

1. Australian Wildlife Management and the Human Dimension

Wildlife management is, literally, a matter of opinion. As a discipline, it is an attempt by humans to achieve some desired state for wildlife, so it should be clear that without people, there would be no wildlife management.

In its modern form, Australian wildlife management is essentially a blend of sciences, such as ecology, with politics. These two aspects interact to determine management success, so both should be considered as important by managers. However, in Australia, the human dimensions are frequently dismissed as problematic rather than treated as a specific issue that should, and can, be addressed. (This is evidenced by throwaway comments about people-problems made by wildlife professionals at the annual Australasian Wildlife Management Society conference.)

Such treatment is odd because from a philosophical standpoint wildlife management, if only as a set of subjective, arbitrary decisions about wildlife, could exist in the absence of sciences but it could never exist without human opinion. Even in practical terms, scientific disciplines, such as ecology, are only important to wildlife management as long as society believes they provide value, for example as an objective means of setting goals for management to achieve or for measuring progress towards such goals. Essentially, science is a tool of public opinion.

Despite this, Australian wildlife managers seldom actively attempt to account for human preferences. This approach, of typically affording little effort to understanding what the wider public think about wildlife management, has probably survived because there has traditionally been little resulting ill-effect. Indeed benign social outcomes are likely when management issues evoke little public opinion or when public opinion is aligned with that of scientists and managers.

However this is increasingly not the case. More and more often it seems that situations are precipitating disparate views among members of society, or between managers and the public, resulting in conflict. In such instances, more appropriately addressing issues of stakeholder diversity would likely benefit the outcomes of management actions, for managers, the wildlife and the public.

Of course, because we operate within a democratic system, public opinion is generally inherently reflected in the management of wildlife. The nature of our society dictates that, because of the collective role individuals have in electing a Government, the overall approach to governing, including aspects like wildlife management, is roughly shaped by the public.

However, it is also because the public forms a grass-roots powerbase that it is perilous for our representatives to ignore situations where specific policy, goals, or management actions do not match public expectations or preferences. Governments, sensibly, tend to want to avoid conflict between their managers and public opinion. Therefore, even if managers are reticent to adopt research into the human dimensions of wildlife management, it is conceivable that such a change, to actively seeking information on public experiences, attitudes and management preferences, may eventually be driven by elected representatives who want to appease the public. Alternatively, it may be sought by managers who either want to avoid conflict with stakeholders or the type of knee-jerk, public-placating reactions by politicians that can impact the ability to manage effectively.

Other countries have long been developing and applying human dimensions research. Individuals in the United States of America, for example, realised there was a need to better understand public stakeholders soon after the Second World War. Somewhat surprisingly, since Australia is often quick to follow the lead of powerful western nations like the USA, little similar research has been undertaken in this country.

It is in the light of these realisations about the nature of wildlife management, the paucity of consideration of social context in Australian scenarios and the likelihood that managers in this country will be further driven to address these issues that this project was undertaken.

1.1 Human Dimensions Research

Essentially, human dimensions research is about understanding people, to improve wildlife management. Whilst many definitions have been offered to describe the field since its conception in the United States of America during the 1940's (see Decker & Lipscomb, 1991; Manfredo *et al.* 1996; Jacobson & McDuff, 1998), that of Decker & Enck (1996) is particularly useful for demonstrating the breadth of approaches human dimensions research can entail and an inherent optimism about its ability to enhance management. They wrote:

“It's the work of separating myth from reality vis-à-vis public “sentiment,” replacing assumptions with knowledge for improved decision making. It's a chest of social science tools, human behavioral understandings and public involvement processes that yield better information for management decision making and, hopefully, better and more broadly accepted management decisions”.

In the face of increasing public interest and involvement in wildlife management (Jones *et al.*, 1998) it has become clear that Australia's wildlife professionals are not effectively equipped to deal with the problems that such interactions pose. This realisation has prompted calls for Australian wildlife managers to “...embrace sociological and economic elements in addition to the traditional and technically oriented biological approach... they must learn to understand and work more effectively with other stakeholders to successfully address complex management issues.” (Korn, 1994).

Similarly, Temby (1995) recognised this new (for Australia) sub-discipline of wildlife management and suggested that “*human dimensions should be incorporated in under-graduate wildlife management courses so that future wildlife managers will be adequately equipped to deal with increasingly complex wildlife management challenges.*”

However, in the decade that has passed since the Australasian Wildlife Management Society's (AWMS) symposium on “Human Dimensions in Wildlife” (Korn & Brennan, 1994) and the seven years since Jones *et al.* (1998) wrote of taking the “North American experience to

Australia”, the field has not been broadly embraced, despite positive claims about the benefits of such research overseas (Enck & Decker, 1997) and the efforts of a small number of researchers who have continued to both extol, and more importantly demonstrate the virtues of better understanding public values, attitudes, knowledge and preferences as they relate to management (see for example, Jones & Everding, 1994; Thomas & Jones, 1998; Miller & McGee, 2001).

Generally, Australia’s wildlife managers continue to derive their understanding of the public through opportunistic interactions with stakeholders or via the submissions of particularly motivated individuals and special-interest groups. There is a notable absence of active sampling or systematic assessments of public views that could help to ensure that managers’ understandings of stakeholders are accurate and up-to-date. This is clearly not the new paradigm that Korn (1994) desired (as cited above) and based on the categories of citizen participation offered by Decker & Chase (1997) such an approach might be considered “passive-receptive”.

Remaining shielded from the public (Jones *et al.*, 1998), managers are forced to rely on the potentially biased information they receive from “calls for expressions of interest” or, where they have no information, to make assumptions about what the public wants (Enck & Decker, 1997). Such assumptions are, of course, not a problem so long as managers can make them accurately. Naturally, this is not always possible when dealing with a diverse public and it has been shown that Australian managers can harbour misconceptions about not just the general public but recognised stakeholder groups too (Miller & McGee, 2001). Demonstrating that Australian managers may not be accurate in their assumptions about stakeholders is important because it has long been recognised that such misunderstandings can result in conflict (Vining & Ebreo, 1991).

The reasons for the slow uptake of human dimensions research in Australia have not been explicitly dealt with but Temby (1995) and Jones *et al.* (1998) indicated that the impediments to incorporating human dimensions research into the management repertoire of the United States likely apply here too. Described by Decker *et al.* (1987), the 3 barriers are:

- biological considerations being seen as the primary determinants of wildlife management decisions;

- limited communication between wildlife professionals who have traditional biological training, and social science-based professionals who deal with human dimensions; and
- the image of human dimensions as a legitimate body of knowledge needing improvement among wildlife managers

Such barriers are unlikely to be quickly overcome (Jones *et al.*, 1998) but the promise of improved interaction between stakeholders and managers that can result from increased efforts to understand people's expectations (Vining and Ebreo, 1991), compared to dire warnings about the perils of not obtaining reliable information about public opinions (Reiter *et al.*, 1999), suggests that exploring human dimensions research will be worthwhile.

A potential solution, then, seems to be providing examples of Australian human dimensions research that may aid in overcoming these barriers, so that managers will adopt a more active approach to involving the public. To this end, Australian human dimensions research has continued along a diverse path featuring both single-species and general approaches (Miller 2000).

Notable examples of the general approach have been the work by Miller & McGee (see Miller, 2000; Miller & McGee, 2001; Miller, 2003) regarding stakeholder values in Victoria and research by Davies *et al.* (2004) addressing knowledge, beliefs, attitudes and behaviour toward urban wildlife. Alternatively, others such as Jones & Everding (1994) and Jones & Thomas (1998), have taken the single-species approach and focused on developing insights into specific wildlife management issues.

Although Decker & Enck (1996) have cautioned that problem-focused studies may be "*limited in their contribution to a generalizable knowledge base*" and "*may make little or no contribution to discovering new insights about human attitudes and behaviours*" it seems that they may play a very important role in motivating Australian managers to take notice of human dimensions research through the potential for "*immediate utility*" (Decker & Enck, 1996).

Particularly in Australia, where relatively little effort is devoted to actively seeking information from stakeholders about their preferences for wildlife management, it seems vitally important that wildlife managers are given such opportunities to evaluate the utility of human dimensions research in real-world, wildlife management scenarios. In this way, it might be possible to directly address the issue of the legitimacy of the field and encourage adoption of at least a more active “inquisitive” approach to understanding what the public want, know and feel.

Consequently, for this project, I have also adopted a single-species approach and chosen to focus my efforts on applying human dimensions research to three, Australian wildlife management case studies with the following, overarching aims:

- To raise awareness of both the need and the applicability of Human Dimensions Research, in Australia
- To determine whether or not researching the social context of a range of diverse wildlife management scenarios can provide outcomes valuable for their management
- To address the gap between current wildlife management efforts and a more holistic approach by offering technical solutions for better understanding stakeholders’ views

1.1.1 Three case-studies in applying human dimensions research

Firstly, the Wild Horse Management case study was chosen as an example of what can go wrong when managers do not sufficiently understand the social context for management. When the NSW National Parks and Wildlife Service (NPWS) staff chose to aerially cull wild horses without first considering the human dimension of the scenario, the ensuing fracas damaged the agency’s credibility and resulted in the NSW Minister for the Environment implementing a ban on future aerial culling of horses within the State. The case study, with specific reference to the Guy Fawkes River National Park and the now-infamous aerial culling operation, retrospectively addressed management of wild horses to determine whether a better understanding of the social context for wild horse management might have reduced the likelihood of conflict by facilitating more appropriate management decisions and actions.

Secondly, NPWS and the NSW Flying-fox consultative Committee (FFCC) planned a large-scale review of commercial fruit growers interactions with, and preferences for, the management of Flying-foxes in NSW. This was, however, to be conducted in the absence of any investigation of the wider public's views of the scenario. I convinced both NPWS and the FFCC to expand the project to include the general public so I could evaluate the potential for human dimensions research to contextualise specific interest groups within the wider community and thereby provide managers with insight into public views and potential heterogeneity over a broad geographic area.

Lastly, following incidents in peri-urban areas where kangaroos had attacked humans, it appeared that developing an understanding of public attitudes towards the animals and expectations of managers could help to optimise management of the scenario. I initially set-out to examine the views of residents in one residential area but it quickly became apparent that other nearby communities also featured populations of peri-urban kangaroos. Consequently, my investigation was expanded to also consider whether or not a homogeneous approach to managing peri-urban kangaroos was appropriate.

2. Case Study One:

Wild Horse Management in Guy Fawkes River National Park

“I fully support the culling of wild horses. Without control there would be herds of sick, deformed and starving animals. Pastures and forests would be damaged beyond recovery if numbers increase above sustainability. Shooting is a quick and merciful way of controlling animals.”

Rural respondent, 2002 Wild Horse Management Questionnaire

“Horses are so much a part of Australian history and working life that the very idea of taking such drastic steps to lower their numbers is absolutely abhorrent to me. I am talking about their culling by the bullet. They are majestic creatures and to see one fall through the impact of a bullet is simply too much for me to bear.”

Rural respondent, 2002 Wild Horse Management Questionnaire

“Sorry if my answers are in some ways conflicting – I am in two minds about the issue. I realize the horses can be an environmental problem in some areas and circumstances and need culling ... humanely. But I also like horses personally and appreciate their cultural heritage significance.”

Rural respondent, 2002 Wild Horse Management Questionnaire

2.1 Why investigate the human dimensions of wild horse management?

During October 2000, the NSW National Parks and Wildlife Service NPWS utilised helicopter-based shooting to kill 606 wild horses in the Guy Fawkes River National Park (GFRNP). According to the NPWS (2003), their decision to aurally cull horses was made because dry conditions and wildfire had severely limited resources for the animals. Regardless, news of the cull spread across Australia and the world, provoking diverse responses from media pundits, politicians and the public alike.

Australian wildlife management rarely receives the sustained level of media coverage that was observed following the cull. Consequently, the scenario's high public profile made it an attractive option for inclusion in this Ph.D. project. In light of early concerns about generating sufficient interest in research about views on wildlife management to obtain a statistically usable response, the level of controversy associated with the cull of wild horses in the GFRNP and generally with wild horse management, suggested that even two years after the specific management action had occurred, it might be possible to get a substantial number of people to reveal their opinions of the scenario.

Whilst the range of opinions reported in the media made it difficult to tell what actually constituted socially acceptable management of wild horses, it was clear that the public was not unified in its response; some people offered support for the culling operation (Hosking, 2001 online; McCrossin, 2002 online) whereas others were obviously against it (Anon., 2000; Peatling, 2002).

Of further interest was the fact that many of the people who commented on the specific management action had little, if any direct association with the GFRNP, and consequently the horses killed during the operation. Despite this, members of the public reserved their right to have an opinion about the management that had occurred and politicians responded to the media-based reaction even though it was not obvious that this truly reflected public sentiment.

Whilst this was not entirely surprising, given that contemporary society regularly encourages people to express their views publicly, e.g. in media polls, 'bumper stickers', Internet bulletin boards or via "blogs", it did reinforce the notion that the sphere of influence surrounding a wildlife management action could be much larger than the geographical area in which that action took place. Moreover, the NSW State Government's reaction following the cull, specifically in banning aerial culling of horses, showed that these geographically widespread and often unsolicited opinions had political value, and therefore the ability to have a real effect on wildlife management.

According to the NSW Minister for the Environment, the ban he imposed on aerial culling was made "*in keeping with broad community expectations*" (NSW Hansard, 2002). However, no referendum, poll or other study of community expectations had been undertaken regarding the issues of wild horse management. Just as the aerial culling operation had been implemented with the latent assumption, by staff of the NPWS, that it was socially acceptable to do so, the subsequent ban on aerial culling was likewise based on an assumption that the public opposed the method, even though the media had presented members of the public arguing both for and against it.

NPWS' public image suffered in conjunction with criticism of the culling operation. News of the cull fuelled detractors' arguments against NPWS as the public was presented with an image of an agency whose policies appeared to be out-of-step with community attitudes. In response, the Minister commissioned a review of the culling operation (English, 2000) and placed a ban on aerial culling of horses in NSW, despite the fact that it had previously been accepted and even recommended as an efficient method for large-scale management of wild horses (SSCAW, 1991; Dobbie *et al.*, 1993; English, 2000; SCA, 2002; Sharp & Saunders, 2004).

In response, there was little that NPWS could do to effectively refute public criticism of the GFRNP cull or to counter political assertions made about prevailing public attitudes towards wild horse management (e.g. NSW Hansard 2002) because they lacked sufficient evidence about community opinion to do so. With the benefit of hindsight it seemed that evidence of what the community at large wanted, collected before control actions were undertaken, could have been

extremely valuable to NPWS. Such information might have allowed managers to objectively assess which methods of horse control were socially appropriate, or at least to more effectively rebut criticism of their chosen methods. Consequently, NPWS might have been able preserve their public image, to save the funds that were used in the reviews of the management action and perhaps to have retained aerial culling as an option for the management of wild horses in NSW.

Whilst it was not possible for NPWS to change the past, it did appear possible for the missing community engagement to be undertaken, *post hoc*, to better evaluate the management scenario that had already occurred and, more importantly to provide context for future management actions. To this end, this research aimed to investigate current public opinion about wild horses and their management both to review the GFRNP cull and to suggest a way forward for future management actions.

2.1.1 Aims of the Wild Horse Management Case Study

The conflict surrounding the October 2000, GFRNP cull suggested that a better understanding of the range and distribution of people's views about wildlife management was integral to avoiding similar problems in the future. However, to adequately incorporate this issue into a research framework, a series of specific tasks were required.

Consequently, the following case study aims were developed to facilitate an examination of community preferences for the management of wild horses.

Aim One: To review previous management of wild horses in Australia, and elsewhere

Aim Two: To develop an understanding of public opinions of wild horses and preferences for their management

Aim Three: To specifically evaluate the GFRNP scenario and subsequent management reactions, in the context of stakeholder sentiment

By addressing these three aims it was hoped that wild horse management, both in the GFRNP, and elsewhere might benefit, not only from the specific information collected but also through a demonstration of the potential to gauge public opinion about wildlife management issues.

A note on terminology

Since I believed that maximising participation would aid my chances of determining the range and frequency of horse-related experiences and preferences, any issues that could influence the response rate were considered to be important. To this end, deciding how to refer to the horses at the centre of this research was an early concern because I suspected that choosing the wrong synonym could adversely affect people's willingness to take part in the project.

Although such an issue might seem trivial, it is common in modern society to consider the sensitivities of particular interest groups to decide whether specific wordings are either used or omitted. In this case, I believed that subjectivity on my part might decrease the likelihood that participants would want to be involved. For example, if people with a particular preference for management believed that I held an opposing point of view, then they might be less inclined to participate if they felt it was likely their views would be ignored.

Feral, Free-ranging, Wild or Brumbies?

Several terms are available to describe horses that live independently of human assistance. Each one, however, carries a degree of support or concern from relevant interest groups. Because it was likely I would be able to find an argument against almost any term, I decided to try to choose one that would provoke the least amount of concern from the largest proportion of people.

The most obvious choices for describing these horses were "brumby", "feral", or "wild", though it is noted that Schott (2003) chose to use "free-ranging horses" to describe animals from the Guy Fawkes River National Park.

Although Berger (1986) recommended "feral" as the most appropriate means of describing horses which had established populations in the wild, it was dismissed because of specific, negative, connotations associated with that term in modern Australian society. Likewise, the Australian word, "brumby" (McKnight 1976), was not selected because it is readily interpreted as supporting the iconic status of horses in Australian culture. Ultimately, "wild horse" was determined to be the least controversial term.

No objection to the choice of “wild horse” was received in the pilot phase of the project and it was noted with some relief that Walter (2003) had also made the decision to describe the horses in her study, as “wild”.

2.2 Methods

2.2.1 Collecting Information from the Public

Essentially, this project was an attempt to communicate with a representative sample of the public about wild horses and their management. Because I wanted to investigate the heterogeneity that appeared to exist within that public it was clear that a reasonably large sample size would be necessary. Consequently, questionnaire-based research was chosen as the most efficient method for contacting a large number of geographically dispersed people, compared to in-person, or telephone, interviews.

Developing a sampling procedure for this project represented a very steep learning curve for me. My background in ecology and associated biological sciences, similar to that held by most Australian wildlife managers, was essentially poor preparation for the essential social science component this type of project relied upon.

I have attempted to cover, in some detail, the methods used for this case study. This is included because I struggled to piece together information on how to sample participants, which made me think it would be likely that many of the Australian wildlife managers and researchers who comprised my target audience would probably also display a similar knowledge gap. As a result, I have tried to make it clear why particular methodological decisions were made and applied so following researchers will have a consolidated methodological framework to base their efforts upon.

Ethics Approval:

Approval was granted by the University of New England, Human Research Ethics Committee for this project to be conducted. Approval number: HE02/197.

Geographic Scope of the Project

Even though comments regarding wild horse management following the GFRNP cull had been widespread, the limited resources available for this research determined that any examination of the hypotheses and related research questions would be restricted to a scale much smaller than the entire Australian public, or even the people of the State of New South Wales.

Further, my concern regarding the potential to secure representative participation from within the public suggested obvious constraints to the location of this research. To maximise responses, the target population needed to be from an area where wild horse management, and preferably the GFRNP cull, were both remembered and relevant.

To address the financial limitations of the study and issues affecting participation, the decision was made to sample the adult population within the Commonwealth Electoral Division of New England (Figure 1.1). This choice was made primarily because the Electoral Division is adjacent to the GFRNP and also because the research was conducted from the University of New England (UNE), which is situated within the study area. Assumed benefits of undertaking the research close to UNE included the likelihood of participants' being familiar with the institution, hopefully making them more likely to take part in the research, as well as relatively short distribution and return times for correspondence with participants.

Stratification

The review of wild horse management in Australia suggested that there was likely to be significant variation within the community regarding views of horses. In sampling, I wanted to ensure that I maximised my ability to capture that variation.

Therefore, the first decision made was to sample randomly – so that each person was equally likely to be selected from the population of interest.

Appropriate sampling includes likely sources of variation within the research design so that differences can be meaningfully identified. To this end, comments by previous authors about likely differences between specific groups, regarding wild horse management, were actively incorporated.

In particular, Berman (1991) noted the likelihood that differing opinions would exist, regarding wild horses, between people with certain life experiences and those people who did not share the same experiences. He specifically suggested that this divide existed between city people and those from rural areas. Even though the New England has no large, metropolitan cities, Berman's observation, together with my own experiences of the differences between rural and urban lifestyles, encouraged me to stratify the population on this basis.

To perform this stratification *ad hoc*, I required a method of differentiation that could be found within the available information on each potential participant. Individuals' addresses appeared to offer a suitable solution. Using the definition applied by the UNE Institute for Rural Futures in their sampling designs (Dr Ian Reeve, personal communication), Rural participants were defined as those people whose addresses contained Lot numbers, Roadside Mailbox Numbers (RMB) or property names. Conversely, Urban participants were defined as those people with non-rural addresses, i.e. those who had an address which contained both a street name and number (including Streets, Avenues, Places, Crescents).

Determining Sample Size

Formula

Sample size calculators are freely available on the World Wide Web (e.g. Creative Research systems online, 2003) and are an appealing, no-thought-required option for people interested in determining how many responses are needed for their survey research. However, in the interest of encouraging Australian managers to take research such as this seriously, a more overtly statistically-based method for determining sample size was sought.

Dr Ian Reeve, from the Institute for Rural Futures, a research organisation that regularly conducts large-scale surveys, was responsible for introducing me to the concepts of survey design and practically acceptable sample size. In doing so, he provided me with a Microsoft Excel spreadsheet that allows one to simply calculate requisite sample size as a function of population size, precision, desired confidence and the hypothesised proportional split of the population regarding an issue/topic.

The formula within matches that of Dillman (2000), who offered the following:

$$N_s = \frac{(N_p) (p) (1-p)}{(N_p - 1) (B/C)^2 + (p) (1-p)}$$

Where N_s is the required sample size, N_p is the population size, p is the proportion of respondents that one expects to choose one of two available responses, B is the desired precision and C is the desired confidence level expressed as a Z statistic.

Population size (N_p)

In the case of the Wild Horse Management case study, the population of interest was comprised completely of adults, i.e. people over 18 years of age, listed on the 2000 electoral roll for the Commonwealth Electoral Division of New England. The size of this population was 83,106 individuals. Because no data was available to provide an estimate of the relative proportions of Rural and Urban people within the population, the population size was deliberately overestimated for each treatment using the total population for each. Thus, for each treatment $N_p = 83,106$.

Confidence level (C)

As it was believed that most managers and researchers presented with the findings of this project would be comfortable with an approach that most closely matched accepted scientific procedure, a confidence level of 95% was chosen. The corresponding Z statistic for this value is 1.96, so $C = 1.96$.

Confidence Interval / Precision (B)

Identifying the exact proportions of participants who held specific beliefs was not vital to achieving the aims of this case study. Similarly, setting a very narrow a confidence interval would result in the need for more responses, in turn increasing the cost of the project. However, it was also recognised that to maximise the utility of data collected during this case study, the confidence interval could not be too broad either. Therefore, based on practices adopted by the Institute for Rural futures, (Dr Ian Reeve, personal communication) target bounds of plus or minus 5% were set, thus $B = 0.05$.

Hypothesised proportional response of the population (p)

As described by Dillman (2000), p measures the expected variation within the population of interest. To account for maximum variation, and therefore to be most conservative, in this case study p was set at 0.5, i.e. where the half the sample population support, and the other half oppose any particular issue.

Sample size

Based on the above values, for the given formula, a sample size of 382 was determined for each of the Rural and Urban treatments. Assuming that it would generally be difficult to solicit responses from the public, I decided to work on a conservative response rate, i.e. approximately 40%, to achieve the desired sample size. Based on this assumption, 1000 participants were selected for each treatment.

Random sampling procedure

The electoral roll from the 2001 Federal election was used to sample for participants since it was the most recently updated data source. All Australian people over 18 years of age are required to register to vote, so the electoral roll represented the most comprehensive, available list of potential participants. Likewise, because the roll contains addresses it was an ideal source of participant data.

Registered voters are listed alphabetically, based on their surname. The first name on the electoral roll was considered to be number 1, and the last name was considered to be number 83,106. Using a random number generator, a list of 1000 numbers was produced for each of the Rural and Urban sample groups. The lists of randomly generated numbers were then used to select corresponding names and addresses which were transcribed into a participant database.

In cases where the address of a sampled participant did not meet the requirements for that treatment that person was omitted from the sample and the next person on the electoral roll, who did meet the treatment's criteria, was selected in their place.

Piloting the Wild Horse Management Questionnaire

With the kind permission of Professor Peter Jarman, I invited students from his wildlife management class to complete a copy of the draft Wild Horse Management Questionnaire as well as distribute copies among a wider range of individuals (all adults) before returning the completed questionnaires to me. In this way, a range of people from within the target population, and some from beyond it, were exposed to the survey. Likewise, the "expert" opinion of students as well as the response of the lay-public were obtained through direct feedback from the wildlife management class, and indirectly, from the comments on questionnaires returned from other participants.

This feedback was used to hone the questionnaire that was actually distributed to Urban and Rural participants within the Commonwealth Electoral Division of New England (Appendix A).

Distributing the Questionnaire

Addresses and Greetings

In each of the rounds described below the questionnaire package was individually labelled with the name and address of the intended participant, as taken from the electoral roll (AEC, 2000). Each letter, in each round bore an individual greeting, written by hand. It was hoped that this attention to detail and personal approach would improve response rates for the questionnaire, based on Dillman (2000).

Main Round

The questionnaire, a letter of introduction and a reply-paid, return-addressed envelope were mailed to 2000 randomly selected adults (1000 at Urban and 1000 Rural participants) within the New England Commonwealth Electoral Division.

Each reply-paid envelope carried a unique code which corresponded to an address on an address database, formed from the list of participants. As each reply was received the questionnaire was marked as Rural or Urban and the corresponding participant's name and their address, was permanently deleted from the database.

Reminder Round

One fortnight after the initial round of contact, a reminder letter, another copy of the questionnaire and second reply-paid envelope were sent to those participants who had not yet replied. As before, subsequent returns were used to update the database.

Non-response survey

Finally, one month after the initial mail-out, those participants who had not returned a copy of the questionnaire were sent a second reminder letter, a non-response questionnaire and a third reply-paid envelope. The non-response survey was comprised of 9 questions from the original Wild Horse Management questionnaire. All remaining information about participants was deleted.

2.2.2 Wild horses, their management and opinions of both

In conjunction with the first aim of this case study, a review of previous management of wild horses, in Australia and elsewhere, was undertaken. Because the management of wild horses occurs within a wider context of previous actions and within a framework of social acceptability, the review of past management for this case study necessarily included the opinions held by the scientific and lay communities regarding these animals as well as the history of horses and their management in Australia.

An International Context for Wild Horse Management

Wild horses exist in many countries but it was not possible within this research project, to undertake a comprehensive review of global wild horse management. However, it is important to note that issues surrounding wild horses are easily internationalised and that various countries have differed in their responses to dealing with wild horses, and public views of them.

Occasionally, foreign individuals have expressed opposition to Australia's wild horse management efforts. For example, the Northern Territory Government was petitioned by a group of German nationals to abandon aerial culling of wild horses (Urban, 1985). Similarly, international media outlets covered the October 2000, GFRNP cull, suggesting Australian wild horse management was both interesting and relevant to the international community.

Given the widespread distribution of horses and the nearly universal contact between people and the animals in recent human history such common interest is unsurprising. However, despite this level of commonality examples of management efforts from other countries may vary from the Australian experience.

Public outcry in the United States resulted in general protection for wild horses (USA Bureau of Land Management, No date, online) and the establishment of an official adoption program. In New Zealand, management of the Kaimanawa population of wild horses has been particularly problematic, forcing the Department of Conservation to include community members in an

advisory group and to retain a sustainable population of the horses on Military land (NZ Department of Conservation, 2004).

Such overseas experiences serve as a reminder that conflicting issues surrounding horse management are not unique to Australia and that public opinion has played a significant role in efforts to deal with these animals elsewhere, albeit with varied outcomes.

A brief history of horses in Australia

Horses, *Equus caballus*, are not native to Australia. Rather, they were introduced to the Australian continent by European settlers from 1788 onwards (MacDougall, 2001). Initially horses were present only as domestic stock but in 1804 the first individual escaped, or was released, into the wild (Sharp & Saunders, 2004). Other surviving escapees and abandoned individuals became feral (Berger, 1986) and established breeding populations across the country.

Populations of wild horses became so widely spread in Australia that McKnight (1976) described an almost ubiquitous distribution, reporting that only the most extreme environments did not sustain them. In 1993, Dobbie *et al.* reported that Australia had the largest population of feral horses in the world; numbering between 300 000 and 600 000 individuals.

Horses in Australian Society

Since their introduction, Australians have used horses for work as well as recreation. Although their role in modern society is now reduced (Heritage Working Party, 2002), they maintain a relatively high profile, for example as the focus of the lucrative horse racing industry.

As in many western nations, great value was historically placed on horses in Australian culture. They were integral to the exploration of this country and the establishment of the European colony. Previous authors have cited the fact that horse thieves were once punished by hanging as evidence of their one-time significance to this country (Heritage Working Party, 2002).

As in the United States, where Congress decreed that wild horses were symbolic of America's pioneering phase (Symanski, 1985) so too the use of horses in the European settlement of Australia has endeared them to some members of the public. To this end, the important status of horses in this country has previously been noted by Black (2000) and is further supported by their place on Australian currency (see the \$10 note) and via inclusion in culturally significant events such as the opening ceremony of the 2000 Sydney, Summer Olympic Games (Heritage Working Party, 2002).

Today, a significant proportion of the population still maintain a history of contact with these animals. Indeed, many living Australians personally experienced the use of horses to perform important services such as delivering food and other goods, even in metropolitan areas (Heritage Working Party, 2002). However, horses are no longer a common means of transporting people or other items. Even in rural areas, many enterprises have replaced the use of horses in activities such as mustering stock, with motorised alternatives, like motorbikes and other vehicles. Despite this general decrease in use, domestic horses are still widely kept today and maintain key roles, through ongoing participation in recreational riding and in the horse-racing industry.

As a result of this diminished role, those individuals who own horses, or others who work with the animals and use them for recreation might now be expected to have significantly more

frequent contact with them than the average person, perhaps contributing significantly to heterogeneity among the public's opinions of, and affiliation to, horses.

Perceptions of Wild Horses

Along with Dobbie *et al.* (1993), which is generally considered to be the authoritative publication on the management of wild horses in Australia, other authors have also produced scientific and/or management-related works regarding these animals. Of key significance to this research is that many of these works refer to the opinions of specific interest groups or the public, demonstrating that sentiment has been widely recognized as an important issue in wild horse management, even if this was not effectively taken into consideration in the case of the GFRNP cull.

The idea that horses are a special animal, from a human perspective, is a recurring theme in the available literature and, despite a claim to the contrary by McKnight (1976), a protectionist sentiment regarding wild horses has long existed in Australia. For example, Thompson (1986) reports that Miles Dunphy, famous for his conservation efforts, publicly opposed the removal of wild horses from the Monaro area of NSW in 1934, on the basis that they were more important than the sheep and cattle which he felt would spell the wild horses' demise.

A number of other authors, such as Rolls (1969) have also dealt with the preference that some people hold for horses, over other species. To demonstrate the point, Berger (1986) used Orwell's famous quote, "*All animals are created equal, but some are more equal than others*" (Orwell, 1946) to describe wild horses.

Berman (1991) also wrote that some people like horses better than the native plants and animals (in Australia) and further highlighted their significance to some members of society by stating that "*those of us who have been closely associated with horses may consider people who eat horses, as cannibals*".

It is important, however, to note that these 'positive' sentiments toward wild horses have not necessarily been representative of the feelings of all people. Rolls (1969) reported that some

Australian's viewed wild horses as pests as early as the 1860's, less than one hundred years after their arrival in the country.

Similarly, McKnight (1976), having conducted a questionnaire regarding feral animals in Australia reported that the respondents were virtually unanimous in their condemnation of wild horses. He described his sample population as "*graziers, policemen, missionaries, shire-clerks, vermin-control officers and many others – who have familiarity with some portion of the Outback*". Further, he stated that this feeling of dislike towards the animals was "*an accurate reflection of the general feeling of the Australian pastoralist towards any animals other than domesticated livestock*" somewhat undermining the notion of a unanimous, special significance of wild horses.

Whether reflecting a shift in attitudes or an increase in general media hype, the excitement that followed the GFRNP cull contrasted with the 1976 observation of McKnight who wrote, "*the general public is not heard from one way or another*" regarding the management of wild horses in Australia.

From the United States, in the nineteen eighties, Symanski (1985) reported both pro and anti-horse sentiments while Berger (1986) contrasted the positive view of horses that stemmed from their place in American folklore with anti-horse sentiment that was based upon their pest status. Soon after, Wurst (1987) also indicated that diverse views of wild horses existed in Australia, listing three main perceptions from among the public. She suggested that whilst some people believed in preserving wild horses for their own sake, horses might primarily be seen as a harvestable resource by other individuals, whilst some saw them as pests based on an understanding of the damage they caused.

Dobbie *et al.* (1993) furthered the view that the public's attitudes were heterogeneous by suggesting that most, but not all, groups accepted that wild horses need to be managed. In the case of pastoralists, the authors argued that feral horses were generally regarded as pests due to their competition with stock and their negative impact on pasture. However, they also suggested

that in Australia the symbolic value of horses, as mentioned above, also caused people to desire their protection.

Related to symbolism, Australian culture has afforded special significance to some horses. Romantic association with early Australian literature, such as A. B. “Banjo” Patterson’s “The Man from Snowy River” firmly rooted the Snowy Mountain wild horses into the psyche of many Australians. Likewise, the role of Australian horses, known colloquially as “Walers”, during World War One no doubt strengthened the affiliation between horses and many people in this country.

Reasons to manage wild horses

Legislated Responsibility

In Australia, State and Territory Governments hold the majority of responsibilities regarding vertebrate pest management (Braysher, 1993). In NSW, legislative requirements compel agencies such as the Parks and Wildlife Division of the NSW Department of Environment and Conservation (formerly NPWS) to control wild horses on land that the agency is responsible for. Two recent management plans for wild horses in NSW specifically cite the National Parks and Wildlife Act (1974) as the legislation that requires NPWS to manage feral species, including horses, on land under its control (NSW National Parks and Wildlife Service, 2002; 2003).

It is important to recognise that legislated responsibility to manage wild horses is frequently based in attempts to minimise the environmental, economic or welfare-based concerns outlined below.

Environmental Impacts

Although the impact of wild horses on the Australian landscape is poorly quantified (Dobbie *et al.*, 1993) their effect on the environment has been cited as a principle reason for their management (Senate Select Committee on Animal Welfare, 1991). On a three-point scale of *serious*, *moderate* or *minor*, Hart (2002) recently described wild horses as a moderate pest species.

The environmental impacts of wild horses have been discussed by several authors and are a primary reason for the management of wild horses in Australia. As with most aspects of wild horse management there has been considerable disagreement over the extent of impacts reportedly caused by these animals in this country. Impacts such as urine and dung scalds, pads (i.e. horse trails, often devoid of cover, that are formed through repeated use by horses), damage to plants by trampling, depletion or fouling of water sources, collapse of wildlife burrows as well as visual and auditory changes to the Australian environment have been attributed to these animals (Dobbie *et al.*, 1993).

In terms of general environmental impacts, virtually any action that wild horses undertake could be interpreted as affecting Australian systems because horses are not native to this country. Quantifying specific impacts, however, has proved difficult as horses and other large, introduced herbivores, e.g. cattle, often overlap in distribution, a fact that has confounded the understanding of wild horse's effects (Berman, 1991). A current study by Lenehan (in prep) is attempting to address this issue by utilising exclosures to examine wild horse impacts in the Guy Fawkes River National Park.

Other authors have also dealt with the impact of wild horses, on the Australian environment. Berman & Jarman (1988) reported that wild horses contributed to the fouling of waterholes and removed vegetation from large areas in Central Australia, whilst Dyring (1990) reported changes in vegetation structure, compaction of soil, formation of horse tracks and disturbance of stream banks in sub-alpine and montane environments of South Eastern Australia.

Berman (1991) reported ten direct impacts on the environment, by wild horses, and a further four he described as indirect (Table 2.1).

As suggested by Berman (above), Andreoni (1998) reported visual changes to the GFRNP both through the sighting of horses and/or through sign of their presence, such as stallions' dung piles. These observations were confirmed by Jarman *et al.* (2003) who also demonstrated that soil compaction was correlated with horse density.

Table 2.1 - Environmental impacts of wild horses as reported by Berman (1991)

Direct Impacts	Indirect Impacts
Horse tracks	Acceleration of soil erosion through hoof impact
Horse pads	Change in pasture composition via selective grazing
Dung piles	Change in native animal distribution via effects on food and or shelter
Damage to plants by trampling	Changes in fire regime due to increased shrub growth where grass is removed by horses
Ground laid bare by grazing	
Damage to shrubs by browsing	
Depletion of water-holes	
Dirtying of water holes	
Visual changes through the presence of horses	
Auditory changes through the presence of horses	

Schott (2002) also described the impacts of horses in part of Guy Fawkes River National Park where they are known to chew the bark and roots of trees and Walter (2003) reported “*an obvious impact on the vegetation and streams*” of areas in parts of the Australian Alps by wild horses.

Perhaps most significantly, Australian Governments and their management agencies have decided that the impact of horses is a significant issue. For example, as mentioned above, the Senate Select Committee on Animal Welfare (1991) concluded that “*In particular horses... have a significant adverse impact on the environment of (the) Northern Territory.*” Likewise, recent Horse Management Plans for Kosciusko National Park (NPWS 2002) and the Guy Fawkes River National Park (NPWS 2003), as well as the Model Code of Practice for the Humane Control of Feral Horses (Sharp & Saunders, 2004), have all described or asserted environmental impacts of wild horses.

Economic Impacts

In economic terms, wild horses are thought to affect private enterprise through a range of negative impacts. McKnight (1976), for example, reported that wild horses compete with stock for feed, foul and/or drink stock's water, interfere with mustering, damage fences and either lure away domestic horses or diminish the quality of their offspring by inter-breeding with them. Any or all of these reasons might be sufficient for landholders to seek a reduction in wild horse numbers.

However, despite these potential problems, feral horses can have economic value through the opportunity for removal for domestication or for other uses such as pet meat and abattoir processing for human consumption (Senate Select Committee on Animal Welfare, 1991; Dobbie *et al.*, 1993; Hart, 2002).

Animal welfare issues

Welfare concerns, too, have been a cause for population control. In particular, the suffering of feral horses during drought has been the focus of welfare-driven management of their populations (SSCAW, 1991; Dobbie *et al.*, 1993). In fact, in the case of the GFRNP cull, the primary reason cited for the culling operation was also one of animal welfare consideration, due to the lack of feed for wild horses in the Park, following recent dry weather and bushfires (NPWS, 2003).

Room for disagreement

These issues of environmental and economic impact, or even animal welfare issues are, of course, still potentially subjective, in terms of whether they are actually occurring in a specific situation and, even if they do, whether they warrant action in the eyes of interested parties.

Legislation or other guidelines for management largely override such disputes by specifying, for example, locations in which particular effects will not be tolerated but this does not remove the potential for disagreement.

Wild Horse Management Methods

Just as it may be difficult to decide whether wild horses should be managed, it can be equally hard to decide how to manage in an acceptable manner. Clearly, even before the GFRNP cull, differences of opinion existed regarding the status of wild horses and people varied in their acceptance of specific management methods.

The Animal Health Committee of the Standing Committee on Agriculture (SCA, 2002) stated that feral animals are of concern because they reduce the profitability of agriculture, compete with native fauna, damage native flora, degrade environmental quality, damage fences, crops and watering facilities, potentially represent a reservoir for disease and can disrupt breeding programs. The SCA defined a feral animal as a member of a domesticated species which has returned to the wild. Combining this definition with the environmental impacts that have been attributed to wild horses, makes wild horses feral and, consequently, of concern.

However, even the official pest status of an animal does not give managers the right to use any method of control they wish. Some management methods are officially and/or socially unacceptable, including many practices once used to control wild horses in Australia, demonstrating that societal preference and acceptance can definitely change over time.

People have undertaken 'management' of wild horses in Australia for much of the time they have existed here. Rolls (1969) wrote that between the 1860's and 1890's wild horses had become "*a very weed among animals*" inspiring a variety of methods to be used in their control. Many of the options that Rolls reported would now be unacceptable (Sharp & Saunders, 2004), if not illegal. Examples include poisoning water sources, depriving horses of water to kill them and deliberately wounding then releasing them so that workers did not have to deal with the dead animals.

In modern times a range of management methods have been employed to control wild horses with various levels of support from among the public. To this end, the SSCAW (1991) made two important points clear. Firstly, that "*sections of the Australian community are concerned about*

control methods used in this country” and, secondly, that of all issues dealt with during their review, *“the methods employed to control large feral animals attracted the most concern”*.

Shooting-based management

Shooting, as a control method for feral animals, including wild horses, has long been seen as effective, and in some cases, the only method for humanely destroying animals (SCA, 2002). However, authors have also acknowledged the potential for shooting, when conducted inappropriately, to be inhumane, and therefore, a significant welfare concern (SSCAW, 1991; SCA, 2002; Sharp & Saunders, 2004).

McKnight (1976) described instances of large-scale shooting of wild horses from locations in Queensland. He wrote that in 1940, 8000 individuals were shot on one property in Burketown, and in the 1950's 2500 were shot in one year in Boulia. Bowman (1987) surveyed 38 Northern Territory stations about their preferences for wild horse management techniques and found that 40% of stations used shooting to control horses. Even in the GFRNP area, shooting, in addition to mustering and removal, was employed by local landholders to control the wild horse population that existed on unoccupied and lease-hold land that later became the National Park (Heritage Working Party, 2002).

The control of wild horses, using shooting, can be performed in two ways that are often seen as being significantly different methods. These are ground shooting and aerial (helicopter) shooting. To this end, it is interesting to note that English (2001a) observed little opposition in response to discussion of ground shooting of wild horses in the GFRNP area, *“even from those implacably opposed to helicopter shooting”*.

Ground Shooting

As historically used by local residents in the GFRNP area (Heritage Working Party, 2002) ground shooting has been applied to manage wild horse populations. Although it has generally received less criticism than aerial methods, ground shooting is still potentially problematic from an animal-welfare perspective as the opportunity exists for inaccurate shots, the escape of wounded

animals and the orphaning of dependent young. Sharp & Saunders (2004) describe ground shooting both as “not effective” and “not cost-effective” because it is labour intensive nature and suitable for control only on a small-scale.

Aerial / Helicopter Shooting

The major benefit of aerial shooting is the ability for managers to reach a large number of target animals almost irrespective of terrain. Further, the helicopters allow shooters to closely approach target animals and, ideally, provide the opportunity to follow-up wounded individuals. These aspects in particular are among the arguments for the use of this method resulting in agencies such as the Department of Primary Industries and Energy describing it as “*the preferred and humane method*” for controlling animals such as wild horses in remote or inaccessible areas (SSCAW, 1991).

However, concern has often been raised regarding the use of helicopters or aerial shooting to control feral animals, even prior to the GFRNP cull. The SSCAW (1991) report described aerial shooting as “*difficult and emotive*” and “*the most contentious issue*” dealt with during an inquiry regarding the culling of large feral animals in the Northern Territory.

Most arguments against aerial culling have focussed on a perceived lack of humaneness associated with the method. For example, during the mid 1980’s the Conservation Commission of the Northern Territory (CCNT) was petitioned by a group of foreign individuals to stop aerially culling wild horses (Urban, 1985) and in the same year, Australians for Animals also indicated to the CCNT that they believed helicopter shooting was inhumane and unacceptable (Arnold, 1985).

Despite this opposition, circumstances creating concern over the welfare of animals have also been used as justification for the use of aerial culling, e.g. Berman in evidence to the SSCAW (1991) suggested that aerial culling was a less agonizing way for horses to die than via disease or thirst during drought. Likewise, although the RSPCA indicated that shooting conducted from a moving platform, such as a helicopter, should never be used to control feral animals it did

concede that it would not oppose such methods, if all suitable safeguards were employed, under circumstances where there was no other option (SSCAW 1991).

Regardless of the imposed ban on aerial culling in NSW, it is still seen as a viable management alternative in other parts of Australia. Sharp & Saunders (2004) for example, described aerial shooting as the most effective way of achieving, quick, large-scale culling, and also indicated that it was conditionally acceptable* with regard to humaneness.

Capture and removal

Capture and removal for the domestication of animals has been undertaken for much of the time wild horses have occurred in Australia, for example in the Australian Alps (Walter, 2002) and in the GFRNP area (Heritage Working Party, 2002).

Welfare concerns also affect the suitability of this method. Experiences in the GFRNP have shown that wild horses can be seriously injured or even killed during attempts to capture and remove them (English, 2001a).

A range of options exist for capturing wild horses. People experienced in “brumby running”, for example, capture wild horses by riding alongside and roping individual animals. Other capture methods involve mustering and/or trapping. Issues of concern regarding trapping, such as capture myopathy, heat stress, injury resulting from either confinement or capture or fighting between unfamiliar individuals, feeding disruption and even abortion by pregnant females, have been cited by authors (SCA, 2002; Sharp & Saunders, 2004).

Even beyond the potential for animals to be significantly stressed during capture, opposition exists to long-distance transport of wild horses between the area of capture and processing facilities. Such concerns caused the Australian Equine Veterinary Association to want the use of wild horses in the export horse-meat trade stopped, instead focussing on the benefits of using

* Sharp & Saunders (2004) defined conditionally acceptable methods as those that “*may not be consistently humane*”, also stating that such methods may induce “*a period of poor welfare before death*”.

animals from the domestic population (SSCAW 1991). Likewise, the SSCAW (1991) recorded the opposition of other groups, such as the Australian and New Zealand Federation of Animal Societies, to capture and transport of wild horses for slaughter.

Still further problems exist regarding what to do with wild horses once they have been captured. Options are limited to either utilisation or destruction under one of the four following categories:

1. Euthanasia, e.g. with an injection of barbiturate (Sharp & Saunders, 2004)
2. Removal for domestication
3. Removal for consumption by humans
4. Removal for consumption by pets

These options, naturally, can also provoke opposition. People vehemently opposed to killing wild horses might be unlikely to support euthanasia, or slaughter for food/pet food, as reported by Berman (1991). Likewise, people committed to a notion of wild horses being wild might oppose, firstly, their capture and, secondly, their domestication as both impinge on the animals' freedom.

Fertility Control

Either by targeting fertility or fecundity, successful methods have been widely sought as a solution to wild horse management problems. However, significant issues exist in terms of developing an effective method. The Northern Territory Government suggested that any fertility-control option must be species-specific, harmless to humans, long-acting, automatically administered and inexpensive to be successful (SSCAW 1991).

Attempts to develop effective fertility control have previously been undertaken (Symanski 1985; Biziorek 1998; Turner *et al.* 2001) but no available method is currently deemed to be effective (Sharp & Saunders, 2004).

A successful fertility control method could eliminate many of the issues associated with wild horse management, i.e. other than for people who believe wild horses should remain unmanaged

or others who might have ethical problems with deliberately limiting animals' potential to reproduce.

Exclusion

Difficulty erecting and maintaining large areas of effective exclusion fencing in remote or rugged areas, together with the associated expense, limits the applicability of this method on any large scale. However, exclusion fencing does offer potential on a smaller scale for protecting sensitive areas (Sharp & Saunders, 2004).

Other potential problems of exclusion fencing include impacts on non-target species via affecting access to water, altering the foraging patterns or dispersions of species and issues associated with entanglement and electrocution (Sharp & Saunders, 2004).

Poisoning

The SCA (2002) indicated that only pigs, among the range of feral livestock animals, are controlled by poisoning, in Australia. Probably due to the general notion of poisoning of animals being unacceptable due to welfare concerns, together with the issues of chemical specificity that relate to concerns about affecting non-target animals, there has been little, if any, discussion of poisoning as a control method for wild horses.

Opinions for managing wild horses in Australia

As mentioned earlier, dissent among the public regarding what constituted appropriate management of horses can be traced back to at least the 1930's, when Miles Dunphy recorded his disagreement with the proposed treatment of wild horses (Thompson, 1986). To address this heterogeneity, and the potential for varying opinions to affect management, previous authors attempted to understand people's views of wild horses and options for their management (McKnight, 1976; Wurst, 1987)

According to Wurst (1987), the incidence of public views being expressed on wild horse management in Australia increased from the mid-1980's onwards. During that period, overseas organisations, such as the National Equine Welfare Committee of Great Britain began to express concerns over management techniques utilised here (Veltman, 1986) apparently as the result of Australians for Animals' campaign to internationalise the issue of Australian wild horse management (Wurst, 1987). Symanski (1994) reported that concerns regarding Australian wild horse management also arose from animal-interest groups including Animal Liberation, London's Royal Equerry and the "International Court of Justice for Animal Rights".

In 1993, Dobbie *et al.* commented on domestic and international attitudes towards wild horse management, stating that the animals had "*developed a major public profile*". They indicated that concerns expressed by members of the public about wild horse management involved issues such as mustering, transport and abattoir slaughter and, like Wurst (1987), also noted public anxiety over helicopter based shooting from Australians and people overseas. The practice of shooting horses from a moving platform, such as a helicopter, was reportedly described by animal welfare groups as "inhumane and brutal" (Wurst, 1987).

Evidence heard during an investigation into the culling of large animals in the Northern Territory, the Senate Select Committee on Animal Welfare (1991) is particularly relevant to the problems of managing wild horses. During the SSCAW's investigation, the South Australian Federation of Animal Societies offered the following:

“Many of us believe that the impact of these animals on the environment is grossly exaggerated by those for whom the protection of the environment is a means to both earning a living and furthering their political agenda aiming at controlling everyone and everything. As for expert opinion on the environment, diametrically opposite views may usually be obtained by suitably picking the experts”.

Such a response is no doubt frustrating to managers and others, who hold a dissimilar view.

In relation to the overall view of wild horses in Australia, Dobbie *et al.* (1993) made several key points. Firstly, they supported the concept of a heterogeneous public by suggesting that most, but not all, groups accepted that wild horses need to be managed. In the case of pastoralists, the authors argued, as did McKnight (1976), that wild horses were generally regarded as pests due to their competition with stock and their negative impact on pasture. However, they also suggested that in Australia, similar to the situation in United States of America described by Berger (1986), *“some Australians believe that wild horses should be retained in wild populations because they represent a symbol of Australia’s pioneering heritage”.*

Dobbie *et al.*, (1993) also raised the issue of differences between experienced and inexperienced people with regard to wild horses and preferences for the animals’ management as well as the significant role that the media can have in influencing public opinion. They suggested that the decision to protect wild horses in the United States, in 1971, was a direct result of media promoting public concern for the animals. This proved to be remarkably similar to the circumstances under which aerial culling was banned by the NSW Minister for the Environment in 2000, following the cull in Guy Fawkes River National Park.

The need for extension

From a current ecological stand-point, wild horses are feral animals and therefore, are commonly deemed not to belong in the Australian environment. However, it is clear that not all people accept this and consequently, some oppose management on these grounds.

Wurst (1987) wrote “*those people who oppose any type of control over wild horses lack a first-hand knowledge of the situation as it currently exists in the Northern Territory*” and, to this end, Berman (1991) also suggested that those people who had not seen areas inhabited by wild horses could not “*fully appreciate the problem*”. Furthering this issue, Dobbie *et al.* (1993) said that groups interested in wild horse management “*may propose or encourage inappropriate management methods*”.

In response to the paucity of knowledge they believed existed among the public about the damage (environmental and economic) caused by wild horses, Berman (1991) and Dobbie *et al.* (1993) recommended extension as a means to communicate effectively with involved groups about wild horse management.

Braysher (1993) also recommended with regard to managing vertebrate pest species, that “*involving all major interest groups in developing pest management strategies is likely to... increase the probability of appropriate management*”.

Interestingly, following the GFRNP cull, having recognised the diverse beliefs about wild horse management present within the public, English (2000) recommended that the community be educated “*concerning the threatening processes confronting our native fauna*”. Unfortunately, unlike extension or even Braysher’s recommendation for “involvement”, the notion of education infers a top-down or authoritative approach where the opinions or experiences of the public are not necessarily considered.

Responses to the GFRNP Cull in the context of the Review

An examination of the literature available on wild horse management, both here and overseas, reveals that the GFRNP cull did not really evoke any new responses from the public, nor new issues about wild horse management. Instead, it seemed mostly to be a case of re-opening “old wounds”, albeit on a significantly greater scale than had previously been seen in this country.

Herein lies perhaps the greatest tragedy of the GFRNP scenario: that the general information, and specific cautions needed to avert the observed public backlash were already available to managers. However, in the light of the GFRNP cull perhaps others might be persuaded to incorporate a better understanding of public views about wildlife into planning and implementation – providing that effective, non-specialist methods can be demonstrated by research such as this Case Study.

2.2.3 A review of the GFRNP Scenario

The Guy Fawkes River National Park

Description

Located approximately 100km east of the city of Armidale, in New South Wales, Australia, the GFRNP comprises approximately 105 000 Hectares of land (NPWS, 2003). Much of the Park is remote wilderness and extensive areas of gorges associated with local rivers, such as the Guy Fawkes.

The GFRNP is comprised of former leasehold land and unoccupied areas that provided common resources, including a source population of horses, for local graziers. Practices that took advantage of this shared resource, such as pushing cattle from the surrounding plateaus into the gorge country to take advantage of food and water, were long established prior to the GFRNP being gazetted and continued until recently via illegal incursions of stock into the National Park (Personal observation).

A change in land title has unsurprisingly impacted little upon many locals' views of the land that constitutes the GFRNP and their preferences for its management have often conflicted with the ideas and actions of agency managers.

Feral horses in the area

Compared to the large numbers of wild horses in central Australia, the relatively small population in GFRNP attracted scant interest, other than that of local people and managers, prior to the October 2000, aerial culling operation. Dobbie *et al.* (1993) for example, only referred to wild horses “*in the hill country east of Armidale, although numbers appear to be low.*”

According to the Heritage Working Party, (2002) horses were introduced to the northern tablelands region, where the GFRNP is located, in the 19th century. This is supported by the NPWS (2003) suggestion that the animals have been known in the area since the 1830’s.

Historical Management of Wild Horses

For most of the time since their introduction, the horse population was managed by local, private landholders through the addition of horses to maintain or improve genetic diversity, through capturing and removing animals suitable for domestication and by shooting others (NPWS, 2003; Heritage Working Party, 2002).

Although locals have reportedly continued to remove animals from the area, management of wild horses in GFRNP was virtually non-existent between the time the GFRNP was gazetted, in 1972, until 1992, when the NPWS trialled capturing and removing animals (NPWS, 2003). It is important to note that since the original establishment of the Park, substantial areas have been added, in some cases significantly increasing the number of horses within managers’ jurisdiction and consequently affecting the potential for effective management as functions of increased population size, area of occupation and varied physical characteristics of the landscape.

NPWS (2003) reported that in October 2000, following the observation that dry conditions and recent bushfires had led to reduced food resources, managers chose to cull wild horses, using helicopter-based shooting, inside the GFRNP.

Ramifications of the October 2000 cull

On a local scale the cull managed to reduce the population, previously estimated at approximately 250, by approximately 600 individuals but it also led to both a nation-wide and international media portrayal that mobilised public debate on wild horse control. In turn, significant State-wide changes were invoked, i.e. a ban on aerial culling of wild horses, in NSW.

Also, the Minister was prompted to commission a review of the culling operation (English, 2000) and to address the issue of wild horse management in all NSW National Parks (English, 2001a; 2001b). A Heritage Working Party was also established for the GFRNP to determine the Heritage value of the wild horses that occurred there; recognising the interests of one special-interest group within the community.

As noted above, some significant events occurred within the GFRNP scenario following the October 2000 aerial cull. These were the official review of the aerial culling operation (English, 2000), the development of a management plan for the remaining horses in GFRNP (NPWS, 2003), the establishment of a Heritage Working Party (Heritage Working Party, 2002) and the impact of a report on the management of feral horses in NSW National Parks (English, 2001b).

The Public Response to the GFRNP Cull

The introduction to this case study raised many of the issues relating to the public response to the GFRNP cull but in this section they have been dealt with in more detail.

Two letters, published in a locally distributed Armidale Newspaper on the 9th of November, 2000, reflected the diversity of views held by members of the public about the GFRNP cull. Headed “*Disgust over brumby cull*” (McFarlane, 2000) and “*Cull critics know nothing*” (McCann, 2000) the two letters outlined each author’s feelings about the recent management action.

MacFarlane outlined her concerns over the disparity between the way in which Australia’s horses had been celebrated at the Sydney Olympic Games and then culled in GFRNP only weeks later.

Further, she indicated that the type of control was an important issue, not the fact that management had occurred, citing a preference for removal and subsequent domestication or slaughter rather than aerial culling, which she perceived as causing prolonged agony for wounded horses.

Conversely, in the second letter, McCann (2000) indicated his support for the cull based on his *in situ* observation of large numbers of horses within GFRNP “*looking sick and very hungry*”. He indicated that he had weighed the balance of animals starving versus them being culled and was in favour of shooting the animals, specifying his belief that aerial culling was a humane method. Further, he stated that horses were causing damage in the Park and on surrounding land sufficient to warrant their control, citing examples of damage to fences and competition with native species as impacts.

On the World Wide Web, a range of views regarding wild horses, and specifically the GFRNP cull, could be found. For example, a forum held on the Australian Broadcasting Corporation’s website (ABC online 2000), showed that contributors held varying opinions about wild horses and the methods used to manage them.

In addition to the conflict observed between the views of individuals, special interest groups also “weighed-in” to the public debate inspired by the GFRNP cull. For example, the Royal Society for Prevention of Cruelty to Animals (RSPCA) decided to prosecute NPWS based on practices undertaken during the GFRNP cull and the Australian Veterinary Association expressed a belief that the operation had occurred without concern for the welfare of the horses and was not suitable in the “*very rugged forest terrain*” of the GFRNP (Australian Veterinary Association, 2000, online). Via the Project Equus website (2000, online), individuals were instructed to voice their opposition to the cull and other web pages also supported the notion that the management “wasn’t a humane cull” (Feitz, 2000, online) particularly because horses were shot from a moving platform (Animals Australia, 2000 online).

Conversely, Keith Muir, the Director of the Colong Foundation for Wilderness offered strong support for the cull, argued against the ban on aerial shooting of horses in NSW, suggesting that

wild horses shouldn't be treated differently to other feral species such as pigs and goats. (Colong Foundation for Wilderness, 2002 online).

Political response

As the cull had been undertaken by the NSW National Parks and Wildlife Service, the Minister for the Environment was involved in the issue and it was he who banned the aerial culling of wild horses in NSW and commissioned the review of the GFRNP cull by English (2000).

Other politicians, however, were also keen to involve themselves in discussion of the GFRNP cull, perhaps unsurprisingly, given the issue aroused extensive media attention and public interest. It is interesting to note that political discussion of the GFRNP was prompted almost exclusively by the State Opposition, i.e. members of Parliament associated with the Liberal and National Parties, rather than the Labor Party Government of the time.

The Member for Coffs Harbour, Mr Andrew Fraser (National Party), described the GFRNP culling operation as an “*inhumane and barbaric slaughter*” (NSW Hansard 2000a). Mr O'Doherty (Liberal Party), Member for Hornsby, stated that “*community members are horrified and appalled by this culling*” (NSW Hansard 2000b) whilst Stuart StClair (National Party), the Federal Member for the New England, reported that “*people from all over the New England and North West are flooding my phones, letting me know that they are appalled and offended by this cruel slaughter or our Aussie icons*” (Anon, 2000).

Management of the GFRNP scenario – post cull

One week after the October 2000 cull, Associate Professor Anthony English, from the School of Veterinary Science at the University of Sydney, was commissioned by the NSW Minister for the Environment to review the management operation in Guy Fawkes River National Park (English, 2000).

In his report, English recommended that aerial culling be retained as a method for feral horse management, and additionally found that the aerial culling operation had been carried out humanely. Regardless, the Minister banned aerial culling of horses in NSW.

Development of a management plan for the feral horses remaining in GFRNP

The expertise of Associate Professor English was again utilised, this time to prepare a management plan for the horses in GFRNP (English, 2001a). Importantly, English recognised that community values affect management and therefore included some rudimentary community consultation in preparation of the management plan.

The efforts to engage the public comprised a facilitated workshop with 25 invitees, including local landholders, local stockmen who had been previously involved in managing feral horses in GFRNP, Rural Lands Protection Board and private-practice veterinarians (including a representative of the Australian Association of Equine Veterinarians), tourist operators associated with the GFRNP, the local Member of Parliament (State) Mr Andrew Fraser, scientists from the University of New England and the NSW Department of Agriculture, members of the National Parks Advisory Committee and staff of the NPWS (English, 2001a) Held at Dorrigo on 10/02/2001, this workshop also dealt with written submissions from interested parties.

Whilst English had made some effort to engage the public via the February 2001 meeting the reticence to discuss issues deemed to be important by stakeholders was disappointing since conflict with stakeholders was the crux of the problem within the GFRNP scenario and a thorough discussion of these issues, even after the cull, might have better guided future management efforts.

A review of the workshop (Jarman, 2001) revealed important issues about stakeholder participation as well as preferences for future wild horse management in GFRNP. As well as acknowledging that the meeting was important as it brought together a range of interested parties, Jarman also noted that local landholders could make valuable contribution to the planning of future horse management. However, significant limitations were also identified, for example, the

belief among local landholders that total removal of horses should not be a management objective (Jarman, 2001) despite the eradication of horses from GFRNP being a stated objective of the NPWS Dorriggo District Pest Management Plan (1998).

Jarman (2001) observed that local landholders believed that the feral horses in GFRNP have strong heritage value, were not causing any environmental damage and could be effectively managed by mustering and removal rather than other means, such as culling.

In his report, Associate Professor English, too, acknowledged the belief of some stakeholders in the heritage value of the horses within GFRNP and, further, indicated that most of these proponents still acknowledged a need to manage horse numbers (English, 2001a). Further, English made clear that other stakeholders felt that horses had significant impacts on the vegetation (both directly and by spreading weeds), on soil (through compaction and erosion) and on water, via fouling.

English (2001a) contrasted the iconic status of the horse, which he wrote exists due to “*a strong and genuine affection for brumbies in the Australian psyche*”, with “*the reality that the horse is an introduced animal in Australia, and when allowed to run wild in large numbers it should be considered to be just another pest animal.*” Further he suggested that, in light of these opposed views, that managers had to “*separate the myth from the reality in a way that can be accepted by the community*”.

Recommendations of the management plan, prepared by English (2001a) included the formation of a Heritage Working Party to report on the heritage status of the GFNRP horses and that the findings of the working party be considered by NPWS, in conjunction with other community and stakeholder feedback, in determining the future management of GFRNP horses.

Heritage Working Party Findings

From a political perspective, the scientific review had targeted claims of inhumane practice, and therefore potentially provided appeasement for the animal welfare concerns inherent in many

objections to the cull. However, some issues related to people with a specific interest in the horses had not been addressed so further retroactive action was necessary on behalf of the Government.

The establishment of the Heritage Working Party was effectively the Minister for the Environment's second overt attempt to placate specific stakeholders, although this time the target group was those people with a special interest in horses. As a result, this action could be interpreted as politically motivated rather than aimed at facilitating effective management of the GFRNP and the wild horses within it.

Based on the prescribed membership of the Heritage Working Party, its outcome was decidedly more predictable than that of the scientific review, but it was equally amiss from the perspective of engaging the public in a representative and productive fashion.

That the Working Party would comprise both 'experts' and community members was a positive step towards community consultation. However, because the terms of reference specified that those members of the public involved in the Working Party would be individuals with "*an acknowledged involvement with and an interest in the history of the feral horses in GFRNP*" (HWP 2002) the external perceptions of its objectivity were significantly diminished. Likewise, the Heritage Working Party's (2002) eventual finding that "*the horses in GFRNP have significant heritage value, sufficient to warrant their being managed on this basis*" was almost inevitable.

Despite co-opting a few members of the public into the decision-making process, the general top-down approach taken by the Minister and NPWS to this management issue had barely changed. Neither the workshop run by English nor the investigations of the Heritage Working Party effectively engaged the wider public about this management scenario. As a result, even though some stakeholders had been involved in the management process, it is fair to say that the top-down approach taken to the whole community's role in this scenario had not changed in a significantly positive way. Managers had neither provided an effective forum for expression of a wide range of community attitudes nor established a way to engage the community effectively.

A Report on the Management of Feral Horses in National Parks in NSW

Also prepared by Associate Professor English (2001b), this report made a series of conclusions on the future management of feral horses. Paramount among these were two realisations:

- That the public was inherently tied to successful management of feral horses, and
- That involving the public actively at the planning stage could improve management outcomes

Unfortunately, once again, a top-down approach for community involvement was inferred. English (2001b) described the need to educate the public about the scenario at hand in the case of feral horse management but overlooked the need for genuine extension, wherein managers would necessarily take into account the stakeholders' perspectives. Even though the need to incorporate an understanding of recreational and cultural values of protected areas was suggested, this approach failed to effectively address the problem that had led to the poor acceptance of the aerial cull in GFRNP in the first place. This view overlooks the fact that without understanding what the public already knows or believes about feral horse management, an education campaign might not be effective in achieving "a harmonious relationship" between managers and stakeholders.

Further, although the conclusions of English (2001b) refer to problems in the relationships between park managers and their neighbours, the recommendations to address lack of public involvement in decision making processes fail to explicitly recommend widespread public consultation, even though widespread public condemnation was a cited reason for the Minister reviewing and changing management practices.

Lastly, it is important to note that English (2001b) recommended "*relevant community groups*" be involved in contextualising feral horse management plans rather than recommending direct consultation with the public in general. In doing so, he assumed that these community groups would be sufficiently representative of the views of the public who are all stakeholders in the management of public land. It seems that, at the very least, such assumptions should be tested before being accepted and implemented.

2.2.4 Addressing Aims Two and Three of the Wild Horse Management Case Study

Having addressed the first major aim of this research by reviewing documented views of wild horses and examining issues surrounding past management practices, an understanding of the range of opinions that existed towards many management related issues had already been estimated. However, the frequency with which such views occurred among stakeholders and whether they were distributed homogeneously between various sectors of the community was not as clear.

Thus, to address the second aim of this case study, i.e. “*to develop an understanding of the public opinion of wild horses and their management*”, the public had to be engaged in such a way as to ensure that the variety of stakeholders had been sampled. If this could be done, both the frequency and distribution of various opinions and preferences for management might be established. Questionnaire-based research was chosen to reach this aim by allowing widespread, cost-effective contact with members of the public.

It is important to note that at least two previous surveys had questioned members of the public about wild horses but both dealt with specific subsets of the public rather than sampling widely across the available range of potential stakeholders. Both studies revealed a mostly negative response to wild horses (McKnight 1976; Wurst 1987).

