management actions are unclear or may differ. For example, our results show that the majority of people would like to see hard hitting action to contain myrtle rust from spreading geographically, so may have failed to see why the government pulled back and decided to transition to a long term management response. Whilst a high level of alarm had been raised initially, things have been left hanging after the change in response to long term management – this may have adverse effects. Many respondents wanted to know what they can do and how they can minimise impacts. Information provided was easy to understand but not particularly useful. There were some gaps in knowledge on what people could be doing and other instances of no need for official information as respondents already felt well informed. Thus, there are differing knowledge needs for people interested or impacted by myrtle rust. Given the uncertainty about action beyond the official response, a gap has arisen in the ‘authority’ of no longer have a centralised control over information and knowledge. A considerable number of people wanted access to better and science-based knowledge on appropriate actions to take.

The acceptability of potential response actions or management options are shown to be aligned with different personas, reflecting a values-based identity along with demographic characteristics. These personas provide a potential reference for designing and developing communication and engagement strategies, as well as guiding likely support for different management options. The QBL value sets and factor analysis provides a reliable set of value-based data that orients different value perspective across six factors. Whilst this extends beyond four value bases, it does contain them. We have generated a map of graduated value orientations for the population sampled residing across all regions of New Zealand. Linear regression analysis conducted across the values statements shows that females care more about environmental, social and cultural values than males, and that Maori care more about values than Asians (except for economic values).

5.2 Limitations

These results provide a guide and insight to how a wider and more representative sample of New Zealanders may respond to myrtle rust and support initiatives for short and long term management. Importantly, they are grounded in a sample of people that are interested in or impacted by myrtle rust. Noting that this study has an education bias, with a higher proportion of respondents having tertiary level education or higher (63%); and age bias with an increasing number of respondents

(up to 74 year) in older age groups and over 50% aged 55 and over; and a gender bias with 56% of respondents' female and 42% male. The research findings would need to be validated with a wider and more representative sample of New Zealanders, particularly incorporating more Maori and Asian respondents, younger persons (particularly aged 35 and under) and those with lower than tertiary levels of education. Furthermore, there are limitations with these results around management actions due to the questioning around the response operation rather than for issues of long term management.

5.3 Recommendations

Our analysis of these results has developed two tools that are useful for guiding practitioners in their engagement, social licence and management activities. These tools are best developed and used with lead agencies and their stakeholders to further develop their management activities related to myrtle rust. They are particularly useful for designing communication and engagement activities in conjunction with other incursions responses and are also useful for developing management options for other biosecurity settings such as long term management.

- Understand the range and importance of different values relevant to myrtle rust and other potential biosecurity operations, and how they influence management actions across different responses to develop appropriate communication and engagement strategies
  - (i) Promote the use of this values test with survey providers to encourage a stronger appreciation of value-based diversity across regions and within particular groups of the community
  - (ii) Further test the values measure for other incursion responses and non-biosecurity settings to validate the instrument for wider use

- Understand personas to characterise different types of audiences and develop appropriate measures and messages for engaging them by focussing on their values and what concerns might influence SLO

  - (i) Some areas of need in terms of science knowledge on management options is outstanding (yet to be delivered) – and at the same time people do have current views on acceptability of different responses (and these seem to be influenced by values)
  - (ii) Clearly, not all value the contribution of Māori to governance or cultural values and aspirations for the development of Māori economy – therefore a different emphasis is required when communicating to public with this persona, as promoting response actions as important to Maori will not be a compelling factor.
  - (iii) Similarly, while the majority were supportive of trying to contain the geographic spread of the incursion, persona five were opposed to this strategy, and require a different communication approach.
  - (iv) Use the personas as a basis for development engagement and communication around myrtle rust, and further develop understanding of the different values across different areas of myrtle rust impact and acceptability of response actions

- Understand how SLO concerns influence impacted communities and use this knowledge as a basis for developing operational plans and engagement of communities that are interested or impacted by short, mid, and long term response operations.

  - (v) Support response team engagement with the findings through facilitation of reflection and desired action for improvement, for example, use the findings to help develop the engagement and communication practices, and support the development of SLO through rubrics

- Support management teams and strategic response operations including long term management in interpreting these results to design and development community partnerships.
  - (i) For example, facilitate the development of seed banking as this stands as the most acceptable response action, second to collecting seed for resistance testing, and support Māori in directing those activities to protect taonga.

(ii) Further explore the reluctance of communities to restrict planting in private and public areas, as well as other management options including use of sentinels, biological control and different types of spray (and their active ingredients) for controlling myrtle rust
(iii) Initiate other response actions for people to continue engagement, e.g., through long term monitoring and surveillance activities and increase awareness of types of interventions that can help reduce the spread risk and facilitate early detection

Whilst there is a strong support for incursion response and good evidence of social licence there are some concerns that relate directly to the expectations and maintenance of interest in biosecurity.

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Appendix A. Survey demographic data

