Social acceptability of the Trojan Female Technique for biological control of pests

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Summary

This report describes the findings from social research conducted as part of a research program on theTrojan Female Technique (TFT), a new method of biological pest control being developed by Landcare Research and other partners. This report presents the result of qualitative research into the drivers of social acceptability of pest population control technologies, and more specifically, the social acceptability of the TFT to New Zealanders. It builds on previous research by the authors into the social acceptability of actual and potential pest control technologies. The current research involved a series of eight focus groups held in various parts of New Zealand in August 2014. The groups were:

- The general public, divided into three groups: rural residents, urban males, and urban females;
- Maori;
- Community-based conservation interests;
- Community-based animal welfare and animal rights interests;
- Scientists; and
- Biosecurity specialists and pest managers.

The key attributes required of an acceptable pest control, noted across all or most of the eight focus groups were that it should:

- Be humane;
- Be safe for humans and non-target species;
- Be specific to the target species;
- Be effective at controlling the target species;
- Be affordable or cost-efficient;
- Generate additional benefits;
- Be tested or well researched or proven; and
- Not involve visible death, and not be messy.

The TFT received in-principle support across all groups. Several concerns were raised about how it would work in practice, but all of them could be addressed. As a participant in the rural public group said:

> *… just about all of the concerns that were raised immediately when you broached the idea were around the periphery and the management of side risks, rather than the core activity of what was going on. That signals to me that the core activity is socially acceptable so long as risks around it are managed.*

Issues raised that need further research include the ecological effects of removing many individuals of a species and the potential irrerversibility and uncontrollability of TFT organisms once released.

Many comments were based on misapprehensions about the TFT, suggesting that a comprehensive communications program is needed. Such a program would play an education role, answer questions raised by the participants in our focus groups (which are the kinds of questions any interested member of the public might ask), and manage any unrealistic expectations of the TFT. To maintain public trust, any such communications will need to be straightforward and truthful.

This research was qualitative, so it can describe the range of views held about the TFT by the public and interest groups. To quantify how widely the various views are held would require a survey.

Introduction

Pests are a major problem in New Zealand, causing environmental and economic damage. Both vertebrate and invertebrate pests are important. New Zealand makes a lot ot use of poisons, particularly 1080 poison, and there are calls for reduced poison usage. Biological controls for pests are seen by research and pest management agencies as having potential but it has proven difficult to research and develop effective biological control agents.

This research is part of a larger project funded by the New Zealand Ministry of Business Innovation and Employment called 'The Trojan Female Technique: A novel non-lethal approach for pest population control' (Smart Ideas Phase I Project C09X1310). The project aims to develop a new, cost-effective method of biological control for both vertebrate and invertebrate pests that is specific, persistent, non-lethal and does not involve genetic engineering. The Trojan Female Technique (TFT) relies on using naturally-occurring mutations (genetic variations) in mitochondrial DNA that cause male infertility with little or no impact on the females themselves. At the moment scientists are working on mice and fruit flies to be sure the technology actually works. If it does work, it could possibly be used on all kinds of pests, both vertebrate and invertebrate. The project is being led by Landcare Research New Zealand Ltd, a Crown Research Institute, and also involves scientists from Otago University and Monash University in Australia.

Social research was integral to the project right from the start. We were asked to investigate the social acceptability of the TFT. We are independent of Landcare Research and the other project partners, although one of us (Wilkinson) worked at Landcare Research from 1994 to 2001. We have worked together on research into the social acceptability of pest control methods (particularly biological controls) in New Zealand since 1994. Our previous research in this field includes work on possums and rabbits (Fitzgerald et al. 1994), Rabbit Haemorrhagic Disease (RHD)—then known as Rabbit Calicivirus Disease, or RCD—Wilkinson and Fitzgerald 1998), possum fertility control (Wilkinson et al. 2000; Wilkinson and Fitzgerald 2006), and stoats (Fitzgerald et al. 2002, 2005). Each of these four major projects included both a qualitative phase (consisting of a series of focus groups) and a quantitative phase (consisting of a national survey).

In summary, our previous research found that:

- 'Pestiness' is not universally agreed. There is considerable variation in opinions around what makes an animal or a species a pest and whether it can be a pest as well as something else (such as a resource).
- The most important criteria for acceptability of a pest control method are humaneness, specificity to the target species, effectiveness and affordability.
- Acceptance of some current pest control methods, in particular 1080 poison, is grudging, in that they are seen as causing damage to the environment but less damage than the pests themselves.
- Biological control is subject to the same acceptability criteria but faces an additional burden because of its unknown nature.
- Fertility control is the most acceptable form of biological control for mammalian pests.

In this current research we build on these findings.

This social research is still at an early stage. At present we have conducted only a qualitative study involving a series of focus groups. No survey has been funded. Given the biophysical research on the TFT is still at the proof-of-concept stage we deemed it premature to conduct a survey, because our previous research suggests clear and full descriptions of a pest control technique are required before survey respondents can evaluate it comprehensively. In any case, qualitative research such as this is a necessary precursor to a quantitative survey.

The aim of this social research is to:

1. Identify the drivers of social acceptability of pest population control technologies generally, and
2. Identify the acceptability of the TFT specifically.

Method

The design of the social research work (Research Aim 1.3) in the TFT project called for qualitative research, namely, a series of focus groups with members of the public and stakeholders throughout New Zealand.

The focus group method was considered suitable since it has been shown to be effective in previous New Zealand social research on perceptions of invasive animals (such as rabbits, possums, and stoats) and current and potential forms of pest population control (such as trapping, shooting, poisoning, diseases, fertility control, and the use of genetically modified organisms for biological control) (Fitzgerald et al 1996a, 1996b; Wilkinson and Fitzgerald 1998; Fitzgerald et al 2002; Wilkinson and Fitzgerald 2006).

In each of the previous studies the focus group method was used to scope the range of views about particular pest animals and particular forms of population control, and to assist in the design of nationwide random sample surveys of the public. In this instance no such sample survey was planned initially, but might still be conducted later.

Prior to implementation, the proposed methodology was subject to the Landcare Research Social ethics review and approval process.

The focus group method

A focus group is a qualitative research method that involves bringing together between six and ten people for a guided discussion on a topic. As Morgan notes, focus groups are "basically group interviews", where

> "the reliance is on interaction within the group, based on topics that are supplied by the researcher, who typically takes the role of a moderator. The fundamental data that focus groups produce are transcripts of the group discussions" (Morgan 1988: 9).

In focus groups, interactions between the participants are encouraged in order to stimulate discussion, thereby eliciting the participants' views, beliefs, values and experiences. Follow-up questions or prompts are used to deepen the discussion. The hallmark of focus groups, compared with other qualitative research methods is their ‘social’ nature, that is, “the explicit use of the group interaction to produce data and insights that would be less accessible without the interaction found in a group” (Morgan 1988: 12).

A series of 'thematic' questions is put to the group and it is the facilitator’s job to ensure the set topics or themes are canvassed without stifling the free exchange between the participants. As such, focus groups are "better suited to topics of attitudes and cognitions” (Morgan 1998:12). The group discussion is audio or video recorded for later transcription and analysis, and the key points written up on flip charts or boards during the discussion.

Participants are typically selected because of their membership of some category of persons relevant to the topic being researched. The main aim of the selection is to achieve a good coverage of the range of possible views and experiences relating to the chosen topic/s among the target group or groups. Hence separate focus group discussions may be held with different sets of stakeholders or sections of the population (e.g. scientists), with the individual participants in each group selected so as to achieve a good range of views from within that group. Focus groups may therefore tap into existing social groups or networks, or may involve creating a group for the purposes of the discussion. For the most part, participants in each of our focus groups were acquainted with one another.

Focus group selection and composition

In consultation with the TFT research programme Advisory Group, it was decided to hold a series of one-off focus groups covering a range of interest groups and the New Zealand public. Eight groups were considered to be necessary covering the following:

- the general public, divided into three groups: rural residents, urban males, urban females;
- Maori;
- community-based conservation interests;

- community-based animal welfare and animal rights interests;
- scientists; and
- biosecurity specialists and pest managers.

The choice of groups and the range of individuals in the groups was informed by the results of previous focus group studies on vertebrate pest control issues (noted above). These previous studies, combined with associated quantitative surveys, demonstrated that different sections of the population have different views on pests and pest control. They also identified a number of key drivers of acceptability of current and proposed pest control technologies.

Focus groups with members of the urban public were held with men and women separately in Christchurch and Wellington respectively, and a mixed group in a rural area (South Canterbury). The participants for the male-only public group were recruited by direct approach to a Christchurch-based automobile club, while those for the female-only group were recruited through a school parent's association in Wellington. In both instances (as in previous focus group studies) attempts had been made over many weeks to recruit participants through the school parents' associations of socio-economically 'average' schools (i.e. decile 5 and 6) throughout metropolitan areas. However, for this study, this recruitment strategy was not successful and the researchers therefore had to draw on other social networks. The location for the rural public group was chosen for its independence from a metropolitan area, accessibility, and socio-economic characteristics, with the participants recruited through a recognised community organisation in the district.

To gain a Maori perspective, a group was organised with a Northland hapu that has had experience of managing pests on its own land, with the individual participants being recruited by a representative of that hapu who had assisted with a previous study.

The special interest groups identified were scientists, biosecurity/pest management specialists, those with conservation interests, and those with an interest in the rights and protection of animals. Participants for the scientist group were recruited though direct approach to individuals, while those for the biosecurity/pest managers group was done through a senior officer in a regional council. The conservation group participants were recruited through representatives of three community organisations, and the animal rights group was recruited through the national office of SAFE (Save Animals from Exploitation). The final composition of the latter two groups was decided in advance through discussion with the relevant representatives.

As part of the recruitment process, potential participants were provided in advance with a written outline of the social research and its purpose.

The eight focus groups held, their composition, locations, dates, and the name and abbreviation by which they are referred to in this report, were therefore:

- Maori, consisting of 6 males and 1 female from the Ngati Hine hapu, Northland — held at Waimahae Marae, 18 August. (Maori, I for Iwi);
- Animal rights and welfare interests, consisting of 10 persons of mixed age and gender drawn mainly from the membership of SAFE — held at the WEA rooms, Christchurch, 19 August (Animal Rights, A);
- Conservation interests, consisting of 10 persons of mixed age and gender drawn from 3 local organisations involved in conservation/stewardship action in the Canterbury region — held at the WEA rooms, Christchurch, 19 August (Conservation, C);
- Scientists from a range of disciplines — consisting of 7 persons of mixed gender, mainly aged 40–60, and from different institutional settings — including Landcare Research, Lincoln University, University of Canterbury, and the private sector — held at the Lincoln Science Centre, Canterbury, 21 August (Scientists, S);
- Biosecurity and pest managers, consisting of 6 regional and local council officers involved in policy and programme implementation across the Horizons Regional Council area (covering the Tararua, Manawatu, Horowhenua, Rangitikei, Wanganui and Ruapehu districts and Palmerston North City) — held at the Horizons Regional Council offices in Palmerston North, 28 August (Pest Managers, P);
- Rural public, consisting of 7 persons of mixed ages, gender, and background, recruited through the Geraldine Resource Centre — held at the Resource Centre, Geraldine, 21 August (Rural Public, R);
- Urban men, consisting of 6 local residents of mixed ages and backgrounds recruited from a car club — held in a private residence, Christchurch, 24 August (Urban Men, M); and

- Urban women, consisting of 6 local residents of mixed ages and backgrounds – drawn from the school community, Island Bay, Wellington — held at Island Bay School, 27 August. (Urban Women, W).