In the case of McKnight, the target population was those people who had “*familiarity with some portion of the Outback*” (McKnight, 1976). Given that McKnight stated a dislike of wild horses accurately reflected the “*general feeling of the Australian pastoralist towards any animals other than domesticated livestock*” it is conceivable that this population was biased, compared to the general population.

Similarly, Wurst (1987) found that 63% of participants believed that feral horses had no place on their land and that 66% of respondents wanted feral horses eliminated from their property. As with McKnight, some bias in Wurst’s results might be expected, compared to a general public survey as all of her participants were from pastoral stations in the Alice Springs district of the

Northern Territory (Wurst 1987), where wild horses have long been considered a burden for property owners, with the exception of cases where they were able to catch and sell them

In addition to addressing Aim Two, it was also hoped that the use of questionnaire-based research would allow an evaluation of the public's view of the GFRNP scenario as well as addressing broader wild horse management issues. In this way both Aim Two and Aim Three could be simultaneously dealt with.

2.2.5 Designing the Wild Horse Management Questionnaire

The questionnaire distributed to participants comprised 36 questions, presented in an 8 page, A5-sized booklet (Appendix A). The general aim was to cover as broad a range of potentially valid issues as possible, since validity is vital to the success of survey-based research (Kline 2000). As a result, the material considered in the review of wild horse management was used to design the questionnaire for this research project. The following section outlines the design of particular questions and reasons for specific wordings.

Section One – Personal Details

The questions in this section were included to facilitate tests of the representativeness of those people who replied to the questionnaire and to facilitate potential analyses of associations between responses and the personal characteristics of respondents.

Question 1A: Gender

This question was included both to allow comparison between groups and to facilitate possible further analyses.

Question 1B : Age:

As above, this question was included both to allow comparison between groups and to facilitate possible further analyses.

Questions 1C.1 and 1C.2: Background Region and Type

As noted earlier, Berman (1991) suggested there was a significant experiential divide between rural and metropolitan people. As a result, the opportunity existed to determine whether any such difference existed regarding wild horse issues.

As discussed in the methods section, participants had been separated *ad hoc* into Rural and Urban treatments due to assumptions about different experiences and opinions that would exist between the two groups. To allow for a test of the validity of this separation a question was asked regarding each individual's background.

Further, because discussion with pilot participants revealed differing perceptions of background, two questions were included. Firstly, information on background region, a broad-scale measure of experience, in terms of whether people were from a rural area, coastal area or metropolitan area, was incorporated as Question 1C.1. Next, in Question 1C.2, participants were asked to indicate their "type" of background from a finer scale, i.e. were they from a town, a city or from a rural property.

Question 1D: Allegiance:

Also related to a participant's background was the possibility that although individuals came from specific areas, they might actually identify more strongly with another demographic or cultural group. For example, someone originally from a "rural" area might actually feel strong affiliation with a "coastal" culture. If this was the case, then such a person's response to questions on background might mask the relationship they had with people from another group and confound correlations with specific attitudes. To account for this possibility, each participant was asked to indicate whether they felt that they were a rural person, a coastal person, a city person or none of these.

Question 1E: Education:

This was included both to allow comparison between groups and to facilitate possible further analyses.

Questions 1F.1 and 1F.2: Shooting experience

Since the management options available for feral horses, including the aerial cull that would be a focus of later questions, involved shooting animals, identifying those participants who had experience shooting animals was deemed to be important. It was thought that people with shooting experience might be more tolerant of shooting animals, compared to the general public.

However, it was also deemed possible that individuals who shoot animals for recreational purposes might have different views compared to those who shoot animals for profit or population control. Therefore, questions were included so that participants with either or both of these experiences could be identified.

Question 1G: Involvement with horses:

Like shooting experience, questions to gauge each participant's involvement with horses were seen as important inclusions within the questionnaire. It was hoped it might be possible to identify relationships between the extent to which participants had been involved with horses and the beliefs and/or management preferences of respondents identified during the project.

Involvement with horses was seen as a more complex issue than simply whether or not people owned a horse, so multiple questions were included to examine a range of variables related to interaction with horses. Ultimately, eight questions, covering four areas of interest, were asked of participants.

Ownership was addressed both in terms of whether or not horses had been owned (Q1G.1) and how many horses had been owned (1G.2). Participants were also asked about the frequency of "live" contact with horses to provide a possible, if crude, measure of their opportunity and likelihood of establishing an emotional attachment to the animals (N.B. "live" was specified as the majority of Australians would see these animals on television and/or in film and print media.)

Whether or not participants were members of any equestrian or horse-related organisations was also sought, as well as the identity of any such organisation they were affiliated with, so that any

homogeneous views from such organisations could be placed in the context of the beliefs of the general public.

Lastly, each participant was also asked if they had seen feral horses in Australia and, if so, where they had seen them. By doing this, it was hoped that not only could the degree to which the public has contact with feral horses be determined but also whether this contact was associated with particular views of the animals and their management.

Section Two: Knowledge and Beliefs

To determine how Australians viewed feral horses, this section dealt with both the status of feral horses and their impact on the Australian environment.

Regarding potential impacts of feral horses, on the Australian environment, the following issues were raised:

- Eating the same species as livestock or native animals (Question 2A)
- Damage to vegetation by chewing the bark and roots of trees (Question 2C)
- Damage to soils via compaction and erosion (Question 2D)
- Competition, specifically with native species (Question 2E)

Strictly speaking, both Question 2A and 2E deal with competition between feral horses and native species but 2A was designed to see if people thought the species potentially ate the same things, not to determine whether they felt competition was occurring between the different species.

Also, determining whether or not participants believed that feral horses were an introduced animal was thought to be potentially valuable in providing better insight into people's overall views of the animals, and their management. This is because animal species not indigenous to Australia are generally viewed negatively when outside the control of humans.

Although this section was titled Knowledge and Beliefs, two relatively broad questions about wild horse management were also included. These two questions were added to Section Two as a safety net option against the length of the questionnaire. That is, to ensure that some questions regarding management were introduced sufficiently early in the questionnaire so that participants who might not want to complete the entire survey might still give some feedback on their management preferences.

Also, because it was a design aim to guide participants from general issues about wild horse management to very specific ones, these broad-scale issues were presented before specific questions about management methods or the decisions made regarding the GFRNP cull.

Retrospectively, questions 2F.1 and 2F.2 should have been presented in reverse order, to better match the aim of moving from broadly focussed to narrowly focussed management issues within the survey, but this minor discrepancy was not realised at the time of printing.

Question 2F.1, provided participants with a range of choices for where feral horses could exist in NSW. Even though some options were recognised as impractical, such as ‘No feral horses at all’ or ‘Feral horses in all NSW National Parks’, they were included to ensure the questionnaire could detect as wide a range of views as possible from among participants.

Lastly, 2F.2 was included to separate those participants who believed in at least some form of management for feral horses in NSW from those who did not. This was important as the majority of the remaining questions in the questionnaire dealt with management related options so identifying opposition to management of feral horses would provide better context for subsequent responses.

Section Three: Management Options

The questions in this section were designed to reveal participants’ views on the use of specific methods of horse management within NSW National Parks.

By using three questions it was hoped that views of aerial culling, in particular, could be sought and cross-checked. Also, by providing a list of other possible management options, some insight into the preferences of participants would be determined, e.g. identifying whether decisions about wild horse management were being made from a standpoint of general support for either lethal or non-lethal methods or whether participants seemed to be discerning between individual management options.

Question 3A: Support for aerial culling in NSW National Parks

In response to this question participants could select from:

- No, I do not support it under any circumstances,
- Yes, I support it,
- Yes, I support it but only under certain circumstances,
- I am unsure, or
- This issue is not important to me

The two affirmative possibilities were provided as it was expected that those people supporting aerial culling might be split between those individuals giving conditional or unconditional support for this practice. The option “*This issue is unimportant to me*” was provided to get a definite measure of that sentiment among the participants rather than have people with such a preference be indistinguishable among “*I am unsure*” responses or have them not respond at all.

Questions 3B and 3C: Preferred and Unacceptable methods for control of feral horses

A list of possible management methods for feral horses was formulated for consideration by participants and provided for review. In Question 3B participants were asked to choose which methods they preferred whilst in 3C they were asked to indicate which options were unacceptable. Although it is unlikely that some of these methods would or could be employed by NPWS managers, e.g. poisoning or contraception, they were nonetheless considered to be available options and the public’s response to them was sought.

It is also important to point out that the list of possible management methods contained some specific options and some general categories of control. For example, shooting was separated into aerial and ground methods because they were thought to be, potentially, significantly different methods from the public's perspective. That is, whilst shooting horses from a moving platform, such as a helicopter, had long been a contentious issue (SSCAW 1991; Dobbie *et al.* 1993; English 2000, 2001a; 2001b), much less opposition seemed to exist regarding the use of ground shooting as a control method; therefore the methods were offered as separate options.

Conversely, a variety of methods were possible for use in the capture of horses, but since public concerns have rarely dealt with differences between them they were grouped under a more general category, capture and removal, with the outcome following capture being the variable.

Section Four

The questions in Section Four were focussed more specifically on the GFRNP scenario than those of the previous three sections.

Question 4A: Experience with Guy Fawkes River National Park

This question asked whether or not participants had visited GFRNP so that extra context for their answers could be established.

Question 4B: Awareness of the October 2000 cull

As in 4A, Question 4B.1 was used to add to the context for each participant's answers by asking whether or not participants were aware of the GFRNP wild horse cull. Next, 4B.2 asked how participants had heard about the cull (providing they had) and, thereby, revealed whether any particular medium was more important to the spread of information about the management scenario or was associated with particular views of the wild horse management action.

Question 4C: The ban on aerial culling in NSW

Question 4C.1 explicitly dealt with whether participants agreed with the ban on aerial culling at the time it was implemented. As well as "I agree", "I disagree" and "I am unsure" options,

participants could also select “I was unaware of this decision”, to ensure that people who had not learned of the Minister’s ban on aerial culling of horses were not forced to take in the “I am unsure” option or not respond at all.

Also, to see whether or not participants had changed their opinion regarding the ban on aerial culling, over time, Question 4C.2 dealt with participants’ current view of the ban.

Question 4D: Impact of the English Report

The official review of the GFRNP cull (English 2000) and the fact that charges brought against NPWS by the RSPCA had been dropped, were seen to be, potentially, important factors affecting public opinion about the GFRNP aerial cull. In Question 4D participants were presented with key information from Associate Professor English’s report and a statement informing them that the charges against NPWS had been dropped before asking them if that information changed their opinion about the ban on aerial culling.

Question 4E: Aerial culling

Participants were asked to indicate, if they objected to horses being shot, why they held that view. In Question 4E.2, a list of feral and native animals was presented to participants so they could indicate which species they would permit to be aerially culled. Horses were not included in the list as participants had already been asked three questions 3A, 3B and 3C about how they viewed aerial culling of feral horses.

Questions 4G, 4H, 4I, 4J: Heritage Value of the Guy Fawkes River National Park Horses

So that questions could be asked about the impact that the findings of the Heritage Working Party (2002) had on the participants’ views of the GFRNP scenario, questions 4G to 4I were prefaced with a summary of the Working Party’s conclusions.

Question 4G then addressed whether or not the findings justify maintaining all, some or none of the feral horses in GFRNP. Next, question 4H dealt with the Minister’s decision that any horses

with Heritage significance would not be killed and whether participants agreed with this decision, whilst 4I examined whether or not the Heritage Working Party's findings justified any special management of the horses at all.

Lastly, in Question 4J, the issue of establishing a Heritage Herd was raised, giving participants the option to choose whether they would agree with such a herd or not and, if so where it should be managed, i.e. in the GFRNP, on State land or on private property.

Additional comments on horses and their management

On the back of the questionnaire, a space for additional comments was made available to participants. This was provided to collect any additional information about feral horses and/or their management that was overlooked in the development of the questionnaire.

2.3 Urban and Rural Responses to the Wild Horse Management Questionnaire

The survey elicited 877 utilisable responses comprising 823 main-round replies and 54 non-response surveys from participants who did not complete the main questionnaire. Taking into account Return to Sender (RTS) mail that resulted from inaccurate address data on the electoral roll, the Rural and Urban response rates were 49% and 45% respectively. These responses were equivalent to precision values of plus or minus 5% for the Rural sample and plus or minus 6% for the Urban sample.[†]

A comparison of the proportion of Urban and Rural responses, adjusted for RTS, revealed no significant difference (Two-by-two table, with Yates correction, $\chi^2 = 2.26$, $P = 0.1329$).

2.3.1 Section One

Question 1A: Gender

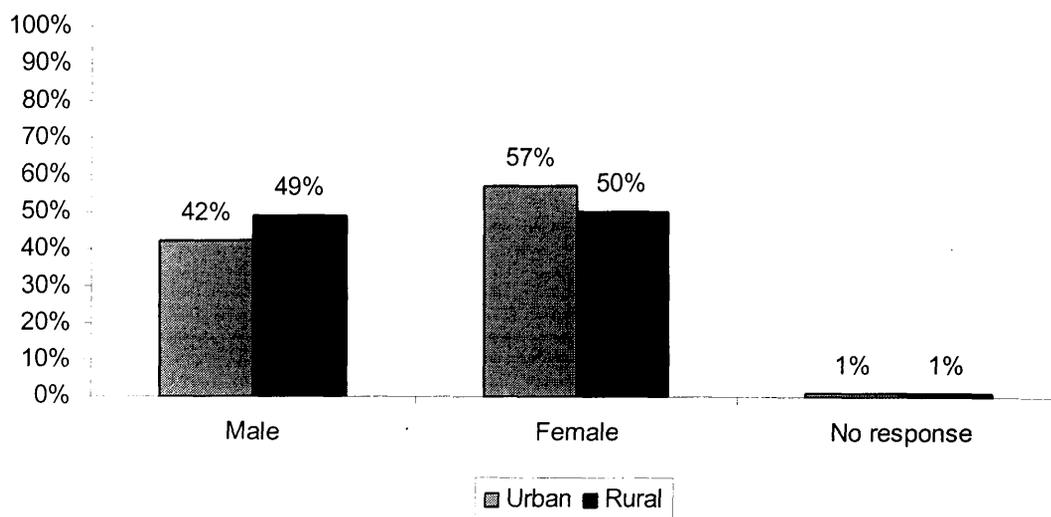


Figure 2.2 : Urban and Rural responses to Question 1A: Gender.

[†] These precision values were calculated to the nearest whole percentage point based on a total population of 83,106 since the exact numbers of Urban and Rural participants within the total population was unknown. Application of these values requires that no significant non-response bias existed – see Non-response Sample.

In both samples, more women, than men, responded to the questionnaire (Figure 2.2). Gender proportions of the Rural and Urban responses were found to be significantly different ($\chi^2= 8.36$, $DF = 2$, $P = 0.0153$).

Comparison with 2001 Census data for the Commonwealth Electoral Division of New England (ABS 2001) revealed no significant difference between Rural gender proportions and those of the entire population of the electoral division (Two-by-two table, Yates corrected $\chi^2= 0.18$, $P = 0.6679$). Urban gender proportions, however, did differ significantly from the overall population due to more receiving more female and less male responses than expected (Two-by-two table, Yates corrected $\chi^2= 0.4.76$, $P = 0.0292$)

Question 1B: Age

Based on those respondents who answered Question 1B, mean age was very similar between rural (50.11 years) and urban (52.06 years) samples. Tests for normality revealed that both samples' data were normally distributed (Urban Wilk-Shapiro value = 0.9829, Rural Wilk-Shapiro value = 0.9881) thus a parametric, two-sample T-test was appropriate to compare the mean age. This test revealed no significant difference between the groups ($T = -1.65$, $DF=732.7$, $P = 0.0952$).

As for gender, the age distribution for the response populations was compared with data from the 2001 census of the Commonwealth Electoral Division of New England (ABS, 2001). These age distributions are illustrated in Figure 2.3. Although no significant differences were found between the age distributions of Rural and Urban samples ($\chi^2= 7.93$, $DF = 7$, $P = 0.3391$) significant differences were observed between the Census data and the two samples ($\chi^2= 77.63$, $DF = 16$, $P = 0.0000$).

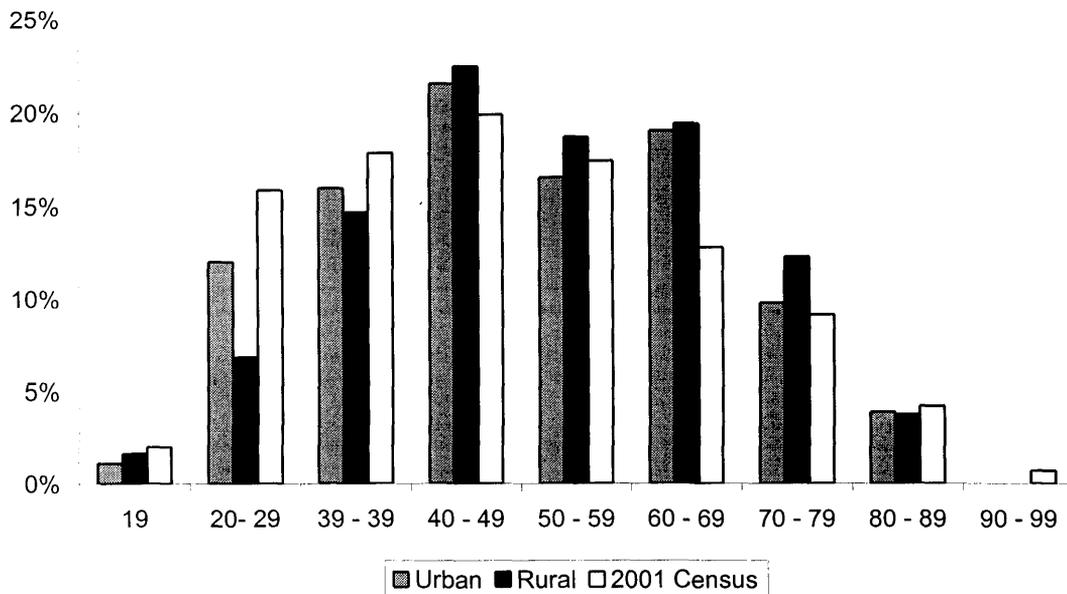


Figure 2.3: Proportions of Urban and Rural respondents from each age category compared with 2001 Census data for the Commonwealth Electoral Division of New England.

Question 1C.1: Is your background rural, coastal or metropolitan?

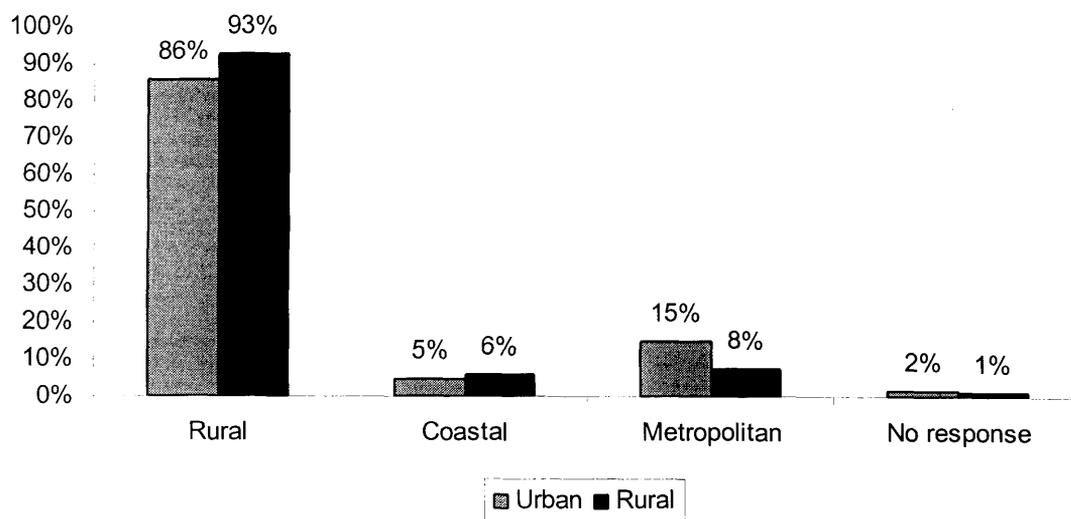


Figure 2.4: Urban and Rural responses to Question 1C.1: “Is your background rural, coastal or metropolitan?” (N.B. Because participants were able to select more than one response to this question, cumulative responses may exceed 100%.)

The vast majority of Urban and Rural respondents indicated that they had a rural background, in response to Question 1C.1 (Figure 2.4). However, Chi-squared tests revealed a significant difference in the proportions of Rural and Urban respondents that selected each option ($\chi^2=11.68$, DF = 3, P = 0.0085)

Question 1C.2: In relation to your answer above, are you from a town, city or property?

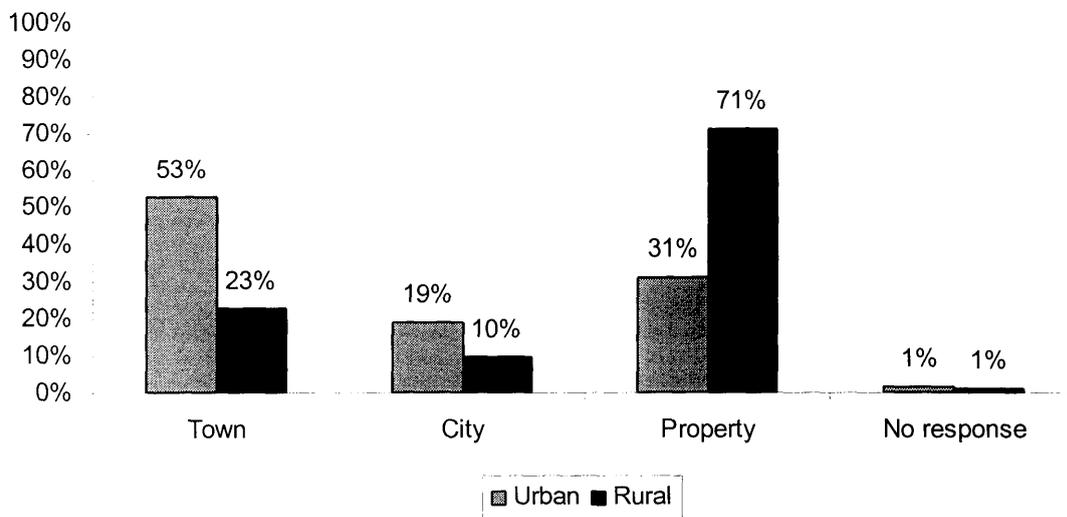


Figure 2.5: Urban and Rural responses to Question 1C.2: “In relation to your answer above, are you from a town, city or property?” (N.B. Because participants were able to select more than one response to this question, cumulative responses may exceed 100%.)

The ratio of responses to Question 1C.2 clearly differed between the two samples (Figure 2.5). Whilst more than half of Urban respondents chose “Town” as their Background Type, less than a quarter of Rural respondents did the same. Likewise, 71% of Rural respondents chose “Property” but only 31% of the Urban people did the same. Chi-squared comparisons between the responses from each sample revealed significant differences ($\chi^2=179.18$, DF = 3, P < 0.001).

Question 1D: Which of the following do you consider yourself to be?

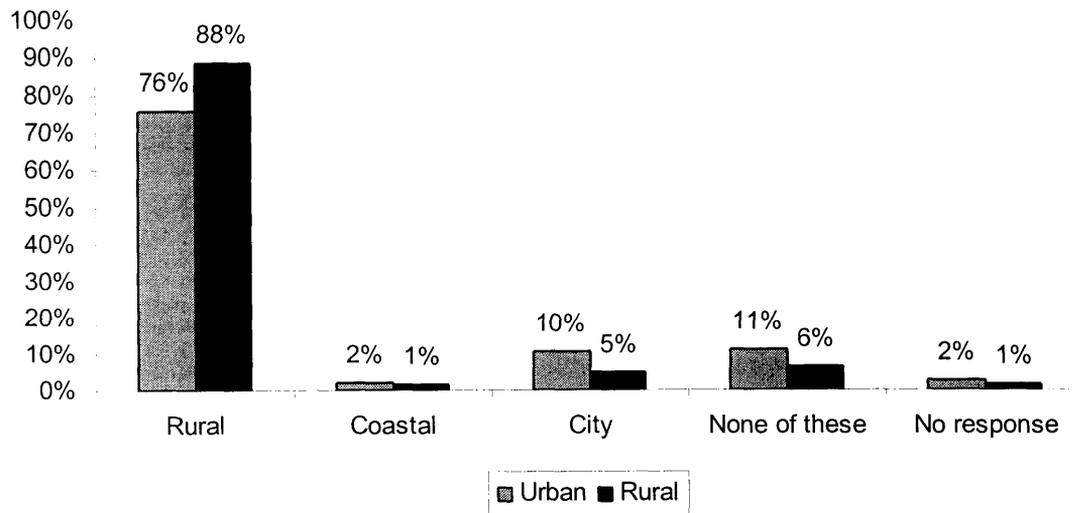


Figure 2.6: Urban and Rural responses to Question 1D: “Which of the following do you consider yourself to be?” (N.B. Because participants were able to select more than one response to this question, cumulative responses may exceed 100%.)

Both the Rural and Urban samples were dominated by a “rural” response to Question 1D (Figure 2.6). Whilst Rural responses were comprised of almost 90% “rural” responses, only 76% the Urban sample selected the same option. Differences between Rural and Urban observed responses were found to be significant ($\chi^2 = 41.44$, DF = 4, $P < 0.001$).

Question 1E: What is the highest level of education that you have obtained?

The majority of both Urban (64%) and Rural (63%) respondents indicated that they had a “High School” education (Figure 2.7). Similar proportions of the two samples indicated they had University undergraduate degrees, although this was slightly greater among Rural (20%) than Urban (14%) respondents. Less than 10% of either group selected, “Primary” or “University post-graduate” education. Just 1% of Urban and 2% of Rural respondents chose “No formal education”. Tests revealed no significant differences between Rural and Urban responses to this question ($\chi^2 = 9.67$, DF = 5, $P = 0.0852$).

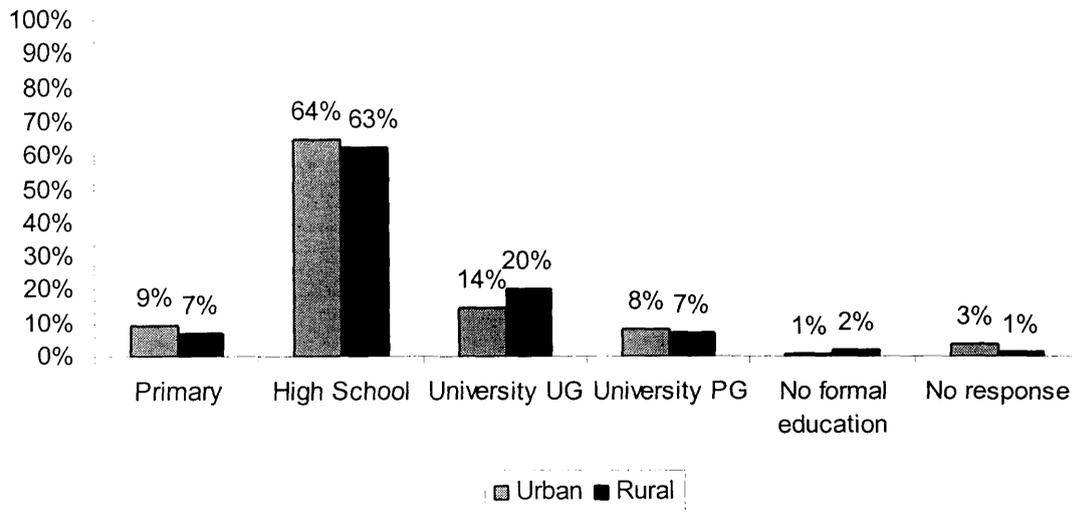


Figure 2.7: Urban and Rural responses to Question 1E: “What is the highest level of education that you have obtained?”

Questions 1F.1: Have you ever shot animals for recreation? and 1F.2: Have you ever shot animals for profit or for the purpose of reducing their numbers?

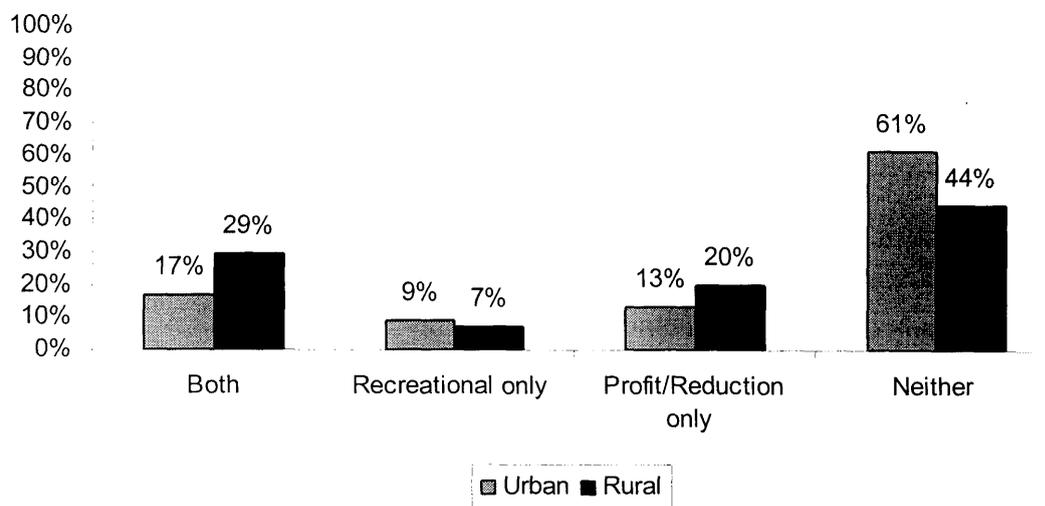


Figure 2.8: Urban and Rural responses to Questions 1F.1 and 1F.2 combined: “Have you ever shot animals for recreation?” and “Have you ever shot animals for profit or for the purpose of reducing their numbers?”

In total, the majority (56%) of Rural respondents had experience shooting animals, compared to less than half (39%) of the Urban group (Figure 2.8).

The majority of both groups' respondents indicated they had not shot animals for recreation. However, a greater proportion of Rural, than Urban, people selected "Yes" in response to 1F.1. Differences between the two samples were significant ($\chi^2 = 6.18$, DF = 2, P = 0.0454).

Differences observed between Urban and Rural response to 1F.2 were also significant ($\chi^2 = 41.86$, DF = 2, P < 0.001). Whilst less than a third of Urban respondents had shot animals for profit, or for the purpose of reducing their numbers, almost half of Rural respondents had done so.

Question 1G.1: Have you ever owned a horse?

The proportion of Rural respondents who indicated that they had at some time owned a horse, was much greater than amongst respondents from the Urban sample (Figure 2.9). Differences between each group's responses were significant ($\chi^2 = 61.88$, DF = 2, P < 0.001).

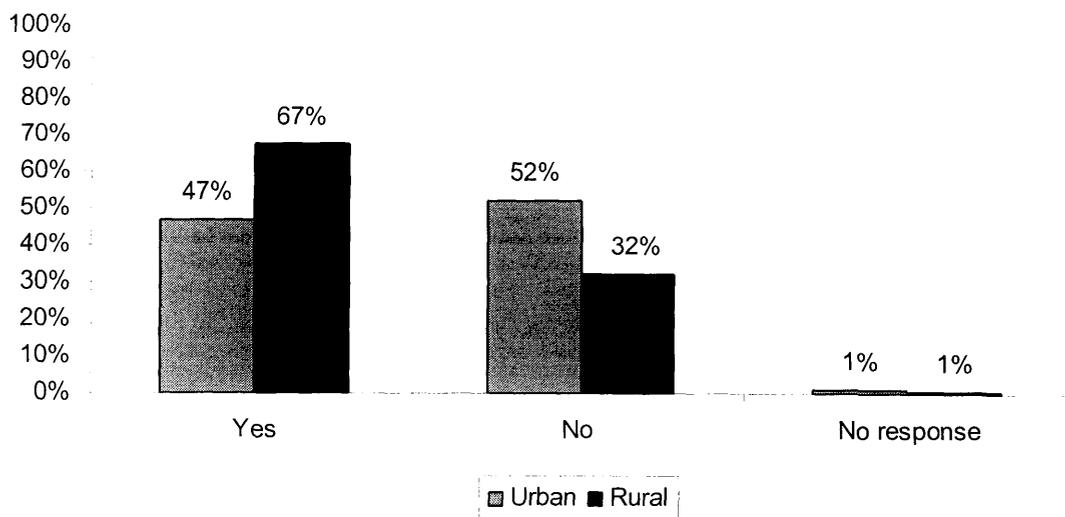


Figure 2.9: Urban and Rural responses to Question 1G.1: "Have you ever owned a horse?"

Question 1G.2: How many horses have you owned?

Urban respondents who answered “Yes” to Question 1G.1, had owned an average of 7.6 horses each compared to 14.58 for each Rural respondent. These means were skewed by individuals who indicated owning more than 100 horses. A significant difference was found in the mean number of horses owned, between samples ($P = 0.002$).

A non-parametric Mann-Whitney U-test was used to compare Rural and Urban groups since data were not normally distributed.

Question 1G.3: About how long ago did you last own a horse?

One quarter of Rural respondents who answered “Yes” to Question 1G.1, currently owned a horse, compared to less than one-in-ten of (8%) of the Urban group. Observed proportions of respondents who were current horses owners differed significantly between Rural and Urban respondent groups (Two-by-two table, Yates corrected $\chi^2 = 39.42$, $P = 0.0000$).

Question 1G.4: How often do you have live contact with horses?

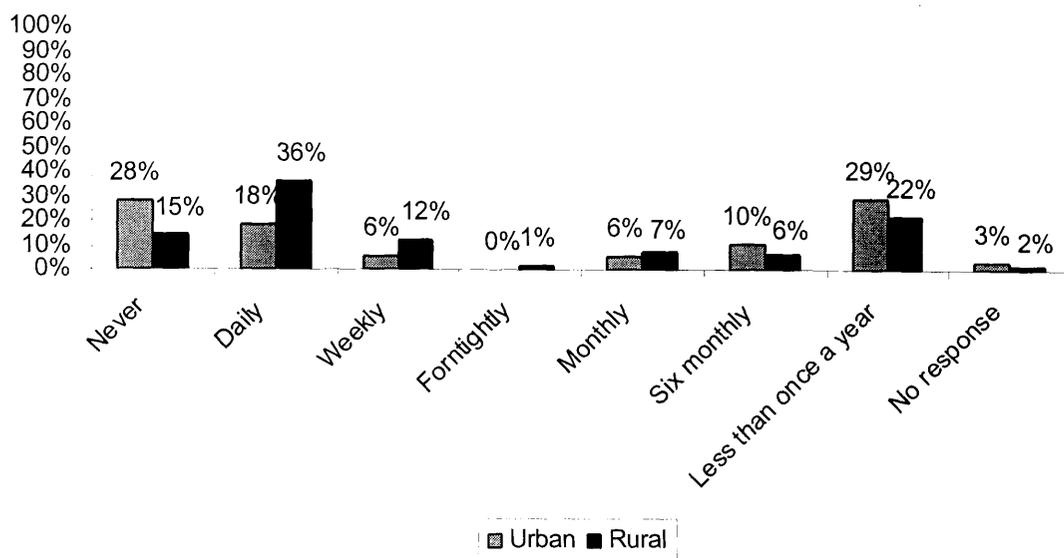


Figure 2.10: Urban and Rural responses to Question 1G.4: “How often do you have live contact with horses?”

Twice the proportions of Rural respondents, than Urban ones, selected “Daily” and “Weekly” responses, suggesting that Rural respondents generally had more frequent contact with horses than members of the Urban group (Figure 2.10). Cumulative totals show that almost half (48%) of the Rural respondents have at least weekly contact with horses, compared to less than a quarter (24%) of the Urban group. Differences between the two samples were found to be significant (Yates corrected $\chi^2=153.27$, $P = 0.0000$).

Low expected values (< 5.0) for several cells necessitated collapsing the response categories into fewer groups. As a result, a two-by-two table analysis was performed for proportions of each samples’ respondents who had at least weekly contact with horses.

Question 1G.5: Are you a member of any horse or equestrian organisations?

Few Urban (6%) or Rural (14%) respondents indicated membership/affiliation to a Horse or Equestrian organisation. However, differences in proportions were found to differ significantly (Yates corrected $\chi^2=14.07$, $P = 0.0002$).

Question 1G.6: Which horse/equestrian organisations are you a member of?

Respondents indicated membership/affiliation to a total of 29 different horse/equestrian associations. These ranged from Pony Clubs, to Show Societies, Breed organizations and others, such as Polocrosse clubs, Harness Racing groups and Campdrafting Associations.

Question 1G.7: Have you seen wild horses in Australia?

Although fewer than half of either groups’ respondents answered “Yes” to 1G.7, a greater proportion of Rural, than Urban, respondents had seen wild horses (Figure 2.11). Significant differences were revealed between each samples’ responses ($\chi^2=14.29$, $DF=3$, $P=0.0025$).

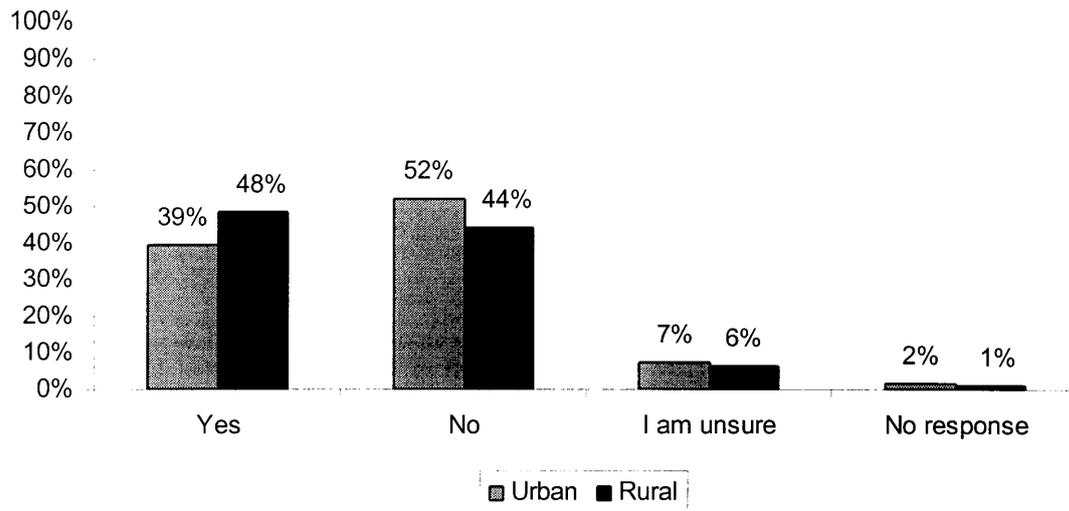


Figure 2.11: Urban and Rural responses to Question 1G.7: “Have you seen wild horses in Australia?”

Interestingly, several respondents who indicated that they had seen wild horses in Australia subsequently wrote that they had seen them “On TV”. This served as a reminder about individuals’ differential understanding of questions as well as perceptions of various responses. It also raised questions about whether these people might have reacted differently to the survey if they had “live” encounters with wild horses.

Question 1G.8: Where in Australia have you seen wild horses?

Respondents listed sightings of wild horses from every mainland State and Territory, other than the Australian Capital Territory, as well as from 38 more specific locations across the country.

2.3.2 Section Two

Responses to 2A: “Wild horses eat plant species that are also consumed by cattle, sheep and native animals such as kangaroos”

Respondents from Rural and Urban groups had similar opinions regarding the statement in Question 2A (Figure 2.12). Few people disagreed that wild horses ate the same food species as cattle, sheep and kangaroos but noticeably more Urban (15%), than Rural people (9%), were “unsure”. Proportions of Rural and Urban responses were not significantly different ($\chi^2=9.38$, DF=4, P=0.0522).

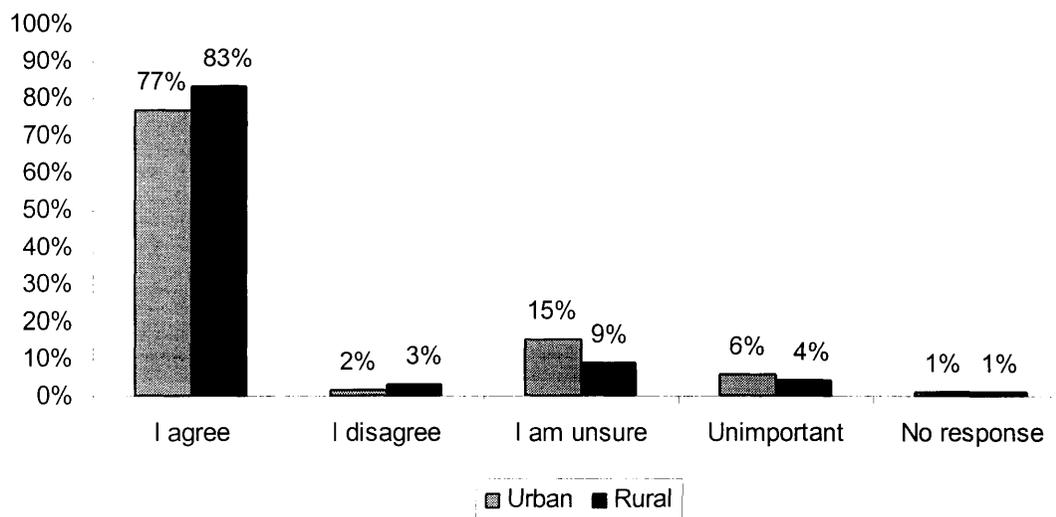


Figure 2.12: Urban and Rural responses to Question 2A: “Wild horses eat plant species that are also consumed by cattle, sheep and native animals such as kangaroos”

Responses to 2B: Wild horses are native to Australia

The majority of respondents from the Rural and Urban groups selected the “correct” answer by disagreeing with the statement that wild horses are native to Australia (Figure 2.13). As in Q2A, almost double the numbers of urban respondents, compared to rural, were unsure about the statement presented. Rural and Urban groups differed significantly in response to Question 2B ($\chi^2=18.17$, DF=3, P < 0.001).

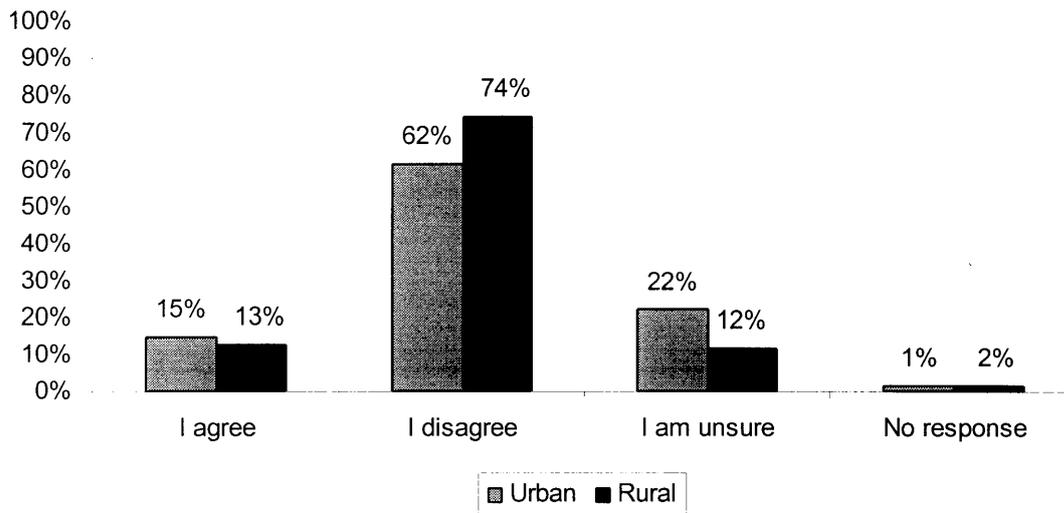


Figure 2.13: Urban and Rural responses to Question 2B: “Wild horses are native to Australia”

Responses to 2C: Wild horse cause damage to native trees by chewing bark and roots

Proportionately, more Rural than Urban participants indicated horses do cause damage to trees by chewing bark and roots (Figure 2.14). Almost one third of Urban respondents selected the “I am unsure” option, compared to just 20% of Rural respondents. Differences between observed proportions of responses were statistically significant ($\chi^2=19.77$, DF=3, P < 0.001).

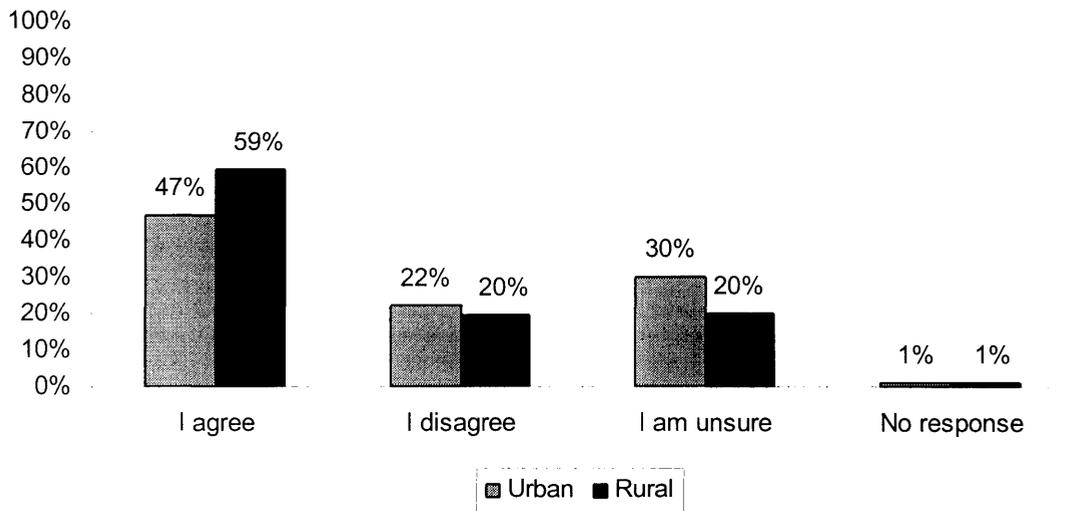


Figure 2.14: Urban and Rural responses to Question 2C: “Wild horses cause damage to native trees by chewing bark and roots”

Responses to 2D: Wild horses cause significant damage to soils in Australia

Although overall responses from the two groups appeared to be relatively uniform to this question (Figure 2.15), observed differences were found to be significant ($\chi^2=9.38$, DF=3, P=0.0246).

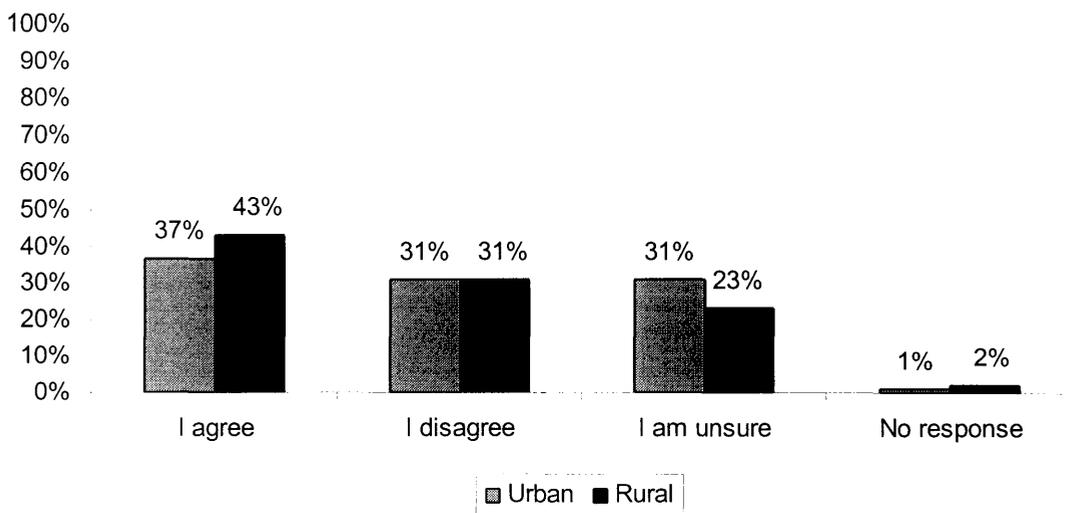


Figure 2.15: Urban and Rural responses to Question 2D: “Wild horses cause significant damage to soils in Australia”

Responses to 2E: Wild horses are significant competitors with native species such as kangaroos

The majority of rural respondents agreed with the statement that wild horses were significant competitors with native species such as kangaroos. Similarly, 46% of urban respondents also agreed. However, nearly 10% more Urban respondents were “unsure” compared to the Rural group (Figure 2.16). The differences observed in the proportions of Rural and Urban responses were found to be significantly different ($\chi^2=10.29$, DF=3, P=0.0163).

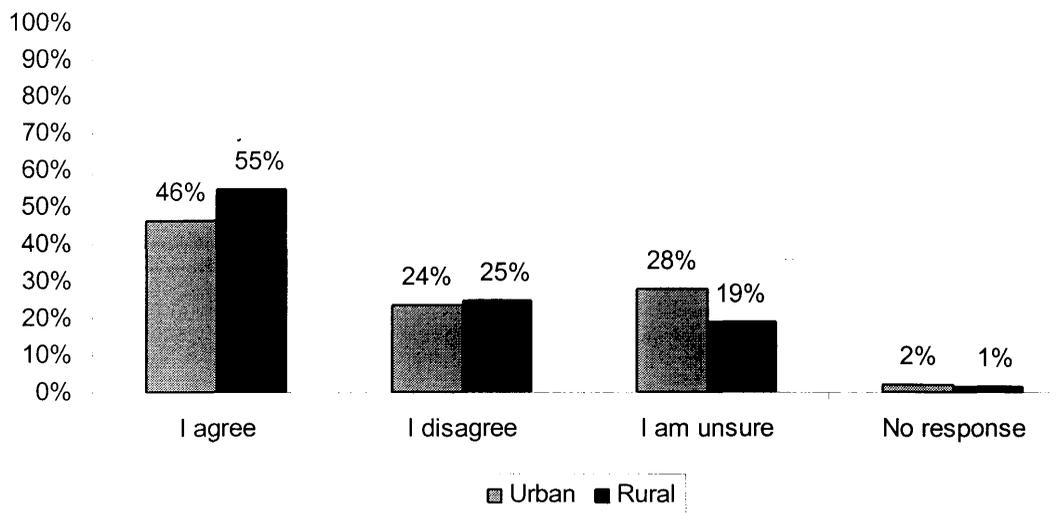


Figure 2.16: Urban and Rural responses to Question 2E: “Wild horses are significant competitors with native species such as kangaroos.”

Frequency of “I am unsure” selections among Rural and Urban respondents

Among the responses to Questions 2A to 2E, Urban respondents were consistently more likely to choose “I am unsure” than their Rural counterparts (Figure 2.17). Proportions of sure and unsure responses differed significantly, for each question, between samples (Yates corrected $\chi^2 < 0.05$).

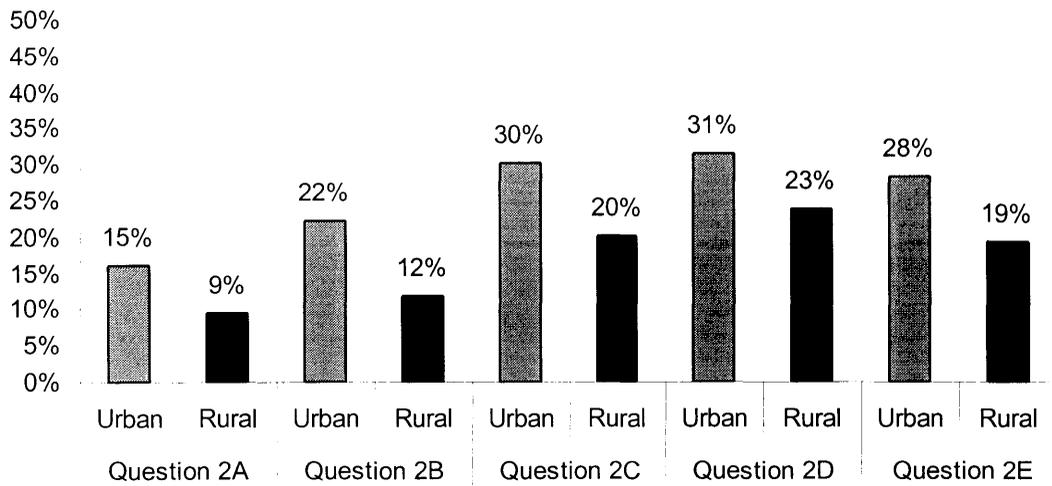


Figure 2.17: Proportions respondents who answered “I am unsure” to Questions 2A to 2E.

Question 2F.1: Which of the following scenarios would you prefer to see in NSW

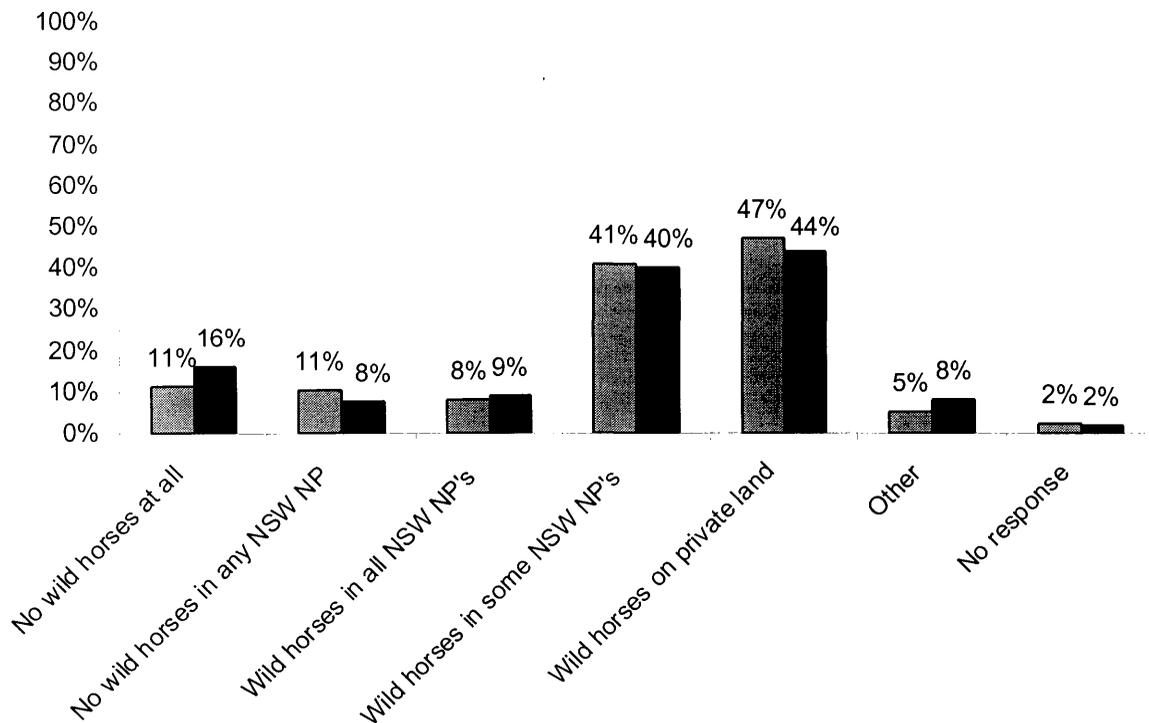


Figure 2.18: Urban and Rural responses to Question 2F.1: “Which of the following scenarios would you prefer to see in NSW?” (N.B. Because participants were able to select more than one response to this question, cumulative responses may exceed 100%.)

Among both sample groups, the most popular response was to have wild horses kept on private land, or in special reserves (Figure 2.18). Next, many respondents (42% of both groups) also indicated support for wild horses in some NSW National Parks. There was little support, for extreme options such as no wild horses at all or, wild horses in all National Parks. No significant differences were found to exist between Rural and Urban responses to this question ($\chi^2=9.12$, DF=6, P=0.1671).

Because many respondents selected 2, or more, responses to 2F.1 the total response exceeded 100% per sample. In a small number of cases, individuals' own choices were conflicting. Two rules were successfully applied to alleviate this problem. Firstly, if a respondent had chosen "No wild horses at all" other options were deemed to be void and, secondly, "No wild horses in any NSW National Parks" was kept in place of additional options of horses in NSW National Parks.

Question 2F.2: If you want wild horses to exist in NSW should they be...

The majority of respondents wanted wild horses to exist in managed populations, in NSW (Figure 2.19).

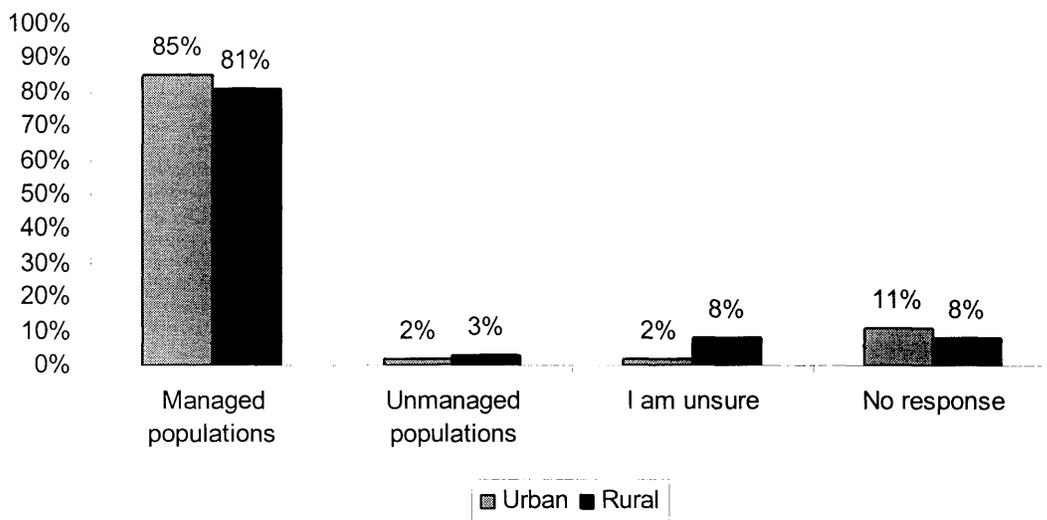


Figure 2.19: Urban and Rural responses to Question 2F.2: "If you want wild horses to exist in NSW should they be..."

An examination of proportional support for “Managed” and “Unmanaged” populations, between samples, revealed no significant differences (Two-by-two table, Yates corrected $\chi^2=0.24$, $P=0.6271$).

2.3.3 Section Three

Question 3A: Do you support aerial culling of wild horses in NSW National Parks?

“No, not under any circumstances” was the single most commonly chosen response to Question 3A, among both samples. However, if “Yes” and “Yes, but only under certain circumstances” are combined, it is clear that a majority of Rural respondents offered at least conditional support for aerial culling of wild horses in NSW National Parks (Figure 2.20). Whilst the same majority was not present within the Urban sample, 42% of those respondents offered at least conditional support; a similar figure to the Urban “No” response. Differences between Rural and Urban samples’ responses were significant ($\chi^2=16.84$, $DF=5$, $P=0.0048$).

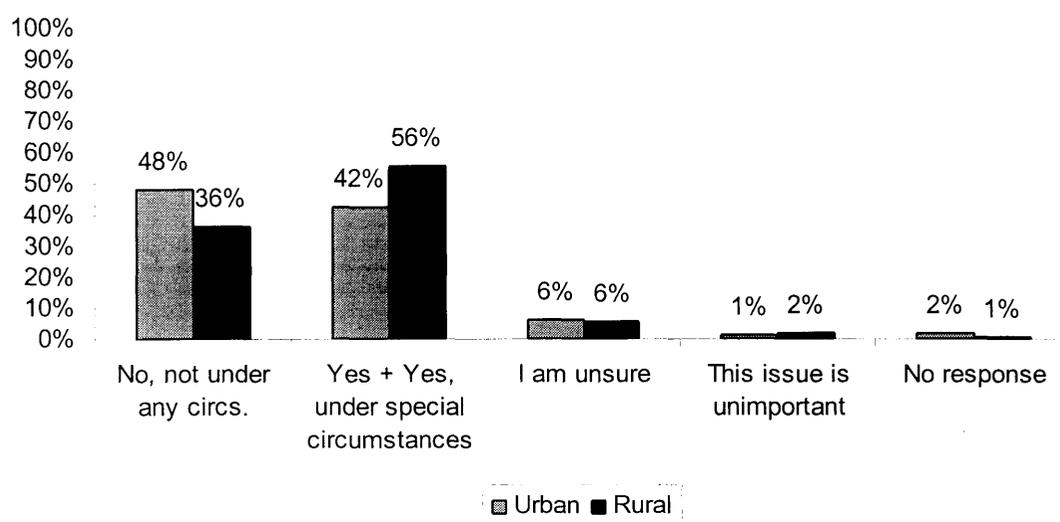


Figure 2.20: Urban and Rural responses to Question 3A: “Do you support aerial culling of wild horses in NSW National Parks?”

Question 3B: Preferred methods of wild horse control

Similar preferences for control options were evident among Rural and Urban respondents. The options of “Capture and removal to private property” and “Capture and removal for consumption, by people or pets” stood out among preferred methods of control for wild horses, as both received over 40% support (Figure 2.21).

Preference for “Aerial shooting” was the control method where a notable difference appeared to exist between Rural and Urban respondents, with just one fifth of Urban respondents selecting it compared to a third of their Rural counterparts. Despite this, no significant difference was detected among the two groups’ responses ($\chi^2=14.12$, DF=8, P=0.0788).

Question 3C: Unacceptable methods of wild horse control

As for Question 3B, Rural and Urban responses to 3C were very similar. “Poisoning” stood out as an unacceptable control method with over 70% of both Rural and Urban respondents selecting it (Figure 2.22). Likewise, “No control” for wild horses was unacceptable to the majority of both samples’ respondents. Only “Aerial shooting”, from among the remaining options, received substantial disapproval from both groups.

All other methods of wild horse control were unacceptable to at least some respondents, although the proportions of disapproval did not exceed 30%. No significant differences were found between Rural and Urban responses ($\chi^2=7.25$, DF=8, P = 0.5096).

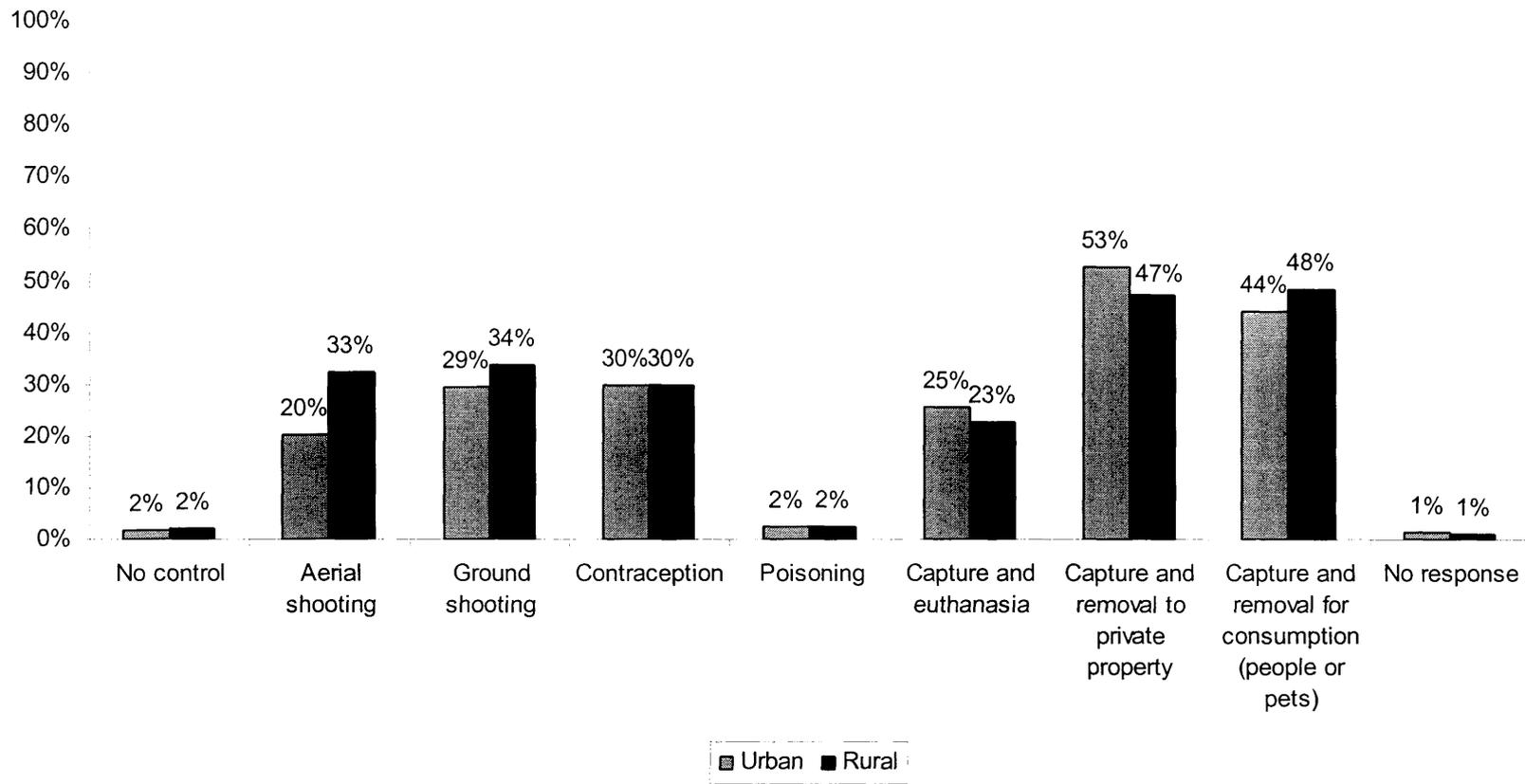


Figure 2.21: Urban and Rural responses to Question 3B: “If all of the following were practical options, which would be your preferred methods of control for wild horses?” (N.B. Because participants were able to select more than one response to this question, cumulative responses may exceed 100%.)