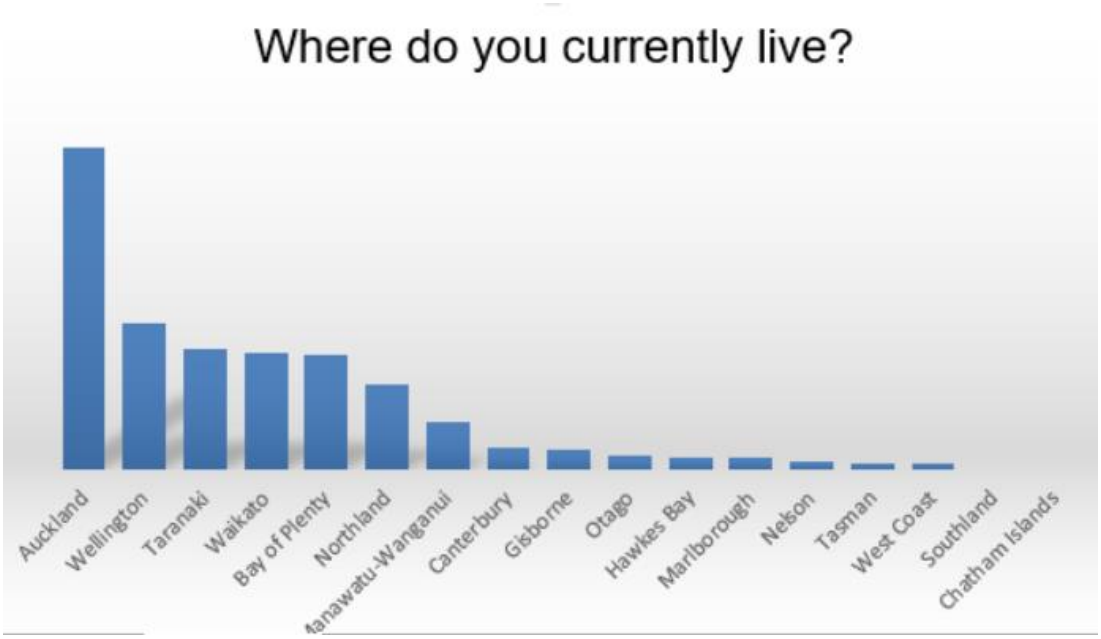

Figure A1: Regions where participants resided

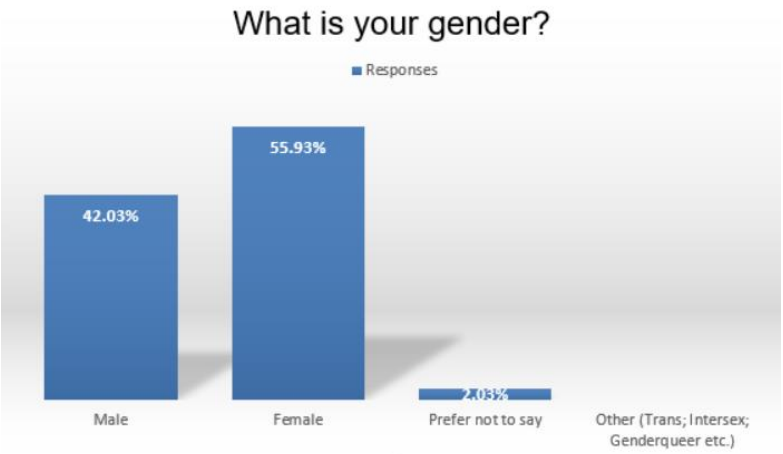

Figure A2: Participants gender

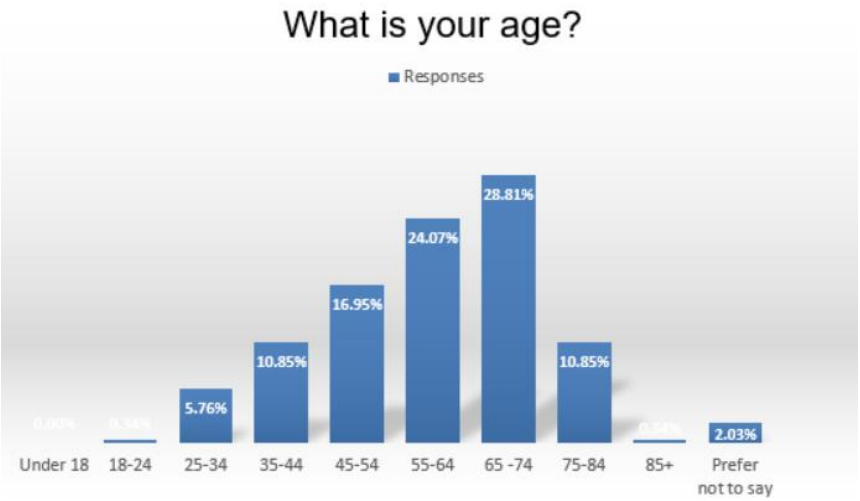

Figure A3: Participants age range

Appendix B. Survey initial contact data

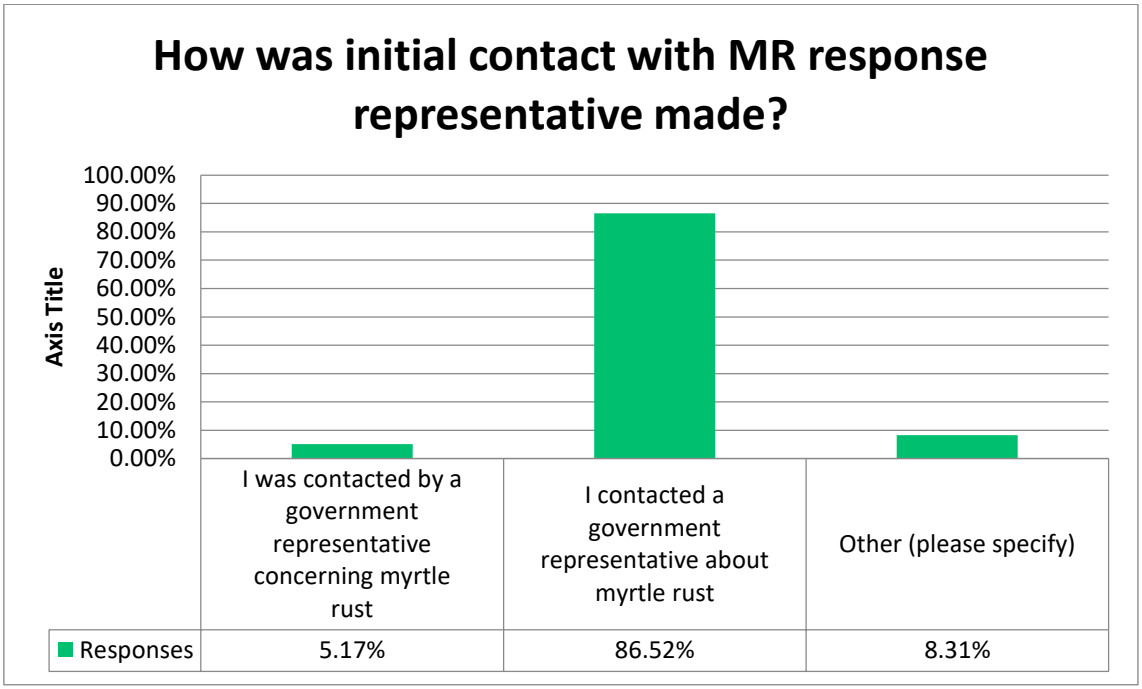

Figure B1: How initial contact was made

Appendix C. Survey qualitative comments

Comments on acceptable/unacceptable actions

Respondents added comments to assist the researchers in interpreting their responses to acceptability of 16 potential management actions. Just under one third of the respondents offered comments (N=143).