In the case of the six focus groups that involved community organisations, a donation was made to the organisation in recognition of its assistance with recruitment and in some cases provision of the venue.

Focus group process

Each group was preceded by an introduction to the researchers, a reiteration of the purpose of the focus group research, an outline of the 'rules' for the group, questions and answers about the work, and a seeking of verbal consent from the participants to proceed.

The discussion began with a round robin of introductions in which the participant gave their first name and an outline of their previous experience of pests and pest management. In the Maori group, the host spoke on behalf of the tangata whenua, and each participant introduced themselves with a personal mihi in Maori and then English. Following the round of introductions, the facilitator put a standard set of questions to each group (Appendix 1). This was accompanied by supplementary questioning to elicit detailed or further comment as necessary. As noted previously, because participants were encouraged to engage with each other on matters of attitudes and values, discussion of the set topics often moved in a non-linear fashion. Nevertheless, each of the set topics was able to be addressed in the time available. The focus group discussions generally lasted from 100 to 120 minutes.

With the prior agreement of the participants, the focus group discussions were audio recorded, supplemented by note taking to facilitate later analysis. Two researchers conducted each group —one researcher acted as facilitator, and the other supported the facilitator by asking follow-up questions as required, noting the key points from the discussion on flipcharts, and monitoring the audio recording.

A verbal briefing on the TFT research was provided prior to discussion of TFT. This briefing was prepared in advance in consultation with the lead Landcare Research scientist and covered the concept of the TFT, the overall research programme, and the current 'proof of concept' laboratory investigations being undertaken on fruit flies and mice. For the full written version of this briefing see Appendix 2.

Analysis

The digital audio recordings of the eight focus groups were transcribed by a professional transcription service based in Australia. The transcribers were provided with background information and place names, institutions, Maori terms, and scientific terms.

The text transcripts were imported into the QSR NVivo qualitative analysis software, and the content coded according to themes/topics derived from the focus group questions and the key research aims. The NVivo software enables the analyst to consolidate the text quotes from the focus groups according to each theme and sub topic, and to produce summaries and overviews, such as 'word cloud' diagrams. From these and the text summaries, the key points made by each group are able to be identified and compared.

The analysis therefore produced descriptive findings and concentrated on identifying and presenting the range of views about vertebrate and invertebrate pests in New Zealand, about various forms of pest control, and about the TFT in particular. No claim is made as to the extent to which the various views occur among the stakeholders or the public as this would require a random sample survey.

Reporting

In this report, verbatim quotations from the participants are presented in italics. Each quote is followed by a code indicating the group from which it came. An ellipsis indicates that words have been excised from the quotation (usually for clarity). Italicised words within square brackets indicate that the words have been changed for clarity reasons. Words in normal font within square brackets are our questions. Long dashes within quoted paragraphs indicate a change of speaker in a discussion.

Findings

What is a pest?

Common perceptions

In all of the study focus groups participants were questioned about what constituted a pest. This produced a wide range of responses ranging from *it depends upon what you do and where you are* (R), to quite technical definitions such as *an animal that comes under the Wild Animal Control Act* (R) or an organism that is on a national register, such as those listed on the Ministry for Primary Industries website.

Other discussions within the focus groups also revealed participants' ideas of what constitutes a pest. For the most part participants spoke about pests by referring to specific animals (vertebrates), rather than invertebrates. They also felt that the term pest was *pejorative* or connoted something *negative*, *unwanted*, and at odds with human beings.

The most common perceived attributes or definitions of a 'pest' included:

- An introduced species that threatens or endangers the environment or people (C, R);
- Something that is in the wrong place (S) at the wrong time (P), or even *on the wrong side of the fence* (S);
- A species that's in competition or conflict with human aspirations or values (S, A), including
    - having a negative economic impact for the nation or particular sections of the community (C, I)
    - reducing people's amenity or enjoyment of their environment (*a nuisance*) (P);
- An introduced species that threatens one's well-being (F), or threatens human survival (A);
- A species that's on an official list of pests (R, P); and
- A species whose population has grown too large and is therefore *out of control* (A).

For the most part, participants in the focus groups concentrated on animal pests and their control, and, apart from wasps, appeared to less acquainted with insect pests.

A contentious social construct

Some respondents pointed out that the idea of a pest is a 'social construction' — it depends on the values, beliefs, and world view of the particular society, community or even individual. Furthermore, it depends on the location or place under discussion. Some also noted that there are degrees of 'pestiness', ranging from a serious national threat to humans and other species, to annoyance or inconvenience to some individuals.

The idea of a pest is therefore contested and variable, as seen in statements such as:

> *Every introduced vertebrate could either be a pest or a pet … there are individuals who love them and individuals that hate them, and it depends on the context.* (S)
>
> *We all have our own individual pests, don't we?* (C)
>
> *It's just whether these [species] are wanted in that environment, so it's a human decision as to whether it's a pest or not.* (R)
>
> *I don't perceive the mouse as a pest. But I would have no difficulty shooting or killing or helping kill a possum, because I've drunk the Kool-Aid that says, 'possums are evil'* . (S)
>
> *You know, that's the human perspective, isn't it? We all have our own pet hates.* (C)

The Pest Managers group raised the issue of different perceptions of particular animals and people's values, which in turn presented complications for them when it comes to instituting pest control:

> *Hunters want the deer not to be classified as a pest because they want to kill it themselves rather than some other agency do it. Of course people don't want cats to be killed because they're lovely and cute and*

> *fluffy, so how could they be doing such damage to our birdlife — The cat is an interesting one because even people that have pet cats don't like strays and ferals because they fight with their cats and damage them; so you can love a cat on one hand and you can hate them on the other, you can have a foot in both camps.* (P)

That 'pest' is a contentious notion was evident in most of the focus groups, though especially so in the Animal Rights focus group. This consisted of people ranging from animal rights activists through to people with an animal welfare focus. The term 'pest' was seen by some as an expression of power by human beings over other living things, wherein humans subjugate other species and exploit them for their own gain. Hence human beings were seen as the most serious pest animal in that they are responsible for the destructive modification of the natural environment; humans have been responsible for widespread deforestation and air and water pollution, and through subsequent industrial scale agriculture, the proliferation of dairy cows and sheep. Some members of this group felt that dairy cows were the most significant pest in New Zealand at present. Participants in the Scientist group also felt that humans were the most significant pest species.

When asked to identify what they thought other New Zealanders considered pests, the Animal Rights group mentioned ferrets, stoats, mice, dogs, and cats, each of which might be seen as being at odds with human interests. But the participants hastened to add that they didn't necessarily agree with these animals being essentially problematic. As noted by one person:

> *as far as pests go, you can talk socially, economically, morally, or ethically … it depends on the situation. It depends on which glasses are you looking at the situation from. For me really, I don't think any of these animals are a pest at all. At all. Even if you ask me 10 million times, I'll still say the same. I don't think any of these animals are a pest.* (A)

For the Animal Rights stakeholders, it seems that a pest is generally something that undermines the survival or right to life of other species.

Pestiness is contextual

Members of the Rural Public, Scientists and Pest Manager groups commented that whether an animal was perceived as a pest depended both on one's point of view and the geographical or landscape context, for example, production land or conservation land. This was commonly expressed in the notion of a pest as being a species *in the wrong place* or *on the wrong side of the fence* (S), or *something in the wrong place at the wrong time causing harm* (P). Participants in the Rural Public group debated as follows:

> *A red deer in native bush is a pest but a red deer on a deer farm, venison, is a farm animal. The deer population on farms is taken from the wild and put behind a fence and they become desirable when you do that. But they're all the same animals.* (R)

> *the farm fence doesn't determine the difference between pest or not. It's the activity. So if they're in a national park where you're trying to preserve native flora and fauna, it's going to do damage to the extent of human activity in that area. Whereas the deer on a venison farm is the reason the farm's there. It's what they're trying to produce. So it's not the fence so much, it's what the intent of the activity is in that area and whether the animal is harmful or beneficial to that.* (R)

> *Taking the high alpine areas, Thar might look noble but they are the rats of the high alpine areas and they do huge harm. They probably do more harm than anything else up there. So depends where you are, what's there, and what opportunities there are for the particular species.* (R)

A species being 'in the wrong place' was not necessarily regarded as qualification for pest status. As members of the Scientist group debated:

> *it's something out of place, PLUS it does something that upsets people … It has an impact. For example we have house sparrows and dunnocks around Christchurch. They are sort of in the wrong place because it is not their natural place, but they don't have an impact.* (S)

> *A kangaroo in Australia can be a pest. They are not on the wrong place, but they've got over abundant. So to be a pest that basically got to have an impact that we don't like really.* (S)

The Pest Managers also felt that there was a scale element to the consideration of a species as a pest. In some places a species may be a problem and treated as a pest to be controlled or eliminated, while in other places, or nationally, that

species is not necessarily regarded as a problem. Examples of localised problem species provided by the Pest Managers included various exotic birds such as Canada geese, rooks, and peafowl.

The other element of scale raised in focus group discussions is the size of the population of the problem species. According to the Scientists, one of the 'qualifications' for a pest is that its population has become too large or at least perceived as being *out of control*. This was explained as the result of the introduced species not having *natural predators* in the New Zealand environment or that it is a rapidly-reproducing (r-selected) species (S).

For some participants, if a species was perceived as being aggressively in the wrong place, and in excessive numbers for the particular environment, it could be regarded as 'invasive'.

Several Scientists tried to sum up the various components or aspects of pestiness:

> *it's a species that's not only in the wrong place, it's in competition with human aspirations … or has a negative impact on some of our values, whether they are production, conservation, anaesthetics, and infrastructure.* (S)

A pest is an introduced threat to the environment

Most of the groups felt that the key feature of a pest was that it had been introduced to New Zealand and had subsequently become a threat or danger to the New Zealand environment, indigenous species, or the human population.

A member of the Conservation group articulated this as *a species that threatens, endangers or even drives to extinction another group of biota, and that could be plants or animals* (C). Others added that a pest can also be a species that threatens ecosystems, or *the commons* (R).

These threats were described in various ways: as a biodiversity threat (P), biosecurity threat (P, C), and a danger to native populations (W). The specific dangers that a pest might present include diseases (R), predation on native birds and insects (W, M), consumption of or damage to indigenous plants (M, W), displacement of native species through territorial aggression or competition, and modification of ecosystems or niches. Some noted that a pest could be a problem because it threatened an individual species (C).

Commonly the focus groups were concerned about the threats to indigenous birds, with perceived 'pestiness' being directly related to the level of invasiveness and degree of damage being caused. Animals commonly mentioned as threats to New Zealand's faunal and floral diversity include stoats and other mustelids, rats, feral cats, possums, hedgehogs, deer, and feral goats. When asked to specify what they thought was New Zealand's biggest pest, a member of the scientist group said what many agreed with:

> *I guess stoats for me would be the biggest pest, the most voracious predator of some of our iconic native birdlife, especially the ones that have low to zero tolerance of predation.* (S)

Perceived biosecurity threats included feral animals that carried diseases, such as bovine tuberculosis.