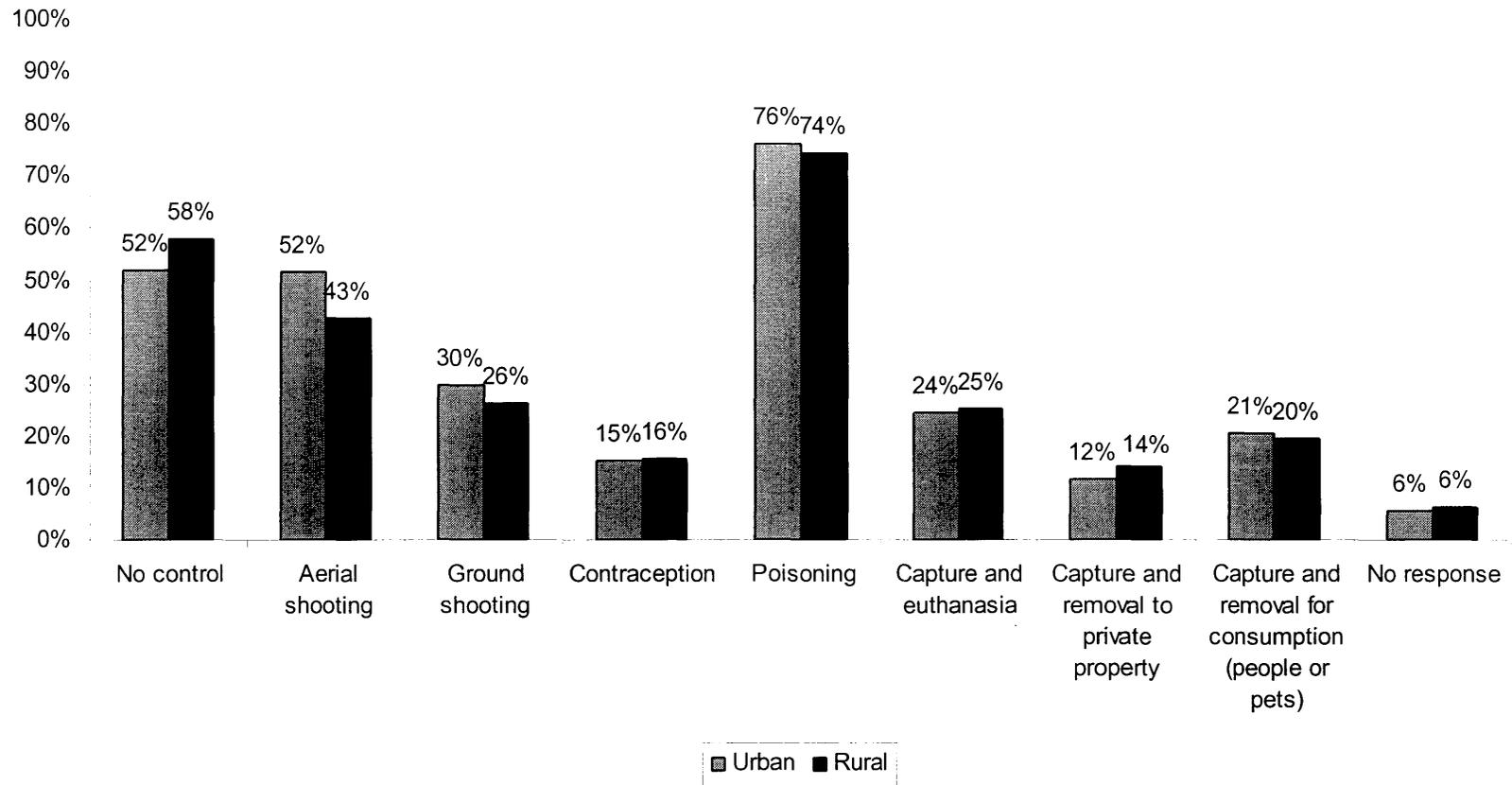


Figure 2.22: Urban and Rural responses to Question 3C: “Are any of these methods unacceptable to you?” (N.B. Because participants were able to select more than one response to this question, cumulative responses may exceed 100%.)

Section Four

Question 4A: Have you ever visited Guy Fawkes River National Park?

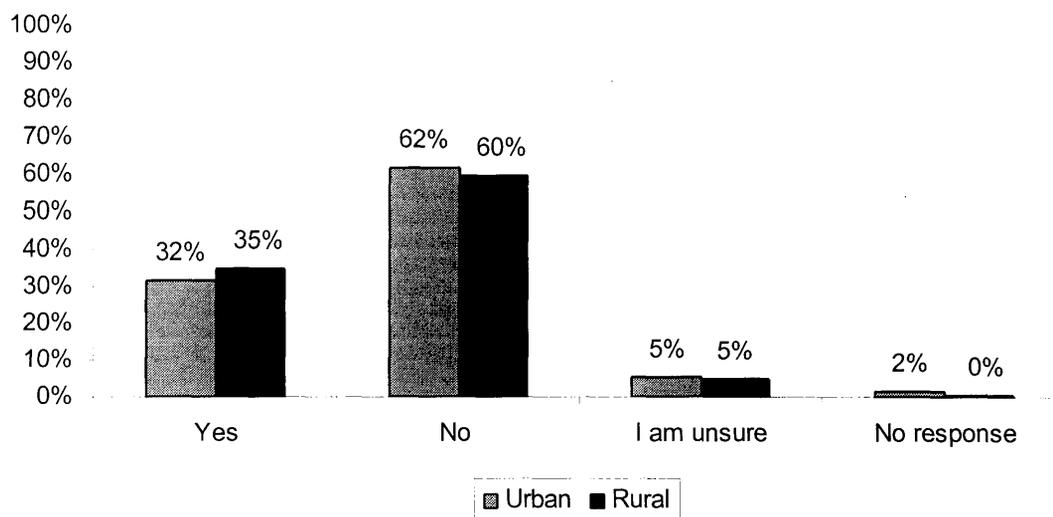


Figure 2.23: Urban and Rural responses to Question 4A: “Have you ever visited Guy Fawkes River National Park?”

Approximately one third of Rural and Urban respondents had visited GFRNP (Figure 2.23). No significant differences existed between these groups in proportions of their responses to Question 4A ($\chi^2=3.48$, DF=3, P = 0.3239).

Question 4B.1: Are you aware of the October 2000 wild horse cull in GFRNP?

More than 80% of respondents from each sample group had heard of the GFRNP cull (2.24). These proportions did not differ significantly between groups ($\chi^2=2.44$, DF=3, P = 0.4864).

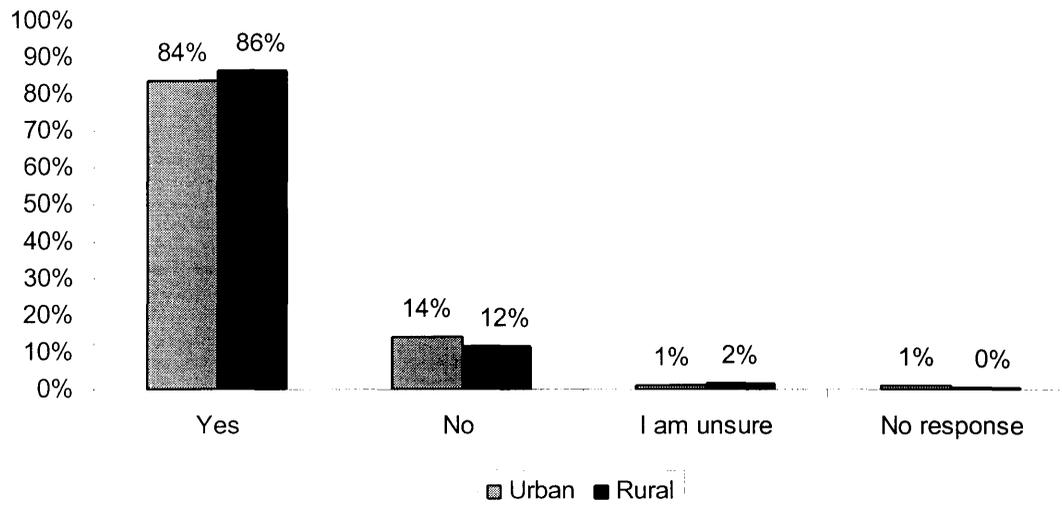


Figure 2.24: Urban and Rural responses to Question 4B.1: “Are you aware of the wild horse culling operation undertaken in October, 2000 by NSW National Parks and Wildlife Service in the Guy Fawkes River National Park?”

Question 4B.2: If aware of the 2000 horse cull, how did you learn of it?

Only minor differences were observed between Rural and Urban responses to this question; the greatest being a 7% difference in the proportions of respondents who chose “TV”. Among both groups television was the most frequently chosen medium by which respondents heard about the GFRNP cull (Figure 2.25). Differences between Rural and Urban samples’ responses were not found to be significant ($\chi^2=4.97$, DF=6, P = 0.5471).

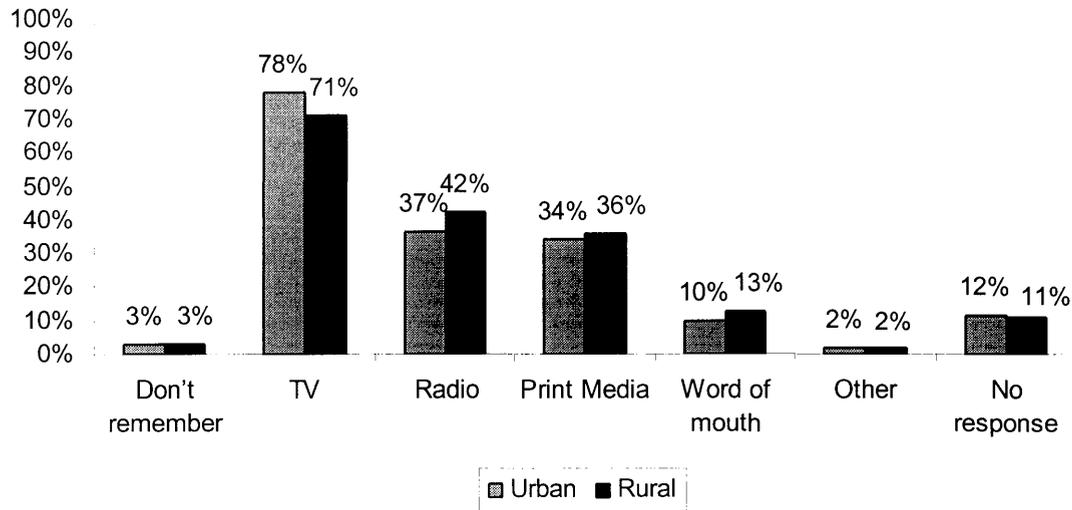


Figure 2.25: Urban and Rural responses to Question 4B.2: “If you are aware of the operation, how did you hear about it?” (N.B. Because participants were able to select more than one response to this question, cumulative responses may exceed 100%.)

Question 4C.1: Did you agree with the Minister’s decision to ban aerial culling, at the time?

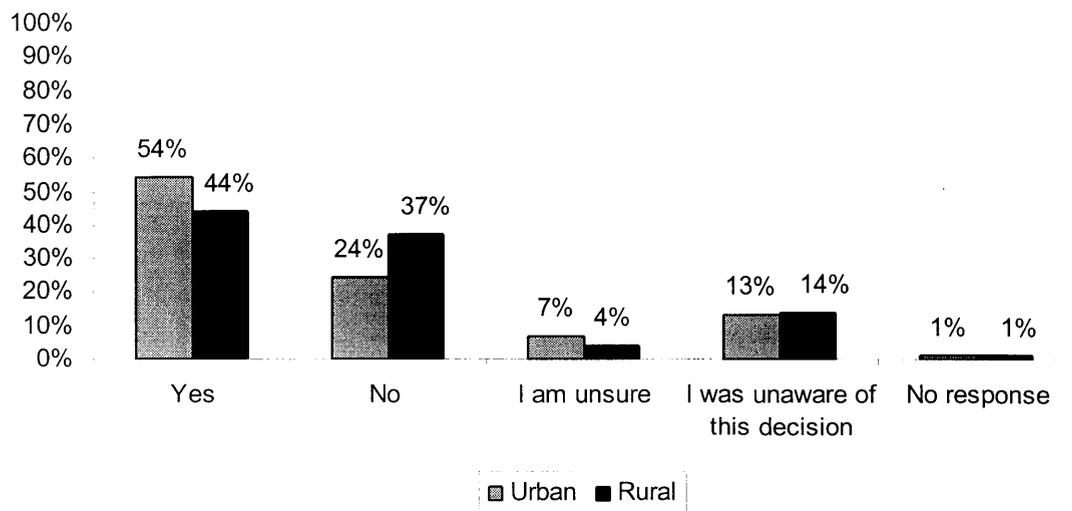


Figure 2.26: Urban and Rural responses to Question 4C.1: “Following this culling operation, the NSW Minister for the Environment completely banned aerial culling of wild horses in NSW. Did you agree with this decision at the time?”

Fewer Rural, than Urban, respondents agreed with the ban on aerial culling, at the time of its implementation (Figure 2.26). Reciprocally more Rural, than Urban, respondents disagreed with the ban at that time. From both samples, more than 1 in 10 respondents were unaware the ban had occurred. Observed differences between the samples' proportions of responses were found to be significant ($\chi^2=17.93$, DF=4, P = 0.0013).

Question 4C.2: Do you currently agree that aerial culling of horses should be banned?

Both samples' "no" response increased compared to Question 4C.1. Interestingly, these increases are comparable to the proportions of respondents who indicated they were "unaware of the cull" in response to Question 4C.1. Urban selection of "yes" increased slightly from the proportion observed in 4C.1 but Rural "No" decreased (Figure 2.27). Differences in the proportions of responses between Rural and Urban samples were significant ($\chi^2=21.00$, DF=4, P = 0.0003).

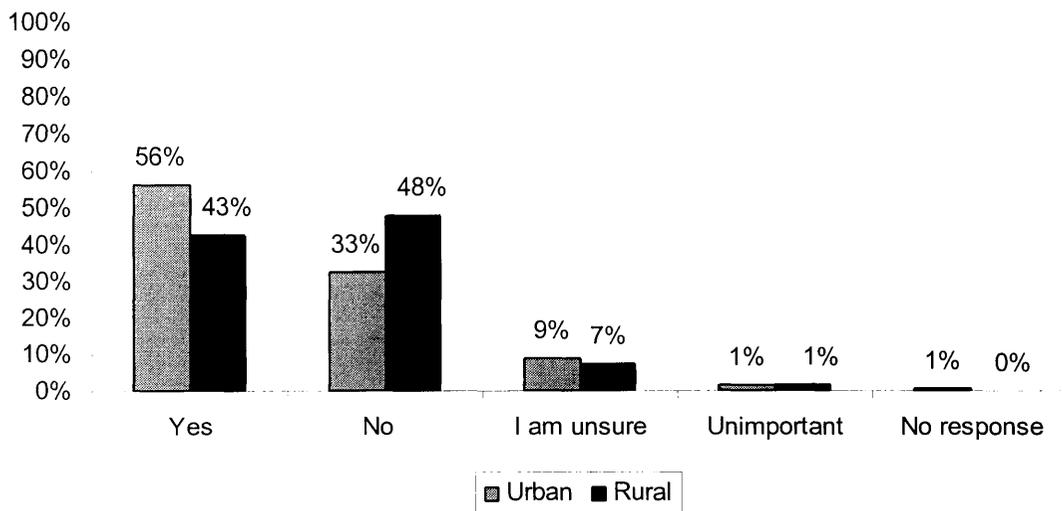


Figure 2.27: Urban and Rural responses to Question 4C.2: "Do you currently agree that aerial culling of wild horses should be totally banned in NSW?"

Question 4D: Does the English report change your opinion about the ban on aerial culling?

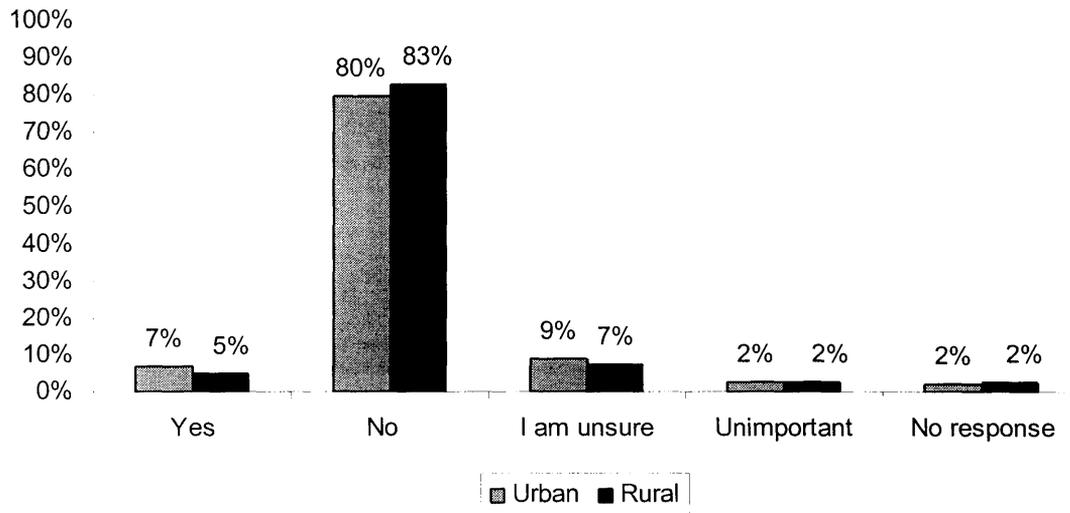


Figure 2.28: Urban and Rural responses to Question 4D: “Does this (the recommendations of the English report and the dropping of charges against the NPWS by the RSPCA) change your opinion about the ban on aerial culling of wild horses?”

The majority of respondents from both the Urban and Rural samples indicated that English’s findings regarding the humaneness of the GFRNP aerial cull (English, 2000), together with the dropping of charges against the NPWS, by the RSPCA, had no effect on their opinion about the ban on aerial culling (Figure 2.28). No significant differences were observed between the two samples ($\chi^2=2.61$, DF=4, P = 0.6248).

Responses to 4E.1: If you object to horses being shot, please indicate why

Notable differences were observed between supporting proportions of Rural and Urban participants for two options, in response to this question. For “I don’t support controlling animals by killing them” and “Horses have a special relationship with people, and do not deserve to be shot” greater proportions of Urban, rather than Rural participants selected each response (Figure 2.29). Indeed, almost 1-in-5 Urban respondents indicated that they didn’t support lethal methods of control, compared to less than 1-in-10 Rural ones. The proportions of responses of the two groups to Question 4E.1 differed significantly ($\chi^2=22.72$, DF=5, P = 0.0004).

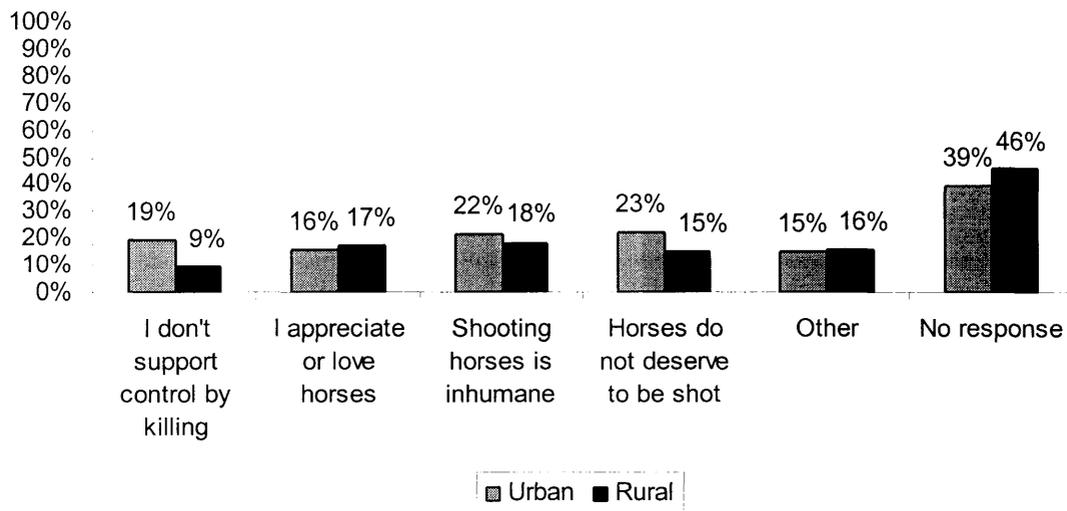


Figure 2.29: Urban and Rural responses to Question 4E.1: “If you object to horses being shot (aerially or otherwise) as a means of population control, please select your reason/s for this from the list below.” (N.B. Because participants were able to select more than one response to this question, cumulative responses may exceed 100%.)

Question 4E.2: For which of the following species should aerial culling be permitted?

Proportions of Rural respondents that indicated support for the aerial culling of animal species offered in Question 4E.2 were uniformly higher than those of Rural respondents (Figure 2.30). However, the order, from most to least support for aerial culling of species, was the same for both samples (Table 2.2).

The greatest difference observed in support for aerial culling, between samples, was for Wild Cattle with 43% Rural support compared to 29% Urban support. Interestingly, just 2% of each sample’s respondents did not support any aerial culling at all. Observed differences, between samples, were not significant ($\chi^2=8.22$, $DF=8$, $P = 0.4122$).

In responses to Question 3C, 52% of Urban and 43% of Rural respondents believed aerial shooting of wild horses was unacceptable. If the remaining proportions of these groups are

assumed to therefore find it acceptable wild horses can be compared to the other animals in Question 4E.2 (Table 2.2).

Table 2.2: Responses to Question 4E.2 summarised as acceptance of aerial culling for the various animal options.

Order of acceptability for aerial culling	Animal species
1 st , i.e. most support observed	Wild pigs
2 nd	Wild dogs
Based on 3C data horses would be here	Wild horses
3 rd	Wild goats
4 th	Kangaroos
5 th	Wild cattle
=6 th , i.e. least support observed	Wallaroes
	Emus

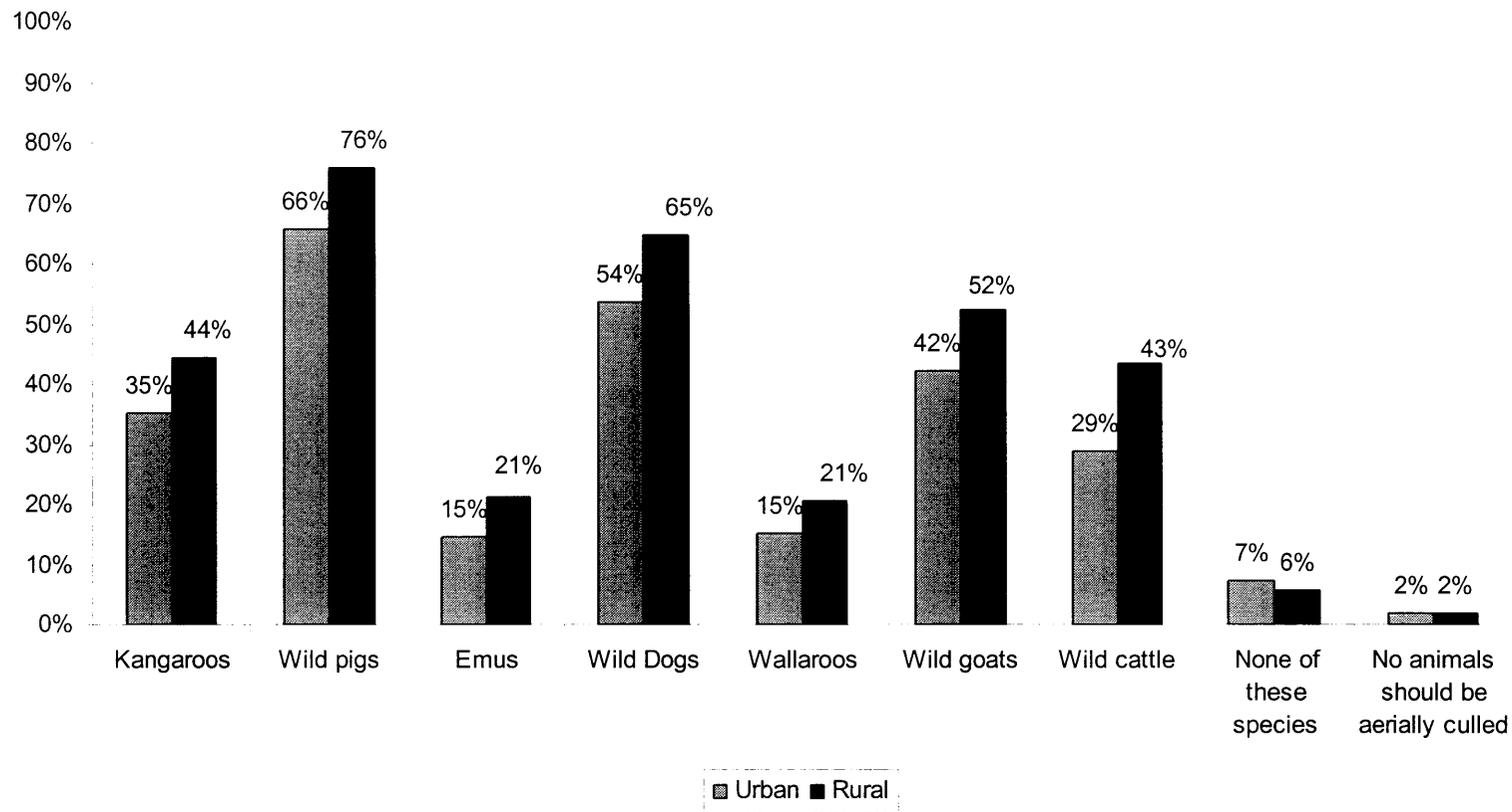


Figure 2.30: Urban and Rural responses to Question 4E.2: “For which of the following animals should aerial culling be permitted?”
 (N.B. Because participants were able to select more than one response to this question, cumulative responses may exceed 100%)

Question 4F: Do the Heritage Working Party’s findings justify maintaining GFRNP horses?

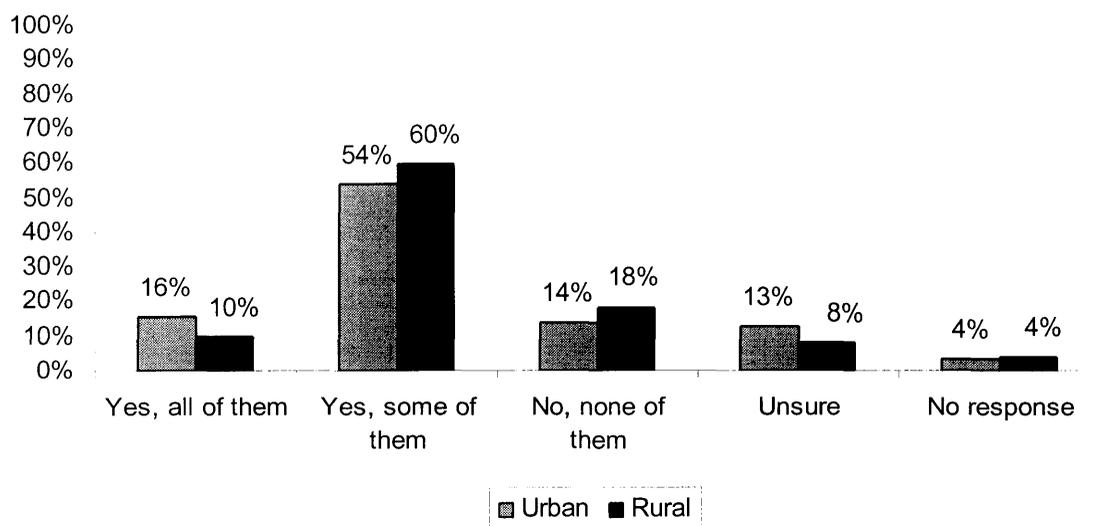


Figure 2.31: Urban and Rural responses to Question 4F: “Do you feel that these findings (of the Heritage Working Party) justify maintaining the Guy Fawkes River National Park wild horses?”

The majority of Rural and Urban respondents believed the Heritage Working Party’s findings justified maintaining “some” of the wild horses from GFRNP (Figure 2.31). However, 18% of Rural respondents, and 14% of Urban ones, did not agree.

The observed differences between Urban and Rural samples’ responses were significant ($\chi^2=13.92$, DF=4, P = 0.0076).

Question 4G: Do you agree that horses with ‘heritage significance’ should not be killed?

More respondents supported, than opposed, the Minister’s decision to prevent GFRNP horses with Heritage Value from being killed (Figure 2.32). However, a greater proportion of Rural, than Urban respondents disagreed with this plan. Significant differences were observed between the samples ($\chi^2=13.92$, DF=4, P = 0.0076).

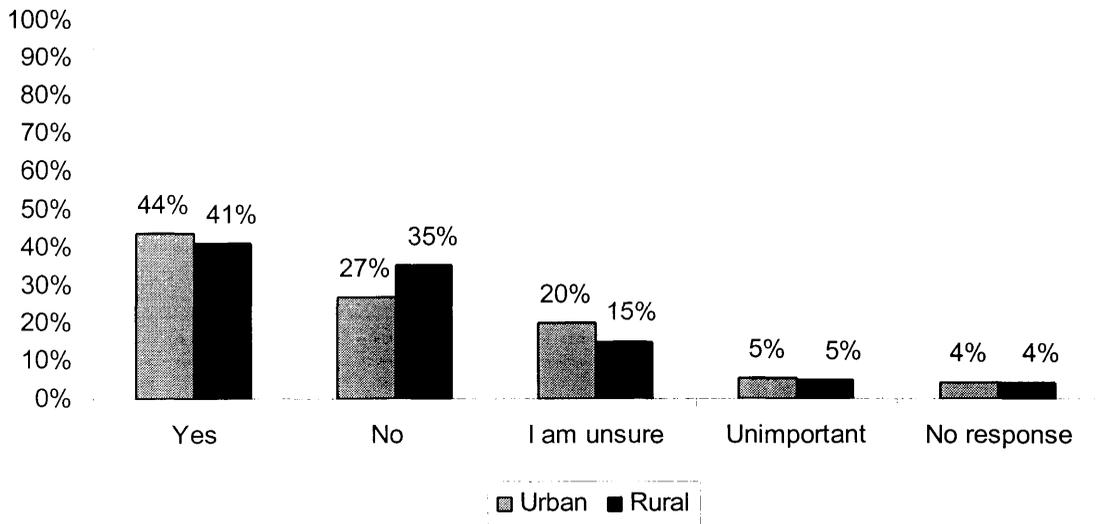


Figure 2.32: Urban and Rural responses to Question 4G: “Before the Working Party was established, the NSW Minister for the Environment determined that any horses with heritage significance would not be killed but would be removed from the Guy Fawkes River National Park. Do you agree with this plan?”

Question 4H: Do the ‘Heritage’ findings justify special management of these horses?

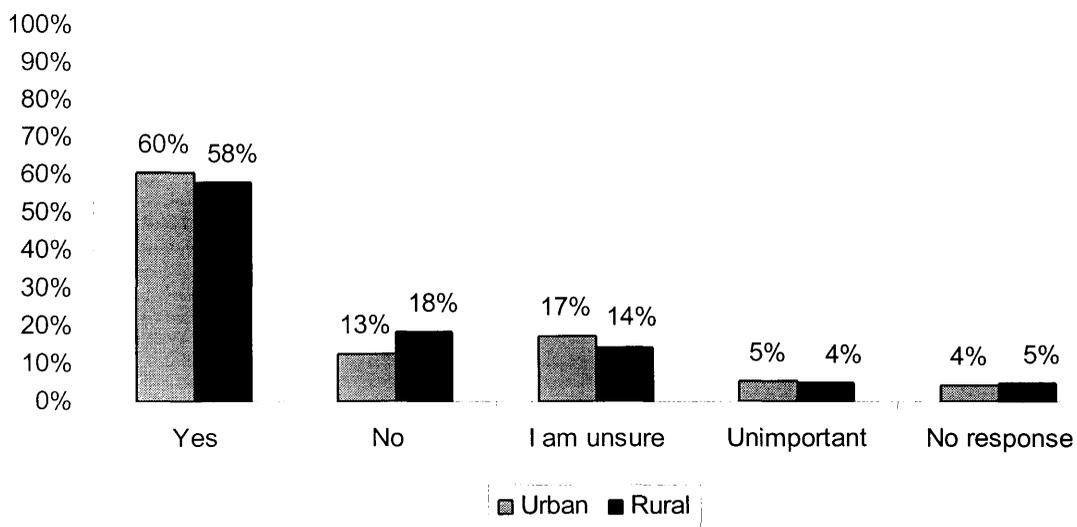


Figure 2.33: Urban and Rural responses to Question 4H: “Do you feel that the findings of the Heritage Working Party justify any special management of these horses?”

The majority of both samples’ respondents indicated a belief that the Heritage Working Party’s findings justified special management of the GFRNP horses (Figure 2.33). No

significant differences were found between Urban and Rural responses ($\chi^2=6.31$, DF=4, P = 0.1771)

Question 4I: Based on the 'Heritage' findings should a heritage herd be established?

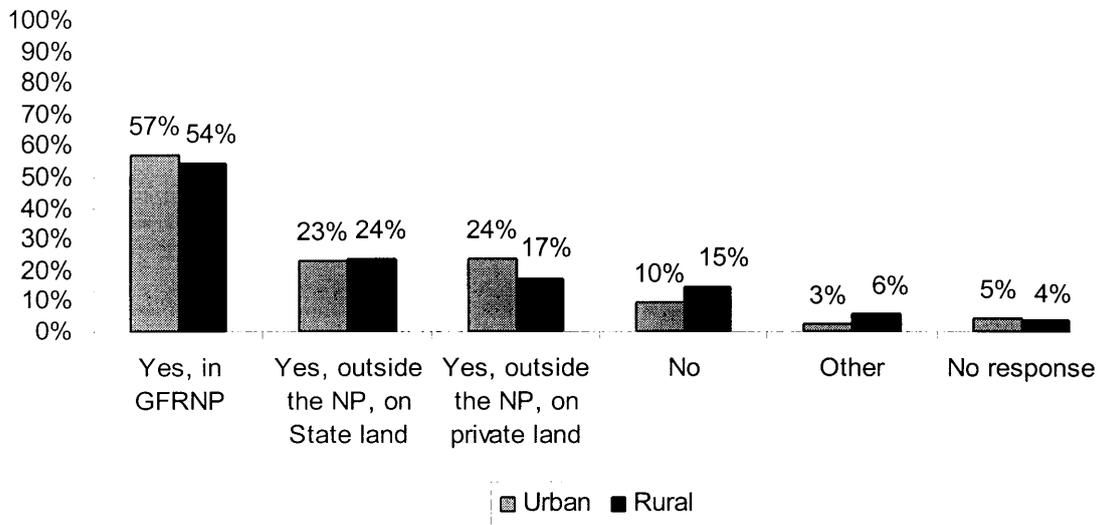


Figure 2.34: Urban and Rural responses to Question 4I: “Based on the heritage value of the wild horses in the GFRNP, would you support the establishment of a managed, heritage herd?” (N.B. Because participants were able to select more than one response to this question, cumulative responses may exceed 100%.)

At least 78% of Rural and 84% of Urban respondents indicated support for the establishment of a Heritage Herd by selecting at one or more of the first three responses to 4I. Interestingly, more than half of the total respondents from each sample indicated support for this herd existing inside the GFRNP (Figure 2.34). In contrast, just 10% of Urban and 15% of Rural respondents opposed the idea of such a herd.

Differences between Rural and Urban responses to Question 4I were significant ($\chi^2=13.61$, DF=5, P = 0.0183).

Additional Comments

Among the responses received, 237 individuals wrote additional comments on the back-page of their questionnaires resulting in more than 40 pages of transcribed text. Individual comments ranged from a few words to multiple pages attached to the questionnaire.

A further, qualitative investigation of these comments, using N6 software, has been initiated as part of a separate research project. Currently, the final outcome of this analysis is not available. However, it is possible to reveal that many of the themes identified within the comments parallel questions included in the Wild Horse Management Questionnaire, e.g. attitudes toward horses, attitudes toward the management action in GFRNP, historical/societal value of horses or the need for use of horses in some way.

2.3.4 Non-response sample

From 940 non-response questionnaires, just 54 completed replies were received. This equates to a response rate of just 6%.

Of the replies, 30 were from the Rural sample. The remaining 24 came from Urban participants. Interestingly, observed trends in Urban and Rural replies were similar to those detected in the responses to the wild horse management questionnaire. However, due the small sample size, statistical comparison with the main round data was deemed to be inappropriate.

2.4 Discussion of the Wild Horse Management Case Study

2.4.1 Overview

Investigation of public opinions regarding Australian wild horse management was undertaken because the GFRNP scenario had unmistakably revealed the issue to be socially divisive. It was an aim of this case study to determine whether managers could have effectively gathered information about public opinions of wild horse management, in such a way as to benefit the GFRNP scenario. This aim was met.

Using questionnaire-based research this study obtained relevant management information from stakeholders that enhanced understanding of the range of public opinion regarding wild horse management. The results suggested that pro-active engagement of the public using the methods applied in this project could have likely yielded information that, interpreted correctly, would have cautioned managers against the implementation of aerial culling.

Of key interest from this perspective were the diverse responses observed regarding specific management options and the significant differences revealed within and between respondent groups. This heterogeneity suggested a mixture of opposition and support among the wider public for many management options indicating the need for further, grass-roots involvement of stakeholders in the management process to achieve broadly accepted wild horse control. Such needs strongly contrast with the actual management undertaken in the GFRNP scenario.

Some limitations existed regarding the methods used and, consequently, the data collected. For example, extrapolation of specific results beyond the respondent group is not recommended due to uncertainty regarding the extent of non-response bias. However, from the perspective of meeting the case study's aims these limitations did not significantly detract from the value of this research. Despite the inherent limitations, this case study demonstrated the efficacy of human dimensions research, in wild horse management, to benefit informed decision-making and subsequently reduce the likelihood of conflict with stakeholders.

Organisation

From my perspective the success of the case study was dependent upon three specific outcomes.

- Firstly, a representative sample of the public had to be contacted about wild horse management issues.
- Secondly, my effort to make contact with the public needed to be reciprocated, i.e. participants had to return information to me in sufficient quantity for the data to be useful.
- Finally, those replies had to have management significance for wild horse management, i.e. the quality of the data needed to be of a sufficient standard for managers to use.

I believed that meeting these goals would help me to evaluate whether this type of research could have made a significant difference to the GFRNP scenario and therefore assist in building a case for more widespread application of Human Dimensions Research, in Australia.

This discussion focuses first on the results obtained using the Wild Horse Management Questionnaire, then turns to the benefits and limitations of the methods used to make contact with, and obtain a response from, the public.

Also, I review management decisions made during the GFRNP management scenario in the light of obtained results to determine if Human Dimensions Research has value for wild horse management.

2.4.2 What did the questionnaire reveal that was relevant to Wild Horse Management?

The discussion of results is presented by Sections, in their order of appearance in the Wild Horse Management Questionnaire.

Section One – Personal Details

The information collected from respondents in Section One of the Wild Horse Management Questionnaire was important for three reasons. It served as a measure of the diversity of the respondents, it could be used to determine the representative nature of the samples, and lastly it served as a potential source of independent variables for analysis of responses to other, management-related questions.

Respondents came from a variety of demographic groups with a diverse range of experiences. Among Urban and Rural samples there were adult men and women from all but the oldest expected age category and with a variety of backgrounds. Since people over 90 years of age were not only unlikely to be sampled due to their rarity but might also reasonably be expected not to make the effort to complete and return the questionnaire their absence from the sample was considered acceptable.

Other factors, such as educational experience, whether respondents were shooters or non-shooters and whether they were horse owners or not, varied within the two (Urban and Rural) samples. These varied characteristics meant that the information gathered using the questionnaire did not come from a single or even just a few common points-of-view, increasing the likelihood of approximating the diversity within the wider community.

Gender and age were two variables easily compared with the ABS (2001) census data to provide a measure of how representative the samples were, relative to the population of the Commonwealth Electoral Division of New England. Examination of the gender ratio of each sample revealed that although the Rural sample did not differ significantly from the wider population, the Urban sample did, as a result of more women than expected completing the questionnaire. Like the variation observed between respondent age distributions and that of the wider population, such differences should serve as a caveat for people who wish to

broadly extrapolate the data. Any such efforts would require that the census data, and information about non-respondents, was used to ‘weight’ or adjust response ratios, to reflect the results from a truly representative population.

With a sufficient number of respondents, it would have been possible to analyse the responses to questions throughout the remaining sections of the questionnaire, using data collected from Section One as independent variables. In fact, using multivariate techniques such as Multiway Frequency Analysis it would theoretically be possible to examine the relative importance of each variable to a predictive model of observed responses. Unfortunately, such analysis typically requires 5 times as many cases as variables (Tabachnick and Fidell 2001), with the addition of each variable having a multiplicative effect on the required number of cases. Such numbers of cases were not planned for, nor received, in this study.

Establishing context for the responses to management questions was important as it would potentially allow associations to be identified between particular group traits and/or experiences with response preferences. Developing an understanding of such relationships was seen as an important step towards being able to predict likely management preferences from basic information about respondents in future research.

A review of data collected from Section One revealed several interesting and potentially important, differences between the Rural and Urban respondents. For example, although the majority both groups’ respondents classified themselves as “rural”, in response to Question 1D, their responses to other Section One questions were substantially different, for example, in terms of experiences related to shooting and contact with horses. This reinforced the notion that self-assessment by respondents, on such a subjective variable, had potential to confound results rather than assist in categorising them in a constructive way.

Differences aside, the high level of horse ownership observed among respondents was an interesting discovery. It was surprising to find that many people had owned large numbers of horses, several indicating ownership of more than 100 animals. As a result, even though just less than half of Urban respondents had been horse owners, the mean number of horses, per owner, was in excess of 7 animals, and more than 14 per owner in the Rural sample.

It was not possible to determine whether respondents were equally likely to have been horse owners as non-respondents, given the small amount of non-response data collected, but obtaining information about people's experience with horses is potentially important to managers as one might expect that a community with many horse owners could be more likely to display an affiliation for the animals, than a community of people who have not owned or regularly had contact with them. Further, if such affiliation is associated with opposition to particular management options then such insight could be extremely useful in terms of predicting likely responses to management, therefore assisting managers to pro-actively tailor their intentions to minimise conflict.

Knowing that few respondents belonged to horse or equestrian organisations was important to demonstrate that the data had not been collected from individuals who would generally be assumed to have strong affiliation to horses. Also, it was possible to show that the respondents were not all people who had seen wild horses or who had encountered wild horses in GFRNP, both of which would have also likely affected the perceptions of the responses being biased.

In summary, although Section One was primarily designed to show that information could be gathered to differentiate between responses regarding management, it also provided insight into the mix of people who completed the questionnaire and revealed that there were significant differences in experiences between Rural and Urban respondents, reinforcing the importance of comparing the two groups' knowledge of wild horses and their management preferences.

Section Two – Knowledge and Beliefs

English (2001a) suggested that the community needed to be educated about wild horses to aid future management of the animals. Likewise, Dobbie *et al.* (1993) also argued for education via extension to increase stakeholders' understanding of facts relevant to wild horse management in the Australian environment. A key step in designing such education should be establishing what stakeholders already know, if only to confirm that there is a knowledge gap. The questions in Section two of the Wild Horse Management Questionnaire were relevant to management because they provided some measure of respondents' knowledge of

wild horses and, thus, where beliefs differed from those that might benefit implementation of management.

The first result from this Section demonstrated that there was no fundamental misunderstanding among respondents regarding the potential for horses to compete with stock and native animals, such as kangaroos. This is valuable since competition is an important reason for managing wild horses (Dobbie *et al.*, 1993) and because general disbelief regarding the role of horses as competitors with other species is likely to be associated with a reduced acceptance of management being undertaken on this basis.

Retrospectively, it would have also been beneficial to further extend this line of questioning among respondents. Whilst understanding or believing that horses are potential competitors could be associated with general acceptance of the need for management one might realistically expect that a more useful measure could be whether or not stakeholders believed that competition was actually occurring within the specific area being managed and, further, whether they believed that specific management options would actually reduce competition in that area.

Because most respondents believed that wild horses are an introduced species, the likelihood was low that observed opposition to their management would be based on a false assumption about horses being indigenous in the Australian environment. Despite this, it was interesting to note that more than 1-in-10 people did believe that horses were native animals. This alone demonstrates that there is room for improvement in public understanding of the issues related to Australian wild horse management, although there is no evidence that addressing this issue, among the small proportion of misinformed respondents, would necessarily create specific, significant benefits.

Bark chewing is an environmental impact of wild horses in at least one part of the GFRNP but it is not a widely reported phenomenon within literature on wild horses. Around half of Rural and fewer than half of Urban respondents believed that wild horses damaged trees by chewing bark and roots, demonstrating that many respondents were not aware of this issue. Again, this revealed a potential opportunity for managers to increase understanding of their need to manage this species within the GFRNP.

Fewer than half of respondents believed that wild horses have a significant negative impact on Australian soils and approximately the same proportions indicated a belief that horses are significant competitors with native species, such as kangaroos. Since these are also potentially issues of concern for managers in the GFRNP, they also represent areas where public knowledge, or perhaps acceptance, might be considered lower than ideal for generating widespread acceptance of management. Again, if the assumed association between knowledge of environmental impacts and acceptance of management, as inferred by English (2001a), held true, there would be an obvious case for addressing the knowledge gap to aid managers' implementation of wild horse control.

From this perspective, however, it is interesting that the preference for wild horse populations to be managed, as observed for the majority of both samples, suggests that the methods of management were more likely to be the source of controversy than the issue of whether or not wild horses should be managed at all. This supports another observation of English (2001a) and suggests that the investigation of the acceptance of specific methods, as undertaken using Questions in Sections 3 and 4, was worthwhile, whilst simultaneously alleviating the need to explore associations between specific beliefs about wild horse impacts and the need for the animals to be managed.

From these observations it is clear that results from Section 2 provided potentially useful insight into the respondents' beliefs and that such information, from a management perspective, could provide a measure of where actual beliefs are incongruent with target ones, allowing managers to evaluate the need for education and extension as well as understand which groups in the community might be targeted for greatest efficiency.

As well as examining beliefs about wild horse impacts, and addressing the issue of whether or not wild horses should be managed, Section two also collected information about respondents' general preferences regarding the existence of wild horses, in NSW.

This question revealed a fundamental difference in ideology between a significant proportion of respondents and the intent of the legislated responsibilities for managers, regarding wild horse management, in NSW. This is true because at least two fifths of Rural and Urban respondents selected the option of keeping wild horses "*in some NSW National Parks*" whereas managers are obliged, by policy, to remove these animals from lands under the

control of the agency (NPWS 2003). Although a greater proportion of respondents supported keeping wild horses on private land than any other option, this did not diminish the importance of the observed contrast between so many respondents with agency policy and management objectives.

From the perspective of the respondent groups, it can therefore be stated that no mandate existed for NPWS to remove wild horses on this basis. Indeed, it is interesting to note that “*no wild horses in any NSW National Parks*” was a somewhat radical option among the respondents, supported by as small proportions of the samples as were “*no wild horses at all*” or “*wild horses in all NSW National Parks*”.

Section two revealed some knowledge deficits within the respondent population about the role of wild horses in the Australian environment. Most people believed that horses could compete with other species and were an introduced animal but the proportions who believed that wild horses significant negative impacts upon trees and soil, or that they actually compete with native wildlife, showed that there is room for managers to increase public awareness. Such education will be valuable if these issues continue to be identified by managers as reasons for wild horse control.

Potentially, such differences could be associated with variation in preferences for management but since most respondents were in favour of wild horse populations being managed, regardless of their beliefs about horses, there is little practical value in pursuing such correlations. Instead, further research efforts should perhaps be applied to determining whether beliefs regarding particular impacts affect acceptance of specific methods of management, such as aerial culling.

Lastly, Section Two of the questionnaire revealed a fundamental disagreement between many respondents and NPWS policy. Identifying such a difference in advance of implementing management has the value of offering managers the opportunity to address the difference and, ideally, avoid significant conflict with stakeholders.

Section Three – preferred management for wild horses in NSW National Parks

Since the GFRNP scenario conflict had been essentially judged on public acceptance of management methods, Section Three was aimed at determining respondent acceptance of, and preference for, specific management options for wild horses.

In particular, assumptions and claims had been made about widespread public dissatisfaction with aerial culling as a method for the control of wild horses. Since these had been based, at best, on anecdotal evidence, responses to Question 3A were of significant interest. Indeed, this single question, more than any other in the Wild Horse Management questionnaire, carried my hopes for the case study. I had hypothesized that by asking a sample of the entire community what they preferred regarding the control of wild horses, one should be able to collect information that would aid in making management decisions that were more acceptable from the public's perspective. The observed results overwhelmingly supported this idea.

Quite contrary to the picture of majority disapproval that arose following the GFRNP cull, Urban respondents were relatively evenly split between supporting or opposing aerial culling and amongst the Rural sample most respondents actually supported aerially culling of wild horses in NSW National Parks.

As a reactive tool for managers, this question and the results it generated were not sufficient to argue that overwhelming public support actually existed for the method. However, as a pro-active fact-finding exercise, the inherent management value of these responses was immense. The results showed that among those individuals who would voluntarily react to a wild horse management stimulus (i.e. the questionnaire), there was significant disagreement over the application of this particular control method. At the very least this should have signalled the need for caution in deciding to employ aerial culling, and, at best, i.e. within a management framework optimised for incorporating community opinion into wildlife management decision-making, it would have triggered further research into methods that would be most acceptable.

Questions 3B and 3C provoked responses suggesting that respondents were more concerned about the specific methods selected to kill horses than whether or not wild horses should be

killed. More than two-thirds of both samples selected at least one lethal control method as their preferred option for wild horse control. Almost half of both samples preferred the option of “*capture (of wild horses) for consumption by people and or pets*”, although it would clearly result in the death of the animals. In contrast, respondents overwhelmingly opposed poisoning as a control method even though the end result to the horse is the same as removal for consumption or any other lethal method. Consequently, it seemed that how the wild horses would die, perhaps best described in terms of the perceived humaneness of the method/s used, was paramount among respondents’ considerations of wild horse management.

This suggests that engagement of the community to establish a socially acceptable management plan for removing wild horses was possible. If the group contacted was similar to the questionnaire respondents it was even likely that lethal control methods would have been acceptable.

By identifying levels of support for specific methods, Questions 3B and 3C provided valuable context for reactions to aerial culling within a framework of other management options. This carried additional interest since the list of management options offered to participants included some methods employed in the GFRNP following the October 2000 cull.

Among Rural respondents, aerial culling did not fair as poorly as might have been assumed from the outcry that followed the GFRNP cull as it was actually the 4th most popular control method selected. For the Urban group, however, it ranked 7th out of the nine available options with only “*poisoning*” and “*no control*” being less preferred.

This difference demonstrates the potential difficulty that managers face in making acceptable decisions about management since contact with stakeholders, such as the respondents in this case study, would be likely to give a very different view of the social acceptability of aerial culling depending upon the Urban or Rural status of the individuals. This is important since the GFRNP scenario revealed that the views of stakeholders, regardless of being Rural or Urban, can have substantial influence over political decisions regarding management and therefore must be addressed. Further, this variation also demonstrates that in engaging the public about management, not sampling sufficiently widely can result in important differences in opinion being overlooked.

More respondents, in both sample groups, preferred the options of removal to private property and removal for consumption than any other methods. Among Urban respondents most people preferred the removal of wild horses to private property whilst almost half of Rural respondents preferred that the animals be captured for consumption.

Aside from demonstrating the difficulty that managers would face if it were their aim to please the majority of people with the choice of a specific management method, asking questions 3B and 3C provided some insight into which methods would likely be most controversial among respondents. To this end the questions could provide something of an early detection system for managers within the planning process if they are interested in avoiding significant, adverse public reactions.

Whilst these results do not make it clear which management option should be adopted, it clearly narrows the range of acceptable methods based on respondents' perspectives and shows that there is potential for managers to extend this process further, to focus groups for example, for the purpose of exploring how the acceptability of potential management methods might be maximised.

With regard to evaluating actual management decisions, these results are also interesting since the final outcome of the GFRNP conflict and subsequent review of management was to remove wild horses from the Park to private property. Also, since horses are not always bought by private owners who wish to keep the animals either for work or recreation, some are sold for consumptive purposes. These two control methods were most preferred by respondents to the questionnaire.

Although one might consider that the results of the survey appear to justify the current management practice it is far more valuable to consider that the use of the questionnaire in advance of the October 2000 cull might have led to these current practices being adopted sooner. If that had occurred there could have been substantial benefits to the relationship between managers and stakeholders rather than the observed damage done to the public image of the management agency.

It was clear that substantial differences existed among respondents, not only regarding aerial culling but for a range of potential methods for wild horse control. Given that the observed responses to questions in Section 3 demonstrated that it was possible to derive information from the public regarding wild horse control methods, the results suggest that pro-active application of such methods could be used to optimise management planning.

Section Four – Public responses to management of wild horses in the GFRNP.

Responses to Section Four's questions further demonstrate the value of this type of research in Australian wildlife management, both for pro-active determination of stakeholders' acceptance of management options and for evaluating management decisions, *post hoc*.

Just as the media response to the October 2000 cull demonstrated that there were many people in the community who were interested in wild horse management so too the fact that more than half of Urban and Rural respondents had never visited the GFRNP also suggested that stakeholders are more diverse than those people who have a direct connection to the specific area of management. This should serve as a reminder for managers to consider a broader population of stakeholders than just those who are physically close to the area of interest.

Although more than 80% of both samples indicated awareness of the 2000 GFRNP cull, it is not possible to state that this reflects community-wide knowledge of the incident, even within the geographical scope of this case study. In the absence of more complete knowledge of the non-respondent population, it is worth noting that rather than participating and coincidentally being aware of the cull, many respondents may have participated specifically because they were aware of the cull.

Although knowledge of the 2000 cull might have been an important factor for consideration in the analysis of responses to wild horse management options, the sample sizes of people who were unaware of the cull were considered to be too small to make appropriate comparisons.

In terms of developing an understanding of the context for participants' responses to the GFRNP scenario, it was interesting to observe how people had become aware of the management action. Overwhelmingly, the majority of Urban and Rural respondents reported

television as their source of information about the culling operation, with more than a third also reporting Radio and Print media.

Even though it was apparent each of these media had played a role in informing respondents about the GFRNP cull, television was more pervasive in its contact with respondents on this issue. In light of this, it might be valuable for managers to further investigate the use of this medium for the benefit of future manager-stakeholder interactions, particularly for extension purposes.

Support for the Ministerial ban on aerial culling was far from overwhelming. Only in the Urban sample did a majority of respondents support the decision to no longer allow wild horses to be aurally culled in NSW. Conversely, just 24% of Urban respondents opposed the ban at the time of its implementation. This ratio of support to opposition was quite different to that observed amongst Rural respondents, who more evenly split. No majority was evident within the Rural sample regarding this issue, again reflecting the difficult position managers face in terms of predicting how stakeholders would respond to such an issue in the absence of representative sampling of opinion.

When I compared respondents' current and previous positions on the ban on aerial culling, no substantial change was observed. It seemed that, over the period of time since the ban was implemented, most people had not changed their minds. Increases in the proportions of respondents who indicated support or opposition for the ban were almost exclusively due the decisions of respondents who were previously unaware of the Minister's actions. Despite almost two years passing, respondents' opinions remained fixed, whether in support or opposition to the ban. None of the information provided following the cull, including the findings of the English report (English 2000), appeared to have affected a significant proportion of respondents either way.

As in Section 3, Questions 4E.1 and 4E.2 represented types of questions that managers could have pro-actively asked stakeholders, to better understand both the context for management and specifically public opinions of management options.

Responses to Question 4E.1 confirmed the findings from Section Three: almost half of respondents did not object to horses being shot. However, among those that did, there was no

single reason that accounted for the majority of objection to control by shooting. In turn, because opposition to shooting horses was based in a variety of reasons, it seems clear that attempting to understand community opposition to shooting, as a management option for wild horses, would be difficult without actively seeking better insight into public opinion.

Finding that respondents were polarised in their acceptance of aerial shooting to control wild horses also provided the opportunity to evaluate whether horses really were a 'special' animal from stakeholders' perspectives. To do this, a comparison was made between acceptance of aerial culling for wild horses and use of the method for controlling other species.

It was apparent from Question 4E.2 that opinions differed, among both samples, about whether or not various animals should be culled in this way. For example, the majority of people comprising the Rural and Urban samples were in favour of aerial culling of wild pigs but far fewer accepted use of the same method to control wild cattle, despite both being feral species.

By comparing data from Question 3A with the results of 4E.2, it was shown that support for aerially culling wild horses (conditional and unconditional combined) was third highest among the various species offered to respondents. These results suggest that wild horses were not an extra-ordinary species for many respondents as greater proportions of both samples supported aerially culling wild horses than other introduced animals, such as wild cattle or even wild goats.

Other species that were unlikely to be managed by aerial culling were also included to see how respondents might distinguish between species. Whereas wild dogs came second only to pigs in terms of support for aerial culling, emus and wallaroos were the two species for which aerial culling was least popular. This low response was perhaps an artefact of public perceptions of their pest status, rather than because they are native species, given that more than a third of Urban and Rural participants favoured aerial shooting of kangaroos.

Despite not appearing to be extra-ordinarily 'special' compared to the species in 4E.2, wild horses still had sufficient cultural value to warrant their being afforded special management. Although only a small percentage of Urban and Rural respondents felt that all of the wild

horses with Heritage Value should be maintained, most respondents were in favour of affording Heritage-Value-based protection to at least some of these animals. This would have been of value for managers to know in advance of the cull.

Even though this question (4F) had been framed within the context of post-cull management, it would likely have been possible to identify the need to ask such as question in advance of the October 2000 cull given the interest of some locals in particular bloodlines within the GFRNP population (English, 2001a) and general societal interest in horses associated with the remount trade during the First World War (HWP, 2002).

It was not surprising that there were similar levels of support for the decision to remove from the Park, but not kill, wild horses with Heritage Value since approximately half of respondents indicated a preference for the capture and removal of horses to private property.

Further, it was both interesting, and a sign of consistency on behalf of respondents, that the notion of keeping wild horses in some NSW National Parks resurfaced in responses to the final question as it had been identified in Question 2F.1. A majority of respondents from both samples, indicated support for establishing a “Heritage Herd” of wild horses within the bounds of the GFRNP. This is a classic example of what has been described as the “rogue-to-respectability phenomenon” (Low 1999), where an introduced or feral organism is treated as if it were a native species. Such occurrences can offer significant challenges to wildlife management, but it would clearly be more beneficial for managers to know that such sentiment existed prior to conflict occurring over the issue than following the implementation of management when only reactive measures can employed.

Viewed cynically, one might see the results of Section Four as evidence for maintaining a top-down, scientific-expert approach to wildlife management rather than allowing Human-Dimensions research to potentially open a Pandora’s Box of community participation. Critics might assume that allowing the untrained, general public access to decision-making power will lead to ecologically flawed decisions, such as sanctioning the existence of wild horses within National Parks. Realistically, however, the public already has the power to achieve such shifts in policy through lobbying the Government but requires catalysis to reach that potential. Each conflict between stakeholders and managers that occurs as a result of

management ignoring public opinion drives the potential for political backlash against scientifically-based management ideals.

From this perspective, Human Dimensions Research is, rather than being something to fear, might be seen as managers' best hope for ensuring that poor management options, i.e. those based on emotion at the expense of scientific evidence, are not implemented. Identifying the existence and extent of attitudes that contradict ecological principles will permit managers to deal with these issues in a constructive way and maximise public support for their initiatives. If agencies can be inclusive, not confrontational, in their approach to management of wildlife they create the opportunity to optimise support for management efforts among the community and, in the long term, enhance managers' reputations as a source of valuable information and opinion regarding management.

The first step in this process should be gathering information about what the general public wants and believes. The Wild Horse Management Questionnaire has shown that taking this step would have been possible and beneficial for managers in the GFRNP context.

2.4.3 Relationships between the results and the review of wild horse management

Importance of the review

The review of wild horse management revealed several topics for investigation that were important to the GFRNP management scenario. Previous authors had written much that would have been of value to managers in developing a better approach to the GFRNP scenario, particularly about the special significance of horses to many people, the diversity of opinions that exist towards wild horse management and varying preferences for specific management options. The relationship between the observed results and these topics are discussed below.

Diversity of Opinion, including Rural and Urban differences

The review of wild horse management revealed that Australians have a long history of association with horses and have displayed disagreement over the management of wild populations of these animals. In reviewing material about the role of horses in Australia, it

was clear that two key trends have emerged over time. Firstly, people's dependence on horses have decreased since their introduction to Australia. Secondly, over the same time, controversy, in the public forum, regarding the management of these animals has increased, climaxing in the case of the GFRNP scenario.

The differences observed between Rural and Urban samples suggest, unsurprisingly, that the decrease in contact between people and horses has been more complete in Urban than Rural areas. However, the general trend for Rural people to be more accepting of the need to manage wild horses suggests that increased contact is not necessarily associated with a protectionist view of the animals.

Indeed Rural respondents were generally more accepting of management, and more specifically, the use of lethal control options, than their Urban peers, supporting the suggestion of Berman (1991) that city people, compared to rural ones, would be less likely to understand the need for wild horses to be managed.

Differences between groups, however, were not the full extent of variation detected during the case study. There was also a great deal of variety of opinion within the Rural and Urban samples. The significance of these differences, for managers, is related to the observed difficulty in making socially acceptable management decisions, for example in the case of the GFRNP scenario. The fact that such heterogeneity existed within samples reaffirmed the need for managers to investigate community attitudes towards wildlife management rather than assuming that contact with small numbers of interested parties would provide an accurate representation of community views.

The wild horse management questionnaire is an example of a 'first-step' to incorporating community attitudes into management by actually sampling them. Consequently, the next step must be recognising similarities and differences within the sample taken from the community of interest. Here the differences between Rural and Urban samples, regarding wild horse management, are most important. The results of the questionnaire suggest that Rural and Urban communities should be treated differently, based on their varying acceptance of objectives and potential methods for management, rather than managers adopting a uniform approach to engaging the public about wild horse management. The need for diverse/flexible

management approaches will be discussed further in the overall discussion, in the light of findings from the other two case studies.

Differential support for management methods – aerial culling

During the review of wild horse management, the issue of differential support for specific management methods among stakeholders was encountered. Previous authors had commented on the strong opposition to some management techniques evident among members of the wider community. In particular, aerial culling was singled, by authors, as a controversial issue (Wurst, 1984; SSCAW, 1991; Dobbie *et al.*, 1993).

The absence of overwhelming majority support for any single management option demonstrated the expected diversity of opinion and the difficulty managers face in selecting an appropriate way forward for management.

Aerial culling, in particular, was unpopular with about half of each sample yet respondents felt other options were worse, including poisoning and no control at all.

Ideally, these results will focus future efforts upon establishing socially acceptable methods by working with the community, rather than operating in ignorance or contrary to their beliefs.

The notion of horses as a special animal

Some individuals and special-interest groups have fought to ensure that horses maintain a status separate from many other species. Additional comments from respondents supported this via suggestions such as allowing horses to remain in the GFRNP and references to horses deserving better treatment by managers due to their service to humans.

In light of historical association between people and horses such responses are understandable. However, the contemporary human population no longer relies upon these animals for day-to-day survival or even conveniences. Whilst there is still an important economic and recreational role for horses, they are not the mainstay of society that they once were. In this light, one might assume that people were less likely to attribute special significance to horses.

Certainly, from the perspective that aerial culling of wild horses gained more support than that of wild cattle or wild goats, there was some evidence that horses were not relatively special for many respondents.

However, it is important to note that once heritage Value was attributed to the horses, the majority of respondents favoured special management consideration, e.g. maintaining a Heritage Herd in the GFRNP.

Among respondents, the idea of horses being 'special' clearly existed but other issues, such as their Heritage Status and the proposed management methods appeared to be more important to the GFRNP scenario.

2.4.4 Methodological considerations within the Wild Horse Management Case Study

Aside from assisting in my own development with regard to this style of research I was aware of the need to identify both the benefits and limitations of the methodology I had used within the case study. This is because I wanted to maximise the potential to assist managers who might be tempted to apply this style of research, given that, in Australia, they were unlikely to have social science or specific Human Dimensions training.

Contacting the public about wild horse management

In evaluating the applicability of this style of research to assist wildlife management, the population of interest was first defined (The Commonwealth Electoral Division of New England) before being stratified to account for expected variation (Rural and Urban samples). Next the required number of responses was determined as a function of desired precision (382 responses per sample) before the actual sample size was determined based on the likelihood of obtaining the required responses (1000 participants to achieve 382 responses).

Overall, responses from the two samples approximated the targets. Although the Urban sample comprised fewer than the requisite number of responses the precision estimates for the two groups differed only slightly, being plus or minus 5% for the Rural sample and plus or

minus 6% for the Urban one. However, it was more important to this research to receive as high a proportion of responses from Urban as Rural recipients of the questionnaire than to learn that precision differed by one percentage point, because equally large sample sizes, at the observed levels, meant that comparison of the two groups was appropriate.

Further, the differences between the precision estimates were of little concern because it was not the primary intention of this research to provide representative estimates of preferences for management options among the wider population.

Sampling Issues

Obtaining contact information for participants was extremely time-consuming. Although finding a source of participant information was relatively simple, the act of sampling individuals from the electoral roll proved to be difficult.

Transcribing participant data

Whilst the Australian Electoral Commission permits some researchers access to electoral roll data in electronic format, this project was not considered suitable for such a concession. As a result, all 2000 names were manually drawn and transcribed from a hard-copy of the electoral roll into electronic format for use during the project. Initially, attempts were made to use a page-scanner to upload participants' names and address data to a computer but the very small font size and relatively high cost of appropriate text recognition software prohibited automation, resulting in reliance upon manual transcription of participants' information.

Ultimately, since manually finding each name and typing it into the database was unavoidable, a template was fashioned from an overhead transparency sheet to allow specific numbers, and therefore individuals, to be more rapidly identified rather than counting down every page. Still, sampling was labour intensive and took approximately a week to complete.

Inaccuracy of the electoral roll

Unfortunately, a further problem also arose from use of the electoral roll to source participants. At least 10% of those people sampled were listed with incorrect addresses. It

was possible to determine that addresses were incorrect rather than simply being non-respondents because more than 200 Return-to-Sender (RTS) items carried labels such as “*Not at this address*”, “*Unknown at this address*”, “*Moved*” or other similar messages. This was disappointing as the 2001 electoral roll was the most up-to-date source of information available for this project; it had been updated for an election in the previous year.

As a consequence of the inaccuracies of the electoral roll data, many intended participants were not exposed to the questionnaire or other associated material. Personalised greetings were used on envelopes and handwritten on letters in an attempt to improve response rates (Dillman, 2000) rather than using a “Dear resident” approach. Whilst the use of generic addressing and equally non-specific greetings on letters to participants might have exposed more people to the questionnaire, those people would not have been the randomly sampled participants and there is no guarantee they would have returned the questionnaire. It is possible that this approach could have further decreased, not improved, the overall sample size, if Dillman’s suggestion about maximising response rates by using a personalised contact method held true.

Inaccuracies within the electoral roll did more than simply reduce the opportunity for people to be invited to participate in the research. Due to the inaccurate address data, the number of recipients and hence the proportion who responded are unclear. It is unlikely that the 200-plus Return-to-Sender items that I received constituted the entire number of incorrectly addressed items. Rather, it is possible that other inaccurately addressed questionnaire packages were discarded by unintended recipients, rather than returned. Thus, the response rate could actually be significantly higher than reported. Unfortunately, there was no cost-effective way to determine exactly how many of the sampled addresses were inaccurate so that I could better estimate the true response rates.