Many indicated that any response was acceptable to protect native species, e.g.,

(vii) *Anything that has to be done to protect our natives should be done.*
(viii) *I believe every effort should be made to protect our myrtle plants by destroying the rust in a safe and eco sensitive way.*
(ix) *I am keen to see myrtle rust being controlled. I have pohutakawa, feijoa and guava on my property and was monitoring them.*
(x) *I believe to protect the biodiversity and natural assets the only restrictions on using every possible solution are few.*
(xi) *"I am in total support doing what we can to restrict and prevent the spread. Unfortunately it is a disease which is easily spread by natural ways.*
(xii) *Due to the nature and potential spread of the disease I think we should do everything we can to stop it.*
(xiii) *"I believe every effort must be made to protect our native species from this disease and value the steps taken to do so .*
(xiv) *The risks of losing our iconic native trees is high.we cannot ignore action is needed.*
(xv) *I also wonder how , if this disease hit our Manuka hard , would it impact on our ever growing honey industry."*
(xvi) *I believe we should be doing EVERYTHING in our power to have this hideous disease contained and eliminated*
(xvii) *Just believe we should do all that we can for the protection of plants likely to be infected*
(xviii) *Bio-security if of utmost importance to protect our native plants and I feel that we cannot turn a blind eye to its existence so every effort should be made to eradicate it and protect our plant life.*
(xix) *I think that it has to be a total attack on all possible fronts, even though this could be upsetting to some people (eg wahi tapu; widespread use of sprays).*
(xx) *Anything which can be done to help seems like it would be worth doing*
(xxi) *EVERYTHING SHOULD BE DONE TO STOP THE SPREAD OF THE VIRUS AND TO PROTECT OUR NATIVE TREES*

Others were concerned about the difficulty or impossibility of eliminating the disease, especially as the disease is airborne, e.g.,

(iv) In answer to 24 I cannot see that restricting access to people in public areas can *help deter an airborne disease.*
(v) *Restricting access to protect an area... why? I the disease is spread on the wind.*
(vi) *"Myrtle rust is here it will be very difficult to eliminate*
(vii) *we need effective treatment measures. Hopefully plants will build resistance."*
(viii) *The acceptability of some actions depends on the likelihood of success. Use of sprays and removal of plants seems pointless, or detrimental in other ways, if the spread of myrtle rust cannot be prevented.*
(ix) *"If wind is the main carrier of the infection, then restricting human access to an area probably wouldn't work. Opposite to Kauri dieback.*

Some were concerned that they lacked good advice on the management of plants, particularly with using sprays, e.g.

(iv) *My connection to myrtle rust surveillance was minor and therefore I do not feel adequately informed to be able to make any objective comment with respect to the above list. MPI did do a surveillance review of my property, however I would welcome advice from them regarding the ongoing management of the plants that MPI are aware I have on my property.*
(v) *I'm cautious about use of sprays without knowing more about them eg. how they affect the environment.*
(vi) *I'm not sure about the impact of sprays which is why I went neutral on that, definitely need education on this before deciding*

(vii) *I do have a concern re the use of fungicides in the natural environment. What other fungi are impacted by the drip line around the plant?*

Some required more research and knowledge on what could be effective in limited the spread or other measures, e.g.,

(iv) *Also, it would be good to know more about all of the strategies possible to limit the spread."*
(v) *Lack expertise on the efficacy of some of the measures suggested*
(vi) *We have to rely on experts to advise us.*
(vii) *as this disease will cause serious problems to NZ the above actions are acceptable to learn more about and to combat the disease. Provided they are managed in an intelligent way.*
(viii) *What I have read about the ability of this rust to disburse in the wind over large areas would mean you should be looking at a strategy of management rather than containment.*
(ix) *I'll leave it to people with a better knowledge of containment / eradication than me to decide what is the best and most effective way forward*
(x) *I accept that in certain circumstances there is a reality that has to be faced in combating myrtle rust but it would be good to think biologically in terms of control and invest in research*
(xi) *I don't feel I know enough about the science involved in some questions*
(xii) *Based on expert opinion that the proposed measures would make a significant difference*

Others, whilst reluctant to see fungicides or tree removal were supportive if it meant protecting heritage trees, e.g.,

(iii) *I hope that removal of plants from public or private land is intended to refer to removing plants that are believed to be infected, rather than total removal of all myrtle species.*
(iv) *Re use of sprays to protect host plants ,I am not in favour but in a infected area may be ok to protect heritage trees.*

Some felt that more context was needed to respond and that actions were needed but within limits, e.g.,

(iv) *Restriction of plant material: again I assume 'infected' material. It should be destroyed effectively on site if possible.*
(v) *Biological control agents and fungicides: yes as long as safe otherwise and no unintended consequences.*

Others also felt that the way things had evolved meant a need to change tack and thus some actions were needed under these circumstances, e.g.,

(vi) *Removal of plants was good at the start of the outbreak to attempt to contain the outbreak but now I see little value in removal even in areas where rust is not present*
(vii) *It's a tough one to manage (we ended up ripping ours out) and I think it is probably going to be a trial and error scenario for a while. Keep up the good work and even though it might seem people don't care, they love our natives and are thankful for all you have done.*
(viii) *I feel the best response is to monitor the Rust infestation and build up resistant stock that will eventually replace the infected species.*
(ix) *Christchurch has outstanding wetlands with lots of boardwalk access and more being established. Eco-sourced planting is ongoing including lots of rohutu. This is species is very susceptible to MYR and until resistant varieties are found, should not be planted to protect the manuka and kanuka also being planted.*
(x) *restricted planting may become necessary, but will alter the face of our landscapes and relationship with our place - of course, so would losing iconic species to diseases and pathogens. So long as due diligence was observed, I am OK with use of sprays and fungicides*
(xi) *At the very least I would like to see the widespread removal of and restrictions on planting of host non-native non-food-bearing plants (ie acmena for a start which also harbour fruit driller moth, another menace that has seen us remove all our plum and feijoa trees). I'd be okay (but not enthusiastic) about attempted chemical control for host native species. We need to get over what seems to have become a 'wet blanket' response to issues that threaten our native species.*
(xii) *The first few examples are generally acceptable to me, but are context dependent. eg, for the first q. removing swamp maire would be a pretty extreme measure, however removing ramarama potentially a good idea*