A pest is an introduced species that threatens the economy

Across most of the focus groups, the next most common view of what makes something a pest was that it was a species that has had, or could have, a negative economic impact on New Zealanders. Impacts noted in the focus groups mainly related to primary production, including

- Reduced levels of agricultural, horticultural or forest production, or reduced quality of products due to
    - grazing/food competition (e.g., rabbits, goats, deer, mice, wasps),
    - consumption of crops by vertebrates (e.g wild geese) and invertebrates (e.g. clover foot weevil)
    - damage to products (especially by invertebrates)
    - animal health/disease (e.g., BTb from possums, Varroa mite).
- Damage to trade and trade barriers (e.g. diseases etc) (C)
- The costs of pest control (P, R)
- Loss of traditional foods and materials (I).

Several members of the men's group also discussed the negative impact of borer insects on timber, though the status of borer was uncertain:

> *borer is more of a pest issue than some species. In New Zealand we predominantly use timber framing for houses and other building . If borer get into it they are eventually going to weaken the structure of your house and reduce its value — But the borer, that's a native. And it's getting into pine trees which is a species introduced from California.* (M)

Some participants also mentioned that a pest vertebrate or invertebrate could also negatively impact on New Zealand's tourism industry, for example, by reducing the natural beauty of the landscape or by harassing tourists (e.g., wasps and sandflies).

Some groups debated whether an indigenous species such as the sandfly could ever be technically classified as a pest. Nevertheless, there was general agreement that such species at least represented a significant nuisance and could reduce people's enjoyment of the New Zealand environment.

> *It's all related to income, really. If your farm is going to be affected by insects you need to use insecticide or you choose to farm in a particular way, that's your choice. The same with birds in the Marlborough region and Central Otago. But yeah, it just depends on how you choose to earn your living and what style of farming, your approach, or you're dealing with stock farming* (R).

> *I would say that sandflies are a pestiferous …. The're annoying but they're unlikely to cause an extinction of any species, whereas wasps are capable of it and possums, and virtually everything else on the list of pests that we've noted here is able to do that.* (C)

> *Regarding sandflies I guess that they are a pest in some respects. You could argue that they had an economic impact. If you lived at Milford Sound for instance a sandfly bite to a person, such as a tourist, with an allergy could be life-threatening* (C)

The Pest Managers group discussed the economics of pest management relative to the economic impacts. As noted by several participants:

> *Deciding to do control is based on cost-benefit analysis usually. Quite simply the cost of controlling the pest shouldn't outweigh the benefits* (P)

> *Anything that can cause production or biodiversity losses or amenity problems, and passes an intervention logic strategy, cost-benefits analysis, and is affecting a neighbour, then it will invoke our attention and we will do something about it.* (P)

> *But disease is also an important element. That's where the possums come in. It's number one really. Over the years a lot of effort is gone on to stopping bovine TB* (P)

Threats to amenity and wellbeing

A number of groups referred to species as being a nuisance or reducing the amenity of their living environment, but don't necessarily qualify as a pest. The Pest Managers' group referred to these as amenity pests, *a technical term for nuisance*:

> *[these species] sit outside our plans, and are not supported by the Biosecurity Act. But we do something about them as a service because, even though they wouldn't stack up under a cost benefit analysis, they are still a significant problem; it's probably one of the most popular programs we haven't pest management.* (P)

Study participants noted that some species undermined the attractiveness of the environment which in turn affected their sense of well-being:

> *if you are going into a public conservation area you want to find a forest that is healthy, looks like it's doing well, and you want to hear birdsong. If it's ghostly quiet and stalky you think that something is not right. It's nothing to do with your livelihood or your personal health or anything. It's just the confidence that you are living in a place that's healthy and is helping look after you and yours and the people about you*.(R)

Several participants in the Urban Women's group also spoke of amenity and pests:

Secondary to that [protecting our native flora and fauna] for me personally is my ability to enjoy my own environment. So if I go to the beach I want to go and sit on the beach without being completely eaten alive by sand lice or to be able to sit with my windows open and doors open at home without having flies and other insects bother me — And the hygiene for me, I do not want my house and kitchen full of mice and rats (W).

Official classification

In the course of discussing the definition of pests and the key attributes of a pest species, members of several groups (S, P, R) noted that there were official definitions and processes for determining whether a species is a pest or not. Several scientists discussed this as follows:

I think it's different for different agencies. So DOC will determine what a pest for their conservation values, for the Crown estate. Farmers will jump up and down about rabbits because it is impacting on the production. Regional councils that are more region-wide based, and focus on rateable non-crown land, go through a process and ask the public what do they feel should be designated as pests under their strategies and plans …

MPI also maintains lists of official pests, animals that people are not allowed to have the New Zealand or bring into New Zealand …

Generally the regional councils have a fairly conservative list in the sense that the more pests they have on the list the more expenditure they are required to devote to controlling them at one level or another …

We really struggle with officially defining animals at the animal welfare advisory committee; where do goats go for example? As soon as you round them up and put them behind a fence they fall under the Animal Welfare Act. But before that they fell under the Wild Animal Control Act. So under the Wild Animal Control Act DOC control deer, Himalayan thar, and chamois, but not wallabies (S)

Indigenous species as pests

A number of the focus groups identified indigenous birds and/or insects as pests, or at least, nuisances. This led to debate about whether an indigenous species could be considered a pest and require pest management, with opinions split reasonably evenly. Species raised in this context include kea, sandflies, borer, and even species that were self-introduced to New Zealand and had become acclimatised, such as mynah birds, Canada geese, and magpies. The following quotes illustrate some of the diverse views:

In Australia … they've got a group of people that say when a pest establishes and it modifies the landscape and it adapts there it's not a pest. That's just evolution and it has the right to be there and exist, and others are pests. Rabbits aren't a pest … to this group of people (P)

Something native could be a pest If there wasn't a predator, or if it got to plague proportions (W)

The perceived main pests

As noted, at the beginning of the focus group discussions, each group was asked to list what they thought were the main vertebrate and invertebrate pests in New Zealand. Table 1 indicates with black shading the main vertebrate and invertebrate pests as noted by the various focus groups. A partial shading on the table indicates where a species was noted by a group as being a regional or localised pest.

Several important marine and freshwater pest species were also identified as pests, including sea squirts (P), koi carp (P, M), rudd (P), gambusia (P), tench (P) and catfish (P).

Table 1: Main identified pests in New Zealand, by group

	Group identifying this species							
VERTEBRATES	Urban Women	Urban Men	Rural Public	Maori	Animal Rights	Conservation	Pest Managers	Scientists
Possums	■	■	■	■	■	■	■	■
Rabbits	■	■	■	■		■	■	■
Stoats	■	■	■	■	■	■	■	■
Rats	■	■	■	■	■	■	■	■
Ferrets	■			■		■		■
Feral cats	■	■	■	■		■	■	■
Feral pigs	■			■		■	▒	
Deer	■	■		■		■	▒	■
Hedgehogs	■			■		■		■
Sheep	■				■			
Cows	■				■			
Feral goats				■		■	▒	
Hares				■				
Chamois						■		
Thar			▒			■		
Feral horses	■							
Mice			■			■		
Wallabies			▒					
Humans	■		■		■	■		■
Dairy farmers	■	■			■			
Rooks						■	▒	
Sparrows				■		■		
Starlings			■			■		
Finches			■					
Kea		■						
Magpies			■	■		■	▒	
Mynah birds				■		■		
Cockatoos							▒	
Peafowl							▒	

INVERTEBRATES	Urban Women	Urban Men	Rural Public	Maori	Animal rRghts	Conservation	Pest Managers	Scientists
Wasps	■	■	■	■	■	■	■	■
Ants							■	■
Flies	■				■	■		
Sandflies	■	■	■					
Mosquitos	■	■			■			
Head lice	■							
Fruitflies				■				
Codling moths	■							
Cockroaches	■			■				
Varroa mite		■	■		■			
Horse flies		■		■				
Borers		■						
Cattle ticks				■				
Clover fleas				■				
Grass grubs			■	■				
Crickets				■				
Other lice				■				
Slugs			■					
Aphids			■					
Stem weevils			■					
Clover root weevils			■	■				

Acceptability of current pest control methods

We asked the groups to list the main pest control methods used in New Zealand. Almost no prompting was required. The groups were then asked to discuss the methods, their main features and their acceptability. There was widespread acceptance that pest animal numbers needed to be controlled somehow. Even the Animal Welfare group, fiercely pro-animal as it was, had participants who said some control of pest numbers was sometimes justified.

> *I don't have a problem with something that kills quickly and humanely and, in saying that, in accepting that sometimes you need to, the populations might get out of control … Because I think we have to accept that certain populations of a few animals are just not sustainable. We just can't keep having so many rabbits out there in Central Otago …* (A)

Poisons

Most concerns around poisons were about the humaneness of the kill, the impact on non-target species, and residual effects on the environment.

The poison with the greatest public profile was **1080**. Every group talked about it. The Scientist, Pest Manager and Maori groups were enthusiastic about it, and the rural public and conservation groups contained some particiants who were favourably disposed toward it:

> *I've said several times it's the greatest environmental tool we have in this country and we would have suffered huge losses without it.* (P)

The other groups were less positive toward 1080. Sometimes this position seemed to have resulted from a lack of knowledge, as in this quote from the animal welfare group:

> *I don't really know anything about poisons or 1080. All I know is that it takes you ages to die and it's horrendously painful. So I wonder why they can't come up with a poison that just kills you.* (A)

The person who made this comment may have been thinking of the way 1080 affects dogs. As a knowledgeable participant in the conservation group explained:

> *Dogs happen to be the most sensitive to it and they do die a terrible death, but they can also be saved if people know what to do, take appropriate action.* (C)

As the best-known poison, 1080 appeared to bear the burden of a generalised public distaste for all poisons.

On balance, there was grudging acceptance of the use of 1080, with comments such as *necessary evil* (C), *the best of a bad lot* (M), and *it's saving more than it's damaging* (M). This grudging acceptance was evident in almost all groups, even those that included participants who did not like it.

Outside the specialist interest groups there was little knowledge of poisons other than 1080.

> [What do you reckon about cyanide?] *Ghastly stuff … Very dangerous.* [What's dangerous about it?] *Well, they say most unexplained murders are actually poisonings.* (W)

Some groups contained participants with some experience of using poisons in pest control operations. Some of these participants described a search for balance between the effectiveness and convenience of poisons and their side-effects:

> *Poisons may do a job but if you could get away without them, they have an element of danger in them. If you can get away without using them, and finding another control, that does not bring those poisons into our environment, I would try to use that first.* (R)

Choice of poisons was summarised well in the Scientists group, though across all groups few participants would have had the knowledge to provide such a summary:

> *1080 is the only toxin registered for aerial control, so you've got no choice there. But for ground control, I mean, cyanide – we know cyanide kills quickly and therefore in terms of the spectrum of acceptability in terms of animal welfare it's really good. Anticoagulants are right at the opposite end. So if people can get the kill they want with cyanide, they should, I think, use cyanide and most people probably would. But often you can't get what you want and therefore you'll end up using anticoagulants, which are not humane at all.* (S)

Manual methods

Trapping was seen as convenient for a bit of small-scale pest control, such as possums in the garden. Also, a participant in the conservation group voluntarily tended a series of kill-trap lines in a forested area. Apart from that, opinions of trapping were generally negative. The main concerns were around humaneness and specificity: Humaneness concerns were raised in several groups, mostly around leg-hold traps and particularly if the traps were not checked frequently.

