When science meets policy – nassella tussock in New Zealand as a case study

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Summary The management of nassella (serrated) tussock (Nassella trichotoma Nees.) in Canterbury, New Zealand is regulated through a Regional Pest Management Strategy (RPMS). Canterbury’s first RPMS did not have a measurable objective and did not result in a regional decline in nassella tussock numbers. To improve the Strategy, and thereby the management of nassella tussock, Environment Canterbury (ECan), the regional authority for the Canterbury region, used newly acquired scientifically-based understanding of the population ecology of the plant. This science had revealed that nassella tussock seeds mature earlier than commonly thought and, based on this, ECan altered its RPMS by implementing a more measurable objective and bringing forward the annual grubbing (chipping) compliance date for over half of the affected properties. To support these changes, ECan disseminated the scientific results upon which they were based in popular publications and through meetings with land managers. This education programme resulted in many farmers voluntarily moving their grubbing operation from late spring to winter/early spring, when plants are more visible. This earlier grubbing is expected to lead to a reduction in population density over time through greater annual reductions in the number of plants that survive to seed.

Keywords Serrated tussock, population monitoring, regional pest management strategies, chipping.

INTRODUCTION
An understanding of the biology and population ecology of a target weed is a necessary prerequisite to a management strategy with achievable goals. Despite this, many New Zealand regional authorities develop weed management strategies with little or no such understanding. The first strategy for the control of nassella tussock (Nassella trichotoma Nees.) in the Canterbury Province of New Zealand, which was based on the assumption that the goal of regional eradication would result from the annual grubbing tactic they had employed since the 1940s, provides an example. Under the Biosecurity Act (Anon. 1993), RPMSs must have achievable goals and the strategy objectives must be measurable; however, the objective set under this first strategy was impossible to measure. In this paper we (1) describe the historical events leading up to the first RPMS, (2) outline the shortcomings of this original strategy, (3) discuss the science that contributed to a new strategy and (4) describe the development of the new science-based strategy.

HISTORY OF NASSELLA TUSSOCK MANAGEMENT IN CANTERBURY
Nassella tussock, first discovered in North Canterbury in 1905, went largely unnoticed until 1938 when farmers noticed it had become widespread throughout the district displacing desirable pasture species. Arthur Healy (Department of Scientific and Industrial Research) was seconded to undertake research to determine the plant’s threat. He described characteristics of the plant, the extent of its spread and assessed potential methods of control (Healy 1945) and was instrumental in having nassella tussock declared a noxious plant in 1946 by a dedicated act of parliament. This act enabled the formation of two central government funded Nassella Tussock Boards, one in North Canterbury (NCNTB) and another in Marlborough. These boards were charged with enforcing control, levying rates and developing policy. In addition, the NCNTB employed staff who carried out much of the nassella control work.

Through the work of the NCNTB, nassella densities were brought down to levels that made the annual control of nassella more manageable for affected landowners. In 1989 the Crown withdrew funding, dismantled the Boards, established a new regulatory authority, Environment Canterbury, under the Local Government Amendment Act 1988 and returned responsibility for nassella control to affected land owners.

In 1993, the New Zealand parliament passed the Biosecurity Act 1993 that enabled the formulation of Pest Management Strategies. Under this Act, strategies must be reviewed every five years to ensure they are cost effective and that all objectives are being met. When developing the first RPMS, organisms identified as potential pests were assessed to see if they met economic and the ecological criteria outlined in section 72 of the Act. Having met these criteria, organisms were documented in a proposed Regional Pest Management Strategy (RPMS) that was subjected to public scrutiny.
Canterbury’s first RPMS became operational on 1 July 1998. This RPMS declared nassella tussock a ‘progressive control’ plant pest with the objective to annually eradicate 98% of plants prior to seeding (by way of manual grubbing) throughout the Canterbury region. An early draft of this first strategy aimed to eradicate 95% of plants in each year of the five year strategy. However, through the public submission process, land managers considered that 95% annual kill would be too low to achieve the goal of progressive population decline. But accepting that 100% was impossible, the 98% kill rate was adopted. The strategy set an annual compliance date of 31st October to ensure plants were eradicated prior to the time when seeds were thought to mature.

SHORTCOMINGS OF THE FIRST RPMS
At the time the 1998–2003 RPMS was implemented it was acknowledged by ECAn that it was based on a poor understanding of the dynamics of the current populations of nassella, relying heavily on the largely qualitative information from Healy’s work and on anecdotal information from land occupiers and their representatives and ECAn biosecurity staff. It was recognised by ECAn that the 1998–2003 strategy objective couldn’t be accurately measured (i.e. how does one measure 98% kill when 100% isn’t known). Another shortcoming of the strategy was that the goal of progressively reducing nassella tussock density was not being met. A monitoring study found that under this strategy the nassella tussock population was not declining but rather remaining static (Bourdôt and Saville 2005, Lamoureaux et al. 2006). A final shortcoming was that the time frame of the strategy was not sufficient to allow ECAn staff to carry out compliance inspections on selected properties prior to seed set.

SCIENCE UNDERPINNING NEW STRATEGY
In order for the new strategy to be more effective, it needed to be based on a better understanding of nassella tussock under current land uses and management practices. To develop a more robust second strategy ECAn commissioned AgResearch during the term of the first strategy to design and supervise a population monitoring programme. ECAn also co-funded an ecological study to provide a scientific basis for determining when and how much annual control is needed to give the desired fall in population size of nassella tussock.

