Invasive Animals Cooperative Research Centre

Will the community accept our science?

Monitoring the community's view about managing pest animals in Australia

NI Fisher, AJ Lee and JHJ Cribb

ValueMetrics Australia

Invasive Animals CRC

Invasive Animals Cooperative Research Centre

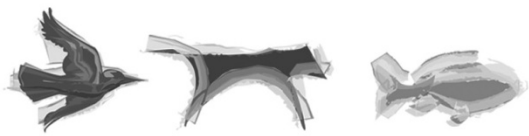
"Together, create and apply solutions"

Will the community accept our science?

Monitoring the community's view about managing pest animals in Australia

NI Fisher[A], AJ Lee[B] and JHJ Cribb[C]

A. School of Mathematics & Statistics, University of Sydney, NSW 2006 Australia (corresponding author)
B. Department of Statistics, University of Auckland, Private Bag 92019, Auckland, New Zealand
C. University of Technology, Sydney NSW Australia



Will the community accept our science? Monitoring the community's view about managing pest animals in Australia
Report prepared for the Invasive Animals CRC Detection & Prevention Program's Project 10.D.12b Community Awareness Survey.

Published by: Invasive Animals Cooperative Research Centre.
Postal address: University of Canberra, ACT 2600.
Office Location: University of Canberra, Kirinari Street, Bruce ACT 2617.
Telephone: (02) 6201 2887
Facsimile: (02) 6201 2532
Email: contact@invasiveanimals.com
Internet: http://www.invasiveanimals.com

ISBN: 978-1-921777-41-7
Web ISBN: 978-1-921777-42-4

Cover images: rabbit (courtesy Brian Cooke, IA CRC), feral cat (Tony Buckmaster, IA CRC), cane toad (Kimberley Toad Busters) and feral pigs (Steven Lapidge, IA CRC).

This document should be cited as: Fisher NI, Lee AJ and Cribb JHJ (2012). Will the community accept our science? Monitoring the community's view about managing pest animals in Australia. Invasive Animals Cooperative Research Centre, Canberra.

Contents

Summary

The Invasive Animals Cooperative Research Centre Community Awareness Survey (CAS) has pioneered a new technique in opinion research called 'Reading the Public Mind' (RtPM). For a comparatively low cost, this technique has provided a 'moving picture' that charts the changes in public attitudes to invasive animals and their control through time and helps explain the reasons behind them. It identifies the drivers of public opinion, thereby increasing the scope for better science communication, for education where public understanding might be faulty and for improved research planning based on knowledge of what the public will and will not accept.

CAS has produced remarkably consistent results over the nearly three years that it operated, providing the first Australia-wide picture of public attitudes and beliefs regarding invasive animals and ways of controlling them. Analysis of survey results (based on 40 respondents a week during the period 13 November 2007–29 June 2010) established overall that:

- The 'top five' pests, in the eyes of the public as distinct from the views of experts or governments, were identified as cane toads, feral cats, wild rabbits, carp and feral pigs.
- The public's preferred methods for controlling pests were so-called 'humane methods*:* fertility control, biocontrol and genetic control, with more traditional methods such as baiting with a traditional poison, gassing and shooting being the least acceptable.
- The public's main concerns about invasive animals and various methods used or proposed for their control were: (i) whether the scientists, government and business involved will keep the Australian community informed, (ii) whether the control method might affect other animals or humans, and (iii) possible contamination of the food supply.
- There was a very high level of concern held by the majority of Australians over the impact of pests such as cane toads, cats, rabbits, feral pigs, foxes and camels, especially on native fauna and flora and agriculture.
- There was a growing level of awareness of the public about the impact of pests such as camels and a receding level of awareness of pests such as rabbits.

- There was a contrast in attitudes between males and females, young and old, and country and city both to invasive animals and their control, implying conflicting pressures on policy makers and managers as time goes by.
- There is public ignorance and unawareness of certain issues related to invasive animals and it is important to remedy this.
- There was a strong public preference for 'soft' control technologies as replacements for shooting, gassing and use of traditional poisons.
- There were public concerns for the safety and health of the Australian food chain.
- There was a desire by the public to be kept informed about feral animals and options for their control.
- The public's two main sources of information on invasive animals were television, and newspapers and magazines.

The RtPM technique is capable of being applied to practically any field of science and technology that is interested in ascertaining how adoptable its ultimate outcomes will be, and whether or not they will generate a return on the public investment, meet with commercial success, or face a difficult pathway to uptake and wide adoption.

Finally, we offer the following policy recommendations, flowing from the findings of this research:

1. There should be specific, targeted public awareness activity by the IA CRC and its partners aimed at informing (a) women and (b) young Australians about the extent of damage caused by various invasives and the best control options.
2. The strong public concern about cane toads and cats should be factored into new research and control programs for these species in particular.
3. Ongoing public awareness activity should be implemented about rabbit impacts, especially among urban populations.
4. Major invasive animal control initiatives (eg camel management) should track public opinion and support or concern about their activities.
5. Growing public pressure for the control of 'urban' pests such as mynahs, pigeons, rats and mice should be monitored.
6. A regular (eg two-yearly) report to the Australian public should be issued on the state of damage caused by, and control policies for, the top five invasives, and other species of particular national or economic significance.

Many of the results in this report, a more extensive discussion about its relevance to science communication, and related references to the literature can be found in Fisher et al (2012).

1. Introduction

In modern democracies, public sanction is an increasingly important determinant of whether or not a new scientifically based policy, a new technology or a behavioural change is widely adopted and implemented — or is stalled, rejected and goes nowhere. Whether or not the public accepts a powerful new technology, policy change or behavioural advice has a strong influence over the ultimate societal value of the science, and whether or not it repays the investment made in it.

For this reason, it has become important for scientific institutions not only to carry out excellent scientific research, but also to understand how the outcomes of their research are likely to be received by the wider society. This is especially the case with so-called 'disruptive technologies' where lives, industries and communities can be profoundly altered, but also applies to areas where scientific advice is likely to flow into national policies or seeks to inform and influence public attitudes and behaviour.

Australia is host to 56 known invasive vertebrate animal species, imported over the last 200 years (http://www.invasiveanimals.com/about-us/). Among these, the most damaging include the rabbit, European red fox, feral cat, feral pig, wild dog, house mouse, brown rat, carp, goat, cane toad, wild horse and camel. Invasive species have many negative impacts including: widespread damage to agriculture, the environment and Aboriginal culture (Edwards et al 2008), risks to health and biosecurity and grave effects on extinction rates among native Australian species of plants and animals. Their direct economic impact is conservatively estimated to be at least $743.5 million annually (eg Gong et al 2009). There is also significant social impact that is more difficult to quantify.

The Invasive Animals Cooperative Research Centre (IA CRC) was set up in 2004 on a research foundation established by the previous Pest Animal Control CRC. It aims to counter the negative impact of invasive animals through the development and application of new technologies and by integrating approaches across agencies and jurisdictions. IA CRC's key objectives are to:

- Develop new tools and strategies to control invasive animals (including birds and freshwater fish).
- Develop new services and remove impediments to empower communities to take greater and more effective action against invasive animals.

- Advance understanding of the nature and behaviour of Australasia's invasive animals to maximise delivery from the above objectives.
- Provide partners with mechanisms for national and international business collaboration, to facilitate route to market for products and services.
- Build greater capacity to anticipate, detect, prevent, limit or manage the impacts of existing or new invasive animals.

In planning for the IA CRC, it was recognised that effective community engagement would be critical to the success of various research programs, to public understanding and support, and to the adoption of the centre's new technologies and approaches for managing invasive species. In turn, this implied a need to study and understand community opinion, both to ascertain awareness of and views about various aspects of invasive species and how they might be managed, to assess the likely public response to new control methods and to measure the impact of specific communication initiatives. When faced with a similar issue, the Pest Animal CRC had contracted ValueMetrics Australia to develop and pilot a means of conducting such a monitoring program. The results were sufficiently promising that ValueMetrics Australia was invited to be a core participant in the IA CRC to implement a suitable process for monitoring the community's views.

Specifically, the goals of this project were:

1. To provide baseline and ongoing research to support the mission of the CRC by:
    a. producing an ongoing assessment of
        (i) the level of community awareness of pest animal issues across the spectrum of CRC activities
        (ii) the existence of the IA CRC
        (iii) support for its work
    b. heightening awareness amongst those surveyed
    c. informing policy discussion and community dialogue, specifically, by helping to identify community concerns, needs and issues with a view to helping the IA CRC to determine operational communication priorities and methods
    d. providing a quarterly report on community awareness to IA CRC board meetings
    e. providing material for media and stakeholder communication.
2. To explore the efficacy of a new internet-based continuous monitoring method for science communication to be deployed in achieving the first purpose.

The Community Awareness Survey (CAS) was developed during 2007 and launched late in 2007. It ran as a continuous weekly survey until the end of June 2010, excluding the two weeks around the end of each year. Quarterly reports provided information to the CRC leadership about trends relating to a range of invasive animals issues, concentrating on the previous quarter and the previous 12 months. This end-of-project report describes the results obtained by analysis of the entire data set throughout its 11 quarters of operation. It both supplements and complements some of the findings in Fitzgerald and Wilkinson (2009).

2. Development of the survey instrument

2.1 Design of the survey instrument

The survey instrument comprised four basic sections:

(a) Elicitation of community views about a series of invasive species and acceptability of general approaches to managing pests.

(b) A Community Value survey, wherein the communities views were sought about the benefits of research into methods of managing invasive species, their concerns about research, and alternative ways of investing resources in environmental research.

(c) Questions that varied over the life of the survey, relating to sources of information, awareness about the IA CRC and specific awareness about rabbits.

(d) Demographic information about the respondents.

An 'expert' focus group was used to identify specific details relating to (a), (c) and (d) and to provide preliminary information for (b). For (a), the invasive species identified for study are shown in Table 2.1.1.

Table 2.1.1 Invasive species studied in the Community Awareness Survey

buffalo	feral goats	sparrows
camels	feral pigs	starlings
cane toads	foxes	tilapia
carp	indian mynah birds	red-eared slider turtle
cockatoos	introduced mice	wild dogs
crows	introduced pigeons	wild donkeys
deer	introduced rats	wild horses (brumbies)
dingoes	kangaroos	wild rabbits
feral cats	mosquito fish (gambusia)	

The experts also identified the range of management methods to be explored in the survey. Table 2.1.2 provides a list of these methods together with examples to clarify the intent of the request.

Table 2.1.2 Management methods studied in the Community Awareness Survey

Method	Examples
baiting with a traditional poison	• 1080 • Ratsak
baiting with a new-generation humane poison	• fast-acting, rendering animal unconscious
biological control	• using a virus such as calicivirus for rabbits • introducing another animal to control existing pest
fertility control	• using contraceptives
genetic control	• sterilising using a genetically modified virus • controlling gender of offspring
destroying nests/ habitats	• ripping up rabbit warrens • spraying eggs to prevent hatching • removing nests
exclusion	• fencing (rabbit-proof fence or dog fence) • netting out birds at orchards • wildlife sanctuaries • electric fences to exclude larger pests such as dogs, pigs, goats and deer • fish gates to exclude exotic fish
gassing	• carbon monoxide, phosphine
shooting	• ground shooting by licensed landholders and sporting shooters • professional marksmen from helicopters
trapping for humane euthanasia	• soft-jawed traps as used for wild dogs • traps for birds and pigs • water traps for camels, goats and buffalo

Most of the design effort was concentrated on developing the Community Value survey instrument in (b). This has been described in detail in Fisher et al (2007). To quote from the abstract, the process of managing Community Value is:

> ... a new approach to measuring and monitoring the quality of dialogue between research groups and the wider community about specific scientific matters. It is an adaptation of a proven marketing process for monitoring customer satisfaction: key drivers of community perception are elicited and measured, so that managers can respond to the issues that are most important to the community, rather than relying on their own perceptions. One important benefit of the approach is that the method provides a means of linking an overall score

for the community's perceived value of a research project to an important business driver such as "Percentage of people very willing to support deployment of the research results".

At the heart of the process is a so-called Community Value Tree that represents the overall perceived Value to the community of the IA CRC's research program in terms of their perceptions of the prospective Benefits of the program, their Concerns about the program and their views about the best ways to invest Resources in environmental research. This can be depicted as shown in Figure 1.

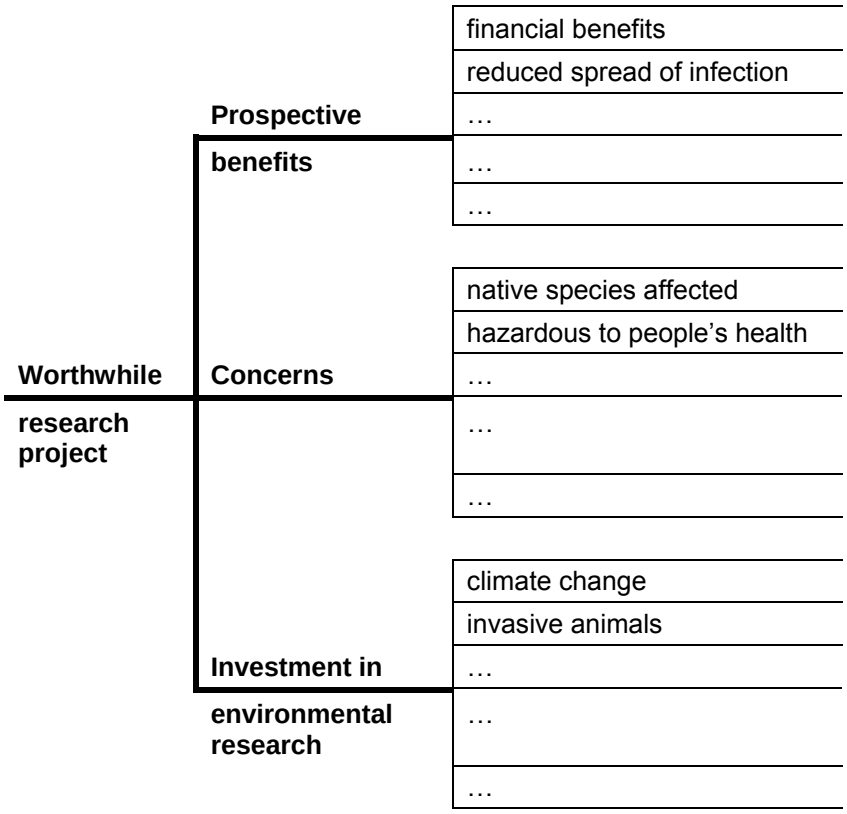


Figure 1: Structure of the Community Value Tree that formed the basis for the Community Value survey instrument

The three sets of attributes are determined from focus groups.

Data obtained from the survey are subjected to statistical modelling and analysis with the aim of determining:

- the relative importance of each of the main drivers in predicting the overall score for Community Value
- the mean rating for Value and for each driver.

This information can then be used to decide how to focus priorities for improvement, by looking for important drivers with low ratings.

The reasons for seeking to increase the community's perception of Value is that Value itself can be linked to higher-level 'business drivers' such as importance of developing controls for invasive species, and willingness to support deployment of a specific technology (eg a viral method) to manage invasive species. We shall see examples of this later, in the data analysis.

2.2 Implementation and conduct of the survey

The survey was implemented as a web-based instrument and housed on a remote web site to guarantee anonymity for the respondents. An 'ethical internet panel' provider was contracted to recruit 40 respondents each week, with the respondents over each 4-week period as best possible for what were regarded as the critical demographic factors of Location and Gender. The term 'ethical' refers to a number of characteristics of the way the internet panel is formed, including:

- people are approached and invited to participate; they are not able to apply (eg by responding to an advertisement for panellists on an internet dating site)
- there is no guarantee of any reward for panellists, whose motivation is generally an ethical one based on a wish to help society
- panels are refreshed reasonably frequently
- there has to be some altruistic purpose for the survey.

The relative merits of internet-based surveys compared with other forms are discussed in Fisher et al (2010). A summary is shown in Table 2.1.2.

Data were accumulated on a weekly basis during the period 13 November 2007 to 29 June 2010. Apart from the two-week non-survey periods noted above, there were a couple of other periods when the survey was unavailable because of redesign of the Community Value component. A total of 5060 responses were obtained, with demographic breakdown as shown in Table 2.2.2.

In view of the paucity of data for the first two educational levels, these data were combined with the next level to form the level 'High School or lower'.

Table 2.1.2 Relative merits of various survey methods

	Method			
	Face-to-face interview	Telephone	Mail	Internet 'panels'
Criterion				
Coverage	potentially, total	biased	biased	biased
Precision (quality of responses)	high	low	medium	medium/high
Cost	very high	high	medium	low
Quality of sampling process	high	low	low/ medium	low/medium/ high(?)
Speed of response	low	medium	low	high
Assurance of anonymity	low	low	medium/ high	medium/high

Table 2.1.2 Numbers of respondents by demographic variable and level

Age	***n***	**Gender**	***n***	**Education level**	***n***	**Location**	***n***
under 25	692	female	2531	no formal education	12	city	2883
25 to 50	2112	male	2529	primary school	51	regional	1484
over 50	2256			high school	1585	rural	693
				college (TAFE), private/tertiary	190		
				university	164		

n = no. of respondents
Total number of respondents = 5060

3. Statistical analysis

We present the statistical analysis in three sections, corresponding to the three basic sections of data acquisition in the survey. Each section evaluates possible effects due to temporal change and to each of the demographic factors.

3.1 Pests

Survey request: *Please indicate up to 5 animals on the following list that you regard as Australia's worst pest.*

Figures 3.1.1–3.1.4 show the community's views about the worst pest over the lifetime of the survey, and the variation in their views according to the different demographic variables.
The 'top five' pests in the eyes of the public, as distinct from the views of experts or governments, were identified as cane toads, feral cats, wild rabbits, carp and feral pigs.

A logistic regression model fitted to each individual pest indicates that there are statistically significant ($P < 0.001$) differential responses, according to these variables:

- there are Age differences for all pests except for rabbits
- there are Gender differences for cats, rabbits, carp, non-native rats, non-native mice and camels
- there are Educational differences for rabbits, Indian mynah birds, non-native rats and non-native mice
- there are Location differences for carp, foxes, Indian mynahs and non-native rats.

In the remainder of this section, we shall focus attention on the top nine pests plus camels (loosely referred to as 'the top 10 pests'):

- cane toads
- feral cats
- wild rabbits
- carp
- feral pigs
- foxes
- indian mynah birds
- introduced rats
- introduces mice
- camels

How the trends for these top ten pests and the relative differences between them changed over time can be seen explicitly in Figures 3.1.5 and 3.1.6.

Each of the demographic factors exhibits some interesting patterns. For each demographic, there are a number of statistically significant differences ($P < 0.001$) in the proportions of people rating particular pests amongst the top five. These differences are shown in Figures 3.1.7–3.1.10.