> *I think if it instantly kills them it's okay. I don't like the idea of animals being held by the leg and suffering or … — Starving to death. — Yeah, or chewing their legs off or something.* (F)

The Conservation group described benefits of live catch traps: *if you catch a domestic cat as opposed to a wild cat, then you can let go your domestic cat.* (C) And:

> *I got a whole family of ferrets over two nights, because once they're in there and they start piddling and fretting, and then the rest of the family came in investigating and came in with the lure and dropped in.* (C)

The scientists discussed the practical difficulties involved in euthanasing live animals caught in traps.

Infrequent checking of leg-hold traps was where concerns about humaneness and specificity appeared to converge, as this quote from the conservation group explains.

> *Don't like them. Get all the ground birds. We had kiwi, things like that, get caught in them. — Yes, even the soft jaw ones do damage, because people do not check them every 24 hours, which they are legally obliged to by law.* (C)

In the Scientists group it was noted that trapping is more useful for its side benefits (such as employing people) than any direct benefit of killing pests, but a participant in the Pest Manager group made the point that effective trapping required a level of skill not possessed by unemployed people looking for work.

> *I remember hearing at a conference a long time ago actually now, there was a fellow gave a really good speech on using sort of under-employed and troubled youth to kill possums and that … it would not have been cost-effective, I wouldn't have thought, in pure dollar terms, but it would have been achieving another goal.* (S)

Opinions of **shooting** were polarised. The Maori group was rurally-based and included several farmers. They and the Rural Public group saw shooting pest animals as a fun, useful and healthy outdoor activity, particularly for young people: *it's good to entertain the townies when they come out on holidays.* (I) And:

> *… there are a lot of kids in this district that are pretty keen on shooting possums and selling [the fur]. They do quite well out of it.* (R)

In constrast, in other groups with knowledge of shooting (pest managers and conservationists) the dangers of shooting were discussed, in particular, recreational shooters (even experienced ones) accidentally shooting other hunters:

> *Some of them are top recreational shooters, in shooting clubs and they're instructors, and they've ended up shooting each other.* (C)

Participants in the Animal Rights group had a range of ethical perspectives. There was general disapproval of aerial shooting in the group:

> *… another thing that really upsets me is the shooting from helicopters of both deer and horses. That's just appalling … It's just so cruel. You're chasing an animal down, scaring the hell out of it, for a start, in the helicopters and then shooting it. You're not always going to get them first-off with the shooting. A lot of them are wounded and then they're chased. — Then they're netted up and you don't know whether they're semi-conscious. — Yeah, I mean, it's just completely unacceptable, I feel.* (A)

Yet one participant felt that in some (limited) circumstances ground shooting could be justified:

> *I really get angry when they take children out shooting. I think that's just disgusting. If the hunters are absolutely experience and they're marksmen, then I feel sometimes that's justified. Possum control, maybe goats and deer, in protection of the native bush and so on. Then that's probably one of the better methods, providing it's a, yeah, spot-on marksman. That's the problem and it's not always.* (A)

Only one person in the Urban Men's group admitted to shooting (*a few rabbits* and *the odd possum*), and only one person in the urban womens's group described having any involvement with shooting.

> *We don't have any guns at home but [my brother-in-law] lives in a rural area and the kids have been target shooting and we used to go out at night and shoot possums, because it controls the possum population because it's a bit of a pest up there. My kids have been; they've done it, they absolutely love it.* (W)

The general position of the Urban Men's and Women's groups was that it was appropriate for professional firearm users such as hunters and farmers to use guns but not amateurs. *I don't mind farmers shooting something if they have to but I won't let my son have a gun, go near a gun.* (W)

Overall, shooting was seen to play only a minor role in management of pest animal numbers and enthusiasm for it was patchy.

Biological control

Perceptions of biological controls for pests were coloured heavily by participants' memories of the unofficial introduction of rabbit haemorrhagic disease (RHD) to New Zealand in the 1990s. In several groups the point was made that the introduction of RHD to New Zealand had been less effective than it might have been had it been introduced through official channels.

> *What happened to that disease thing they brought in? — Calicivirus. — Yes, calicivirus. What happened? Well, it's run its course. They didn't do it very well and as a result the rabbits built up immunity. — Resistance. — Yes. So those rabbits are just laughing at that now. —Yes, that's because it was brought in by farmers and wasn't done as an official, you know, it was smuggled in and released. — You need a country-wide release or a proper control method. — It was brought in illegally, wasn't it? — Yes, and not necessarily the right strength or the right amount. Rabbits, you know, they evolve quite nicely. I mean, if it was any good Australia would have no rabbits. But it doesn't work, well, it works to a limit …* (M)

Public perceptions of biological controls are not helped by the fact that the best-known biological control agent in New Zealand, RHD, is that most feared of organisms, a virus.

> *… viruses can morph, they can change. They adapt, they can, what's to say —So what if it became the canine calicivirus or the — Well, there's nothing to stop it suddenly. Maybe not tomorrow but — Species-jumping. — Species-jumping, things like that … Science is great but you don't, you can't say what if we do this, do this, there's no way it's going to do that. — It comes back to that fear of unintended consequences.* (W)

This fear of unintended consequences was the other commonly raised concern about biological controls, that they involve releasing organisms that, once released, cannot be controlled and may have unforseen effects. The temptation to introduce a further biological control for the prevuiously introduced, now failed, biological control was also mentioned.

> *The biocontrols that we've used in the past have always stuffed up, because it's like the … old lady who swallowed a fly, et cetera, et cetera. She swallowed the spider and so on. That's what our biocontrols, when they miss the mark they can really do a lot of damage. Like, we bring in a species to biocontrol another species and then we've got two problems instead of one. So we bring in another species to control that and so on it goes.* (C)

The potential for a biological control to spread to other countries was discussed in the Pest Managers group, where it was said that Australians would not allow New Zealanders to develop a biological control for possums.

Some positive things were also said about biological controls, but often mixed with negative things.

> *The current new biocontrol agents for plants are working really well. But when we're talking about biocontrol agents for animals, invertebrate animals, we can always go back to the introduction of the mustelids to control rabbits, a significant failure, introduction of wasps to control blowflies … It takes a lot of energy in thinking to get a biocontrol even anywhere near ready to be ready for sticking out there in the open.* (P)

Criteria for acceptabiilty

Throughout the focus group discussions the opportunity was taken to explore the attributes of pest controls that made or would make them acceptable or unacceptable to the various stakeholders. The attributes required of an acceptable pest control that were noted across all or most of the eight focus groups were that it should be:

- Humane;
- Safe for humans and non-target species;
- Specific to the target species;
- Effective at controlling the target species;
- Affordable or cost-efficient;
- Generates additional benefits;
- Tested or well researched or proven; and
- Not involve visible death, and not messy.

Humane

Almost all of the discussion of the necessity for humaneness of the pest control was in relation to pest animals, and it was not mentioned with respect to pest invertebrate control.

As may be expected, the participants in the Animal Rights group were particularly focused on the humaneness of, and justification for, any form of pest control. For them any form of control should not cause distress to an animal. For example, if it is necessary to kill the animal (which some felt was unacceptable), it needed to be done quickly, without pain, and without degrading a living being. A non-fatal control (e.g., exclusion fencing, or mustering and relocating) should not frighten or distress the target animal. The positions of individuals in this group varied, and can be seen in the following quotes:

> *In an ideal world it would be wonderful if we didn't have to control pests. I'd love everything to live side by side too. It would be fantastic. But it's not an ideal world unfortunately.*
>
> *You talk about humane methods of slaughter and all sorts of things, but it's never humane in the end. I mean, in the end the animal's going to get killed.*
>
> *It's like capital punishment. Just because it's a rat and it carries some disease it doesn't mean it's supposed to be just killed straight away.*
>
> *If we have to have something that's going to kill them, let's have something that just sends them to sleep, that there's no pain. It's just, off you go to sleep. That to me would be acceptable* (A)

The Conservation group participants did not particularly focus on humaneness other than to comment on particular methods, for example, that leg hold traps were unacceptable due to their cruelty, and that anticoagulant poisons are inhumane because of their slowness in killing the animal that had been poisoned.

The Maori group participants felt that any form of control should not be cruel especially to animals, and that it should kill quickly. Some traps were viewed as being unacceptable because of the suffering of the trapped animal.

The Pest Managers were very quick to refer to the necessity for a control method to be humane, and especially noted the unacceptability of some types of leg hold traps.

The Scientists group participants felt it was important that the method for killing target pest animals should be quick and that the animals did not suffer pain. They also noted that humaneness was just one consideration in the choice of a control method:

> *If you've got a site that's getting impacted by a pest, you've got to deal to that pest. So you pick the most cost-effective and humane method. That doesn't mean they are humane, depending on how you define humaneness, but you pick the best you can. So if you're trying to do a huge area of forest and remote areas for possum control, you'd use 1080. Now, that doesn't mean the welfare impact of 1080 is acceptable. It just means there's no other tool and therefore in the interim, until we get something better, we use that tool.* (S)

Among the public groups the Rural Public group participants felt that any form of pest animal control should not be cruel, noting that leg hold traps were unacceptable in this respect although cage traps and kill traps were acceptable. The Urban Men's group participants did not explicitly mention humaneness as a necessary feature of pest control. In contrast, the Urban Women were very keen to note that pest control should cause *no prolonged or needless suffering* to the target animal, and that a fatal control should be quick and clean. They did not want to have animals *going away and bleeding out of every orifice and dying slowly over hours.* Leg-hold or gin traps, some poisons, and RHD were perceived by some of the women participants as involving needless suffering of the target animal. The following quote typifies a number of the Urban Women's positions on controlling pest animals:

> *I'm like well yeah, okay, eradicating pest. But could we do it as humanely as possible so that it's not a long agonising suffering death for a creature that's got a heartbeat* (W)

Safe for humans and non-target species

Almost all the stakeholder focus groups raised the question of the safety of the various possible pest control methods. Safety referred to 3 main things:

- The method should be safe for the operator or user (for example a person handling or laying poisoned baits
- The method should not endanger members of the public or affect their health
- The method should not harm or endanger other species or ecosystems (in this respect safety is an aspect of specificity).

All but the Scientist group mentioned the specific requirement that a pest control method be safe in order for it to be acceptable. Poisons came in for particular comment and even criticism in relation to perceived safety.

Conservation group participants felt that a pest control poison/chemical should not accumulate in the food chain or in the environment generally, that is, that it broke down rapidly into non-toxic components. They also saw shooting as a dangerous form of pest animal control. In introducing themselves, one member of this group said:

> *My main interest is trying to eradicate rats. They're a personal hate. But something safe that's not going to affect kiwis* (C)

Members of the pest manager group discussed various aspects of safety including that control should present no or low risk to pest control staff or users and the public, that it did not accumulate in the food chain, and that it didn't affect non-target species. They also noted that 1080 poison had become increasingly safe to use due to improvements in practice, handling, and placement, and declining dose levels. Cyanide paste was described as *very deadly* and *unsafe* if poorly used and managed. They noted that all poison use must be accompanied by proven safe practices and the availability of antidotes. Shooting was described as dangerous, though it had a role in pest control.