The public’s response

Second among my three criteria for success was receiving a utilisable response from the contacted participants and the 823 completed questionnaires that I received constituted exactly that. This feedback was a substantial accumulation of data sourced directly from the public. The quantity received was sufficiently large for me to identify important trends

among the respondent population and to make worthwhile comparisons between the Rural and Urban treatments.

Also, given the number of responses, potential existed to go beyond the key aims of the case study, and use the data to accurately report the preferences of the public regarding wild horses and their management. However, estimates of non-response bias were insufficient to permit this because the participants who did not complete a questionnaire or non-response survey are a potential source of non-response bias. Without being able to account for their preferences, one cannot assume that the sample is truly representative of the wider population.

Response rates

As indicated in the methods section, it was anticipated that response rate for the questionnaire would not exceed 40%. Given my concern that the public would be resistant to completing an unsolicited questionnaire I was extremely happy to receive more than 800 responses from my first attempt to conduct a large scale survey of human preferences for wildlife management and was surprised to see that the Rural sample response closely approached 50%. Further, achieving such a response on my first attempt, suggested that with more experience and refinement of the methodological approach, larger response rates might be achievable in the future.

Whilst it was disappointing that the inaccuracy of the electoral roll masked the actual response rate, it was unlikely there would have been a substantial difference as a result of knowing exactly how many incorrectly addressed items were sent out. For example, even if the 200-plus RTS items represented as much as one-half of the incorrectly addressed items, then response rates would have only increased to approximately 50% and 55% for the Urban and Rural groups, respectively.

What was most important to this case study was that the large amount of information obtained came from a diverse range of public participants. The respondents came from virtually all possible demographic groups in proportions that were reasonable for the population of interest. Both genders, horse owners and non-owners, shooters and non-shooters, people with a variety of educational experience, different backgrounds and virtually all ages, responded to the questionnaire.

The questionnaire did not appear to be biased against the participation of specific demographic groups. That is, respondents included many individuals who responded positively and many others who responded negatively to questions about horse ownership, participation in shooting, frequency of contact with horses and whether or not they had personally observed wild horses. This showed that the respondents were diverse in terms of personal experiences that were potentially related to views on wild horse management.

Where proportions of respondents with specific characteristics differed noticeably from other groups, plausible explanations existed. For example, the absence of respondents greater than 90 years of age was unsurprising given the reduced likelihood of sampling this relatively small age group and the effort required for someone of this age to complete and return a questionnaire. So too, low numbers of respondents who indicated having a coastal background were expected within these samples due to the inland location of the study area and the general trend for Australians to move from inland areas to the coast, rather than vice versa.

Overall, the important message regarding response rates is that this case study suggests it would have likely been possible for managers to gather data from a significant number of individuals, representing a range of demographic groups, had they attempted to similarly engage the community in advance of the GFRNP cull.

Obviously, it must be acknowledged that the fact the cull had already occurred could have increased the likelihood of the population participating in this case study, compared with the likelihood prior to the much publicised cull. So too, the effect of the research being conducted independently, rather than by NPWS might have biased response rates in some way but, regardless, the actual response rate shows that such research is worth considering as a means of collecting information from a larger and more diverse sample of the public than is achieved through incidental, passive means.

Non-response round

The most disappointing aspect of this case study was the low participation rate observed among individuals who did not reply to either of the first two rounds of survey questionnaires (i.e. non-respondents).

This is problematic because surveying non-respondents is essential for situations where one wants to ensure that observed results are representative of the wider population. Although the success of this case study was not wholly dependent upon the representative nature of the data, it would likely have helped to encourage managers to attempt such research in the future if information on non-respondents had been simple to obtain.

The response rates, and therefore actual response numbers, were sufficient to allow population estimates equivalent to plus or minus 5% for Rural and plus or minus 6% for Urban samples but only if the respondents and non-respondents were not significantly different (See Determining Sample Size, Sample Size). Clearly, with just 54 non-respondents participating from amongst the combined Rural and Urban samples, a comparison with respondents was not appropriate and the precision estimates could not be utilised.

Options other than a mini-questionnaire, delivered by post, were considered when planning the non-response round. Interviews of those participants who did not complete a questionnaire, for example, were contemplated but rejected for several reasons. Firstly, it was thought that interviews would be too time-consuming, given the geographic distribution of participants. Also, the expense associated with telephone interviews was prohibitive, as well as the additional difficulty of finding telephone numbers for each participant since they are not available on the electoral roll.

It was interesting to observe such a clear difference among the participants regarding their willingness to respond to the questionnaires. I had expected that the length of the questionnaire might have been a significant factor affecting participation but if this was the case a larger number of non-response replies should have been received given that the mini-questionnaire was much smaller than the Wild Horse Management Questionnaire.

Several other explanations are possible. Firstly, non-respondents might have been genuinely disinterested in the issue of wild horse management. Certainly, a few individuals who did respond included additional comments that clearly stated their preference for managers being allowed to make decisions based on their expertise, rather than having to turn to the public for advice. If this truly were the case then managers could safely operate with the data collected in a broader fashion than recommended above.

Another alternative explanation for complete non-response is the potential for individuals' opposition to completing surveys to override their willingness participate in the project. People commonly express disinterest and frustration regarding requests to participate in research and with receiving unsolicited mail. Similarly, the effort and time required to complete and then post the questionnaires might be sufficient disincentive to prevent participation, even though the size of the questionnaire was minimised and the reply-post procedure simplified via pre-addressed, reply-paid envelopes.

It is important to note that even in the absence of replies from respondents it is not clear that these people would be averse to either supporting or opposing actual management initiatives. Thus, cautions about the representative nature of the data collected still apply.

Additional comments from respondents

The additional comments written on the back of questionnaires provided an opportunity to check that the Wild Horse Management questionnaire had sufficiently covered the issues relevant to wild horse management, including those specifically relevant to the GFRNP scenario, from stakeholders' perspectives. Generally, additional comments served to expand upon responses within questionnaires and few novel issues were raised.

However, among those issues not identified during the review, the most notable was the perceived role of horses in reducing bush-fire risk as a justification for maintaining them, and other livestock species, within National Parks. Multiple responses were received from people who strongly felt that horses should remain to assist NPWS staff in controlling fire risk.

This had not been identified during the review of Australian wild horse management issues and served to demonstrate that even a thorough review of the literature was not a substitute for interacting with the public, in attempting to determine the range of issues relevant to management. As a result, it is recommended that future research include a scoping stage where members of the community are invited to discuss management issues with the investigator, to maximise the relevance and coverage of questionnaires or interviews for stakeholders and, therefore, the management scenario.

The value of collecting information about wild horse management

Lastly, and perhaps most importantly, it was vital that the data collected from the public was useful for management. Without this utility it would be pointless investing the effort to establish contact with members of the community in the first place.

Questionnaire Design

It seemed clear that the first step in getting appropriate information would be asking appropriate questions. Even before piloting the questionnaire to confirm that questions could be understood and were in an appropriate order, some reference was needed to guide the inclusion of issues as questions.

A key concern in obtaining responses from the public was optimising the design of the Wild Horse Management Questionnaire. Design was considered to include the aesthetic aspects of the questionnaire as well as the content. Whilst there is no doubt the format and layout of the questionnaire have an affect on response rates, in terms of convincing participants to take part and with respect to the ease with which it could be completed (Dillman, 2000), it is the content that was of most concern during this case study.

The review of wild horse management in Australia revealed a wide variety of issues that were relevant to the public's view of wild horses and their management. As a result, deciding which questions to ask participants was challenging. Narrowing the array of options to a manageable number for inclusion in the questionnaire was not simple but the issues raised during media coverage following the GFRNP cull helped determine which questions were relevant to that scenario.

However, because I was interested in the potential application of this type of research prior to implementing management, considering questionnaire design in the absence of information such as feedback on the GFRNP scenario was also important. Essentially, how could one ensure that questions were valid if one did not have guidance from the media releases from special interest groups, articles in newspapers, discussion on radio and segments on television that were utilised in this project?

The review of wild horse management had shown that asking questions about every aspect of managing these animals was not feasible. The obvious solution seemed to be to actively engage the public during the design phase of the project, for example using community meetings or interviews, to determine the range of issues that they found relevant to wild horse management as well as those that were of inherent interest to managers. An examination of the literature revealed that such approaches had been used widely in overseas studies involving Human Dimensions Research. For example, Bright and Manfredi (1996) successfully used telephone interviews to determine questionnaire content in an examination of attitudes towards wolf reintroduction in the USA.

Evaluating GFRNP scenario management actions in the context of stakeholder sentiment

The third aim of this case study was met by examining key management decisions, identified during the review of the GFRNP scenario, in light of responses to the Wild Horse Management Questionnaire.

I would like to stress that in undertaking this evaluation it was not my aim to criticise managers. Rather, I hoped that by constructively assessing the GFRNP scenario, in the context of respondent's sentiment, I might better establish the efficacy of this type of research in benefiting Australian wildlife management.

The following management decisions* were the most significant ones in the GFRNP scenario:

- Managing wild horses in NSW National Parks
- Aerially cull horses in GFRNP,
- Review the aerial cull action, in response to public debate,
- Banning aerial culling,
- Engaging the community about future management of horses in GFRNP,
- Confirming the Heritage value of the GFRNP horses,
- Using the Heritage value of the horses to justify special management,
- Removing, but not kill, horses with Heritage value, from the GFRNP

Managing wild horses and the decision to use aerial shooting

One of the most important issues revealed in this case study was the separation between acceptance of wild horse management and acceptance of specific methods for achieving that management. That is, although most respondents indicated a preference for wild horses to be managed in NSW, they were polarized about whether such management should be achieved via aerial culling.

In light of around half of respondents opposing aerial culling the ban on this method of control might, at first, seem appropriate. However, a more optimistic view might suggest that this was important information that could facilitate further investigation of community

* These were made at various levels of the NSW wildlife management hierarchy, not solely by local managers.

attitudes towards the method to determine if acceptance could be improved. Such an approach seems particularly worthwhile since respondents did not generally oppose lethal control methods. This suggests that there were specific negative aspects of aerial culling that might have been identified and addressed, to increase public acceptance.

From the perspective of respondents, managers appear to have had a mandate to manage horses but not to aerially cull them.

Banning Aerial Culling

In political terms, the ban on aerial culling made good sense. Following the GFRNP cull, the combined effect of media reports and press releases by special interest groups and opposition politicians gave the impression that a majority of the public might be opposed to this practice. In light of this it no doubt seemed possible that this single issue could be damaging to the State Government's public image if the issue was not addressed.

In wildlife management terms, however, the ban was disappointing since an effective method of controlling wild horses was lost. In the first instance, when the Minister for the Environment indicated that all aerial culling would be banned in NSW there was the potential for widespread, significant setbacks to feral animal management in the State. However, even reducing this ban to cover only wild horses meant that an important control method was lost. From this perspective it would have, again, been beneficial to have a measure of what the public actually thought about aerial culling because there was no hard evidence, only inference, to suggest that such a ban was needed.

In the case of the respondents to the Wild Horse Management questionnaire, the samples were clearly polarized about aerial culling. Although this showed there was a substantial group opposed to the method it also revealed that there was considerable support for its use, in fact a majority among Rural respondents. This shows that rather than implementing a reflex ban and surrendering aerial culling as a control method it could have been beneficial to determine whether there was a place for the aerial culling in NSW in the eyes of the public. As discussed in the section above, such an investigation could have addressed not only the extent of support and opposition but whether these could be changed by addressing concerns over aspects of the technique.

Overall, the results of this research suggested that aerial culling was understandably an attractive choice for managers. However, the division of respondents on the use of this technique suggests that its use in the GFRNP was premature given the absence of detailed information on how the public would react.

Reviewing the cull and exploring future management options via consultation

The range of responses obtained in this research and the outcry that followed the GFRNP cull suggest that the Minister's decision to review the cull was sound. Obviously, management objectives did not meet those of at least some members of the public so an investigation was warranted to see whether differences could be bridged, in this case, or avoided, in the future.

Such an investigation should have aimed to determine how well the vocal opposition to the GFRNP cull represented the wider community. Unfortunately, this important objective was not included in the official review of the GFRNP cull. As a result, managers and politicians knew little more about the public's preferences for wild horse management after the review had been conducted. This is unfortunate since this research showed it was possible to obtain such information.

Although English (2001a) wrote that there were "*a wide range of community and other values that will impinge on any management decisions*" his efforts to gather information to assist future management in the GFRNP did not address this. An attempt was made to engage members of the community about future wild horse management. However, the focused approach taken to identifying important stakeholders meant that just 25 people were consulted at the February 2001 workshop (English, 2001a). This decision contradicts the indications of this research about maximizing community representation to ensure that managers are armed with the best possible information about the social context for management. This contradiction arises from the fact that in the case study, it was clear that a wide range of people, including those who had never owned horses, and never visited the GFRNP were interested in wild horse management. Thus, broad community consultation would have been a better option for investigating future management options. The workshop could have complimented such actions by providing insight into the extreme points of view held by special interest groups but could not effectively demonstrate how the public would react to future management.

The idea of engaging the public to improve future management of wild horses in GFRNP was sound but, based on the observed heterogeneity among randomly sampled respondents in this study, the methods used were only appropriate for scoping the diversity of opinion within a few, small sections of the community.

Heritage Values and the Heritage Working Party (HWP)

There is little doubt that the decision to investigate the heritage value of the GFRNP horses was appropriate since English (2001a) had suggested that this issue was significant for some stakeholders in the GFRNP scenario. Indeed, this decision showed promise from the perspective of engaging the community about their views of wild horses and their management, something that had not been attempted prior to the October 200 cull. However, in practice, the methods used were far from representative and focused mostly on the interests of people who were affiliated with the wild horses, rather than a representative cross-section of stakeholders in the general community.

Although respondents' attitudes about whether or not the horses had heritage Value were not sampled, it was clear that most supported special management for the GFRNP horses based on their assigned Heritage Value. However, this end cannot be used to justify the means used to determine that GFRNP horses had Heritage Value. Because the inclusion of members of the public on the HWP was restricted to those people who had "*an acknowledged involvement with and an interest in the history of the feral horses in GFRNP*" (HWP, 2002) the outcomes from the HWP appeared to be pre-determined. The non-representative methods used ensured that it would be particularly difficult to justify the findings of the HWP to members of the public with a dissenting view.

Removing from GFRNP, but not killing, horses with Heritage Value

On one hand, the results from responses to the Wild Horse Management questionnaire openly contradict the decision to remove the Heritage Valued horses from GFRNP but on another, provide some support for this action.

Responses to the question about the Minister's decision to remove, but not kill horses with Heritage Value revealed more support than opposition but a majority of Rural and Urban respondents supported maintaining a Heritage Herd of wild horses in GFRNP.

Thus, within the framework of contemporary policy, removal appeared to best suit the responses to the Wild Horse Management Questionnaire. This is especially true since the favoured control methods selected for wild horse management were capture and removal to private property or for consumption. Both of these have occurred with horses from the GFRNP (Hoy, 2005).

Whilst it was clear that preferences of respondents, within the context of available management options, were met by the decision to remove but not kill horses from the GFRNP it was also clear that other options, were more preferred. Managers should consider attempting to resolve such conflicts to ensure that their management efforts are supported.

2.4.5 How the case study aims were addressed

Aim One: To review previous management of wild horses in Australia, and elsewhere

Completing the review of Australian wild horse management (see Section 2.2.2) meant that the first aim of this case study was met. As covered in the section on the design of the wild horse management questionnaire, the review was important as it formed the basis for many of the questions asked of participants.

The review showed that sufficient information existed about wild horse management and about people's preferences regarding related issues, to avoid the public backlash from the GFRNP aerial culling operation. In an ideal situation managers would have read through the available literature on wild horse management and recognised that wild horse management, and aerial culling in particular, were controversial issues.

The use of aerial culling had been extensively criticised in Australia in the 20 years prior to the GFRNP cull. Several publications, including the text considered to be the authoritative guide to wild horse management in Australia, deal with the issue of wild horse management. These treatments include the likely conflict with individuals and groups based on issues of horses as special animal and the perceptions of inhumanness associated with aerial culling.

Despite these suggestions, the GFRNP cull was undertaken in the absence of sufficient consideration of the potential for conflict with stakeholders. Consequently the scenario gained political prominence, ensuring that managers were destined to re-visit the issue *ad nauseum* through the English reviews, Heritage Working Party and a wild horse advisory committee.

Recurring themes identified during the review of Australian wild horse management, especially those with direct relevance to the GFRNP scenario, were addressed within the wild horse management questionnaire.

As described during the discussion of results, respondents frequently selected options that supported previous authors' views on issues relating to wild horse management but this was not uniformly true, as many questions yielded significantly heterogeneous responses.

As described during the discussion of results, respondents frequently selected options that supported previous authors' views on issues relating to wild horse management but this was not uniformly true, as many questions yielded significantly heterogeneous responses.

Examples of specific issues identified within the review and also supported by responses to the questionnaire, include the following:

- That views of wild horses vary among members of the public,
- That Rural people, were more likely to accept management of wild horses than other, non-rural people,
- That there are differing levels of support for various wild horse management techniques, e.g. aerial culling,
- That beliefs vary within the community about the impacts that wild horses have on the Australian environment,
- That there is a need to communicate with the public about wild horse management

Aim Two: To develop an understanding of the public attitudes towards wild horses and their management

During much of the discussion in this case study, I have focused on the responses to the wild horse management questionnaire. What is evident from the review of these results, is that an understanding of attitudes about wild horses and their management was achieved via the design and implementation of the questionnaire

Whilst it was beyond the scope of this case study to attempt to develop such an understanding for the entire public this investigation of a randomly drawn sample of the public showed that questionnaire-based research could be used to better understand public views of wild horse management. Vivally, it revealed that is possible for managers to determine whether or not significant heterogeneity exists among public stakeholders, for wild horse management issues. This suggests that other applications might also be possible and certainly warrant investigation.

Aim Three: To specifically evaluate the GFRNP scenario and subsequent management reactions, in the context of stakeholder sentiment

My evaluation of what had occurred during the management of the GFRNP wild horses comprised two-parts. Firstly, the review of wild horse management in the GFRNP and then specifically how the management decisions within that scenario appear when reviewed in the light of information from respondents.

I believe the review of the GFRNP scenario, alone, shows that the decisions made by managers were understandable but their basis and implementation were significantly flawed. These negative aspects were invariably linked to the insufficient involvement of stakeholders resulting in management that was not inclusive of social opinion or beliefs. This is reinforced by the results collected from respondents.

The range of replies that I received, from a diverse cross-section of the public, showed that virtually any management decision would face a degree of opposition. In some cases, with regard to GFRNP management decisions, this opposition comprised substantial proportions of the respondent groups. This suggested that management decisions made within the GFRNP scenario were not ideal but, in the absence of more information about the public, it was unlikely that managers would make more appropriate choices.

2.5 Conclusion

Whilst the magnitude of the reaction that followed the aerial cull of 600 wild horses, in GFRNP, during October 2000 was unique in Australian wildlife management history, the themes underlying conflict between stakeholders and managers were not. In retrospect, it is clear that conflict over the decision to aerially cull wild horses was likely to arise. Authors, prior to the cull, had described the controversial nature of wild horse management in Australia, and had suggested that the potential for conflict with stakeholders, about wild horse management decisions, might be minimised via extension efforts. Unfortunately, these issues were not addressed in the lead up to the GFRNP scenario.

Demonstrating that public opinion varied regarding preferred management goals was a key outcome of the October 2000 cull. Likewise it appeared that members of the community were not unified in their preferences for how management outcomes should be reached. Even though this case study did not aim to accurately determine the proportions of the public that supported or opposed specific management options, it was able to demonstrate a way to enhance pro-active management. This research showed that it is possible, and relatively simple, to discover the range of relevant public sentiment in such a way that managers can better understand the social context for their decisions. Such information could provide the opportunity to detect likely problems ahead of time and reduce the reliance on reactive management.

In this regard, the diverse responses to specific management options and the significant differences revealed within and between respondent groups were particularly interesting. The observed heterogeneity suggested a mixture of opposition to, and support for, many management options existed among the wider public. This indicates that there was a need for further, grass-roots involvement of stakeholders in the GFRNP management process to achieve broadly accepted wild horse control.

Community involvement was effectively absent in the design and implementation of management of the GFRNP wild horses, resulting in a reliance upon reactive strategies to address conflict between stakeholders and managers. The time, effort and cost (both in financial terms and damage to public image) to the agency, from the GFRNP situation showed

that the approach taken was not ideal. However, the expert or top-down approach applied by managers is quite typical of Australian wildlife management efforts.

This case study demonstrated a viable method for achieving positive change to the status quo. Even if the questionnaire had served only to gauge the most extreme views from among the community it could be considered a 'dry-run' for real management and, therefore, constitute a worthwhile exercise; a demonstration of one method for collecting information about the range of beliefs and preferences within the community. However, since the number of people from the samples who responded to the questionnaire was far greater than that of the general public who contacted media outlets or the NPWS about the GFRNP management action, this study holds more significance than simply being a revelation of extreme views from particularly outspoken stakeholders.

Although, as I have repeatedly stated during the Discussion, insufficient information was collected from non-respondents to make large-scale assumptions about the preferences of the total population, the data was sufficient to identify the significant support for, and opposition to, various management actions. In terms of applying this to the GFRNP scenario, knowing that aerial culling was likely to be a significantly divisive issue could have guided managers to temper the proposed management actions or at least prompted interaction with the public, e.g. via focus groups, to determine acceptable management options.

This case study has shown that Human Dimensions Research is not only achievable in Australia, via questionnaire-based methods, but clearly could have been of significant benefit to the management of wild horses in the Guy Fawkes River National Park.

3. Case Study Two:

The Human Dimensions of Flying-fox management

“I am not a fruit grower, but, the government should subsidise or give grants to fruit growers to help them protect their crops, without harm to the Flying-foxes... I have patted a flying-fox and they are adorable and I think a necessary part of our community. Thank you.”

Public respondent, 2003 Flying-Fox Management Questionnaire

“If society as a whole has decided that FF should be protected then society as a whole should pay the cost. At present I believe commercial fruit growers pay a higher price than the rest of the community”

Commercial Fruit Grower, 2003 Flying-fox Management Questionnaire

“If fruit growers are unable to survive in the Australian environment they should go into liquidation... Put simply if orchardists resort to the environmental carnage for which they are famous then lock them up, confiscate their properties as compensation, and export their jobs. As for you and me helping them financially to survive (a tax on non-orchardists) then I have to admit my feelings are unprintable.”

Public respondent, 2003 Flying-Fox Management Questionnaire

“The (flying) fox problem is so bad that neither of my boys want the farm... I have lost my family, my sons, my job, my income and I used to employ 5 casuals which I cannot do any more... All this has come about because of the Grey-headed Flying-fox.”

Commercial Fruit Grower, 2003 Flying-fox Management Questionnaire

3.1 Flying-fox management in NSW

Historically, conflict has dominated interactions between humans and Flying-foxes in Australia. From the time of European settlement, a negative perception of the species, based on a cultural dislike of bats and furthered by damage caused to fruit crops, has underpinned widespread lethal control.

Over time, however, societal acceptance of Flying-foxes has changed, as evidenced by their relatively recent legal protection. In keeping with a general trend towards increased acceptance of a range of values for wildlife, Australian policies and priorities related to Flying-foxes have officially shifted from a focus on eradication to one of conservation, albeit at a slower pace than for other native fauna.

Whilst legal protection is aimed at aiding Flying-foxes' conservation, it has not resolved ongoing inter-specific conflicts with people. As a result, these animals hold dual status as both a threatened species and a pest, creating a significant conundrum for wildlife managers.

In New South Wales, interactions between fruit-growers and Flying-foxes have attracted the greatest management focus. Whilst efforts have been made to facilitate a change in methods of control from lethal to non-lethal means, fruit-growers have resisted, for a range of reasons. Thus, despite the fact that almost 20 years have past since Grey-Headed Flying-foxes were first offered legal protection, wildlife managers have not yet ceased the practice of issuing permits to fruit-growers to harm (i.e. kill) the animals. Consequently, many are killed each year in the interest of mitigating damage to crops.

Given the economic significance of a long history of Flying-foxes' impact on fruit production and the direct negative effect that culling has on bats, there is little wonder that most management efforts have focussed on interactions between growers and Flying-foxes. However, reports of urban conflict reinforce the fact that problems with these animals occur on a much broader front than at sites of fruit production alone. Such situations may stem from specific damage caused to private property or impacts on highly valued rainforest remnants. Still others result from noise, odour and disease concerns held by residents living close to camps and/or those who have gardens visited by Flying-foxes.

It is important that managers address these situations because most Australians now live in urban areas. This point has not been lost on media outlets that have provided extensive coverage of urban Flying-fox issues in recent times. Such reporting has made it clear that there is an expectation among the public that someone, i.e. scientists, wildlife managers or both, should address their wildlife-related concerns. Unfortunately, as in many scenarios involving humans and wildlife, it is difficult for managers to know what the public actually wants, or will accept, as the views and suggestions from individuals within affected communities can be diverse.

When the NSW Flying-fox Consultative Committee (FFCC) called for expressions of interest in conducting a survey of fruit growers, regarding Flying-fox management, I was buoyed by their desire to better understand an important interest group but was equally disappointed that the project did not go further, and seek to establish a context for their opinions and experiences within those held by members of the wider public. If managing conflict at the agricultural front represents the history of Flying-fox management then surely urban conflict represents the future. Although managers have long been confronted with what Industry wants, in terms of Flying-fox management, they have rarely, if ever, clearly understood whether these desires were supported by the general public. By addressing the lack of understanding regarding the public's views of Flying-foxes, I believed that managers could better address the management of Flying-foxes in general.

This second case study details my research into the interactions that occur between people and Flying-foxes in NSW, dealing specifically with the attitudes and experiences of commercial fruit growers as they compare to those of the wider public.

3.1.1 Background to the Case Study on Flying-fox Management

What are Flying-foxes?

Flying-foxes are large bats belonging to the Order Megachiroptera. In Australia, Hall and Richards (2000) separate Flying-foxes (Genus *Pteropus*) from fruit-bats (Genus *Dobsonia*), blossom-bats (Genera *Syconycteris* and *Macroglossus*) and tube-nosed fruit-bats (Genus *Nyctimene*); however, the lay-public tend to use several or all of these common-names interchangeably (in particular using 'fruit-bats' for all megachiropterans)

Three species of *Pteropus* are found in NSW. These are *P. poliocephalus*, the Grey-headed Flying-fox (GHFF), *P. scapulatus*, the Little Red Flying-fox (LRFF), and *P. alecto*, the Black Flying Fox (BFF). The project this case study built upon was intended to focus on interactions between people and the GHFF alone, but in practice it broadened to include *P. scapulatus* and *P. alecto* since I could not be sure that participants could discriminate between species.

Changing status and changing policies

As mentioned above, the legal status of Flying-foxes has changed dramatically between early days of widespread culling in Australia and their current protection under Commonwealth law. In conjunction with this change, NSW policies regarding harm to Flying-foxes have been repeatedly modified in attempts to balance conservation with the damage mitigation needs of commercial-fruit growers. For the benefit of readers unfamiliar with this history of changing policy, a summary is provided below.

Managing Flying-foxes: a history of shifting policy

Factors that impacted Flying-foxes changed significantly when Europeans came to Australia. Although people, as predators, have long been a factor in the ecology of Flying-foxes (Tidemann & Vardon, 1999, online) the European juggernaut carried with it new species and novel views towards local wildlife and the broader environment. Like other endemic fauna and flora, Flying-foxes were affected by both.

From the time of the The Native and Imported Game Act of 1879, NSW legislation protected a growing number of select native species. Contrary to this trend, Flying-foxes were specifically excluded from subsequent legislation, including the Birds and Animals Protection Act 1918 and the Fauna Protection Act 1948. Eventually, following the enactment of the 1974 National Parks and Wildlife Act (NPW Act), *P. poliocephalus* and *P. scapulatus*, were the State's only unprotected native mammals.

Although the species' status changed when both were finally protected under the NPW Act in 1986, this did not end the practice of using lethal control measures to protect fruit crops. Rather, the NSW National Parks and Wildlife Service (NPWS) instigated a system of licences for growers who wished to shoot the animals, ideally restricting the number of animals harmed via a quota per licensee.

In a species management report on Flying-foxes, Eby (1995) suggested that changes to the conservation status of GHFF were probable, based on observed "*levels of habitat loss*", and further noted that such a change would likely result in a total ban on lethal management of Flying-foxes to protect crops. As a consequence, she suggested that NPWS should establish a process that would encourage growers to utilise exclusion and deterrent-based management rather than relying upon lethal control.

Eby's suggestion to phase-out shooting of Flying-foxes was not implemented but NPWS did meet with representatives of the fruit growing Industry, prompting one of many "in-house" reviews of the licensing system and associated policies (Mandelc, 1999; Mandelc and Carr, 2000; Waples, 2001; NPWS, 2002a; NPWS 2003; DEC, 2004).

Although suspended briefly in 1997, the licensing system has continued despite more dramatic changes to the protected status of GHFF which have further impacted NSW policy. Final determination of the GHFF as a vulnerable species in 2001 resulted in changes to the types of licences issued to growers for Flying-fox control and began a practice of limiting quotas to a maximum of 50 individuals per licence and to no more than 1% of the estimated GHFF population (n = 320,000) statewide (NSW NPWS, 2002a).

Then, in December 2001, the GHFF also became listed as a vulnerable species under the 1999 Commonwealth Environmental Protection and Biodiversity Conservation Act (EPBC Act)

following recognition that the species, thought to number 566 000 in NSW in 1989, had declined nationally to less than 400 000 individuals (Environment Australia, 2003).

NPWS foresaw that the Commonwealth vulnerable listing would likely mean that any activity that would significantly impact upon GHFF would require approval from the Federal Minister but such referrals were waived in lieu of State agencies remaining responsible for permitting harm to GHFF (NPWS, 2002a). In conjunction with this decision, NPWS agreed to reduce its total quota from 1% to 0.95% of the minimum GHFF population estimate to ensure that national culling pressure remained below 1.5% of the total population (NSW NPWS, 2002a).

In 2002, NPWS decided that current licensing procedures would continue until the end of the 2005–2006 season (NSW NPWS, 2003) and have continued the practice of annual policy reviews (Mandelc, 1999; Mandelc & Carr, 2000; Waples, 2001; NPWS, 2002a; NPWS, 2003; DEC, 2004).

Most recently, one of the major developments in Flying-fox management was the decision of NPWS to establish a NSW Flying-fox Consultative Committee (FFCC). In doing so, NSW managers have followed the lead of Queensland, and brought together representatives from relevant interest groups to review, and advise on, aspects of Flying-fox policy. Together with staff from NPWS and NSW Agriculture, the FFCC includes representatives from the fruit growing industry, conservation groups, animal welfare organisations and local government.

Case Study Development

The greatest significance of the formation of the FFCC was an acknowledgement on the behalf of managers that different perspectives must be considered to improve management of Flying-foxes. In keeping with this approach, the FFCC's primary role is to "*provide a forum for...consultation on the range of issues pertaining to the conservation and management of flying-foxes in NSW*" (NPWS 2002c, online).

As part of a 2003 review of Flying-fox policy, the FFCC called for expressions of interest from student researchers interested in conducting a survey of growers regarding crop damage caused by Flying-foxes and the types of crop-protection methods used to mitigate such damage.

As explained previously, whilst I was impressed that the FFCC wanted to better understand issues relating to this important interest-group's role in the Flying-fox scenario I felt that the project was too narrowly focused. Like Lunney *et al.* (2002), I was concerned by "*an overemphasis in management on the commercial aspects of flying-foxes, when other community perceptions are present*". My argument for expanding the project to include the public and to go beyond experiences to also include attitudes and management preferences, was that the survey would thus develop context for the views of growers whilst simultaneously providing managers with an understanding of the broader attitudinal environment within which their Flying-fox-related policies and practices must operate.

Fortunately, NPWS and representatives of the FFCC agreed with the proposed amendments to the original grower survey concept and a research contract was entered into for a project that would include working with both fruit growers and the general public.

3.1.2 Project Aims

Overall aim

NPWS stated that the “grower survey project” would assist with the management of Flying-foxes to achieve the following three outcomes:

1. To enable fruit growers to run sustainable and economical operations without impacting on the conservation status of Flying-foxes (with an emphasis on Grey-headed Flying-foxes);
2. To guide the design and implementation of targeted capacity-building campaigns;
3. To improve understanding of the various perspectives surrounding this contentious issue (GHFF management)

My overall aim for this research, as a case study, excludes some of the FFCC’s specific aims for the survey project. From the perspective of contributing to this thesis, I was most interested in understanding the views/attitudes of commercial fruit-growers, relating to Flying-foxes and their management, within the context of wider public opinion.

The FFCC, however, also hoped that a range of data could be gathered from commercial fruit growers. For example, they were particularly interested in quantifying the extent of damage caused by Flying-foxes and grower opinions regarding the efficacy of various lethal and non-lethal methods for reducing such damage.

Naturally, all aims were addressed during the project but, in this thesis, only a subset will be dealt with in detail.

Specific aims

The final project brief I received included six aims. These were:

1. To define the extent of damage being caused by Flying-foxes
2. To quantify the uptake and extent of netting and gauge fruit growers’ perceptions of the efficacy of netting as a damage-mitigation technique
3. To identify the use of other non-lethal methods used to protect crops and gauge fruit growers’ perceptions as to the efficacy of these techniques

4. To assess the reliance on shooting of Flying-foxes and gauge fruit growers' perceptions as to the efficacy of shooting as a damage mitigation technique
5. To understand fruit growers' perceptions of management responsibilities for Flying-foxes and the role they see for themselves.
6. To gauge fruit growers' perceptions of Flying-foxes

Since the FFCC agreed to an expansion of the project to also include members of the public who were not commercial fruit growers, I added a seventh aim:

7. To gauge the NSW general public's perception of Flying-foxes and their management:

Of these 7 aims, numbers 5, 6 and 7 are of most importance to this case study as they deal specifically with the attitudes of growers and the public.

3.2 Methods

Geographic area of interest

Although GHFF have been recorded from the Western slopes of NSW (Tidemann, 1998) and even South Australia (Tidemann, 1999) they are generally found along the eastern coast of Australia, restricted to a narrow band, east of the Great Dividing Range. Historically, a variety of geographic limits have been suggested for the species with GHFF reported from as far north as Rockhampton (Eby, 1995) and as far south as the islands of Bass Strait (Tidemann, 1999).

More recently, however, authors have described the northern limit to be approximately Bundaberg (Eby 2000a) or Miriam-Vale (Hall & Richards, 2000) with Melbourne representing the southern extent (Eby 1995; Tidemann, 1998; Eby 2000a; Hall & Richards, 2000). As a consequence, the distribution of GHFF includes the entire coastline of New South Wales and, thus, overlaps the majority of the State's human population.

The FFCC specified that the geographic range of the project would be the extent of the GHFF in this State. They further prescribed this extent to be the area between Tweed Heads and Eden, east of the Great Dividing Range. Further information about the geographic area covered by this research is provided in the section on stratification of the participant population.

Project Steering Committee

During the development of the grower survey concept, the FFCC identified potential threats to the project's success and a series of actions to address them. In addition to a general concern that results would not '*translate into management*' the committee was most anxious about how growers would perceive the attempt to engage them about their experiences and attitudes. Specifically, members of the FFCC held concerns that a questionnaire would create '*suspicious among growers*' and that the involvement of NPWS would '*cause distrust*'.

To avoid these potential problems NPWS and the FFCC established a Steering Committee. As well as providing me with support and guidance, it was the role of this group to promote

the project among Industry and to assist in identifying benefits to growers that would help motivate them to participate. Throughout this research, members of the committee (Table 3.1) were consulted about the design and implementation of the project and they were given the opportunity to review project-related documents, such as draft questionnaires.

Table 3.1: The project's Steering Committee

Name	Organisation	Position
Belinda McNeill	NSW Farmers' Association	Senior Analyst
Edward Biel	NSW Farmers' Association	Commercial Fruit Grower
Peter Fleming	NSW Agriculture	Senior Research Officer, Vertebrate Pest Research Unit
Nancy Pallin	Nature Conservation Council and Ku-ring-gai Bat Conservation Society	
Martin Smith	DEC	Ranger, Coffs Coast Area
Kelly Waples	DEC	Coordinator, Wildlife Management
Amelia Hurren	DEC	Senior Threatened Species Officer
Kylie McClelland	DEC	Threatened Species Officer
Richard Davies	DEC	Coordinator, Urban Wildlife Project

Ethics Approval

Approval to conduct this project was obtained from the University of New England, Human Research Ethics Committee. Approval Number: HEO3147.

Project design

Differentiation and stratification of participants

Discussions with DEC staff and other members of the FFCC revealed a widespread expectation that commercial fruit growers and members of the general public (non-growers) would differ in terms of their experiences with Flying-foxes, their attitudes toward the animals and their preferences for management. Consequently, the decision was made to treat growers and the public as separate participant groups.

Further differences were also expected to exist within the public based on an assumption of differential contact with Flying-foxes along the coast of NSW. It was hypothesized that contact between people and Flying-foxes was greatest in the north of the State and least in the south. In northern NSW three species of *Pteropus* overlap in distribution and interactions between people and Flying-foxes were perceived as being quite common. Conversely, despite the fact that GHFF also establish large camps in the south of the State, Steering

Committee members were confident that interactions between people and Flying-foxes would be less frequent in southern areas such as Sydney, compared to communities in the northern parts of NSW.

Thus, to account for these expected differences, the geographic range of the study was subdivided into three participant groups in separate geographic zones (Figure 3.1). These were:

- Zone 1 – North Coast, i.e. from Tweed Heads to Coffs Harbour (the approximate southern limit of commercial banana production in NSW)
- Zone 2 – Central Coast, i.e. South of Coffs Harbour to Newcastle
- Zone 3 – Gosford, Sydney and other coastal areas south to Eden.

Delineation between zones, at a fine scale, was determined by the boundaries of NSW electoral districts. These were utilised because participant information was sourced from lists based on NSW electoral roll data (see *Sampling participants*). Stratification of the grower population was not attempted due to difficulties in accessing information about this group (See *Contacting commercial fruit growers*)

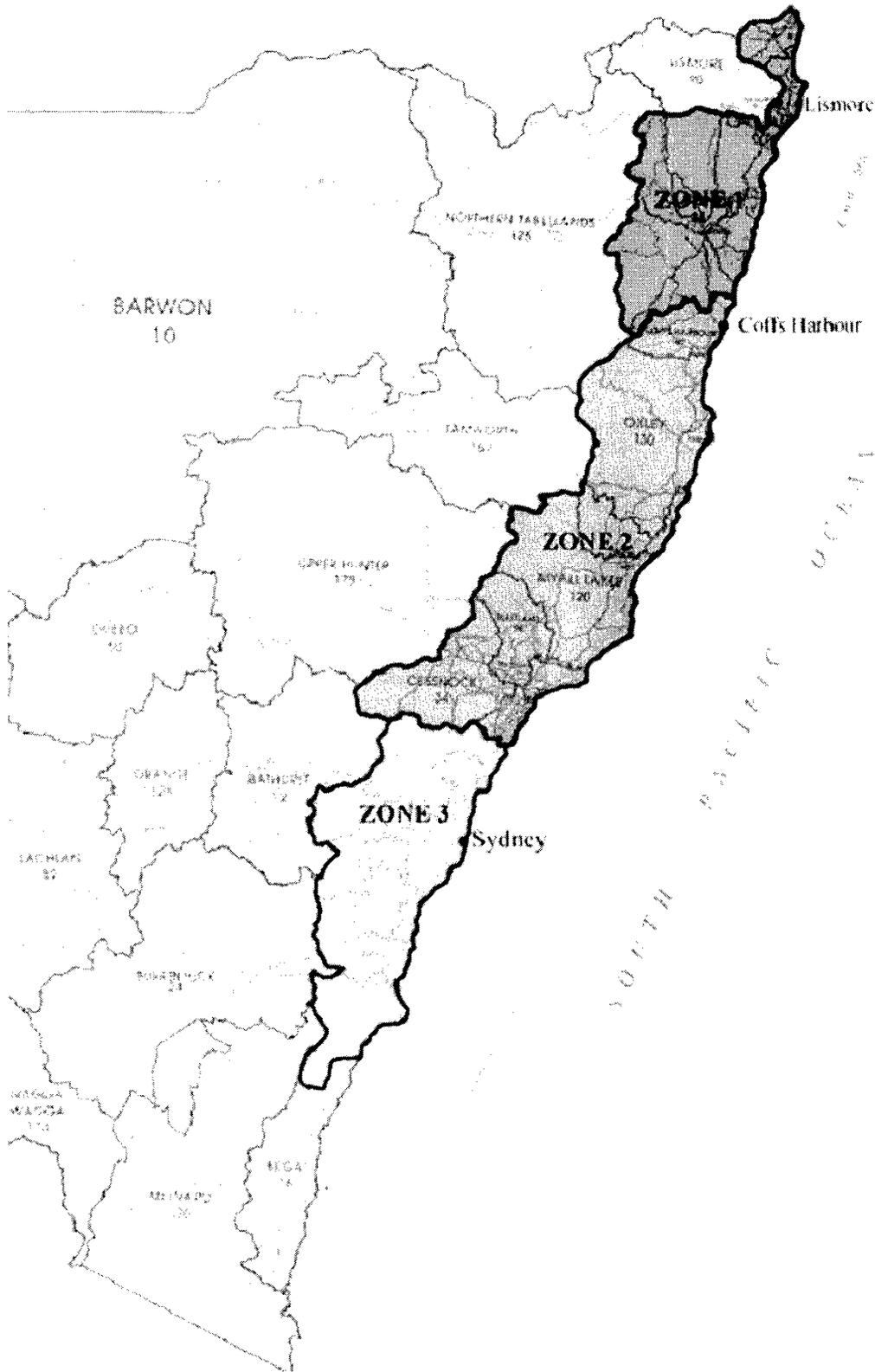


Figure 3.1: The three public participant Zones sampled in the Flying-fox case study. Original map from the State Electoral Office (2003, online).

The consultation phase

Using public meetings to consult with potential participants

In the wild horse management case study additional comments on returned questionnaires revealed that some relevant issues had been overlooked in the design of the survey. This problem resulted from reliance upon identifying key issues relating to wild horse management in the literature alone. Thus, during the development of the project brief for this case study, I suggested that my methodology would include not only mail-out questionnaires but also a face-to-face component of interaction with participants. The FFCC was satisfied with this proposal and a series of public meetings with participants became an important scoping phase of the project as well as, ideally, building public and grower interest in the project to aid in maximizing response rates.

In accordance with the decision to differentiate between growers and the public, and the stratification of participants, two meetings were held in each Zone. Meetings with growers were held separate from those with the public to maximise the relevance of content to attendees, increase the likelihood of people expressing their views and to avoid conflict between interest groups with significantly different perspectives on Flying-fox management.

Attendance at meetings

Ross Boyle, president of Bananas NSW, organised the Coffs Harbour growers' meeting in conjunction with local banana producer, Manjit Singh. I met with this group ahead of the others since their enthusiasm provided an opportunity to pilot both the format of meetings and some draft grower-specific questions in advance of subsequent grower and public meetings.

Word-of-mouth advertising, as well as Industry publications such as the "Coastal Growers' Newsletter" were used to inform commercial fruit growers about the time, dates and purpose of meetings. Further, as per the contractual agreement, DEC media staff were utilised to generate public awareness of the project, including advertising meetings.

Prior to meetings and the release of questionnaires, it was agreed that a Media Officer from DEC, who had relevant experience with publicity for Flying-fox related issues, would distribute a media release to radio and newspaper sources. The date of release was set for the

4th of December (04/12/03) with the aim of generating a public profile for the project and to advertise the times and dates of meetings so that participation would be maximised. Unfortunately, the media officer did not issue the release until 09/12/03, leaving little time for people to plan to attend the meetings that were scheduled for the 12th, 15th and 17th of December, respectively.

Disappointingly, meetings were generally characterised by low attendance (Table 3.2). This was thought to be primarily due to the limited publicity for the events but also due to the time of year. December is particularly busy for many Australians, with the approach of Christmas and associated holidays for school students, but can be even more hectic for fruit-growers who are attempting to harvest at this time. In an attempt to reduce the impact of the latter issue, grower meetings in Castle Hill and Lismore were held at night, on the advice of Ed Biel, (fruit grower and Steering Committee representative) but this would have been of little consequence if people were not interested in attending them or had limited knowledge of the events.

Despite the low levels of attendance the meetings were definitely worthwhile. Excellent feedback was obtained on issues relating to Flying-foxes and their management (see *Feedback from meetings with growers and the general public*). Specific issues regarding wording of potential questions for the survey instruments were also dealt with. Ultimately, the small numbers of attendees allowed me to explore issues in great depth with each meeting essentially becoming a focus group.

Table 3.2: Meetings held with growers and members of the public

Location	Date of meeting	Group	Attendees
Castle Hill	15/12/2004	Public	4
Castle Hill	15/12/2004	Growers	7
Coffs Harbour	17/12/2004	Public	10
Coffs Harbour	23/10/2004	Growers	11
Lismore	12/12/2004	Public	6
Lismore	12/12/2004	Growers	4

The questionnaire phase

Sampling public participants

The key limiting factor in sampling participants was access to name and address data. As in Case Study One, electoral rolls were judged to be the best option for sourcing participants since compulsory electoral enrolment means that all Australian adults (i.e. people over 18 years of age) are listed by their address. Thus, electoral roll data was targeted even though significant problems had been encountered in the wild horse management case study with the accuracy of data from Commonwealth electoral rolls.

Instead of the larger Commonwealth Electoral Divisions, State Electoral Divisions were used to better approximate the western limit of the project's range and the boundaries between public participant Zones. Unfortunately, this meant that many more electoral rolls were required.

The State Electoral Divisions (SEDs) comprising each zone are listed below.

1. Zone 1: Tweed Heads to Grafton.

This zone consisted of 3 SEDs: Ballina, Clarence and Tweed.

2. Zone 2: Coffs Harbour to south of Newcastle.

This zone consisted of 12 SEDs: Cessnock, Charlestown, Coffs Harbour, Lake Macquarie, Maitland, Myall Lakes, Newcastle, Oxley, Port Macquarie, Port Stephens, Swansea and Wallsend.

3. Zone 3: Sydney to Eden.

This zone consisted of 56 SEDs: Auburn, Blacktown, Bligh, Blue Mountains, Cabramatta, Camden, Campbelltown, Canterbury, Cronulla, Davidson, Drummoyne, East Hills, Georges River, Gosford, Granville, Hawkesbury, Heathcote, Heffron, Hornsby, Illawarra, Keira, Kiama, Kogarah, Ku-Ring-Gai, Lakemba, Lane Cove, Liverpool, Macquarie Fields, Maroubra, Marrickville, Menai, Miranda, Mount Druitt, Mulgoa, North Sydney, Parramatta, Peats, Penrith, Pittwater, Port Jackson, Riverstone, Rockdale, Ryde,

Smithfield, South Coast, Southern Highlands, Strathfield, The Entrance, The Hills, Vaclusse, Wakehurst, Wentworthville, Willoughby, Wollongong and Wyong.

The substantial variation in number of electoral districts per zone is due to the concentration of the human population around the central coast of NSW and the Sydney metropolitan area. Electoral districts are determined so as to ensure that the number of people within each district is similar. Consequently, small geographic areas with high populations, e.g. Sydney, are comprised of many SEDs.

Due to the large population size and number electoral rolls required ($n = 71$), manual sampling of electoral data was not feasible in this research. Similarly, using a scanner to acquire the information was seen to be too labour intensive and, as in the first Case Study, access to electronic copies of the electoral roll data was not permitted.

The alternative was to purchase participant data from a commercial list-broker. As a result, a range of these companies were contacted. Most explained that their data was regularly updated from publicly accessible sources (i.e. electoral rolls). Some used only Commonwealth data and thus were not appropriate for this study. Others used both State and Commonwealth data and two businesses also indicated that they use telephone account data to regularly update address information in their lists.

Quotations were requested from list brokers, based on the following dataset criteria:

- All participants must be adults (over 18 years of age)
- Data must be separable based on NSW SEDs
- For each Zone, all SED data must be pooled before a random sample of participants, without replacement, was drawn
- Datasets must be supplied in electronic format, e.g. spreadsheet or database

Three companies were able to meet these criteria and supplied me with quotations. The least expensive option was selected.

Sample size – Public participants

The proposed precision of plus or minus 5%, with a 95% confidence interval was deemed to be acceptable by DEC and the Steering Committee. Using the same formula as in the wild horse management study (see *Case Study 1: Determining Sample Size*), the following number of responses were deemed necessary:

- In Zone 1, 383, based on an adult population of 139 558.
- In Zone 2, 384, based on an adult population of 559 019.
- In Zone 3, 384, based on an adult population of 2 585 865.

Based on these numbers of respondents, an estimate was made of the number of participants that should be sampled. Following the response observed in the wild horse management questionnaire I was cautious about the likely response rates in this project. Since greater resources were available than in the wild horse management case study I chose to send questionnaires to 2000 individuals in each Zone.

Contacting commercial-fruit growers

The task of contacting commercial fruit growers proved to be extremely difficult. Unlike dealing with the public stakeholders, a pre-existing list of names and addresses for commercial fruit growers could not be sourced. Alternative methods such as internet searches and looking through telephone directories yielded details for some individuals and organisations but was generally found to be ineffective as many growers are not specifically listed as commercial operations.

Even my attempts to establish the number of commercial fruit-growing operations within the range of the study were relatively unsuccessful. I contacted both the Australian Bureau of Statistics (ABS) and the Australian Bureau of Agricultural and Resource Economics (ABARE) but neither could provide me with information on the number of commercial fruit growing operations within the project's range.

According to an ABS (1999, online) summary of Agricultural activity there were 2567 fruit growing “establishments” in NSW. Unfortunately, since some important fruit growing areas, e.g. the NSW Riverina, exist outside the study’s geographic range this data served only to provide an indication of the order of magnitude for growers relevant to the project.

In light of these difficulties, it was clear that the grower survey could only succeed with the direct assistance of organisations that represent fruit growers. I had initially hoped that an assurance of confidentiality would aid in sourcing growers’ addresses from these groups but discussions with members of the project steering committee, including representatives of the NSW Farmers’ Association, suggested that asking grower organisations to provide lists of grower addresses would not be successful, primarily due to privacy concerns. Such concerns were, at least in part, linked to previous legal action taken by Humane Society International to access data about growers who were licensed by NPWS to harm Flying-foxes. In the case of the NSW Farmers’ Association, Belinda McNeill indicated that member data could not be provided due to privacy-related legal constraints.

Further, the steering committee suggested it would be unlikely that organisations would distribute questionnaires on my behalf; instead indicating that commercial fruit growers receive many requests to participate in surveys and organisations would be unlikely to add to this directly. So, to address these problems, I asked organisations to distribute invitations to receive a questionnaire, so that interested parties would supply me with their contact details and could then be sent a copy of the questionnaire directly.

Although Ross Boyle, from NSW Bananas, offered to send copies of the questionnaire to all members of his organisation, it was thought to be more appropriate that the method of distribution remain uniform across all organisations to limit bias in the results. This was particularly important given specific tensions and mistrust evident between growers from various sections of the Industry (see *Feedback from commercial fruit growers*)

Belinda McNeill provided a solution to the difficulty of contacting fruit growers’ organisations by supplying me with a list of Australian horticultural organisations (Hortguide, 2003). Using this information, a letter of introduction was sent to 29 horticultural organisations. Those groups selected were ones that I either knew to have relevant members or those that did not specify their membership was from outside the range of the study.

Organisations whose memberships were entirely within other States, e.g. Western Australian groups, were not approached.

The letter sent to these 29 groups outlined relevant details of the project and requested assistance distributing pre-packaged envelopes to individual fruit growers. In the letters I also explained that I would cover financial costs associated with addressing supplied packages as well as their postage. A follow-up letter was also sent to organisation that did not reply to my initial request.

Eight grower organisations responded to the request for assistance or to the follow-up letter sent to them. Responses varied greatly. Some groups did not reply at all; a few explained that they did not have members within the range of the study; and some stated that Flying-fox damage was not an issue for them. Still others agreed to take part.

Bananas NSW, Australian Pear and Apple Limited, the NSW Farmers' Association and the Australian Custard Apple Growers Association all agreed to provide assistance by distributing invitations. The Australian Macadamia Society Limited indicated that their members were not adversely affected by Flying-foxes at the fruiting stage due to the nuts' protective shells. Citrus and Dried Grape organisations both indicated zero membership within the project's range.

The absence of a response from two organisations, in particular, was noted by the Steering Committee. Neither the Australian Lychee Growers' Association nor Summerfruit Australia had replied to my initial requests for help. A telephone call to a representative of the Lychee grower association revealed that they were not prepared to assist, despite the fact that their contact person was also a member of the FFCC.

In the case of Summerfruit Australia, Ed Biel, a fruit growing member of the Steering Committee, offered to contact the organisation on my behalf. Following Mr Biel's request, Summerfruit Australia also agreed to distribute my invitations to their members. Participating organisations and their numbers of members within the project's range are summarised in Table 3.3.

The distribution of invitation packages was organised with each participating organisation and it was expected that approximately 1400 individuals (assuming no overlap in memberships) would receive invitations to participate in the grower survey.

Table 3.3: Commercial fruit grower organisations and the number of members they claimed to represent within the project range.

Grower Organisation	Grower members
Bananas NSW	725
Summerfruit Australia	300
Australian Pear and Apple Limited	192
NSW Farmers' Association	135
Australian Custard Apple Growers' Association	50

However, in May 2004, Australia Post contacted me regarding 232 items that had been left at the Lismore Post Office *sans* postage. The packages were identified as invitations to growers and returned to the researcher. Upon checking the addresses on the envelopes, only 40 were found to be addressed to growers within the range of the project. The remaining invitations had been addressed to growers that were in areas outside the project range. Based on the number of invitations and the location they were found at, it seemed that they were packages that had been provided to Summerfruit Australia for distribution.

After adjusting for the items recovered from the Lismore Post Office, the maximum possible number of invitations distributed to growers was 1170.

3.3 Developing the questionnaires

3.3.1 Separate questionnaires and separate motivations

The use of two, separate questionnaires was part of my original proposal to NPWS and the FFCC. I intended to tailor the grower and public questionnaires to deal with issues specific to each group whilst also including a set of common questions that would permit a comparison of Flying-fox related experiences and attitudes.

This intention was driven mainly by my concern that people presented with a questionnaire containing many issues not specifically relevant to them would be less likely to participate, i.e. members of the public might be disaffected by a survey that had a strong focus on commercial crop protection.

Separate questionnaires also seemed more appropriate following early contact with the steering committee who suggested that fruit growers would be hesitant to take part in the project if there was too great a focus on comparison between their views and those of the public. Some grower representatives felt that the public would oppose growers' views on Flying-fox management and that this project would result in an opportunity for managers to impose unwanted changes in crop-protection practices on the basis of majority-rule. Thus, rather than focusing on inter-group comparison, the main "selling-point" for the grower questionnaire became the opportunity for individuals to have an input regarding Flying-fox management directly to the FFCC.

For the public, I also strongly encouraged participants to 'have a say' about Flying-fox management and focused on the value of each individual's experiences, stressing that their responses were important to this research, and therefore to management, even if they had previously had little or no interaction with Flying-foxes.

As in the wild horse management case study, previous authors' impressions of Flying-foxes and their management were considered in the development of questions and are presented in the following sections. However, in this research I additionally drew on feedback gathered from public meetings and input from steering committee members to design appropriate questions.

3.3.2 Important aspects of Flying-fox biology and ecology

Flying-foxes' diet, mobility and camp forming habits contribute not only to their important ecological role but also to their interactions with people, and, in some cases, enhance the animals' nuisance value.

Camps

During the day, GHFF can typically be found hanging from tree limbs in groups commonly known as camps. (Eby (1995) suggested that Ratcliffe (1932) was responsible for establishing the use of this term but it had been used earlier, for example in Darnell-Smith's description of GHFF, in 1917 and by Tryon in 1920). GHFF utilise a variety of native vegetation for camps and as sources of food, e.g. subtropical and temperate rainforest, sclerophyll forest and sclerophyll woodland greater than 10m in height, swamps and heaths (Eby, 1995). They are also found in association with mangroves (Hall, 2002).

Importantly, camp size varies both between locations and in the same site, over time (Parry-Jones & Augée, 1991). Populations of camps may be small, comprising a few score individuals or range up to much larger aggregations of tens-of-thousands (Parry-Jones & Augée, 1992) or hundreds-of-thousands (Eby, 1991a) of individuals.

Bats may 'abandon' camps virtually over-night and such sites can remain empty for long periods of time. However, because GHFF show high camp fidelity (NPWS, 2001), sites may be quickly re-populated through sudden influxes of animals as food becomes locally abundant. Thus, areas that appear free of Flying-foxes may be suddenly re-colonised, sometimes to the surprise of human inhabitants who have moved into an area containing an unoccupied camp site (Smith, 2002).

Diet

The opportunistic feeding habits of GHFF have contributed not only to the species' success (Steller, 1986) but also to their conflict with humans. Although typically attracted to mass flowerings of native species like *Eucalyptus* spp., *Angophora* spp., *Melaleuca* spp. or *Banksia* spp., and to native fruit, e.g. *Acmena* spp. and *Ficus* spp. (Steller, 1986; Parry-Jones, 1987;

Eby, 1991b; Eby, 1998) GHFF will also consume the foliage, flowers and fruit of introduced plants.

Authors have previously asserted that GHFF do not prefer commercial fruits, e.g. stonefruit (Parry-Jones & Augee, 1991), but for those people who suffer damage to commercial crops, or even to their backyard fruit trees, whether or not Flying-foxes prefer that fruit may be of little consequence. Regardless of a suggested preference for native fruits and flowers, Flying-foxes have long been associated with damage to introduced fruit grown in backyards and commercial orchards (Lucas, 1896; Darnell-Smith, 1917; Ratcliffe, 1932). Indeed the rapid incorporation of economically important foods into Flying-foxes' diets has been a major cause of inter-specific conflict with humans. (See *The nature of Flying-fox impacts on commercial fruit production*, below)

Mobility

As a nomadic species (Eby, 1991b) GHFF display mobility that is integral to their survival and simultaneously problematic for management. During nightly feeding forays, GHFF range substantial distances from their camps. Observations in Melbourne (Menkhorst & Dixon, 1985) showed that most individuals foraged within 10km of their camp but other authors have suggested individuals will fly twice as far (Spencer *et al.*, 1991) or even further, up to 50km in a night, to feed (Eby, 1991). Thus, GHFF from a specific camp may be responsible for damage over a relatively large area, suggesting that relocations of animals between camps, on a small-scale, are likely to be redundant in alleviating crop damage.

Also, because individuals within a camp may fly to separate food sources, the impact of Flying-foxes from a single camp may be spread over a considerable area and be shared between vegetation in commercial fruit crops, backyard gardens, parks etc.

On a larger scale, GHFF undertake migrations between camp sites in association with changing food availability (Parry-Jones & Augee, 2001). Movements between food sources can be in the order of hundreds of kilometres (Eby 1991a; Spencer *et al.*, 1991). Because of this, management of Flying-foxes in one area may impact other areas within the range of the species. That is, lethal control in one area does not only impact the abundance of the species

in the area immediately adjacent to the site of management but, rather, affects ecosystem interactions throughout the range of the culled individuals (See *Ecological role*, below).

Whilst the mobility of GHFF has allowed the species to survive in an environment where important foods are discontinuous the same ability has important ramifications for their management as a protected species and as a pest.

Because the animals can move large distances, elimination of individuals on crops or even in camps close to the site of damage will not necessarily prevent other animals moving to the area to feed. This no doubt frustrated early attempts to eradicate local populations of Flying-foxes as even the destruction of an entire camp could not prevent animals from elsewhere replacing the culled individuals.

In terms of their conservation, mobility was also a threat to the species during times when their vulnerable status was differentially recognised by State Governments. As can often be the case for highly mobile species, although protected in NSW, GHFF did not possess the same status in Queensland so animals moving across the State border were theoretically at greater risk of harm. Even within NSW movements between different food sources result in differential levels of culling risk depending upon whether or not GHFF move to areas of commercial fruit production.

3.3.3 Ecological role

Flying-foxes as seed and pollen vectors

Flying-foxes, in general, have been described as animals of key ecological importance (Fujita and Tuttle, 1991) not only because they inherently add to biodiversity but especially because plants benefit on a range of scales from interaction with GHFF.

Both the mobility of GHFF and their feeding habits make them important dispersers of seed and pollen (Eby, 1991b; Spencer *et al.*, 1991; Lunney & Moon 1997). As a result, plants benefit via the maintenance of genetic integrity (Eby, 1991b; 1995) by movement of material between geographically separate populations, or because seed movement over small distances can increase the likelihood of germination (Eby, 1995).

Although this role is not universally recognised, support has arisen for conservation of GHFF as a vital component of Australia's east coast ecosystems. As a result, authors, such as Eby (1995), have called for managers to ensure that strategies for dealing with GHFF function to preserve the nomadic habit of the species, and consequently their ecological role.

3.3.4 Interactions between people and Flying-foxes

Of the interactions that occur between people and Flying-foxes, by far the most attention has been paid to those with a perceived negative outcome for humans. Positive interactions do occur, but most accounts involve conflict. Since perspectives on GHFF are frequently divided between notions of the impacts GHFF have on people and those that people have on GHFF, I have dealt with each separately.

Flying-fox impacts on humans

Although economic loss in fruit producing enterprises is the most significant problem caused by Flying-foxes it is not the only reason for human conflict with the species. People have also sought to manage flying-foxes because of other impacts on property and because of concerns about disease which add to long-held notions of bats as being worthy of fear (Eby & Lunney, 2002).

The nature of Flying-fox impact on commercial fruit production

Although direct consumption of fruit by GHFF may be the most obvious problem caused for commercial fruit growers it is not the full extent of the species' impact in orchards. Aside from that consumed by Flying-foxes, fruit may be damaged by sample bites or scratching (Tidemann *et al.*, 1997). Further, profitability can be reduced by staining caused to fruit (Jamieson, 1987) via defecation, urine scalding and "*frass*"; the chewed fruit and blossom spat out by Flying-foxes during feeding.

As a result of this damage, Flying-foxes have become widely recognized as a pest for fruit producers but the economic impacts of GHFF have remained relatively poorly quantified. This, in itself, has been a significant problem for fruit growers in justifying their need for

control, and similarly for managers in determining the nature and extent of control/mitigation activities that should be permitted.

Tidemann *et al.* (1997) estimated that Flying-foxes, annually cause around \$20 million damage to Australian fruit crops. Other estimates have typically dealt only with parts of Australia, from states to small, localised growing regions and none have been specific to GHFF given the difficulty of allocating blame for damage caused at night, in areas where different Flying-fox species overlap in distribution.

A common factor among several authors' accounts of Flying-fox impacts on commercial fruit production has been the varying extent of damage caused. Just as the presence and extent of flying-fox populations are varied, so too, differences have been observed in the amount of damage cause to fruit crops. Growers from different areas and those with different crops within the same areas are affected by Flying-fox predation to varying extents. Similarly, from year-to-year, the effects of Flying-foxes can vary, with "bad years" being decidedly worse than others.

Fleming & Robinson (1987) for example, reported that 60% of all respondents to their 1983 survey of North Coast (of NSW) commercial fruit growers indicated typical, annual damage equal to approximately 1% of their crops. However, their study also revealed that during the 1983 season two-thirds of respondents suffered damage to greater than 20% of their crops, with 30% of all participating growers reportedly losing more than half of the fruit they produced. As a result, 1983 was considered to be a "bad year" for Flying-fox damage on the North Coast.

Another project, involving North Coast (NSW) stonefruit producers, found that damage levels varied between 5% and 90% (Loebel, 1987). Similarly, a Queensland grower survey, revealed that, over multiple years, within the same region, less than 1% of avocados were reported to be affected by bats but lychee damage consistently exceeded 20% (Jamieson, 1987) and Ireland (1989) reported that banana growers from the North Coast lost an average of 10% of their crops to Flying-foxes, whilst stonefruit growers lost an average of 20% in the same area.

Crops reported to suffer damage from Flying-foxes

Although different crops suffer damage to varying extents, many Australian fruit crops have been reported to suffer at least some damage from Flying-foxes (Table 3.4). In NSW however, producers of bananas, lychees and stonefruit have been considered to be most affected.

Table 3.4: Australian commercial fruit crops reportedly affected by Flying-fox damage.

Fruit type	References
Apples	Jamieson, 1987; Wahl, 1994
Apricots	Fleming & Robinson, 1987; Jamieson, 1987; Wahl, 1994
Avocados	Jamieson, 1987
Bananas	Fleming & Robinson, 1987; Loebel & Sanewski, 1987; Jamieson, 1987; Wahl, 1994; Qld FFCC, 2000
Berry fruit*	Fleming & Robinson, 1987; Jamieson, 1987
Carambola	Loebel & Sanewski, 1987; Wahl, 1994
Citrus*	Jamieson, 1987; Wahl, 1994
Custard apple	Jamieson, 1987
Figs	Jamieson, 1987; Wahl, 1994
Grapes	Wahl, 1994
Guavas	Fleming & Robinson, 1987; Loebel & Sanewski, 1987
Longan	Loebel & Sanewski, 1987; Wahl, 1994
Lychees	Fleming & Robinson, 1987; Loebel and Sanewski, 1987; Jamieson, 1987; Wahl 1994; Qld FFCC, 2000
Mangoes	Fleming & Robinson, 1987; Loebel & Sanewski, 1987; Wahl, 1994; Qld FFCC, 2000
Nectarines	Fleming & Robinson, 1987; Wahl, 1994
Papaws	Loebel & Sanewski, 1987; Jamieson, 1987; Qld FFCC, 2000
Pears	Wahl, 1994
Peaches	Fleming & Robinson, 1987; Wahl, 1994
Persimmons	Fleming & Robinson, 1987; Jamieson, 1987
Plums	Fleming & Robinson, 1987; Wahl, 1994
Rambutan	Qld FFCC, 2000
Stonefruit*	Loebel & Sanewski, 1987; Jamieson, 1987; Wahl, 1994; Qld FFCC, 2000
Tamarillo	Jamieson, 1988

*The fruit included in these general categories were not specified by the original authors

Non-agricultural impacts

Impacts of Flying-foxes, and associated concerns, are not limited to fruit-crops and orchardists. In recent years several case studies of urban Flying-foxes have surfaced, in response to public interest in the issue. Described in one newspaper as “the bane of urban existence” (Benson, 2000) Flying-foxes have garnered substantial attention and fuelled conflicts within communities.

The main complaints against Flying-foxes in urban areas focus on the damage they cause to plants, the noise they make, their odour and their potential to act as vectors of disease.

In Melbourne and Sydney, attention has focused on the presence of Flying-fox camps in the cities' Botanic Gardens where damage has been caused by individuals roosting in "culturally significant" trees (Richards, 2002; Miller, 2003). Aside from damage to the plants within each Botanic Garden, the smell and noise created by Flying-foxes have also been cited as problems (ABC, 2001 online; Miller, 2003) resulting in substantial time, effort and money being directed to removing or reducing the animals' presence.