From these graphs a number of interesting issues emerge with relevance to science communication, approval and adoption. For example, Figures 3.1.1–3.1.4 show that the cane toad clearly occupies the spotlight when it comes to the public's awareness of invasive species, likely a consequence of the animal's particular appearance rather than the actual harm it causes. For science, this carries two important considerations:

- the public is less well informed about invasives that cause the most damage, and can tend to value less highly the efforts made to control rabbits, foxes, pigs, camels and other key species
- the public clearly has a strong expectation that cane toads will be a primary target for scientific control, and its attitudes towards control programs in future might be influenced by perceptions of the success or failure of efforts to check cane toads.

A second notable point is that a majority of Australians (varying around 60–75% in the survey) regard cats as an important invasive (Figures 3.1) and are aware of the havoc they wreak on native wildlife in particular. The significance of this finding is that for decades Australian science has avoided research into cat control on the assumption that most of Australians liked cats and would not tolerate the expenditure of public money on this research and development (R&D). RtPM shows this assumption to be incorrect and that there may be a significant groundswell of opinion among Australians for cat control (though a minority might still oppose it.) This result also underlines the value of this type of research in providing governments and industry with the confidence to adopt new scientific advice and modes of control in cases when these are considered controversial.

A third issue is the way rabbits have fluctuated in public awareness throughout the poll (Figure 3.1.5), from fifth to third place. This is thought to reflect the increasing urbanisation of the Australian community (a generation ago, no Australian would have to be told the rabbit was our worst pest), a growing lack of awareness of rural and agricultural issues among the younger generation and how the media (especially television) has shaped public beliefs regarding invasive animals, resulting in significant misperceptions about the relative importance of various pests.

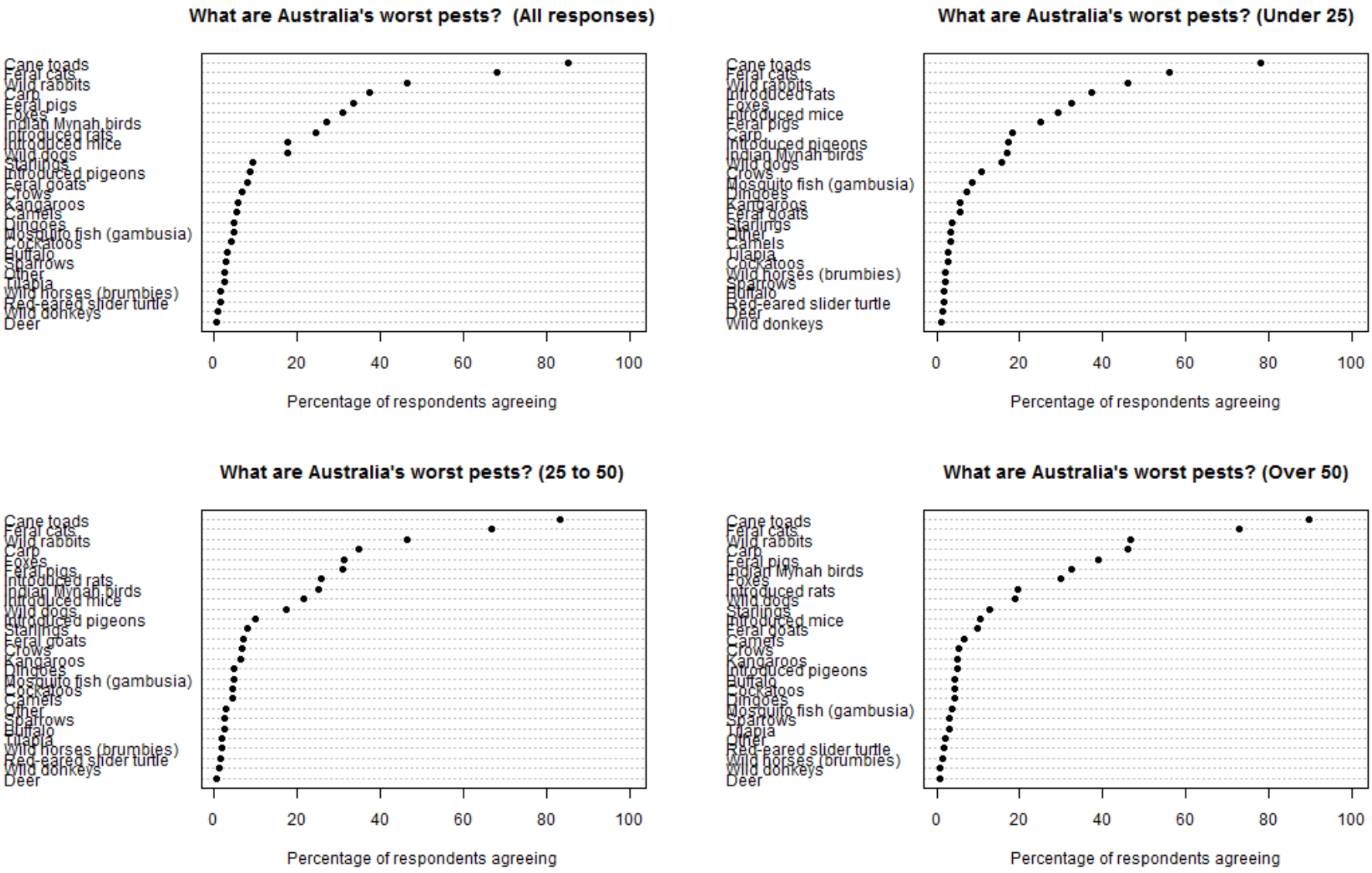


Figure 3.1.1 Species rated as the worst pests: overall ratings and differential ratings by age group

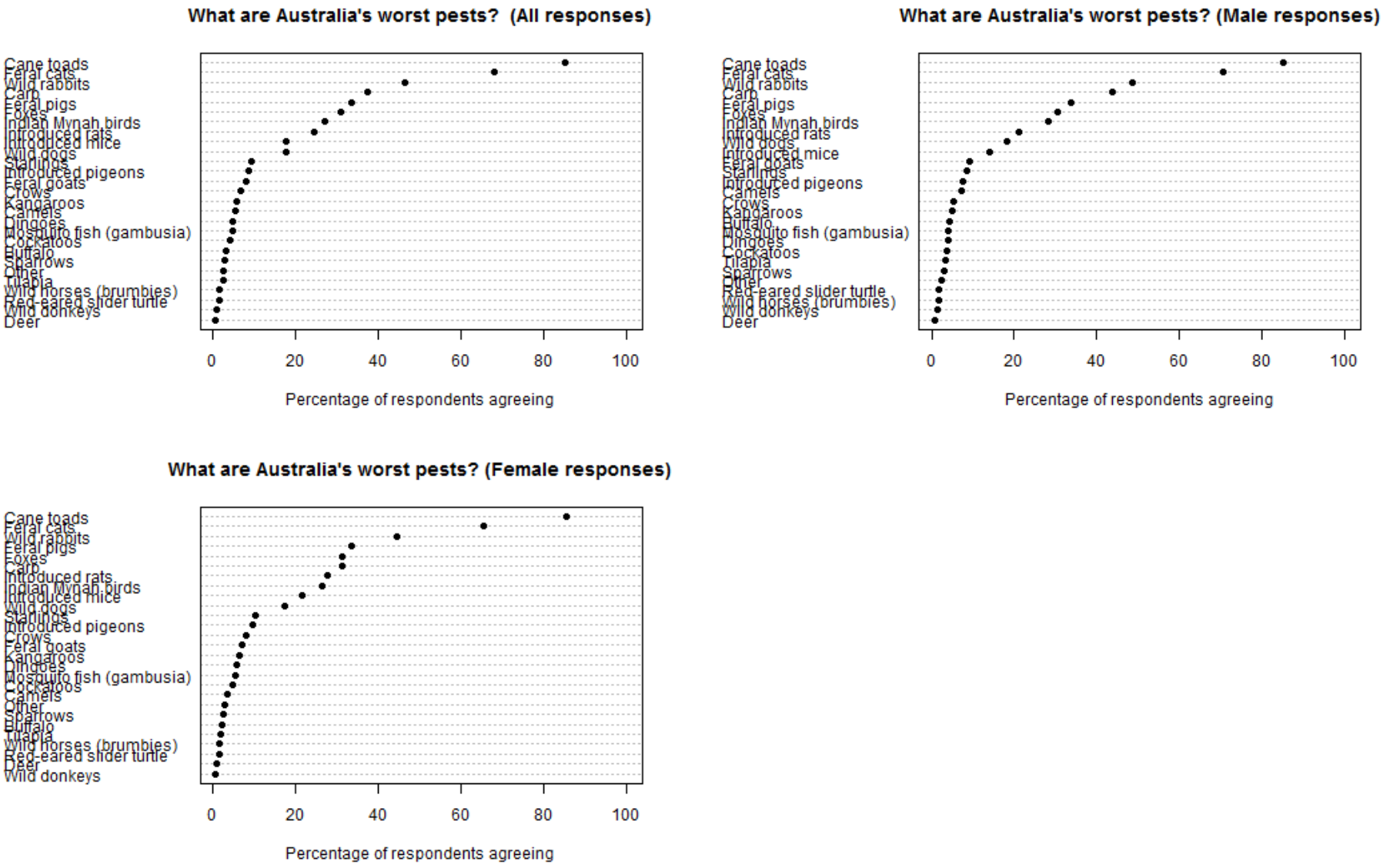


Figure 3.1.2 Species rated as the worst pests: overall ratings and differential ratings by gender

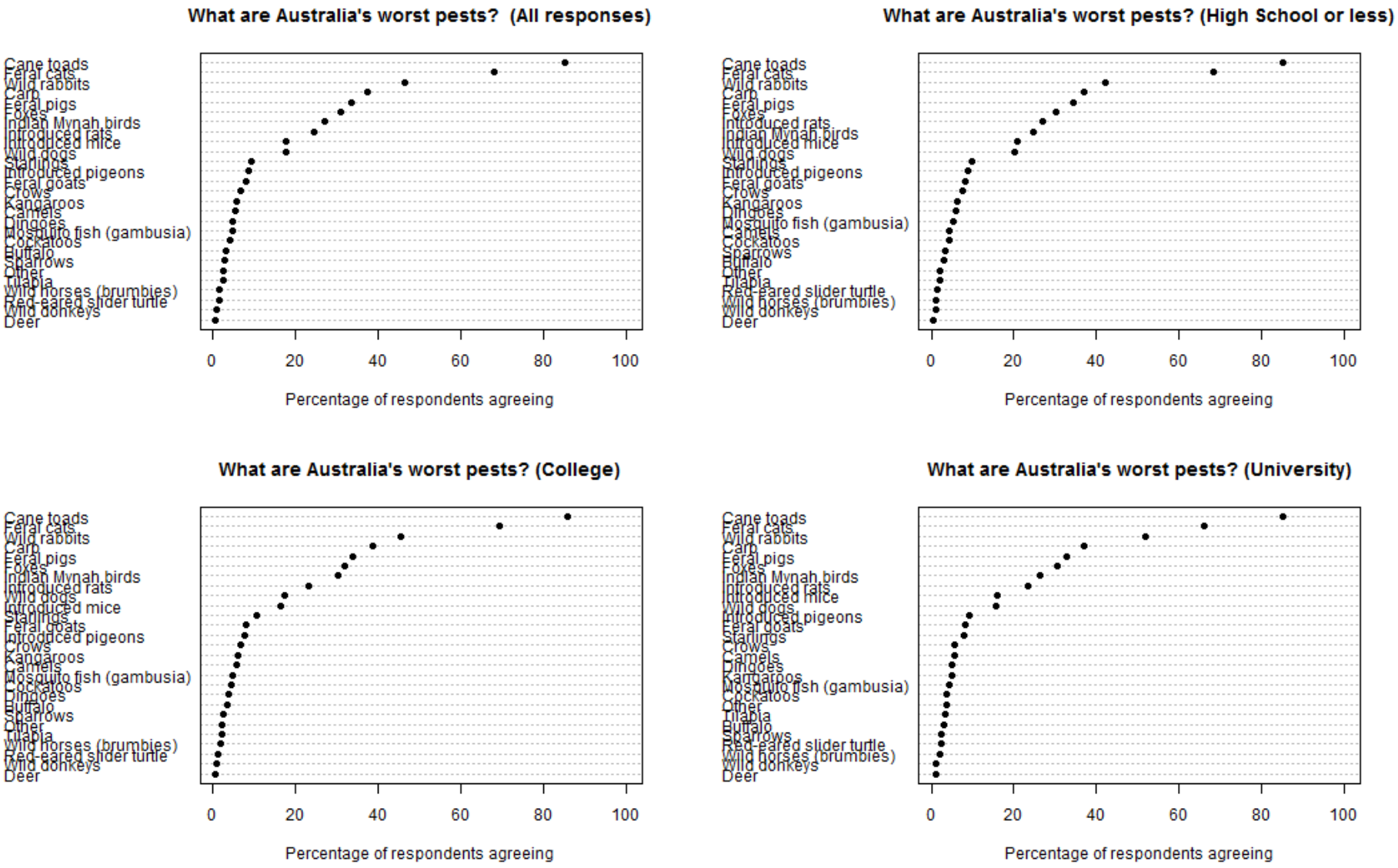


Figure 3.1.3 Species rated as the worst pests: overall ratings and differential ratings by highest educational level reached

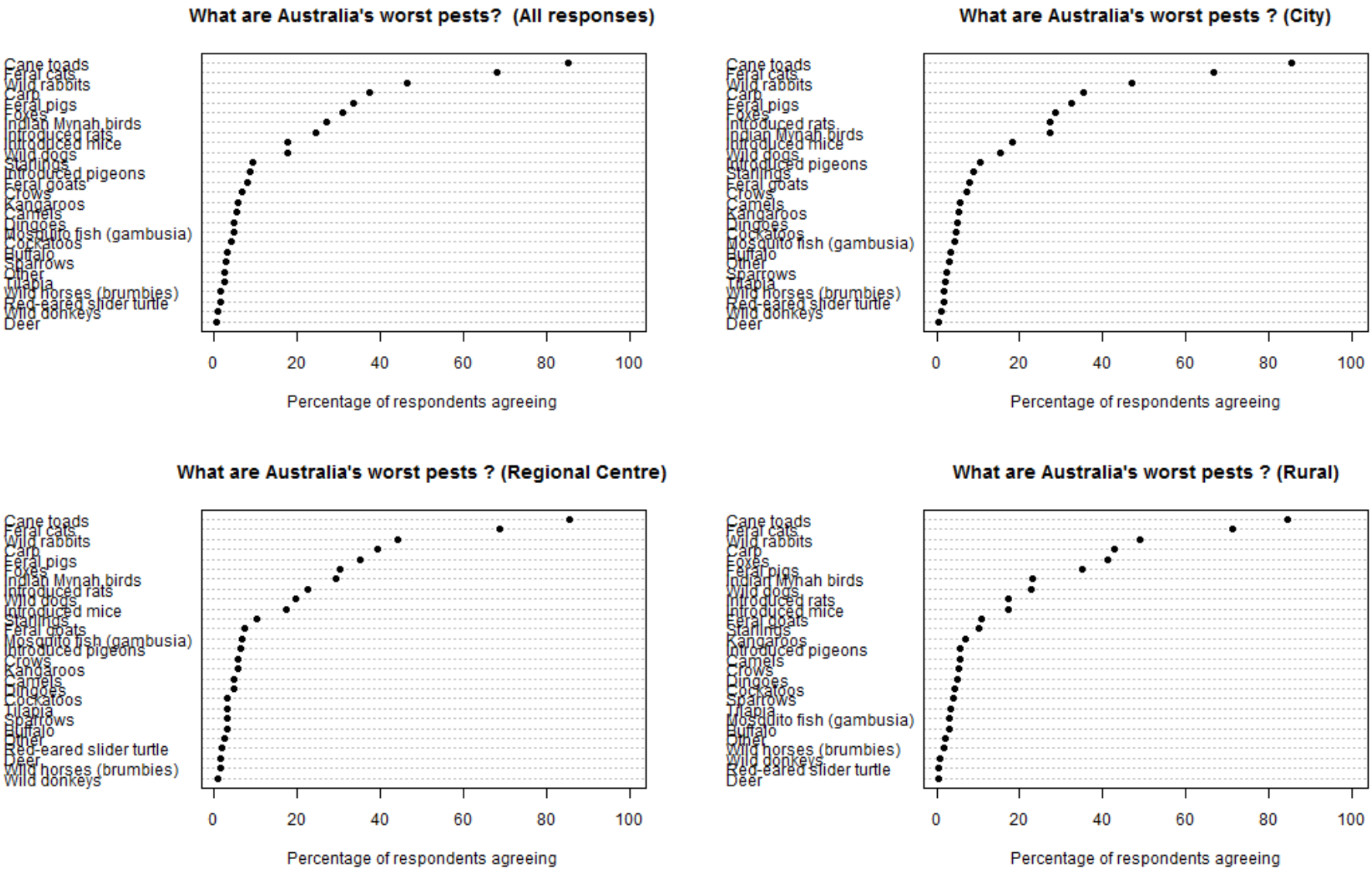


Figure 3.1.4 Species rated as the worst pests: overall ratings and differential ratings by location

However, offsetting this, a major rabbit awareness campaign by IA CRC and partners that took place halfway through the survey resulted in a steady increase in public perceptions of rabbits as one of our worst pest animals in the survey results, raising them from fifth to third position in the public mind by the end of the survey (see Figures 3.1.5 and 3.1.6). This provides support for the efficacy of well-planned science-based communication in helping to shape community attitudes, and also indicates that it is possible to measure the direct impact of such activity — something that has rarely, if ever, been possible before.

A similar situation applies to feral camels, which originally occupied 21st place in the public's rankings, but came up to and stayed at 11th place (Figure 3.1.6b) following a major report by the Desert Knowledge CRC into the damage inflicted by the over one million feral camels on Australia's central deserts, and a subsequent public focus on control activity. Again, as shown in Figure 3.1.6, RtPM charted a change in public attitudes following awareness raising — a factor that is important when potentially controversial control campaigns (in this case the shooting of 300,000–400,000 camels) are proposed.