Among the participants in the three public groups, the Rural Public participants noted various aspects of safety: that the pest control method be safe for the user, for the public, for non-target animals, and for the environment, and that it does not enter the food chain and present health problems. When it comes to poisons this means that the particular chemical should *break down quickly*, not get into waterways, not be a broad-spectrum toxin for living things or *too toxic*, and be well tested.

The Urban Men noted that a pest control should be safe for the user, should break down quickly if it's a chemical, and leave no residues in the environment. Some poisons had particular issues with safety, for example, cyanide was seen as deadly and potentially dangerous to the user, while 1080 was seen as potentially dangerous if not used according to current best practice. When queried about what he meant by a TFT-based biological control being *safe*, an Urban Mens group participant responded:

> *It means that the risk of it crossing into other species is very slim or remote … the risk of lack of oversight, again, is very remote, small.* (M)

The Urban Women participants felt that a control should not find its way into waterways, the ground or the food chain, and especially that it should not affect the health of their families or their living environments.

Safety of poisons was a particular concern, with an ongoing perception among the urban public and Animal Rights participants that 1080 still presented a risk to the environment and human health. The safety for farm animals was an issue in the case of some of the Maori group participants:

> *We found some of our yearling calves dead. It wasn't at the bait station, but [a forestry company] had come onto our place and they were just putting their poison straight on the ground, not in bait stations. We found dead yearlings … so they're pretty effective, and they kill dogs as well. We don't want our dogs killed … they don't need to eat the 1080 [to kill them], they just smell it.*(I)

Specific to the target species

In our previous research on attitudes to various forms of pest control, specificity of the control method proved crucial to its acceptability. This was particularly true of biological controls. In the focus groups for this study the requirement that a pest control method be specific to the target species was raised in almost all of the focus groups and commonly mentioned in relation to the main control methods currently being used in New Zealand. Specificity was also discussed as an aspect of the safety of pest control technologies.

Participants in the various focus groups spoke of specificity in a variety of terms, stating that a pest control developed and used to New Zealand should:

- Have no effect on non-target creatures (C);
- Be 'safe' for non-target animals (R);
- Have no by-catch (I);
- Not destroy things that are valued (I);
- Not affect farm or domestic animals (P);
- Not affect native Australian wildlife (P);
- Have limited non-target effects, such as 'secondary poisoning' (S, F);
- Not get into other ecosystems or species (R);
- Not damage indigenous biodiversity (R); and
- Have no unintended consequences for flora, fauna, and humans (W).

The question of the specificity of a pest control was not explicitly raised in the Animal Rights group, largely due to the members' concentration on the ethics of pest control and the humaneness of the methods.

With respect to the various methods or technologies in use or under investigation, participants in most groups raised the question of unintended poisoning and deaths of non-target species from 1080, especially of dogs, birds, and farm stock. Cyanide was described as *indiscriminate* by participants in the Conservation group. One of the main sources of unease about biological controls (including diseases, fertility controls that have previously been the subject of research, and the use of genetically modified organisms) was of risks or uncertainties around specificity of the control organism. Older style leg hold traps were also considered to be somewhat indiscriminate adding to their general perception of being unacceptable. Shooting was noted by some as being specific (F) and by others as dangerous (P, C).

Members of the Rural Public group noted in relation to new potential biocontrol techniques:

> *There's a wide range of biological controls; any living organism has predators, parasites or other organisms that will do it harm in one way of another. If you can find an organism that is going to work on the particular pest that you're trying to control, that does not look for another host and cause harm in the New Zealand environment, and doesn't get out of control itself, then there is a great potential for it to be used in pest management.* (R)

Effective at controlling the target species

Across the various focus groups, participants noted that an important feature of any pest control method was that it was effective at reducing the population of the target pest species, or more specifically, at killing the target species. Effectiveness seems to be one of the basic and essential qualities necessary in a pest control, and a number of study participants queried the likely effectiveness of fertility reduction using TFT or other proposed technologies.

Cost-efficient and affordable

Related to the requirement that a control be effective in reducing pest populations is that it be cost-efficient. This was raised as a requirement in the all groups except the Animal Rights group. Participants did not necessarily explain what they meant by this notion, though it appears to be associated with the relative cost of different control methods. For example the Conservation group participants referred to the required labour inputs, equipment requirements, and transportation costs of conducting pest control over a particular area (for example of trapping compared with poisoning); the Pest Managers and Scientists talked about the level of kill (*desired kill rates*) for each method compared with its cost and time inputs; and the Urban Women and Rural Public groups felt that the amount of effort, time, and monetary input required for a particular outcome was a consideration.

Participants in some groups mentioned *cost* (C, S), *affordability* (M) and *efficiency* (C, P, S) without necessarily elaborating on what these terms meant. Some participants in the Animal Rights group felt that on the domestic front of pest control the method should be easy to use, for example, for houseflies, mosquitoes, and other undesired insects.

Generates additional benefits

It has been a common view in our previous studies that expenditure on pest control should have multiple benefits rather than simply the reduction of the population of a target pest species. This view was expressed in a number of the groups in the current study.

Participants in the Maori, Scientist, Urban Men, and Rural Public groups, for example, felt that a control method for vertebrate pests should be able to realise some economic return from the dead animals, typically meat for dogs or humans, fur, and pelts. Trapping and shooting were seen as enabling such resource recovery. Maori and Urban Men's group members felt that the pest control could also be a recreational activity for local families and communities. Participants in the Urban Men's and Women's public groups also felt that the creation of jobs through its use added to the acceptability of a control method, although this would not always be consistent with a desire for cost-efficiency or even effectiveness.

Tested or well researched or proven

Throughout the groups there seemed to be a general unease with the deployment of novel or experimental pest control methods. This was particularly true in relation to biological controls. This gave rise to the requirement for a control to be well researched (C), independently tested (C, R), proven (P), and backed by a rigorous decision process (R). Such testing was also seen as providing assurance of specificity and lack of unforeseen ecological effects.

As observed in previous studies, some people wanted total certainty over the safety, specificity, and effectiveness of any new pest control methods and saw research and testing as providing that certainty. However, other participants in several groups also pointed out that there could never be certainty, and therefore decision making required balancing the risks with the benefits (R, M).

Death is invisible

Participants in several of the groups felt that an important feature of a vertebrate pest control method was that it did not result in the 'visible death' of the target animal. Not being confronted with dead animals was important for participants in the Urban Women's group, while members of the Maori and Scientist groups recognised that visible death was likely to generate public controversy and lack of acceptance, and should therefore be an important feature of a pest control method.

One participant in the Scientist group observed that the need for death to be removed or distant from people included emotional or psychological distance:

> *All pests can also be pets … and so we kind of generally objectify the killing of pest species, just as we do in killing humans, sort of warfare. We have to objectify the enemy … Or the hamburger that we eat, or whatever … so that they make them not like us, not like people.* (S)

A member of the Maori group illustrated the sensitivities by describing an incident with an overseas visitor:

> *I had a whole lot of visitors … from overseas. This lady went ape because I killed this possum. She didn't like seeing this animal being killed. The possum just came into the camp as if it owned the place … I just*

got a stick and whacked it and killed it and she went crazy … They just didn't like to see them being killed. I could understand that, but we didn't want possums coming in where visitors were sharing a meal and that (I)

Related to this, members of the Urban Women's group said that they did not like methods that were *messy* and they did not like having to handle mice, rats or possums that had been poisoned or trapped. Again, some Scientist group members noted that 'messy' methods are distasteful and likely to be unacceptable to the public. One participant noted the importance of the 'yuck' factor for the public through this story:

I had a major mouse infestation in my house over the winter and I went in to get traps for the mice that I could use in the house. I went in as a girl looking for traps and the sales woman immediately said, I know just the one you want. She said, it's this one, where you don't have to touch the mouse to get it out of the trap. So that was the major criteria, was that the trapper didn't have to actually touch the dead mouse. To be honest, I was happy not to have to touch the dead mouse, but I probably could have managed (S)

Other features

Discussion in the various groups also identified a range of other features potentially determining the acceptability of pest control method. For example among the Animal Rights participants it was felt that methods that are fatal or distressing to animals are unacceptable to those with an interest in animal rights.

Members of the Conservation group felt that a method should be flexible in so far as it can be used on a range of species, examples being 1080 poisoning, and shooting. On the other hand this group also felt that a control method should not result in the scattering of other individual animals, such as occurs with shooting and the use of helicopters.

The Pest Managers noted that it was important that a pest control method not be controversial since it makes it harder for them to do their work, and in the case of biological control methods they felt that such controls should especially not involve the use of genetically modified organisms or viruses. Some thought that the issues of 1080 use among some sections of the community, especially among hunters, was *a legacy controversy rather than around current practice*. Certainly attitudes of some members of the Urban Women's group towards 1080 use appeared to be founded on misunderstanding or ignorance of the science and current practices.

Members of the Rural Public group also felt that control methods should be 'natural' and not involve the use of genetically modified organisms:

Our experiment with genetic modification had some very bad press, such as that of Schmeiser vs Monsanto in Canada. I think it's been misreported but you know those early 28 day trials on rats really got alarm bells ringing for a lot of people. I think they have far, far better testing regimes now, and I think it's wrong to have a per se opposition stance. We need to be open-minded and keep a watching brief on it but got to be careful, a bit of a cautionary approach (R)

Members of the Urban Women's group noted that a pest control method should itself be controllable, and this was a concern with respect to biological control methods, as in the following exchange over diseases versus fertility control:

Person A : It comes back to that fear of unintended consequences. With de-sexing you know what you're going to get. With a virus, there's that fear that it could. In hindsight we'll regret and we won't know what

Person B: And how to control it, because de-sexing you are in control but with a virus you're not necessarily ever going to be in control of it.

Person C: there's that unpredictability of what's going to happen in five or 10 years' time, isn't it? (W)

Along with members of the Rural Public group, the Urban Women generally felt that methods which caused offence to people or which are controversial should be avoided.

Acceptability of Trojan Female Technique

Discussion of the Trojan Female Technique in the focus groups commenced with a briefing for the participants. The description of the technology used in the briefing was based on written material supplied to us by the project leader (Appendix 2). Opinions about the TFT were mixed, and more negative comments were made than positive ones. Many questions were raised. Overall, there was guarded support, particularly for further research to answer the questions.

Although the briefing did not mention possums, the groups tended to focus on possums as an important pest and many of the comments were about possums.