Extensive defoliation, and subsequent weed infestation, of rainforest remnants have also been reported from Maclean, in northern NSW (Tidemann, No date, online). In that town, the local high school was built directly adjacent to a rainforest remnant that contains a long-established Flying-fox camp (West, 2002). Maclean's local community has been divided by the issue of how to manage Flying-foxes within urban precincts. Interested parties' concerns focused not only on damage to the rainforest remnant but also the disturbance of people by noise and the potential effect of bats on the health of students in the adjacent school grounds (Powell, 1999).

Similarly, in recent years, urban residents along the Coffs Coast of NSW have engaged in an ongoing public debate about Flying-fox management. Local newspapers have published letters from residents complaining about impacts on commercial enterprises due to odour (Mann, 2004), the pollution of adjacent water-bodies by bat faeces (Blacker, 2004; Limbert 2004), damage to camp vegetation (Anon, 2004), increased respiratory illness in humans (Glennon, 2004) all of which have, allegedly, been caused by Flying-foxes.

Concerns surrounding disease carried by Flying-foxes have also led to fears among the public that these animals are dangerous. Following studies that show Flying-foxes carry viruses which can be dangerous to humans and other animals (Allworth *et al.*, 1996; Williamson *et al.*, 1998) the public was advised not to touch Flying-foxes a warning that has since been reiterated several times by public health authorities (Gibney, 2004).

Human impacts on GHFF

Duncan *et al.* (1999) reported six confirmed threats to the GHFF. Among these, the following five are directly associated with human activities:

1. Habitat clearing,
2. Roost disturbance,
3. Pollutants,
4. Crop protection activities, and
5. Collision with human infrastructure

Whilst some of these factors may have an immediate effect on Flying-foxes, such as colliding with powerlines and being electrocuted (Eby, 1995), others progress more slowly, such as pollution from industry or car emissions (Hariono, Ng & Sutton, 1993). Regardless, all five of these anthropogenic influences reduce the viability of the GHFF population.

Clearing native vegetation

Despite a general preoccupation with the negative impact that culling has on GHFF, clearing is a significant issue affecting their survival. Removal of native vegetation has reduced the availability of traditional food sources and eliminated or adversely affected camp sites of GHFF, resulting in a reduction in the numbers of Flying-foxes seen in areas such as northern New South Wales (Lunney & Moon, 1997).

Eby (1991) cautioned that the GHFF population was “*vulnerable to further destruction of habitat and reduction of diversity and abundance of tree species throughout their range*”. Despite this warning, GHFF were listed as vulnerable, eight years later, due to “*projected population decline in response to documented on-going reduction in critical habitat in north east New South Wales and south east Queensland*” (The Action Plan for Australian Bats, 1999).

Urbanisation

Clearing need not directly impact upon food or camp sites to be problematic for GHFF. In situations where vegetation surrounding camps is cleared, they may be closely approached by urban development resulting in little space between humans and GHFF. Such situations can

lead to conflict between bats and people who live nearby, e.g. Maclean (Tidemann, No date, online.), Ku-ring-gai (Larsen *et al.*, 2002) and Coffs Harbour (Smith, 2002) As a result of the close proximity to people, camps may experience disturbance by urban noise or via intrusions of people and pets into camp sites (Personal observation).

Aside from disturbance and the potential for residents to pressure managers into moving bats (as previously occurred at Maclean) urbanisation has also been implicated in a shift among GHFF from their traditional, nomadic lifestyle, to the establishment of resident populations in permanent camps. Thus, rather than following food sources and using a range of temporary camps, GHFF may be settling in urban areas e.g. at Coffs Harbour (Smith 2002) and the Melbourne Botanic Gardens (Miller, 2003) due to the ongoing availability of food from mixed urban plantings that can maintain GHFF throughout the year (Parry-Jones & Augee, 2001).

Mitigating Damage to Fruit Crops

Protecting crops from damage can occur at the site of fruit production or at camps. Once both the public and growers could freely shoot Flying-foxes at camps, where the animals, conveniently, congregate during the day. Alternatively, some people used explosives to destroy both the animals and the local vegetation. Such camp-based management was quite popular but is now prohibited.

Growers are consequently left with the option of managing Flying-foxes on-site, at the place of fruit production. A range of measures exist which may be separated into those that kill, those that deter and those that exclude (Table 3.5). Several of the lethal methods are illegal due to concerns about their humaneness and the effectiveness of various deterrents has been questioned. In NSW, DEC and NSW Agriculture advocate full-exclusion netting, as the only reliable method suitable for crop protection and minimizing injury to native wildlife (NSW NPWS, 2004, online).

Table 3.5: Categories of on-crop protection methods, with examples.

Lethal	Deterrents	Exclusion
Shooting	Light, e.g. strobes	Full-exclusion netting, permanent
Poisoning, e.g. strychnine	Sound, e.g. gas guns, shooting, high frequency devices	Full-exclusion netting, temporary
Electrocution, e.g. wires over crop	Smell, e.g. burning sulfur and oil	
Entanglement, e.g. barbed wire	Taste, e.g. spray on chemicals	
	Partial exclusion netting	
	Flamethrower device	

A detailed review of crop protection methods is not included as it is most relevant to sections of the questionnaire that have been omitted from this case study. Suffice to say that many of the options in Table 3.5 are still used today and, among these, shooting and netting are most frequently discussed. This occurs particularly in the context of attempts by NPWS to shift the fruit industry from a focus on shooting to use of full-exclusion netting. Whilst exclusion netting is considered to be a humane and effective crop protection method (Rigden & Chapman, 2002; NSW NPWS 2004, online) shooting results in injury and deaths for many Flying-foxes each year.

Attitudes towards Flying-foxes

Although managers and researchers have begun to recognise the value of understanding community attitudes towards Flying-foxes (Lunney *et al.*, 2002) little research has specifically addressed this issue and no broad-scale study of Flying-fox-related attitudes has been attempted. Despite this, previous authors' accounts of Flying-foxes and related management allow some insight into Australians' changing views of these animals, over time.

Tidemann & Vardon (1997) wrote "*these animals (Flying-foxes) are very different things to different people*". As evidenced by the ranging views of individual members of the FFCC (personal observation), there is little doubt that this is currently the case. Historical evidence, however, suggests that past views of Flying-foxes, in Australia, were more homogeneous.

Since Europeans settled in Australia, the prevailing attitude towards Flying-foxes has mostly been negative. Other than in the past 20 years, in association with an emerging protectionist movement for Flying-foxes, these animals have been feared, hated or both and consequently managed predominantly by lethal means.

Whilst indigenous Australians had valued Flying-foxes at least as a food resource (Tidemann & Vardon, 1997) Europeans considered Flying-foxes to be *faunae non gratae* from their first contact with the species. This notion is supported by reports that a crew member aboard the first ship to map Australia's eastern coast referred to Flying-foxes as "winged devils" (Eby & Lunney, 2002).

The interactions that occurred between people and Flying-foxes, following settlement, did little to improve the apparent dislike of the species. In a developing nation focused upon agricultural success, initially for survival and later for economic growth, Flying-foxes' role in impacting fruit production did not aid their conservation. Instead, it ensured they were not tolerated by society and that significant effort was outlaid on population reduction.

Like Gould, who made it clear in his 1863 account of the species that the Grey-headed "vampire" (GHFF) was the "most troublesome" of native species (Dixon, 1976), descriptions of Australia's Flying-foxes from the late 1800's and early 1900's almost uniformly refer to them as being problematic, particularly for orchardists (Lucas, 1896; Darnell-Smith, 1917).

As stated above, this negative view of the animals has been associated with ongoing culling, not just on crops but also at their camps. Records from the late 1800's show people were determined to find and destroy Flying-foxes, offering money to local Aboriginals to reveal the sites of camps to facilitate education (Lunney & Leary, 1988).

In 1928, to address Flying-fox related problems caused by the animals and to obtain information for the development of control methods, the Governments of Queensland and New South Wales, with the Council for Scientific and Industrial Research, commissioned Francis Ratcliffe to undertake a biological investigation of Flying-foxes. In his resulting report Ratcliffe (1931, p57) provided some insight into how people of that period felt about Flying-foxes, why this perspective had arisen and the impact it had on management of the species:

"Psychological factors play a far from negligible part in determining the general attitude towards the Flying-fox. The very nature of the animal precludes an unbiased assessment of its economic importance. It is a bat, and an unnaturally large one into the bargain. It is nocturnal, noisy, smelly and usually infested with parasites. During this investigation it was quite astonishing the number of individuals who prefaced

their information regarding Flying-foxes with a statement that they were “stinking, lousy brutes”. This attitude is really very significant”.

Ratcliffe believed that the animal's appearance and behaviour resulted in a dislike amongst the public, which, in turn, led to bias in the estimates of damage he collected from fruit growers. Indeed, it was because he was so sure that this dislike had permeated society that he predicted his findings, that Flying-foxes were not a significant pest to agriculture, would be widely rejected (Ratcliffe, 1931, p46).

Despite the assertion that Flying-foxes were “*not a serious menace to the fruit growing Industry*” (Ratcliffe, 1931, p77) the negative view of Flying-foxes in Australia continued to prevail and as recently as the 1970's local government on the NSW North Coast supplied ammunition for Flying-foxes to be shot at their camps (Smith, 2002).

More than pests?

Against the trend of “*popular blacklisting*” of Flying-foxes (Fujita & Tuttle, 1991) in recent times it has become clear that views of the animals are not solely negative. To the contrary, a protectionist movement for Flying-foxes has arisen in Australia, associated with increased societal awareness of Flying-foxes' ecological role, and general support for conservation of fauna and promotion of native biodiversity.

In NSW, the establishment and growth of the Ku-ring-gai Bat Conservation Society (KBCS) and the Flying-fox Group of Cabramatta (FFGC), both of which are involved in community education to promote Flying-fox conservation (KBCS, 2005, online; FFGC, 2005, online), demonstrate that some people definitely hold positive attitudes towards Flying-foxes.

Although the advent of such groups does not represent a complete reversal of negative views towards Flying-foxes it does show that some attitudinal heterogeneity exists within the public. Of the few studies of interactions between people and Flying-foxes that have not focused on damage to fruit crops, Larsen *et al.* (2002) found that a majority of respondents to their survey of residents surrounding the Ku-ring-gai Flying-fox Reserve were positive, to some extent, about living near the local bat colony whilst others were negative in response to the same issue.

Further, Smith's (2002) comment that "*Flying-foxes elicit a fascinating range of human responses, from the 'aren't they beautiful' to a murderous 'kill the bloody lot of them'*" makes it clear that managers recognise there is definitely attitudinal diversity within the community. However whilst this also suggests that there are poles of perception regarding Flying-foxes, little consideration is generally given to the existence of intermediate views and even less to how these opinions are distributed among the community, even though such an understanding could have significant benefits for the allocation of wildlife management agencies' resources.

To develop such an understanding, however, it was necessary for the questionnaires in this project to reflect the different experiences and opinion present within the population. I felt that this would be best obtained from the source, i.e. by consulting with the public, and growers, about Flying-foxes.

3.3.5 Feedback from meetings with growers and the general public

Meeting procedure

In accordance with Human Research Ethics Committee guidelines, everyone attending the grower and public meetings was presented with an information sheet for participants and subsequently signed a participation form stating that they were over 18 years of age and that they understood how the meeting would be conducted and how information collected from them would be used.

Following this, meetings proceeded in 3 steps. Firstly, I reiterated the purpose of the project and the meetings, described what the FFCC was and established some guidelines for participation, i.e. letting each other talk and respecting people's rights to hold opinions that may differ from those of other attendees. Secondly, I facilitated discussion by drawing on a series of prepared questions that dealt with issues relating to experiences with Flying-foxes and preferences for their management.

Although attendees were able to ask questions throughout the meetings, I specifically invited comments and questions after each specific point of interest had been covered. In this way, I

ensured that there was opportunity for attendees to raise any issues they felt were relevant to the project.

Lastly, attendees were invited to speak to me individually regarding any issue they did not want to raise in an open forum. This offer proved to be particularly valuable for gaining information about sensitive issues, e.g. participation in illegal culling activities, and was utilised by attendees at every meeting.

At the Coffs Harbour meeting with fruit growers the generic meeting plan was followed by distribution of copies of an early draft of the grower questionnaire and discussion of issues relating to its content and design.

The following summary of information gathered from attendees is not offered as a representation of the views held by all growers or members of the public but rather as an example of the range of views and issues relevant to Flying-fox management that emerged from the meetings.

Feedback from Commercial Fruit Growers

It is important to note that all attending growers indicated that they had previously suffered crop damage caused by Flying-foxes.

Flying-foxes and fruit production

At each meeting there were some growers who indicated that Flying-foxes have a significant impact on their fruit production, including some individuals who believed that the animals are the single most limiting factor for commercial fruit production. Although neither view was held unanimously, many attendees expressed a belief that it was unlikely they would be able to remain in the fruit growing industry if Flying-fox damage was not alleviated. The estimated time to loss of viability for enterprises varied between growers but was reported to be as near as just one or two seasons for some attendees.

Low profit margins on fruit were offered as an important reason that Flying-fox damage is a substantial problem for commercial fruit producers. Growers stressed that even low levels of Flying-fox damage significantly impact their enterprises and expressed a belief that this was poorly understood by managers and the general public.

As expected, based on the results of previous grower surveys, estimates of annual crop damage varied widely, ranging from 15% to total crop loss. Likewise, growers emphasised that crop damage varies between years; however, inter-year loss estimates for the same growers appeared to lie within a narrower range than those reported between growers/enterprises within years.

When I asked why growers believed Flying-foxes attacked commercial fruit crops various explanations were offered. Some stated it was because the animals preferred commercial fruit or because there was no longer sufficient native food for them. Others suggested it was because, unlike native food, commercial fruit could be found consistently in the same place, each year. Some individuals expressed concerns that carers were feeding commercial fruit to captive animals and were therefore inadvertently training them to seek out orchards when released.

Netting as an option for crop protection

All attendees indicated that they were aware of the use of netting to protect fruit crops from Flying-fox damage and at each meeting there were growers who currently used netting for this purpose.

Growers who did not currently use netting were asked to explain why not. Banana growers generally replied that it was not possible to net bananas due to the steeply inclined land used for their production in NSW and the height of netting required. Some individuals further specified that they actually believed netting of banana crops was possible but they felt it was not feasible. This was based on an expectation that specialised engineering for very tall netting and limitations of machinery on steep slopes would make installation cost-prohibitive.

Another commonly expressed view was that low profit margins on fruit ensure that netting remains out-of-reach of many growers. Even with low-interest loans, many of the growers indicated that they or other producers that they knew would not be able to pay for netting and remain profitable, thus defeating the purpose of installing it. From this perspective, not installing netting was a calculated risk since, with netting, many believed the loss of their enterprise through financial ruin was unavoidable whilst variability in Flying-fox damage without netting allowed a chance for some years, at least, to be profitable.

Growers responded very negatively to questions about the option of low-interest loans via the Rural Assistance Authority. Much of the negative sentiment was directed towards the RAA specifically with many attendees indicating that interaction with the authority was, in itself, a significant disincentive for pursuing netting options based on past experiences and reputation.

Additionally, most growers indicated that the criteria for allocation of low-interest loans for netting was unrealistically prohibitive and many also added that they felt the maximum low-interest loan available through the RAA scheme was insufficient.

Those growers who had installed netting were strong advocates for it from the perspective of reducing crop damage but also raised concerns regarding other impacts on fruit production, such as increased vegetative growth, higher densities of insects than prior to netting and concerns regarding reduced pollination of fruit.

One grower indicated that changes in micro-climate significantly affected the profitability of his fruit by affecting the timing of ripening. In his case, fruit that was once highly valuable because it was consistently available early in the season now ripens at the same time as fruit produced in other areas, reducing its value and, in turn, the grower's profit margin.

Shooting as an option for crop protection

No grower indicated a desire to harm Flying-foxes for any reason other than the reduction of damage to their crops.

Many attendees indicated that shooting was not a preferred management option; however, reasons for this varied considerably between individuals. Some growers believed that the effectiveness of shooting as a crop protection method was limited. Others listed the substantial effort required, particularly in terms of time, to be problematic. Still other attendees indicated that they held safety concerns for self and others, were worried about disturbing family and/or neighbours and that the increasing cost of firearms and ammunition limited shooting activities.

Whilst some growers expressed a genuine appreciation for the efforts of local NPWS staff, e.g. Martin Smith in the Coffs Harbour area, others were frustrated by the process of licence

applications and several individuals expressed a belief that it was too difficult to get licences to shoot Flying-foxes. Many growers that currently or previously had licenses to shoot Flying-foxes indicated that the number of individuals they were permitted to cull was insufficient to make a difference to the level of crop damage sustained.

Other growers, however, were satisfied with shooting as a crop-protection method, suggesting that timing was the key to success. Among these individuals, several subscribed to a 'scout' theory although specific beliefs about the role of the particular Flying-foxes varied. Some growers believed that the Flying-foxes that arrive earliest at crops serve to attract others to the area. Growers suggested that this might happen either actively, through some kind of deliberate communication, or simply via their presence demonstrating that this was a good area to feed. Alternatively, other growers believed that shooting the 'scouts' is important because, once frightened, they would 'tell' other Flying-foxes not to use that particular food resource.

Regardless, shooting 'scouts' was suggested to be the key to effective control using firearms and beneficial since, if done appropriately, few individuals needed to be shot, compared to instances when these early visitors were overlooked resulting in much higher shooting pressure being required to remove large numbers of Flying-foxes once they have settled to feed.

Methods of shooting Flying-foxes varied. Some growers indicated a preference for using shot-guns but noted that these were most effective for shooting Flying-foxes "on the wing". Other shooters preferred to use small, e.g. .22 calibre rifles, to shoot Flying-foxes once they had landed on fruit trees. Whereas a shotgun can damage fruit if used on bats that have already landed, rifles provided the advantage of minimising collateral damage to fruit as there is only one projectile. Some growers suggested that strapping torches to rifles was helpful as it allowed spotlighting and shooting to be done more efficiently.

Some growers that shoot Flying-foxes indicated that they do so without licenses or in excess of their quota. One individual indicated shooting up to 200 individuals per night with the aid of family members. This particular grower also indicated a genuine dislike for killing Flying-foxes but felt that shooting was the only affordable way to provide some crop protection based on current financial circumstances.

Recognising and alleviating grower hardship

At the Castle Hill meeting, individuals expressed a desire for this research to focus people's attention on the role of native habitat loss as they cause of Flying-fox problems rather than the 'relatively small' impacts that fruit production or crop damage mitigation has had on GHFF. Growers at this meeting suggested that current management of GHFF was inequitable since their industry consistently paid the most significant price for the ongoing existence of GHFF. They stressed that unlike other situations where growers might be able to effectively pass on the costs of impacts to consumers, the low prices that large supermarkets offer for fruit ensured that this was not possible.

Discussion of this point led to the suggestion that some growers might be happy to grow fruit for Flying-foxes providing that they were remunerated for it. Because there was a general feeling that Flying-fox damage was sufficiently problematic to cripple fruit producing enterprises under their current economic circumstances growers discussed possible exit strategies from the Industry including paying growers to permanently leave the Industry, i.e. a Government funded 'tree-pull'. Since many growers expressed a desire to remain associated with fruit production, another of their suggestions involved remunerating growers for fruit damaged by Flying-foxes or paying growers to produce fruit solely for Flying-foxes. In both cases, these ideas were based on a belief that commercial fruit had become an important part of the diet of GHFF in NSW and that removal of fruit crops would result in a significant loss of food resources for Flying-foxes.

Growers were generally confident that subsidies for netting, although desirable from their perspective, would never be adopted by Governments and instead suggested that some form of tax relief, based on accelerated depreciation of netting, might assist that control method's uptake by fruit producers.

Other individuals also raised the possibility that facilitating widespread netting would be detrimental to Flying-foxes since they had become 'dependent upon commercial fruit'. Some growers agreed that a State-wide replanting should be undertaken to alleviate impacts of GHFF on fruit production but others, who felt this would not happen, again stressed that options for remunerating growers for Flying-fox damage to crops represented the best option for growers and bats.

Interestingly, several growers made the point, both in meetings and through additional comments on questionnaires, that they believe Flying-foxes will become an increased burden on food resources in urban areas without access to commercial fruit crops and thus preferred not to net their crops but take the remuneration option.

Other issues

A key issue raised in meetings was the fact that many growers were not convinced that GHFF have declined. Rather, based on the number of animals and extent of crop damage experienced, many growers felt that numbers have obviously increased. This belief was associated, in some cases, with a general distrust in the involvement of NPWS in managing Flying-foxes from the perspective that the GHFF decline was fiction. Alternatively, some growers indicated a belief that the methods used to determine Flying-fox numbers were obviously either seriously biased or fundamentally flawed.

The role of Flying-foxes as an important seed disperser was also challenged. Opponents suggested that 'anyone' who had observed how Flying-foxes feed 'knows' that solid material is spat out with only liquid being retained. Consequently, they believed it was not possible for these animals to transfer seeds via ingestion and defecation.

Some growers also expressed concerns regarding the disease-vector potential of Flying-foxes. In addition to worry about Menangle, Hendra and Lyssa viruses concerns were also raised about the potential for unspecified or unknown diseases to be spread. Because attendees were concerned about disease transmission via indirect contact, e.g. through chewed fruit, urine, faeces and contaminated water supply, they believed there was a case for population control especially on fruit crops and, in some cases, strategically eliminating camps that were of particularly high risk, e.g. those near human water supplies. Additionally, one grower at the Coffs Harbour meeting described 'rashes' and 'welts' that he and his employees suffered after they had carried bunches of bananas covered with Flying-fox frass.

Other methods of Flying-fox control were also discussed. One grower indicated his intention to inject developing bunches of bananas with vanilla essence because he had heard that Flying-foxes would either be deterred by the strong smell or that the odour would mask the plants' chemicals that attract Flying-foxes.

In terms of generally deterring Flying-foxes from the local area, one grower mentioned his use of fishing line strung over the water sources, dams, on his property to prevent Flying-foxes from drinking there. He hoped this would reduce their presence in his area. Other growers spoke of using similar methods but instead of fishing line, using barbed or plain wire strung across rivers where Flying-foxes were known to drink. Many participants remembered taking part in management at camps, including shooting, in the past. Some growers described past use of “44-gallon drums of blue-metal” (or similar aggregate) with explosives to destroy camp vegetation and injure or kill Flying-foxes.

One attendee spoke of the use of strychnine, by a non-grower, to poison Flying-foxes in a suburban area. A bunch of bananas laced with the poison was left out overnight and successfully killed tens of GHFF. No growers indicated support for the use of poison to control Flying-foxes.

Banana growers from the Coffs Harbour area spoke of a belief that the presence of overripe fruit attracted Flying-foxes. They believed that key attracting chemicals in the fruit were more potent when it was fully ripe or over-ripe and that this was an important attractant for Flying-foxes. Subsequently, the potential problem of poorly maintained or ‘abandoned’ plantations was raised, especially since several growers in the area have left or were in the process of leaving the Industry. Attendees were worried that these plantations would lure more Flying-foxes to the local area with flow-on effects to their enterprises from a higher local density of the animals.

Although coffee had not been previously identified as a crop affected by Flying-foxes in my background research, a grower from the Coffs Harbour area detailed his problems with the animals. Of greatest interest in his account was his description of Flying-foxes targeting coffee only at a particular stage of the ripening process. Despite the presence of Flying-foxes in the immediate area on nights before and after this stage, he stated that they were only briefly attracted to the coffee and felt that this suggested there was an important chemical cue that the bats were sensitive to.

I asked growers several questions relating to the identity of Flying-foxes that impacted fruit crops and whether they could tell the difference between them. Responses were mixed. Most growers blamed damage mostly on GHFF but some described little-red Flying-foxes also. A

small number of growers seemed to think that Little-red Flying-foxes were juveniles of GHFF. At the Coffs Harbour meeting, several growers distinguished between Flying-foxes and a smaller, “blossom-bat”, that they had observed feeding on banana flowers.

It was interesting to see that tension existed between growers from different areas in the State and between different parts of the Industry. Such tension was not related solely to competition for market advantages. Growers at the Lismore and Coffs Harbour meetings expressed a view that Sydney growers were not taking advantage of netting since they were not genuinely interested in remaining in the Industry and were simply maintaining their properties until land prices became sufficiently high to sell them for development.

Individuals suggested that this occurred despite the fact that enterprises in southern areas of NSW, e.g. Sydney, were better suited to netting, due to flatter land and smaller areas, than those on the north coast, especially bananas. Some north-coast growers felt that this alleged stalling by Sydney growers had contributed to a poor reputation for growers generally which would, in turn, adversely affect those fruit producers who genuinely want to remain in the Industry. This notion, when presented at the Castle Hill meeting, was firmly rejected on the basis that many attendees indicated their land could not be sold for development and because they did want to remain involved in fruit production.

Feedback from meetings with the Public

As for growers, attendees at public meetings were provided with an approved information sheet detailing aspects of their participation and were asked to sign a consent form to take part. I used a series of questions about individual’s experiences with Flying-foxes and their opinions of management to facilitate discussion relevant to the project. Members of the public were invited to raise any issues about Flying-foxes and management of these animals that they felt were not adequately discussed and, like the grower meetings, time was also allocated for attendees to speak to the researcher about any issues they did not want to discuss publicly.

Unsurprisingly, the meetings did not attract people without a specific interest in Flying-foxes. Instead, the public attendees comprised Flying-fox carers, local government staff with an interest in Flying-fox management, and residents from areas close to urban Flying-fox camps.

Flying-foxes in Urban Areas

Although tolerance for the activities of GHFF varied among public participants it was generally acknowledged that these animals can be a nuisance to people.

Problematic interactions with humans included noise, which was reported to be an issue both during the day, for residents who live in close proximity to urban camps and at night for residents whose yards are visited by Flying-foxes. Described as ‘screeching’ by one participant, the noise of Flying-foxes in trees around houses was considered to be sufficient to wake people and pets, resulting in further disturbances, such as dogs barking etc.

Impacts on sight and smell

One attendee, in particular, was frustrated by the impact of Flying-foxes on the aesthetic value of his property. This person lived in an area close to a camp (within hundreds of metres) and stated that the staining of property with Flying-fox faeces was a significant problem. Their house, surrounding concrete, car and laundry, when hung outside, were all reportedly affected. This person expressed frustration that complaints, made to the local council, had been fruitless other than a suggestion to not leave laundry out overnight which, in their opinion, was “not solving the problem”.

Other residents who lived near camps also expressed concerns regarding the smell caused by Flying-foxes. Although some people indicated it was only a problem during wet weather, others did not agree and stated that the presence of Flying-foxes in the camp, irrespective of weather conditions, resulted in an offensive odour.

These problems led the participant to also express a concern that the presence of Flying-foxes would be a significant factor affecting the resale value of their house and land, with an expectation that it would be reduced relative to other, Flying-fox free areas.

To allow potential purchasers to avoid similar problems in the future, and because other participants were interested in minimising conflict between people and Flying-foxes, most participants supported some form of caveat that would advise new residents there was a Flying-fox camp in their area.

Flying-foxes' use of urban vegetation

Participants stated that a range of garden plants, both native and introduced, were utilised by Flying-foxes. Often this use was reported to result in damage to the fruit, flowers or foliage of the plants. Levels of concern regarding this damage varied. Unsurprisingly, some of the Flying-fox carers were less worried about this damage than they were interested in the role that gardens might play in assisting the animals through provision of appropriate food sources.

Some carers did, however, express concerns regarding plants that are problematic for Flying-foxes, especially Cocos palms, as bats attracted to the plants' fruit became entangled, resulting in injury.

Disease

The role of Flying-foxes as vectors of disease prompted interesting discussion. All public participants acknowledged the potential for Flying-foxes to carry diseases that could affect people but carers were quick to state that they believed this risk to be very small for the general public. Carers who were also involved in community education, and had previously toured schools with Flying-foxes to promote awareness and acceptance among school students told of the sharp downturn in school participation with their program following the media's interest in disease carried by Flying-foxes. They reported that many school principals were no longer prepared to have them visit with bats, even though students would not be touching the animals and saw this downturn in childhood education as a significant setback for Flying-fox conservation efforts.

Why are there urban camps?

It was interesting to hear from one member of the public that they “*did not understand*” why Flying-foxes would choose to live in an urban camp when there were so many State forests and National Parks around. It simply “*didn’t make sense*” to them that these “*wild*” animals would want to use urban resources when large tracts of native vegetation exist outside towns and cities and, further, the Flying-foxes “*should be moved*” to those areas.

Flying-foxes are a problem for fruit growers

In addition to urban problems, public respondents also indicated concern regarding impacts of Flying-foxes on commercial fruit crops. Carers were almost uniformly in support of the use of exclusion netting to protect crops and Flying-foxes. When I suggested that growers might not be able to afford netting, attendees recommended the establishment of Government subsidies or loans.

Carers’ concerns and other points of interest

In addition to comments about Cocos Palms and the negative impact of disease-related media coverage, carers singled out the impact of barbed wire and overhead powerlines as two significant problems for Flying-foxes.

Carers also raised the issue of Flying-foxes’ preference for native foods, rather than commercial fruit following the discussion of impacts on fruit growers. At two of the three meetings different individuals testified to this preference for native foods giving examples of captive animals demonstrating such a tendency even when presented with blossom for the first time, following a diet of commercial fruit. Carers strongly opposed the notion that Flying-foxes fed on fruit crops because they preferred commercial fruit instead suggesting that this was an artefact of habitat loss.

3.3.6 Designing the Flying-fox management questionnaires

As stated above, this case study involved the development of two questionnaires that overlapped in content but also contained questions specific to either the public or commercial fruit growers respectively.

Presenting all of the results from the grower and public questionnaires in this thesis was neither feasible nor appropriate. Since the FFCC's grower survey project served as a vehicle for me to further explore people's attitudes towards wildlife and associated management, the aspects of the questionnaire I chose to review in this thesis are those involving the attitudes and experiences of respondents relevant to Flying-foxes and their management.

Consequently, the following description of question design and the subsequent results deal only with those questions common to both the public and grower questionnaires (Appendix B).

Public and Grower Section One – Local Experiences with Flying-foxes

The ten questions in Section One were included primarily to: establish context for participants' attitudes towards Flying-foxes; to allow comparison between each group's experiences with Flying-foxes; and to provide opportunities to examine associations between attitudes and experiences.

1A: Have you ever heard of animals called Flying-foxes?

1B: Have you ever seen Flying-foxes in the wild?

1C: Have you ever touched or held a Flying-fox?

Based on a hypothesis that differential contact with Flying-foxes would contribute to different attitudes towards the animals and their management, Questions 1A, 1B and 1C were designed to identify different "levels" of contact between participants and Flying-foxes. From discussions with meeting attendees and the steering committee the three experiences used to differentiate between experiences levels were:

- Basic/Low: Being aware of animals called Flying-foxes (1A)
- Intermediate: Having seen Flying-foxes in the wild (1B)

- High: Having touched or held a Flying-fox (1C)

Initially, Question 1B simply asked whether participants had ever seen the animals but the condition of whether observation occurred “in the wild” was added because steering committee members believed there would be a difference between observing these animals in the wild and seeing them in a zoo, particularly from the perspective of appreciating the need for management.

1D: Do Flying-foxes in your garden, or local area, wake you at night?

Being woken by Flying-foxes has long been recognized as a significant contributing factor to the nuisance value of the animals (Eby, 1995). Since this was also supported by growers and public meeting attendees Question 1D was included to identify participant’s exposure to this potentially annoying activity. Further, it was also thought this variable might provide a way to discriminate between Zones by providing an indication of the extent of interaction participants have with Flying-foxes.

1E: How often do you notice Flying-foxes in your local area?

1F: Please indicate when you notice Flying-foxes in your local area by circling the month or months from the list below:

1E was aimed at providing a simple, straightforward way of determining how much exposure participants had to Flying-foxes, since this might be associated with attitudes toward the animals. Next, to better understand when interactions between people and flying-foxes occurred, and to determine whether this was different between respondents from the different Zones, participants were also asked to indicate the specific months they noticed Flying-foxes (1F).

1G: How do you know when Flying-foxes are in your local area?

I was interested to see whether participants differed in the way they detected Flying-foxes in their local area, and whether there was an association between particular means of detection and specific attitudes towards the animals. Obviously, seeing Flying-foxes would be an important indicator of their presence. However, noise created by Flying-foxes in urban areas has previously been discussed by several authors (Eby, 1995; Larsen *et al.* 2002 and Smith 2002) and their odour has been a recurring theme in literature regarding the animals (Tryon,

1920; Smith, 2002). Thus, 1G offered participants the response options spanning sight, smell and sound.

1H: Are you, or is someone you know well, a Flying-fox carer or rescuer?

1I: Do you live near (within 1 kilometre) of a Flying-fox roost or camp site?

It was evident from meetings that people who cared for injured or orphaned Flying-foxes represented a special interest group in Flying-fox management. Particularly relative to growers, “carers” seemed to have a substantially more positive attitude toward the animals and were far more accepting of the behaviours of the animals, e.g. damaging garden plants and making noise at night. Because of this, I felt it was important to be able to distinguish between these people and other members of the public so that a potential source of bias could be identified and treated separately; hence Question 1H.

Due to their, potentially, ongoing exposure to Flying-foxes, it was also deemed important to identify participants who lived near to a Flying-fox camp (1I). This is because, in meetings, many complaints about Flying-foxes in urban areas focused on the noise, smell and disease potential of camps.

1J: Should potential residents be told that there is a Flying-fox roost/camp site near the house before they buy, rent or live in it?

Unlike the other questions in Section One, 1J did not seek to establish background information or categorise participants based on an independent variable. It was a management-related question dealing with participants’ opinion about whether or not people should be informed about the presence of a local Flying-fox camp before they move into an area. This question stemmed not only from comments at public meetings but also from Smith (2002). Although this question might be more appropriately placed in later Sections, it was included in Section One in case participants chose not to answer any more than the first page of questions and because it potentially related closely to Question 1I.

Public and Grower Section Two: Personal details

As in the wild horse management questionnaire, some demographic information was sought to facilitate detection of trends within the responses. Consequently, Question 2A sought participants' gender, Question 2B asked when they were born and Question 2C was designed to establish the highest level of education obtained. Lastly, in Question 2D, each participant was asked to indicate in which region they had spent the greatest proportion of their life. This question resulted from suggestions, at meetings, that city people didn't understand the impacts of Flying-foxes in the same way rural people did.

Public and Grower Section Three: Attitudes towards Flying-foxes

Determining the attitudes held by growers, and the public, towards Flying-foxes were important aims of this project. To achieve this, it was necessary to go beyond the questionnaire development experience I had gained in the wild horse management case study and attempt to design a scale of measurement for attitudes.

Considerations in constructing the Flying-fox attitude scale

One of the significant methodological advances I attempted in this case study, compared to the wild horse management questionnaire, was the inclusion of an attitude scale. In Section Three, I presented participants with 19 Likert-scale statements, each with 5 possible responses of Strongly agree, Agree, Neither agree nor disagree, Disagree and Strongly disagree.

This approach was utilised not only to gather feedback on the issues contained in each statement but to develop an overall sense of strength and direction of attitude towards Flying-foxes.

I aimed for the 19 statements to cover a wide range of issues surrounding Flying-foxes, and their management, and they were therefore based on aspects of Flying-foxes and their management identified from available literature, feedback from public meetings and from my interactions with the Steering Committee.

Selection of statements

Likert (1974) stressed that all items in an attitude scale should be “*expressions of desired behaviour and not expressions of fact*” since people with different attitudes might still agree on facts. From this perspective it might be argued that some items in the attitude scale I developed for the Flying-fox questionnaire were inappropriate as they appear to deal with statements of accepted scientific facts rather than attitudes. However, public meetings and piloting of questionnaires revealed that responses to such items were largely variable in association with people’s views about Flying-foxes. That is, responses to such issues were clearly matters of opinion for participants, so they were included in the scale.

Concise construction of statements

Avoiding double-negatives, two-part items and ambiguity, as well as using as simple vocabulary as possible were suggested by Likert (1974) as key aspects of “concise construction” for attitude scale statements. From this perspective, feedback from the steering committee, public meetings and pilot participants were used to assist in the design process.

A similar number of positive and negative statements

To address the potential problem of respondents at a particular end of the attitude continuum always selecting similar response alternatives (Likert, 1974), statements in Section 3 were randomly assigned a “positive” or “negative” expression. Consequently, 11 of the 19 items were designed so that people with a positive attitude towards Flying-foxes would respond at the strongly agree or agree end of the scale whilst they would tend towards the strongly disagree end for the other 8 statements.

Correctly assigning numerical values to items

Related to the above issue is whether or not the numerical values for responses to each item have been appropriately assigned, i.e. should strongly agree equal 2 or -2 for a particular question? Likert (1974) recommended using inter-item correlation to answer this question. Since all inter-item correlations were found to be positive for Section 3, it was concluded that numerical values had been correctly assigned.

Items from Section Three

A brief explanation of the source of each item in the attitude scale is provided below.

3A Flying-foxes are intelligent animals

Just as the intelligence of Flying-foxes has long been recognized by people interested in managing these animals (Ratcliffe, 1931; 1932) so too the majority of meeting attendees expressed a view that Flying-foxes were intelligent, and therefore difficult to manage. Whilst this was clearly frustrating for growers who sought to protect their crops, the same individuals often expressed a degree of appreciation for this characteristic.

3B Flying-foxes are a significant problem for the NSW Fruit Growing Industry in areas east of the Great Dividing Range

A long history of conflict between fruit growers and Flying-foxes on the east coast of Australia has been a key reason for management (See *Flying-fox impacts on humans*, above). Steering Committee members suggested the inclusion of “*in areas east of the Great Dividing Range*” to ensure the item was specific to the project’s area of interest.

3C Flying-foxes are important in NSW forest ecosystems as pollinators and seed dispersers

As discussed in the review of the biology and ecology of GHFF (see *Ecological Role*, above) both seeds and pollen are distributed by Flying-foxes. Meetings revealed that some growers did not believe this to be the case and, rather, that the idea of seed and pollen dispersal had been fabricated as a reason to protect the animals.

3D Flying-foxes prefer to eat commercial fruit species rather than native foods (eg Blossom)

Like Parry-Jones & Augee (1991), Flying-fox carers took an opposite view to this item during public meetings but many fruit-grower attendees were of the opinion that Flying-foxes definitely prefer commercial fruit to native foods.

3E Flying-foxes should be eradicated from fruit growing areas

Ireland (1989) reported a desire among growers for a reduction of Flying-foxes, particularly in fruit growing areas. Similarly, in my meetings some growers expressed a desire for fruit growing areas to be free of Flying-foxes.

3F Any commercial fruit grower with a firearms licence should be able to shoot Flying-foxes to protect their crop

Although shooting Flying-foxes in Australia was once unregulated, growers now must have permission from NPWS to harm the animals. Feedback from meetings suggested that many growers oppose obtaining licenses for this activity. The item was changed from an initial wording of: “*Any commercial fruit grower should be able to shoot Flying-foxes to protect their crop*”, to reflect current legal requirements of a firearms license for the possession and use of a firearm, in NSW.

3G There should be no restriction on the number of Flying-foxes that Commercial Fruit Growers can shoot to protect their crops

Related to Item 3F, there have previously been calls from fruit-grower groups for permission to shoot Flying-foxes as required (Ireland, 1989), rather than being restricted to quotas by NPWS. Although growers at my meetings did not call for unrestricted culling this statement represents an extreme view that I believed would help to discriminate between differing attitudes towards Flying-foxes.

3H Damage to backyard fruit and plants is a small price to pay for having Flying-foxes in the local area

Several Flying-fox carers were adamant that the damage caused by Flying-foxes was outweighed by the joy or benefit of the animal’s presence, both because this represented a more natural state and because the animals themselves were a source of enjoyment or satisfaction.

3I Flying-foxes are threatened by habitat removal and loss in NSW

Although it is widely accepted in the scientific and conservation communities that habitat loss is a significant issue for bat conservation (see *Human impacts on Flying-foxes*, above) comments at meetings suggested that people did not uniformly support this idea.

3J Humans do not benefit sufficiently from Flying-foxes for them to be protected in NSW

At the grower meetings some growers suggested that protecting Flying-foxes was not worth the effort because the animals do not provide sufficient benefit to people. Conversely, as mentioned above regarding Items 3C and 3H, other people believe that Flying-foxes do make a significant contribution that should be appreciated by humans.

3K I would be concerned if, in the future, Flying-foxes only existed in zoos and fauna reserves
Based on a carer's statement that it would be a great shame if, in the future, Flying-foxes only existed as exhibits in zoos, this hypothetical future for Flying-foxes was raised with attendees at public and grower meetings. Since a wide range of responses were received, it was incorporated into an Item for Section 3.

3L Killing Flying-foxes should be completely banned in NSW

The possibility of a ban on killing Flying-foxes, as Eby (1995) suggested would be likely based on changes to the legal status of the animals in Australia, inspired vehement opposition from some growers, at meetings. Conversely, some public attendees, who were interested in Flying-fox conservation, expressed strong support for this option.

3M Governments should offer subsidies for methods of fruit crop protection, like netting, that do not harm Flying-foxes

This was proposed at meetings both by members of the public and by growers as an option to benefit Flying-foxes, as well as growers.

3N The noise and odour of Flying-foxes is a small price to pay for having these animals in your local area

At meetings this issue was generally supported by Flying-fox carers but rejected by growers and by a resident at the Coffs Harbour meeting who lives near the local Flying-fox camp.

3O To stop Flying-foxes eating commercial fruit crops we should replant native foods and replace important habitat for them

Since reduced availability of native foods has suggested as an important contributing factor to Flying-foxes' use of commercial fruit (Parry-Jones & Augee, 1991) replanting native food has been suggested as an option for reducing crop attacks. As well as having been suggested by previous authors (Law, Eby & Somerville, 2002) this option was raised at meetings by growers and members of the public.

3P Flying-foxes deserve to be protected from harm in NSW

Several steering committee members were opposed to inclusion of the word 'deserve' on the basis that it was too emotive. However, public and grower meetings reinforced the fact that

Flying-fox management is an emotive issue and, moreover, some people do feel that Flying-foxes “deserve protection”.

3Q Flying-foxes should be protected because they are “cute”

As in 3P, members of the steering committee were concerned about this item also. In this case, conservationist and manager representatives expressed an opinion that this notion might damage the credibility of ‘genuine reasons’ for protecting the animal. The item was kept, however, because appearance has been noted as an important factor in perceptions of Flying-foxes (Ratcliffe, 1931). Moreover, responses from meetings suggested that an attitudinal divide exists between people who find the animals repulsive to look at and others who attribute substantial aesthetic value to them.

3R Many Commercial Fruit Growers, east of the Great Dividing Range in NSW, are forced to undertake costly and laborious management to reduce Flying-fox damage to their crops

This statement was proposed by grower representatives to provide participants with an opportunity to acknowledge the difficulties experienced by growers, as a result of Flying-fox damage. I agreed to include it because a range of managers, conservationists and fruit growers I met with suggested that some individuals exaggerate the efforts required to deal with Flying-foxes and, more importantly, because it adds to the overall picture of how individual participants perceive Flying-foxes.

3S Flying-foxes are a significant disease risk to people in NSW

Perceiving Flying-foxes as a disease risk no doubt contributes to negative views of the animals for some individuals. Not only has this issue previously been raised in conjunction with concerns about Flying-foxes (Birt *et al.*, 1998; Smith 2002) but interest in this aspect of Flying-fox management among many growers, during meetings, suggested that this item was a necessary inclusion.

Reliability and Validity of the attitude scale

Reliability and validity are key aspects of questionnaire design (Kline, 1998). In this case study, I attempted to address the validity of items included in the questionnaires through consultation with growers and members of the public along with the direction and approval of the Steering Committee.

To establish that the questions were reliable, however, I calculated Cronbach’s alpha, using SPSS 12.0.1. Reliability coefficients are used to determine the uni-dimensionality of a set of questions/items in a survey instrument, or, as Cronbach (1951) described, “*whether the test designer was correct in expecting a certain collection of items to yield interpretable statements about individual differences*”. Cronbach’s Alpha is a commonly used example of such a coefficient and was calculated for the items in Section 3 of the Flying-fox questionnaire, because these were the questions I was interested in using to determine an overall attitude score for respondents.

Before calculating alpha, the data were screened in the following way, based on advice from Dr Laurel Bornholt, University of Sydney, (Personal communication). Scores for each response were determined by assigning them a value between -2 and 2. Where an item had been worded positively, regarding Flying-foxes, values were: strongly agree = 2, agree = 1, neither agree nor disagree = 0, disagree = -1 and strongly disagree = -2. Conversely, for those items that had been worded negatively, response scores were reversed: strongly disagree = 2, disagree = 1, neither agree nor disagree = 0, agree = -1 and strongly agree = -2.

Next, the distribution of responses was tested, and found to be normal (Wilk-Shapiro values exceeded 0.85). Individual respondents missing greater than 10% of responses to items in Section Three (i.e. those with > 2 non-responses) were deleted from the dataset. Other non-responses were replaced with the mean score for that item.

Since group scores exceeded 0.85 (Table 3.6) the questions in Section 3 were regarded as being sufficiently reliable to use for determining attitude as values of alpha greater than 0.8 are generally taken to represent a reliable scale.

Table 3.6: Reliability results for each response group.

Group	Growers	Zone 1	Zone 2	Zone 3
Cronbach's Alpha	0.879	0.921	0.892	0.888

Comparing 'attitudes' between groups

Responses to items in Section 3, within each group, were averaged to determine an overall attitude score between -2 and 2, where 2 was most positive, 0 was neutral and -2 was most negative. Whilst a score of -2 reflects a stronger negative response to Flying-foxes than a score of -1 it is not possible say how much more negative that score is because the scale is relative, not absolute.

Because the scores of attitude scales, such as that in Section Three, are based on categorical data, I was surprised to learn from an examination of published research, e.g. Clendenning *et al.* (2005) and Casey *et al.* (2005), in addition to the advice of Dr Bornholt, that comparing scores of mean attitudes/knowledge using parametric tests such as Analysis of Variance (ANOVA) is an accepted practice.

Thus, following tests to confirm the normality of each groups responses (Wilk-Shapiro values > 0.85) a one-way ANOVA was used to compare the mean attitude score between groups followed by a post hoc comparison-of-means test, (Tukey test).

Public Section 5 / Grower Section 6 – Other questions based on issues from meetings

5/6A: Why do you believe GHFF have reached population levels that require them to be listed as vulnerable?

Discussions with members of the public and growers showed that a range of opinions existed regarding why GHFF were listed as vulnerable and whether or not they should be afforded this status.

5/6B: Do you believe that GHFF should be listed as vulnerable?

As for Question 5/6A, a host of reasons were offered to explain why Flying-foxes were listed as vulnerable, if individuals actually agreed that they deserved this status.

5/6C: Please select the response that best describes your opinion of why Flying-foxes cause damage to fruit crops:

Growers and members of the public suggested a variety of reasons for damage to fruit crops, by Flying-foxes. This question was included not only to understand better why people

believed damage occurs, but also to determine whether or not significant differences existed between groups.

5/6D: A key aspect of managing Flying-foxes is understanding changes in the size of the population. Some people have indicated they are confident that the counts of Flying-foxes are sufficiently accurate. Do you feel that counts of Grey-headed Flying-foxes are accurate enough?

A significant issue raised by growers attending meetings was their disbelief regarding official counts of Flying-foxes. Based on their own experiences, many growers could not believe that Flying-fox numbers were up to an order of magnitude less than their own estimates. Carers, however, were confident that counts accurately reflected the vulnerable status of Flying-foxes. This question was included to see how members of the general public and growers felt about Flying-fox counts, and if they knew they took place at all.

Public Section 6 / Grower Section 7

The Castle Hill meeting resulted in three ideas for managers and Governments to provide a future both for growers and Flying-foxes. Growers at this meeting were keen for these options to be presented to their peers and to members of the public so that some idea of the level of support for these options could be established.

Given the need to keep explanations of each alternative as brief a possible, it was decided that rather than asking for an indication of outright support, participants would be asked: “*Do you see merit in exploring any of these potential management options? (You may tick more than one option)*”

Additional Comments

Participants were invited to add any further comments about Grey-Headed Flying-foxes or their management in NSW to the back pages of the grower and public questionnaires.

Distribution of Questionnaires

Growers

A package containing a copy of the grower questionnaire, an information sheet for participants (ISP) and a pre-paid return-addressed envelope were distributed to each grower that replied to the invitation to participate. After a fortnight had passed, a modified, reminder-ISP with another copy of the questionnaire and second pre-paid, return-addressed envelope were sent to those people who had not supplied a completed questionnaire. One fortnight after the reminder round, those growers who had still not responded were sent a final, reminder-ISP together with a brief (six question) non-response questionnaire, and a pre-paid, return-addressed envelope.

Public

Each public participant was sent a package containing an ISP, pre-paid envelope and a copy of the public questionnaire. As per growers, a reminder round was sent after two weeks to those participants who had not replied and a non-response questionnaire was distributed one month after the initial mail-out to those people who replied to neither of the initial two rounds.

Statistical comparisons

Comparing response frequencies

For each question (other than 2B: Age) the frequencies of observed responses were compared between the four response groups using Chi-square tests. Whilst it would also be possible to categorise respondents based on selection of specific options and then compare responses between categories of different experiences, knowledge or preference, this was not the focus of this research. For example one could compare the responses of people who have touched or held a Flying-fox with the responses of people who have not but in this study I was more interested to see whether there was a difference in the occurrence of these responses between groups.

For those instances where comparisons of two categories were being made between just two groups, two-by-two tables, with Yates Correction, were used. In all comparisons, the presence

of a significance difference was accepted when the resulting P-value was less than 0.05 ($P < 0.05$).

Whilst the percentages of “no response” replies, rounded to the nearest percentage point, are provided for each question in the result section, the counts of these replies were not included in Chi-square comparisons because I wanted to compare selection of the available response options.

Also, for many items, the low frequency of “No response” replies would have resulted in such low cell values that the results of the Chi-square analyses would have been compromised. For the same reason, in some situations it was necessary to combine observed frequencies of responses within questions, prior to analysis, to avoid low cell values.

Cross-tabulations and strength of association between variables

To determine the degree of association between pairs of cross-tabulated, categorical variables, I used SPSS 12.0.1 to calculate Cramer’s V. Cross-tabulations were performed between responses from Sections 1 and 2, with responses to items in Sections 3 and 5/6 of the questionnaires. Those questions for which respondents could choose more than one option were not included.

Whilst it would also be possible to conduct cross-tabulations between responses to items in Section 3, to determine whether there were associations between the selection of particular response options, this was not the focus of this research.

Values of Cramer’s coefficient range between a maximum value of 1, which may occur when variables are perfectly correlated, and 0, which occurs when the two variables of interest are independent (Siegel & Castellan, 1988). Interpreting values of Cramer’s V between 0 and 1 is essentially a subjective process and whilst larger values may be taken to indicate stronger association than smaller ones, suggestions regarding values of V that correspond to “weak”, “moderate” or “strong” associations vary between researchers. Importantly, whilst Siegel and Castellan (1988) stated that a Cramer’s coefficient value of 0.51 represented a moderate association they also stressed that, unlike Pearson’s r^2 , differences in the magnitude of

Cramer's coefficient have no direct interpretation. Because of this, values of Cramer's V calculated in this study are considered in a relative sense only.

Relative differences in opinion between growers and the public

I also decided to use the responses to Section 3 to build a simple visual and hopefully useful, indication of differences between item-specific responses of growers and the public. This was done by graphing mean responses to each statement, using the same -2 to 2 scale as for overall attitude score, to demonstrate the relative position of the grower and public mean responses, for each issue.

In interpreting these relative positions, it is necessary to keep in mind that the distances between points on the scale do not have a specified value. When referring to the "strength" of the groups' views this can only be a relative indication of where responses lie on the scale of: -2 = Strongly disagree, -1 = Disagree, 0 = Neutral, 1 = Agree and 2 = Strongly agree. Although a score closer to 2 can be interpreted as being more positive than another that is closer to 1, it is not possible to say how much more positive the first score is, i.e. a score that is twice as far away from the neutral point as another score it is not necessarily twice as strong.

Thus, to allow an examination of the groups' views across all items, the items were ranked, based on the difference in mean response score between growers and the public and on whether or not their overall views were aligned.

In the tabulated ranking, both strength and orientation of views were considered because the mean responses of two groups that are both supportive of a statement may have the same difference between their means as two groups with opposite mean responses.

3.4 Results

Grower responses

In response to the 1170 invitations that were distributed, 188 commercial fruit growers requested a copy of the questionnaire. From these individuals, 64% of questionnaires (n = 120) were returned. If one assumes that the total grower population in the study area was 1170, then 120 questionnaires are equivalent to a final response rate of 10.25%.

Using the sample size equation from the first case study (See *Determining Sample Size*), it was possible to calculate that 120 responses from 1170 individuals equates to a precision of plus or minus 15%, at the 95% confidence level. However, this precision is only of value if the responses of the 120 growers were not significantly different to those of non-participating growers. Since this cannot be demonstrated due to insufficient information about non-respondents the results should not be assumed to be representative of growers across the range of the study.

Public responses

Response rates varied for the three public Zones, ranging between 24% and 31% (Table 3.7). Although the target number of responses (384) for each public Zone was exceeded, the low rate of responses should serve as a caution against extrapolation of these results beyond the respondent group, as in the case of the grower survey (above). Compared to Case Study One, few return-to-sender (RTS) items were received.

Table 3.7: Response rates for each public zone.

	Gross Participants	RTS*	Net Participants	Responses	Response rate
Zone 1	2000	51	1949	605	31%
Zone 2	2000	70	1930	522	27%
Zone 3	2000	83	1917	461	24%

* RTS: "Return to sender", indicating that postal delivery did not occur.

3.4.1 Comparing public and grower responses

Demographic information

Question 2A: Gender

The grower response group was heavily biased towards males with only 15% of respondents being female (attendance at grower meetings was also largely male-dominated). In contrast, the female to male ratio of public respondents approached 6:4 (Table 3.8). Chi-square comparison revealed significant differences between growers and public groups but not amongst the public groups (Table 3.9).

Table 3.8: Respondents' Gender

	Female	Male	No response
Growers	15%	83%	2%
Zone 1	57%	43%	0%
Zone 2	56%	42%	1%
Zone 3	56%	44%	0%

Table 3.9: Chi-square results for responses to Question 2A.

Comparison	χ^2	P	DF
All	75.33	0.0000	3
Z1,Z2,Z3	0.26	0.8720	2

Based on data from a 2001 National census, The Australian Bureau of Statistics (2002, online) lists the number of males and females in New South Wales, over the age of 15 (the closest group to the 18 years age cutoff used in this research) as 2,442,821 (49%) and 2,554,997 (51%) respectively. As a result, proportionately more females and fewer males, responded to the public questionnaires than expected.

Question 2B: Age

The mean age of grower respondents and those from the public Zones are presented in Table 3.10.

Table 3.10: The mean age of respondents, based on responses to “In which year were you born?”

Group	Mean age (years)	Standard Deviation
Growers	54.78	12.02
Zone 1	51.62	15.92
Zone 2	50.42	16.76
Zone 3	48.97	16.04

Having confirmed the data were normally distributed (Wilk-Shapiro > 0.85), a parametric one-way ANOVA was used to test the null hypothesis that there was no significant difference in the mean age of respondents from each stakeholder group.

The ANOVA revealed a significant difference ($F = 7.94$, $DF = 3$, $P < 0.0001$) did exist between the mean ages of the four stakeholder groups (Table 3.11). Post-hoc analysis, using a Tukey comparison of means test, revealed two homogeneous groups (Table 3.11). The first group contained growers, Zone 1 and Zone 2 respondents whilst the second group contained Zone 3 respondents only. The mean age of Zone 3 respondents was lower than those of the other three groups (growers, Zone 1 and Zone 2).

Table 3.11: ANOVA results for the comparison each groups' mean age

Source	DF	SS	MS	F	P-value
Between	3	6069.93	2023.31	7.94	< 0.0001
Within	16566	421437	254.593		
Total	1659	427505			

Question 2C: Education

Grower respondents were much more likely to have terminated education at high-school level than respondents from any of the public zone (Table 3.12). Reciprocally, a University education and TAFE certification were more common among public respondents than growers. To allow comparison, by avoiding low expected cell values in Chi-square tests, categories of education were combined to form four groups: Less than high school education, High school education, TAFE and University education.

Overall, significant differences were observed between the four groups (Table 3.13). Other than Zones 2 and 3 ($P = 0.3901$), all groups differed significantly from each other ($P < 0.05$).

Table 3.12: Responses to “What is the highest level of education you have completed?”

Level at end of education	Growers	Zone 1	Zone 2	Zone 3
No formal education	0%	0%	0%	0%
Primary School	2%	4%	5%	2%
High School (7-10)	51%	29%	28%	20%
High School (11-12)	20%	13%	14%	15%
TAFE or similar	8%	24%	26%	29%
University (undergraduate degree)	13%	19%	17%	19%
University (postgraduate degree)	4%	10%	8%	14%
No response	2%	1%	1%	1%

Table 3.13: Chi-square results for comparisons of responses to Question 2C.

Comparison	Chi	DF	P
All	63.14	9	0.0000
Growers versus Zone 1	35.29	3	0.0000
Growers versus Zone 2	36.95	3	0.0000
Growers versus Zone 3	53.34	3	0.0000
Zone 1 and Zone 2	3.01	3	0.3901
Zone 1 and Zone 3	9.40	3	0.0244
Zone 2 and Zone 3	13.14	3	0.0043

Question 2D: Background

Growers mostly indicated a rural background (77%) with nearly half (43%) also indicating a coastal background (Table 3.14). As expected, few growers (16%) indicated a largely metropolitan life experience.

In Zone 1, more respondents indicated a coastal background (54%) than a rural one (51%) with over a quarter (27%) stating they had a metropolitan history. This appears to be quite different to the overwhelming response to having a coastal background from Zone 2 respondents (74%) followed by 44% of replies being ‘rural’ and 29% that chose ‘metropolitan’. Lastly, Zone 3 was dominated by a metropolitan response (79%) and just over half of the respondents from this Zone also chose ‘coastal’ (51%). Of all the stakeholder groups, Zone 3 had the smallest response to a ‘rural’ background (29%).

Thus, each group could be stereotyped in the following way:

- Growers as “rural-coastal”,
- Zone 1 as “coastal-rural” (but more rural than Zone 2),
- Zone 2 as “coastal-rural” (but more coastal than Zone 1) and
- Zone 3 as “metropolitan-coastal”

Chi-square analysis revealed significant differences ($P < 0.05$) within each possible group-pair (Table 3.15).

Table 3.14: Responses to “In which region have you spent the greatest proportion of your life?”

	Coastal	Rural	Metropolitan	No response
Growers	43%	77%	16%	2%
Zone 1	54%	51%	27%	1%
Zone 2	74%	44%	29%	2%
Zone 3	51%	29%	79%	2%

N.B. Because respondents were able to choose more than one option, the sum of the percentages within a group may exceed 100%.

Table 3.15: Chi-square results for comparisons of groups' responses to Question 2D.

Comparison	Chi-value	P-value	DF
Growers versus Zone 1	11.27	0.0104	3
Growers versus Zone 2	43.48	0.0000	3
Growers versus Zone 3	125.45	0.0000	3
Zone 1 and Zone 2	19.57	0.0002	3
Zone 1 and Zone 3	159.65	0.0000	3
Zone 2 and Zone 3	146.72	0.0000	3

3.4.2 Background experiences with Flying-foxes

Question 1A: Have you ever heard of animals called Flying-foxes?

Most respondents, in each stakeholder group, indicated that they had previously heard of animals called Flying-foxes (Table 3.16). Knowledge of Flying-foxes among public respondents was greatest in Zone 1 and least in Zone 3.

Table 3.16: Responses to “Have you ever heard of animals called Flying-foxes?”

	Yes	No	I am unsure	No response
Growers	97%	1%	0%	3%
Zone 1	95%	4%	1%	1%
Zone 2	85%	11%	3%	1%
Zone 3	74%	22%	3%	1%

Two-by-two tables were used to compare the frequencies of “yes” and “no” responses between groups. All group-pairs, except growers and Zone 1 ($P = 0.1931$), differed significantly (Table 3.17).

Table 3.17: Results of two-by-two table comparisons of responses to Question 1A.

Comparison	χ^2	P-Value	DF
Growers versus Zone 1	1.69	1	0.1931
Growers versus Zone 2	11.66	1	0.0006
Growers versus Zone 3	29.02	1	0.0000
Zone 1 and Zone 2	24.75	1	0.0000
Zone 1 and Zone 3	89.30	1	0.0000
Zone 2 and Zone 3	20.66	1	0.0000

Question 1B: Have you ever seen Flying-foxes in the wild?

The majority of respondents had seen Flying-foxes in the wild (Table 3.18) although, as in response to Question 1A, proportions of “yes” responses were greatest among grower respondents and decreased from Zone 1, through Zone 2, to Zone 3.

Table 3.18: Responses to: “Have you ever seen Flying-foxes in the wild?”

	Yes	No	I am unsure	No response
Growers	97%	1%	0%	3%
Zone 1	93%	4%	1%	3%
Zone 2	85%	11%	3%	1%
Zone 3	74%	22%	3%	1%

Two-by-two comparisons of “yes” and “no” responses, revealed significant differences ($P < 0.05$) within each group-pair other than for growers and Zone 1 ($P = 0.1662$) (Table 3.19).

Table 3.19: Results of two-by-two table comparisons of responses to Question 1B.

Comparison	χ^2	P-value	DF
Growers versus Zone 1	1.92	0.1662	1
Growers versus Zone 2	9.98	0.0016	1
Growers versus Zone 3	28.65	0.0000	1
Zone 1 and Zone 2	17.01	0.0000	1
Zone 1 and Zone 3	71.84	0.0000	1

Question 1C: Have you ever touched or held a Flying-fox?

Unlike Questions 1A and 1B, in response to 1C a minority of the public had touched or held a Flying-fox (Table 3.20). In contrast, most grower respondents had done so. With 61% choosing “yes”, this meant that grower respondents were more than twice as likely to have had physical contact with a Flying-fox than non-grower respondents in Zone 1 and a little over four times as likely to have done so, compared to Zone 3 respondents.

Table 3.20: Responses to: “Have you ever touched or held a Flying-fox?”

	Yes	No	I am unsure	No response
Growers	61%	34%	0%	5%
Zone 1	29%	68%	0%	3%
Zone 2	17%	82%	1%	1%
Zone 3	15%	83%	1%	1%

Two-by-two comparisons of “yes” and “no” replies (Table 3.21) showed that whilst responses from Zone 2 and Zone 3 did not differ significantly ($P = 0.4960$), those from all other group-pairs did ($P < 0.05$).

Table 3.21: Results of two-by-two table comparisons of responses to Question 1C.

Comparison	χ^2	P-value	DF
Growers versus Zone 1	48.38	0.0000	1
Growers versus Zone 2	105.87	0.0000	1
Growers versus Zone 3	112.97	0.0000	1
Zone 1 and Zone 2	11.25	0.0008	1
Zone 1 and Zone 3	15.77	0.0000	1
Zone 2 and Zone 3	0.46	0.4960	1

Question 1D: Do Flying-foxes in your garden or local area wake you at night?

In terms of being woken at night responses indicated that grower participants were most affected by Flying-foxes (Table 3.22). From the public, responses again formed a decreasing gradient of reported contact with Flying-foxes from Zone1, through Zone 2, to Zone 3.

Significant differences ($P < 0.05$), in responses to Question 1D, were evident within each group-pair (Table 3.23).

Table 3.22: Responses to: “Do Flying-foxes in your garden or local area wake you at night?”

	Yes	No	I am unsure	No response
Growers	69%	26%	1%	4%
Zone1	48%	51%	0%	1%
Zone2	25%	72%	2%	1%
Zone3	16%	78%	5%	1%

Table 3.23: Results of two-by-two table comparisons of responses to Question 1D.

Comparison	χ^2	P-value	DF
Growers versus Zone 1	21.13	0.0000	1
Growers versus Zone 2	90.84	0.0000	1
Growers versus Zone 3	135.83	0.0000	1
Zone 1 and Zone 2	62.68	0.0000	1
Zone 1 and Zone 3	110.85	0.0000	1
Zone 2 and Zone 3	9.58	0.0020	1

Question 1E: How often are you aware of Flying-foxes in your local area?

Just over half of grower respondents reported that Flying-foxes were in their local area, “all year round” (Table 3.24). Although a similar proportion of Zone 1 respondents also chose this option, less than 1-in-5 respondents from Zones 2 and 3 did the same.

Table 3.24: Responses to: “How often are you aware of Flying-foxes in your local area?”

Option	Growers	Zone 1	Zone 2	Zone 3
All year round	53%	47%	16%	16%
Six months per year	24%	16%	16%	8%
Three months per year	15%	12%	16%	14%
One month per year	2%	5%	6%	6%
One fortnight per year	1%	1%	2%	2%
Less than a fortnight per year	1%	4%	6%	7%
Never	1%	10%	32%	40%
No response	4%	6%	7%	6%

By converting responses to 1E into proportions of the year that respondents are aware of Flying-foxes, locally, it is easier to see the differences between the responses of each group.

Thus, responses were converted to scores (proportion of the year) as follows:

- All year round = 1.00, i.e. 100% of the year
- Six months of the year = 0.50
- Three months of the year = 0.25
- 1 month of the year = 0.08
- 1 fortnight or less = 0.04
- Never = 0, 0% of the year

After each individual’s response was converted, they were averaged within the four groups. Grower respondents reported the most frequent presence of Flying-foxes in their local areas, followed by Zone 1, Zone 2 and Zone 3 respectively (Figure 3.2).

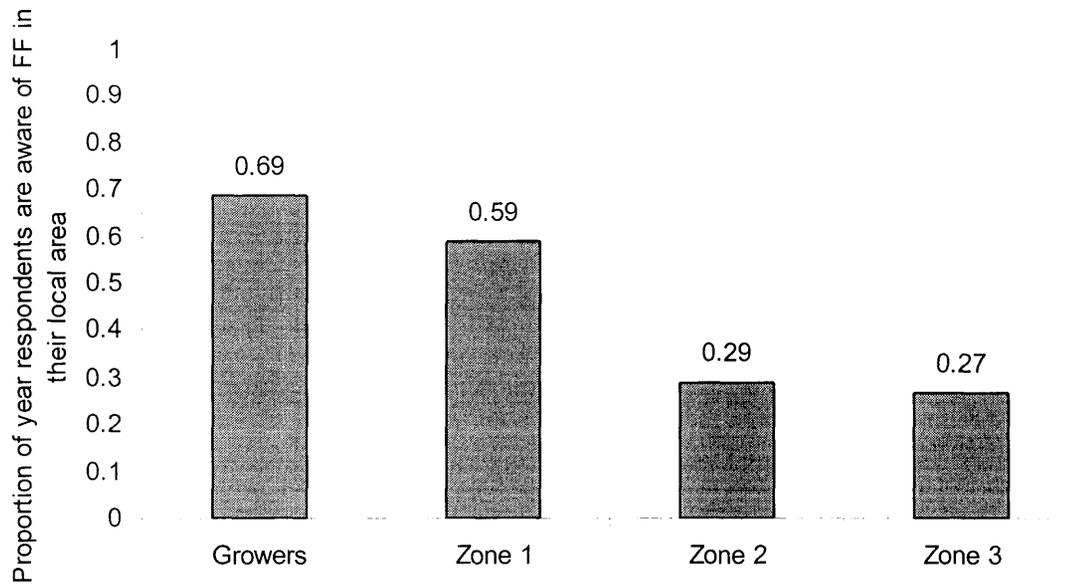


Figure 3.2: Responses from Question 1E as a mean proportion of the year that respondents are aware of FF in their local areas.