Other interesting trends to emerge from public attitudes to invasive animals include:

- a tendency among Australians to be more concerned about 'urban pests' such as rats, mice, mynah birds and pigeons, which can lead to increased public priority for their control (Figure 3.1.1) — and potentially to decreased emphasis on rural and landscape invasives
- the low awareness of invasive animals generally among younger Australians, an issue that might over time affect the willingness of governments to support for research and control; see the boxplots in Figure 3.1.7, where each individual plot shows concern increasing with age
- scope to exploit the cane toad as an 'icon invasive', standing for all invasives, in general activity directed at increasing public awareness and support for control, because of its consistent top rating as a pest (Figures 3.1.1, 3.1.5)
- the value of ongoing scrutiny of public attitudes to invasives and their control methods, in order to ensure that public approval is likely in the event of future control programs and methods, and so enhance the rate of adoption of new control science — this will increase the return on publicly funded invasives control
- significant variations in awareness and opinion between different groups in the community; for example between:
    - differing age groups (Figure 3.1.7), with younger people consistently less concerned than older people about the effects of feral animals, except for rats and mice

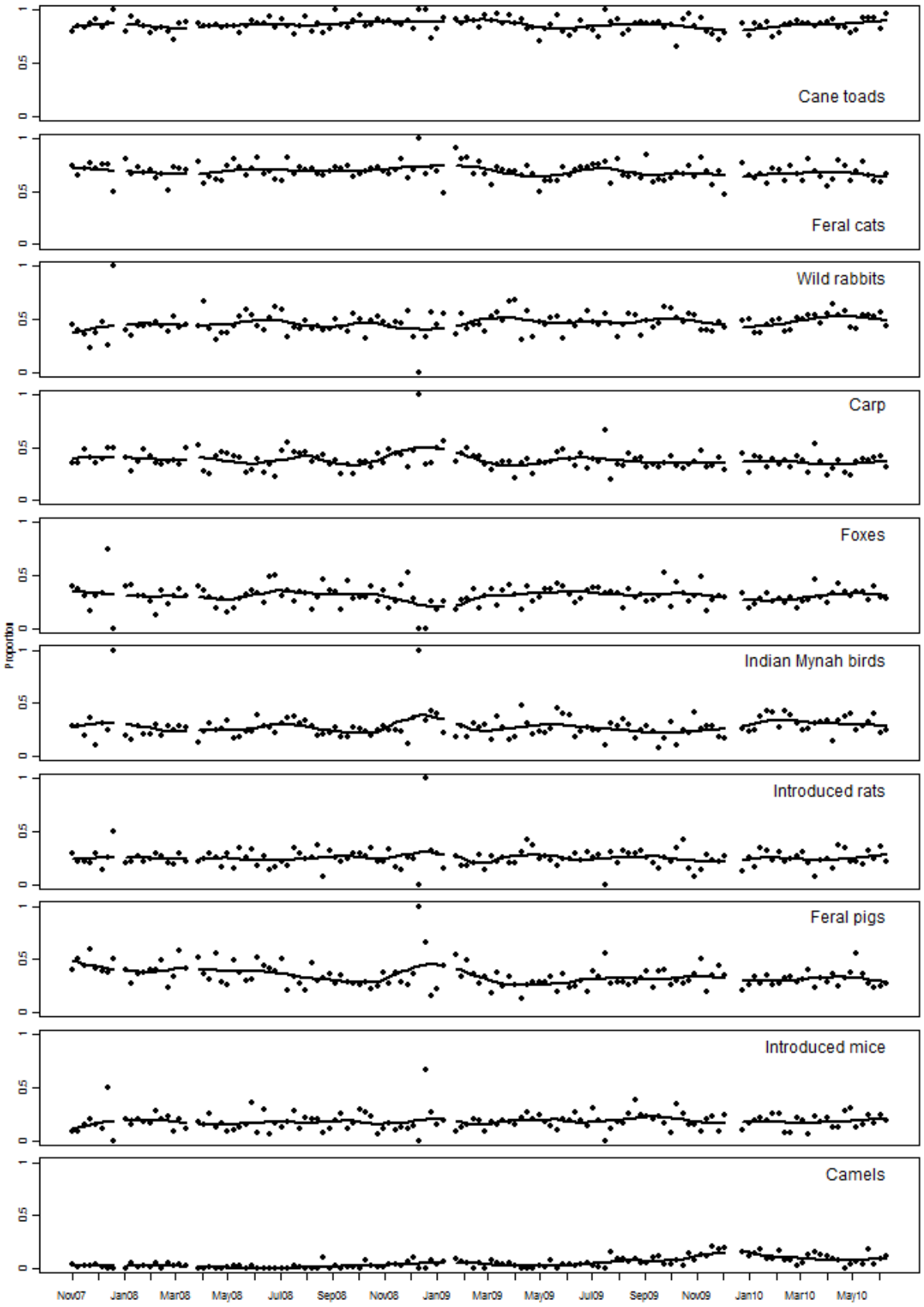


Figure 3.1.5 Trends in ratings during the lifetime of survey, showing smoothed weekly averages (breaks in the data and curves correspond to periods when no data were collected)

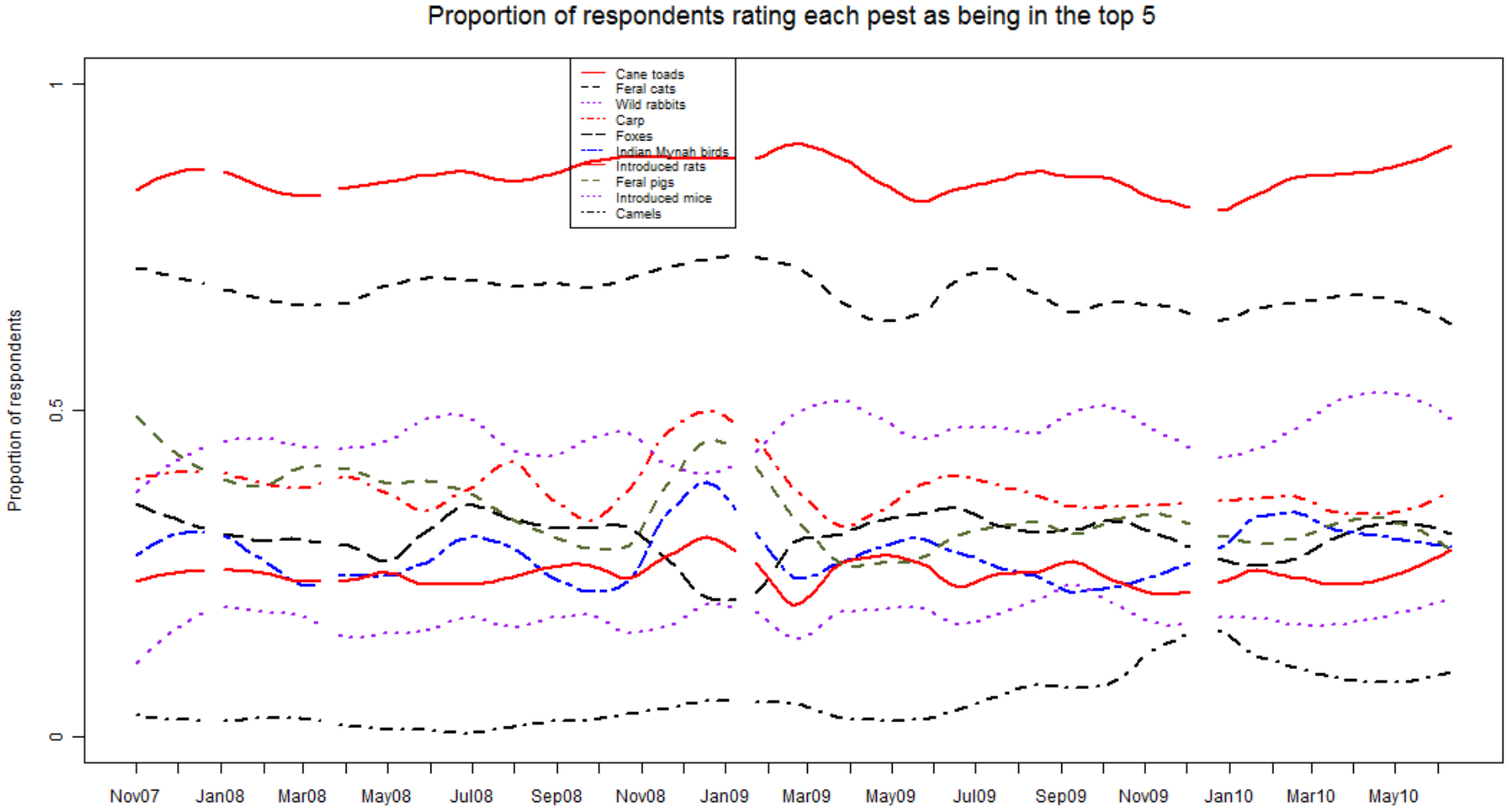


Figure 3.1.6(a) Comparative trends in ratings of the top ten pest animals during the life-time of survey on a common graph
(breaks in the data and curves correspond to periods when no data were collected)

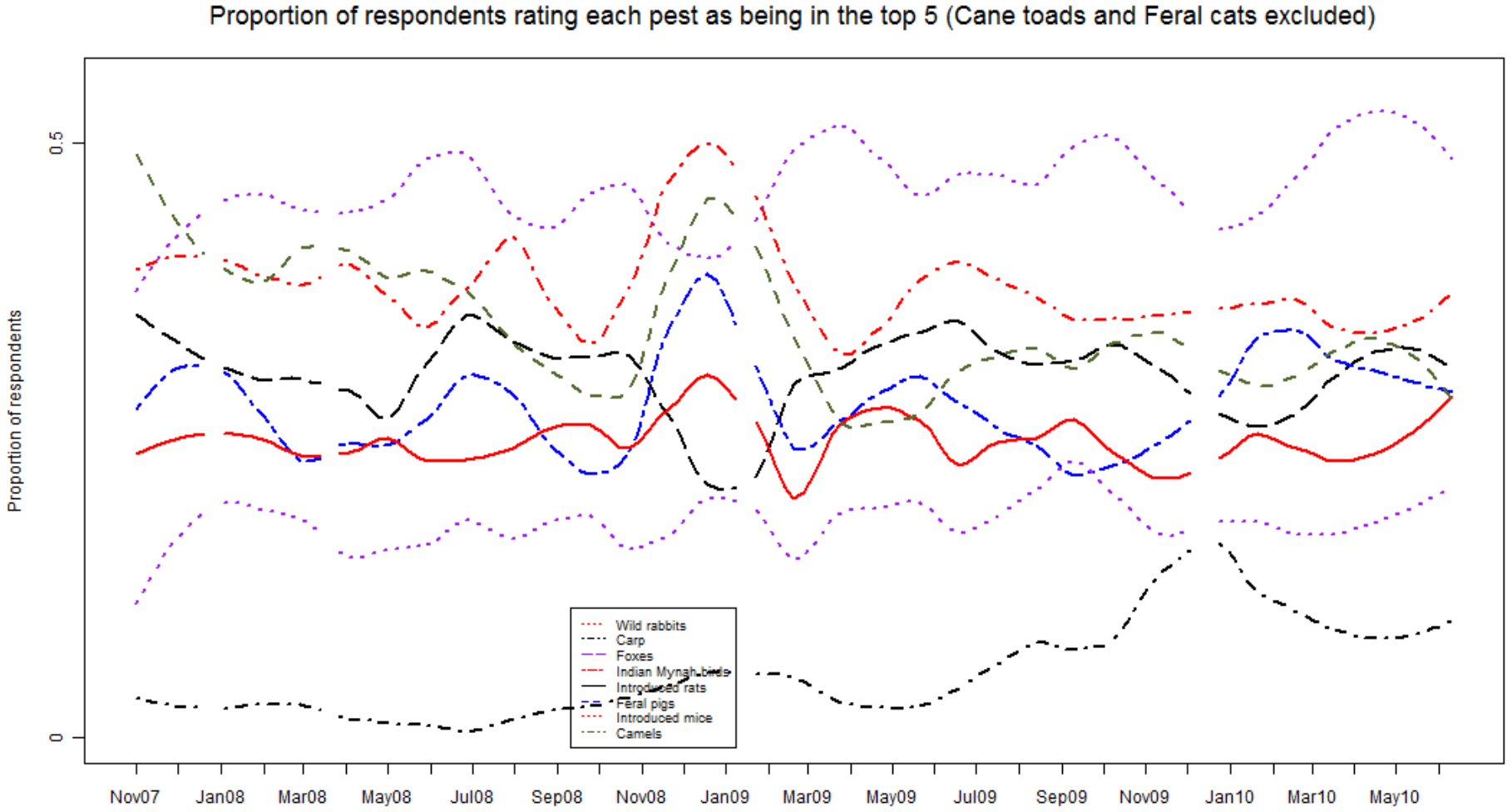


Figure 3.1.6(b) Comparative trends in ratings of the top ten pest animals, excluding cane toads and feral cats, during the lifetime of survey on a common graph (breaks in the data and curves correspond to periods when no data were collected)

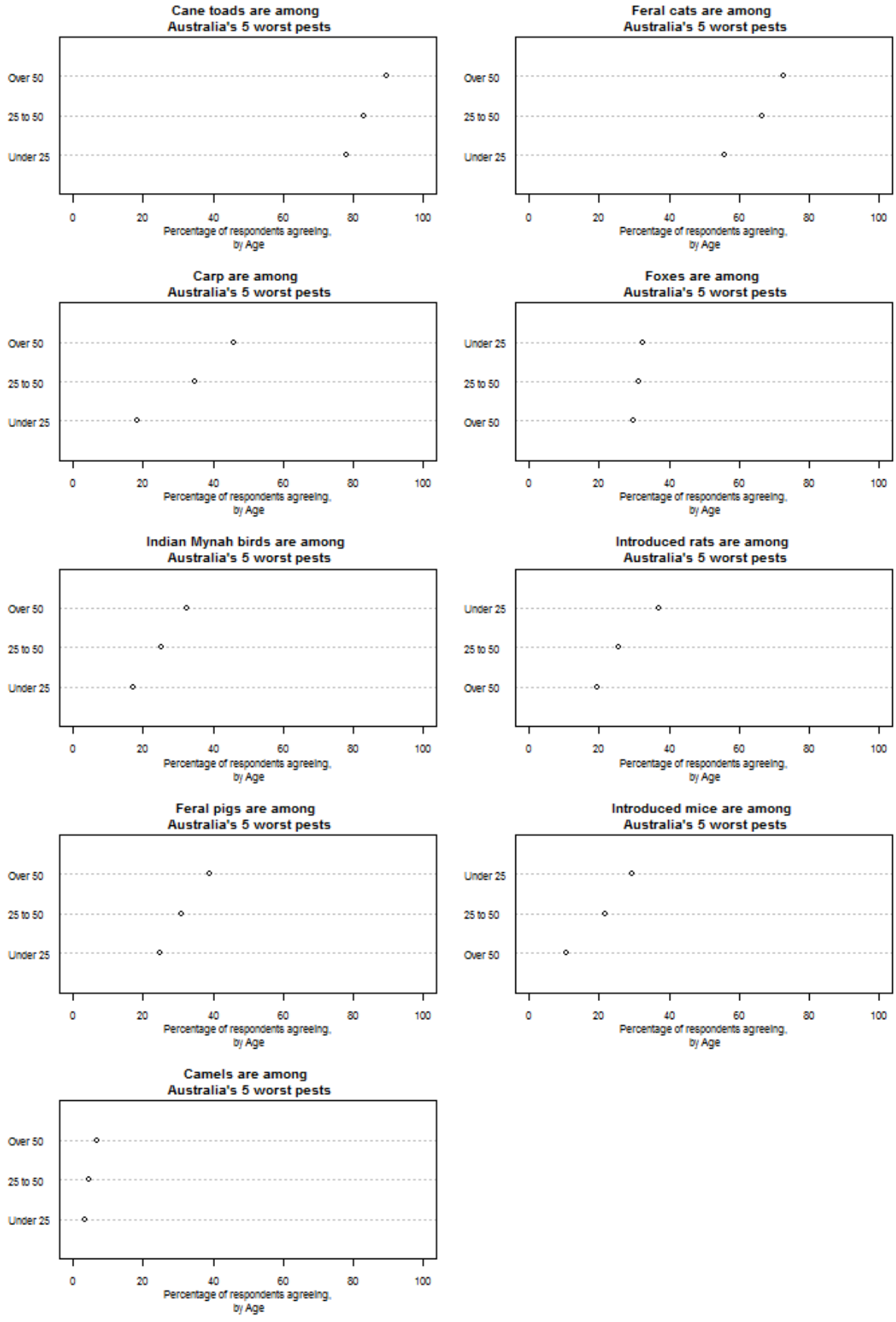


Figure 3.1.7 Statistically significant differences (in each plot) between different age groups in terms of their ratings of individual pests as being in the top five

- male and female respondents (Figure 3.1.8), with more males than females agreeing that cats, rabbits, carp and camels were in the top five, but more females agreeing that rats and mice were in the top five small but indicative trends of increasing concern with increasing educational level (Figure 3.1.9) and with remoteness of location (Figure 3.1.10).