Positives

Only a few comments about the TFT were straightforwardly and unambiguously positive. The Pest Managers group was the most strongly supportive, making several positive comments, including *actually quite excited by the idea* (P) and *I'm excited by the idea, I think it has a lot of merit* (P). One of the pest managers thought the TFT could be a source of both pride and revenue:

> *it's a way of putting New Zealand back on the map for science and research and perhaps making us money if you can crack rats. That's something that we can then sell to everybody else. I mean, rats are everybody's problem.* (P)

The Maori group, while acknowledgeing that possums had their uses, also saw clearly the damage they did, and were happy to be rid of them:

> *To me, the object of the exercise is to get rid of possums and if that's one way of getting rid of them, I'd, to be clear, I'd be very happy if they get rid of them completely.* (I)

The Conservation group was rather less enthusiastic, offering cautious support: *From what you've briefly told us, it sounds pretty safe.* (C). This quote could be seen as an example of a theme of conditional or mixed support, where an ostensibly positive comment was made, followed immediately by and integrated with an elaboration that was rather more negative than positive. Here is another example from the Conservation group:

> *Well, I think it's got more potential than anything else, but there is a saying that says that, if something can go wrong, it probably will go wrong. But you don't know when. It's a bit like, I watched something on that Ebola the other night and they were saying it's been around for ages in monkeys. Doesn't really produce much of a problem for them. But then it showed the locals butchering them, blood and guts everywhere, and nibbling on monkey heads and all that, and it's made the jump [to humans]. You don't know what's going to happen. But I still think it's got more potential than anything else we're doing.* (C)

The spectre of Ebola (much in the news at the time of our focus groups) was raised by this group more than once (and by two other groups once or twice) to invoke ideas of unpredictability and uncontrollability of biological agents, particularly viruses, but by extension anything small and created by scientific endeavour.

Another example of mixed support was provided in the Maori group. We asked that group whether there was any particular cultural offence caused by deliberately breeding infertile animals. The group members, mostly farmers and all from a rural area, said there was no offence to them but it would be possible for a Maori academic to assert that the TFT involved *trampling on the mana of a species*.

A clearer and more positively phrased statement of the overall acceptability of the TFT, though matched with recognition of risks and concerns, was made in the Rural Public group. This was the best overall summary response to the TFT across all of the groups.

> *… just about all of the concerns that were raised immediately when you broached the idea were around the periphery and the management of side risks, rather than the core activity of what was going on. That signals to me that the core activity is socially acceptable so long as risks around it are managed.* (R)

Negatives

There were more negative comments about the TFT than positive ones and they were more strongly expressed than the positive comments. The negative comments were mostly around the irreversibility of the TFT and the potential for

unintended consequences, in particular the possibility of TFT genetics spreading to other species or other countries and the potential ecological effects of removing large numbers of one particular pest species from an area.

Because possums appeared to be widely regarded in the focus groups as an important pest, several groups framed much of their discussion around possum-related issues. Three groups (Animal Welfare, Iwi and Urban Men) raised the possibility of possum TFT genetics spreading to Australia, where possums are a protected native species.

> *… if we bring some kind of biological control into New Zealand which causes a possum to become infertile and that jumps over to Australia, where they're a protected species, and suddenly they're all dying out because of fertility control, there's kind of, we're essentially saying we're going to make a species extinct, potentially, by introducing a fertility, a biological fertility control.* (A)

A related negative perception, mentioned in the Conservation group, was that the TFT might jump species. The example of a virus was used (and as the quote that mentioned Ebola earlier in the section shows, the example of a virus was invoked in this group more than once). Although we as facilitators pointed out that the TFT did not actualy involve the use of a virus the group held to the idea of a virus as an example of biological controls getting out of control in unintended ways.

> *On the surface of it, it looks as though it could be foolproof. We breed up a population of possums. We spread them in the environment. They go through and possums just peacefully stop breeding and they die away. But we know that things like virus and bacteria, I suppose, as well, can in fact jump species and sometimes they can introduce a gene problem for that species … The only dangers I can see would be if there was a virus … that moved from species to species, e.g. from possums to sheep and possibly from sheep to humans or whatever, and the virus was able to carry that little gene code and this trait was somehow able to jump the species. That would be something that we would have to think of, would be a downside to such a thing.* (C)

A similar negative response possibly based on misunderstanding was evident in the Urban Women's group, where one participant reacted negatively to the idea of a genetically modified strain of laboratory mice being used in the proof-of-concept research on the TFT:

> *Just putting on another hat here. The alarm bell went off when you said genetically modified, so those kind of words are quite scary. I know you're talking about a mouse but I don't know whether I'm putting my Dr Frankenstein hat on here but the whole modifying, how can it be assured that what you're modifying is just that one area, that something else isn't changing within the genetic makeup of the animal, since it's so complex? — From what I understood they're not changing the genetics of the animal, they're just taking the — Selective breeding. — Yeah, the least fertile females so therefore the genetics aren't changing. — Not altered. — Yeah, they're not being altered, they're just, it would be like" I've got four kids, [she's] got one kid, so therefore select her".* (F)

The participant did soften her concern by talking about *putting on another hat*, and the other poarticipants did correct her immediately, but the fact that she made the statement at all shows how easily vague feelings of scariness can be conflated, in the same way as viruses were invoked in the previous quote. Clear communications about how the TFT actually works will be needed.

The other main negative perception of the TFT centred on the ecological effects of substantially reducing the numbers of a pest species in an area. Two possible effects were described. One was that if you remove one pest species another will probably take its place:

> *I go back to pest ecology and we really need to be super careful of that. You know, if you take one pest out and you might think, oh great, we've got one pest species out but what remains might actually really go to town and could do more harm … So the pest ecologists needs to be involved.* (R)

The other ecological effect mentioned was the displacement effect, described in the Pest Managers group, where reducing the number of animals of a pest species in an area creates an ecological 'vacuum' that is filled by other animals of that species moving in from other areas:

> *… you go back to what the old boys used to tell us when we started. The only thing to keep a rabbit out of a piece of country is another rabbit … So it's all about displacement … We know from experience, once you've supressed the possum population it just acts as a net for pulling more in. So with the natural suppression through breeding, I suspect you'd get the influence of the wild populations from the margins, always putting pressure on that population.* (P)

Because of the potential for unintended consequences, in two groups it was suggested that the TFT's irreversibility made it potentially dangerous.

> *So it's not reversible? Once it's implemented, it just, like, say, to possums, it just goes through indefinitely?* [It would seem so, yeah.] *Yeah, so you can't reverse it, if you suddenly say, oh, heck, we've mucked up here badly … It's permanent.* (I)

The Animal Rights group said that a reversible biological control would be a better solution, suggesting:

> *a contraceptive drop … that can be reversed, if necessary. But it won't affect populations in other, species in other countries. It would not create playing God with a species and potentially wiping it out.* (A)

An alternative solution for dealing with the irreversibility of the TFT was suggested in the Maori group:

> *I think what needs to be done is that make sure that you've got a control species that isn't affected by this. You know, like they do with trying to fence off areas that nothing else can get into … So … it doesn't work, or it has bad effects, you've got a group of possums there that are still from the original species.* (I)

In several groups, the development and deployment of a biological control such as the TFT was described as *playing God* (A, R) or *fiddling around with nature* (I), the unspoken implication being that if mortals play God they eventually incur God's wrath.

Comparison with existing methods

Some of the comments made about the TFT in the focus groups involved comparisons of the TFT with existing mentods of controlling pest numbers, and these comparisons were almost all favourable. The biggest perceived advantage of the TFT over existing methods was its humaneness, and this was mentioned by several groups with a diverse range of interest, from the Animal Rights group (*this is sounding a hell of a lot better than the cruelty that's being inflicted on these animals at the moment*) to the Maori group:

> *… it's definitely not as bad as poison, because they're not dying. They're not getting created for a start, so they're not suffering in their dying, like in a trap or in poison. I don't know if you've seen poisoned possums and that, but it's not a pretty sight. They're all long and the eyes are, yeah, they're not pretty to watch … So we're not having that, so they're actually not being born, so that's a bit better than something being born and then suffering.* (I)

Perceived humaneness benefits of the TFT also extended to the public groups: *I think if you put this up next to 1080 then I would pick it every time.* (F).

The one negative comparison of the TFT with an existing method was made in the Animal Rights group, where it was suggested that a non-permanent biological control would be safer:

> *I think it would be better if it was something like we have from female contraception, where you can take it and it will wear off after a while. This is permanent.* (A)

Cautions and concerns

During the discussions of the TFT several cautions or concerns were raised in the focus groups. These cautions can be categorised as follows: that the TFT research is ambitious, that the research into and use of the TFT needs independent oversight, and that the TFT research needs to be supported with good communications.

Several groups responded to the statement in the briefing that the researchers hoped to be conducting the first applications of the TFT to real pests before 2020, suggesting such a target was optimistic. Most such comments came from the Pest Managers group: *If the target is 2020 they're going to have to get a wriggle on, aren't they … Because these things do take time* (P). Someone in the Conservation group was even more pessimistic:

> *I think we have to expect almost that the first few goes at this are probably not going to work terribly well. It may take 70 years for it to get right before we really get it to work.* (C)

The Pest Managers group raised three different difficulties in making the TFT work in the field. One involved possible resistance to the release of Trojan females:

You'd probably get a lot of farmer resistance if you walked onto a farmer's place today and said, well, I want to release 100 possums on your property. (P)

The second involved the need to manage landholder and public expectations of the TFT:

You don't want people believing it's an answer or a potential solution too soon because then the pressure goes on, get rid of 1080, it's not needed. (P)

The third difficulty was related to the second, in that it involved managing people's expectations, because biological controls took time to become established and people would have to tolerate the presence of larger numbers of pest animals until the biological control took hold.

… an obstacle to introducing any biocontrol, is that lag phase, so people are going to have to put up with increased numbers for a while, while that population, or that gene population, establishes itself … (P)

A desire for independent oversight of the research and deployment of the TFT was expressed in several focus groups. A range of reasons were given for this desire. This participant in the Urban Men's group did not trust scientists:

I have reservations … I don't trust these people implicitly that are doing it. So I think when people like this are doing this research, like all the research investigation, that there needs to be a watchdog. Now, theoretically I don't, just in principle, if you've got a group of scientists working on something it would be good to have a small group of two or three watchdog people who could get access to them at any time they wanted to and question what they were doing. (M)

This participant in the Scientists group, discussing likely public responses in the way that some of the interest groups tended to, talked of a public concern about who would get to make the decision about which species would be the focus of TFT work:

I think that will be a fear or an apprehension that people will have, or an anxiety, is that if this can be used on possums, which they might approve of, but then it might be one of the things you get is, what happens next? Who gets to decide what species and all that kind of, those questions. (S)

In the Urban Women's group one participant was concerned about unintended consequences of deploying the TFT and wanted long-term monitoring to ensure any TFT-based pest control was working as intended:

It feels like it's going to need long-term monitoring to ensure that the objectives that were set at the beginning will be maintained without it morphing into something else. Is there from the outset a commitment to this long-term monitoring of it to ensure that there aren't going to be these unintended consequences, over a period of time, because these are species that populate and regenerate quite quickly. So it's not going to be too many generations before there's going to be some very measurable impacts on that species over time. Is the commitment there to keep monitoring and ensuring that it stays within the framework of the original policy objectives long-term? (F)

Within the Urban Women's group there was also concern that decisions about the TFT should be taken out of political and commercial hands and placed with a non-political, non-commercial body that could make decisions on the basis of what was best for the environment:

I think it would have to be non-political to do anything like this in an effective way. You'd have to take anything political out and have a non-partisan body sitting there going this is what is best for the environment for the long term and not have it subject to funding whims and everything else. It's got to be a group of experts in this field that decide yes, this is good for the environment or no, it's not. — And therefore not commercially driven. — Yeah, not commercially driven. (F)

The final group of concerns centred aroung a desire for increased communication by scientists. One of the scientists talked about another scientist who had embarked on a program of research involving fertility control and commenced a public information campaign right at the start of the work in an attempt to ensure the public was never surprised by the direction of the research. The Unban Women's group talked about a need for scientists to communicate their purpose:

It's about educating on why they're doing this, how they're doing it, what do they see is the likely outcomes or a fix, what's their modelling? — [Will] … the species still be able to breed … — Has it been done in any other countries and what is the evidence to show how effective it's been and what the implications have been. (F)

Information required

After the briefing, participants were able to ask questions to clarify their understanding of the TFT. The questions are summarised below. Our main purpose in listing them exhaustively is that they form a checklist of topics that would need to be covered in a public information and communications program. Some of the questions are specific and easy to answer; others are fundamental in nature and could influence the future direction of the TFT research.