Some positions were contested, e.g., movement controls or restricted access to areas for protection or restricted plantings, e.g.,

(xi) *Restriction of access should be much more common. With making access so easy we have allowed a lot of weeds to spread, which I find very sad for our precious unique flora.*
(xii) *Given it is wind borne, restricting public to access to area seems onerous, if people spreading the disease isn't the main way it spreads.*
(xiii) *Restrictions wont work anymore most people are moving debri wherever they want..It moves in the wind can't be stopped now*
(xiv) *"I see that most plants being of these species are still being sold at garden centres. It should be compulsory to at least advise costumers when purchasing these plant of possible problems they may face which would give them an option to buy more robust plants.*
(xv) *As my concern turned out to be inaccurate, I'm not sure what to think. I'm not keen on total abolition of uninfected plants but I favour monitoring possible host plants.*
(xvi) *We need to do everything we can to control &/or eliminate the disease but I don't think that it is right to restrict people from planting myrtles on their own land.*
(xvii) *With Biological control agents I am a bit less favourable due to potential adverse affects on other aspects of the ecosystem. However I am still positive towards them as I know these agents go through rigorous tests to try to ensure that there are no adverse effects.*
(xviii) *"Bio-control through limiting movement is very important.*
(xix) *Chemical control should be undertaken in areas surrounding infected areas to prevent spread. Biological control may back-fire and requires substantial prior research. This may not work in the available time-frame."*
(xx) *"I see that most plants being of these species are still being sold at garden centres. It should be compulsory to at least advise costumers when purchasing these plant of possible problems the may face which would give them an option to buy more robust plants.*

Some had issues around compensation, e.g.,
(iv) *I had recently replaced pittosporum hedges within my village some only being in ground for 3 months before being ripped out by MPI.*
(v) *We had 245 Ramaramas pulled at an average cost (small to large) at $25.00 .....$6000+dollars*
(vi) *No compensation."*

Others felt the expense was a waste of taxpayers money, e.g.,
(iii) *The myrtle rust seemed to come with a rush of panic.....It was never heard of again till you emailed me twice.....Is it still here and how many people are now getting onto the wagon at great cost to the taxpayer...*
(iv) *If Myrtle rust is windborne then for every identified infected tree there is bound to be many more undetected. I felt many reactions were a case of shutting the stable door after y horse had bolted.*

A couple of response made specific comments about environmental and cultural impacts, including the duty to include iwi in decision making e.g.,
(iv) *Christchurch has outstanding wetlands with lots of boardwalk access and more being established. Eco-sourced planting is ongoing including lots of rohutu. This is species is very susceptible to MYR and until resistant varieties are found, should not be planted to protect the manuka and kanuka also being planted.*
(v) *I still think alot of the questions answered will only give u a qauntitum measure and that discussions need to be held with Mana tangata of the land assessed as to what access and provisions ate set in place... especially in regards to waahi tapu, and places of cultural significance that the people of place co manage their lands.*
(vi) *as a representative of a ToW settled iwi, we see direct consultation is required, the partnership between iwi/crown (i.e. MPI & DoC) is paramount to protecting our taonga waahi tapu and Taiao. first question of this survey is indicattive of current approach as not 1 of them involved iwi as affected party. As the owners of the native taonga being affected as guaranteed under ToW no action or decision should be made without iwi import at the very top of this decision making process. And should not be determined by a survey of acceptance! Too many of our taonga are now threatened or extinct without our input to allow another process the ability to make impact decisions without consultation is unacceptable.*

One was particularly concerned that greater national coordination of an eradication effort was not maintained,
(v) *Response needed to be a blanket removal and incineration of all myrtles nationwide with a replanting programme to start 2-4 years after all plants removed and incinerated. Or the*

government needed a plan in place and already done research into how the rust has affected other countries, for example QLD Australia, it's now more than 10 years since they got it and they have naturally resistant plants growing now, it destroyed the myrtle growers for a few years but they are back on their feet now.

Some were concerned about using chemicals, e.g.,

(vi) *It is important that NZ does all that is possible to restrict the spread of this disease, but if we can do it through natural methods and not lots of sprays, would be great.*

(vii) *I am against the use of chemicals as they have an unknown effect on soil health. I'm only an interested individual who happened to purchase plants from infected nursery*

(viii) *I am concerned that some sprays may have unacceptable side effects*

(ix) *"Use of fungicides depends - if pregnant women could be exposed it's a teratogen so needs to have restricted use /public access*

Others resisted the idea of tree removal, particularly on private property, e.g.

(iii) *I strongly disagree with the removal of (suspected) myrtle rust affected trees on private property without confirmation from the owners of that private property. I feel this way because feijoa trees were cut down on a friends property, when it was later discovered feijoa is resistant to myrtle rust. I believe unless it is ok'd by the owner, and is proven to be infected (especially fruit trees) trees should be preserved.*

(iv) *I would not be keen to see uninfected trees removed and even where there is already infection it may have already moved on and the trees would be lost without preventing the movement. Unless the chemical use was certain to be effective I would prefer biological efforts.*

A few felt that it depended on the circumstances and that they did not have enough information to judge, e.g.,

(iv) *Q7: It all depends on whether the plants are indigenous or not. I am totally in favour of you removing alien non-native plants. I would be happy for NO alien plants to ever be planted on roadsides/ public land etc. Under certain circumstances I would accept that native plants need to be removed or restricted also, to limit the threat. But you need to get the info/ reasons out there in the public domain.*

(v) *On some of the questions I have stated neutral as I do not know enough about what you are suggesting*

(vi) *A lot of my responses above are "acceptable" rather than "totally acceptable" because I think the level of response would depend on the extent of infestation/s and "how far gone" it may be.*

(vii) *I don't fully understand what is implied by the three plant removal and restriction measures. I need more information to comment*

(viii) *I haven't responded to most of these options, through not knowing the science behind containing this disease.*

(ix) *We don't understand the possible consequences of some of these options well enough to make a considered response.*

Some sought prevention rather than treatment, and a high level of resistant to removal of native plants, e.g.