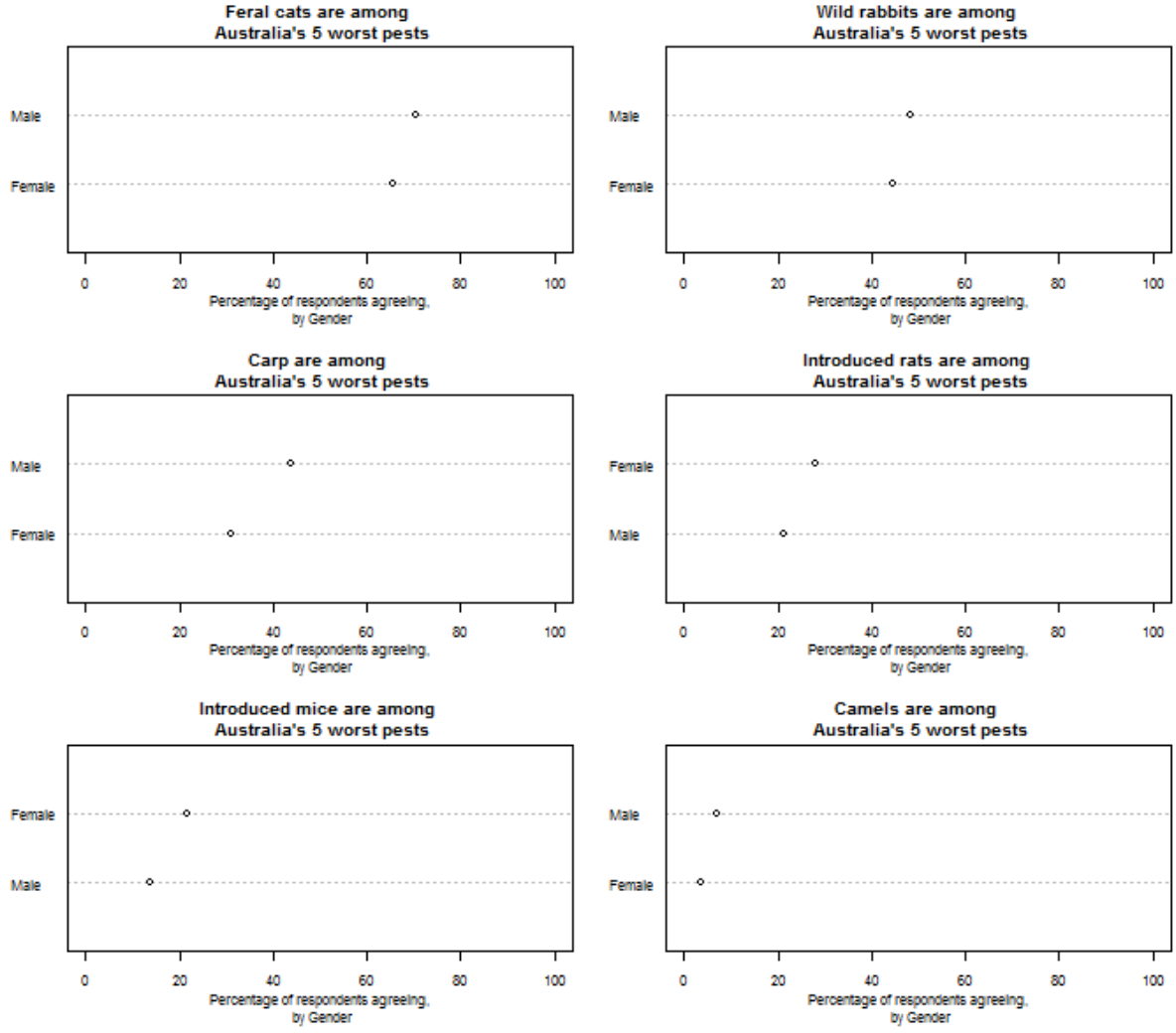


Figure 3.1.8 Statistically significant differences (in each plot) between females and males in terms of their ratings of individual pests as being in the top five

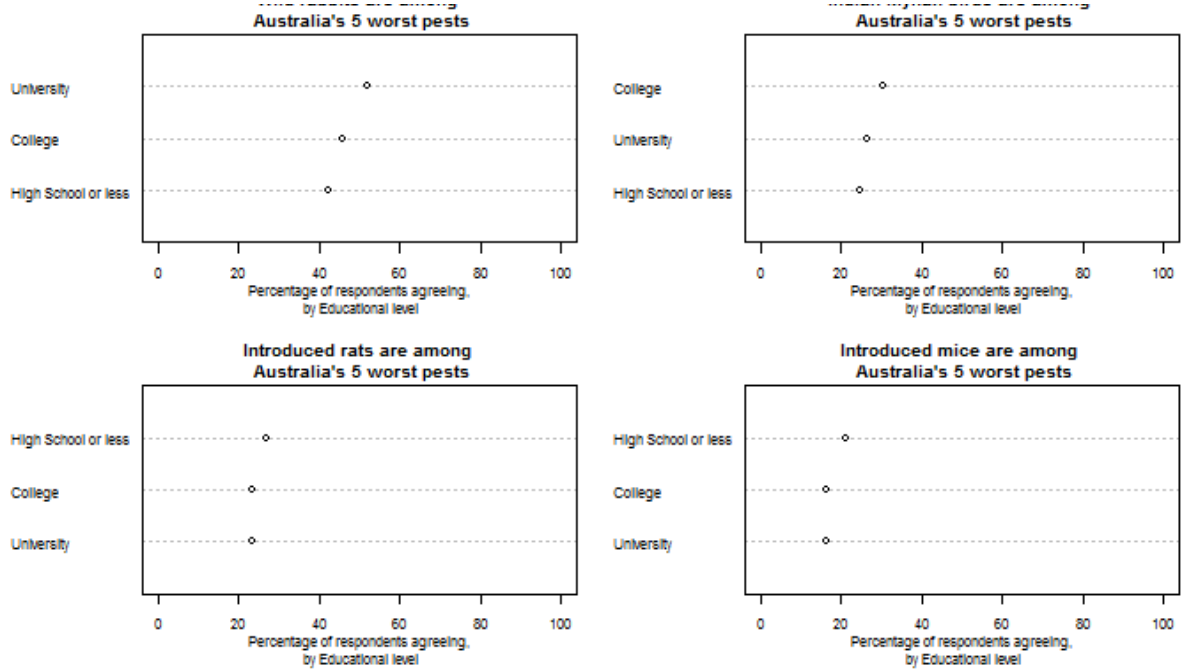


Figure 3.1.9 Statistically significant differences (in each plot) between people with differing attained educational levels, in terms of their ratings of individual pests as being in the top five

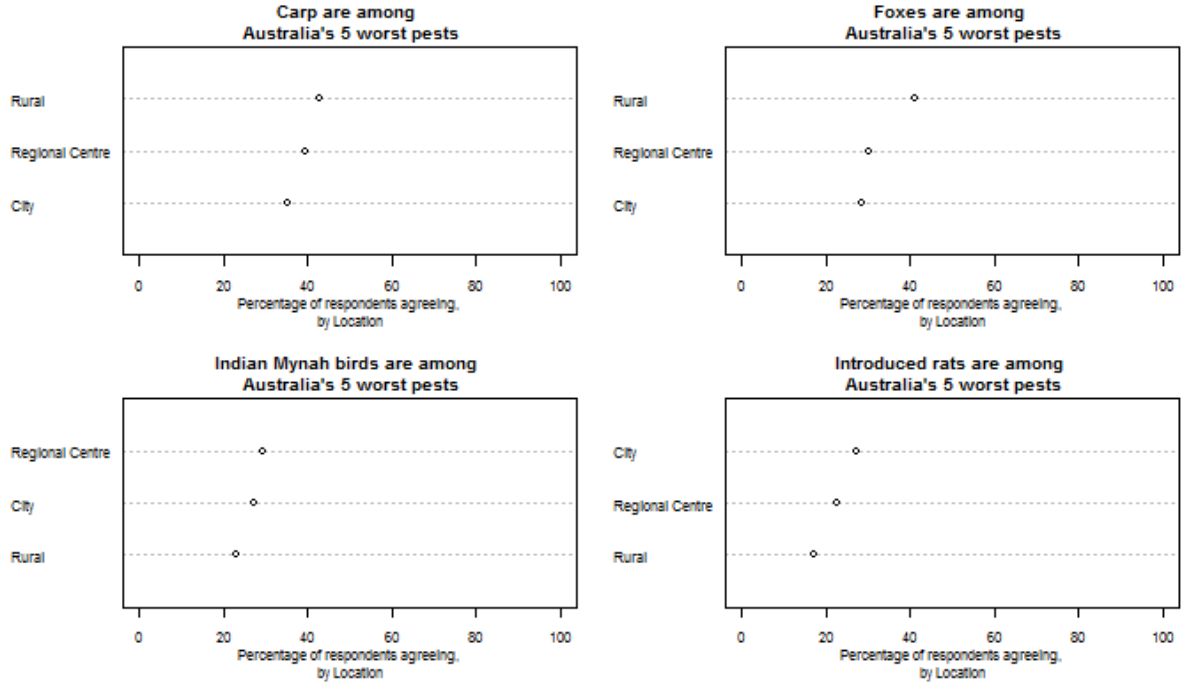


Figure 3.1.10 Statistically significant differences (in each plot) between people from different locations, in terms of their ratings of individual pests as being in the top five

3.2 Control method

Survey request: *Please rate the following methods of control of invasive animals according to how acceptable you find them where 1 = totally unacceptable and 10 = very acceptable.*

Figures 3.2.1–3.2.4 show boxplots of the acceptability of different methods of control, and the variation in their views according to demographic variable. Again, for each demographic variable, there were statistically significant differences ($P < 0.001$). These are shown in Figures 3.2.5–3.2.8. Overall trends for each of the control methods over the lifetime of the survey are shown in Figure 3.2.9.

This section of the RtPM community survey provided the first clear, nationwide evidence for the acceptability and unacceptability of various methods for controlling invasive animal species. In general terms, these findings are of particular value when considering how best to allocate slender scientific research budgets and in choosing those projects with the best prospect of widespread acceptance and adoption, thus delivering the highest return on the public investment.

The survey showed strong public support for 'humane' control methods, especially fertility control, biocontrol and genetic control (Figure 3.2.1, which also shows that support for most methods increases with Age, results confirmed by the statistically significant differences shown in Figure 3.2.5). This tendency was particularly marked among female respondents (Figure 3.2.2). However, females tended to be less approving of any method of control compared to males (Figure 3.2.6), pointing to female Australians as an influential target audience for education, information and consultation about future control methods and programs. Towards the end of the survey period a preference also emerged for the use of new 'soft' poisons, which became the public's second most preferred option (Figure 3.2.9). Less marked trends are present for Education and Location, where the only statistically significant differences relate to biological control and fertility control (slight differences due to Education, as shown in Figure 3.2.7) and to shooting (slight differences between City, Rural and Regional, Figure 3.2.8).

It also revealed a rising intolerance in the Australian community towards 'traditional' methods of control such as shooting, gassing and baiting (see Figure 3.2.9), suggesting that as time goes by the public pressure for these to be replaced with more acceptable methods will increase.

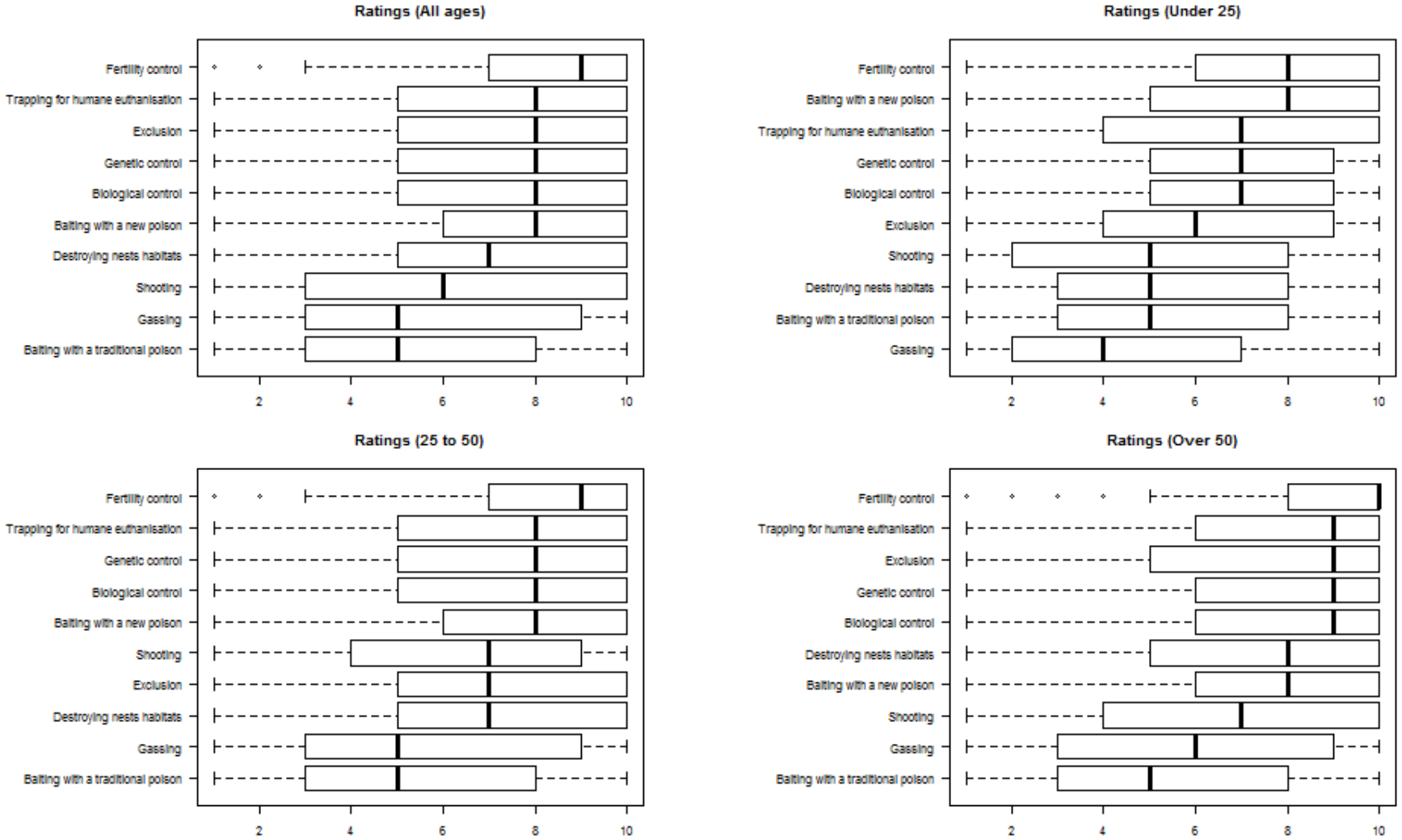


Figure 3.2.1 Overall ratings and differential ratings for control methods by Age group (respondents were asked to rate methods of control on a scale of 1 to 10, where 1 = totally unacceptable and 10 = very acceptable)

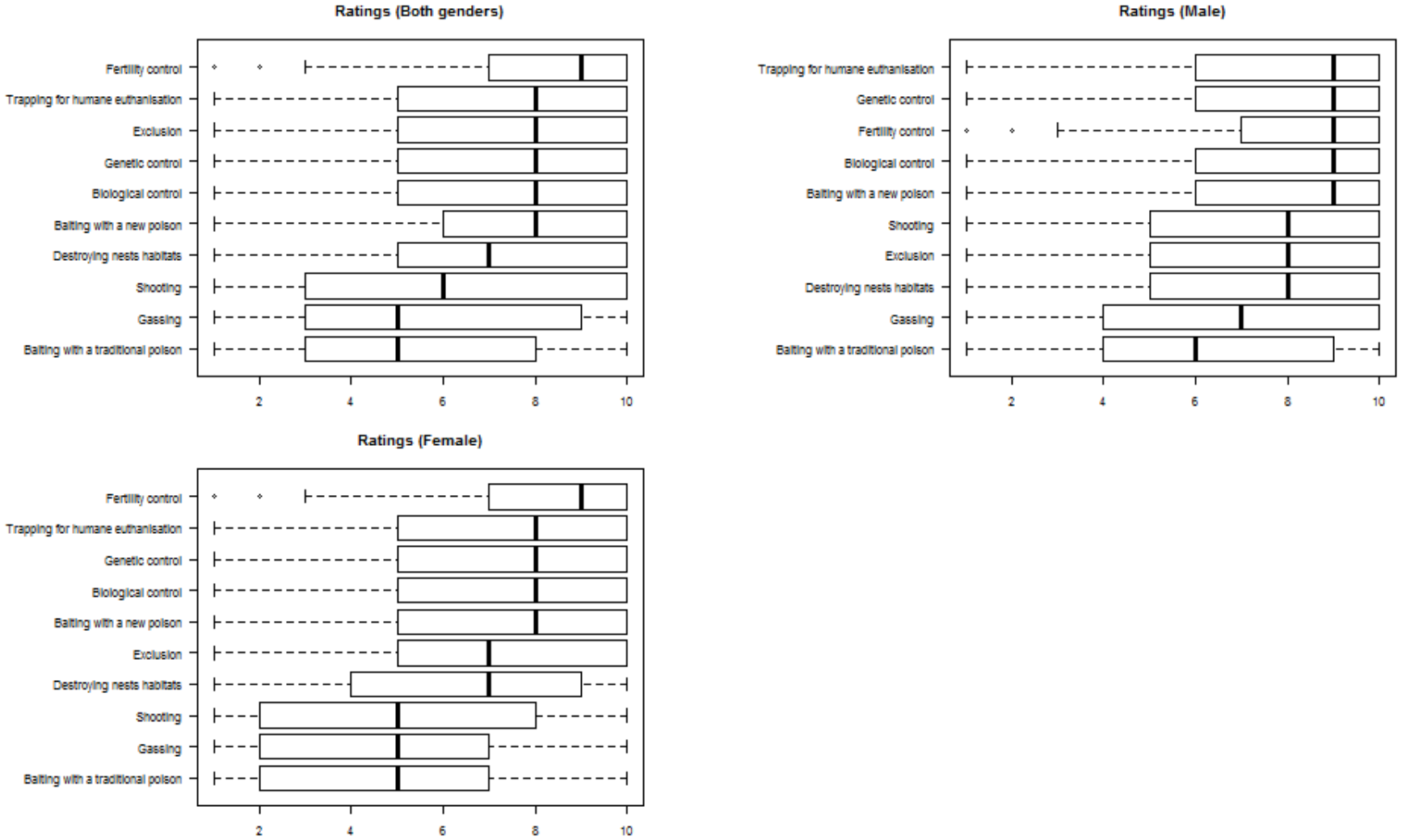


Figure 3.2.2 Overall ratings and differential ratings for control methods by Gender group (respondents were asked to rate methods of control on a scale of 1 to 10, where 1 = totally unacceptable and 10 = very acceptable)