Biological questions

- *What actually triggers [the naturally occurring mutation] in the first place? … is there a reason for it? I mean, there's always a reason for everything so why does it happen? Does it happen in areas where food is short … Is there sort of a natural reason why it occurs?* (P)
- *… what's the frequency of occurrence of the mutation in the test animals?* (S)
- *… is this a little fly that has to fly around and find these animals?* (C)
- *So those mitochondrial DNA are passed on to 100 per cent of the offspring?* (S)
- *… is this Trojan female going to affect every possum that mates with it? … how effective is [it] going to be if they're going to mate with a multitude of males?* (I)
- *So is it to say that the less fertile of the females will dominate the population and supress other fertile females? How do they do that?* (P)
- *So the mothers that have the baby boys that don't reproduce very well, the mothers that have baby girls, then do they pass it on to their babies as they grow up and get pregnant?* (A)
- *Can it be reversed naturally?* (P)
- *Would it be more effective, for example, with animals that have a large number of offspring? Rabbits, for example, or cats.* (S)
- *Does the infertility continue through species that are genetically similar?* (R)
- *There could still be a viable population going on with the non-modified females … They may not even displace them … Then they'll die out … particularly if there's a breeding disbenefit to it, and nature always goes for getting rid of that sort of stuff out of the environment … [Would you need to] couple the genetic disability of the breeding along with the opposite, an increased fitness to say a particular toxin?* (P)

Ecological questions

- *You're actually purpose breeding in a facility somewhere to release these? … What are the survival capabilities of something that's been bred in captivity and released …* (P)
- *… you'd have to repopulate them at almost … peak capacity to stop migration [of non-TFT individuals] … so then you have the perception from some people [that] you're perpetuating the pest problem … [How do you deal with that?]* (P)
- *Is there not a danger of that though, if you do away with a species something else is going to come in stronger?* (M)

Field deployment questions

- *… how would you get [the TFT] out into the bush?* (C)
- *What sort of numbers are you talking about, like taking the difficult one like possums? I mean, are you having to breed up tens of thousands? … Or what proportion of the population need to [carry the TFT gene]?* (S)
- *… if they're not producing offspring as much … How do you get enough of them out there… to displace the fertile ones?* (P)
- *Once it's in the population, are you going to have to continue to seed the population … ?* (S)
- *So it's going to take a number of years then to really become quite effective, isn't it? If you can only release a few here and a few there and a few there.* (C)

- *I was going to ask if you could have a label on the animal, like we do with chickens. You know, the coloured chickens are all male … [so people know not to shoot them]* (S)
- *What sort of in-the-field research do you think they will do or have done so far? My thoughts are a good way of trialling it in some way in the field would be to isolate a population, say, like an offshore island, and actually try to model it on that population there and make it work in that way.* (P)

Policy questions

- *So the goal is eradication? Yeah? Or is it just going to reduce the populations in New Zealand, rather than eradicate?* (S)
- *… if possums first, what next, and then where does it kind of go to from [there]? … What might be the next target?* (S)
- *Has it been tried in other parts of the world or is this research ground-breaking?* (F)

Continuing the research

The last question we asked the groups was whether they thought the TFT research should be continued. There was general agreement that the research should be continued. The discussion in the Rural Public group was the deepest and most nuanced.

> *I think investigating it is acceptable. I don't think we've got to the stage of using it being acceptable … I don't think we know enough to go the next step yet, which is not to say we wouldn't when we get there.* (R)

This was the group that made the comment quoted earlier, that the core activity was acceptable and the concerns were about side risks. It is worth quoting again.

> *… just about all of the concerns that were raised immediately when you broached the idea were around the periphery and the management of side risks, rather than the core activity of what was going on. That signals to me that the core activity is socially acceptable so long as risks around it are managed.* (R)

The side risks perceived by the various focus groups, described earlier, provide a guide to issues that need to be considered in future TFT research.

Other issues

Several other issues arose during the focus group discussions that impinge on the development and deployment of the TFT. These were:

- trust in scientists and science institutions;
- technology decision-making processes; and
- potential consequential effects of developing the TFT, especially for the main vertebrate pests in New Zealand.

Trust in science

Several participants in the Conservation and Rural Public groups expressed concern about Landcare Research's involvement in the development of a biological control for pests.

First, Landcare Research was seen by some as lacking scientific independence, with it being *essentially a government department with a political master*, and since these *political masters are not ruled by science*, the scientific work in the area of pest management would inevitably serve the political and economic goals of the government of the day (C). It was suggested that the TFT work might better be carried out in one of the larger universities since they were seen as being 'one step further away' from political influence.

The second and related concern about Landcare Research was its direct involvement with the 2013 release of exotic dung beetles to New Zealand. Several participants in the conservation group felt that the introduction of the dung beetle was done without sufficient consultation and consideration of independent opinion and public involvement. They noted that:

> *it's just a done deal now. If some people had been able to have some input it may not have happened the way that it did. For what is a reasonably small economic gain they've taken a big gamble with yet another introduction* (C)

The worry expressed was that Landcare Research, working with its major stakeholders, could now attempt to release an organism under the TFT program into the environment *before it's been fully discussed with the New Zealand public* and giving other experts the opportunity to have some input into the decision (C). The pressure to release such organisms was seen as being related to inadequate funding by government for conservation protection and sustained pest control (an example being a claimed lack of action on the wasp invasion of forests of the South Island).

Decision-making

Several groups commented on decision processes for new organisms and related environmental risks, with a number of people commenting on the adequacy of existing processes.

Participants in the Pest Managers group noted that any kind of environmental intervention carried risk: the question was how those risks are dealt with. In the discussion concern was expressed that decision processes for the release of TFT organisms may not be rigorous enough. Reference was made here to poor risk management around the cleaning of oil rigs arriving in New Zealand, allowing deer repellents to be added to 1080 baits, and the fiasco of the illegal introduction of RHD.

The Rural Public group felt that when it came to pests and pest control decisions, the question of who participates in them depended on the community that would be particularly affected, with the State only being involved when it was a national issue or pest. The crucial thing for these participants was that the introduction of any organism to New Zealand should be seen to be subject to a robust process of risk assessment and evaluation of cost and benefits. They also noted, as did participants in the Animal Rights group, that the breeding and introduction of a TFT organism involved moral decisions, including the relative potential benefits and harms, and that this was quite complex.

> *you can look at the benefits and harms for yourself as a sole organism, or you can look for your family, or you can look at your community, or you can look nationwide and internationally for benefit and risk. The judgements that you make are going to be different depending upon which scale you looking at. And I'm afraid I don't think some of your scientists are the right people to make those judgements* (R)

Again, this was related to the question of the independence of the scientists involved and the bodies tasked to make decisions on bio security and the environment:

it's like a catch 22. You can't know the risks until you've trialled it but you don't want to trial at either because of the potential risks … If I'm promoting it I would probably understate the risks, and if I'm opposed I would properly overstate the risks. You need someone, the right party, to make that decision. (R)

The crucial aspects of a sound decision-making process for a new pest control technology such as the TFT would appear to be transparency of the decision processes, public and expert involvement in the process, independent scientific and expert evaluation, rigour, and sufficient time for consideration of benefits and risks.

Knock-on effects

Several of the focus groups discussed the potential consequences of successful development and introduction of a TFT based biological control for possums and rabbits.

The Pest Managers expressed a concern that a successful introduction could dramatically reduce the official and public support for 1080 use (which is already controversial), which would eliminate a key technology for vertebrate pest control generally, and for use as an initial population knockdown tool and as a backstop method.

Some Conservation participants felt that a successful use of TFT for vertebrate pests would bring about a further reduction in government spending for conservation and environmental protection. The Pest Managers and Rural Public groups noted that funding for a possum control for animal health purposes could also be discontinued.

Participants in the Maori and Rural Public groups expressed concern about the potential loss of livelihood by those currently involved in pest control and those harvesting pest animals for products if the TFT were introduced for possums.

These various concerns reinforced the various calls made for a comprehensive and independent evaluation of any proposal involving the use of the TFT for pests in New Zealand.

Discussion and Conclusion

The Trojan Female Technique sounded good in theory to most participants in our focus groups, and by “most” we mean almost everyone except those ideologically opposed to humans messing with animals. At an early stage in the biophysical research, when few straight and unequivocal answers can be given to participants’ questions, support in principle is all that could be expected from members of the public. At this stage it is too early to answer questions about whether the TFT would receive public support in practice. What we can do, though, is to map a course of action that could be taken to increase the likelihood that a TFT-based biological control would receive public support for field release. The best approach would be to consider, deal with and answer the concerns and questions raised about the TFT in the focus groups. Because the particular focus groups were chosen to ensure the likely range of views about the TFT was obtained, we can state with confidence that we have elicited the range of views that are likely to be brought to bear on the TFT.

The focus groups elicited many concerns and questions about how the TFT would work and whether it might have unintended consequences. These concerns and questions are a valuable guide to the perceptions of the public and the various interest groups about the TFT. Initially stated positions are a poor guide to how people really think about new biological technology. Our earlier work on perceptions of RHD for rabbit control showed that the reasons people gave for their initial responses were a better guide to their underlying position than the initial position itself (Wilkinson and Fitzgerald 1998). Only some of those with an initial positive position on the release of RHD were eventually classified as outright supporters of the technology, and only some ot those with an initial negative position were eventually classified as outright rejectors. All other respondents to our survey were conditional in their eventual position, even many of those who initially said yes or no. We found out what made their position conditional by asking them their reasons for their initial position (Wilkinson and Fitzgerald 1998). We expect people’s concerns and questions about the TFT to act similarly, as indicators of what is conditional about their response to the TFT and thereby what issues need to be addressed.

Most of the concerns and questions raised in the focus groups were about how the TFT would work in practice rather than about any ethical or practical objections to the use of a biological pest control such as the TFT. Indeed, our past research has shown the general acceptability of fertility controls for pests (Fitzgerald et al 1996b; Wilkinson and Fitzgerald 2006). The concerns and questions that were raised are mostly about side issues, many of which could be addressed by better communications with the public and interest groups. Some concerns were about important practical issues and may need to be addressed by specific pieces of biophysical research.