Chi-square comparisons of the original responses revealed no significant differences between the grower group and Zone 1 ($P = 0.9816$) or between those from Zones 2 and 3 ($P = 0.6516$). All other group-pairs were found to differ significantly ($P < 0.05$, Table 3.25).

Table 3.25: Chi-square results for comparisons of responses to Question 1E.

Comparison	χ^2	P-value	DF
Grower vs Z1	3.53	0.9816	11
Grower vs Z2	32.02	0.0002	11
Grower vs Z3	49.63	0.0000	11
Z1 vs Z2	35.5	0.0002	11
Z1 vs Z3	52	0.0000	11
Z2 vs Z3	8.68	0.6516	11

Question 1F: When do you notice Flying-foxes in your local area?

The overall pattern of when stakeholders noticed Flying-foxes in their local area is very similar but proportions differ greatly between stakeholder groups (Figure 3.3). For each public Zone, December, January and February represented the high-points of noticing local Flying-fox presence.

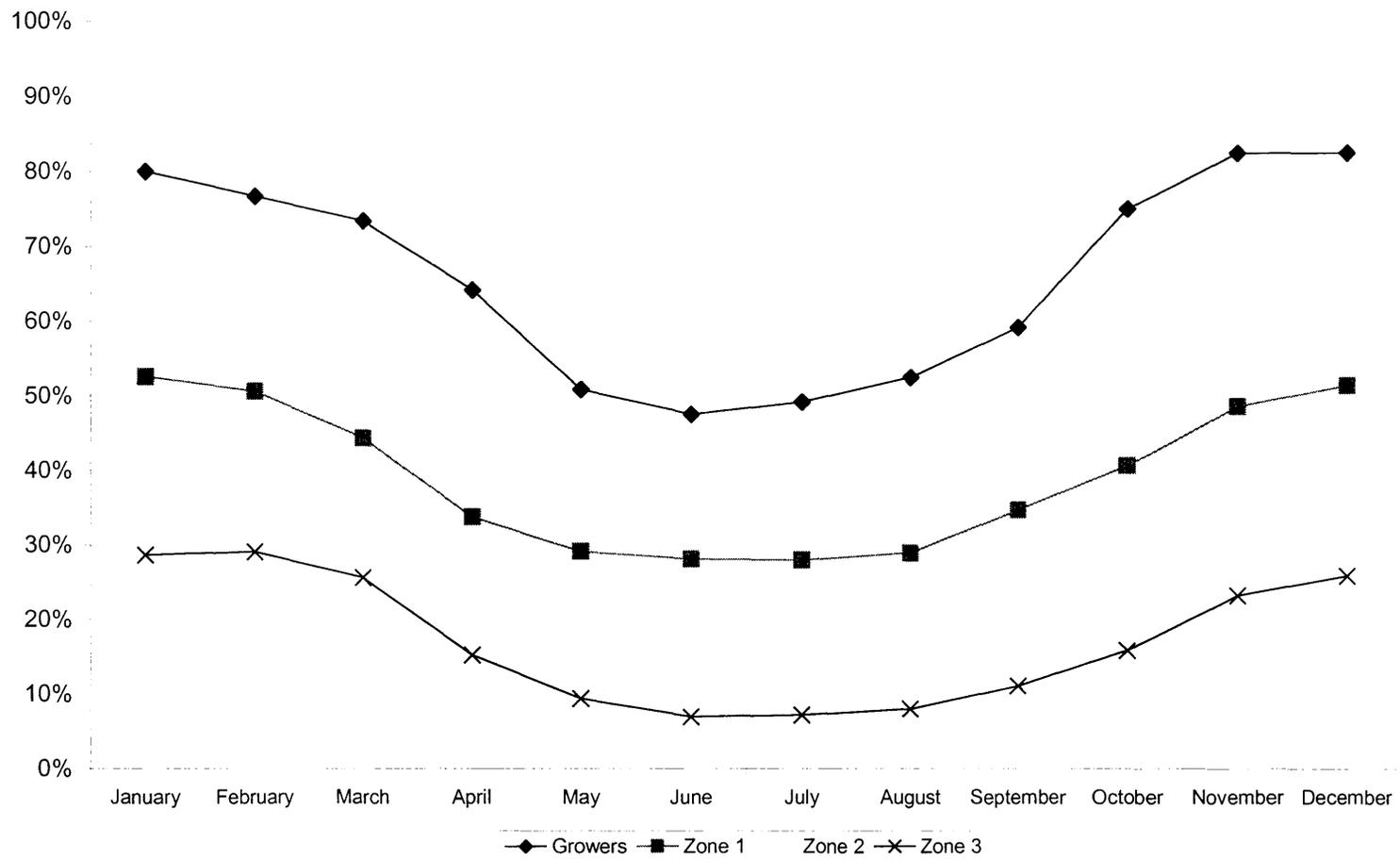


Figure 3.3: Percentages of respondents that reported Flying-foxes in their local area for each month of the year.

Question 1G: How do you know when Flying-foxes are in your local area?

In public meetings, the odour from Flying-foxes was raised as a serious concern regarding these animals. Growers, conversely, made few comments about the animals' odour. It was interesting, therefore, to see that small proportions of public respondents indicated that they "smell" Flying-foxes compared to more than half of growers. Unsurprisingly, it was more common, in all four groups, for respondents to report seeing or hearing Flying-foxes (Table 3.26).

Table 3.26: Responses to "How do you know when Flying-foxes are in your local area?"

	Growers	Zone 1	Zone 2	Zone 3
Not applicable	0%	8%	26%	31%
I see them	90%	79%	68%	50%
I hear them	83%	68%	59%	33%
I smell them	53%	19%	13%	5%
Other	7%	14%	13%	10%
No response	4%	2%	7%	8%

Chi-square comparisons were used to compare the ways (i.e. sight, sound and smell) respondents from each group reported detecting Flying-foxes in their local areas (Table 3.27). Significant differences were observed between all groups ($P < 0.05$) except Zones 1 and 2 ($P = 0.5285$).

Table 3.27: Chi-square results for comparisons of responses to Question 1G.

Comparison	χ^2	P-Value	DF
All	61.81	0.0000	6
Growers versus Zone 1	26.05	0.0000	2
Growers versus Zone 2	32.41	0.0000	2
Growers versus Zone 3	50.35	0.0000	2
Zone1 and Zone2	1.28	0.5285	2
Zone1 and Zone3	16.22	0.0003	2
Zone2 and Zone3	10.29	0.0058	2

Question 1H: Are you, or is someone you know well, a Flying-fox carer or rescuer?

Few respondents were Flying-fox carers or knew someone who was a Flying-fox carer or rescuer (Table 3.28). Among the four groups, a greater proportion of grower respondents than any other stakeholder group answered “yes” to this question.

Table 3.28: Responses to: “Are you, or is someone you know well, a Flying-fox carer or rescuer?”

	Yes	No	I am unsure	No response
Growers	15%	77%	3%	5%
Zone 1	6%	89%	3%	1%
Zone 2	3%	92%	3%	2%
Zone 3	3%	94%	1%	2%

Two-by-two comparisons of “yes” and “no” replies revealed significant differences ($P < 0.05$) within all possible group-pairs except Zones 2 and 3 (Table 3.29).

Table 3.29: Results of two-by-two table comparisons of responses to Question 1H.

Comparison	χ^2	P-Value	DF
Growers versus Zone 1	11.58	0.0070	1
Growers versus Zone 2	26.92	0.0000	1
Growers versus Zone 3	26.15	0.0000	1
Zone1 and Zone2	4.70	0.0301	1
Zone1 and Zone3	4.67	0.0308	1
Zone2 and Zone3	0.00	1.0000	1

Question 11: Do you live within 1km of a Flying-fox roost or campsite?

More than twice the proportion of respondents from Zone 1 reported living within 1km of a Flying-fox camp, compared to the other 3 response groups (Table 3.30). Across all four groups relatively large proportions (21 – 56%) of respondents were “unsure” in response to this question.

Table 3.30: Responses to: “Do you live within 1km of a Flying-fox roost or campsite?”

	Yes	No	I am unsure	No response
Growers	13%	63%	21%	3%
Zone1	29%	43%	27%	2%
Zone2	13%	44%	41%	2%
Zone3	6%	37%	56%	2%

Two-by-two table comparisons of “yes” and “no” responses within all possible group pairs revealed significant differences ($P < 0.05$) between Zone 1 and each of the other respondent groups. No other pairs differed significantly from each other (Table 3.31).

Table 3.31: Results of two-by-two table comparisons of responses to Question 11.

Comparison	χ^2	P-Value	DF
Growers versus Zone 1	16.17	0.0001	1
Growers versus Zone 2	0.93	0.3361	1
Growers versus Zone 3	0.31	0.5759	1
Zone1 and Zone2	23.41	0.0000	1
Zone1 and Zone3	41.73	0.0000	1
Zone2 and Zone3	5.31	0.0212	1

3.4.3 Respondents' Attitudes towards Flying-foxes

Responses to items in Section 3 of the Public and Grower questionnaires were considered in two ways. Firstly, they are presented collectively, as an indicator of each respondent group's overall attitude toward Flying-foxes. Next, they are dealt with individually, as responses to specific aspects of the NSW Flying-fox management scenario.

Looking at Section Three Collectively: Response trends

A clear trend was evident among responses to Section 3 of the questionnaires. From the perspective of how positive respondents were to Flying-foxes, Zone 3 > Zone 2 > Zone 1 > Growers for 16 of the 19 items. For the public Zones this represents an increasing gradient of positive sentiment from North to South.

The items that represented exceptions to the general trend were:

- 3A, which did not fit the overall pattern,
- 3C, in which Zone 2 and Zone 3 are reversed compared to the general trend, and
- 3M which, although ostensibly a positive statement regarding Flying-foxes, followed the trend of negatively worded statements.

Also, for most items, a greater proportion of respondents from Zone 3 selected the “neither agree nor disagree” option than those from the other three groups.

Results of the attitude scale

Attitude scores (Figure 3.4) show that each of the 3 public Zones were generally positive towards Flying-foxes. As per responses to individual items in Section 3 a gradient of increasing positive attitude towards Flying-foxes was evident from Zone 1 through Zone 2 to Zone 3. Interestingly, this gradient parallels that of decreasing contact between respondents and Flying-foxes. Meanwhile, the grower respondent group had a mean score of -0.52, placing it on the negative end of the scale.

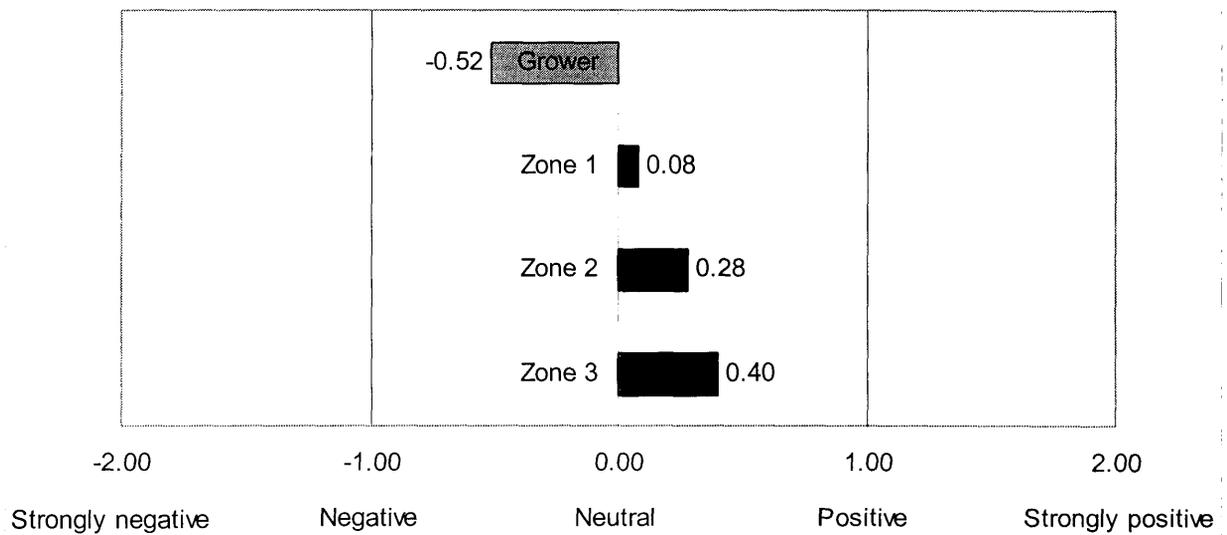


Figure 3.4: The overall attitude scores of each group, based on responses to items in Section 3.

Comparing 'attitudes' between groups

Since responses were normally distributed a one-way ANOVA was used to compare the mean attitude score between groups. Significant differences were observed between each response group (Table 3.32). Further, a post hoc comparison-of-means test, (Tukey test), showed each group was homogeneous and therefore, significantly different to each of the other three groups.

Table 3.32: One-way ANOVA results for comparison of groups' mean scale scores

SOURCE	DF	SS	MS	F	P
BETWEEN	3	90.2954	30.0985	61.51	0.000
WITHIN	1635	799.998	0.48930		
TOTAL	1638	890.293			

The correlation between respondent group and attitude score

As stated above, the various Zones differed significantly from one another in terms of mean attitudinal score. A cross-tabulation between response group and attitude score revealed a significant ($P < 0.001$) Cramer's V value of 0.313.

3.4.4 Individual item results from Section Three

Item 3A: “Flying-foxes are intelligent animals”

The majority of each group agreed or strongly agreed that “Flying-foxes are intelligent animals” (Table 3.33) with the highest support for this item in the Grower group. Among the public, however, more than a third of respondents neither agreed nor disagreed.

Table 3.33: Responses to 3A, “Flying-foxes are intelligent animals”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	24%	42%	26%	3%	3%	2%
Zone 1	13%	41%	37%	6%	2%	1%
Zone 2	12%	44%	38%	2%	1%	3%
Zone 3	9%	41%	45%	3%	1%	3%

Overall, both public and grower respondents had a positive average response to 3A (Figure 3.5).

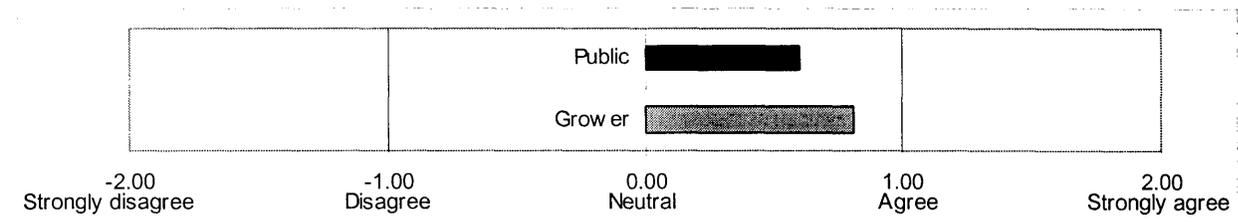


Figure 3.5: Mean response scores of public and grower respondents to Item 3A

Table 3.34: Chi-square results for comparisons of groups’ responses to Item 3A.

Comparison	χ^2	P-Value	DF
Grower vs Zone 1	14.31	0.0064	4
Grower vs Zone 2	19.30	0.0070	4
Grower vs Zone 3	32.44	0.0000	4
Zone1 vs Zone2	13.64	0.0085	4
Zone1 vs Zone3	17.36	0.0016	4
Zone2 vs Zone3	6.32	0.1764	4

Chi-square comparisons revealed that significant differences existed within all possible group-pairs except between Zones 2 and 3 (Table 3.34).

Item 3B: “Flying-foxes are a significant problem for the NSW fruit growing industry in areas east of the Great Dividing Range”

As expected, the majority of grower respondents strongly agreed that Flying-foxes were a significant problem for the fruit growing Industry (Table 3.35). Indeed, in all four groups, more respondents agreed than disagreed with the statement.

Table 3.35: Responses to 3B, “Flying-foxes are a significant problem for the NSW fruit growing industry in areas east of the Great Dividing Range”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	85%	12%	2%	0%	0%	2%
Zone 1	41%	38%	15%	3%	1%	2%
Zone 2	23%	43%	28%	2%	1%	2%
Zone 3	14%	37%	43%	3%	1%	2%

Mean responses of grower and public respondents were positive regarding 3B (Figure 3.6).

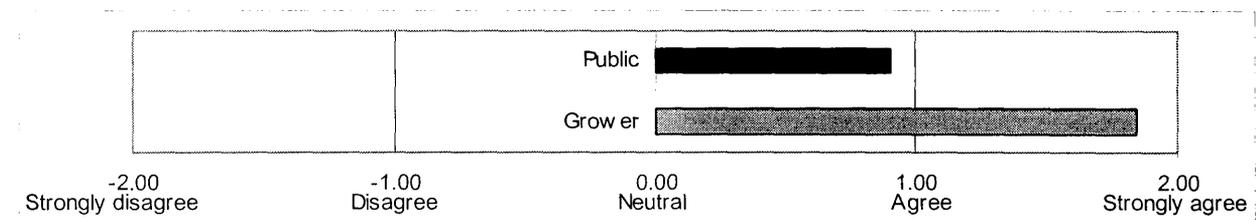


Figure 3.6: Mean response scores of public and grower respondents to Item 3B

Table 3.36: Chi-square results for comparisons of groups’ responses to Item 3B.

Comparison	χ^2	P-Value	DF
Grower vs Zone 1	80.03	0.0000	4
Grower vs Zone 2	116.18	0.0000	4
Grower vs Zone 3	240.76	0.0000	4
Zone1 vs Zone2	50.03	0.0000	4
Zone1 vs Zone3	138.49	0.0000	4
Zone2 vs Zone3	31.60	0.0000	4

For each comparison of the frequencies of responses between stakeholder groups, a significant difference was observed (Table 3.36).

Item 3C: “Flying-foxes are important in NSW forest ecosystems as pollinators and seed dispersers”

Public respondents chose the ‘strongly agree’ option more frequently, and the ‘strongly disagree’ option less frequently, than grower respondents (Table 3.37). Zone 3 respondents were most likely to support the notion that Flying-foxes are important seed and pollen dispersers.

Table 3.37: Responses to 3C, “Flying-foxes are important in NSW forest ecosystems as pollinators and seed dispersers”.

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	15%	31%	29%	15%	9%	1%
Zone 1	27%	33%	27%	7%	5%	2%
Zone 2	23%	46%	25%	3%	1%	2%
Zone 3	20%	48%	26%	3%	0%	3%

Mean responses of grower respondents and the public group were positive for 3C (Figure 3.7).

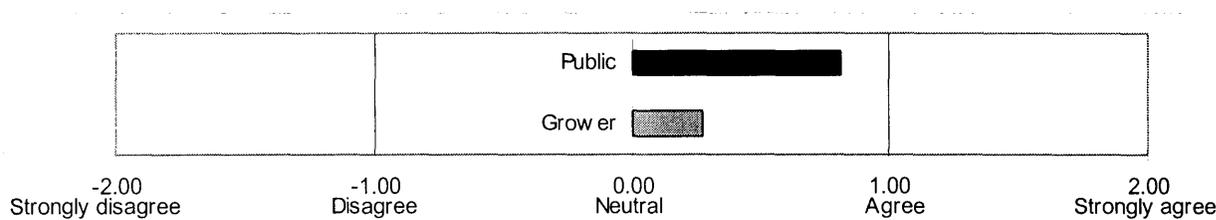


Figure 3.7: Mean response scores of public and grower respondents to Item 3C

Table 3.38: Chi-square results for comparisons of groups’ responses to Item 3C

Comparison	χ^2	P-value	DF
Grower vs Zone 1	16.06	0.0029	4
Grower vs Zone 2	56.43	0.0000	4
Grower vs Zone 3	65.59	0.0000	4
Zone1 vs Zone2	34.92	0.0000	4
Zone1 vs Zone3	48.07	0.0000	4
Zone2 vs Zone3	3.32	0.5062	4

Only Zones 2 and 3 were found to not differ significantly from each other (Table 3.38).

Item 3D: “Flying-foxes prefer to eat commercial fruit species rather than native foods”

Whilst almost half of growers either strongly agreed or agreed that “Flying-foxes prefer to eat commercial fruit species rather than native foods”, just 27% of Zone 1 respondents did the same (Table 3.39) with support further reduced in Zones 2 and 3. Around half of all public respondents neither agreed nor disagreed.

Table 3.39: Responses to 3D: “Flying-foxes prefer to eat commercial fruit species rather than native foods”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Grower	28%	21%	27%	17%	6%	2%
Zone 1	8%	19%	45%	21%	5%	2%
Zone 2	5%	13%	50%	24%	5%	3%
Zone 3	4%	11%	54%	22%	5%	4%

Whilst the mean public response was negative, grower respondents’ mean response was positive (Figure 3.8).

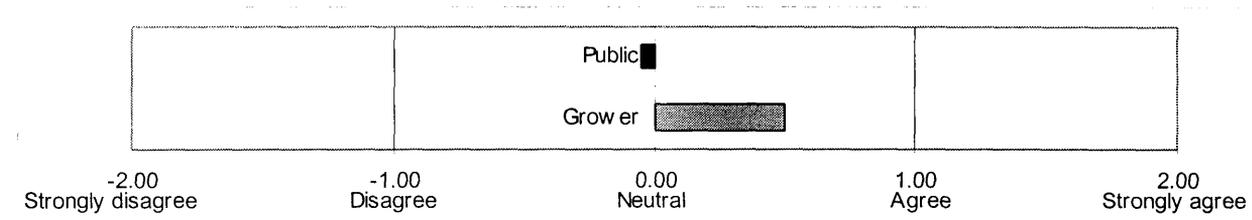


Figure 3.8: Mean response scores of public and grower respondents to Item 3D

Table 3.40: Chi-square results for comparisons of groups’ responses to Item 3D.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	43.95	0.0000	4
Grower vs Zone 2	70.53	0.0000	4
Grower vs Zone 3	87.33	0.0000	4
Zone1 vs Zone2	12.20	0.0159	4
Zone1 vs Zone3	23.02	0.0001	4
Zone2 vs Zone3	2.94	0.5671	4

Chi-square comparison of responses, between groups, found no significant difference between Zones 2 and 3. All other between-group differences were found to be significant (Table 3.40).

Item 3E: “Flying-foxes should be eradicated from fruit growing areas.”

Majority support for the eradication of Flying-foxes from fruit growing areas (Table 3.41) was evident only from the grower group. Among the public respondents, maximum support for eradication was 33%, in Zone 1. In all public zones, more respondents disagreed with eradication than supported it.

Table 3.41: Responses to 3E, “Flying-foxes should be eradicated from fruit growing areas.”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	35%	18%	23%	16%	8%	1%
Zone 1	16%	17%	22%	25%	19%	1%
Zone 2	11%	20%	26%	26%	15%	3%
Zone 3	6%	13%	33%	29%	16%	3%

For 3E, the mean public response was negative, whilst that of the grower groups was positive (Figure 3.9).

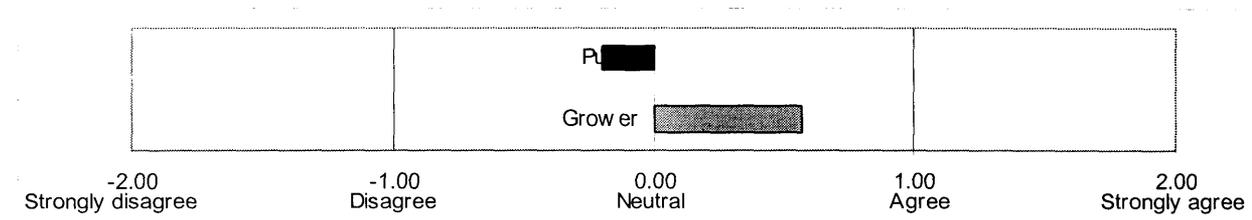


Figure 3.9: Mean response scores of public and grower respondents to Item 3E

Table 3.42: Chi-square results for comparisons of groups’ responses to Item 3E.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	28.48	0.0000	4
Grower vs Zone 2	45.28	0.0000	4
Grower vs Zone 3	82.22	0.0000	4
Zone1 vs Zone2	13.34	0.0097	4
Zone1 vs Zone3	42.56	0.0000	4
Zone2 vs Zone3	18.79	0.0009	4

All four stakeholder groups differed significantly from each other in responses to Item 3E (Table 3.42).

Item 3F: “Any commercial fruit grower with a firearms license should be able to shoot Flying-foxes to protect their crop”

Whilst nearly three quarters of grower respondents supported the statement in 3F, only a minority of each public group did the same (Table 3.43).

Table 3.43: Responses to 3F: “Any commercial fruit grower with a firearms license should be able to shoot Flying-foxes to protect their crop”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	51%	23%	9%	11%	6%	1%
Zone 1	19%	20%	15%	23%	22%	1%
Zone 2	10%	22%	18%	27%	21%	2%
Zone 3	7%	17%	20%	29%	24%	3%

On average, grower respondents favoured the statement in 3F whilst the public respondents did not (Figure 3.10).

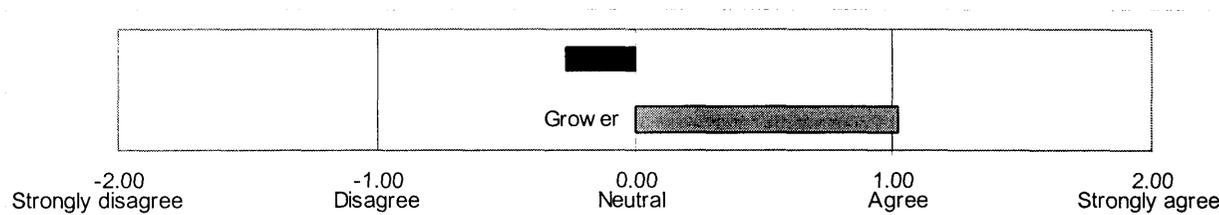


Figure 3.10: Mean response scores of public and grower respondents to Item 3F

Table 3.44: Chi-square results for comparisons of groups’ responses to Item 3F.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	65.48	0.0000	4
Grower vs Zone 2	122.43	0.0000	4
Grower vs Zone 3	150.36	0.0000	4
Zone1 vs Zone2	21.36	0.0003	4
Zone1 vs Zone3	37.59	0.0000	4
Zone2 vs Zone3	7.47	0.1132	4

Other than Zones 2 and 3, which did not differ significantly, tests revealed significant differences between all other possible combinations of respondent groups (Table 3.44).

Item 3G: “There should be no restriction on the number of Flying-foxes that commercial growers can shoot to protect their crop”

Around two-thirds of grower respondents supported unrestricted culling of Flying-foxes for crop protection purposes (Table 3.45). In comparison, support among the public was relatively low, with the majority within each response group selecting “disagree” or “strongly disagree”

Table 3.45: Responses to 3G: “There should be no restriction on the number of Flying-foxes that commercial growers can shoot to protect their crop”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	47%	18%	14%	11%	9%	2%
Zone 1	16%	17%	14%	26%	26%	1%
Zone 2	7%	16%	17%	29%	28%	3%
Zone 3	5%	11%	17%	36%	27%	4%

Whilst the average public response was negative, for 3G, the mean grower response was positive (Figure 3.11).

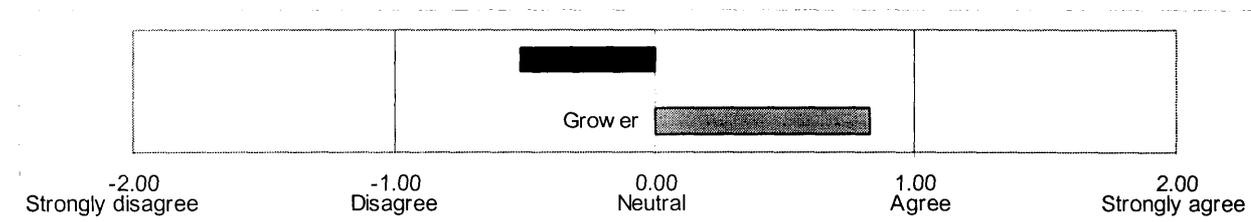


Figure 3.11: Mean response scores of public and grower respondents to Item 3G

Table 3.46: Chi-square results for comparisons of groups’ responses to Item 3G.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	68.46	0.0000	4
Grower vs Zone 2	138.12	0.0000	4
Grower vs Zone 3	155.59	0.0000	4
Zone1 vs Zone2	23.60	0.0001	4
Zone1 vs Zone3	43.14	0.0000	4
Zone2 vs Zone3	9.09	0.0588	4

Responses to Item 3G were found to differ significantly between all stakeholder groups except Zone 2 and Zone 3 (Table 3.46).

Item 3H: “Damage to backyard fruit and plants is a small price to pay for having Flying-foxes in the local area”

Although support approached 50% in Zones 1 and 2, and exceeded it in Zone 3, less than a quarter of growers “agreed” or “strongly agreed” with Item 3H (Table 3.47).

Table 3.47: Responses to 3H: “Damage to backyard fruit and plants is a small price to pay for having Flying-foxes in the local area”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	8%	16%	28%	26%	22%	1%
Zone 1	14%	31%	20%	18%	16%	1%
Zone 2	12%	35%	26%	20%	4%	2%
Zone 3	16%	42%	22%	13%	4%	3%

Whilst the mean grower response to Item 3H was negative, the mean public response was positive (Figure 3.12).

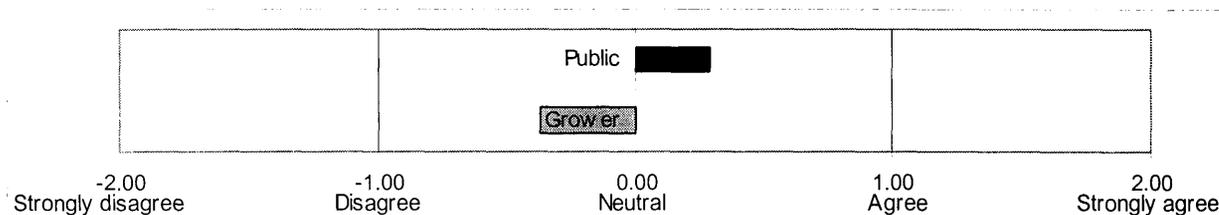


Figure 3.12: Mean response scores of public and grower respondents to Item 3H

Table 3.48: Chi-square results for comparisons of groups’ responses to Item 3H.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	17.35	0.0017	4
Grower vs Zone 2	52.01	0.0000	4
Grower vs Zone 3	71.73	0.0000	4
Zone1 vs Zone2	41.67	0.0000	4
Zone1 vs Zone3	50.59	0.0000	4
Zone2 vs Zone3	14.26	0.0065	4

All stakeholder groups differed significantly from each other in response to Item 3H (Table 3.48).

Item 3I: “Flying-foxes are threatened by habitat removal and loss in NSW”

A majority of public respondents supported the idea that habitat removal and loss in NSW threatened Flying-foxes (Table 3.49) but just a third of grower respondents “agreed” or “strongly agreed” with this item, and half of the grower responses did not support 3I.

Table 3.49: Responses to 3I: “Flying-foxes are threatened by habitat removal and loss in NSW”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	18%	15%	16%	21%	29%	1%
Zone 1	23%	33%	24%	11%	8%	1%
Zone 2	19%	40%	28%	8%	2%	3%
Zone 3	21%	41%	30%	3%	2%	3%

The mean public response was positive for Item 3I, however, that of the grower group was negative (Figure 3.13).

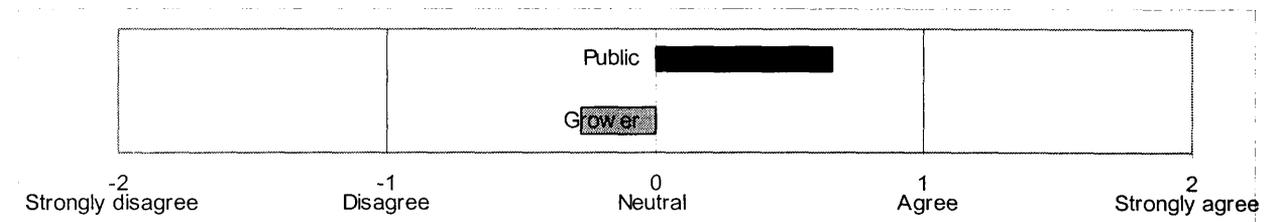


Figure 3.13: Mean response scores of public and grower respondents to Item 3I

Table 3.50: Chi-square results for comparisons of groups’ responses to Item 3I.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	62.83	0.0000	4
Grower vs Zone 2	140.50	0.0000	4
Grower vs Zone 3	160.62	0.0000	4
Zone1 vs Zone2	30.02	0.0000	4
Zone1 vs Zone3	46.59	0.0000	4
Zone2 vs Zone3	10.52	0.0325	4

All stakeholder groups’ responses differed significantly from each other in frequencies of responses to Item 3I (Table 3.50).

Item 3J: “Humans do not benefit sufficiently from Flying-foxes for them to be protected in NSW”

The statement in 3J was supported by most responding growers but less than half of those from public groups (Table 3.51). Interestingly, however, public respondents indicating disagreement did not represent a majority. Instead, more than a quarter of Zone 1 respondents and nearly 40% of those from Zones 2 and 3 selected “neither agree nor disagree” as their reply.

Table 3.51: Responses to 3J: “Humans do not benefit sufficiently from Flying-foxes for them to be protected in NSW”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	29%	29%	25%	9%	7%	1%
Zone 1	13%	20%	28%	22%	15%	2%
Zone 2	5%	23%	37%	22%	12%	2%
Zone 3	3%	15%	37%	28%	15%	3%

Whilst the public, on average, disagreed with Item 3J, the average grower response supported it (Figure 3.14).

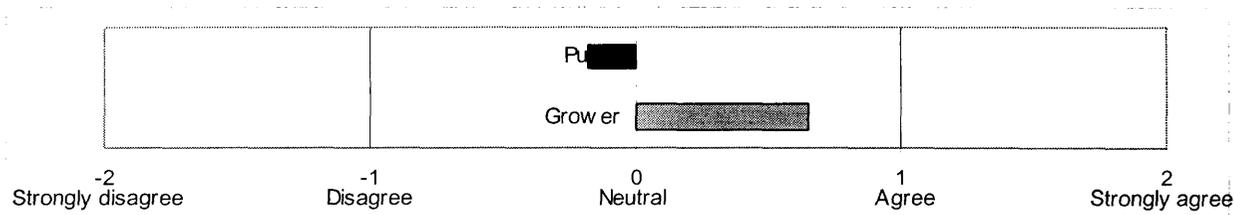


Figure 3.14: Mean response scores of public and grower respondents to Item 3J

Table 3.52: Chi-square results for comparisons of groups’ responses to Item 3J.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	34.02	0.0000	4
Grower vs Zone 2	77.65	0.0000	4
Grower vs Zone 3	113.41	0.0000	4
Zone1 vs Zone2	33.67	0.0000	4
Zone1 vs Zone3	262.71	0.0000	4
Zone2 vs Zone3	15.04	0.0046	4

Significant differences existed between each pair of respondent groups (Table 3.52).

Item 3K: “I would be concerned if, in the future, Flying-foxes only existed in zoos and fauna reserves”

A majority of public respondents supported Item 3K. Among growers, just less than half of respondents agreed to some extent, but this was greater than those who either were neutral (27%) or those who disagreed (Table 3.53).

Table 3.53: Responses to 3K: “I would be concerned if, in the future, Flying-foxes only existed in zoos and fauna reserves”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	18%	31%	27%	13%	11%	1%
Zone 1	35%	30%	15%	10%	8%	1%
Zone 2	36%	39%	14%	6%	3%	2%
Zone 3	45%	35%	11%	4%	2%	3%

Mean responses of growers and members of the public were positive, for Item 3K (Figure 3.15).

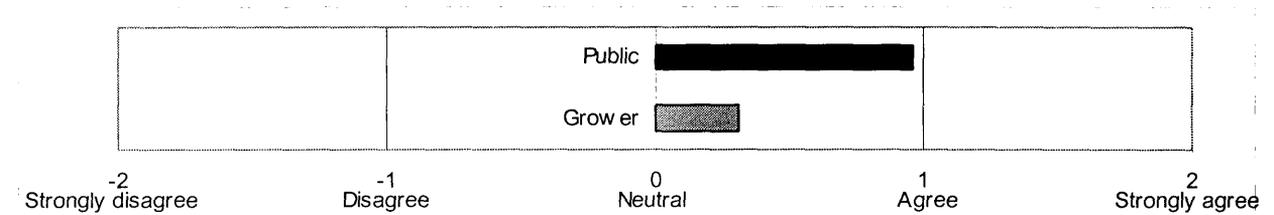


Figure 3.15: Mean response scores of public and grower respondents to Item 3K

Table 3.54: Chi-square results for comparisons of groups’ responses to Item 3K.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	18.72	0.0009	4
Grower vs Zone 2	41.96	0.0000	4
Grower vs Zone 3	67.53	0.0000	4
Zone1 vs Zone2	26.13	0.0000	4
Zone1 vs Zone3	41.15	0.0000	4
Zone2 vs Zone3	10.05	0.0396	4

Differences in the frequencies of responses observed between stakeholder groups were found to be significant except for those between Zone 2 and Zone 3 (Table 3.54).

Item 3L: “Killing Flying-foxes should be completely banned in NSW”

Within each of the three public groups, respondents were divided almost evenly between supporting, opposing or being neutral regarding a complete ban on killing Flying-foxes. Conversely, grower respondents displayed a clear preference against such a ban (Table 3.55).

Table 3.55: Responses to 3L: “Killing Flying-foxes should be completely banned in NSW”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	7%	3%	7%	28%	54%	1%
Zone 1	14%	12%	26%	29%	17%	2%
Zone 2	14%	17%	29%	29%	9%	2%
Zone 3	15%	17%	31%	28%	6%	3%

Both grower and public respondents has a negative average response to Item 3L (Figure 3.16).

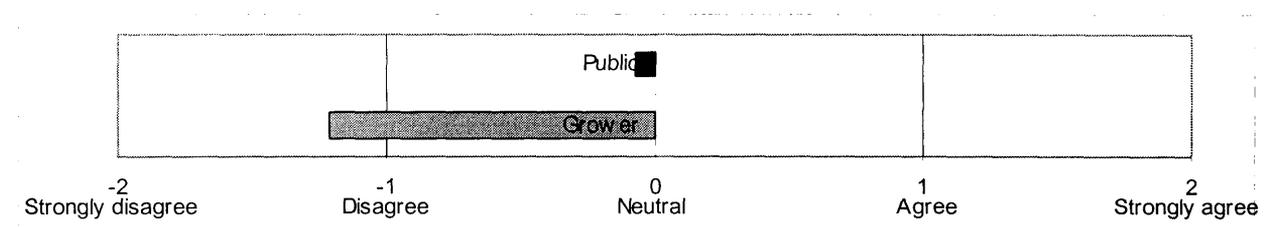


Figure 3.16: Mean response scores of public and grower respondents to Item 3L

Table 3.56: Chi-square results for comparisons of groups’ responses to Item 3L.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	86.22	0.0000	4
Grower vs Zone 2	146.85	0.0000	4
Grower vs Zone 3	171.08	0.0000	4
Zone1 vs Zone2	19.20	0.0007	4
Zone1 vs Zone3	32.45	0.0000	4
Zone2 vs Zone3	3.12	0.5374	4

Tests found no significant difference between Zones 2 and 3 but there were significant differences for all other comparisons between respondent groups (Table 3.56).

Item 3M: “Governments should offer subsidies for methods of fruit crop protection, like netting, that do not harm Flying-foxes”

More than two-thirds of respondents from each group supported subsidising methods of crop protection that do not harm Flying-foxes (Table 3.57). The greatest opposition for such a suggestion was just 14%, from Zone 1.

Table 3.57: Responses to 3M: “Governments should offer subsidies for methods of fruit crop protection, like netting, that do not harm Flying-foxes”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	53%	30%	8%	5%	3%	1%
Zone 1	31%	38%	14%	10%	4%	3%
Zone 2	28%	46%	16%	6%	1%	3%
Zone 3	27%	46%	16%	5%	2%	3%

Item 3M prompted mean positive responses from both grower and public groups (Figure 3.17).

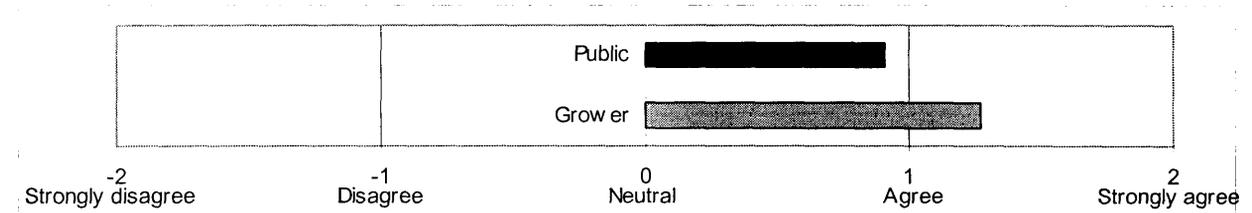


Figure 3.17: Mean response scores of public and grower respondents to Item 3M

Table 3.58: Chi-square results for comparisons of groups’ responses to Item 3M.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	21.42	0.0003	4
Grower vs Zone 2	28.93	0.0000	4
Grower vs Zone 3	28.39	0.0000	4
Zone1 vs Zone2	18.64	0.0009	4
Zone1 vs Zone3	13.58	0.0088	4
Zone2 vs Zone3	1.54	0.8199	4

Chi-square tests revealed significant differences between respondent groups (Table 3.58), with the exception of Zone 2 and Zone 3.

Item 3N: “The noise and odour of Flying-foxes is a small price to pay for having these animals in your local area”

A majority of growers “disagreed” or “strongly disagreed” with the statement in Item 3N (Table 3.59). Zones 1 and 2 were divided more or less evenly between those who supported 3N, those who opposed it and a neutral view. The greatest support for 3N came from Zone 3, at 47%.

Table 3.59: Responses to 3N: “The noise and odour of Flying-foxes is a small price to pay for having these animals in your local area”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	7%	8%	20%	27%	37%	2%
Zone 1	11%	26%	22%	22%	17%	2%
Zone 2	10%	28%	26%	24%	8%	3%
Zone 3	14%	33%	32%	13%	5%	3%

Whilst the public average was positive, that of growers was negative for 3N (Figure 3.18).

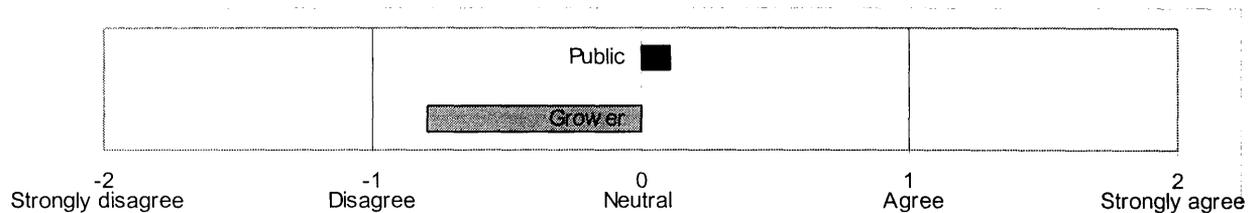


Figure 3.18: Mean response scores of public and grower respondents to Item 3N

Table 3.60: Chi-square results for comparisons of groups’ responses to Item 3N.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	34.06	0.0000	4
Grower vs Zone 2	74.64	0.0000	4
Grower vs Zone 3	125.95	0.0000	4
Zone1 vs Zone2	21.71	0.0002	4
Zone1 vs Zone3	66.13	0.0000	4
Zone2 vs Zone3	30.30	0.0000	4

All four stakeholder groups were found to be significantly different from each other when Chi-square analysis was used to compare observed frequencies of responses (Table 3.60).

Item 3O: “To stop Flying-foxes eating commercial fruit crops we should replant native foods and replace important habitat for them”

Most respondents from the public zones supported the statement in 3O (Table 3.61). Although support among grower respondents was proportionally less than that of the public groups, more grower respondents were in favour of 3O than opposed it.

Table 3.61: Responses to 3O: “To stop Flying-foxes eating commercial fruit crops we should replant native foods and replace important habitat for them”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	17%	24%	27%	16%	16%	1%
Zone 1	28%	37%	18%	9%	5%	2%
Zone 2	29%	46%	16%	5%	2%	2%
Zone 3	25%	49%	16%	5%	3%	3%

Mean responses of grower and public respondents were positive, for Item 3O (Figure 3.19).

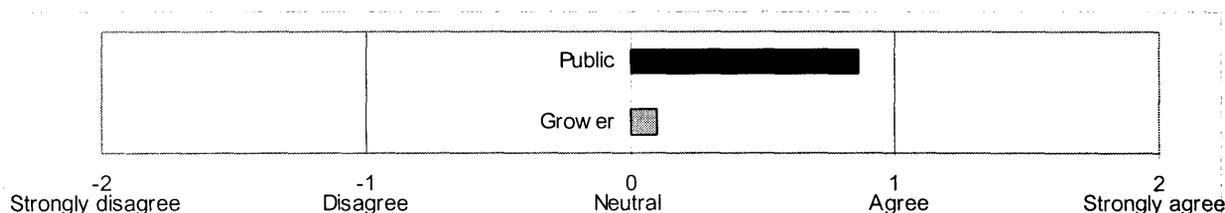


Figure 3.19: Mean response scores of public and grower respondents to Item 3O

Table 3.62 Chi-square results for comparisons of groups’ responses to Item 3O.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	33.14	0.0000	4
Grower vs Zone 2	82.67	0.0000	4
Grower vs Zone 3	67.54	0.0000	4
Zone1 vs Zone2	22.24	0.0002	4
Zone1 vs Zone3	20.90	0.0003	4
Zone2 vs Zone3	3.55	0.4702	4

Except for Zones 2 and 3, Chi-square comparisons of stakeholder groups’ responses revealed significant differences (Table 3.62).

Item 3P: Flying-foxes deserve to be protected from harm in NSW

Whilst the majority of grower respondents did not agree that “Flying-foxes deserve to be protected from harm in NSW” more public respondents supported this statement than opposed it (Table 3.63).

Table 3.63: Responses to 3P: “Flying-foxes deserve to be protected from harm in NSW”.

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	8%	9%	25%	23%	33%	1%
Zone 1	18%	29%	22%	17%	12%	1%
Zone 2	18%	35%	28%	12%	3%	3%
Zone 3	19%	43%	24%	9%	2%	3%

A negative, mean response to Item 3P was observed for growers whilst public respondents, replied positively (Figure 3.20).

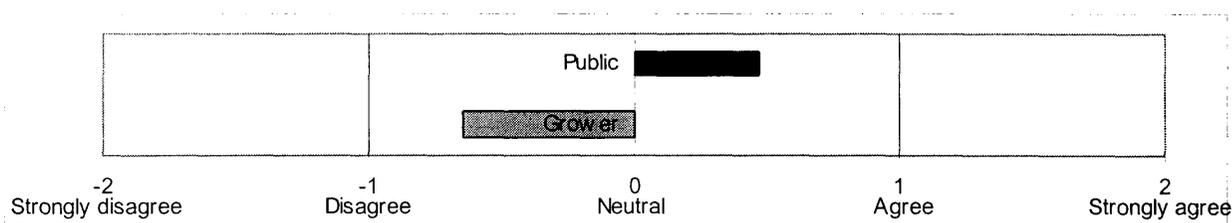


Figure 3.20: Mean response scores of public and grower respondents to Item 3P

Table 3.64: Chi-square results for comparisons of groups’ responses to Item 3P.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	54.47	0.0000	4
Grower vs Zone 2	130.79	0.0000	4
Grower vs Zone 3	157.62	0.0000	4
Zone1 vs Zone2	34.60	0.0000	4
Zone1 vs Zone3	57.16	0.0000	4
Zone2 vs Zone3	8.96	0.0620	4

Chi-square analyses revealed significant differences between all groups except Zones 2 and 3 (Table 3.64).

Item 3Q: “Flying-foxes should be protected because they are cute”

Few people supported the notion of protecting Flying-foxes because they are cute (Table 3.65). Instead, more than half of all four groups either “disagreed” or “strongly disagreed” with 3Q, and many public respondents were neutral.

Table 3.65: Responses to 3Q: “Flying-foxes should be protected because they are cute”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	2%	3%	4%	27%	63%	1%
Zone 1	2%	4%	23%	38%	30%	3%
Zone 2	3%	4%	33%	40%	18%	2%
Zone 3	3%	4%	37%	37%	15%	4%

The average responses, of grower respondents and public respondents, to 3Q were negative (Figure 3.21).

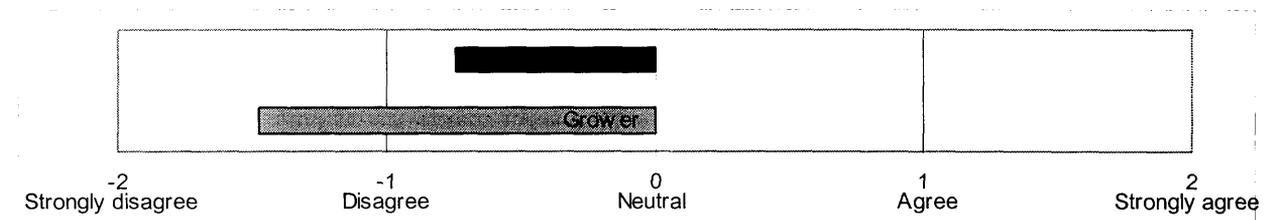


Figure 3.21: Mean response scores of public and grower respondents to Item 3Q

Table 3.66: Chi-square results for comparisons of groups’ responses to Item 3Q.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	52.08	0.0000	4
Grower vs Zone 2	110.41	0.0000	4
Grower vs Zone 3	124.86	0.0000	4
Zone1 vs Zone2	28.32	0.0000	4
Zone1 vs Zone3	44.12	0.0000	4
Zone2 vs Zone3	2.85	0.5838	4

Significant differences ($P < 0.05$) were found within all possible group-pairs except for Zones 2 and 3 (Table 3.66).

Item 3R: “Many commercial fruit growers, east of the Great Dividing Range, are forced to undertake costly and laborious management to reduce Flying-fox damage to their crops”

Almost every grower supported Item 3R (Table 3.67). The public, however, varied between majority support in Zones 1 and 2 to a mainly neutral response in Zone 3.

Table 3.67: Responses to 3R: “Many commercial fruit growers, east of the Great Dividing Range, are forced to undertake costly and laborious management to reduce Flying-fox damage to their crops”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	72%	24%	2%	0%	1%	2%
Zone 1	25%	44%	26%	1%	1%	2%
Zone 2	13%	40%	42%	1%	1%	2%
Zone 3	5%	33%	55%	2%	1%	4%

The mean responses of grower and public groups, were positive regarding Item 3R (Figure 3.22).

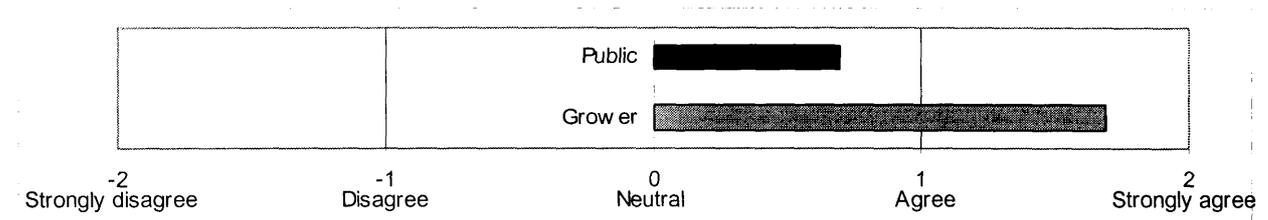


Figure 3.22: Mean response scores of public and grower respondents to Item 3R

Table 3.68: Chi-square results for comparisons of groups’ responses to Item 3R.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	106.62	0.0000	4
Grower vs Zone 2	191.52	0.0000	4
Grower vs Zone 3	283.06	0.0000	4
Zone1 vs Zone2	42.36	0.0000	4
Zone1 and Zone3	33.6	0.0000	2*
Zone2 and Zone3	19.24	0.0001	2*

*responses were combined to form ‘agree’, ‘neutral’ and ‘disagree’ categories due to low expected cell values

All groups differed significantly from each other in response to Item 3R (Table 3.68).

Item 3S: “Flying-foxes are a significant disease risk to people in NSW”

More than 60% of grower respondents felt that Flying-foxes are a significant disease risk to people in NSW (Table 3.69). Among the public groups, greatest support for Item 3S was evident from Zone 1 (34%) and decreased in Zone 2 and Zone 3 respectively. The proportion of respondents that selected “neither agree nor disagree” was greater than a third in all public groups, and consisted of more than half of respondents in Zone 3.

Table 3.69: Responses to 3S: “Flying-foxes are a significant disease risk to people in NSW”

	Strongly agree	Agree	Neither	Disagree	Strongly disagree	No response
Growers	28%	36%	21%	8%	6%	2%
Zone 1	12%	22%	37%	23%	6%	1%
Zone 2	6%	20%	45%	22%	5%	2%
Zone 3	4%	10%	54%	21%	8%	3%

Whilst the mean public response was effectively neutral, for 3S, the mean grower response was positive (Figure 3.23).

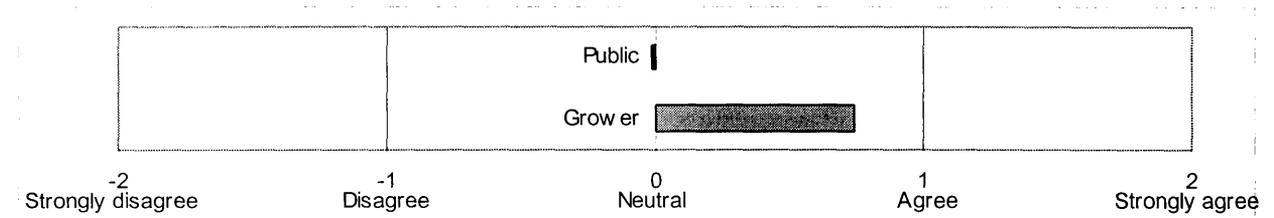


Figure 3.23: Mean response of grower and public participants to Item 3S

Table 3.70: Chi-square results for comparisons of groups’ responses to Item 3S.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	46.93	0.0000	4
Grower vs Zone 2	80.42	0.0000	4
Grower vs Zone 3	135.17	0.0000	4
Zone1 vs Zone2	14.05	0.0071	4
Zone1 vs Zone3	61.13	0.0000	4
Zone2 vs Zone3	25.47	0.0000	4

All stakeholder groups differed significantly from each other in response to Item 3S (Table 3.70).

3.4.5 Ranked similarity/difference in opinion between growers and the public

Using the difference in average response scores from the public respondents and the grower respondents it was possible to rank each Item in Section 3 in terms of similarity of mean response. From this ranking, it was evident that the greatest difference in opinion existed for Item 3G: “There should be no restriction on the number of Flying-foxes that commercial fruit growers can shoot to protect their crops” (Table 3.71). Conversely, the least difference was observed for Item 3A: “Flying-foxes are intelligent animals”.

Table 3.71: Differences between grower and public response scores to each question in Section 3.

	Item	Difference between Growers and the Public	Response orientation	Question theme/topic
Least similar responses ^	3G	1.35	Opposite	FF culling should be unrestricted
	3F	1.29	Opposite	Any grower should be able to shoot FF
	3P	1.12	Opposite	FF deserve protection
	3I	0.94	Opposite	FF are threatened by habitat loss
	3N	0.90	Opposite	Noise/odour a small price for local FF
	3J	0.83	Opposite	FF provide insufficient benefit to be protected
	3E	0.77	Opposite	FF should be eradicated from fruit growing areas
	3A	0.21	Opposite	FF are intelligent animals
	3H	0.66	Opposite	Damaged backyard fruit a small price for local FF
	3D	0.55	Opposite	FF prefer commercial fruit to native foods
Most similar responses <	3L	1.14	Same	Complete ban on killing FF
	3R	0.99	Same	FF cause growers costly/laborious management
	3B	0.94	Same	FF are a significant problem for growers
	3O	0.77	Same	Replant native foods to reduce FF crop damage
	3S	0.76	Same	FF are a significant disease risk to people
	3Q	0.73	Same	FF should be protected because they are cute
	3K	0.65	Same	Concerned about FF only in zoos, in future
	3C	0.54	Same	FF are important pollinators/seed dispersers
	3M	0.36	Same	Government should provide subsidies for netting

3.4.6 Management preferences and related knowledge

In addition to the management related items within Section 3, other, specific questions about Flying-fox management were asked of grower and public respondents. The responses to these questions are presented and compared below.

Question 1J: “Should potential residents be told that there is a Flying-fox roost or camp site near their house before they rent or live in it?”

Most grower respondents, as well as those from public Zones 1 and 2, felt that potential residents should be told that there is a Flying-fox roost or camp site near their house before they rent or live in it (Table 3.72).

Table 3.72: Responses to 1J, “Should potential residents be told that there is a Flying-fox roost or camp site near their house before they rent or live in it?”

	Yes	No	I am unsure	No response
Growers	79%	6%	11%	4%
Zone1	70%	14%	15%	2%
Zone2	61%	16%	22%	2%
Zone3	46%	25%	28%	2%

Other than for the Chi-square comparison between grower respondents and those from Zone 1 differences between each stakeholder group were found to be significant (Table 3.73).

Table 3.73: Chi-square results for comparisons of groups’ responses to Question 1H.

Comparison	χ^2	P-Value	DF
Growers versus Zone 1	6.93	0.0741	3
Growers versus Zone 2	19.97	0.0002	3
Growers versus Zone 3	51.91	0.0000	3
Zone1 and Zone2	11.71	0.0084	3
Zone1 and Zone3	64.25	0.0000	3
Zone2 and Zone3	24.8	0.0000	3

Public Question 5A / Grower Question 6A: Why do you believe GHFF have reached population levels that require them to be listed as vulnerable?

More than 40% of Zone 1 respondents, and more than half of those from the other three groups, were unsure why GHFF have reached population levels that require them to be listed as vulnerable (Table 3.74). Among respondents who did choose a reason for the animals' vulnerable listing, "clearing of habitat/food for housing and infrastructure" was most frequently selected followed by "clearing of habitat/food for agricultural purposes".

Table 3.74: Responses to Public Question 5A / Grower Question 6A, "Why do you believe GHFF have reached population levels that require them to be listed as vulnerable?"

	Growers	Zone 1	Zone 2	Zone 3
I'm not sure why these animals are vulnerable	60%	42%	51%	53%
Clearing of habitat/food for housing and infrastructure	27%	43%	44%	39%
Clearing of habitat/food for agricultural purposes	16%	38%	35%	33%
Population control by commercial fruit growers	4%	18%	16%	17%
Competition from other Flying-foxes species	8%	8%	6%	4%
Other	4%	4%	2%	2%
No response	13%	8%	7%	7%

Chi-square analyses revealed significant differences between all stakeholder groups except between Zone 1 and Zone 2, and between Zone 2 and Zone 3 (Table 3.75). "Other" and "No response" were not included in these comparisons.

Table 3.75: Chi-square results for comparisons of responses to Grower Q6A/Public Q5A.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	38.83	0.0000	4
Grower vs Zone 2	26.31	0.0000	4
Grower vs Zone 3	26.23	0.0000	4
Zone 1 vs Zone 2	7.63	0.1059	4
Zone 1 vs Zone 3	16.46	0.0025	4
Zone 2 vs Zone 3	3.46	0.4844	4

Public Question 5B / Grower Question 6B: “Do you believe that GHFF should be listed as a vulnerable species?”

Few respondents from each group indicated that they believed GHFF should be listed as a vulnerable species (Table 3.76). Instead, most of each public group indicated that they were unsure, whilst the majority of grower respondents disagreed.

Table 3.76: Responses to Public Question 5B / Grower Question 6B: “Do you believe that GHFF should be listed as a vulnerable species?”

	Yes	No	I am unsure	No response
Growers	8%	63%	25%	4%
Zone 1	18%	27%	51%	3%
Zone 2	20%	15%	62%	3%
Zone 3	18%	9%	70%	3%

Table 3.77: Chi-square results for comparisons of responses to Grower Q6B/Public Q5B.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	60.24	0.0000	2
Grower vs Zone 2	127.16	0.0000	2
Grower vs Zone 3	177.84	0.0000	2
Zone 1 vs Zone 2	25.40	0.0000	2
Zone 1 vs Zone 3	60.35	0.0000	2
Zone 2 vs Zone 3	10.25	0.0059	2

Observed frequencies of responses were found to be significantly different between all groups (Table 3.77).

Public question 5C / Grower Question 6C: “Why do Flying-foxes cause damage to fruit crops”

Grower respondents mostly indicated that fruit crops are affected because they are an easy to find, consistent food source (65.83%), and that there are too many Flying-foxes (60%). Although many public respondents also chose the “easy to find” option, proportions doing so were smaller than among growers. Conversely, greater proportions of the public chose “not enough native food” than from the grower group.

Interestingly, whilst 60% of grower replies indicated there were “too many Flying-foxes” fewer than 30% of public respondents from any Zone agreed with this (Table 3.78).

Table 3.78: Responses to Public question 5C / Grower Question 6C: “Why do Flying-foxes cause damage to fruit crops”

	Growers	Zone1	Zone2	Zone3
No response	2%	2%	3%	3%
Prefer to eat commercial over native food	33%	15%	10%	7%
Not enough native food	39%	44%	48%	42%
Too many Flying-foxes	60%	28%	16%	8%
Fruit crops are an easy to find, consistent food source	66%	46%	42%	35%
I am unsure	6%	9%	18%	21%

Table 3.79: Chi-square results for comparisons of groups’ responses to Grower Q6C/Public Q5C.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	28.80	0.0001	4
Grower vs Zone 2	61.61	0.0000	4
Grower vs Zone 3	88.54	0.0000	4
Zone 1 vs Zone 2	21.42	0.0003	4
Zone 1 vs Zone 3	45.70	0.0000	4
Zone 2 vs Zone 3	7.56	0.1079	4

All possible pairs of respondent groups, except Zones 2 and 3, were significantly different (Table 3.79).

Public Question 5D / Grower Question 6D: “Do you feel that counts of GHFF are accurate enough?”

Growers and the public responded to this question quite differently (Table 3.80). Among the grower group, approximately half of respondents indicated that they did not believe counts of GHFF were accurate enough with less than a quarter unaware of the methods used. In comparison, around a third of public respondents chose “I didn’t know they were counted” and nearly a half selected “unaware of the methods”.

Table 3.80: Responses to Public Question 5D / Grower Question 6D: “Do you feel that counts of GHFF are accurate enough?”

	Yes	No	I didn't know they were counted	Unaware of the methods	No response
Growers	3%	54%	11%	24%	1%
Zone1	5%	13%	27%	45%	2%
Zone2	4%	8%	32%	43%	2%
Zone3	3%	4%	35%	46%	2%

Chi-square comparisons showed that all groups differed significantly from each other in response to Grower Question 6D/Public Question 5D (Table 3.81).

Table 3.81: Chi-square results for comparisons of groups’ responses to Grower Q6D/Public Q5D

Comparison	χ^2	P-value	DF
Grower vs Zone 1	104.83	0.0000	3
Grower vs Zone 2	143.05	0.0000	3
Grower vs Zone 3	191.75	0.0000	3
Zone 1 vs Zone 2	9.56	0.0227	3
Zone 1 vs Zone 3	31.96	0.0000	3
Zone 2 vs Zone 3	8.67	0.0340	3

Public Question 6A/ Grower Question 7A: Options for managing future interactions between commercial fruit growers and Flying-foxes

Among grower respondents, remuneration for fruit damaged by Flying-foxes (Option C) was the most popular response. However, around 50% of growers chose netting subsidies (Option B) too, whilst around a quarter selected a funded industry restructure (Option A) (Table 3.82).

Few public participants supported an Industry restructure and only around a third opted for remunerating growers for damaged fruit. Instead, more than 70% of respondents from each public group indicated a preference for netting subsidies.

Table 3.82: Responses to 3 options for managing future interactions between Flying-foxes and growers in Public Question 6A/ Grower Question 7A.

	Industry Restructure	Netting Subsidies	Remuneration for damage	None of these
Growers	25%	51%	58%	19%
Zone 1	4%	73%	33%	7%
Zone 2	6%	73%	29%	10%
Zone 3	6%	71%	29%	9%

Although Chi-square comparisons (Table 3.83) showed that grower respondents and each group of public respondents differed significantly no significant difference was found between public groups.

Table 3.83: Chi-square results for comparisons of groups' responses to Grower Q7A/Public Q6A.

Comparison	χ^2	P-value	DF
Grower vs Zone 1	71.43	0.0000	3
Grower vs Zone 2	57.01	0.0000	3
Grower vs Zone 3	53.14	0.0000	3
Zone1 vs Zone vs Zone 3	6.99	0.3222	6

3.4.7 Associations between variables

Values are reported only for cross-tabulations where Cramer's V differed significantly from zero. All other instances are denoted with "NS".

Generally, values of Cramer's V did not exceed 0.3, but cross-tabulations between Attitude Score and Group, Attitude score and responses to 1D or Attitude score and responses to 1H were exceptions (Table 3.84).