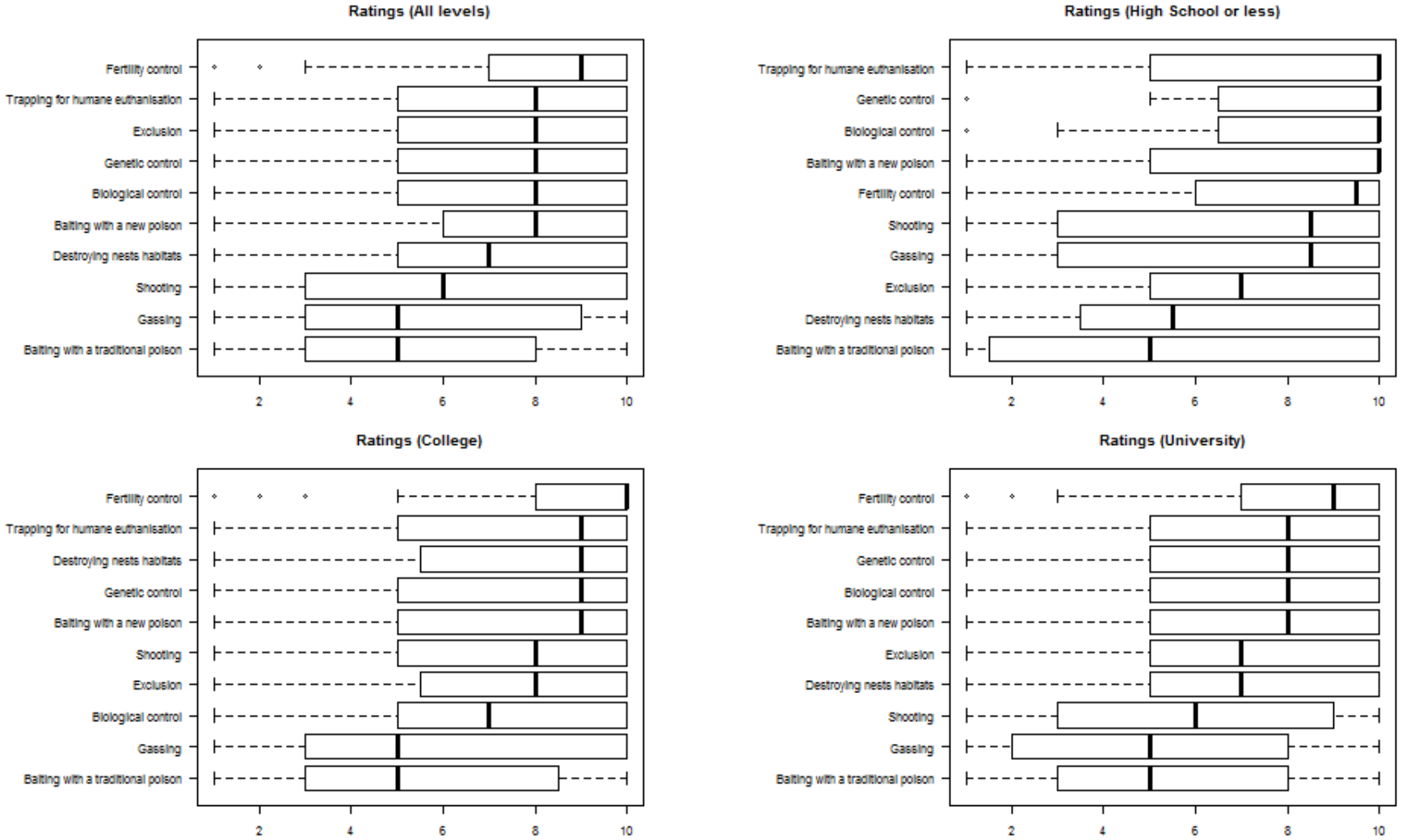


Figure 3.2.3 Overall ratings and differential ratings for control methods by highest attained educational level (respondents were asked to rate methods of control on a scale of 1 to 10, where 1 = totally unacceptable and 10 = very acceptable)

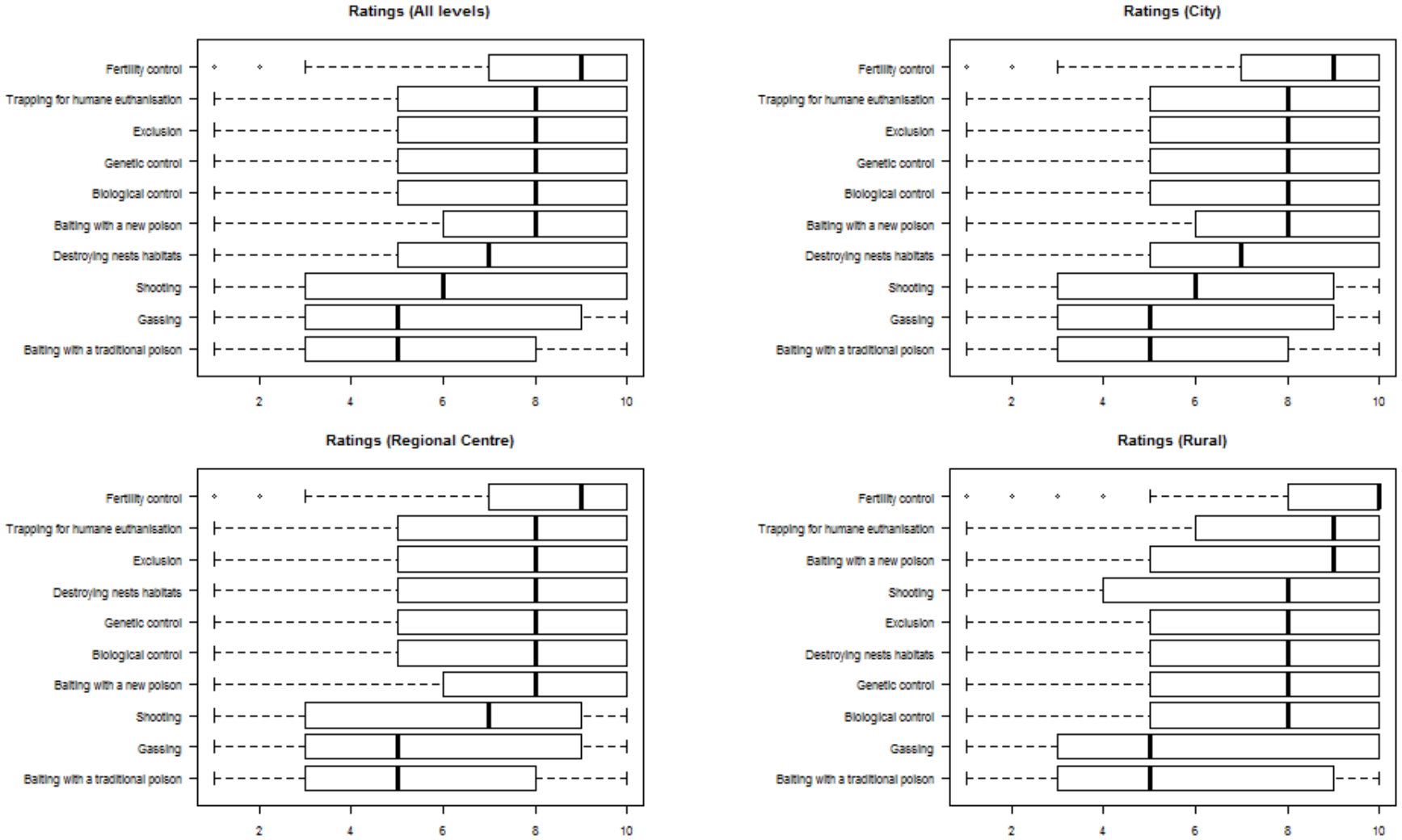


Figure 3.2.4 Overall ratings and differential ratings for control methods by Location group (respondents were asked to rate methods of control on a scale of 1 to 10, where 1 = totally unacceptable and 10 = very acceptable)

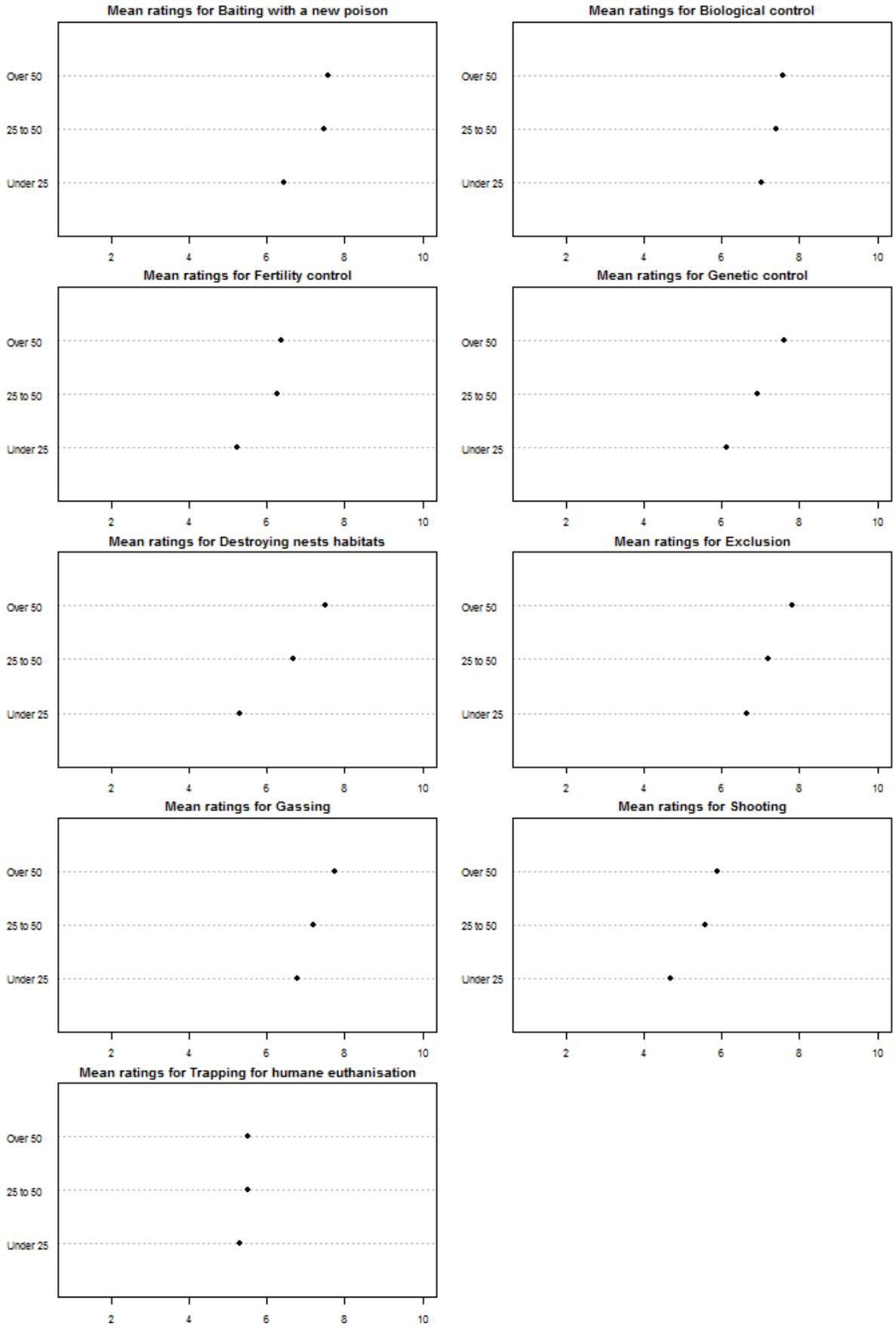


Figure 3.2.5 Statistically significant mean differences between age groups in terms of levels of approval of control methods (1 = totally unacceptable and 10 = very acceptable)

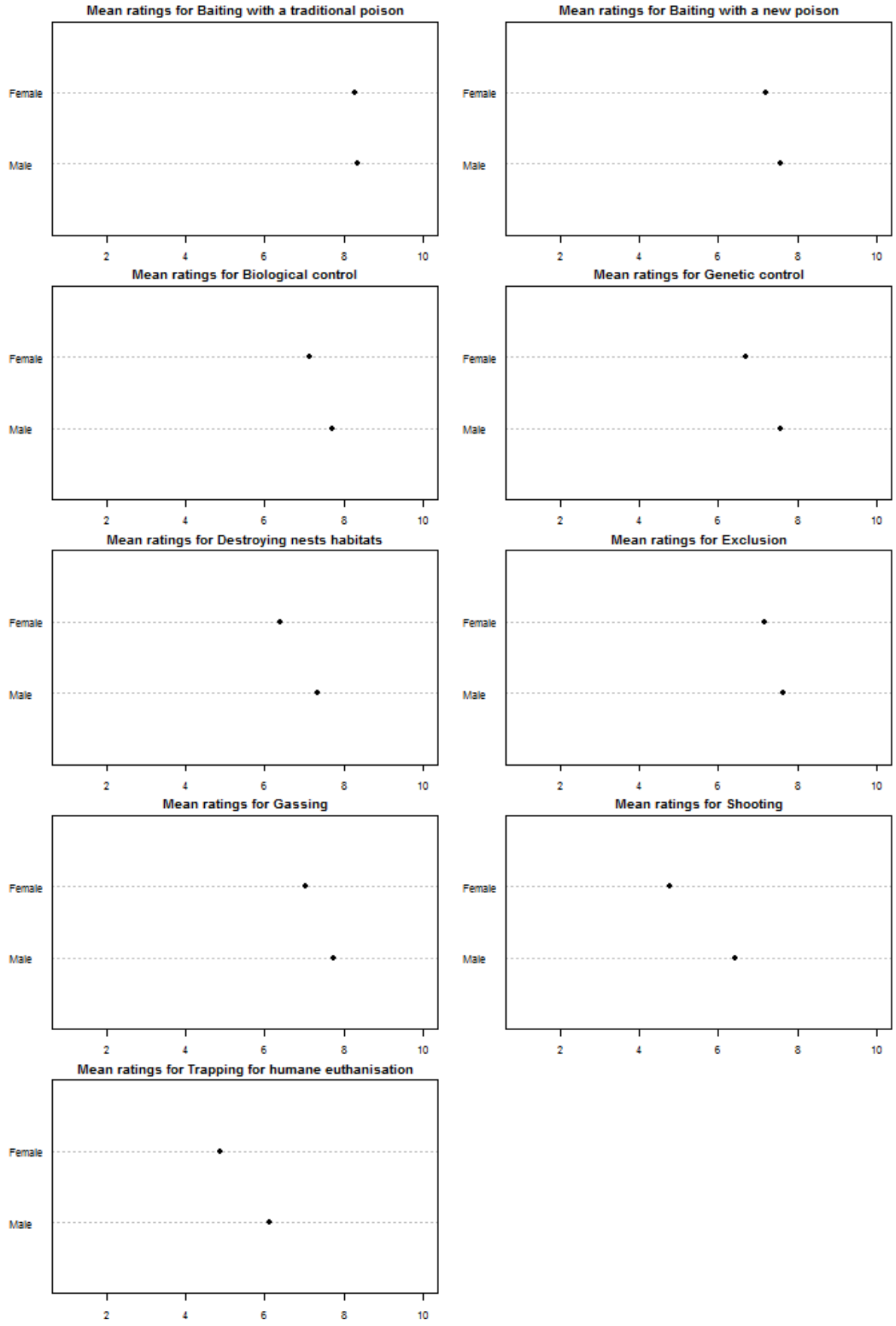


Figure 3.2.6 Statistically significant mean differences between females and males in terms of levels of approval of control methods (1 = totally unacceptable and 10 = very acceptable)

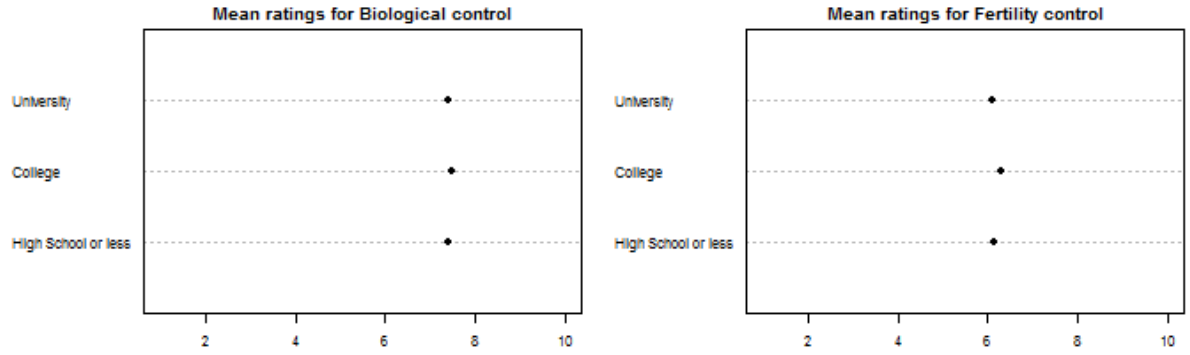


Figure 3.2.7 Statistically significant mean differences between groups with different educational levels, in terms of levels of approval of control methods (1 = totally unacceptable and 10 = very acceptable)

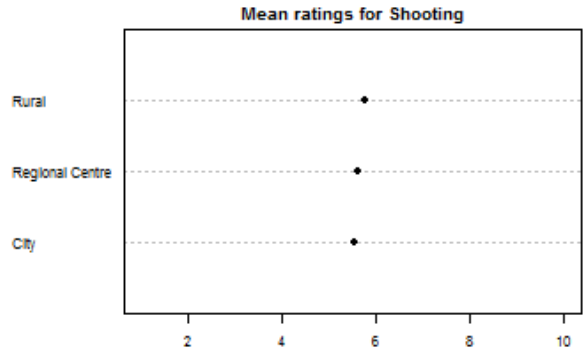


Figure 3.2.8 Statistically significant mean differences between groups from different Locations, in terms of levels of approval of shooting as a control method (1 = totally unacceptable and 10 = very acceptable)

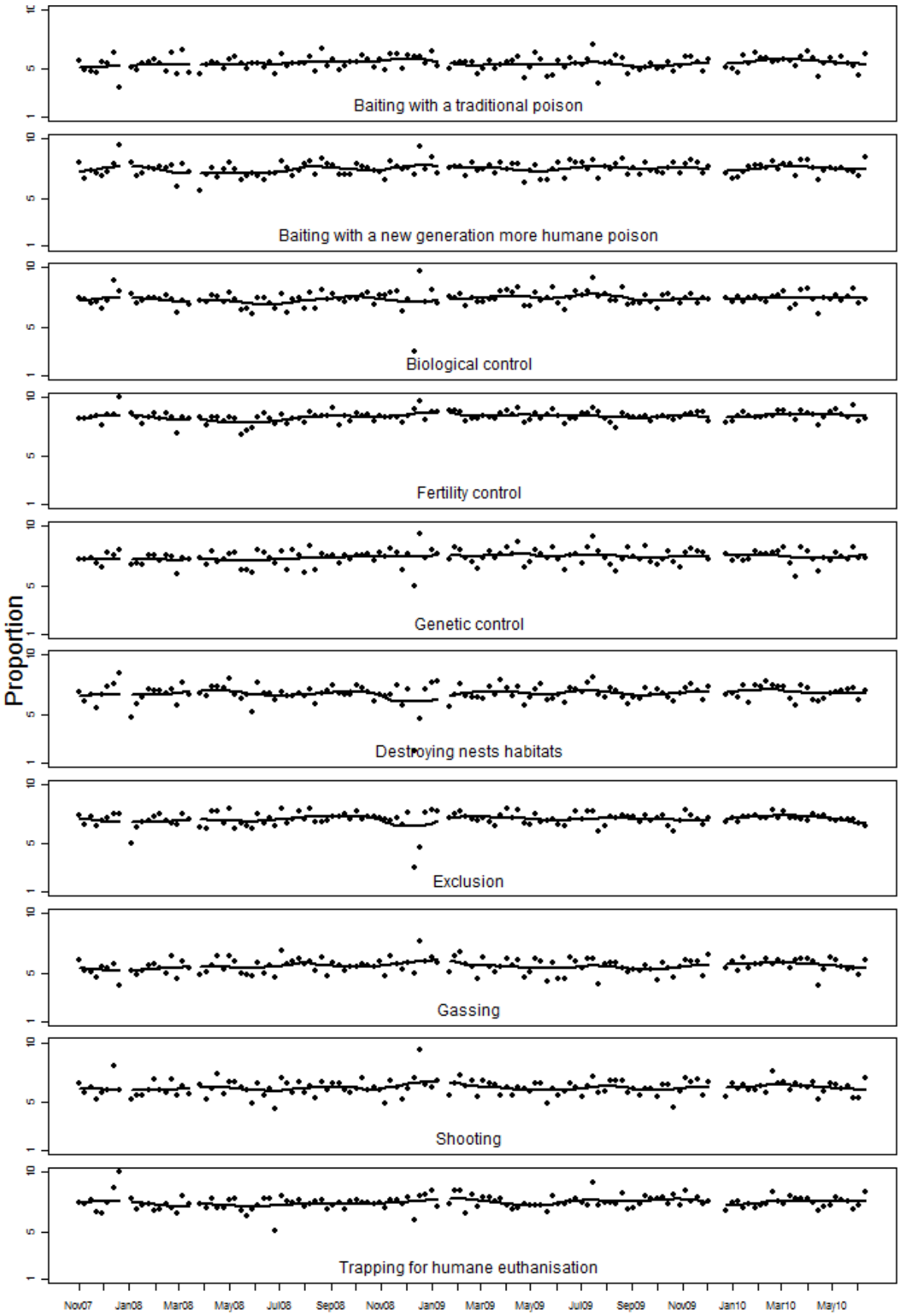


Figure 3.2.9 Time series of approval ratings for different methods of control (1 = totally unacceptable and 10 = very acceptable)

3.3 The Community Value Survey

3.3.1 Introduction

This section of the survey constituted a Community Value survey (Fisher et al 2007) and followed the tree-structured design in Figure 3.3.1:

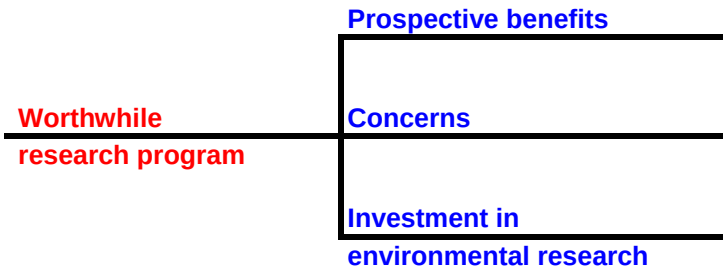


Figure 3.3.1 High-level structure of a Community Value tree

This figure shows the main drivers postulated to explain Community Value ('worthwhile research'). Each driver has a number of attributes that form the basis of a Community Value survey.