Many of the comments about the TFT seemed to be based on misconceptions or misapprehensions. Some of these seemed to result from limited knowledge, which is understandable in the early stages of research on a new technology. Others seemed to be based on the conflation of fears about various uncontrollable biological agents, whereby a relatively unknown agent such as the TFT is given the features of one that is known or topical, such as the Ebola virus. The phychometric perspective on risk perceptions is that risks of a technology are seen in two main dimensions, commonly labelled ‘dread’ and ‘unknown’ (Slovic 2000). These labels could certainly be applied to many of the comments on TFT made by some of the focus group participants in this study. Dealing with the misconceptions and misapprehensions will require a combination of research and communication.

Research needs

The focus group participants were generally happy for research on TFT to continue. There was a widespread perception that the stated target in the briefing notes of the year 2020 for commercial scale trials was optimistic, and to reach it intensive research would be required. Through their comments and questions the participants raised issues they felt needed further research. Some of these issues may be planned already; others may need to be added to the TFT research program. The two major strands of research that were suggested are described below.

The first main strand of research required is ecological. In several groups the ecological effects caused by wholesale removal of pest animals by the TFT was raised. Two kinds of ecological effect were mentioned: invasion by other pest species that could be more damaging than the original species, and in-migration by other individuals of the same species to re-populate the area and lessen the effect of the TFT.

The other main strand of research required is biological. Several concerns about the irreversibility and uncontrollability of the TFT were raised. Research into ways of reversing or controlling the spread of infertility within a TFT-affected population of pests would help allay these concerns. There were also fears expressed that the TFT might somehow jump species. To allay these fears, TFT researchers may need to conduct research explicitly to test whether the TFT can jump species, even if scientific consensus is that it cannot do so. Such fears might seem to scientists to result from an unfounded and erroneous conflation of fears. However, lay people tend to frame scientific issues more comprehensively than scientists, in that they assume fewer things away as irrelevant (Wynne 1996). Simply asserting that the TFT cannot jump species is more likely to increase public fears than reduce them. Being able to point to specific research on this topic would help scientists build public trust.

A related controllability concern resulted from the tendency of most groups to focus at least part of their discussion of the TFT on possums. What if possum TFT genes reach Australia? The rabbit virus, RHD, was given as an example of the unofficial importation and release of a biological control agent, suggesting that it would not be possible to prevent the introduction of a TFT for possums into Australia.

Communication needs

Many comments on the TFT by the focus group participants were based on a lack of clarity and knowledge about how it actually works, misconceptions around the role of genetic modification and viruses in the TFT, and generalised fears about uncontrollability. A comprehensive communications program is needed to explain how the TFT would actually work, what the researchers are doing, and what the benefits and risks to New Zealand would be. Being straightforward about admitting the risks is an important component in building trust (Sandman1993). Such a campaign would have three functions. First, it would play an education role, ensuring that the TFT is known about before any field release. This would help prevent an adverse public reaction or outrage. Second, it could answer the questions raised by participants in our focus groups, which can be seen as representative of the kinds of concerns the NZ public and the various interest groups are likely to hold. Third, it could help manage any unrealistic expectations of the TFT.

The public is not a singular entity. There are multiple publics, multiple segments and interests within the so-called general public, even before the various special interest groups and stakeholders are added. Some of them are neither interested nor involved in pest management and will not want to know how the TFT works and may not care whether it is used. Offering information to these people is unlikely to change their views. People with a strong view one way or another are unlikely to be persuaded to change their view by information. Attitudes, once strongly formed, are resistant to change (Eagly and Chaiken 1993). The people most influenced by communications are those who are at least partly interested in pest management but do not have strongly formed attitudes. Factual, open information may prevent such people joining radical pats of the public in becoming outraged, but it needs to be tested before being deployed. The inadvertent use of potential trigger words (such as genetic modification) without proper testing and evaluation can result in miscommunication.

One way to communicate that a cautious approach is being taken without saying anything would be to establish some kind of independent watchdog authority to oversee the TFT research and release. This was requested in several of our focus groups. Actions sometimes speak louder than words and are more important to building public trust than words. A clear process for making decisions about research and release of TFT organisms was also wanted.

Further social research

It is still early in the TFT research process. It is sensible to conduct social research on public perceptions of the TFT in parallel with biophysical research to develop and refine the TFT, to ensure that any development of the TFT is done in a way that will receive public support. As the biophysical research develops and builds on what has gone before, so does the social research. The next step in social research on the TFT is a national survey. Our focus groups have established the range of views held about the TFT; a survey would establish how widely those views are held. It would show how a collective public view of the TFT is built up from various specific views held by various segments of the public. A survey would allow us to quantify the various attitudes to the TFT and beliefs about its acceptability, identify the various segments among the public and their size and positions on the TFT, and suggest appropriately targeted communications that address the specific needs of each segment.

Conclusion

Despite receiving limited information on the TFT and how it might work, our focus groups were generally favourable toward it in principle. Given the early stage of TFT research and the limited and non-specific nature of the information we provided to the focus groups, in-principle support is all that could be expected. We have provided a list of questions raised in the groups and made suggestions for research (including social research) and communication to help provide answers to these questions. The next step is to find the answers to people's questions and go back to the public and ensure the answers are satisfactory.

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Appendix 1. Focus group topics

Describe the purpose of the study.

Outline the focus group procedure – confidentiality etc. Informed consent agreement.

Set rules

1. Round robin: brief statement of any personal involvement with vertebrate (animal) pest control or invertebrate (insect) pest control
2. What do you think the main animal pests (problem animals) are in NZ? (list them eg on board)

   Why?

3. What do you think are the main insect pests?

   Why

4. What methods do you think are currently being used in NZ for controlling animal pest numbers?

   List on white board or powerpoint

5. What do you think or feel about the acceptability of these methods (eg trapping, shooting, poisoning, biocontrol)

6. What do you think or feel about the use of genetically modified organisms in vertebrate pest control? What about for invertebrate / insect pest control? Does the way in which genetic modification is used make a difference, *e.g. research, development, field*?

7. Are any of these methods that we have discussed unacceptable to you ? – why

8. What makes a pest control technology acceptable or unacceptable to you? (*possible use of prompts for particular features/characteristics. Does the method of biocontrol make a difference, e.g. disease or fertility control)*

9. Of these various factors that make up acceptability which are the most important to you?

We would now like to discuss a possible new form of pest control that is under study in NZ at present .

Give the briefing on TFT

10. What do you think of TFT as a possible form of pest control? (what's good about it, and what's not so good?) Any additional information required?

11. Are there any aspects of this technology/technique that bother you, or which might make it unacceptable for use in NZ.

Wind up.

Appendix 2. Trojan Female Technique briefing notes

What is it?

The Trojan Female Technique is a new idea for managing pest organisms (including vertebrates such as possums and stoats, and invertebrates such as weevils and fruit flies) that cause losses to both our agricultural sector and native biodiversity. It would also be applicable in other countries to managing vectors of disease threats to human health (such as mosquitoes). We are currently in the middle of a two year project working with fruit flies and mice in the lab, to demonstrate that the idea is actually feasible to develop for the 'real' pests impacting New Zealand's agricultural sector.

How does it work?

The idea is based on the mitochondria that occur in the cells of all animals. These are the 'batteries' of the cell, providing the energy needed to carry out all of its essential processes. We have discovered that inherited variation, causing a decrease in the energy output of these batteries, occurs naturally among individuals. Most cells have low energy requirements and lots of mitochondria, so such variation doesn't normally affect them. However, a unique exception is sperm. Sperm have high energy requirements and very few mitochondria, so that males with such variation can have compromised (or no) fertility. This effect has previously been recognised as a potential threat to small populations of endangered species, and is a known cause of human male infertility. We want to turn this concept on its head, and purposefully use it to reduce the breeding output of pests and thus the size of the populations that they can grow to.

What's behind the name?

In addition to being a catchy title, the name refers to two key elements of this new idea. First, as noted above, the idea is based on variation that compromises fertility in male pests but has no effect on females (or, indeed, any other effect on males). Second, all animals inherit their mitochondria from their mothers (in the egg) and not from their fathers (with the few mitochondria in sperm being left behind upon fertilisation of the egg). So, similar to how the Trojan Horse was used to smuggle Greek fighters into Troy to sack the city in ancient history, here the females themselves of the pest species targeted would carry the agent of its decline.

What could we use it on?

Since all animals have mitochondria, this idea is potentially applicable to the full range of vertebrate and invertebrate pest species impacting agriculture, conservation, and human health.

Why do we need it?

Vertebrate and invertebrate pests cause output losses of $885 million p.a. to New Zealand's primary sector. Application of this idea thus has the potential to not only eliminate a substantial proportion of these losses (and associated pest management costs), but also provide a basis for control development to combat new incursions. In this manner it will support sustainable productivity growth in New Zealand. Beyond the current project, the idea is also applicable to controlling the animal pests (such as stoats, possums and rats) that continue to decimate our native biodiversity.

What advantages does this idea have over similar existing approaches?

The Trojan Female Technique is a novel twist on an existing paradigm used to manage insect pests worldwide, called the Sterile Male Technique. This technique, involving the yearly mass release of large numbers of males that have been irradiated to sterilise them, has proven highly successful. For example, it has been used to eradicate the parasitic screwworm fly from multiple countries with an estimated $1 billion p.a. saving to the agricultural sector of the USA alone. Unlike the Sterile Male Technique, where the population suppression effects of releases are transient (necessitating the yearly release of large numbers), the effects of Trojan Female Technique population suppression are persistent (because the females carrying the variation compromising male fertility are not themselves affected by it). Models thus predict the same eradication effect at much lower effort and cost, such that this approach could even be applied to suppressing vertebrate pest populations.

How could it be applied?

For managing invertebrate pests, large number of females carrying the Trojan Female Technique variation could be released into the target populations that we want to control. After an initial increase in pest population size, the population would reduce and be held at a lower level. Further releases could be conducted to reduce even lower, or even eradicate, the target pest populations. For situations where large releases are undesirable due to the impact that they might have in the initial 'increased population' phase, or if it's not feasible or economic to rear such large numbers, standard methods of population control could be applied first, after which the release of far fewer Trojan Female Technique females would limit the size to which the post-control population grows back (including eradication). Such an approach would also be applicable to vertebrate pest control.

Does the Trojan Female Technique involve GMO?

Our goal for the Trojan Female Technique is the ability to use the variation in male fertility that naturally occurs in animal populations to control those populations, by identifying the mitochondrial variation that has the desired effect (compromised male fertility only) and selectively breeding females for release that carry that variation. However, to be able to do this we need to know what type of variation in the mitochondrial genome that we are looking for. To gain this understanding for vertebrates, we are working with GMO mice in the lab in the two years of the current project. After this, further GMO use, either in the research development phase or for the actual application of the Trojan Female Technique to the control of real pest populations, will not be necessary.

Who is developing this?

The current project is being conducted through a joint venture combining scientific experts from Landcare Research, the University of Otago, and Monash University, with independent sociologists and agricultural consultants. Project governance is provided by a cross-stakeholder Advisory Group and the project is funded by an MBIE Biological Industries 'Smart Ideas Phase I' grant.

How long might the Trojan Female Technique take to develop?

If this work continues, we would hope to be conducting the first applications of the Trojan Female Technique to real pests (both vertebrate and invertebrate) in a real-world situation before 2020.

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