Questions posed for this study included:
1) When during plant development do the seeds of nassella tussock become viable?
2) How long do the seeds of nassella tussock remain viable in the soil?
3) Is the control effort reducing the nassella tussock population at a regional scale?
4) What annual kill rate of plants is sufficient to progressively reduce a nassella tussock population?

Prior to the ecological study, common beliefs in the community were:
1) ‘Nassella seed does not become viable until panicles are fully extended and are dry and falling to the ground’;
2) ‘Plants come from seed that has been in the ground for many years (25 or more)’;
3) ‘Seedlings can grow into mature, reproductive tussocks within one year’; and
4) ‘It doesn’t matter when nassella tussock is grubbed so long as the plants are removed’.

However, the science revealed:
1) That seed is viable well before panicles extend above the tussock canopy (Lamoureaux and Bourdôt 2002a, Lamoureaux et al. 2006);
2) Most recruitment of plants occurs from seed produced in the previous flowering season and that the seed bank is relatively small (Lamoureaux and Bourdôt 2002b, Lamoureaux et al. 2006);
3) Most seedlings remain as very small, unrecognisable and non-reproductive plants for several years (Lamoureaux, unpublished data); and
4) That if most plants are removed annually prior to seeding there would be a marked decline in population due to the depletion of a small and transient seed bank (Lamoureaux et al. 2006).

Because new strategies must go through a public submission process, it was recognised that any changes based on scientific findings must have the support of the affected community. To that end, the results of the science were disseminated to the public over time with each new finding. Education of the public occurred via compliance letters, newspaper articles, public meetings and field days, a survey and brochures (Lamoureaux et al. 2006). Councillors and staff of Environment Canterbury have been regularly updated via annual reports, meetings, and emails.

DEVELOPING A SCIENCE-BASED STRATEGY
In 2003, ECAn proposed a new strategy as part of the RPMS 1998–2003 review process. Through the review process a new strategy was adopted in 2005 (Environment Canterbury 2005) with two main changes: 1) the more measurable objective of ‘progressively reducing the population of nassella tussock within the Canterbury Region’ over the duration of the strategy was adopted; and 2) the compliance date was changed from October 31 to September 30 for approximately 900 of the 1300 properties where nassella tussock occurs. A further change to the nassella tussock management
policy was the date previously allowed for exemptions to the RPMS compliance date rules.

In order for this new strategy to fulfil its obligations under the Biosecurity Act, there must be processes in place to determine whether there has been a decline in the number of nassella tussocks throughout the region over the term of the strategy. The monitoring project supports this obligation by producing data that can be used to estimate nassella tussock density through time.

The compliance date was brought forward in the new strategy to alleviate the problem of insufficient time for property inspections by ECAN staff prior to seeding. Under the old strategy, properties couldn’t be inspected until either the occupiers contacted ECAN to say the work had been completed, or after the 31 October compliance date, whichever came first. Many land occupiers, even those with small properties and few plants, were leaving their work until late October. This left only about a fortnight until seeding would start with between 700 and 800 properties for ECAN to inspect resulting in many properties not being inspected until seeding had commenced. The change of compliance date for most properties would enable the inspection program to be spread over a longer period and to allow enough time between compliance inspections and the onset of flowering to enable properties not compliant to carry out further grubbing operations before seed set.

Initial public discussions on the new strategy revolved around shifting the compliance date forward from 31 October to 31 August. This was ‘unpalatable’ to many land occupiers. Further discussions resulted in a compliance date change to 30 September for all land occupiers in Canterbury with the exception of approximately 400 densely infested properties in the ‘hard’ hill country of the Hurunui District. These 400 properties were exempt because the land occupiers felt that it would be too onerous for them to finish their grubbing activities by 30 September. Alongside ECAN changing the date, there has been a voluntary shift to conduct control operations earlier in the year (Figure 1), indicating that farmers are beginning to better understand how nassella tussock populations behave.

The dissemination of the science results made the change of compliance date easier because by the time the public consultation for the RPMS review process got underway in 2003 there was some degree of public awareness. Also, under the new strategy, the date for the granting of an exemption to the RPMS rules to allow land occupiers to complete their work later in extenuating circumstances was brought forward from 30 November to 15 November, a time when the amount of viable seed on plants is low (Lamoureux and Bourdôt 2002a, Lamoureux et al. 2006).

**DISCUSSION**

Change within the community has been slow. Many land occupiers have difficulty in understanding the implications of the ecology study and the impacts a change in the timing of control operations would have. This is because a generation of farmers have been conditioned to believe the way they are going about their control work will continue to result in the reduction of nassella tussock numbers on their land. They have seen the population decline over a period of more than 50 years and have had no reason, until now, to doubt that this would continue. Further reductions in the regional density of nassella tussock will require more of the farmers with densely infested land to modify their control efforts. When the changes are seen to be making substantial reductions in nassella tussock density on their properties, these farmers will begin to spread the word, which will result in more land occupiers adopting the new practices.

The rate of non-compliance with the RPMS rules in respect of nassella tussock has fallen over the past four years from 28% to 11% (Figure 2). It is suspected...
this has a lot to do with the amount of pressure being applied to people to complete their work. The science has raised the general level of understanding of the importance of doing this work well and on time.

CONCLUSION
The science has helped support the modifications to the RPMS. Further and perhaps more radical modifications in the Strategy’s objectives and goals may arise from the ongoing science. The challenge then will be to convince landholders of the merits of such further changes. The success to date in using the science to identify necessary changes in strategy, and the moderate acceptance of these changes, indicates that the implementation of further improvements should be achievable.

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REFERENCES