As described in Fisher et al (2007), data obtained from the survey are subjected to statistical modelling and analysis with the aim of determining:

(a) the relative importance of each of the main drivers in predicting the overall score for Community Value

(b) the mean rating for Value and for each driver.

This information can then be used to decide how to focus priorities for improvement, by selecting improvements likely to lead to the largest increase in Value. However, this begs the question: Why should we focus on increasing Value? The answer to this lies in the fact that Value itself can be linked to higher-level business drivers such as 'Perceived importance of developing controls for pest animals'. We shall see examples of this shortly (see below).

3.3.2 Data acquisition and statistical modelling

Scores are elicited from respondents by posing three sets of requests. The survey requests used in this Community Value survey were:

3.1 Prospective benefits arising from research programs into managing invasive animals
If the Invasive Animals CRC is successful in its research programs, Australia is likely to benefit in a number of ways. Some of the most important are listed below. Please provide ratings for them using the scale of 1 to 10, where 1 = poor and 10 = excellent.

If you feel that you haven't got sufficient information or knowledge to make an assessment of a particular Benefit, please check 'Don't know'.

[*List of prospective Benefits follows*]

3.2 Concerns about research programs into managing invasive animals
Earlier in the survey, you rated a number of different approaches to managing pest animals. The results of carrying out research into some of these approaches may provide some people with cause for concern.

[1]Some of the most important Concerns that have been identified by the community are listed below. Using the scale of 1 to 10, where 1 = unconcerned and 10 = very concerned, please rate the following Concerns about possible outcomes of the IA CRC's research into managing invasive animals.

[*List of Concerns follows*]

If you feel that you haven't got sufficient information or knowledge to make an assessment of a particular Concern, please check 'Don't know'.

3.3. Investment in Environmental Research
Apart from management of pest animals, Australia has a number of other major environmental issues requiring research. Some of the most important ones are listed below. Please provide ratings for them using the scale of 1 to 10, where 1 = unimportant and 10 = very important.

*** In other words, the more important the issue, the higher the rating you should assign to it.

If you feel that you haven't got sufficient information or knowledge to make an assessment of a particular issue, please check 'Don't know'.

[*List of Environmental areas follows*]

After each set of requests, respondents are asked to provide an overall summary rating. Finally, the respondent is asked to provide an overall rating of perceived Value (as described by the term 'Worthwhile Research Program'), taking account of their three summary ratings.

Additionally, after assigning each of the four summary ratings, respondents are invited to provide the main reason for assigning the rating.

At this stage, a set of hierarchical statistical models is fitted to the resulting data set (Fisher et al 2007), wherein:

- the driver 'Benefits' is modelled as a function of its Attributes
- the driver 'Concerns' is modelled as a function of its Attributes
- the driver 'Environmental issues' is modelled as a function of its Attributes
- Value is modelled as a function of Benefits, Concerns and Environmental issues.

An unusual — and remarkable — feature of a survey structured in this fashion (ie an instrument with a hierarchical structure), is that it is possible to statistically test to check whether an important Driver or Attribute is missing. This is done by assessing the adequacy of fit of each of these hierarchical statistical models. In fact, the first few survey rounds revealed just such issues in the choice of Attributes, and so statistical analysis of this part of the survey used only data collected from the final eight survey quarters.

Because data were collected weekly, we were able to look not only at the results for each survey quarter, but to monitor how the impact weights and mean ratings changed over time, using the methodology developed by Fisher et al (2005). Accordingly, we shall present two sets of results:

(a) mean ratings and impact weights at the end of the survey
(b) trends in these quantities during the course of the survey.

Before describing the results, we note one problem that arose in terms of relation to respondents' ratings for Concerns. Collection of valid data for this part of the survey was held up for some months because, despite extensive experimentation with the wording, a significant proportion of respondents were confused by the rating system and provided high scores when they intended to assign low ones and vice versa (this was evident from some of the comments supplied). Many attempts were made to avoid this by rewording of survey statements and by providing simple and glaring examples showing the difference between the two ends of the rating scale, but to no avail. It appears that some people simply don't read sufficiently carefully before responding. The problem was eventually solved by developing a technical correction (Fisher and Lee 2011).

3.3.3 Summary of results

The final weights and mean ratings are based on the final survey quarter (March–June 2010) and these are shown in Table 3.3.1 with the trends shown in Figure 3.3.2.

Table 3.3.1: Impact weights and mean ratings for Value ('Worthwhile Research Program') and its three drivers, Perceived Benefits of the Research, Concerns about the Research and Environmental issues requiring Research, for the final round of surveying

Driver	Impact weight (%)	Rating	95% conf. interval
Benefits	32	8.2	(8.02, 8.30)
Concerns*	24	6.6	(6.41, 6.82)
Environmental issues	28	8.0	(7.81, 8.13)
Value		8.1	(7.92, 8.20)

*Scores for Concerns are to be interpreted similarly to those for Benefits and Environmental issues, with a higher score (7–10) indicating less overall concern and a lower score (1–4) more overall concern.

There are several points to note from Table 3.3.1 and Figure 3.3.2:

(a) Each Driver of Value carries significant weight in terms of influencing Value, with Benefits being the dominant Driver.

(b) There appears to have been a modest decline in Overall Concerns over the survey period. Benefits appear to have increased slightly in importance, whereas the perceived importance of Research into Environmental Issues appears to have waxed and waned somewhat.

(c) Value has remained essentially steady. As we noted earlier, it is important because it provides a connection to higher-level 'business drivers' or can be calibrated in some other way. For this reason, the survey concludes with requests for responses to three so-called 'business impact' statements:

- On a scale of 1 to 10, where 1 = unimportant and 10 = very important, please rate the importance of developing effective, safe and humane controls for Australia's pest animals.
- On a scale of 1 to 10, where 1 = very little and 10 = very substantial, please rate the efforts that you believe Australia should put into pest animal control.
- On a scale of 1 to 10, where 1 = unwilling and 10 = very willing, please rate your willingness to participate in community or local government programs to control pest animals.

Using these data, graphs can be constructed of the form shown in Figure 3.3.3. The predicted impact on each driver resulting from an increase of, say, 0.5 in the overall Value score can be estimated using the fitted curves. From the third graph, it appears that while people regard development and deployment of controls as important, they are

reluctant to make efforts themselves to manage invasive animals, and that even if they were fully supportive (Value score close to 10), a significant proportion would be loath to participate in community programs to control pest animals.

These graphs can be used to establish targets. For example, suppose that one were hoping to have at least 50% of the community very willing to participate. This would imply that a Value score of about 8.5 would need to be achieved. We describe below (Section 3.3.4) how one might use the results from the survey to set improvement priorities designed to increase the overall Value score.

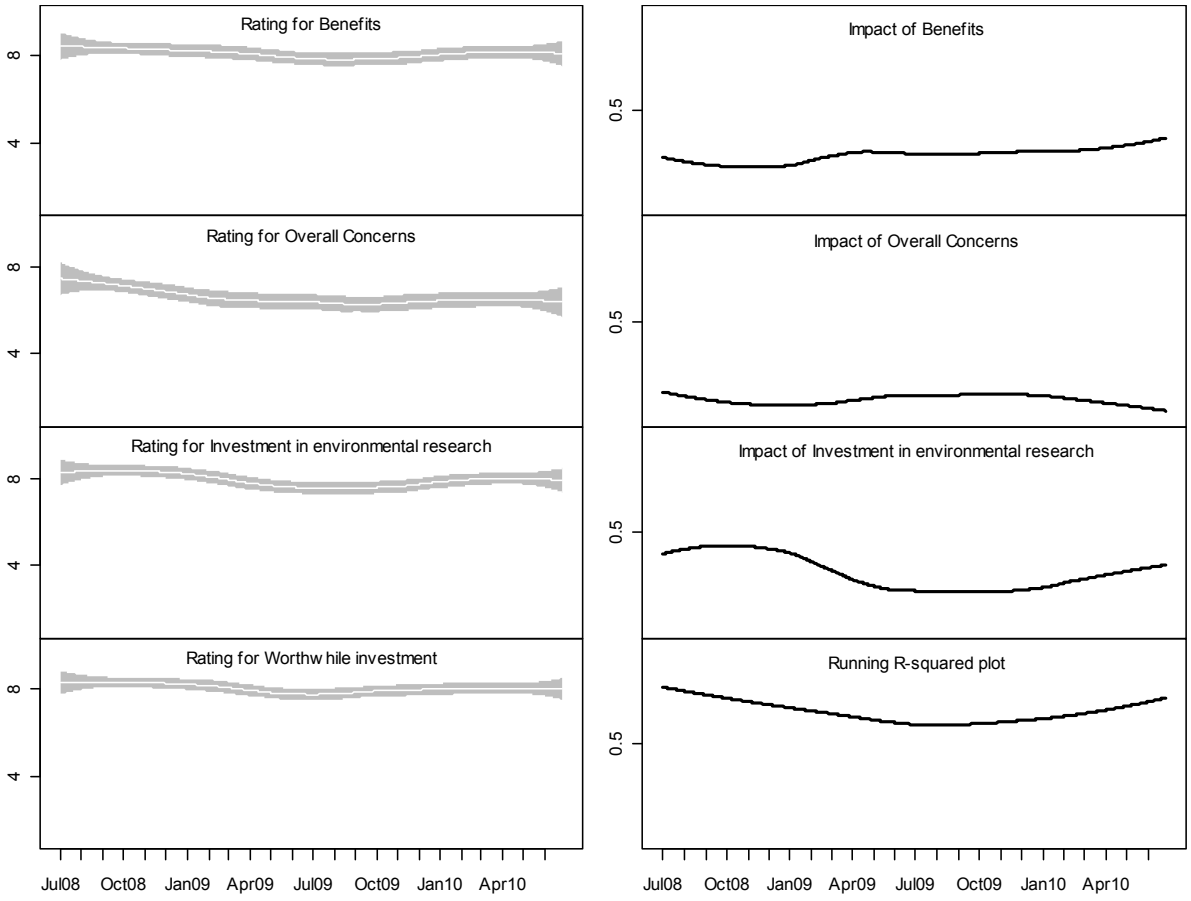


Figure 3.3.2 Graphs showing how the various ratings of Value and its three drivers, and the relative importance of these Drivers, change with time
('Relative importance' refers to the Impact weights in Table 3.3.1, here expressed as simple fractions.) The first three pairs of graphs show the time trends for each of the three drivers of Value, over the last 12 months. The rating trends are indicated by the white line, with the shaded band providing a 95% confidence interval for the mean trend. The graph at the bottom left shows the overall trend in Value = Worthwhile Investment. The bottom right graph is an indication of the quality of fit of the statistical model, and shows the model is accounting for in excess of 70% of the variation in the data, a reasonable amount of explanation for this type of data.)

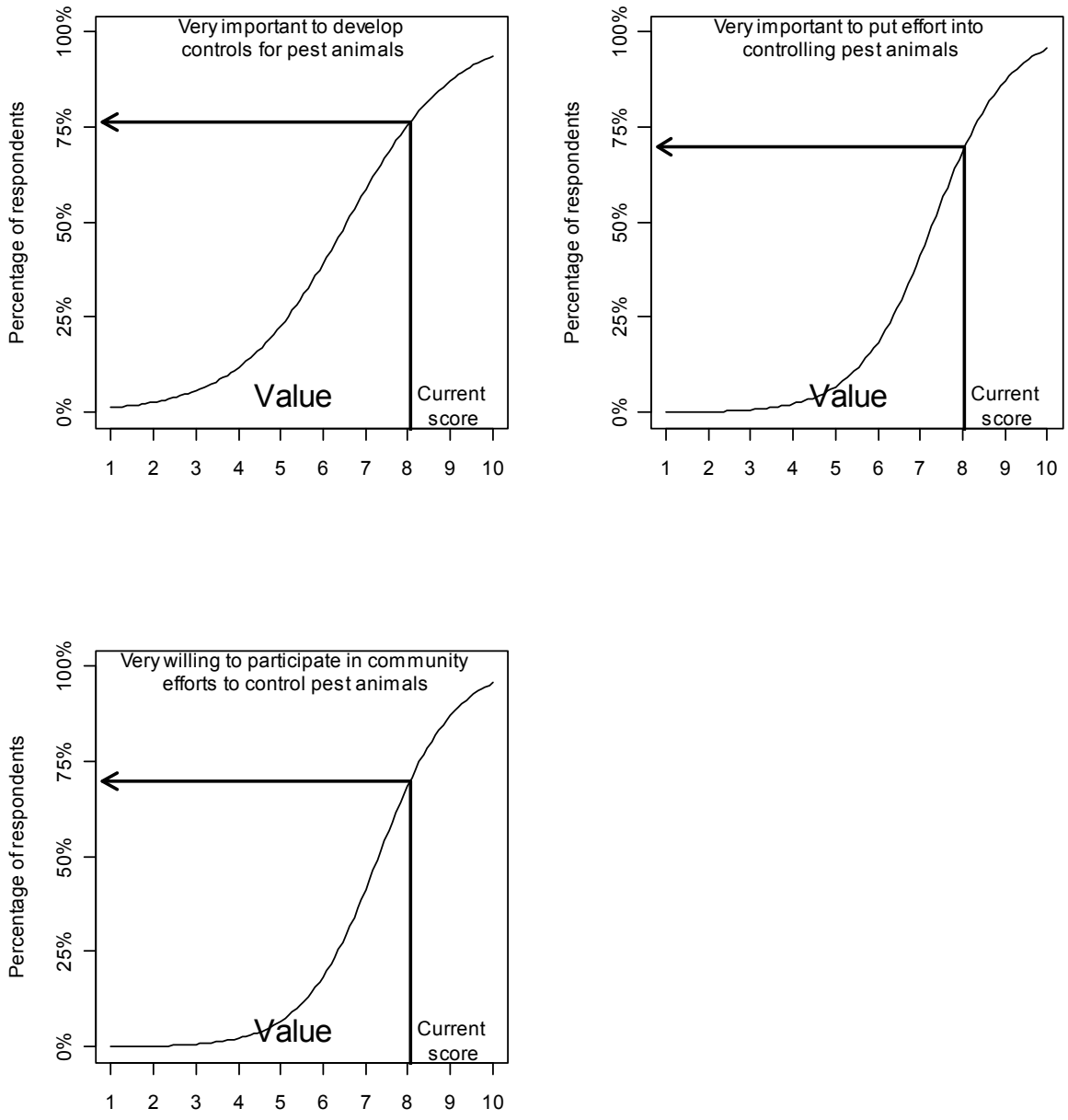


Figure 3.3.3 Figures showing the relationship been Value and each of the higher-level business drivers

The predicted impact on each driver resulting from an increase of, say, 0.5 in the overall Value score can be estimated using the fitted curves.

(d) Concerns carry significant weight (24%) and, whilst its rating is not in the very low range, it is poor relative to the other two Drivers of overall Value of the research program. The biggest improvement in the Value score is likely to be achieved by focussing communication messages on some of the Concerns in Table 3.3.2 below.

(e) Insight into the reasons that respondents assigned their summary scores for Benefits, Concerns, Environmental Issues and Value can be gleaned by studying comments captured during the survey. Respondents were asked for the main reason why they assigned the summary ratings they did.

(f) Time trends of the ratings and impact weights over the last 24 months are shown in Figure 3.3.2. These indicate that there has been little or no change either in the ratings or their relative importance.

To address the issue of how the Value score can be improved, we need tables corresponding to Table 3.3.1 for the Drivers of Value: Benefits, Concerns and Environmental Issues. These are shown in Tables 3.3.2–3.3.4; the corresponding trends in impact weights and average ratings are shown in Figure 3.3.4–3.3.6.

It was interesting to note that the public attached the greatest weight to support for farmers and to humane solutions for invasive animal problems. An interesting feature in Table 3.3.3 is the significant weight and low rating associated with whether scientists, government and business involved will keep the Australian community informed. It is clear that the community attaches great importance to being 'kept in the picture' about new scientific advances in pest control and there is an implied threat that if it isn't, support or sanction for new approaches might be withheld. This appears to be a Concern susceptible to productive action through increased communication, education and public information activity. The considerable weight given to invasive animals relative to other environmental concerns in Table 3.3.4 is encouraging, as it implies high interest on the part of the community in action in this sphere.