(iii) *This is beautiful plants and to remove them from public areas will be a disgrace. Rather treat them to prevent an outbreak again. They are distinctive of NZ and had to be seen by public and their glory enjoyed in many private properties*

(iv) *Instead of just surveillance and lack of action, how about a removal team to act instantly on infected plants. rather than waiting weeks, or as current situation is, doing nothing and letting infected pohutakawa remain in public areas!!*

Others felt that actions needed to be more rapid to effective control the spread, e.g.,

(iv) *Instead of just surveillance and lack of action, how about a removal team to act instantly on infected plants. rather than waiting weeks, or as current situation is, doing nothing and letting infected pohutakawa remain in public areas!!*

(v) *There are too many examples of lack of diligence by all parties in not taking expeditious action to prevent incursions, spread and eradication of unwanted plants, animals, diseases and materials in to our environment."*

(vi) *I was disappointed with the lame effort and contact following me notifying concerns. I would like to see HASTE TO INVESTIGATE UPON RECEIVING POSSIBLE SIGHTINGS added to this list above.*

Some called but found that there concern was not actually realised as myrtle rust, e.g.,

(iv) *There needs to be a Full list & photographs of infections on each tree type affected online. This would save the staff/response team from having their time wasted as was the case in my situation. Our trees were infected with sooty mould, essentially a waste of your time.*

Some recommended resistance breeding as an only certain solution, e.g.

(v) *Given the extent of the spread I would imagine that eradication was not possible and that a resistance breeding program along with spraying and MC in highly infected areas would be the best bet.*

(vi) *"1 and 2 do not specify that the plants are infested; just removing plants doesn't allow for the opportunity of finding resistant cultivars. If resistant cultivars are identified then planting of them would be acceptable(#s 3,4).*

#8 Could resistant cultivars be moved into uninfected areas?

Other priority concerns list listed in forced ranking of risks

Concern about the spread or impact of myrtle rust was the most commonly raised concern (n=12) and the next most common concern was about the response operation (n=11).

Concern about spread/ impacts (n=12)

(v) *The affect on NZ stick insects if they lose a lot of plants they feed on.*
    1. *Not being able to grow and harvest myrtle fruit - e.g. feijoas*

(vi) *Loss of biodiversity in the wild.*

(vii) *Related to ecosystem loss is the loss of coastal protection provided by myrtle forests particularly in the north.*

(viii) *Loss of these affected species which are pioneering species and thus pivotal species for regenerating native bush*

(ix) *Honey industry and the discovery of resistance plants. No active RESEARCH??????*

(x) *Concern of threatened species that may be lost because of myrtle rust*

(xi) *Loss of NZ 's clean green image & reputation due to our inability to control disease and pests.*

(xii) *Nothing to add except to say that I regard to the invasion of our eco system in New Zealand by foreign diseases as very serious*

(xiii) *Concern for loss of revenue from exports of Manuka Honey and Feijoa.*

(xiv) *I'm very concerned about the potential for pohutakawas on coastal areas (such as on our property) being lost to myrtle rust and losing the erosion control on the cliffs and banks.*

(xv) *"The need to act quickly and "nip the problem in the bud" as it were...don't dither about and let it get further out of control, endangering more areas and aspects of our heritage. The potential to lose our big old pohutukawa forest remnants around the coastline that protect us from erosion, & are important tsunami energy dissipaters/protection.... The old song that says "we don't know what we've got till it's gone" is so true.....can you even bear to imagine what the loss of our wonderful pohutukawa trees would do to the landscape...the same applies to manuka and kanuka, which is also extremely valuable for the specialist honey it provides, as well as it's visual impact."*

MPI/ AQ response (n=11)

(iv) *Inefficient and wasteful use of public money during response.*

(v) *The slow response from the myrtle rust line. We didn't have rust but were worried that we did. If it was urgent to contact the department it should not have taken days for a response.*

(vi) *Mixed messages re myrtle rust response flowing from slow reaction to unfolding events by the Minister.*

(vii) *No. The response I got when I reported a suspected outbreak on Mauao in Tauranga was excellent. Website was good too.*

(viii) *Yes the fact you haven't bothered to take a look at people s property which phoned you.* 👎

(ix) *to be taken seriously by the person at the other end of the phone instead of being asked to do this or that as we don't know if you are right that it is Myrtle rust It is important deal with it*

(x) *Lack of ongoing contact from MPI to visit my premises to advise best detection method or possible actions if further detection*

(xi) *"Yep, came home one night to Neighbours hedge laying on my drive. Rung Asure and was told I wasn't an affected landowner so there no risk of contamination. Took three weeks for our driveway to be cleared. Then I seen them spraying suspected trees with a mist blower! If it is spread in the wind then that seemed a great idea to me! It seemed there was a lack of knowledge on the whole scale of the operation. We couldn't get a contact for anyone to discuss the impacts, we just had people wondering through our property in white suits looking at our plants. They didn't have a contact for us to call and discuss what was happening."*

(xii) *"A unified voice and answer when questions about the safely of treatments (fungicides and concrete sprays etc) are being used, and how that will affect not only us as humans, but also animals and insects (especially bees!!!). I was very disappointed that one MPI staff member would say a specific treatment is fine and would not affect bees, but speak to one other staff member and receive the complete opposite as their truth to that question. Please ensure every staff member is well educated, and if no answer is certain, please say so! Especially if you don't know for certain!"*

(xiii) *"Education and awareness!! I speak to a lot of people about this issue. it is very common that people either have no idea what it is or have never heard of it, or they believe the issue is over and resolved as they have not heard anything in the media, either national or local for a long time. My biggest concern locally is the number of infected pohutukawa in the local town (Kerikeri) reserve. This is an area where all locals and visitors spend a lot of time, particularly in summer, walking dogs, playing sports or eating. It is also the main thoroughfare for the 1500+ students from the local high and primary schools. In other words, a high pedestrian traffic area, positively and heavily infected trees, nothing being done!"*