Table 3.84: Values of Cramer's V from cross-tabulations of responses and overall attitude score

Items	Group	1A	1B	1C	1D	1H	1I	2A	2C
Attitude score	0.313	NS	NS	NS	0.333	0.322	NS	0.251	0.252
1J	0.078	0.218	0.166	0.150	0.162	0.227	0.209	0.155	0.081
3A	0.105	0.128	0.152	0.130	0.127	0.158	0.093	0.129	0.115
3B	0.251	0.134	0.148	0.116	0.197	0.141	0.135	0.149	0.141
3C	0.148	0.151	0.157	0.127	0.154	0.167	0.092	0.133	0.149
3D	0.155	0.137	0.142	0.123	0.153	0.145	0.107	0.126	0.138
3E	0.147	0.155	0.170	0.126	0.209	0.197	0.123	0.148	0.161
3F	0.193	0.163	0.155	0.133	0.201	0.170	0.115	0.154	0.150
3G	0.205	0.156	0.151	0.134	0.198	0.159	0.114	0.134	0.143
3H	0.155	0.173	0.140	0.118	0.188	0.165	0.105	0.142	0.139
3I	0.209	0.156	0.158	0.146	0.183	0.163	0.108	0.144	0.139
3J	0.170	0.170	0.173	0.123	0.177	0.167	0.115	0.157	0.168
3K	0.140	0.174	0.169	0.122	0.161	0.164	0.141	0.155	0.164
3L	0.207	0.166	0.153	0.133	0.181	0.172	0.100	0.133	0.101
3M	0.107	0.150	0.127	0.102	0.147	0.127	0.081	0.129	0.098
3N	0.177	0.149	0.156	0.111	0.178	0.154	0.122	0.133	0.147
3O	0.145	0.164	0.163	0.133	0.156	0.152	0.117	0.173	0.144
3P	0.201	0.174	0.164	0.134	0.193	0.169	0.124	0.173	0.158
3Q	0.181	0.150	0.135	0.107	0.172	0.171	0.109	0.128	0.104
3R	0.266	0.142	0.150	0.125	0.204	0.127	0.139	0.133	0.114
3S	0.179	0.182	0.174	0.133	0.189	0.174	0.140	0.157	0.163
5B	0.212	NS	NS	NS	0.177	0.142	NS	0.098	0.090

NS = association was not significant.

3.4.8 Results of the non-response questionnaire

Few participants completed and returned a non-response questionnaire (Table 3.85). Despite these small sample sizes, comparisons of main round and non-response round replies, are presented below, to demonstrate observed trends.

Table 3.85: Response rates for the public non-response questionnaire

Zone	Non-respondents	Replies	Response rate
1	1344	64	5%
2	1408	45	3%
3	1456	35	2%

Non-response survey, Question 1: Have you ever heard of animals called Flying-foxes?

No significant differences were observed between non-respondents and main round respondents for Question 1 (Table 3.86).

Table 3.86: Results of Chi-square comparisons between main-round and non-response round responses to: “Have you ever heard of animals called Flying-foxes?”

Zone	Chi-value	P-Value	DF
1	3.11	0.3754	3
2	7.81	0.0500	3
3	6.55	0.0878	3

Non-response survey, Question 2: Do you ever notice Flying-foxes in your local area?

No significant differences were observed between non-respondents and main round respondents for Question 2 (Table 3.87).

Table 3.87: Results of Chi-square comparisons between main-round and non-response round responses to: “Do you ever notice Flying-foxes in your local area?”

Zone	Chi-value	P-Value	DF
1	1.49	0.4910	2
2	0.2	0.9064	2
3	5.59	0.0611	2

Non-response survey, Question 3: In your opinion, are Flying-foxes a significant problem for the NSW Fruit Growing Industry in areas east of the Great Dividing Range?

A greatly increased proportion of ‘I am unsure’ responses among Round-3-respondents resulted in a significant difference between non-respondents and replies to the main round questionnaires for this question (Table 3.88).

Table 3.88: Results of Chi-square comparisons between main-round and non-response round responses to: “In your opinion, are Flying-foxes a significant problem for the NSW Fruit Growing Industry in areas east of the Great Dividing Range?”

Zone	Chi-value	P-Value	DF
1	35.84	0.0000	2
2	69.47	0.0000	2
3	136.92	0.0000	2

Non-response survey, Question 4: Do Flying-foxes deserve to be protected from harm in NSW?

Zones 1 and 3 differed significantly between main round and non-response round replies to Question 4 but Zone 2 did not (Table 3.89). In both cases, greater proportions of non-respondents, than main-round respondents, disagreed with the statement that Flying-foxes deserved to be protected from harm.

Table 3.89: Results of Chi-square comparisons between main-round and non-response round responses to: “Do Flying-foxes deserve to be protected from harm in NSW?”

Zone	Chi-value	P-Value	DF
1	25.2	0.0000	2
2	1.13	0.5690	2
3	52.94	0.0000	2

Non-response survey, Question 5: Are you male or female?

Zones 1 and 3 differed significantly between main round and non-response round gender ratios, due to proportionally more female/fewer male respondents, but Zone 2 did not (Table 3.90).

Table 3.91: Results of Chi-square comparisons between main-round and non-response round responses to: “Are you male or female?”

Zone	Chi-value	P-Value	DF
1	48.95	0.0000	2
2	1.76	0.4158	2
3	4.94	0.0263	1

Non-response survey, Question 6: In which region have you spent the greatest proportion of your life?

Across all three Zones there was a tendency for proportionally more ‘metropolitan’ responses in reply to the non-response questionnaire than were observed in the main rounds. This resulted in significant differences between main-round responses and non-response replies for Zones 2 and 3 (Table 3.92).

Table 3.92: Results of Chi-square comparisons between main-round and non-response round responses to: “In which region have you spent the greatest proportion of your life?”

Zone	Chi-value	P-Value	DF
1	1.56	0.4593	2
2	7.78	0.0205	2
3	6.88	0.0320	2

3.5 Discussion

Despite encountering some problems reaching grower participants and less interest than I had hoped for from the grower and public groups, sufficient information was collected to make a comparison of Flying-fox related experiences and opinions between growers and the public. Consequently, I am satisfied that I had sufficient data to meet my aim of understanding the experiences and attitudes of commercial fruit growers, within the context of the wider public.

I have chosen to begin this discussion with a review of the observed results, followed by comments on the limitations of the methodology, the relevance of the results for management and a summary of the project.

3.5.1 Respondent Characteristics

Demographic variation between the response groups

To appropriately consider the ranges of attitudes, experiences and views of management that were observed in this study, it was necessary to first understand respondents' underlying characteristics.

As reported in the results section, response groups differed significantly for each of the four demographic variables examined (gender, age, education and background).

Men predominate within the fruit growing industry so a gender bias towards them was not unexpected among grower respondents; they had also greatly outnumbered women at the three grower meetings. Equally, because a trend for more women to respond than men had been observed in the wild horse management case study, I was not surprised that the gender ratios observed among the public respondents were uniformly biased towards females.

Differences in the mean age of respondents, between Zone 3 and the other 3 groups, initially seemed out of place but this probably reflected differences in the ages of the general population in each Zone. An examination of age data from the 2001 census showed that in the centres of Coffs Harbour (Zone 1) and Newcastle (Zone 2) the proportion of the local population aged over 65 years was approximately 20%, whereas in Sydney (Zone 3), this age

group represents less than 15% of the total population (ABS, 2002a; 2002b; 2002c, online). This is perhaps due to the recent, and ongoing, “sea-change” phenomenon of older people, in particular, moving away from major metropolitan areas.

The observed difference between groups’ educational experience was also expected. Firstly, this was because fruit growing has traditionally been dominated by individuals without tertiary education, so it was no surprise that a greater proportion of grower respondents terminated their education at a high school level compared to those from the public groups. Secondly, the concentration of employment opportunities for people with tertiary qualifications in metropolitan areas, such as Sydney, suggested that Zone 3, as observed, should have a greater proportion of tertiary trained individuals than Zones 1 and 2.

As in the wild horse case study, I used “background” as a measure of similarity between respondents’ life experiences. Because of this, it would make sense, as was observed, for adjacent Zones (i.e. 1 & 2 or 2 & 3) to have more in common than those which were geographically separate (i.e. 1 & 3).

As primary producers, growers were expected to be more likely to identify with a “rural” background. Similarly, since Zone 1 is more distant from metropolitan areas than Zone 2, and because Zone 3’s sample population largely comprised residents of Australia’s largest city, Sydney, there was little surprise that Zone 1 respondents were more “rural” than the other two public groups. Reciprocally, the distance of respondents from Sydney suggested that Zone 3 would be most “metropolitan”, followed by Zone 2 and Zone 1 respectively.

Finally, because all respondents were selected from the area along the NSW coastal strip, east of the Great Dividing Range, it was probable that many would choose a “coastal” background. Allowing for the trends described above, it makes some sense that Zone 2, which was located between the Zone most likely to be “rural” (1) and the Zone most likely to be “metropolitan” (3) would have an intermediate level of each of these responses and similarly be more “coastal”.

Experiences with Flying-foxes

As predicted, the results from Sections One and Two confirmed that respondents from the various groups had substantially different experiences with Flying-foxes. For nearly every question, proportionally more growers than public respondents selected response options that indicated some experience with the animals. Naturally, this is understandable because Flying-foxes are attracted to growers' crops, for food.

For example, in response to Q1C, it was expected that growers would have the most experience touching or holding Flying-foxes because the animals are found on their crops. Experiences such as collecting the bodies of dead Flying-foxes following shooting or removing individuals caught in netting or on barbed wire are to be expected among this group, compared to public respondents who have little cause to touch the animals unless visiting a zoo/fauna park or removing a dead or injured animal from their yard etc.

Similarly, the consistent trend among public responses, for Zone 1 respondents to have the most contact with Flying-foxes, followed by those from Zones 2 and 3 respectively, matched the steering committee's expectations that people in the north of the state would be more likely to have contact with Flying-foxes since it is in that part of NSW where three *Pteropus* spp. overlap in distribution.

Question 1F, in particular demonstrated the decreased awareness of when Flying-foxes are in respondents' local areas along a southward coastal gradient. It should be noted, however, that the observed trend within groups, probably better reflects respondents' likelihood of having contact with Flying-foxes than being an effective measure of when the animals are actually around. This is because people are more likely to be outside in the evenings during warmer months (October to March) than in colder time (April to September).

The observed similarity of responses between growers and Zone 1 for Question 1E may reflect the fact that many, if not most, of the responding growers are likely to have come from the Zone 1 area, rather than from Zones 2 or 3. This commonality of experience or contact between growers and Zone 1 respondents may also suggest why many public respondents from this area share the pre-dominating grower views evident from responses to other questions, e.g. in Section 3.

Initially, it may appear surprising that growers were more likely than public respondents to have known someone that is a Flying-fox carer (Question 1H) but several growers at meetings indicated that they pass injured or orphaned flying-foxes on to animal carers. Similarly, some carers indicate that they source supplementary food for the animals in their care from local fruit growers. Such activities may explain the heightened contact with carers, relative to that of the public respondents.

Question 1I was interesting because it revealed the high proportion of Zone 1 respondents that live near to a Flying-fox camp, relative to the other groups. Compared to Zone 1, only around a third and a fifth as many Zone 2 and Zone 3 respondents, respectively, lived within a kilometre of a Flying-fox roost. Although a majority of people did not share this experience, it is reasonable to expect there might be greater discussion and awareness of issues relating to urban Flying-fox camps in Zone 1, than in the other two public zones because a much greater proportion of the population has such an experience.

Reduced likelihood of growers living near Flying-fox colonies, compared to Zone 1 respondents, may be due an interaction of past practices of destroying colonies closest to fruit growing areas and extensive clearing of native vegetation for agricultural land.

3.5.2 Responses to individual questions about Flying-foxes and their management

Aside from contributing to an understanding of the overall attitude displayed by each group, questions were also important individually because they referred to specific issues in the Flying-fox management scenario. In this section, the patterns of responses to each of these items are discussed, in turn.

3A: Flying-foxes are intelligent animals

Although both growers and the public generally supported the notion of Flying-foxes being intelligent, there is likely to be differential outcomes of such a view between the groups due to their varied experiences.

That few members of the public disagreed with this statement that may bode well for Flying-foxes because people tend to support conservation for animals, particularly mammals, that they believe are intelligent. Cetaceans and primates are good examples of this. The large proportions of the public groups that neither agreed nor disagreed however, may represent an opportunity to enhance or detract from public views of the animal's intelligence for interested groups. For example, if managers desire to enhance support for conservation they might attempt to convince these neutral respondents that the animals were, in fact, intelligent.

My experiences during this project, however, suggest such an approach of building and utilising a belief in the animals' intelligence to enhance conservation, would not necessarily work with growers. This is because members of this group do not necessarily perceive the animals' intelligence as a positive trait. Instead, meetings revealed that growers saw the animals' intelligence as integral in their role as a pest of fruit crops because they are 'smart' enough to learn to ignore apparent threats, such as light and sound deterrents, and to circumvent other attempts at control, such as partial exclusion netting.

3B: Flying-foxes are a significant problem for the NSW Fruit Growing Industry in areas east of the Great Dividing Range

It was not surprising that most grower respondents indicated Flying-foxes were a significant problem for the NSW fruit growing Industry since this has been an ongoing issue in Australian management of the species (see *Flying-fox impacts on humans*, above) and a key reason for the establishment of the initial project underlying this case study. Interestingly, large proportions of public respondents also supported this idea, suggesting they might also support management to alleviate the problems that growers face.

The large proportion of neutral responses from Zone 3, probably reflects isolation, both geographically and socially, from commercial fruit growers, resulting in many people not being convinced that the animals are a “significant problem”.

3C: Flying-foxes are important in NSW forest ecosystems as pollinators and seed dispersers

Given the nature of growers’ interactions with Flying-foxes it was expected that a majority would be unconvinced about their importance as pollinators and seed dispersers for native vegetation. Discussions with growers who attended meetings revealed that they mostly observe Flying-foxes when the animals are eating their fruit-crops and many consequently think the animals prefer commercial fruit. It is conceivable that this contributes to a belief that Flying-foxes are therefore not important pollinators and seed dispersers because this ‘preference’ for commercial fruit suggests they do not have a strong tie to native foods. Also, growers’ comments revealed that some individuals believe the frass left behind when Flying-foxes feed on crops is evidence against the seed-dispersing role of Flying-foxes because they do not think much solid material, such as seeds, is actually ingested.

Proportions of neither-agree-nor-disagree responses were similar amongst the public and grower group, suggesting that education has not been sufficiently effective or wide-reaching to convince around a quarter of respondents that Flying-foxes disperse seeds and pollen.

Despite this, for those individuals or groups interested in management that promotes Flying-fox conservation, finding that a majority of public respondents supported the statement in 3C may be promising because it suggests a support base exists for the ecological importance of

the animals. It does not, however, provide an indication of the relative importance of this information for respondents. Thus, whilst people may agree that Flying-foxes are important for the environment, this result alone does not show that their role in the environment makes them a higher priority for protection than, for example, fruit production.

3D: Flying-foxes prefer to eat commercial fruit species rather than native foods

It is not hard to imagine how such a belief has developed among growers who have observed Flying-foxes visiting their orchards despite the presence of large areas of native vegetation within flying distance of their properties, and therefore, why a majority supported the statement in 3D. Further, some growers at the Castle Hill meeting recounted their experience of observing Flying-foxes feeding on fruit even when there were flowering gums adjacent to their crops. For these individuals such an event was sufficient to demonstrate a preference for fruit over native food, even though the scientific community might perceive such observations as little more than circumstantial evidence.

Based on similar feedback at each of the grower meetings, I had expected that a majority of growers would believe that Flying-foxes had a preference for commercial fruit. Thus, I was interested to find that just under a half chose this option and more than a quarter neither agreed nor disagreed.

That the public's choice of the neutral response was almost double that of growers was probably because public respondents have had little cause to previously consider the issue. As a result, the average public opinion which was found to be negative regarding 3D might be moved either way by effective lobbying or extension. By conservation-minded groups, it is possible this could be used as an opportunity to increase support for replacing/replanting native habitat whilst growers might be able to increase support for assistance as the victims of a scenario where these protected animals prefer their crops.

3E: Flying-foxes should be eradicated from fruit growing areas

Eradication is an extreme act, suggesting support for such an action would be based in an extreme attitude regarding Flying-foxes in fruit growing areas. Again, for growers, majority support for eradication is understandable since they depend upon fruit production to make a

living. It is interesting, however, that nearly a quarter of growers disagreed to some extent with eradication. Discussions with growers suggest that opposition to this option may be based in their view that it would be impossible to eradicate Flying-foxes so it would be more cost-efficient to offer assistance to protect crops rather than harm the animals.

Although majority support was not evident for any response option, substantial proportions of neutral responses, combined with more than 40% of each public group selecting disagree or strongly disagree ensured that the average opinion of the public was skewed in favour of “disagreeing”.

As a result, a clear difference in orientation of views was evident between growers and the public suggesting that if the observed results are indicative of the wider populations then growers are clearly out-of-step with much of society’s views on this issue.

3F: Any commercial fruit grower with a firearms licence should be able to shoot Flying-foxes to protect their crop

Despite an overall indication of support for 3F from among the public respondents, it could not be safely assumed that this option would be either supported or opposed in Zones 1 and 2 as respondents from these groups were split mainly between those in support of 3F and those against it. Conversely, the grower response was decidedly positive regarding this issue.

These results suggest that although any plan to allow this would likely draw general opposition from public respondents, substantial amounts of support might also be expected, not just from growers but also from the public within Zones 1 and 2.

3G: There should be no restriction on the number of Flying-foxes that Commercial Fruit Growers can shoot to protect their crops

Unlike 3F, where Zone 1 and Zone 2 respondents were neither mainly committed to supporting nor opposing the statement, for 3G all 3 public response groups displayed majority opposition to unrestricted culling of Flying-foxes, by commercial fruit growers. Realistically, this result should not be surprising, given that society has condoned the regulation of Flying-fox culling since 1986.

Similarly, since grower respondents belong to a group whose livelihoods are impacted by Flying-foxes, it was no surprise that most supported unrestricted culling.

This general opposition between the public and growers embodies the difficulty faced by managers in addressing the Flying-fox scenario since to meet the preference of grower respondents on such an issue would draw majority disagreement from the public respondents, and vice versa.

3H: Damage to backyard fruit and plants is a small price to pay for having Flying-foxes in the local area

It seems that the more experience respondents had with Flying-foxes the less tolerant they were of the animals' impacts on humans. This idea neatly explains why support for Item 3H: "Damage to backyard fruit and plants is a small price to pay for having Flying-foxes in the local area" is greatest in Zone 3, where interaction with Flying-foxes is lowest, whilst almost half of grower respondents disagreed to some extent.

If such a trend is widespread, managers can expect differential support from individuals or whole communities for policies relating to Flying-fox management where differences exist in the extent of contact with the animals. This could prove to be increasingly important if the use of urban resources by Flying-foxes, or the approach of camps by urban development, increases in the future.

3I: Flying-foxes are threatened by habitat removal and loss in NSW

As per the item above, increased experience with Flying-foxes was associated with decreased support for this option. Thus, those people who have most experience with Flying-foxes were also those least likely to believe the animals are threatened by processes such as clearing. This suggests the people who have most contact with Flying-foxes may not simply dislike the animals but actually believe they do not need protection from processes such as clearing.

3J: Humans do not benefit sufficiently from Flying-foxes for them to be protected in NSW

The widespread view among the grower respondents that Flying-foxes were not sufficiently beneficial, to humans, to be protected was out of place when compared to the views of public respondents.

The fact the growers generally agreed with 3J, whilst the public agreed, overall, may stem from the fact that the outcome of a theoretical sum of all interactions with Flying-foxes has a different general outcome for growers, compared to the public.

For growers, fruit production, which is a vital part of their life, is impacted by these animals, so the negative value of this might be expected to outweigh potential positive experiences with Flying-foxes or beliefs in the animals' inherent value. Such a view could be expressed as a belief that the animals do not provide enough good to outweigh their impacts. For other growers, who experience less damage as a result of the animals or afford them higher esteem, for example due to a belief that they play an important role in the environment, the net outlook of Flying-foxes may be positive, or if they are undecided, neutral.

Similarly, among the public those people who are woken by the animals at night, are affected by the odour emanating from nearby camps or who lose backyard fruit to the animals may, similar to those growers adversely affected by crop damage, also have a net negative experience with Flying-foxes. Alternatively, for people who never see the animals or who are conflicted between reports of their problems for others and their supposed benefits, a neutral response may result. Finally, for other members of the public who experience few, if any impacts from Flying-foxes, and see the animals rarely, even novelty value might be sufficient to tip the scales in the bats' favour. That the results show greatest public support for 3J in areas where interaction is highest and most neutral and opposition where humans and Flying-foxes interact least offers support for these possibilities.

3K: I would be concerned if, in the future, Flying-foxes only existed in zoos and fauna reserves

Most importantly, the observed results for the grower respondents, on this issue, when compared with others, demonstrate just how specific individuals' views of a wildlife

management scenario can be. Initially, it seems incongruous that almost half of the grower respondents would express concern about a future where the animals exist only in zoos and fauna reserves when most of them also wanted Flying-foxes eradicated from fruit growing areas (3E) and supported unrestricted culling of the animals for crop protection (3F). However, what this shows is that the grower respondents' negative views of Flying-foxes have bounds. Despite a wish to control the animals in fruit growing areas, using lethal means, almost half of grower respondents on some level, believe that Flying-foxes should be able to exist in the wild.

Further, unlike many of the other items, a lack of experience with Flying-foxes was not associated with increasing levels of neutral responses. Rather, the opposite trend was observed. Grower respondents, more than those from the public groups, were indecisive about their feelings on this issue, perhaps reflecting the difficulty of resolving the conflict between a negative view of the animal and the loss of the species from the wild.

3L: Killing Flying-foxes should be completely banned in NSW

Majority disagreement with a ban on killing Flying-foxes, among grower respondents, made sense. As stated previously, these participants are generally worse affected by Flying-foxes than members of the general public, since their income is impacted by damage to fruit crops. Thus, they might be expected to have more reason to want to ensure that culling, as a management option, remains available.

Perhaps more interesting, from the perspective of Flying-fox management was that only a minority of the public respondents, in each group, supported a total ban on Flying-fox culling. Instead, more public respondents believed, for some reason, that there was a need to be able to cull Flying-foxes in NSW than thought the practice should be banned. This could conceivably be based in personal, negative experiences with the animals, empathy for growers' losses or because of a belief in the need to have the option available should a need arise to kill the animals in the future, e.g. to control the spread of disease.

If these results reflect the opinions of the wider community then any decision to eliminate culling as a management option for Flying-foxes, as Eby (1995) suggested was likely to

occur, then widespread disagreement might be expected not just from growers but the general public as well.

3M: Governments should offer subsidies for methods of fruit crop protection, like netting, that do not harm Flying-foxes

The substantial support, among all groups, for Government subsidies for fruit crop protection that does not harm Flying-foxes is an important finding because it shows that despite opposing each other's views on various issues regarding Flying-fox management, growers and the public could still agree on a potential way forward.

Growers' motivation for supporting subsidies is quite obvious, i.e. for those who can use netting in their enterprise subsidies could provide an affordable way to install netting, thus improving their quality of life, by eliminating the need for additional work managing Flying-foxes, and improving their business, by reducing fruit losses. For the public, the reason for their support is less clear but may be based in a belief that subsidies represent a way to simultaneously help growers and reduce harm to Flying-foxes; an apparent "win-win" opportunity.

3N: The noise and odour of Flying-foxes is a small price to pay for having these animals in your local area

Much like 3H, this item essentially asked participants to determine whether any positive aspects of having Flying-foxes in their local area override the noise and smell the animals produce.

One might reasonably expect growers to oppose this issue due to the threat Flying-foxes pose to their livelihood. From such a perspective, damage to crops by Flying-foxes may represent a substantial negative value that other aspects of the animals' existence would need to overcome for the statement in 3N to be supported. Based on this, it is not surprising that most grower respondents "disagreed" or "strongly disagreed" with 3N.

Whilst the grower responses overall were decidedly negative, those of the public were less so, although in Zone 1 more respondents opposed than supported 3N. As for several of the other

results observed in response to Section Three items, the limited impact of Flying-foxes on the lives of public respondents, relative to growers, may explain the gradient of decreasing disagreement with 3N from Zone 1 to Zone 3.

Although it is tempting to assume that those people in Zone 1 who live close to Flying-fox camps might also represent the bulk of respondents who disagreed with 3N, this was not the case. Rather, it may be that noise of Flying-foxes visiting house-yards is a sufficiently widespread and annoying phenomenon to tip the balance against the animals in this statement. Alternatively, a heightened awareness of problems occurring for people living near camps may exist among the Zone 1 respondents, resulting in decreased support for this Item.

3O: To stop Flying-foxes eating commercial fruit crops we should replant native foods and replace important habitat for them

Due to reduced proportions of “neither agree nor disagree” responses it is clear that public respondents were generally more decisive about this issue than many of the others in Section 3 of the questionnaires. Indeed, in response to this question, the public were more decisive than the grower group.

Definite majority support for 3O shows public respondents believed not only that replanting should occur but that it would make a difference to growers’ conflict with Flying-foxes. Whilst such a view, if widespread among the public, would suggest support exists for revegetation to benefit growers, the grower respondents were less convinced, even though slightly more grower respondents supported than rejected the statement. These results describe a situation where although the public largely believe such a measure will help growers, that help is not wanted by most.

Growers, at meetings, indicated to me that this option was unrealistic because it would be prohibitively expensive to undertake. Others worried that an increase in food resources would inevitably lead to more crop damage due to a resulting increase in the Flying-fox population and still others simply opposed replanting because they strongly believed that commercial fruit is preferred by the animals (see 3D, above).

3P: Flying-foxes deserve to be protected from harm in NSW

When I first proposed this item, members of the steering committee reacted strongly to use of “deserve”, suggesting that it is an emotive word which can provoke substantial pro- or anti-Flying-fox sentiment. This, as I explained, was exactly what I wanted.

I believed the notion of “deserving” something was inherently associated with individuals’ concepts of “justice” or what is fundamentally “right”, so views on whether or not Flying-foxes “deserved” protection would be closely related to preferences for management.

Given that growers can face such problematic interactions with Flying-foxes, the majority disagreement of grower respondents with 3P was not surprising. At meetings growers expressed frustration with previous suggestions that they should not take damage by Flying-foxes personally. From their perspective, such damage is very ‘personal’, because it affects their abilities to provide for their families. Consequently, growers may feel that they are the ones who “deserve protection” rather than the Flying-foxes. Although this sentiment cannot be drawn from responses to this item, the observed data make it clear that few grower respondents felt Flying-foxes deserve to be protected from harm.

For the public, it may be that most respondents in Zones 2 and 3, given their relatively low frequency of contact with Flying-foxes, have no particular reason to believe that Flying-foxes do not deserve protection. This would explain why majority support was observed from these groups’ respondents for 3P.

For Zone 1, however, levels of experience with Flying-foxes more closely approach that of growers, so the proportional support for Flying-foxes deserving protection was decreased, relative to Zones 2 and 3, but not as low as seen among growers.

For managers, a key message from these results is that grower respondents, in particular, and to a lesser extent those from Zone 1, cannot be assumed to be supportive of management based on the animals deserving protection. Thus, management initiatives reliant upon support for such a premise may first require a convincing case to be built.

3Q: Flying-foxes should be protected because they are “cute”

For all groups, it was apparent aesthetic appeal alone is insufficient reason to justify conservation of Flying-foxes that since most respondents disagreed with 3R.

Suggestions from members of the steering committee, regarding growers' likely responses, were supported by the overwhelming rejection of appearance as justification for protection. Indeed, some steering committee members suggested the question should not be included but I had argued it was important to see whether or not participants had some “aesthetic” reason for wanting the animals to be conserved, and especially to see whether this varied between public and grower groups. The results show that it did, although not as I expected.

I estimated that any differences between grower respondents and public respondents for this item would probably occur because more members of the public would agree than growers. Instead, similar numbers of growers and public respondents agreed but many public respondents neither agreed nor disagreed, possibly suggesting they are undecided about the issue.

The greatest opposition to this item being offered to participants had come from people dedicated to the conservation and care of Flying-foxes. They expressed concern that this would undermine legitimate reasons for conserving Flying-foxes and generally detract from the public image of conservation. Whilst I can empathise with their concerns, I am satisfied it did neither and instead, showed them that respondents are not interested in the appearance of these animals as a reason for their protection.

3R: Many Commercial Fruit Growers, east of the Great Dividing Range in NSW, are forced to undertake costly and laborious management to reduce Flying-fox damage to their crops

Whilst, overall, growers and the public were aligned in terms of their response to 3R, the contrast observed between minority support from Zone 3 and the majority support from Zones 1 and 2 showed that public respondents were not uniformly aware of growers' experiences.

There is little wonder that growers, especially the respondent group who had pre-selected themselves on the basis of an interest in Flying-fox management, supported an item acknowledging growers' efforts to reduce crop damage.

Interestingly, at meetings, some growers expressed a belief that non-growers, especially those from metropolitan areas, did not appreciate the effort involved in mitigating damage by Flying-foxes. Whilst few public respondents disagreed to any extent with 3R, the large proportions of Zone 2 and 3 respondents that neither agreed nor disagreed may reflect the lack of understanding that growers predicted.

3S: Flying-foxes are a significant disease risk to people in NSW

Responses to this item reflected the sentiments observed at meetings. Most grower respondents believed Flying-foxes were a significant disease risk whereas opinion was split among the public. Whilst this may be a positive result for Flying-foxes, from the perspective that the public respondents were not generally concerned about the potential for disease transfer from the animals, the high level of neutral responses suggests the public are insufficiently informed to make a decision on this issue.

Such lack of awareness among the public might prove advantageous for groups prepared to use public ignorance to their advantage, particularly since Flying-foxes are known to carry diseases that may be harmful to people (Allworth *et al.*, 1996). That is, for pro-conservation groups it might be important that the public understands both the circumstances under which disease transfer can occur and its likelihood, so that a widespread misconception of the animal as a significant threat to people's health does not arise. Conversely, for those individuals intent on having Flying-foxes removed from a particular area, support might be gained for their cause by engendering fear of disease among the public.

1J: Should potential residents be told that there is a Flying-fox roost or camp site near their house before they rent or live in it?

As Smith (2002) explained, people who are unaware of local Flying-foxes when they move to a home can be surprised and frustrated by the interactions that result with the animals. Thus, people from areas where contact with Flying-foxes is greatest might be expected to

understand such impacts better than people from places where problematic interaction with the animals is less frequent. This could explain why “yes” responses to Question 1J were higher among grower and Zone 1 respondents than those from Zones 2 and 3.

Thus not only do previous experiences (Smith 2002; Eby 2002) suggest that it would be wise to inform potential residents about the likely presence of Flying-foxes in the local area but most public respondents from Zones 1 and 2 believe this should be done. On this basis, it might be prudent for managers to at least investigate methods of advising prospective home-buyers or occupants about nearby Flying-foxes, not only to reduce the likelihood of these people suffering from unexpected, negative interactions with the animals but also to reduce the need for managerial involvement at a later time.

Whilst some people might argue that such a strategy would de-value real-estate in areas officially declared to be “near” to Flying-fox camps, this is balanced, to some extent, by the likely improved satisfaction of residents with their local environment and the potential for members of the public who are seeking a lifestyle featuring wildlife experiences to be attracted to such properties.

Most importantly, by proactively informing people about local Flying-foxes, as well as issues such as likely impacts, why the animals use urban resources, their conservation status and why they are ecologically important, managers may alleviate the need for reactive management which occurs when involved parties may already be frustrated with Flying-foxes and consequently more difficult to work and reason with.

5A/6A: Why do you believe GHFF have reached population levels that require them to be listed as vulnerable?

It is extremely relevant to Flying-fox management that a majority of respondents, from three out of the four groups, chose the “unsure” response to this question because it suggests that education of growers and the general public about Flying-foxes has not been wholly effective. For those individuals or groups interested in Flying-fox conservation it may be worthwhile to consider how realistic it would be to expect support for their cause whilst large proportions of the public are unsure, or unconvinced, why conservation is required.

5B/6B: Do you believe that GHFF should be listed as a vulnerable species?

Responses to this question may provide one reason why managers have struggled to find a solution that is satisfactory to growers. This is because a majority of grower respondents disagreed with the fundamental tenet of modern Flying-fox management: that the animals are vulnerable. Such a clash of points-of-view is likely to present problems because it reflects a situation where managers are trying to get growers to abide by rules and strategies they do not believe in.

The issue is slightly different for public respondents since a majority did not disagree but, rather, responded that they were unsure in their beliefs about whether GHFF should be listed as vulnerable. Such an outcome presents both a real and a possible problem for managers. Firstly, whilst respondents are undecided, they do not agree with current management policy and may be hesitant to support specific strategies based on the animals' vulnerable status. Secondly, there may be potential for people to make their mind up in the negative and, like many growers, oppose the listing. In both cases, it appears that managers might be well advised to investigate extension to improve acceptance of this basic principle for Flying-fox management.

5C/6C: Why do Flying-foxes cause damage to fruit crops?

Again, growers' views on this issue were different to those of the public, possibly because of their unique experience with Flying-foxes as a recurring threat to their livelihoods. As for Item 3D, many grower respondents believe that Flying-foxes prefer commercial fruit to native foods. For these people, the reason Flying-foxes cause damage to fruit crops is obvious even though researchers have rejected such a preference (Parry-Jones & Augee, 1991).

Growers were also dissimilar to the public, since most grower respondents believed that Flying-foxes damaged fruit-crops because numbers were too high. Although the basis of this view was not specifically explored in the questionnaires, discussions with growers revealed that different perspectives contribute to this idea. Firstly, some growers expressed a belief that numbers are artificially high because of the availability of resources such as commercial fruit crops and urban garden plants whilst others simply believed that current population sizes are unsustainable. Either way, for these individuals, reducing the number of Flying-foxes

might be an obvious solution but since it contradicts the management goal of preventing a reduction in population size alternative foci might be more attractive for managers.

More commonly selected by all groups, and particularly popular among the public, were the notions that fruit crops are an easy-to-find, consistent food source and that there is not enough native food. From this perspective, pursuing management strategies that deal with these issues seems to be a logical way of securing both public and grower support. Further evidence for this is the substantial public “agreement” observed for items 3M and 3O which show most of each Zones’ respondents supported Government subsidies for crop-protection methods that do not harm Flying-foxes, and for replanting native food. Such strategies would make commercial fruit less available to Flying-foxes and attempt to remedy the issue of reduced availability of native food.

5D/6D: Do you feel that counts of GHFF are accurate enough?

Based on the feedback I received from meetings, the reason a majority of growers selected “no” as their response was probably related to lack of belief in the results of counts, as much as it was due to a specific problem with the methods used. Some individuals suggested that the results were “made-up” because, based on their experiences, they could not believe it was possible that numbers of Flying-foxes had decreased. (For a similar opinion see Biel, 2002)

This view is understandable given that the position of growers’ is unique within this scenario. That is, they see the Flying-fox population from a viewpoint where the animals are concentrated on crops, sometimes in very large numbers. Thus, it may not be apparent that the entire population has actually decreased in size. Also, since the availability of native food for Flying-foxes may also be decreasing due to clearing, it is conceivable that Flying-foxes are actually increasingly taking advantage of fruit crops, to offset this loss. If this is the case then it might also add to growers’ belief that Flying-foxes are not in decline and, instead, that they may actually be increasing.

The public responses revealed something quite different to those of the growers as the majority of public respondents knew too little to comment. It was interesting to note that lack of knowledge was relatively consistent, irrespective of the extent of each public groups’

experience with Flying-foxes. This suggests that the mechanisms supporting management decisions may be poorly communicated.

6A/7A: Do you see merit in exploring any of these potential management options? (Paid to leave industry, subsidies for netting, remuneration for damaged fruit)

Three aspects of the pattern of responses to this question are particularly interesting.

Firstly, a greater proportion of the grower group selected the “none of these” option than respondents from any of the other groups. That this occurred despite the fact the options were devised in conjunction with growers at the Castle Hill meeting serves as a reminder that these were not a comprehensive list of management options. Similarly, the fact that 20% of respondents were not satisfied with any of the three options shows that consultation with a small group of individuals should not replace more widespread research into management preferences.

Secondly, it was also valuable to see that, again, responses from grower and public respondents varied significantly between groups. Differences between growers and the public were evident as more grower respondents than public respondents generally favoured the response options and because the support for particular alternatives also differed between growers and the public.

For Option A, it is understandable that growers who wish to leave the industry would be excited by the prospect of being paid to do so by the Government. Equally, there was little surprise that the public, who would indirectly fund these schemes through taxes, were not overly keen for an option which is literally a government-funded change of profession.

Option B was most popular with the public, but only second in terms of grower respondent support. The preference of public respondents for this option probably stems from netting being the best known of these options as well as a “common-sense” approach for providing benefits to growers without directly harming Flying-foxes. Conversely, reduced grower respondent support for this option may be due to the relatively high proportion of banana producers involved in this project, relative to producers of other fruit. This is because banana

growers mostly believe that netting bananas is impractical and therefore is not an attractive option for them (see *Feedback from Grower Meetings*, above).

Unlike netting subsidies, the option of remuneration for damaged fruit (Option C) is potentially widely applicable across the fruit growing Industry so there is little surprise it enticed the most support from grower respondents. For the public, however, such a scheme may appear to be too difficult to regulate and, reciprocally, too easy to defraud, making it a less attractive option for the use of public-sourced funding.

Thirdly, and most interestingly, the public groups did not differ significantly from one another. This suggests that pursuing these options, especially netting subsidies, may be a way for managers to attain uniform levels of public support across the three Zones whilst also providing management options that benefit Flying-foxes and growers.

Patterns of similarities and differences in responses to individual items

Based on the average opinion of the public and grower groups towards each item in Section 3 it was possible to identify not only those topics where there was greatest similarity, or difference, in response but also to determine whether or not there were types of issues or themes for which the two groups were more likely to agree or disagree.

Those statements which provoked the most closely aligned statements between the two groups were varied. Aside from supporting subsidies for methods of crop protection which do not harm Flying-foxes, both groups generally agreed Flying-foxes were important pollinators/seed dispersers, were concerned about a future where the animals only existed in zoos and disagreed that being cute was sufficient cause for protection. Despite the absence of a definitive pattern among the issues which growers and the public agreed upon, it is clear that there is some common ground between the two groups.

In terms of differences between growers and the public, it was interesting to note that the four items for which there was greatest disparity in mean response were all related to harming Flying-foxes. Specifically, the groups differed in opinion regarding statements that suggested culling the animals should be unrestricted, that any firearms-licensed grower should be permitted to shoot Flying-foxes, that the animals deserve protection and that there should be a

complete ban on killing Flying-foxes. Put simply, grower respondents tended to prefer the options supporting the harm of Flying-foxes for crop management whilst responding members of the public group generally did not.

3.5.3 Limitations

It would be ideal when dealing with sentiments about wildlife management, to have a representative sample of the relevant population. However, the low response rates and limited amount of data collected from non-respondents made it inappropriate to assume the results of this research were representative of the grower and public sample populations, let alone all of the NSW commercial growers potentially affected by Flying-foxes and the entire public within the project's range.

Despite these limitations, which some might consider overwhelming, I strongly believe that the collected data held both management and academic value, and were therefore worth discussing, rather than discarding. This was a pragmatic decision, made with the knowledge that despite best efforts, researchers and managers may not always have the data they would like. Under such circumstances, providing that suitable effort has been made to facilitate representative participation, I believe that the absence of information from people who did not respond to the questionnaire should not become more important than the responses of those who did.

Obviously, when appropriate response targets are met, in the context of sufficient information about the non-responding individuals, researchers' and managers' confidence can be highest in understanding the context for the data, as well as decisions based on that information. However, when insufficient participation occurs for the data to be considered representative of the entire population, I would argue that the best alternative is to have a measure of those people who are most likely to voice an opinion about management. This is because expressed views, regardless of whether they are dissenting or assenting with respect to managers' plans, are evidence that can be used by managers to support or modify their own initiatives, respectively. Alternatively, they may be used by lobby groups and politicians to force change.

Low response rates

It was frustrating that the Flying-fox questionnaires elicited few responses. I was particularly disappointed since, although I had, relatively, placed extra time and effort into the development of these GHFF survey instruments, the wild horse management case study had received proportionally more interest from the public.

Initially, I was focussed on the possibility that problems with the questionnaires' designs had led to low response rates, i.e. they were worded poorly, might have taken too long to complete or were formatted inappropriately. However, I realised that since there had been substantial review of the questions by interested parties at meetings with growers and the public, and because the layout and wording of items had been ratified by the expert steering committee, it seems unlikely that this was the reason many people chose not to participate.

By focussing on problems with the methods, especially questionnaire design, I believe I initially overlooked a much simpler and more likely explanation for low response rates: that few people were sufficiently interested in Flying-fox management to take part in such a project. Although I had attempted to raise the profile of the research through media releases and tried to generate interest via the Information Sheet for Participants that each participant received, Flying-fox management might simply have been too low a priority for many people to devote their time and effort to completing the questionnaire.

I also realised that the low response rates evident from amongst the grower group, however, did not appear to support this theory. Because growers arguably have more to benefit from management of Flying-foxes that is inclusive of their views, compared to other interested people, it seems incongruous with my hypothesis of reduced interest in Flying-fox management that few opted to even receive a questionnaire. However, I believe this disparity can be explained by a substantial difference in the opinions of wildlife managers held by growers and the general public.

Disaffected growers

Whilst for the public the key issue in deciding whether or not to participate might have been whether there would be any possible benefit from participating, for the growers the ability of this research to translate their wishes into action was probably more important. This is based

not only on my interaction with growers and members of the steering committee but also on the history of interaction with managers that has frustrated growers (Ireland, 1989; Commensoli, 2002).

Most growers that I spoke with during this project knew what they want from managers, i.e. to be able to make a living from growing fruit without being impacted by Flying-foxes. Because the last two decades of management have not facilitated this, policies protecting Flying-foxes have become a hindrance, resulting in many growers becoming disaffected with DEC and other pro-Flying-fox individuals and groups.

This negative view of managers was enhanced, for some potential grower participants, by concerns regarding the likelihood of DEC disclosing information gathered during this research. This anxiety and distrust arose from a previous incident when Humane Society International used legal means to gain access to information about growers whom DEC had licensed to harm Flying-foxes for crop protection purposes (Hughes, 2002).

Because of these issues, the FFCC expected growers would have some concerns about participating in the project and attempted to address them by including key grower representatives in the project's steering committee. Similarly, when it became necessary to distribute invitations to participate in the questionnaire via grower organisations, I hoped this would have an additional benefit of improving the credibility of the research among the organisations' constituents. Unfortunately, while it is possible these efforts made some difference, they were clearly not sufficient incentive for a larger proportion of growers to take part.

Advertisement of meetings

As described earlier, (see *Attendance at meetings*, above) advertising of meetings did not run as planned. I believe this had a negative impact on attendance at the meetings and cost me further positive exposure within the community, especially among growers.

Non-response round

More significant than the low response rates to the main round questionnaires, the paucity of information gathered from non-respondents limited extrapolation of the results. If I had been able to ascertain that non-respondents did not differ significantly from respondents or that they were simply uninterested in Flying-fox management, the results would be more readily acceptable for managers, researchers and the educated public.

There is little doubt that using the same method to source non-respondent information as was used to obtain main round data is not ideal. Unfortunately, it was not possible within this project to add additional costs of purchasing telephone data and making calls to non-respondents as is used in contemporary human dimensions studies overseas (for examples, see Zinn and Andelt, 1999; Hayslette *et al.*, 2001). Similarly, face-to-face interviews with non-respondents were not possible, given the project spanned a thousand kilometres of coastline.

Despite the fact that I am hesitant to recommend that participants who do not want to answer mail-out questionnaires should be further harassed by phone-calls from researchers, especially since unsolicited phone calls are currently a topic of hot debate in Australia, it seems phoning such participants would be the best way (for lack of any better) to source necessary information about non-respondents in similar, future projects.

Addressing grower participation in future Flying-fox research

Feedback from meetings with growers revealed that many believed their involvement in Flying-fox management, so far, has had little net value. As stated by Biel (2002) there is a belief among growers that since our society apparently wants to secure the existence of Flying-foxes, then growers alone should not bear the burden of such conservation.

Similarly, it may be unrealistic to expect an altruistic investment, in projects such as this one, from growers who are negatively impacted by Flying-foxes. It seems that to improve grower participation there must be hard-evidence that policy-makers and managers are working to provide benefits to growers in addition to meeting society's desire to conserve wildlife.

Further, if such benefits are provided this should be done in conjunction with evidence that grower participation has helped to facilitate change. Such positive reinforcement is likely to

be important in building growers' confidence in future participation in information exchange with managers or their proxies. Ideally, this type of interaction between managers and growers could help to shift the latter's perspectives from concerns about top-down management focussed primarily on conservation, at growers' expense, to believing that there is at least some willingness amongst managers to integrate the growers' needs of growers with those of wildlife.

Whilst such a change in approach might not be easy to achieve, the fact that public respondents were supportive of options that benefited both growers and Flying-foxes should serve as encouragement for at least trying this approach.

If this does not happen, there will continue to be insufficient reason for growers to want to participate. Further, managers need to reinforce that beneficial changes to policy stem from growers' participation, when this occurs.

Getting the public involved in Flying-fox management

Methodologically, increasing the advance notice about such projects is likely to increase public participation. As for growers, there also needs to be incentive for the public to take part. This, however, will probably remain difficult among people who have little knowledge of, or experience with, Flying-foxes.

We, as managers and researchers, need to decide whether increased public participation in projects such as this one is a goal for the future. Conceivably, managers may be satisfied to only have those people independently interested in Flying-foxes contribute to management of the species. In this way little extra effort would be required on their behalf.

Alternatively, managers may see that there is a potential advantage in getting increasing proportions of the public interested in Flying-fox management, particularly if they believe interaction with Flying-foxes is likely to increase in urban areas. Also, it may be beneficial to have greater interest in Flying-foxes where it is difficult to achieve desired levels of funding from the Government for conservation and management purposes.

However, to achieve this increased interest, managers might take either a passive or active approach.

The passive option is essentially one of “wait-and-see”. If interaction between Flying-foxes and urban residents does increase over time, as more natural habitat is cleared and more housing closely approaches established bat camps, it might be expected that willingness to participate will increase. However, this approach will still leave managers faced with reacting to observed attitudes and preferences, which, if the trend observed in this study continues, will mean that managers have to deal with increasing numbers of people with a negative view of the animals.

The alternative, active approach involves managers engaging communities about Flying-foxes ahead of any increased interaction, to pique interest in the species. If done appropriately this will not only increase willingness to participate in future research but also prepare people for future interactions with Flying-foxes and perhaps encourage a positive view of both Flying-foxes and managers.

3.5.4 The implications of this research

Growers and Flying-fox management

For growers, the information generated in this project suggests that whilst some members of the public who take an active interest in Flying-fox management are relatively closely aligned with their views, many are not. As several grower attendees at meetings suggested, respondents from metropolitan areas generally did not share their views or the experiences they have with Flying-foxes.

Despite a substantial proportion of public respondents believing that Flying-foxes were a significant problem for fruit growers, far less support was evident from public responses for the management options favoured by growers, such as the eradication of FF from fruit growing areas, allowing any growers with a firearms licenses to shoot Flying-foxes and not restricting the number of Flying-foxes growers can shoot to protect their crops. In practical terms this suggests that problems for growers are not seen by the public as sufficient justification for returning to previous methods of management.

Conversely, although grower and public attitudes towards Flying-foxes clearly differed, the overall positive attitude of public respondents was not so extreme that culling of Flying-foxes was completely unacceptable. Rather, that less than a third of public respondents supported a total ban on Flying-fox culling shows that those participants interested in commenting on Flying-fox management were supportive of the need to kill Flying-foxes under some, unspecified, circumstances. This has management relevance since any plan to finally phase out culling, as suggested Eby (1995) suggested would eventuate, would not be supported by many grower or public respondents.

Knowledge and views of issues important to Flying-fox management

Whilst growers and the public shared many beliefs and views about Flying-foxes, including why they cause damage to fruit crops, there were also key discrepancies between the ways they perceive important aspects of the Flying-fox management scenario. For example, despite agreeing upon some aspects of why Flying-foxes cause damage to fruit crops, such as the ease and consistency with which crops can be found, and because of a lack of native food, many growers believed, unlike the public, that damage was also related to there being too many Flying-foxes.

So long as substantial proportions of growers believe Flying-foxes are not in decline and do not warrant special conservation status, effectively involving these people in management will continue to be problematic. That almost two thirds of grower respondents did not believe Flying-foxes should be listed as a vulnerable species is evidence of a fundamental barrier for management that promotes conservation. This is because such conflict between ideologies means those individuals who do not agree with management must be convinced, or forced, to comply. Such top-down management is likely to promote conflict between managers and growers and between growers and Flying-foxes.

Although growers present a genuine problem for current Flying-fox management aims, many of the points of view respondents expressed were understandable. Firstly, not believing that Flying-fox population sizes have decreased to levels requiring management for conservation of the species makes sense when these people live and work in an environment that attracts the animals. Indeed, given the reduction in Flying-foxes' natural food sources (Eby, 1995;

Law *et al.*, 2002) one might expect that alternative food sources will be increasingly important to the animals; so growers could plausibly experience an increase in their visitations. From inside this frame of reference, it would be easy to believe that the Flying-fox population had not decreased.

Similarly, if growers do not accept the “facts” that underpin management, it is hardly surprising that they are keen for assistance to facilitate changes in the way they deal with Flying-foxes. The point made by Biel (2002) about sharing the cost-burden of conserving Flying-foxes across the community is a crucial one for many growers. Their frustrations with Flying-fox management are compounded by a feeling that they are trapped between the wishes of the public, which require additional expenditure both financially and in terms of effort, and the price control of a retail oligopoly that essentially prevents growers being able to pass on the costs of modified management, such as exclusion netting, to consumers. Consequently, growers seek subsidies, remuneration or a viable way to leave the Industry; as seen in responses to Grower Question 7A.

Lack of faith in the methodology used to establish the population size of GHFF is a key example of grower respondents’ disbelief in the facts managers base their decisions upon. That more than half of grower respondents do not believe the methods used to count Flying-foxes are accurate enough, 11% did not know they were counted and nearly a quarter were unaware of the methods suggests there is, at least, a significant communication problem. Obviously, such problems must be addressed if Flying-fox management is to be truly effective. Managers need to take responsibility for identifying such issues and effectively dealing with them. This might be done, for example, by engaging widely with growers to understand where conflict between beliefs and facts occur and then finding convincing ways to demonstrate the validity of important facts. If this is not done, resistance to management initiatives is likely to continue.

Although response rates were lower than I had hoped for, the methodology holds promise for improving how managers deal with growers and the public in the Flying-fox scenario. The growers that attended meetings were forthright with their concerns. Whilst this might not have equally been the case had the meetings been directly with managers, it is possible to use independent parties, as was my role, to collect information.

Public responses

Although public respondents were mainly positive about Flying-foxes, several issues warrant managers' attention. Firstly, the public is not homogeneous. The fact that the majority of the public respondents were positive does not mean they are all satisfied with current management or that support for specific management will continue. Just as there was a trend of increasingly positive views southward along the NSW coast, so too the proportion of individuals that selected "I am unsure" responses, or "neither agree nor disagree" also increased. I suggest that the prevalence of these neutral views should be seen as an opportunity for managers. Managers might convince these individuals, if approached correctly, to support their initiatives and ensure the balance of public support lies in favour of strategies that are appropriate for conservation of wildlife.

As seen from the comparison of response frequencies and graphical representation of mean responses, consistent, significant differences existed between grower respondents and public respondents in terms of preferences for management and overall attitude towards Flying-foxes. These suggest that, for many issues, management strategies based on the preferences of one response group are unlikely to equally satisfy members of the other. Likewise, even within the public, consistent differences between Zones are also important because management strategies suitable for a particular Zone may not be appropriate for others.

If these differences also exist within the wider population, managers have various options available to deal with this. Firstly, the variation could be ignored and management could continue irrespective of public preference with a likely outcome of heightened conflict between managers and those people who have dissenting views.

Alternatively, managers could develop flexible arrangements under which the various Zones are managed according to the prevailing attitudes within each. Although at first glance this might appear to provide a solution, it would probably only shift difficulties associated with conflicting attitudes to a smaller scale since every response group showed internal heterogeneity and because the distribution of fruit growers is not limited to one area.

Thirdly, as I have suggested several times already during the discussion, where views are not aligned with management aims, an extension campaign might be undertaken to strategically

engage and build capacity for acceptance of specific initiatives among the public, and/or growers. Note that I have suggested extension, as a multi-way exchange of information rather than education alone. Naturally, positive outcomes for such a plan are still heavily dependent upon a rational response to information which, in emotive issues such as this, may not always be guaranteed.

3.5.5 Summary

The GHFF population has reached a level where its existence is dependent upon support from humans. Thus, for those people interested in conserving the animals, understanding the relationship between the animals and society is important. Interactions of growers, managers and the public with Flying-foxes are complex and cannot be managed using scientific knowledge alone. I believe this case study has shown that Human Dimensions Research provides a way forward for those parties involved in the Flying-fox management scenario

Although these observed results provide insight into the diversity of views and various trends that exist among respondents they may not provide a comprehensive view of the situation since many growers and members of the public chose not to participate. Nevertheless, based on my experiences with managers, the FFCC, and a range of participants, I believe the following conclusions are important to the management of Flying-foxes in NSW.

Despite the fact that grower respondents had an overall negative view of Flying-foxes, it was also clear that there were bounds to their dislike of the animals. Whilst some of the options growers preferred for management were not equally supported by public groups, they were not irrational. For most grower respondents the commercial importance of their fruit crops simply outweighs the conservation value of the Flying-foxes feeding upon it. Similarly, for the public respondents, their positive view of Flying-foxes and associated preference for the animals' conservation was not so extreme that they would not accept the animals being harmed to allow growers to make a living.

If these results are indicative of the feelings of the wider populations of growers and the public then there is a positive option for progressing Flying-fox management. Public respondents condoned subsidising methods of fruit crop protection that don't harm Flying-

foxes. Specifically, they were in favour of subsidising netting. This option should be pursued by managers.

Commercial fruit growers

A key problem for resolving conflicts with grower respondents, regarding management policies, is that many did not accept important facts that underpin conservation of Flying-foxes. If managers seek to increase support among growers for current conservation-based management policies, they must increase levels of agreement regarding the ecological importance of Flying-foxes and acknowledgement of their decline in numbers, for example through extension. Such a convergence of grower and conservation-minded understanding, however, should not be expected to resolve the negative interactions between growers and Flying-foxes because it will not eliminate the damage that the animals cause. At best, it might conceivably lead to shifts in the approaches used by some growers to mitigate crop damage.

Instead, if managers wish to reduce fruit growers' reliance upon methods of damage mitigation that result in harm to Flying-foxes, they will need to provide greater incentive to do so. To this end, it was invaluable to see that of the three options proposed by growers for reducing their own reliance upon harm to Flying-foxes, two were supported by a majority of public respondents and in particular, all three public groups were keen to investigate ways of subsidising growers to use exclusion netting.

However, the diversity of needs and views among grower participants suggest that whilst promising, subsidies for exclusion netting alone will not provide a solution. This may especially be true whilst some growers resist its use due to compatibility issues with specific crops, such as bananas. Likewise, the belief that netting can have significant impacts on production, such as affecting the timing of fruit ripening, which in turn can cost producers key market advantages (Ballard, 2004) may be a barrier to wide-spread acceptance of netting alone.

Instead, a potential short-term solution appears to lie in adopting an integrated approach combining netting subsidies with remuneration for damaged fruit, in cases where netting is inappropriate/unacceptable.

Over time, however, the absence of an alternative crop protection method will require subsidies to be ongoing otherwise conflict between growers and Flying-foxes will reignite when netting needs replacement. Unless the Flying-foxes' need for food can be accommodated by replanting native vegetation, any attempt by managers or governments to buy a solution to the conflict between growers' needs and conservation goals through subsidies and remuneration should also fund research into alternative strategies for affordable crop-protection that will replace netting.

The Public

The public participants who responded were not indifferent to the needs of Flying-foxes or the problems faced by commercial fruit growers. However, many, particularly those in metropolitan areas, appeared to have insufficient experience with the animals to be able to decide whether they did nor did not support specific management options. This is good for Flying-foxes as, in the absence of negative experiences, people were generally positive about the animals and supportive of conservation. Increasingly negative attitudes were associated with living in areas that experience more frequent contact with Flying-foxes and with specific types of interaction, such as being woken by the animals at night.

This trend, in particular, could prove to be a problem for future management if urban interactions with Flying-foxes increase. It suggests that an increasingly negative attitude toward Flying-foxes may develop as more people become exposed to interactions with the species; this is a possibility given the ongoing removal of natural food resources (Parry-Jones & Augee 1991; Eby 1995; Law *et al.* 2002).

For managers, this trend suggests a need to undertake extension in those areas most likely to be increasingly frequented by Flying-foxes, particularly in areas where development is approaching known camp sites or where food sources are close to residential areas. Specific issues worth targeting include: Flying-foxes' role in the environment; their intelligence; why population levels have declined; why the animals use resources in urban areas and whether they would prefer to use natural ones; specifying the circumstances under which they are a disease risk; and providing suggestions on how to avoid common negative interactions, such as bringing laundry inside at night to avoid fouling and erecting netting over backyard fruit trees.

Further, as urban expansion continues, some thought could also be given to the types of vegetation planted in specific areas, both to deter Flying-foxes from coming too close to housing and to provide beneficial resources elsewhere.

3.6 Conclusion

Obviously I cannot claim that the application of human dimensions research to this scenario has resulted in a comprehensive understanding of the views and attitudes of growers or the public. I was admittedly disappointed with the levels of involvement, especially growers, since it, in turn, limited my ability to extrapolate the data. This suggests to me that a re-allocation of resources, especially devoting more time, effort and money to securing information from non-respondents, will be appropriate for future research.

Despite these limitations, I have identified potentially important trends among the public and grower participants. These could be utilised by managers to reduce conflict, to lower the reliance upon harm to manage interactions with Flying-foxes and to improve conservation efforts.

The results suggest that for the majority of public participants who interact with Flying-foxes, experiences are limited to being woken by the animals at night or losing fruit and flowers as the animals come into their yards to forage. Less commonly, participants may live in areas close to camps and consequently experience problems of noise, smell and fouling of their property with bat faeces. These types of interactions occur in a general pattern along the east coast of NSW, where extreme interactions are more frequent in the north of the state, rather than the south. Consequently, a trend of increasingly negative interactions from south to north was also observed.

Grower respondents were more negative towards the animals than any public response group. Again, this was unsurprising since they reported the most extensive interactions with Flying-foxes and their livelihoods can be threatened by the animals' use of their crops.

As in the Wild Horse Management Case Study, this research revealed important differences within and between interest groups, further highlighting the heterogeneity that exists within contemporary society regarding wildlife experiences and management preferences.

By engaging growers and the public about Flying-fox management it became clear that there might be a way to reduce the harm inflicted by growers, on Flying-foxes. This arose because the public respondents mostly agreed that growers should not be forced to bear the costs of protecting a species which has been declared to be important to society in general. To this end, growers' wish for financial support to exclude the animals from their crops or at least to be remunerated for damage by an organism was shown to be reasonable to the interested public and therefore worth further investigation by managers.

Further, by identifying the observed trend of increasingly negative attitudes among respondents in association with increased experience with the animals, managers have a chance to address, proactively, future interactions between people and Flying-foxes so that acceptance and support for their conservation status is not undermined.

4. Case Study 3:

Kangaroos in peri-urban areas

“People who come into these areas should know that these are the wildlife areas. If they don't like it go somewhere else. The traffic is something that should be looked into, not the animals. Left to their devices they don't interfere with anyone which is more than I can say about humans.”

Safety Beach Resident, 2004/05 Kangaroo Management Questionnaire

“I don't appreciate rounding a corner to come face-to-face with a roo who stands his ground and forces me to take a different approach to get inside my house. I don't dislike 'roos. I just think they should be in a better environment than my backyard.”

Safety Beach Resident, 2004/05 Kangaroo Management Questionnaire

“We are quite happy living with kangaroos with one proviso: If a kangaroo is aggressive toward a child then it should be killed. I do not support the 'leave them in peace' policy of NPWS who appear to me to be a total waste of taxpayers' monies.”

South Grafton Resident, 2004/05 Kangaroo Management Questionnaire

“Kangaroos and people can be dangerous. People are invading the roos' habitat so of course there will always be problems – keeping the public informed/educating – in how to responsibly live with “wildlife” is very important. National Parks do a terrific job”

South Grafton Resident, 2004/05 Kangaroo Management Questionnaire

4.1 Human Dimensions Research and Urban Wildlife Conflict

Whilst sympatry between humans and wildlife may lead to interactions that are either positive or negative, wildlife management is frequently focused on resolving conflicts associated with the latter. Researchers have reported a diverse range of scenarios involving real and perceived problems resulting from close associations between people and wildlife from around the world (Table 4.1).

Table 4.1: International examples of human-wildlife conflicts.

Continent	Wildlife species in conflict with humans	Reference
Africa	Elephants; Colobus monkeys	Thouless, 1994; Siex & Struhsaker, 1999
Asia	Sloth bears; Sun bears	Rajpurohit & Krausman, 2000; Fredriksson, 2005
Australia	Brush turkeys; Torresian crows; Magpies	Jones & Everding, 1991; Jones & Everding 1994; Jones & Thomas, 1998
Europe	Lynx; Wolverine; Brown bear; Wolves	Kaltenborn <i>et al.</i> 1999
Nth America	Prairie dogs; Canada geese; White-tail deer	Zinn & Andelt, 1999; Coluccy <i>et al.</i> , 2001; Chase <i>et al.</i> 1999
Sth America	Andean bears	Goldstein, 2002

This global phenomenon of human-wildlife conflict is also increasing in frequency and severity (Madden, 2004; Raik *et al.*, 2005) as the human population, and associated development, continues to expand. Consequently, many conflicts arise within urban areas, particularly at the interface between the urban matrix and agricultural or “natural” areas (Manfredo & Doyer, 2004).

Although the animal species involved in particular conflicts with people may be unique, strong parallels exist between many international scenarios due to the underlying reasons for conflict, e.g. competition between humans and wildlife for habitat or food. Managing such conflicts can be difficult in any environment but problems may be further heightened in urban areas (Jones & Thomas, 1999). This is because stakeholders, often with diverse and potentially conflicting views of management (Lee & Miller, 2003), are found in close proximity to the site of conflict, thereby intensifying pressure on managers.

Because managing diverse stakeholder attitudes can be especially problematic (Jones & Thomas, 1998) international researchers have increasingly attempted to understand the perspectives of urban residents in conflict with wildlife (Decker & Enck, 1996). Whilst such

efforts have become common in North America, little similar research has been undertaken in Australia.

Jones and his colleagues have provided rare examples of Australian studies that make the transition from recognising the impact of diverse public opinion (Jones & Everding, 1991) to actively seeking to understand attitudes and preferences regarding urban-wildlife ecology and management (Thomas & Jones, 1997). Through that work on Australian Brush Turkeys, as well as other scenarios involving Torresian Crows (Jones & Everding, 1994) and Australian Magpies (Jones & Thomas, 1998), diverse opinions were revealed among community members and levels of acceptance for a variety of management alternatives were also established.

Such outcomes align well with key aspects of Decker & Chase's (1997) generalised model for meeting the management "challenge" of the human dimensions of living with wildlife. Specifically, by working with community participants, Jones and his co-workers have involved stakeholders in evaluating management action and demonstrated the potential for using similar information in ongoing management efforts.

4.1.1 The human dimensions of peri-urban kangaroo management

Many Australians are amused by overseas visitors' expectations of ubiquitous kangaroos, hopping down the streets of our cities and towns or living in house yards. However, there are urban areas where kangaroos can be commonly found. In Canberra, the nation's capital, together with an apparently increasing number of towns along Australia's east coast, kangaroos can be regularly found within the urban matrix, rather than restricted to rural lands and other "wild places" where they are most common.

Kangaroos in urban areas can be problematic, especially from the perspective of collisions with motor-vehicles. Indeed, kangaroos are responsible for more collisions with vehicles than any other Australian wildlife, accounting for more than three-quarters of the 11,000 claims made annually against our biggest motor insurer (NRMA, 2003 online). Not surprisingly, most urban kangaroo management to date has focussed on this aspect of the animals' interactions with humans.

Other issues relating to humans living in close proximity to these well known marsupials have received relatively little attention but, in 1996, reports of an attack on a teenage boy by an Eastern Grey Kangaroo piqued Australian and international interest regarding human-kangaroo interactions. The incident occurred on a golf course situated at the rural-urban interface of South Grafton, a town in northern New South Wales. As a result of the animal's scratching, biting and kicking, the boy sustained injuries including a fractured eye-socket and deep lacerations.

Kangaroos, which are still common in the area, have long been an attraction for visitors to the Golf Club and also occur in adjacent agricultural land and nearby residential areas, where they graze on lawns, drink from urban water sources and rest in the shade of garden trees and shrubs.

Subsequent, similar incidents involving kangaroo aggression towards people have occurred in the area and although none have attracted equally widespread media attention as the 1996 "attack", they have nonetheless forced local staff of the NSW National Parks and Wildlife Service (NPWS) into action regarding the management of the animals in or near urban areas. These efforts have mainly focussed on incident-specific reactive management, such as attempting to identify and remove individual aggressive animals and allowing the Golf Club to reduce population levels (David Redman, personal communication).

Managers have attempted to prevent further problems by providing residents with pamphlets detailing how to live with urban kangaroos (Redman & Jarman, 1999) as well as via annual educational efforts in local schools. Despite the fact that such education has reinforced the low risk of kangaroo attacks, local concern about kangaroo aggression is evident, though not unanimous. Some residents are adamant that the animals should be reduced in number whilst others object to such notions and expect that residents, with or without the assistance of managers, should be able to live harmoniously with the local kangaroos.

In the face of public concern about the prospect of future kangaroo attacks, managers have been forced to consider whether anything else could or should be done to avert such incidents. Since the issue of kangaroo management in South Grafton directly addresses the environment in which local residents live, community perceptions of appropriate outcomes and which methods should be used to achieve them, are inherently tied to such questions. From a

research perspective this provided an ideal opportunity to work with the community to provide useful data for managers.

As mentioned above, residents live in close proximity to kangaroos in a number of communities. Several of these areas can be found close to South Grafton, on the Coffs Coast of NSW. The proximity of these communities to South Grafton and the absence of any reports of similar conflicts between people and kangaroos, prompted me to consider whether or not people in these areas had similar experiences with the animals compared to their South Grafton counterparts? Further, would they have similar expectations of how interactions with the animals should be managed?

4.1.2 Human-Kangaroo Interactions

As in previous Australian studies of urban interactions between humans and native wildlife (see Jones and Everding, 1991; 1994, Jones and Thomas, 1998), a range of positive and negative outcomes are possible when people interact with kangaroos.

It has previously been noted that “*where suitable habitat occurs close to, or within agricultural lands, Eastern Grey Kangaroo populations may thrive because of favourable habitat modification and reduction of predation.*” (Kangaroo Advisory Committee, 1997). However, the animals’ presence in such areas will only be problematic if their activities conflict with human interests. A variety of kangaroo activities may be perceived by people, as negative but few authors have considered these issues. Only attacks have received attention to date and this has been in the realm of media and popular reporting.

The following sections are included to provide some context for the urban interactions that may occur involving kangaroos and people.

Description

The Eastern Grey Kangaroo, *Macropus giganteus*, can be found throughout the eastern States of Australia, from the Pacific Coast to the inland plains (Poole, 1998). Like other large macropod species, Eastern Grey Kangaroos exhibit sexual dimorphism, with adult males often substantially larger than adult females. Whilst females grow to around 1.9 metres in

length, including the tail, males may reach 2.3 metres (Poole, 1998), and reach 95kg in mass while females rarely exceed 40kg (Redman & Jarman, 1999).