Table 3.3.2 Impact weights and mean ratings for perceived Benefits of the work of the IA CRC, and the main Attributes of Benefits

Attribute	Impact weight	Rating	95% conf. interval
Benefits for farmers and their families	20	8.4	(8.20, 8.52)
Economic benefits to whole Australian community	7	8.2	(8.00, 8.33)
Environmental benefits	9	8.6	(8.47, 8.78)
Enhancing Australia's international image	6	6.9	(6.66, 7.10)
Reduced risk of disease for people and animals	9	8.1	(7.97, 8.33)
More targeted ways of controlling pest animals	14	8.2	(8.08, 8.41)
More humane ways of controlling pest animals	18	8.1	(7.91, 8.28)
Benefits		**8.3**	**(8.13, 8.42)**

Table 3.3.3 Impact weights and mean ratings for perceived Concerns about the work of the IA CRC, and the main Attributes of these Concerns

Attribute	Impact weight	Rating	95% conf. interval
The control method might affect other animals or humans	15	7.3	(7.10, 7.54)
Possible contamination of the food supply	14	7.5	(7.27, 7.71)
Scientists government and business involved will Keep the Australian community informed	24	6.4	(6.16, 6.65)
The costs of developing and using the approaches will outweigh the benefits	5	5.4	(5.13, 5.59)
The control methods may not work properly on the targeted pest	9	6.8	(6.60, 7.03)
Unintended consequences of the research	10	7.0	(6.74, 7.17)
Concerns		**6.6**	**(6.41, 6.82)**

Table 3.3.4 Impact weights and mean ratings for the perceived need for Investment in environmental research, and the main areas requiring investment

Attribute	Impact weight	Rating	95% conf. interval
Climate change	13	7.4	(6.74, 8.07)
Invasive animals	24	7.6	(7.10, 8.12)
Land issues	0	7.5	(6.96, 8.01)
Reduction in biodiversity	13	7.6	(7.03, 8.17)
Soil degradation	3	8.0	(7.52, 8.46)
Water	22	8.7	(8.27, 9.12)
Weeds	5	7.3	(6.81, 7.86)
Investment in environmental research		**8.2**	**(7.69, 8.62)**

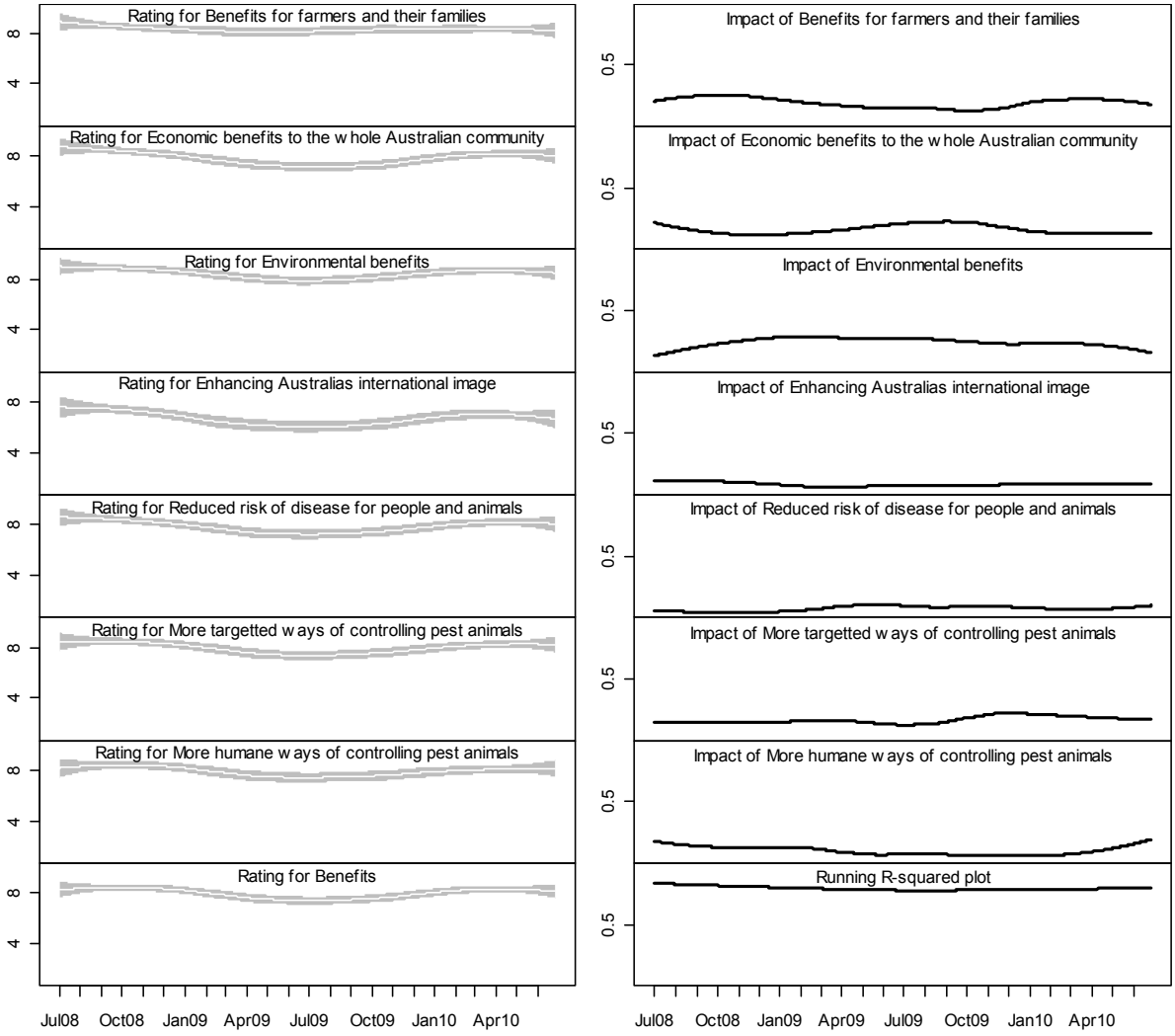


Figure 3.3.4 Graphs showing how the ratings of Benefits and its Attributes, and the relative importance of these Attributes, change with time

The first seven pairs of graphs show the time trends for each of the three drivers of Benefits, over the last 24 months. The rating trends are indicated by the white line, with the shaded band providing a 95% confidence interval for the mean trend. The graph at the bottom left shows the overall trend in Benefits.

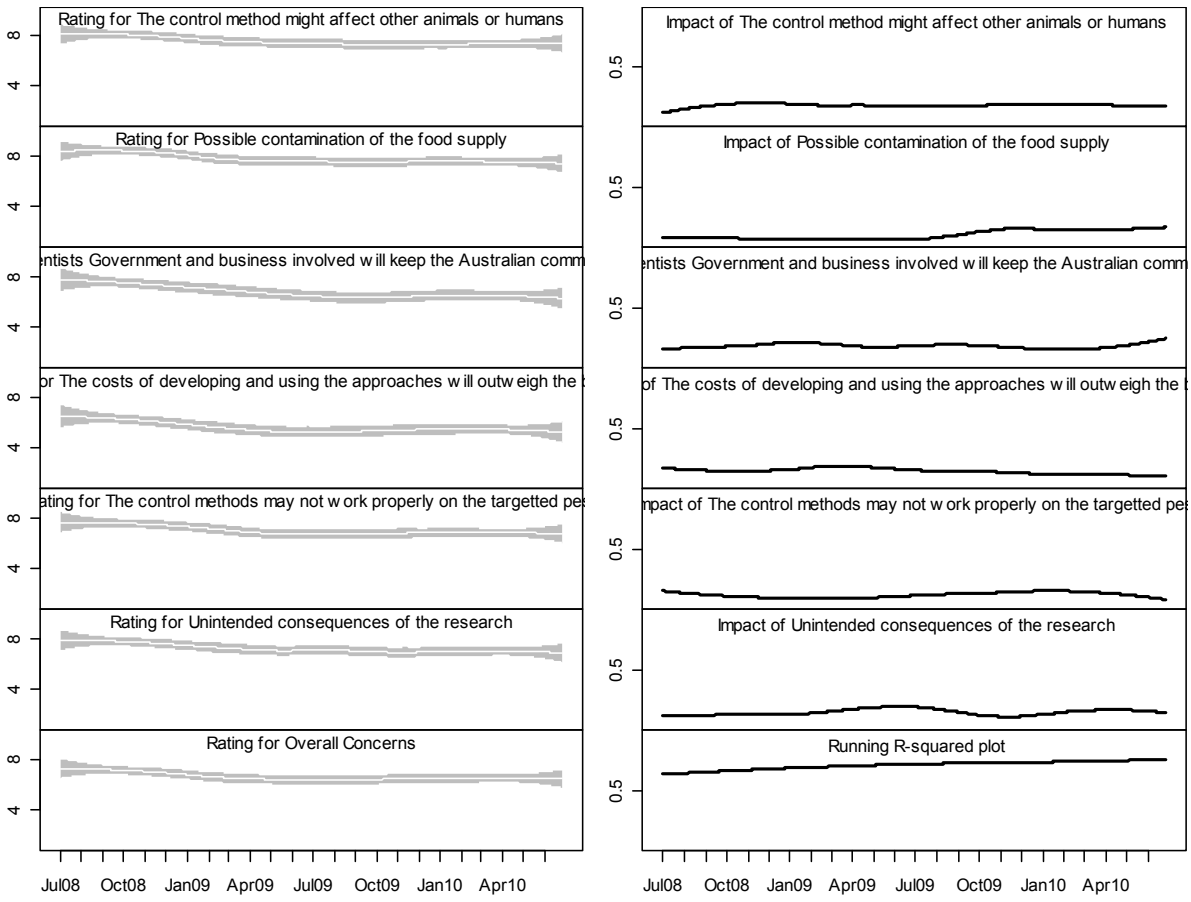


Figure 3.3.5 Graphs showing how the ratings of Concerns and its Attributes, and the relative importance of these Attributes, change with time

The first six pairs of graphs show the time trends for each of the three drivers of Concerns, over the last 24 months. The rating trends are indicated by the white line, with the shaded band providing a 95% confidence interval for the mean trend. The graph at the bottom left shows the overall trend in Concerns: the higher the rating, the lower the level of Concern.

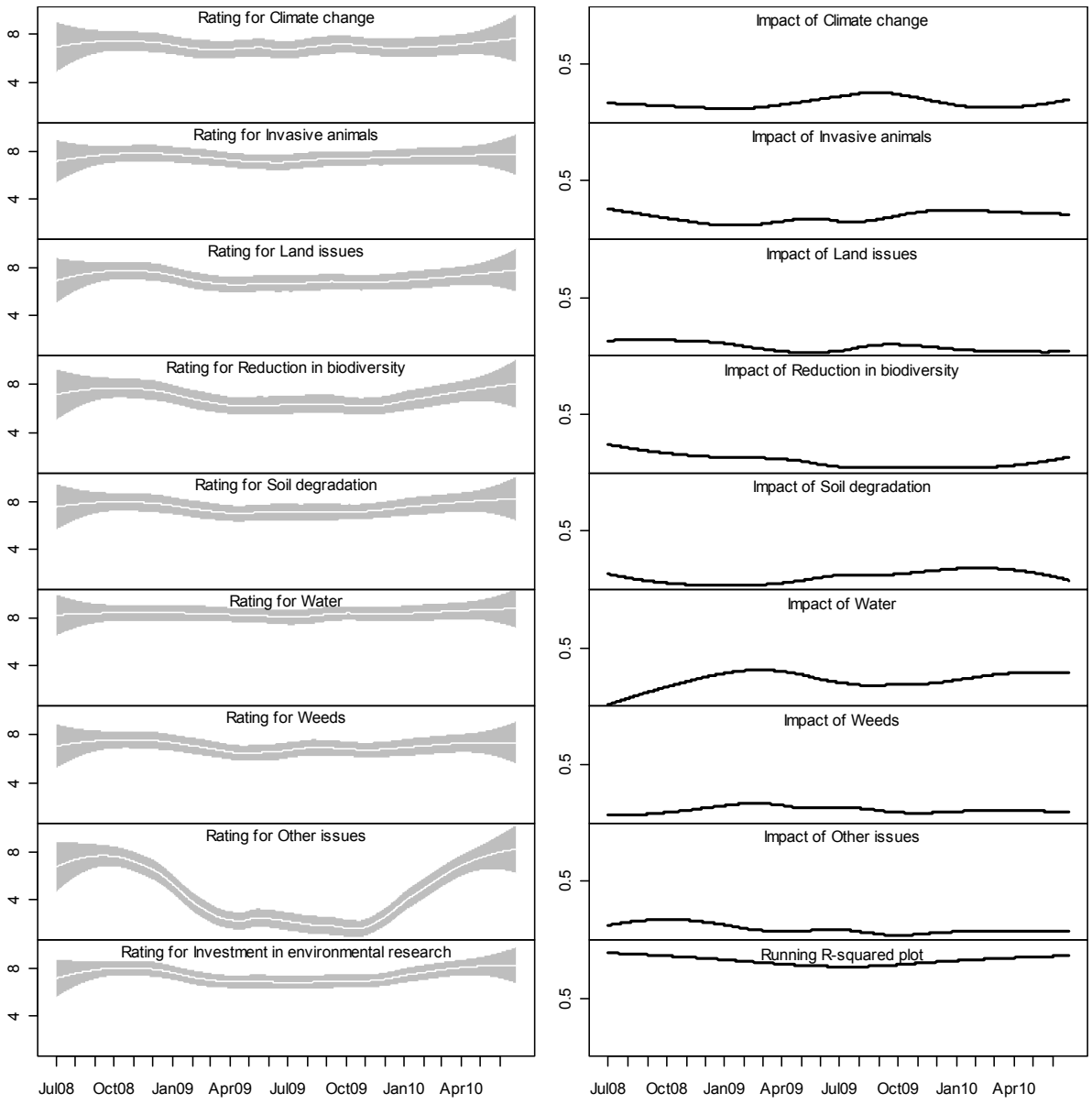


Figure 3.3.6 Graphs showing how the ratings of need for Investment in environmental areas and the main environmental areas, and the relative importance of these areas, change with time

The first seven pairs of graphs show the time trends for each of the three drivers of Concerns, over the last 24 months. The rating trends are indicated by the white line, with the shaded band providing a 95% confidence interval for the mean trend. The graph at the bottom left shows the overall trend in rating of Investment in Environmental Issues.

3.3.4 Using the results to select priorities for improvement

As noted in Section 3.3.1, the main purpose of the Community Value approach to surveying is that the structured nature of the survey instrument provides a guide to setting priorities for improvement. Figure 3.3.3 demonstrates relationships between the overall Value score and higher-level business drivers. The overall Value score is currently 8.1. Taking the third graph in the figure as an example, it suggests that a Value score of around 8.5 would correspond to about 50% of the community being very willing to participate in programs to assist in the management of pest animals. How can an increase in Value of 0.4 be achieved?

The starting point is Table 3.3.1. We look for at the impact weights of the three Drivers and at their ratings. While Benefits carries the most weight, the corresponding rating is already quite high. On the other hand, Concerns carries an impact of 24% and is rated low at 6.6, affording much more opportunity for an increase. Suppose that the overall rating for Concerns could be increased by 1 unit, from 6.6 to 8.0, by using a suitably constructed communications initiative. The estimated increase in Value from this, with no change in the ratings of the other Drivers, is then obtained by calculating 24% of this increase: $0.24 \times 1.4 = 0.336$. By also making smaller improvements in the other two Drivers, the desired increase in Value may be achievable over 1–2 years.

How can such an increase be achieved? We simply go to Table 3.3.3 and carry out the same sort of analysis: look for Attributes with higher impact weights and lower ratings. This leads to establishment of priorities for improving communication.

3.3.5 The effects of demographic factors

The data for the period July 2008–June 2010 were used to explore possible differential effects due to varying levels of each of the four demographic variables: Age, Gender, Educational level and Location. This was done by including them in each of the linear models for Benefits, Concerns and Environmental Issues in terms of their Attributes, as well as the higher-level model for Value as a function of its three Drivers. The basic results of statistical tests are summarised in Table 3.3.5.

Table 3.3.5 Results of significance tests for differential effects of different levels of each demographic variable

Result of test	Benefits	Concerns	Environmental Research	Value
Age	—	—	—	P < 0.01
Gender	—	P < 0.01	—	—
Education level	—	—	—	P < 0.01
Location	—	—	—	P < 0.01

However, the size of the observed effects, of the order of 0.1–0.4, compared with the 1 to 10 rating scale, suggests that there is no need to take specific account of them in further Community Value survey work.

3.3.6 Concluding remarks about Community Value methodology

This study has provided a thorough test of a Value-based approach to managing community attitudes towards possibly contentious technologies, in relation to both their development and their deployment. Critical aspects of its application have been:

- use of an 'ethically' constructed internet panel to obtain respondent data
- collecting data on a weekly basis to allow continuous monitoring of the community's attitudes.

The approach appears to provide consistent and interpretable results that facilitate a dialogue between researchers and the community, by identifying where to focus communication activities likely to result in the greatest increase in perceived value of the work being done by IA CRC: focus communication activities on drivers and Attributes that carry significant impact weight and are rated relatively poorly. Increasing Value is important, as it can be linked to increased support for higher-level business drivers, such as the community's willingness to support release of a new agent for managing pest animals.

Successful application of the approach critically depends on:

- selection and conduct of focus groups representative of the target community, so as to identify all the main factors affecting the community's perceptions of the benefits and concerns of the research, and of alternative ways of spending research funding
- great care in the wording of statements in the survey instrument
- careful statistical modelling of the survey responses in the early stages, to ensure that no important factor has been omitted from the survey, and subsequent monitoring to detect possible qualitative changes in the factors the community views as important
- an ongoing commitment from management to use the regularly reported survey results both tactically — in generating stories and making short-terms responses to specific issues — and strategically, in terms of selecting a target Value score to be attained, in the context of the desired level of support needed in the long term to justify appropriate exploitation of the research.

3.4 Rabbit-specific questions

The survey concluded with some requests for additional information, which varied over the lifetime of the survey. Some requests related to investigating how people received information about environmental issues, others to assessing the community's awareness of the CRC program in general and the IA CRC in particular. From April 2009 onwards, there was specific focus on issues relating to rabbits, as a number of initiatives were launched by the IA CRC in relation to rabbits. Specifically, there was an increase in communication activity in relation to rabbits in late December 2009.

The following requests were made in the survey:

1. On a scale of 1 to 10, where 1 = no problem and 10 = serious problem, please rate rabbits as a problem for Australian agriculture.
2. On a scale of 1 to 10, where 1 = no problem and 10 = serious problem, please rate rabbits as an environmental problem for Australia.
3. In your opinion, is Australia doing enough to control rabbits? (Yes / No / Unsure)

The results are summarised in Figures 3.4.1–3.4.3 and Tables 3.4.1 and 3.4.2.

Figures 3.4.1 and 3.4.2 show the trend in weekly ratings about the problems posed by rabbits to Australian agriculture and to the environment. The curves are consistently towards the higher end of the scale ('serious' problem). A small peak is evident in each graph around late December 2009, when the communication activity increased; the fact that each falls away might be due to a lack of data collected at that time (no sampling during the week either side of New Year's Day). Tables 3.4.1 and 3.4.2 indicate that the older age groups are rather more concerned than is the youngest age group (under 25 years).