(xiv) *"1) The fact that MPI did not contact me for over two weeks after I notified them of the infection. 2) The fact that MPI after saying they would let me know within a week, waited over two weeks to tell me that I could either ignore the infection and do nothing or remove the plant myself."*

Appendix D. Overview of methods

OVERVIEW OF QBL VALUES

- 16 items related to generic values (Q66-81). In forming these, we tried to get 4 each relating to each of the 4 QBL area (Env; Soc; Cult and Econ). They were informed from an Australian study (Donovan, 2008) which looked at QBL aspects in research impact.
- A factor analysis (PCA) was run on these items to categorise them into different factors, as a check on whether they were distinctly measuring scales relating to the four QBL categories (Env; Soc; Cult and Econ). The factor analysis found 4 distinct groups – however, one of the factors wasn't reliable (Cronbach Alpha of 0.519), and the first factor contained highly reliable factor (Cronbach Alpha = 0.867) but was socio-cultural, and the second factor was about environment and equity values (Cronbach Alpha = 0.771). There was however, a high reliability (Cronbach Alpha) between the original items that could be determined as relating to each of the QBL categories.

OVERVIEW OF PERSONA METHODOLOGY

- The 27 items relating to important values associated with myrtle rust response (q37-63); along with the 16 generic QBL values (Q66-81) were collated into a single values 'set'. Each respondent has ranked each of these items on a scale from 0-10 (0 being unimportant; 10 being very important)
- After cleaning of data, N= 375 respondents
- These 43 items were run through a QSORT using Ken-Q analysis https://shawnbanasick.github.io/ken-q-analysis/
- Ken-Q is an online Q Methodology
- Each respondents' rating over the 43 items was ordered from highest to lowest importance score, and then the following QSort scale applied:

5, 5, 4, 4, 4, 3, 3, 3, 3, 2, 2, 2, 2, 1, 1, 1, 1, 1,0,0,0,0,0,0,0,0, -1,-1,-1,-1,-1,-2,-2,-2,-2,-3, -3,-3,-3,-4,-4,-4,-5,-5

- Centroid extraction found 6 factors over Eigenvalue of 1.0, which explained 63% of the variance.
- 6 factors were retained for further extraction and rotated (Varimax)
- Factor loadings (those above 0.4 were retained into factor sets) applied
- One factor (Factor 6) only contained a single respondent
- The Qsort visualizations were captured for the other 5 factors (not factor 6) – these represent an overall sort of the statements for each factor as a whole
- Those statements which had values of -5 and -4; and 5 and 4, were termed high and low respectively within the persona write-ups (And those that are in bold are ones with a significantly higher (lower) Q-score than for other factors.
- These high and low statements for each factor were assessed subjectively, to find some overarching theme or commonality.
- Five new variables were created named F1-F5, where the respondents relating to that persona were set to 1; and those not in that persona set to 0.
- ANOVA was undertaken on each of F1-F5 to assess mean differences between F-scores for key demographic variables: Age; gender; personal income; household income; education level; residency status; ethnicity; region of residence
- Significant differences in demographics were also highlighted as part of the propensity of certain demographics to be present (or absent) in each factor. The demographic difference and the high and low statements from each factor created each 'persona'.

Appendix E. Regression analysis of the Myrtle Rust survey

To: Andrea Grant and Karen Bayne

From: Tarek Soliman

Date: 29 January 2019

Subject: Regression analysis of the Myrtle Rust survey

Introduction

A survey on Myrtle Rust was developed to collect information on the community experiences of the myrtle rust incursion and response across multiple regions of New Zealand. This report evaluates how demographic characteristics of the respondents including ethnicity, gender, age, education, and income correlate with community perceptions. The demographic characteristics considered are ethnicity, gender, age, education, and income of the respondents while the community perceptions considered are (1) the quality of the communication & engagement between the regulatory authorities and the community (communication), (2) the level of acceptability for potential intervention measures to control Myrtle rust (acceptability), (3) the national impacts and outcomes that are important to the community (impacts), (4) the perception of the community to the potential risks that are posed by myrtle rust (risk), and (5) the values that are important for the community to protect (values).

Methods

A linear regression model was used to test the effect of demographics on groups of questions in the survey.

The linear regression model assumes that the explanatory variables are the demographics of the respondents. These demographics are defined as categorial variables. The response variable is numeric variable and is estimated as the sum of the scores given to the Likert scale for each question.

The dataset initially consists of 451 responses. However, after removing all responses with missing values we end up with a total of 241 responses. As the dataset has several dependent variables that are representing the same information[4], we have used a "Multiple correspondence analysis" and "principle component analysis" to identify the most important variables that could represent the four community perception points. We then aggregate these identified variables as one variable for each perception point. The list of questions in each value are shown in Appendix 1.

Results

1. Values

In general, the results showed that female care more than male about values and Maori care more than Asians about values (except for economic values). In addition, it was shown that socio-cultural and cultural values receive the most agreement between Māori respondents on their importance to them. More details about each value and level of agreement between respondents are shown below.

[4] In the survey some questions were asked several time but in different wording to insure that the respondent has consistent views across the survey.

Table 1 shows the effect of the demographics on the economic values. The results show all demographic variables are insignificant.

Table 1: Economic values

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	27.34589	5.534229	4.941229	1.49E-06***
Gender Female (Baseline)				
Gender Male	-1.0151	0.678536	-1.49601	0.136021
Gender Prefer not to say	-5.48562	3.716136	-1.47616	0.141268
Identity Asian (Baseline)				
Identity Māori	-2.71254	2.158779	-1.25652	0.210203
Identity NZ	0.854092	1.201394	0.710917	0.477856
Identity other	1.160415	1.522175	0.76234	0.446638
Identity Pakeha	-1.32843	1.148176	-1.15699	0.248477
Age 18-35 (Baseline)				
Age 35-55	0.087628	1.719498	0.050961	0.959401
Age 55+	1.997637	1.628644	1.226564	0.221241
Degree No school (Baseline)				
Degree School	-4.52834	5.253317	-0.862	0.389587
Degree Uni	-5.71199	5.202367	-1.09796	0.27337

Table 2 shows the effect of the demographics on the environmental values. The results show that female cares more about environmental values compared to male (by 1.36 percent).

Table 2: Environmental values

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	37.99163	4.059902	9.35777	7.64E-18***
Gender Female (Baseline)				
Gender Male	-1.36185	0.497773	-2.73589	0.006707**
Gender Prefer not to say	1.15361	2.726152	0.423164	0.672571
Identity Asian (Baseline)				
Identity Māori	2.235505	1.583677	1.411591	0.159422
Identity NZ	0.689522	0.881341	0.782356	0.43481
Identity other	1.208927	1.116665	1.082623	0.28011
Identity Pakeha	0.393207	0.8423	0.466825	0.641067
Age 18-35 (Baseline)				
Age 35-55	-0.36677	1.261421	-0.29076	0.771496
Age 55+	0.977018	1.194771	0.817745	0.414349
Degree No school (Baseline)				
Degree School	-1.57875	3.853826	-0.40966	0.682439
Degree Uni	-2.31178	3.816449	-0.60574	0.545284

Table 3 shows the effect of the demographics on the cultural values. The results show that female cares more about cultural values compared to male (by 2.7 percent). In addition, Māori respondents tend to care more about cultural values compared to Asians (by 5.67 percent).

Table 3: Cultural values

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	35.37879	7.200831	4.913154	1.70E-06***
Gender Female (Baseline)				
Gender Male	-2.76255	0.882874	-3.12904	0.001981**
Gender Prefer not to say	-1.14267	4.835229	-0.23632	0.813394
Identity Asian (Baseline)				
Identity Māori	5.677831	2.808883	2.021384	0.044399*
Identity NZ	0.142039	1.563188	0.090865	0.927679
Identity other	2.236789	1.980569	1.129367	0.25992
Identity Pakeha	0.997269	1.493942	0.667542	0.505095
Age 18-35 (Baseline)				
Age 35-55	1.220922	2.237315	0.545709	0.585795
Age 55+	2.38649	2.119101	1.12618	0.261263
Degree No school (Baseline)				
Degree School	-6.88617	6.835324	-1.00744	0.314783
Degree Uni	-8.26465	6.769031	-1.22095	0.223355

Table 4 shows the effect of the demographics on the social values. The results show that female cares more about social values compared to male (by 1.69 percent). In addition, Māori respondents tend to care more about social values compared to Asians (by 3.6 percent). However, there is less agreement between respondents on the social values compared to cultural values.

Table 4: Social values

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	27.44735	4.767354	5.757355	2.72E-08***
Gender Female (Baseline)				
Gender Male	-1.69162	0.584512	-2.89407	0.004169**
Gender Prefer not to say	0.496967	3.201193	0.155244	0.876765
Identity Asian (Baseline)				
Identity Māori	3.600425	1.859638	1.936089	0.054082˚
Identity NZ	0.343148	1.034918	0.33157	0.740516
Identity other	1.317206	1.311248	1.004544	0.316172
Identity Pakeha	0.100914	0.989074	0.102029	0.918823
Age 18-35 (Baseline)				
Age 35-55	-0.12056	1.481228	-0.08139	0.935203
Age 55+	1.143355	1.402964	0.814957	0.41594
Degree No school (Baseline)				
Degree School	-1.97175	4.525368	-0.43571	0.663456
Degree Uni	-2.93082	4.481478	-0.65398	0.513775

Table 5 shows the effect of the demographics on the environmental-equity values. The results show that female cares more about environmental-equity values compared to male (by 1.8 percent). In addition, Māori respondents tend to care more about environmental-equity values compared to Asians (by 3.4 percent). However, there is less agreement between respondents on the environmental-equity values compared to cultural values.

Table 5: Environmental-equity values

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	47.13585	5.200208	9.064222	5.63E-17***
Gender Female (Baseline)				
Gender Male	-1.87332	0.637583	-2.93816	0.003638**
Gender Prefer not to say	2.703195	3.491847	0.774145	0.43964
Identity Asian (Baseline)				
Identity Māori	3.483939	2.028485	1.717508	0.087232 °
Identity NZ	0.694498	1.128884	0.615208	0.539026
Identity other	2.130526	1.430303	1.489562	0.137709
Identity Pakeha	0.371694	1.078877	0.344519	0.730771
Age 18-35 (Baseline)				
Age 35-55	-0.02602	1.615717	-0.0161	0.987166
Age 55+	1.365778	1.530347	0.892463	0.373078
Degree No school (Baseline)				
Degree School	-2.37191	4.936252	-0.48051	0.631322
Degree Uni	-3.39932	4.888377	-0.69539	0.487514

Table 6 shows the effect of the demographics on the socio-cultural values. The results show that female cares more about socio-cultural values compared to male (by 4.45 percent). In addition, Māori respondents tend to care more about socio-cultural values compared to Asians (by 9.27 percent). However, there is similar agreement between respondents on the socio-cultural values compared to cultural values.

Table 6: Socio-cultural values

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	62.82614	10.82996	5.801144	2.17E-08***
Gender Female (Baseline)				
Gender Male	-4.45417	1.327831	-3.35447	0.00093***
Gender Prefer not to say	-0.6457	7.272123	-0.08879	0.929325
Identity Asian (Baseline)				
Identity Māori	9.278255	4.224525	2.196284	0.029071*
Identity NZ	0.485186	2.351014	0.206373	0.836682
Identity other	3.553995	2.978751	1.193116	0.234053
Identity Pakeha	1.098183	2.24687	0.488761	0.625476
Age 18-35 (Baseline)				
Age 35-55	1.100366	3.364893	0.327014	0.743955
Age 55+	3.529845	3.187101	1.107541	0.269217
Degree No school (Baseline)				
Degree School	-8.85791	10.28024	-0.86164	0.389781
Degree Uni	-11.1955	10.18054	-1.09969	0.272615

Value scale – based on factor analysis of values statememts

CULTURAL VALUE SCALE (ALPHA= 0.821)