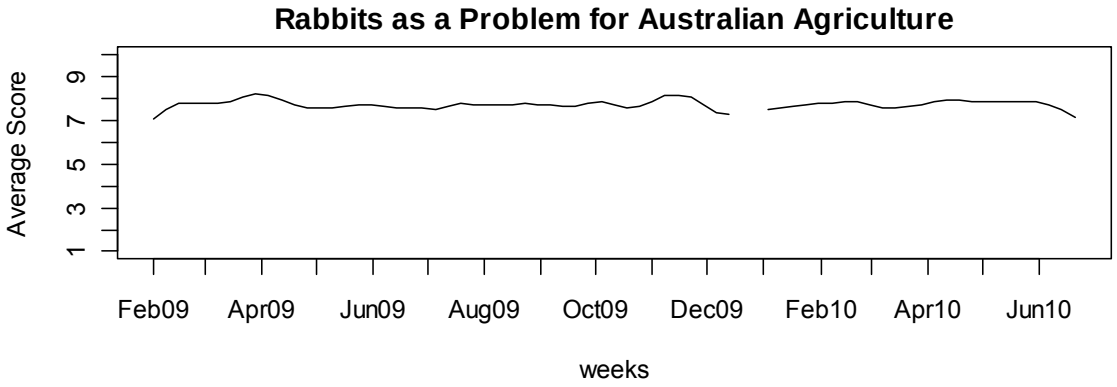


Figure 3.4.1 Ratings of the community's views about rabbits as a problem for Australian agriculture (scale of 1–10, where 1 = no problem and 10 = serious problem)

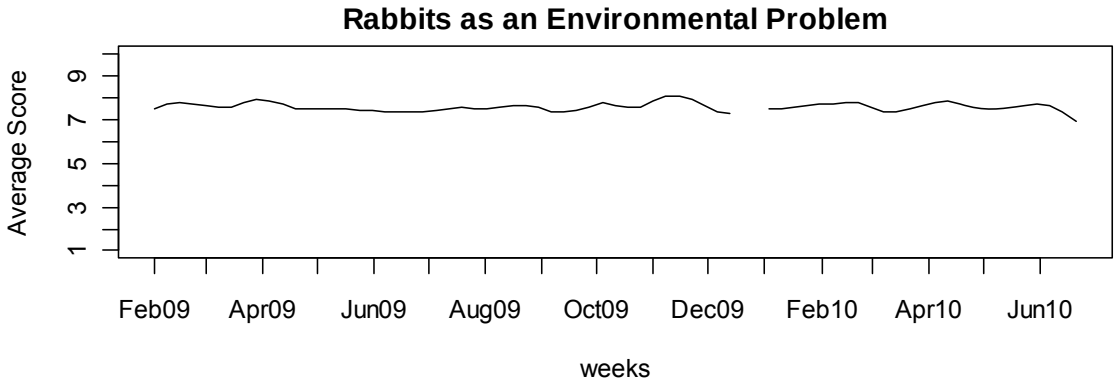


Figure 3.4.2 Ratings of the community's views about rabbits as a problem for the Australian environment (scale of 1–10, where 1 = no problem and 10 = serious problem)

Table 3.4.1 Means ratings and 95% confidence intervals of the community's views about rabbits as a problem for Australian agriculture (scale of 1–10, where 1 = no problem and 10 = serious problem). The lowest age group has significantly lower level of concern than the two older age groups.

Age group	Mean	95% conf. interval
under 25	7.01	(6.78, 7.23)
25 – 50	7.62	(7.51, 7.74)
over 50	8.07	(7.97, 8.18)
All ages	7.74	(7.66, 7.81)

Table 3.4.2 Means ratings and 95% confidence intervals of the community's views about rabbits as a problem for the environment (scale of 1–10, where 1 = no problem and 10 = serious problem). The lowest age group has significantly lower level of concern than the two older age groups.

Age group	Mean	95% conf. interval	
Under 25	6.81	(6.57,	7.04)
25 – 50	7.49	(7.37,	7.61)
Over 50	7.92	(7.81,	8.03)
All ages	7.58	(7.50,	7.66)

Figure 3.4.3 provides a temporal view of the community's attitude to whether enough is being done to control rabbits, by indicating the relative proportions who responded 'Yes', 'No' and 'Unsure'. There is some evidence towards the end of the survey that some of the 'Unsure' people had decided that not enough was being done. Table 3.4.3 summarises the responses in each category. It is worth noting the fact that 60% of respondents to this part of the survey are unsure about whether enough is being done to manage rabbits; this probably reflects a decline in awareness among an increasingly urban populace of the impact of rabbits on agriculture and the environment, about their current status and about what is being done to control them. It points to an information gap and a clear risk that future Australians will see less need to invest in new and better ways to control rabbits.

Table 3.4.3 Overall proportions of responses to the question of whether Australia is doing enough to control rabbits

	Responses (%)	95% conf. interval	
Yes	11.9	(10.6,	13.1)
No	28.9	(27.1,	30.6)
Unsure	59.3	(57.3,	61.2)

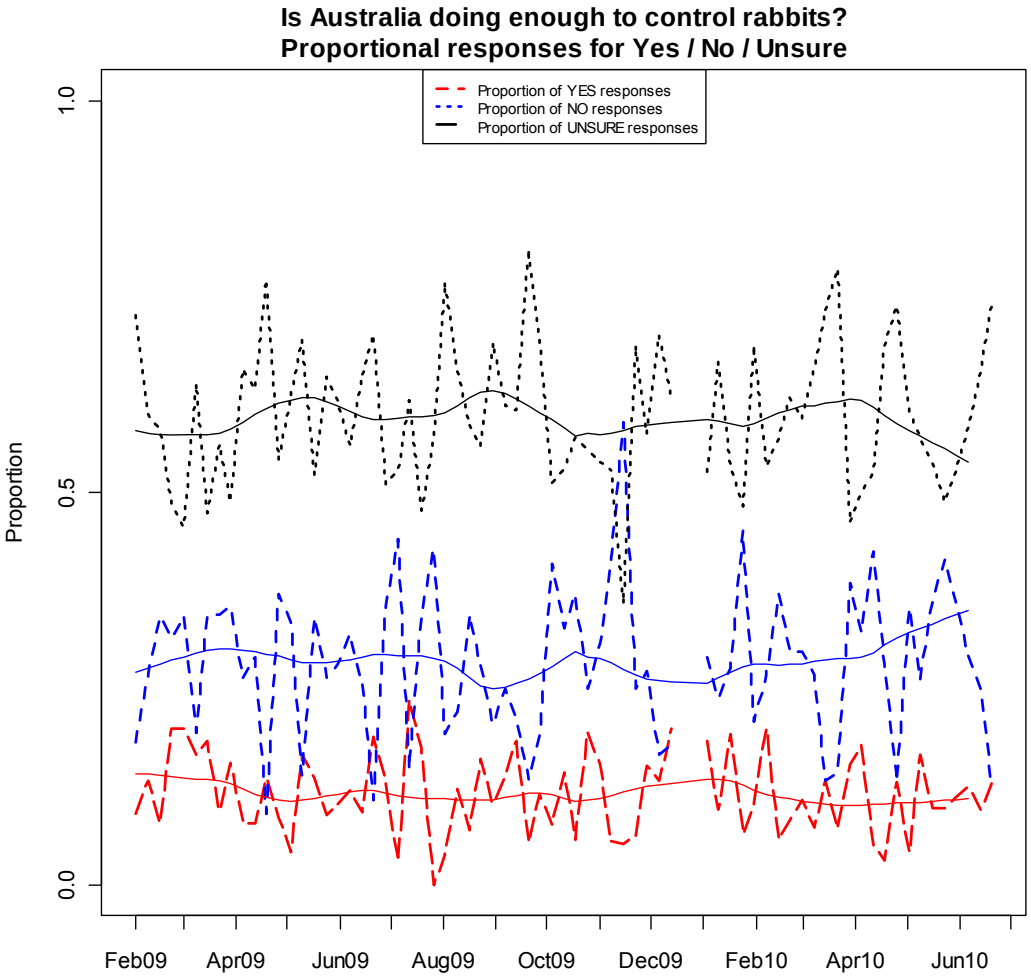


Figure 3.4.3 Weekly proportions of respondents voting 'Yes', 'No' and 'Unsure' to the question of whether Australia was doing enough to control rabbits
Solid lines indicate overall trends. Towards the end of the survey there is some evidence of increasing community feeling that more needs to be done.

4. Discussion and Conclusions

This project broke new ground in the communication of science with the public. It employed a novel statistical technique to gauge public opinion, nationally, in real time and on an ongoing basis. It found that the public consistently considers cane toads, cats and rabbits to be Australia's worst three invasives, and that it favours humane and scientific methods of control. Opinion and knowledge of the issues varied considerably according to gender, age, education level and locality.

4.1 Statistical issues

There are three principal findings of a statistical nature arising from our experience in running the survey:

(a) It is feasible to obtain reliable data about community attitudes towards pest animals and their management, from a national survey of 40 respondents per week, in terms of detecting interesting differences in the views and perceptions of key demographic groups about specific issues.

(b) An important aim of the project has been to demonstrate the validity of the Community Value Survey component of the survey, where 'validity' refers to being able to obtain reasonable statistical models for

- Value (worthwhile research project) in terms of the three Drivers: perceived Benefits, Concerns and Investment in environmental research
- perceived Benefits as a function of a small number of key Attributes
- Concerns as a function of a small number of key Attributes
- Investment in environmental research as a function of a small number of key Attributes.

The quality of each model fit suggests that no important Attribute has been omitted from consideration, so the impact weights and mean ratings associated with each model provide a sound quantitative basis for identifying priorities for focusing community dialogue.

Further, the trends in average ratings and the relative importance of Attributes and Drivers derived from the continuous monitoring have enabled confirmation of the impact of significant events on community perceptions.

(c) At a technical level, the issue of obtaining correct data when asking people to rate their Concerns caused problems for some time, because of the difficulty of making it clear to respondents which way the rating scale operated (eg did a rating of 1 correspond to a low level of Concern or a high level?). The technical device based on use of an expectation–maximization (EM)-base algorithm appears to provide a satisfactory way of managing this issue.

It is important to recall that this has been conducted as a national survey with just 40 respondents randomly sampled each week, on which basis we have sought to identify important trends and variations according to a number of demographic factors. Developing a more precise understanding of these trends and variations, and exploring possible interactions, would require rather larger sample sizes (although once the survey instrument is established, the cost of sampling more respondents is relatively cheap). A more interesting challenge would be posed if it were desired to explore the perceptions of the

farming community in particular, which experience elsewhere suggests is a group with very low response rates to surveys (eg Fisher et al 2010).

4.2 Recommendations to management

We propose the following actions flowing from specific findings of the research:

1. Owing to the wide disparity in views about invasive animals held by men and women and by older and younger Australians, and the potential for this to influence public policy down the track, we recommend specific, targeted public awareness activity by the IA CRC and its partners aimed at informing (a) women and (b) young Australians about the extent of damage caused by various invasives and the best and latest options for their control.
2. The strong public concern expressed about cane toads and cats in particular is indicative of public sanction for an increased research effort aimed at controlling these pests, and this should be factored into national research priorities.
3. There should be ongoing public awareness activity about the damage caused by rabbits, especially among urban populations, as there is clearly a risk that this issue will be downgraded in national priority and support for an ongoing R&D effort to control rabbits will progressively dwindle for lack of public interest and sanction.
4. There is a clear requirement for major new invasive animal control initiatives, such as the Australian Feral Camel Management Program, to track public opinion and support or concern about their activities, or else risk the withdrawal of sanction (as has occurred in previous cases, such as with feral horses).
5. There is growing public pressure for the control of urban pests such as Indian mynahs, pigeons, rats and mice. This should be developed in parallel with larger-scale control programs in rural and regional areas, or else there is a risk it might eventually compete for resources and priority.
6. We strongly recommend a regular (eg two-yearly) report to the Australian public on the state of damage caused by, and control policies for, the 'top five' invasives, and other species of particular national or economic significance.

4.3 Science communication issues

Our Community Awareness Survey using the RtPM technique has achieved a number of significant firsts for science communication and adoption. It has carried out the first detailed research into Australian public attitudes nationally about invasive animals and their control, providing a foundation for future research planning, communication and adoption.

It has pioneered the use of a web-based ‘moving picture’ (as opposed to the traditional snapshot) technique for studying ongoing change in public opinion about a scientific issue, and the drivers behind it. The data generated has been notably consistent over the three years of the survey, even though the sample of Australians surveyed changed continually throughout that time.

It has demonstrated the power of this technique to ascertain public attitudes, values and beliefs regarding the introduction of important new technologies, and to provide confidence in their ‘adoptability’. This can assist in increasing the impact of science and the return on public investment in R&D, as it allows researchers to anticipate the likely public reception of new advice or technology on the basis of repeated data — rather than guesswork, which is the technique most widely used in science. It also allows research managers and researchers to identify new technologies that, potentially, are likely to encounter public concern or rejection and to take appropriate action.

It offers science and technology institutes and agencies a powerful new tool for ‘listening’ to the community (or to subsets of it) and assessing the state of its awareness of key issues and its preferences for what should be done about them. For the first time it also offers science an informed basis for advising politicians, governments and industry about the likely public reception of a new policy or technology, giving greater confidence to decision makers.

It offers a new tool for measuring the direct impact of science communication activity by assessing the attitudes and response of the public to scientific messages. This is important, as most forms of assessment measure only indirect and secondary outcomes (such as media clips) instead of understanding how the community actually reacts to the scientific information imparted to it. Furthermore, it allows communication planners to identify those groups or audiences most in need of accurate scientific information, enabling them to be better targeted. Unlike other methods, it can be used to gather both quantitative and qualitative data about public opinion on science issues.

The RtPM survey revealed new insights into what Australians are thinking on the subject of invasive animals and their control, such as:

- low public awareness of the relative impacts of different invasive animals
- the usefulness of planned communication activity in rectifying public misperceptions (eg in the case of rabbits)
- a potential consensus for a national cat control program

- public expectations that the cane toad should be the top target of national control activity
- lack of awareness among young Australians about invasive animals in general and the need to control them, risking a national decline in priority for this area as time goes by
- a strong public preference for humane and 'soft' control methods and a growing dislike of traditional methods
- the importance of women in the granting of public sanction for the deployment of new control technologies
- the rise in relative public priority attached to 'urban invasives'
- the present high public weighting of invasive animal control relative to other environmental issues
- a strong wish on the part of Australians to be kept in the picture with regard to invasive species and proposed control methods
- the high level of public approval and appreciation of IA CRC and its work, as reflected in the thousands of supportive individual comments submitted voluntarily by respondents to the survey.

The detailed reports of this research are of particular value to managers of invasive animal control programs, as they provide insight into the degree of support and/or opposition they are likely to incur from sections of the community in implementing controls. These attitudes are clearly reflected in both the quantitative and qualitative data gathered by the research, which is recommended reading for anyone involved in invasive animal control in Australia.

Furthermore, the research indicates promising scope to better inform Australian public attitudes to invasive animals and their control, so achieving a more enlightened national context in which new policies, approaches and technologies can be pursued. This in turn will lead to more rapid adoption and thus to more timely intervention against species of concern.

In conclusion, we state with some confidence that RtPM offers a powerful new way for scientific agencies, especially those engaged in public good, policy and commercial areas, to measure and understand the basis for public acceptance and rejection of the outcomes of research and development. Carried out in parallel with research itself, this has considerable potential for increasing both the rate and extent of adoption of new research findings or technologies, and for securing a great return on the public investment in R&D.

Used widely, such techniques can also help to allay some of the mistrust and negative sentiment on the part of the community towards science that has arisen in recent years, as documented by the UK House of Lords (2002) and others, by demonstrating both that science is listening to society and that the two are partners in determining the future direction of innovation and technology policy.

Finally, we offer the following policy recommendations, flowing from the findings of this research:

- Further periodic research to ascertain whether there has been any significant change in public awareness, attitudes and wishes regarding invasive animals and control, in particular focussing on the less-aware groups identified (eg young Australians), is highly recommended.
- A regular two-yearly report on each of the top five pests identified by the survey, informing the public and decision makers about its current status, harm caused and control methods being pursued or proposed. This would help to underpin ongoing public support for R&D to control invasive species in Australia and is a useful way to account to the public for its investment made in R&D.
- An effort to communicate to the Australian public the key findings from this research, as informing the community of its own views is very helpful in seeding greater awareness of the issue and allows science the opportunity to correct any misperceptions and to introduce new concepts.
- That the IA CRC seek recognition of its role in pioneering a new method to improve the rate of adoption of Australian science by reporting to relevant ministers, departments, the Chief Scientist, the academies, Science & Technology Australia (formerly FASTS), the Australian Science Communicators and other key stakeholders about the outcomes of this project, and its potential for much wider application to all kinds of scientific research and issues affecting or affected by Australian public attitudes.

5. Acknowledgements

Preparation of this report was funded by the Invasive Animals Cooperative Research Centre, and by ValueMetrics Australia.

6. References

Edwards GP, Zeng B, Saalfeld WK, Vaarzon-Morel P and McGregor M (Eds) (2008). *Managing the Impacts of Feral Camels in Australia: A New Way of Doing Business*. DKCRC Report 47. Desert Knowledge Cooperative Research Centre, Alice Springs. http://www.desertknowledgecrc.com.au/publications/contractresearch.html .

Fisher NI, Cribb JHJ and Peacock AJ (2007). Reading the public mind: a novel approach to improving the adoption of new science and technology. *Australian Journal of Experimental Agriculture* 47: 1–10.

Fisher NI and Lee AJ (2012). Getting the `correct' answer from incorrect survey responses: a simple application of the EM algorithm. *The Australian and New Zealand Journal of Statistics*, in press.

Fisher NI, Lee AJ and Cribb JHJ (2012). A scientific approach to monitoring public perceptions of scientific issues. *International Journal of Science Education*, in press.

Fisher NI, Lee AJ, Cribb JHJ and Haynes, GD (2010). Public perceptions of foxes and fox eradication in Tasmania. *Australian Zoologist*. 35:576–589.

Fisher NI, Lee AJ and Sparks R (2005). No more static. *Marketing Research*, Spring 2005: 14–19.

Fitzgerald G and Wilkinson R (2009). *Assessing the Social Impact of Invasive Animals in Australia*. Invasive Animals Cooperative Research Centre, Canberra.

Gong W, Sinden J, Braysher M and Jones, R (2009). *The Economic Impacts of Vertebrate Pests in Australia*. Invasive Animals Cooperative Research Centre, Canberra.

www.invasiveanimals.com