- Growing the Māori economy
- Celebrating our heritage as a nation
- Understanding our past and future aspirations as a society
- Maintaining my cultural values and practices

ECONOMIC VALUE SCALE (ALPHA= 0.790)

- Maintaining a high standard of living
- Maintaining our productive economy
- Maintaining global competitiveness

SOCIAL (ALPHA= 0.769)

- Maintaining social bonds with family and friends
- Ensuring an inclusive and diverse society
- Enhancing levels of social equity and justice

ENVIRONMENTAL (ALPHA= 0.754)

- Protecting New Zealand biodiversity and our natural environment
- Maintaining personal health and wellbeing
- Ensuring an environment that all people can enjoy
- Improving the quality of our water and air

ENVIRONMENT & EQUITY (ALPHA= 0.771)

- Enhancing levels of social equity and justice
- Protecting New Zealand biodiversity and our natural environment
- Maintaining personal health and wellbeing
- Ensuring an environment that all people can enjoy
- Improving the quality of our water and air

SOCIO-CULTURAL (ALPHA= 0.867)

- Growing the Māori economy
- Celebrating our heritage as a nation
- Understanding our past and future aspirations as a society
- Maintaining my cultural values and practices
- Maintaining social bonds with family and friends
- Ensuring an inclusive and diverse society
- Enhancing levels of social equity and justice

Appendix F. Persona groups based on Q-sort related to response actions

Qsort persona		Removal of plants from public land (reserves, domains, conservation parks, national parks)	**Removal of plants from private property (including wahi tapu (sacred sites), trust and individual landowner sites)**	**Restricted planting of myrtle plants in public areas (roadsides, reserves, river banks)**	**Restricted planting of myrtle plants on private property (land trusts, wahi tapu, individual sites)**	**Use of sprays, e.g., currently concrete sealer, to lock in the pathogen before removing plants**	**Use of sprays, e.g., copper oxide, to treat plants that are hosts for the disease**	Restriction of plant material movement from infected areas	**Restriction of plant material movement into uninfected areas**	**Public investment in monitoring plants to increase chances of early detection in uninfected areas**	**Public investment in monitoring myrtle rust impacts on ecosystems and landscapes**	**Use of biological control agents, e.g., such as companion plants or algae, to protect plants from infection**	**Use of fungicides, e.g., with active ingredients to protect plants from infection or boost resistance to the pathogen**	Planting susceptible plants into high value areas to act as an early warning of disease presence	Gathering seed from uninfected areas to conserve susceptible species	Gathering seed from infected areas to test and analyse resistance of plants	**Restricting access to protect an area, e.g. via rahui or restriction on public access**
1.00	Mean	7.13	6.78	8.00	7.91	8.26	8.77	9.05	8.82	9.18	9.09	9.00	8.43	7.83	9.18	9.17	8.13
	N	23	23	23	23	23	22	22	22	22	23	23	23	23	22	23	23
	Std. Deviation	3.266	3.059	2.523	2.610	2.261	1.716	1.558	1.893	1.259	1.345	1.595	1.805	2.498	1.532	1.497	2.881
2.00	Mean	7.53	7.58	7.52	7.54	8.42	8.65	9.51	9.20	9.54	9.24	9.22	8.41	7.93	9.63	9.43	9.25
	N	96	96	94	95	96	95	95	97	98	98	98	98	96	98	98	97
	Std. Deviation	3.074	2.912	2.727	2.685	2.369	2.118	1.271	2.009	1.364	1.873	1.750	2.389	2.852	1.358	1.370	1.528
3.00	Mean	7.48	7.75	7.38	6.71	7.58	8.54	8.93	8.46	8.47	8.57	8.95	8.32	7.51	9.10	9.26	7.66
	N	88	87	87	87	89	87	86	87	88	88	87	88	88	84	88	88

	Std. Deviation	3.074	2.978	3.016	3.136	2.895	2.271	2.152	2.574	2.363	2.175	1.771	2.395	2.738	2.080	1.636	2.924
4.00	Mean	7.23	7.09	6.94	6.35	7.74	8.42	9.21	8.42	8.97	8.87	8.56	7.84	7.85	9.41	9.09	8.13
	N	136	137	134	134	136	138	136	136	137	136	137	137	136	136	139	136
	Std. Deviation	3.132	3.318	3.087	3.314	2.789	2.511	1.626	2.405	1.753	1.809	2.419	2.590	2.877	1.621	1.950	2.520
5.00	Mean	5.95	4.70	5.05	5.58	5.70	7.05	8.60	7.90	7.30	7.63	7.84	7.00	7.05	8.95	8.85	7.25
	N	20	20	19	19	20	20	20	20	20	19	19	20	20	20	20	20
	Std. Deviation	2.743	3.045	3.778	3.791	3.164	2.874	2.604	3.463	3.230	3.218	3.060	3.325	3.034	2.564	2.540	3.177
6.00	Mean	5.00	5.00	5.00	5.00	7.00	7.00	10.00	10.00	10.00	10.00	10.00	9.00	10.00	10.00	10.00	9.00
	N	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Std. Deviation																

Appendix G. Data retrieved from Statistics New Zealand (2016)

National age data (I) compared with our sample (II)

Age structure (I)		Age structure (II)	
0-14	19.6%	0-18	0.0%
15-64	65.5%	18-64	58.0%
65 and over	14.9%	65 and over	40.0%
		Prefer not to say	2.0%

National gender data (I) compared with our sample (II)

Gender (I)		Gender (II)	
Male	49.7%	Male	42.03%
Female	51.3%	Female	55.93%
		Prefer not to say	2.03%
Sex ratio	0.97 M/F	Sex ratio	0.75 M/F

Nationality

New Zealander		
Major ethnic	European	74%
Minor ethnic	Maori	14.9%
	Asian	11.8%
	Pacific peoples	7.4%

Ethnicity

Stats NZ data		Our data	
		Pakeha	42%
		New Zealander	32%
		European	12%
Total European (major ethnic)	74%		
		Other	10%
Maori (minor ethnic)	14.9%	Maori	3%
Asian	11.8%	Asian	1%
Pacific peoples	7.4%	Pacific peoples	0%
Total	(does not total to 100)		

*I expect this does not total because people could identify as both Maori and European