Occurring as individuals or in groups of varying size the animals typically graze during the period from afternoon, through the night, until morning. During the remaining daylight hours, kangaroos may be found resting, often in the shade of trees and shrubs (Poole, 1998).

Problematic use of urban resources

Whilst previous reports (K.A.C., 1997) have noted the potential benefit of urban kangaroos to humans, especially relating to pleasure derived from observing the animals, and the potential for negative impacts on the animals, e.g. harassment by dogs, or injury from collisions with cars, other outcomes are also possible. Kangaroos may benefit from close association with people, for example by sourcing food, water or refuge within urban areas. Conversely, use of such resources may frustrate people and present opportunities for conflict.

Kangaroos directly impact lawns by grazing, although many people may not see this as a serious problem as they tend not to shorten it to soil level. However, aesthetic damage to gardens may be caused by animals actively pulling clumps of grass from lawns or damaging shrubs and trees by play-fighting with foliage or rubbing against plants. In areas where this behaviour is common many residents feel obliged to protect their plants by fencing off individual plants or whole gardens.

Startled animals, e.g. those fleeing dogs, may hop through gardens at speed, causing damage not only to plants but to fences and other property. People living in kangaroo-inhabited communities have also reported washing being pulled off clothes-lines and the site manager of a retirement village reported animals kicking the gas-powered water-heaters installed on the outside of local residences, as well as striking and kicking at windows and glass doors (Barry Cook, personal communication).

Kangaroo aggression

Intra-specific aggression is well known among Eastern Grey Kangaroos. Southwell (1981) for example, described fighting between males and between females as well as both active and passive supplanting behaviour. Anecdotal reports of inter-specific aggression toward domestic dogs and dingoes are not uncommon, particularly among rural Australians, and descriptions of early hunts by European settlers refer to cornered kangaroos disembowelling canine pursuers (Hornadge, 1972).

Wright (1993) described the self-defence behaviour of a male Eastern Grey Kangaroo confronted by a dingo. Her observations of the kangaroo kicking at and hopping toward the dingo demonstrate the animal's preparedness to behave agonistically towards a perceived aggressor. In the same paper, Wright also described the use of water as a refuge by kangaroos. This behaviour in particular, gained widespread attention in 2004, when two separate incidents of domestic dogs being drowned by kangaroos were reported from the Australian Capital Territory (Colman, 2004).

"Attacks" on people by kangaroos

Obviously, aggressive interactions or "attacks" are an extreme example of negative impacts on people. Such attacks are not common but a review of media reports from the past 10 years suggests that the 1996 incident at the South Grafton golf course was not unique (Table 4.2).

Further, following a period of intense media interest in this project during early 2005, I was contacted by another dozen or so people from across the country who wanted to recount the details of their experiences with kangaroo aggression. Such information will be the subject of further research outside the scope of this thesis.

Table 4.2: Examples of reported inter-specific aggression by kangaroos, towards humans.

Year	Place	Victim	Reference
1996	South Grafton, NSW	Teenage boy	Jones, 2000
1999	South Grafton, NSW	Two children	NPWS, 2004
2000	Wattle Glen, Vic	Mother and son	The Daily Telegraph, 2000
2002a	Buderim, Qld	Woman	Webb, 2002
2002b	Lake Weyba, Qld	Man	Webb, 2002
2003	Monto, Qld	Man	Honeywill, 2003
2004a	Burpengary, Qld	Woman	Australian Associated Press, 2004
2004b	Gulmarrad, NSW	Boy	NPWS, 2004
2005a	Port Macquarie, NSW	Boy (toddler)	Sullivan, 2005
2005b	Port Macquarie, NSW	Woman	Sullivan, 2005

Using human dimensions research to benefit urban kangaroo management

State wildlife agencies that have previously shown an interest in human-kangaroo interactions have focused on different aspects of such scenarios but acted consistently in their attempts to find a solution through “educating” the public.

Environment ACT, for example, targeted a reduction in accidents between kangaroos and motor-vehicles through their “*Give Kangaroos a Brake: Slow Down*” (2004), as part of their urban wildlife program. Similarly, after 2 incidents where kangaroos drowned domestic dogs in 2004, Environment ACT advised people about the potential for kangaroos to be aggressive, particularly when threatened by the presence of humans or their pets (Murray Evans, personal communication).

The Queensland Parks and Wildlife Service provides information on their departmental website about interacting safely with kangaroos (Queensland Parks & Wildlife Service, 2005 online). Similarly, NSW National Parks and Wildlife Service (NPWS) have used media releases to warn resident about the potential for aggression between people and kangaroos (NPWS, 2002; 2004) and, as described earlier, an educational brochure (Redman & Jarman, 1999) has been distributed in some communities where there is potential for negative interaction between people and the animals.

Whilst the A.C.T. Kangaroo Advisory Committee (KAC) advocated adaptive kangaroo management that incorporates community input (KAC 1997) there have been no specific attempts to establish what the public preferences are for interactions with kangaroos or exactly what actions residents either expect or will accept from managers. Other than a community meeting held by NPWS in South Grafton following the 1996 attack, resident involvement in management of urban kangaroos has typically been limited. Usually only the “victim” of the attack, or their immediate family, has had any direct involvement with regard to management and this has typically relied on reactive measures such as attempting to identify and kill responsible animals or by generally reducing local populations following attacks.

4.1.3 Aims

As in my previous Wild horse and Flying-fox projects, I wanted to use this case study to test whether it was possible to provide managers with a sense of the public’s views on kangaroos since doing so seemed likely to aid management efforts by removing some of the “guess-work”, that is otherwise inherent in assumptions about how particular scenarios should be appropriately dealt with.

I hoped to evaluate the potential for Human Dimensions Research to be utilised by managers of peri-urban kangaroo scenarios. To do this, I intended to identify some of the problems that local managers face in deciding how to manage peri-urban kangaroo issues, then undertake a targeted examination of communities where residents live in close proximity to kangaroos, to better understand relevant experiences and management preferences.

A useful relationship between wildlife values and kangaroo management preferences?

Rokeach (1973) defined the concept of a value as “*an enduring belief that a specific mode of conduct or end-state of existence is personally or socially preferable*”. Although such values are not the sole determinant of attitudes towards wildlife, since knowledge, perceptions of individual species and the relationship that exists between people and wildlife also contribute to these (Kellert, 1996), values are at the basis of the cognitive hierarchy that culminates in people’s behaviours (Fulton *et al.*, 1996).

Kellert (1996) described a taxonomy of value categories among the American public that has long been used as the basis of a variety of studies of wildlife-related values and attitudes around the world (e.g. Kellert 1993; Miller, 2000). During the Flying-fox and Wild-horse case studies it seemed to me that Kellert’s values were evident among respondents, particularly from the additional comments provided on the back of questionnaires. Moreover, it appeared that associations existed between value orientations and particular management preferences. This prompted me to consider the practical worth of values-research for managers and whether it might be possible to make predictions about the acceptance of management strategies within particular communities based on the general values held by residents, rather than their specific reactions to proposed management.

Attempting this also seemed to have potential for bridging the gap between the problem-focussed approach that I had taken within this thesis and the more generalised, theoretical approach of other Australian Human Dimensions research, e.g. Miller (2000).

Whilst Miller (2000) demonstrated that managers may have inaccurate perceptions of public values regarding wildlife and rightly suggested that such inaccuracies may negatively impact upon wildlife management programs, I hoped that I might be able to provide managers with a tool to make accurate predictions about acceptable management for urban kangaroos. I wanted to see whether it might be possible to use rapid assessment of values to tailor the management approach used in specific community locations, by identifying relationships between the values held by participants and their management preferences for urban kangaroos.

Professor Stephen Kellert kindly allowed me access to his original values questionnaires to use as the basis of my attempt at assessing values. Consequently, I followed a similar

approach and attempted to define a series of questions that would identify values among participants. My first attempt was piloted on a group of undergraduate students from the Bachelor of Rural Science and Bachelor of Natural Resource Management degrees at the University of New England. Using this information to refine the scale I then applied the questionnaire to approximately 150 college residents from mixed degrees and backgrounds.

Kellert (1996) presented a typology of nine basic values: Aesthetic; Dominionistic; Ecologistic-Scientific; Humanistic; Moralistic; Symbolic; Negativistic; Utilitarian; and Naturalistic. My scales, unfortunately, only clearly identified two groups corresponding to those from Kellert's typology, i.e. naturalistic and ecologistic. The overwhelming majority of pilot participants identified with these two groups.

Ultimately, I was forced to accept that I did not have sufficient time to develop an appropriate values-scale for use in the kangaroo case study. However, interest from managers I dealt with in this case study regarding the potential for such an application of values information suggest that it could be worth revisiting in the future.

4.2 Methods

4.2.1 Study Area

Location

South Grafton and the other 5 communities of interest are distributed along a 250km stretch of the New South Wales North-Eastern Coast (Figure 4.1).

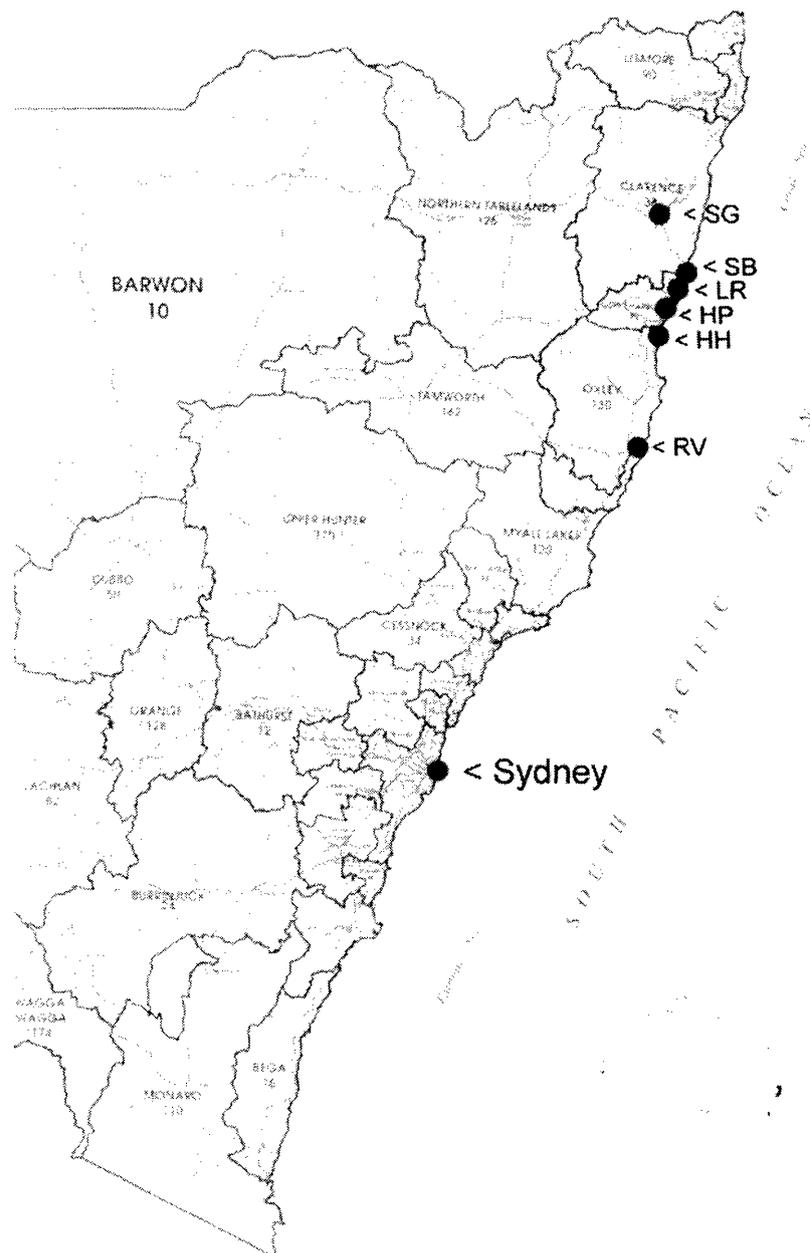


Figure 4.1: A map of the east coast of NSW (Australia inset) showing locations of the six communities of interest. (Original map State Electoral Office, 2003 online).

Study site selection

The six sites were chosen because they are communities where kangaroos can regularly be found within residential areas. Four of the sites, i.e. Safety Beach, Lake Russell, Heritage Park and Hungry Head, are satellite communities associated with larger urban centres of Woolgoolga and Coffs Harbour. This region of NSW has, in recent years, become known as the Coffs Coast.

The remaining two communities, the Retreat Village and South Grafton, are areas at the rural-urban interface of Port Macquarie and Grafton respectively. Unlike the other five communities, which are adjacent to the coast, South Grafton is situated approximately 40km inland.

South Grafton (SG): The residences sampled in this area were a targeted subset of the entire community. Streets selected for inclusion were those adjacent to areas of communal green-space, such as the South Grafton Golf Course and nearby agricultural land. In total, this area comprised 233 houses at the time of sampling.

Safety Beach (SB): Safety Beach occupies a narrow strip of land between the Pacific Ocean and the Pacific Highway. To the north the community is bounded by a golf course and to the south by remnant coastal vegetation. At the time of sampling there were 232 houses at Safety Beach.

Lake Russell (LR): Located on the western side of the Pacific Highway, this community surrounds large wetlands and extends into the nearby, wooded hills. As in Heritage Park, block sizes are much larger than those of the other four communities, with many greater than a hectare in size. Lake Russell is immediately north of Heritage Park with a planned, but as yet undeveloped, road connecting them. Lake Russell had 116 residences when sampled.

Heritage Park (HP): As stated above, Heritage Park is characterised by large block sizes. Like the majority of Lake Russell, Heritage Park has considerable space between houses. Most blocks have retained some of the original trees, but the understorey has been replaced with lawns. Several have their own dams and many yards are unfenced. A total of 93 residences were present at the time of this research.

Hungry Head (HH): The Hungry Head sample comprised the two small, adjacent communities of Wollumbin Drive and Osprey Drive. Osprey Drive is a mixture of residences interspersed among Macadamia Nut plantations and surrounding coastal forest. Wollumbin Drive is similarly surrounded by forest but is a residential area only. In total, just 51 residences are found in this area.

The Retreat Village (RV): This retirement community is situated on the western, expanding edge of Port Macquarie. All residents are over 50 years of age. It is bordered by wetlands on one side which overlap into the Village, providing some small ponds, surrounded by lawns. On another side, the Retreat Village is adjacent to, but fenced from, residential housing. The community is currently being extended, through further development of adjacent agricultural land. Very small block sizes characterise the community. Most residences closely approach the kerbside so few have front yards whilst backyards, other than those bordering nearby residential areas, are unfenced, creating corridors of shared lawn throughout the community. In total, 195 residences were present at the time of sampling.

4.2.2 Sampling community issues and opinions

Initially, only South Grafton and the four Coffs Coast sites were included in the project. Data was gathered from these communities using the methods described below during 2004. However, in May 2005, Professor Peter Jarman, my supervisor, was contacted by Amanda Smith from the Department of Environment and Conservation about negative interactions between humans and kangaroos in the Retreat Village. Following discussions about the area, I initially intended only to visit the area to record accounts of interspecific aggression. However, it became clear that this sixth site might be opportunistically included in the study and add to the comparison of responses between communities.

Meeting with the Coffs Coast and South Grafton communities

To scope residents' opinions on issues that were locally important in kangaroo management, as well as to establish a profile for this study within the local communities, I held community meetings.

Following the disappointing attendance at meetings during the Flying-fox case study, I used both a press-release, sent to local media sources, and generic invitations placed in mail-boxes throughout the study areas to encourage attendance at proposed meetings.

Where it was not possible to hold the meeting within the bounds of the local community, I selected a venue as close as possible. Meeting venues included a local bed-and-breakfast at Hungry Head, the Woolgoolga Ex-services Club (for Safety Beach Residents), the Moonee Beach Hall (for people from Heritage Park and Lake Russell), and the South Grafton Golf Club.

Small groups of people, between 5 and approximately 20 individuals, attended each meeting, other than at South Grafton, where no-one attended. Fortunately, I received several phone calls from interested Grafton residents who could not attend so these were used, in conjunction with information from NPWS staff, to gather information about local issues.

The Retreat Village Meeting

Advertising for the Retreat Village meeting was quite different to that in the other areas. I supplied posters to the community's Social Committee, who placed them on relevant noticeboards throughout the area. Further, the Retreat Village has a centrally located Hall at which the meeting was held. Approximately 120 residents attended.

Questionnaires

Managers' input

Before undertaking the development of the questionnaires, I met with David Redman, from DEC in Grafton, and Mark Graham, from Coffs Harbour City Council to discuss the proposed project and to offer them an opportunity to suggest questions or topics that they felt might provide valuable information. David, in particular, has had extensive experience managing interactions between people and kangaroos in the Grafton area and offered to review the questionnaires before I distributed them to the public. Likewise, I discussed issues relevant to the Port Macquarie scenario with Amanda Smith, a local staff member from DEC, and with Mr Barry Cook, the site manager at the Retreat Village.

Specifically, managers wanted to know the following:

- What expectations the community had in terms of how kangaroo issues are dealt with?
- What preference does the community have for managing aggressive kangaroos?
- Are interactions with kangaroos are important to the community?, and
- Are education efforts about living with kangaroos having a worthwhile impact?

Community meeting procedures

At all meetings, I used a series of questions to prompt discussions. These were focussed upon the following issues, whilst being mindful of the specific issues which managers were most interested in (above):

- people's background in the local area,
- experience with kangaroos, including frequency and perception of interactions
- the importance attendees placed on local kangaroos,
- awareness of any kangaroo-related management undertaken in the area and opinions of it,
- their hopes for the future with regard to kangaroos in the local area

Attendees were generally extremely forthcoming and it was necessary only for me to guide discussion gently to ensure that the above issues were explored in detail.

I attempted to keep the Coffs Coast meetings as casual as possible, which lead to the discussions being quite conversational in nature. Generally, opinions were divulged in association with anecdotes, providing insight into the range of opinions and experiences that occur within these areas. At the Retreat Village, however, the meeting was more structured in an attempt to facilitate as many people as possible having useful input. Compared to the Coffs Coast meetings, I generally gave speakers shorter amounts of time to make their point and looked for indications of support or disagreement from the crowd of very vocal attendees.

Meeting outcomes

The information gathered from the community meetings and interviews with Grafton residents is summarised below.

Firstly, the frequency of contact between residents of the communities and kangaroos appeared to be generally high, ranging between seeing the animals daily to fortnightly. Similarly, for some people, contact occurred in their house-yards whilst other reported the animals never visit their homes, and instead, they observe them in other parts of the local area.

All participants indicated that kangaroos lived in their local areas, prior to their own decision to move there. No group, however, uniformly agreed on whether the population of local kangaroos was increasing or decreasing in size. Some claimed that drought had resulted in more frequent use of the areas whilst others disagreed and suggested numbers had actually decreased due to local development and loss of connectivity of habitat.

A minority of attendees were concerned about conflict between people and kangaroos in each area, although support for this notion was highest among Retreat Village participants. Some people were specifically concerned about the danger posed by kangaroos in their yards but most were satisfied that they could recognise when it was safe to approach the animals and when it was not.

Consequently, many attendees reported very close interaction with kangaroos, e.g. coming within 2 metres of animals or even closer, on a regular basis. Such anecdotes included stories of kangaroos lying contentedly nearby as people tended to their gardens, washed cars or hung laundry. Others told how they feed bread to the animals and one fellow related how he hoses down kangaroos on particularly hot summer days. Many of these people seemed to believe they were immune to the risk of conflict due to the relationship they had with the animals or that their ability to judge when it was appropriate to approach them allowed them to avoid conflict. Others, however, were cautious about being so close to “wild animals”.

Generally, attendees were more concerned about aggression towards people by male kangaroos rather than females, although many believed both could be dangerous. One woman, from Hungry Head, reinforced the point that female kangaroos can be aggressive by telling of an attack on her son, who walked between a female and her young. Interestingly, she was not opposed to the presence of kangaroos but, rather, was in favour of them remaining. Likewise, she expressed regret at the decision of wildlife managers to euthanase the animal.

Other people, however, were less accepting of such behaviour and several indicated a belief that aggressive kangaroos should be killed. By comparison, there was much more support for relocating aggressive animals although few people seemed to understand the time, effort or risk likely to be involved in such management.

Although aggression was a concern for a considerable number of people at the Retreat Village meeting, attendees at the Coffs Coast meetings were more interested in negative interactions involving traffic or dogs. In keeping with the general interest in preserving their local kangaroo populations many residents were interested in ways in which the threat of vehicle collisions with kangaroos could be reduced. Suggestions included signage, reduced speed zones, increased lighting, barriers to keep wildlife off roads and speed mitigation devices (e.g. speed humps).

In the Retreat Village car collisions with kangaroos were less of a concern than kangaroos hitting cars. The 10km per hour speed limit, residents believed, gave them ample time to see kangaroos but they worried that startled animals could flee onto roads and hit cars.

Each Coffs Coast community and an interviewee from Grafton mentioned incidents of conflict between dogs and kangaroos. People reported injuries and death for both dogs and kangaroos as a result. Attendees generally blamed the dogs' owners for these problems and from Hungry Head and Safety Beach, in particular, there was a significant degree of frustration evident regarding free-roaming dogs. Again, the Retreat Village participants were much less concerned about this issue as only a very small number of residents have dogs and they are confined to owner's residences.

Fences were a frequently suggested method for controlling pets; however, participants were divided on their use in the various communities. Some were generally opposed to them as they limited the movement of wildlife through their local area but others, particularly a group from the Retreat Village were strongly in favour of fencing kangaroos out of their residential area completely.

Many people indicated they had their own ways of managing interactions with kangaroos, such as encouraging dogs to bark at kangaroos so they will not enter yards. Other people spoke of modifying the habitat in their garden to increase or decrease the attractiveness of the

area for kangaroos. For example, a couple from the Retreat Village reported using a commercial wildlife repellent on their lawn and strongly believed it was effective. Another fellow, whose wife was frightened of kangaroos, had removed a bird bath from his garden to reduce, but not eliminate, use of his property by the animals. Likewise it was common for people to describe building small fences around young plants or placing stakes amongst foliage to reduce damage by kangaroos who wanted to “play with” vegetation.

Generally, attendees told how information about managing interactions with kangaroos was shared amongst residents. For many people this seemed to be a preferred way of managing, rather than having external bodies heavily involved. Most attendees agreed that there was a role for managers and/or local government to play in educating new residents and visitors about appropriate ways to interact with kangaroos but did not want a strong bureaucratic involvement in their community. Although people from the other areas generally believed they were sufficiently informed about kangaroos, either through experience or peer-education, people at the Retreat Village meeting almost unanimously agreed they needed more information from managers about how to safely interact with kangaroos.

Designing questions for the Kangaroo Management Survey

Background information about residents' contact with kangaroos

Q1: How often do you see live kangaroos?

This was asked to provide a simple measure of the frequency of contact that individual respondents, and the various communities generally, have with kangaroos.

Q2: Where do you see kangaroos?

One of the potentially important points of difference in experience between residents was where they encountered kangaroos. This was considered relevant because it is conceivable that people who see kangaroos in their yard might have different views, or concerns, than people who see them only in nearby parks, undeveloped land or paddocks given the reduced likelihood of contact with the animals.

Q3: If you see kangaroos in your yard, do they do any of the following?

As in Q2, I was interested in similarities/differences within communities regarding kangaroos' use of house-yards. In this case, knowing what kangaroos do in people's yards might give managers insights into ways in which the environment could be manipulated to promote or deter the animals.

Q4: Which of the following kangaroos do you see?

Feedback from meetings suggested that residents differed in levels of concern regarding male and female kangaroos. Consequently, I was interested to see whether male or female kangaroos were observed most frequently by respondents.

Q5: How long ago did you move to this address?

Some of the long-term residents from the communities believed that newer residents held different opinions of the local wildlife, particularly kangaroos. I asked this question to determine whether there was a relationship between length of time respondents had lived in the areas and specific views of kangaroos or preferences for management.

Q6: Did you know there were kangaroos in the area before you moved there?

Aside from determining whether people generally knew they moving to an area with resident kangaroos, I was interested to see whether or not pre-existing knowledge of kangaroos' presence in the area was associated with specific responses.

Q7: Since you moved to your present address, have the numbers of kangaroos in your area...? The variability of people's views on this issue during meetings prompted my interest in whether or not a larger sample would reveal a clearer trend. I was also interested to see if there was an association between responses to this question and the length of time people had lived in the area.

Q8: If you knew then, (when you moved to your current address) what you know now, about living with kangaroos, would you still have moved in?

This was offered to see whether interactions with kangaroos were a sufficient problem for people to have wished they had not moved to the area.

Q9: How do you feel about the following statement? "It is important to me to have kangaroos in my local area"

Using a five-point response scale, from strongly agree to strongly disagree, I hoped this item would allow a comparison both within and between groups, regarding views about the animals. Rather than asking whether people liked the animals or not this was designed to provide a general indication for managers about how the local population valued the animals.

Q10: Which of the following scenarios would you prefer to see in your local area?

(Free-roaming kangaroos, kangaroos but not in house yards, kangaroos but not on roads, No kangaroos at all)

This question allowed respondents to indicate their ideal local scenario involving kangaroos. I hoped responses would provide an indication of the difference, if any, between what respondents want and what they currently have.

Q11: If you have a dog, or dogs, are they...?

Because dogs were identified by many meeting attendees as a significant problem for kangaroos, this question was asked to identify which respondents were dog owners and to

provide an indication of the extent to which local dogs are restrained. Further, it was also included to see whether dog ownership was related to specific attitudes about management.

Q12: If you have a dog, or dogs, do they...?

Aside from seeing whether respondents would admit to their dogs chasing kangaroos, I was interested to obtain an indication of the proportion of local dogs that might be involved in chasing kangaroos in each community as well as how aware people were of others' dogs chasing kangaroos.

Q13: Are you concerned that dogs, in your area, interact in a negative way with kangaroos?

This question was included to provide an indication of the level of concern, within each community, about dogs chasing kangaroos.

Q14: Do you think restrictions should be placed upon the dogs, or on the kangaroos to stop this?

This was a straight-forward assessment of people's preference for where control should be directed.

Q15: Are you concerned about the prospect of vehicle accidents with kangaroos in your area?

As in Q13, I wanted to know if respondents were concerned about this issue and whether concern varied between communities.

Q16: Have you ever hit a kangaroo in your car, in the local area?

Motor-vehicle accidents were a concern for some residents, both from the perspective of danger to humans and the welfare of kangaroos. Through this question I sought to gauge the relative incidence of such accidents among residents of the various communities.

Q17: Which of the following would you prefer to minimise traffic accidents with kangaroos?

Meetings revealed that selecting options to reduce motor-vehicle collisions with kangaroos might be particularly difficult. In response to this question, participants could express their preferences from among the options suggested by meeting attendees.

Q18: In community meetings, some residents suggested that people could do more to live in harmony with wildlife in the local area. Would you agree with any of the following...?

As stated by meeting participants stated, kangaroos are just one of the wildlife species present in these communities, albeit the most noticeable and most likely to provoke conflict between managers and residents. As in Q17, this was included to see which options, if any, respondents preferred, particularly for the purpose of informing future land-use planning in the local area

Q19: Are you concerned about the potential for conflict between people and kangaroos in your local area?

Understanding whether residents are concerned about the prospect of negative interactions between people and kangaroos was thought to be important, if only as an indication of the communities that require interaction with managers. Communities that are particularly concerned about conflict with kangaroos might require more immediate attention from managers than others where residents are less concerned.

Q20: Which of these scenarios are you most concerned about in your local area?

To determine the relative importance of residents' concern about kangaroo attacks this question provided respondents with a set of associated statements that drew upon issues raised at the community meetings. Participants were asked to choose one of three options from each of the following.

- Kangaroo attacks or dog attacks or neither
- Kangaroo attacks or snake bites or neither
- Kangaroo attacks or magpie attacks or neither
- Kangaroo attacks or road accidents or neither
- Kangaroo attacks or people hurting wildlife or neither

Q21: Which are you most concerned about in terms of aggression towards people?

I included this question because I thought information about people's perceptions of relative danger posed by each gender of kangaroo might provide a basis for better educating residents to avoid negative interactions in the future.

Q22: If you were attacked by a kangaroo, what do you think you would do?

Previous education, by managers, in some of these communities had focussed on what to do if residents were attacked by a kangaroo. I was interested to see whether respondents who had

received such information would reply differently to those who had not. The “correct” response, based on information provided to residents by NPWS, was “curl into a ball”.

Q23: If a kangaroo has been aggressive towards people should it...?

This issue was of particular interest for NPWS managers in Grafton and Port Macquarie because they believed knowing which methods of management the community preferred would provide them with the best chance to avoid conflict with residents.

Q24: If kangaroos are culled to reduce the population size, is it important to you that they be used for something, e.g. pet food or leather?

Because some participants at meetings expressed a belief that it was a waste to just shoot kangaroos, I decided to ask people if they believed culled kangaroos should be used for something.

Q25: If you or a family member were attacked by a kangaroo, what would you do?

It was interesting, in meetings, to see that residents were divided in terms of those who would seek assistance from some kind of authority or agency and those who would not. Further, I hoped to see who people would call if they were attacked and whether choices varied between communities.

Q26: Are you concerned about kangaroos as a disease risk, for humans, in your area?

I was surprised by the claim from a Hungry Head resident that he had caught Q-fever from collecting and removing the kangaroo faeces from his yard. He was adamant this was the case and that his General Practitioner had confirmed this was how he had most likely contracted the disease. Soon after the Hungry Head meeting I became aware of similar, unsubstantiated claims being made by a Roads and Traffic Authority worker who believed he had contracted Q-fever through contact with the carcass of an infected kangaroo. As a result I included this question to see whether any respondents in these communities, where kangaroos are commonly found, held concerns that the animals were a risk to people because they carried disease.

Q27: Have you received any information, e.g. a leaflet from wildlife managers, about how to live with kangaroos in your area?

To facilitate an examination of the effectiveness of managers' previous education efforts, I asked participants whether they had received any information about how to live with the local kangaroos.

Q28: Should people who move into an area with wildlife, such as kangaroos, be provided with information on how to best live with these animals?

As stated in my summary of meeting outcomes, attendees were keen for new residents to be given information about how to live with kangaroos, for the benefit of the residents or the animals. This question was included to see how widespread this belief was among participants.

Q29A: Gender of respondents, Q29B: Education, Q29C: Background

These questions, as used in the wild horse and flying-fox questionnaires, were included to provide a measure of similarity between respondents and options for exploring trends among responses to the other questions.

Q29D: Value Types

Although I had not been able to develop an effective scale for determining respondents' values, I included this question to see whether respondents identified with any simple descriptions of the wildlife values identified by Kellert (1976).

Questions asked only of the Retreat Village Respondents

Retreat Village Q10: How do you feel about the following statement? "*The kangaroos should be allowed to remain within the bounds of the Retreat Village*".

This direct question was asked to provide the site managers with a clearer idea of what residents wanted.

Retreat Village Q16: Have nearby kangaroos ever made you feel uncomfortable about stepping out of your house?

One of the earliest issues raised with me about the interactions between people and kangaroos in the Retreat Village was that some people did not feel safe about leaving their homes. This had not been raised by residents of the other five communities. I wanted to determine how widespread this issue was.

Retreat Village Q22: Who do you feel should be responsible for ensuring that people and kangaroos do not come into conflict in your community?

One of the conflicts in the Retreat Village scenario was based around who should be responsible for managing the kangaroos, with opinion divided mainly between NPWS and the site manager.

Additional Comments

As per the wild horse and flying-fox case studies, participants were invited to write additional comments on the back of the kangaroo questionnaires.

4.2.3 Questionnaire Distribution and Non-respondent Interviews

Sampling was undertaken using an approach modified from Dillman (2000). Each residence* within the communities of interest that had a mailbox was provided with a summary of outcomes from the community meetings, a copy of the Kangaroo Management Questionnaire (Appendix C) and a postage-paid envelope for its return. Reply-paid envelopes carried a code that corresponded to the specific residence they were delivered to.

One fortnight after the initial round of questionnaires were distributed, a reminder letter, second copy of the questionnaire and another pre-paid, return-addressed envelope were delivered to residences from which no reply had been received.

One month after the initial round was delivered, I visited each non-responding residence to conduct a brief interview of non-respondents. If no-one was home, I left a non-response survey, with a letter requesting their assistance and a third envelope for the survey's return.

* In South Grafton, only residences in streets adjacent to area of communal green space, such as the local golf course or undeveloped agricultural lands were contacted.

Statistical Analyses

Using the software program Statistix, Chi-square tests were used to compare the observed frequencies of responses between communities. “No response” counts were not included in analyses. Significant differences were accepted for $P < 0.05$.

Feedback for communities

South Grafton and Coffs Coast respondents received a summary of results (Appendix D) from selected questions. Retreat Village results were provided to the community Social Committee for distribution among residents. Feedback was provided to give residents a sense of how their personal views related to those of their peers and with those of other communities. Further, I felt it was important to demonstrate to these people that the data they provided was actually used for something and to keep lines of communication open regarding the issue of kangaroo management.

4.3 Results

4.3.1 Response rates

Considerable variation was evident between communities' response rates for the Kangaroo Management Questionnaire (Table 4.3). Whilst proportionally the South Grafton response was smallest, at 43%, the Retreat Village had the greatest response rate, with 71% of households returning a completed questionnaire. Other community's response rates ranged between 49% and 59%

Table 4.3: A summary of response rates

Community	Response rate
Hungry Head	57%
Heritage Park	57%
Lake Russell	49%
Safety Beach	59%
South Grafton	43%
Retreat Village	71%

Two-by-two table comparisons revealed significant differences in the proportions of respondents between South Grafton and the Retreat Village (Yate's corrected $\chi^2 = 12.92$, P-value = 0.0003, DF = 1). Differences between all other possible combinations of communities were not significant (all P-values > 0.05).

4.3.2 Results of Individual Questions

Q1: How often do you see live kangaroos?

More than 86% of respondents from each community saw kangaroos daily (Table 4.4).

To avoid excessively low cell values, responses were combined within communities to form two categories of "daily" and "less than daily" for Chi-square comparisons. Significant differences were observed between communities ($\chi^2 = 20.73$, P-value = 0.0009, DF = 5).

Table 4.4: Responses to Q1: “How often do you see live kangaroos?”

	HH	HP	LR	SB	SG	RV
Daily	100%	100%	91%	86%	97%	86%
Weekly	0%	0%	9%	11%	3%	12%
Fortnightly	0%	0%	0%	1%	0%	1%
Monthly	0%	0%	0%	0%	0%	0%
Six Monthly	0%	0%	0%	0%	0%	1%
Never	0%	0%	0%	0%	0%	0%
No response	0%	0%	0%	1%	0%	0%

Q2: Where do you see kangaroos?

Responses to this question were generally consistent between communities although Retreat Village respondents were much less likely to report seeing kangaroos in yards on their street than those from the other communities (Table 4.5).

Respondents from Safety Beach, South Grafton and Retreat Village indicated that they were less likely to see kangaroos in their own yard than elsewhere in their local area, such as other yards on their street, or in the case of the Retreat Village, in communal areas. Quite differently, Hungry Head, Heritage Park and Lake Russel respondents were most likely to see kangaroos in their yard.

Table 4.5: Responses to Q2: “Where do you see kangaroos?”

	HH	HP	LR	SB	SG	RV
My yard	100%	94%	96%	74%	75%	78%
Yards on my street	79%	75%	75%	85%	80%	60%
Yards on nearby streets	72%	68%	66%	74%	59%	52%
Local Parks	31%	6%	11%	23%	37%	NA
Vacant Blocks	76%	70%	68%	90%	86%	NA
Undeveloped land/paddocks	86%	64%	77%	82%	88%	NA
No response	0%	0%	0%	1%	0%	1%
Communal areas within the Retreat Village (RV only)						92%

Due to differences in offered response options, the Retreat Village was not included in this comparison. However, the pattern of Retreat Village responses most closely resembled that of South Grafton. No significant differences were observed between the five other communities ($\chi^2 = 30.98$, P-value = 0.0555, DF = 20).

Q3: If you see kangaroos in your yard, do they do any of the following?

Only the responses of participants, who indicated that they see kangaroos in their yard (Q2), were included in this analysis.

Almost all respondents who reported seeing the animals in their yards reported that they ate lawn grass (Table 4.6). However, selection of other response options varied considerably. For example, the reported incidence of kangaroos eating plants other than grass ranged between 4% in Safety Beach, to more than half of respondents from Hungry Head.

Table 4.6: Responses to Q3: “If you see kangaroos in your yard, do they do any of the following?”

	HH	HP	LR	SB	SG	RV
Eat lawn grass	100%	98%	94%	96%	97%	100%
Eat other garden plants	52%	14%	41%	4%	28%	19%
Drink water	59%	47%	50%	12%	23%	19%
Rest or lay about	86%	88%	89%	69%	68%	95%
None of these	0%	0%	2%	3%	1%	NA
No response	0%	0%	2%	10%	3%	1%

Chi-squared analysis revealed significant differences ($\chi^2 = 58.22$, P-value = 0.0000, DF = 20) amongst the other 5 communities. With Safety Beach removed, no significant differences were found between the other groups ($\chi^2 = 11.68$, P-value = 0.3069, DF = 10).

Q4: Which of the following kangaroos do you see?

More than three quarters of each group reported seeing “All of these at different times” (Table 4.7).

Table 4.7: Responses to Q4: “Which of the following kangaroos do you see?”

	HH	HP	LR	SB	SG	RV
Male and female kangaroos	7%	15%	18%	14%	12%	23%
Single males	3%	4%	5%	4%	6%	1%
Single females with young	3%	11%	7%	8%	5%	13%
All of these at different times	93%	83%	80%	81%	85%	76%
No response	0%	0%	0%	0%	2%	0%

No significant differences were observed between the responses from each community, ($\chi^2 = 19.05$, $P = 0.2115$ and $DF = 15$).

Q5: How long ago did you move to this address?

On average, Safety Beach residents had lived in their area the longest, whilst Heritage Park had most recently moved to their present address (Table 4.8).

Table 4.8: A summary of responses to Q5: “How long ago did you move to this address?”.

	HH	HP	LR	SB	SG	RV
Mean (yrs)	7.28	2.41	9.29	10.08	7.14	4.39
St dev	5.41	1.54	9.46	8.17	6.98	3.20
Maximum (yrs)	26	7	30	35	40	13

Because the data from South Grafton was found to be non-normally distributed (Wilk-Shapiro value < 0.85), a non-parametric, Kruskal-Wallis, One-way Analysis-of-Variance (ANOVA) was used to compare data between groups. Significant differences were found between the groups (K-W statistic = 67.31, P-value < 0.001). A comparison of mean ranks revealed where differences occurred (Table 4.9).

Table 4.9: Results of post-hoc comparison of mean ranks for data from Q5.

	HH	HP	LR	SB	SG	RV
HH	-	*	ns	ns	ns	ns
HP	*	-	*	*	*	ns
LR	ns	*	-	ns	ns	ns
SB	ns	*	ns	-	ns	*
SG	ns	*	ns	ns	-	*
RV	ns	ns	ns	*	*	-

* = significant difference between communities, ns = no significant difference.

Q6: Did you know there were kangaroos in your area before you moved there?

More than 70% of respondents from each community were aware of the presence of kangaroos in the area before they moved to their current address (Table 4.10). (N.B. Several respondents cited the presence of kangaroos as the main reason for moving to the area).

Table 4.10: Responses to Q6: “Did you know there were kangaroos in your area before you moved there?”

	HH	HP	LR	SB	SG	RV
Yes	97%	100%	89%	90%	83%	71%
No	3%	0%	11%	8%	12%	24%
I am unsure	0%	0%	0%	0%	5%	5%
No response	0%	0%	0%	2%	0%	1%

Significant differences were observed between the proportions of responses to this question, from each community ($\chi^2 = 42.8$, $P < 0.0001$ and $DF = 10$).

South Grafton and Retreat Village responses did not differ significantly ($\chi^2 = 5.17$, $P = 0.753$, $DF = 2$). When these were removed from the analysis, no significant differences were observed between the other four communities ($\chi^2 = 6.31$, $P = 0.0973$, $DF = 3$).

Q7: Since you moved to the area have kangaroo numbers...?

Belief about the trend in the local kangaroo population varied within each group of respondents (Table 4.11). In no case did a majority of respondents hold a particular belief, although exactly half of the South Grafton replies indicated an increase in kangaroo numbers. Generally, respondents were more likely to indicate an increase than a decrease and in all communities approximately a third, or more, felt numbers had “stayed about the same”.

Table 4.11: Responses to Q7: “Since you moved to the area have kangaroo numbers...?”

	HH	HP	LR	SB	SG	RV
Increased	45%	28%	38%	27%	50%	47%
Decreased	0%	19%	11%	22%	3%	6%
Stayed about the same	38%	47%	46%	38%	36%	32%
I am unsure	14%	6%	4%	12%	11%	14%
No response	3%	0%	2%	1%	0%	1%

Significant differences were observed between the communities ($\chi^2 = 50.05$, $P = 0.0000$, $DF = 15$).

Q8: If you knew then (when you moved to your address) what you know now, about kangaroos, would you have still moved there?

In each community, at least 95% of respondents replied ‘Yes’ to this question (Table 4.12). In fact, only 3 communities had any respondents who replied “No”.

Table 4.12: Responses to Q8: “If you knew then (when you moved to your address) what you know now, about kangaroos, would you have still moved there?”

	HH	HP	LR	SB	SG	RV
Yes	100%	96%	98%	98%	95%	86%
No	0%	2%	0%	0%	3%	6%
I am unsure	0%	2%	2%	1%	2%	8%
No response	0%	0%	0%	1%	0%	1%

Significant differences were observed between communities ($\chi^2 = 72.25$, $P < 0.0001$, $DF = 20$). Further comparisons showed that South Grafton and the Retreat Village did not differ significantly from each other ($\chi^2 = 4.80$, $P = 0.0905$, $DF = 2$). Similarly, no significant differences were observed between the other four communities ($\chi^2 = 5.19$, $P = 0.5202$, $DF = 6$).

Q9: How do you feel about the following statement? “It is important, to me, to have kangaroos in my local area.”

Unlike South Grafton, where less than half of the respondents agreed to any extent with the statement, all other areas displayed approximately 75% agreement (Table 4.13). Likewise, almost one fifth of South Grafton respondents indicated disagreement with the statement whilst in the other four communities the same type of response was observed in less than one-in-ten respondents.

Table 4.13: Responses to Question 9: “How do you feel about the following statement? It is important, to me, to have kangaroos in my local area.”

	HH	HP	LR	SB	SG	RV
I strongly agree	52%	53%	48%	52%	21%	25%
I agree	34%	21%	25%	29%	27%	26%
I neither agree nor disagree	7%	21%	18%	15%	33%	30%
I disagree	3%	4%	5%	1%	11%	13%
I strongly disagree	0%	2%	2%	1%	6%	6%
No response	3%	0%	2%	1%	2%	0%

To determine a score for each community, regarding their belief in the importance of local kangaroos, each response was converted to a value between 1 and 5 where: 1 = Strongly Agree; 2 = Agree; 3 = Neither agree nor disagree; 4 = Disagree; and 5 = Strongly disagree. Overall, each community was found to be positive regarding the importance of local kangaroos (Figure 4.2).

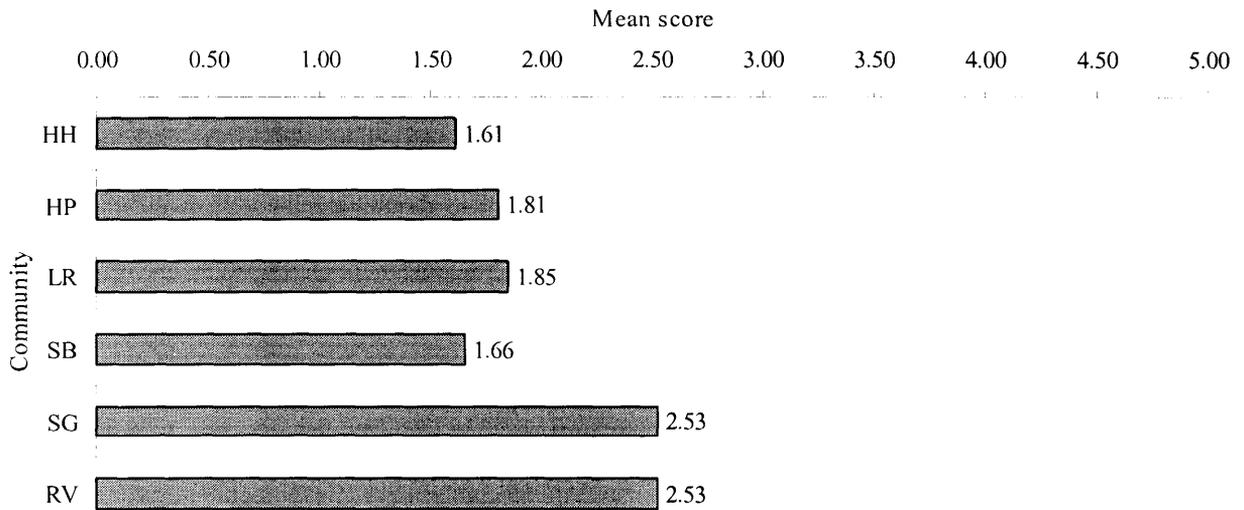


Figure 4.2: Mean scores of responses to Question 9, to each community.

Then, since the distributions of scores were found to be normal (Wilk-Shapiro values > 0.85) a one-way Analysis-of-Variance (ANOVA) was used to compare communities’ mean scores. Significant differences were observed (Table 4.14). A post-hoc, Tukey-test revealed two homogenous groups among the 6 communities. Retreat Village and South Grafton respondents comprised one group whilst the other group contained the remaining four communities.

Table 4.14: One-way ANOVA results for a comparison between mean scores from Q9.

Source	DF	SS	MS	F	P
Between	5.00	83.82	16.76	15.49	0.0000
Within	503.00	544.38	1.08		
Total	508.00	628.20			

Q10: Which of the following scenarios would you prefer to see in your local area?

Markedly fewer respondents from South Grafton and the Retreat Village wanted free-roaming kangaroos in their local area, than from the other four communities (Table 4.15). Similarly, only respondents from South Grafton and the Retreat Village selected the option of “No kangaroos at all” as their response.

Table 4.15: Responses to Q10: “Which of the following scenarios would you prefer to see in your local area?”

	HH	HP	LR	SB	SG	RV
Free-roaming kangaroos	79%	79%	77%	82%	48%	56%
Kangaroos, but not in house yards	7%	8%	18%	6%	27%	16%
Kangaroos, but not on roads	14%	17%	30%	19%	33%	12%
No kangaroos at all	0%	2%	0%	0%	12%	9%
No response	0%	0%	0%	0%	0%	1%
Local kangaroos, but not in the Retreat village (RV only)	NA	NA	NA	NA	NA	22%

Retreat Village respondents were not included in statistical comparisons for this question as they had a different range of response options available to them. However, the distribution of responses resembled that of South Grafton more than it did the other communities.

Significant differences were observed between the other 5 communities’ proportions of responses ($\chi^2 = 66.06$, P-value < 0.001, DF = 12). With South Grafton removed from the analysis, no significant difference was found between the remaining four communities ($\chi^2 = 12.3$, P-value = 0.1968, DF = 9).

Q11: If you have a dog, or dogs, are they...?

Levels of dog ownership were relatively consistent across the 5 communities*, with a mean of 51% of respondents indicating that they own a dog, or dogs (Table 4.16). No significant differences were found to exist between communities in terms of the proportions of respondents who indicated that they were/were not dog owners ($\chi^2 = 8.67$, P-value = 0.3708, DF = 8).

For the following results from Question 11, only the responses of those participants who indicated that they were dog owners were included.

The extent of control exercised over pet dogs varied between the communities. For example, whilst more than three quarters of respondents from Safety Beach indicated keeping their pet behind a fence, more than half of those from Lake Russell allowed their dogs to roam freely (Table 4.16). Also, whilst few Safety Beach respondents restrained their dogs only at night, between a fifth and two-fifths of other communities' respondents selected that option.

Table 4.16: Responses to Q11: "If you have a dog, or dogs, are they...?"

	HH	HP	LR	SB	SG
Always behind a fence	38%	52%	23%	77%	68%
Always tied up	0%	3%	3%	7%	7%
Able to roam freely	23%	17%	55%	13%	14%
Restrained only at night	38%	34%	42%	8%	20%

Chi-squared analysis revealed significant differences between communities ($\chi^2 = 48.50$, P-value = 0.0000, DF = 12). Comparisons of pairs of communities were conducted to determine where significant differences existed (Table 4.17). Significant differences were found to exist between Safety Beach and all of the other four communities. Lake Russell also significantly differed from South Grafton and Heritage Park.

* The Retreat Village was not asked questions regarding dogs

Table 4.17: A summary of outcomes of Chi-square comparisons between pairs of communities for responses to Question 11.

Comparison	Chi ² Value	P-Value	DF
HH vs HP	0.96	0.8099	3
HH vs LR	3.2	0.3613	3
HH vs SB	11.43	0.0096	3
HH vs SG	4.35	22.61	3
HP vs LR	9.23	0.0264	3
HP vs SB	10.48	0.0149	3
HP vs SG	2.61	0.4564	3
LR vs SB	33.79	0	3
LR vs SG	20.4	0.0001	3
SG vs SB	3.1	0.3761	3

Q12: If you have a dog, or dogs, do they...?

As in Question 11, only the responses of participants who indicated they were dog owners were included in this analysis.

Between 10 and 34% of dog-owning respondents indicated that their dogs chased kangaroos with even higher proportions of respondents indicating that their dogs barked at kangaroos (up to 54% in Hungry Head). Substantial variation was observed in the proportions of respondents that selected the option “Other dogs in my area chase or bark at kangaroos” (Table 4.18). In Lake Russel, more than two-thirds of dog owners chose this option.

Table 4.18: Responses to Q12: “If you have a dog, or dogs, do they...?”

	HH	HP	LR	SB	SG
Chase kangaroos	15%	10%	19%	10%	34%
Bark at kangaroos	54%	28%	23%	23%	50%
Neither of these	31%	48%	52%	52%	27%
Other dogs in my area chase or bark at kangaroos	38%	45%	68%	11%	18%
I don't have a dog	8%	3%	0%	3%	2%
No response	15%	10%	19%	10%	34%

Analysis revealed significant differences between communities ($\chi^2 = 42.74$, P-value = 0.0003, DF = 16).

Comparisons of pairs of communities found significant differences between South Grafton and three of the other communities (Heritage Park, Lake Russell and Safety Beach) and between Lake Russell and Safety Beach (Table 4.19).

Table 4.19: A summary of outcomes of Chi-square comparisons between pairs of communities for responses to Question 12.

Comparison	Chi ² Value	P-Value	DF
HH vs HP	2.82	0.5291	4
HH vs LR	7.67	0.1046	4
HH vs SB	6.53	0.1631	4
HH vs SG	3.55	0.4704	4
HP vs LR	2.77	0.5979	4
HP vs SB	7.22	0.1195	4
HP vs SG	12.64	0.0132	4
LR vs SB	15.73	0.0034	4
LR vs SG	18.52	0.001	4
SB vs SG	15.06	0.0046	4

Q13: Are you concerned that dogs, in your area, interact in a negative way with kangaroos?

With the exception of South Grafton, approximately half of the respondents from each community indicated concerns about dogs in their local area interacting in a negative way with kangaroos (Table 4.20).

Table 4.20: Responses to Q13: Are you concerned that dogs, in your area, interact in a negative way with kangaroos?

	HH	HP	LR	SB	SG
Yes	48%	53%	46%	49%	28%
No	34%	32%	36%	34%	47%
I am unsure	14%	15%	16%	15%	21%
No response	3%	0%	4%	3%	4%

No significant differences were observed between communities ($\chi^2 = 12.81$, P-value = 0.1186, DF = 8).

Q14: Do you think restrictions should be placed upon the dogs, or on the kangaroos to stop this? (i.e. Negative interactions)

Whilst restricting dogs was the most frequently recorded option from each community, respondents' support for this option ranged between 25% in South Grafton to 68% in Heritage Park (Table 4.21). In comparison, a belief that restrictions should be placed on neither the dogs nor the kangaroos was relatively consistent, ranging between 15% and 26%.

Table 4.21: Responses to Question 14: "Do you think restrictions should be placed upon the dogs, or on the kangaroos to stop this?"

	HH	HP	LR	SB	SG
On neither	24%	15%	25%	26%	20%
On both	7%	8%	9%	5%	12%
On dogs	52%	68%	48%	52%	35%
On kangaroos	3%	0%	4%	1%	12%
I am unsure	10%	6%	9%	10%	17%
No response	3%	4%	5%	5%	4%

Significant differences were observed between communities' proportions of responses ($\chi^2 = 36.36$, P-value = 0.0026, DF = 16). However, with South Grafton removed from the analysis, no significant differences were observed ($\chi^2 = 8.57$, P-value = 0.7390, DF = 12).

Q15: Are you concerned about the prospect of vehicle accidents with kangaroos in your area?

Other than respondents from the Retreat Village, a majority from each community expressed concern about the prospect of vehicle accidents with kangaroos, in their area (Table 4.22).

Table 4.22: Responses to Q15: “Are you concerned about the prospect of vehicle accidents with kangaroos in your area?”

	HH	HP	LR	SB	SG	RV
Yes	76%	64%	73%	55%	74%	40%
No	21%	28%	25%	38%	25%	54%
I am unsure	3%	2%	2%	4%	0%	2%
No response	0%	6%	0%	4%	1%	4%

Significant differences were observed between communities ($\chi^2 = 41.47$, P-value < 0.0001, DF = 10). However, with the Retreat Village removed from the analysis, no significant differences were found ($\chi^2 = 13.21$, P-value = 0.1047, DF = 8).

Q16: Have you ever hit a kangaroo in your car, in the local area?

Two communities' respondents revealed much higher levels of kangaroo-vehicle incidents than the others groups (Table 4.23). From Safety Beach and South Grafton, 38% and 35%, respectively, indicated they had hit a kangaroo, in their car, in the local area. The Retreat Village had the lowest incidence of vehicle-collisions with kangaroos as just 1% of respondents selected this option.

Table 4.23: Responses to Q16: “Have you ever hit a kangaroo in your car, in the local area?”

	HH	HP	LR	SB	SG	RV
Yes	38%	9%	5%	16%	35%	1%
No	59%	91%	95%	79%	65%	90%
I do not drive a car	0%	0%	0%	1%	0%	6%
No response	3%	0%	0%	4%	0%	3%

Significant differences were observed between communities' responses ($\chi^2 = 85.43$, P-value < 0.0001, DF = 10.)

Q17: Which of the following would you prefer to minimise traffic accidents with kangaroos?

Other than for the Retreat Village where more than half of respondents wanted increased lighting, wildlife warning signs were the most popular choice as a means for minimising traffic accidents with kangaroos (Table 4.24).

Some options were very popular in particular areas, but less so in others. For example, around two-thirds of respondents from Hungry Head and Heritage Park wanted reduced speed limits, whilst this option was favoured by 12 – 41% of respondents from the other communities.

The option of reducing kangaroo numbers in an attempt to reduce accidents with vehicles was generally poorly supported. No respondents from Hungry Head chose this option and in Lake Russel, just 13% of people opted for a reduction in the number of kangaroos. However, in South Grafton and the Retreat Village, higher levels of support were recorded.

Table 4.24: Responses to Question 17: “Which of the following would you prefer to keep minimise traffic accidents with kangaroos?”

	HH	HP	LR	SB	SG	RV
Wildlife warning signs for motorists	76%	87%	68%	78%	65%	44%
reduced speed limits	66%	68%	41%	41%	16%	12%
Speed humps or chicanes	14%	21%	20%	26%	13%	8%
barriers to keep wildlife off the roads	14%	8%	30%	12%	19%	23%
A reduction in the number of kangaroos in the local area	0%	8%	13%	6%	36%	22%
Increased lighting along roads	21%	34%	30%	40%	32%	54%
None of these	3%	0%	2%	1%	3%	6%
No response	0%	0%	0%	0%	0%	1%

Significant differences were observed between communities ($\chi^2 = 162.65$, P-value < 0.0001, DF = 30).

Q18: In community meetings, some residents suggested that people could do more to live in harmony with wildlife in the local area. Would you agree with any of the following...?

- i. *Banning dogs:* Support for this option ranged between just 5% from Lake Russell to 21% from Safety Beach and Hungry Head (Table 4.25).

- ii. Banning cats: More popular than banning dogs, the percentage of respondents that selected this option varied from 18% in South Grafton to 34% in Heritage Park and Hungry Head.
- iii. Keeping some blocks vacant for wildlife to use and move across: This was the most popular option in each community, particularly in Safety Beach where almost two thirds (64%) of respondents selected it.
- iv. Banning Fences: More than a fifth of respondents selected this option in Safety Beach, Hungry Head and Heritage Park. (Heritage Park initially had this included in land covenants). In Lake Russell and Safety Beach few respondents chose this option with 11% and 7% support respectively.
- v. Maintaining grassed areas as part of each property: Little support existed for this in South Grafton (although the majority of yards there have lawns) but in each of the other four communities more than a third of resident selected this option.
- vi. None of these: Proportions of respondents who selected this option ranged between 8% in Heritage Park to 22% in South Grafton.

Table 4.25: Responses to Question 18: “In community meetings, some residents suggested that people could do more to live in harmony with wildlife in the local area. Would you agree with any of the following...?”

	HH	HP	LR	SB	SG
Banning dogs	21%	15%	5%	21%	11%
Banning cats	34%	34%	21%	28%	18%
Banning fences	34%	28%	11%	20%	7%
Keeping some blocks vacant	48%	55%	46%	64%	54%
Maintaining grassed areas	38%	40%	32%	31%	14%
None of these	10%	8%	21%	10%	22%
I am unsure	7%	6%	5%	4%	10%
No response	7%	4%	5%	3%	1%

Significant differences were observed between communities ($\chi^2= 64.99$, P-value < 0.0001, DF = 24). However, with South Grafton removed from the analysis, no significant differences were observed ($\chi^2 = 22.55$, P-value = 0.2086, DF = 18).

Q19: Are you concerned about the potential for conflict between people and kangaroos in your local area?

Almost half of South Grafton respondents and more than half of those from the Retreat Village expressed concern about the potential for conflict between people and kangaroos (Table 4.26). In comparison, the other four response groups ranged between 18% and 34% support for this “yes” option.

Table 4/26: Question 19: “Are you concerned about the potential for conflict between people and kangaroos in your local area?”

	HH	HP	LR	SB	SG	RV
Yes	31%	34%	18%	26%	48%	55%
No	55%	60%	73%	65%	47%	37%
I am unsure	10%	6%	5%	4%	4%	6%
No response	3%	0%	4%	2%	1%	2%

Significant differences were observed between communities’ proportions of responses ($\chi^2 = 43.01$, P-value < 0.0001, DF = 10). However, the Retreat Village and South Grafton did not differ significantly ($\chi^2 = 2.85$, P-value = 25.32, DF = 2) and, when they were removed from the analysis, no significant differences were observed between the remaining four communities ($\chi^2 = 5.81$, P-value = 0.4446, DF = 6) .

Q20: Which of these scenarios are you most concerned about in your local area?

Although never a majority, South Grafton respondents consistently favoured the option of “kangaroo attacks” in higher proportions than the other four groups, in reply to A, B, C, D and E (Tables 4.27.1 – 4.27.5 respectively).

Table 4.27.1: Responses to Q20, Part A: “Which of these scenarios are you most concerned about in your local area?”

	HH	HP	LR	SB	SG
Kangaroo attacks	7%	13%	9%	5%	39%
Dog attacks	31%	43%	38%	40%	18%
Neither	45%	28%	30%	41%	33%
No response	17%	15%	23%	12%	10%

Significant differences were observed between communities ($\chi^2 = 58.03$, P-value < 0.0001 , DF = 8). However, with South Grafton removed from the analysis, no significant differences were observed between communities ($\chi^2 = 6.57$, P-value = 0.3623, DF = 6).

Table 4.27.2: Responses to Q20, Part B: “Which of these scenarios are you most concerned about in your local area?”

	HH	HP	LR	SB	SG
Kangaroo attacks	3%	4%	5%	2%	22%
Snake bites	34%	53%	55%	51%	41%
Neither	41%	26%	23%	31%	23%
No response	21%	17%	16%	15%	14%

Significant differences were observed between communities ($\chi^2 = 38.46$, P-value < 0.0001 , DF = 8). However, with South Grafton removed from the analysis, no significant differences were ($\chi^2 = 5.67$, P-value = 0.4613, DF = 6).

Table 4.27.3: Responses to Q20, Part C: “Which of these scenarios are you most concerned about in your local area?”

	HH	HP	LR	SB	SG
Kangaroo attacks	7%	15%	4%	2%	24%
Magpie attacks	7%	17%	18%	21%	22%
Neither	66%	43%	46%	54%	38%
No response	21%	25%	32%	23%	16%

Significant differences were observed between communities ($\chi^2 = 36.27$, P-value < 0.0001 , DF = 8).

Table 4.27.4: Responses to Q20, Part D: “Which of these scenarios are you most concerned about in your local area?”

	HH	HP	LR	SB	SG
Kangaroo attacks	0%	4%	2%	0%	20%
Road accidents	55%	66%	63%	56%	45%
Neither	34%	19%	23%	28%	22%
No response	10%	11%	13%	16%	13%

Significant differences were observed between communities ($\chi^2 = 49.84$, P-value < 0.0001, DF = 8). However, with South Grafton removed from the analysis, no significant differences were observed ($\chi^2 = 8.38$, P-value = 0.2118, DF = 6).

Table 4.27.5: Responses to Q20, Part E: “Which of these scenarios are you most concerned about in your local area?”

	HH	HP	LR	SB	SG
Kangaroo attacks	7%	4%	4%	4%	21%
People hurting wildlife	48%	60%	63%	52%	37%
Neither	34%	23%	18%	33%	23%
No response	10%	13%	16%	11%	19%

Significant differences were observed between communities ($\chi^2 = 37.72$, P-value < 0.3741 , DF = 6). However, with South Grafton removed from the analysis, no significant differences were observed ($\chi^2 = 6.46$, P-value = 0.3741, DF = 6).

Q21: Which are you most concerned about in terms of aggression towards people?

Around half of the respondents from Hungry Head, Heritage Park, Lake Russell and Safety Beach made it clear that they were “not concerned about kangaroo aggression”. The same option, however, was much less frequently selected by respondents from the Retreat Village and South Grafton (Table 4.28).

Male kangaroos were more frequently the focus of respondents’ concerns than females or “both males and females”.

Table 4.28: Responses to Q21: “Which are you most concerned about in terms of aggression towards people?”

	HH	HP	LR	SB	SG	RV
I am not concerned	55%	47%	55%	55%	29%	29%
Female kangaroos	3%	0%	2%	1%	2%	8%
Male kangaroos	34%	38%	25%	33%	39%	31%
Both males and females	3%	13%	7%	6%	22%	24%
I am unsure	3%	2%	9%	4%	8%	7%
No response	0%	0%	2%	1%	0%	1%

Significant differences were observed between communities ($\chi^2 = 71.29$, P-value < 0.0001, DF = 20). However, South Grafton and the Retreat Village did not differ significantly ($\chi^2 = 4.17$, P-value = 0.3830, DF = 4) and when they were removed from the analysis, no significant differences were found between the other four communities ($\chi^2 = 12.59$, P-value = 0.3996, DF = 12).

Q22: If you were attacked by a kangaroo, what do you think you would do?

Of all the options, none stood out as a clear preference across the different communities (Table 4.29). Some, however, were more popular than others, e.g. running away and curling into a ball. Interestingly, as many respondents selected “I am unsure”.

Table 4.29: Responses to Question 22: “If you were attacked by a kangaroo, what do you think you would do?”

	HH	HP	LR	SB	SG	RV
Try to fight it	10%	6%	0%	2%	9%	6%
Call for help	7%	25%	14%	14%	21%	33%
Play dead	14%	15%	16%	7%	18%	15%
Run away	28%	28%	27%	33%	21%	31%
Curl into a ball	28%	23%	25%	29%	46%	17%
I am unsure	28%	23%	30%	31%	18%	24%
No response	7%	2%	5%	2%	1%	3%

Significant differences were observed between communities ($\chi^2 = 55.65$. P-value = 0.0004, DF = 25).

Q23: If a kangaroo has been aggressive towards people should it...?

More than half of each group selected “Be relocated away from people” as their preferred method of dealing with aggressive kangaroos (Table 4.30). Comparatively little support was observed for the other options, other than a third of South Grafton respondents who thought aggressive kangaroos should be killed.

Table 4.30: Responses to Q23: “If a kangaroo has been aggressive towards people should it...?”

	HH	HP	LR	SB	SG	RV
Be killed	14%	19%	21%	14%	34%	7%
Be left alone	24%	17%	16%	10%	10%	21%
Be relocated away from people	52%	55%	54%	63%	52%	67%
I am unsure	7%	8%	5%	10%	4%	5%
No response	3%	2%	4%	3%	0%	0%

Significant differences were observed between communities ($\chi^2 = 55.65$, P-value = 0.0004, DF = 25). However, for this question, the responses from South Grafton and the Retreat Village differed significantly ($\chi^2 = 29.74$, P-value < 0.0001, DF = 3). When they were removed from the analysis, no significant differences were observed between the other four communities ($\chi^2 = 12.59$, P-value = 0.3996, DF = 12).

Q24: If kangaroos are culled to reduce the population size, is it important to you that they be used for something, e.g. pet food or leather?

Other than from Safety Beach and the Retreat Village, half or more of each groups' respondents believed kangaroos should be used for something, if culled (Table 4.31).

Table 4.31: Responses to Question 24: “If kangaroos are culled to reduce the population size, is it important to you that they be used for something, e.g. pet food or leather?”

	HH	HP	LR	SB	SG	RV
I don't support culling of kangaroos	28%	32%	29%	36%	13%	30%
Yes. They should be used if culled	59%	58%	50%	41%	62%	45%
No. There is no need for them to be used	3%	9%	7%	6%	3%	12%
I don't have a preference	10%	8%	18%	18%	25%	13%
No response	0%	0%	0%	2%	0%	6%

Significant differences were observed between communities ($\chi^2 = 35.01$, P-value = 0.0025, DF = 15). With South Grafton removed from the analysis, however, no significant difference was observed between the other five groups ($\chi^2 = 12.26$, P-value = 0.04247, DF = 12).

Q25: If you or a family member were attacked by a kangaroo, what would you do?

Again, a variety of preferences were observed among respondents (Table 4.32). In each community, the agency most likely to be contacted following an attack by a kangaroo was “National Parks” (now the NSW Department of Environment and Conservation) but in no case did the proportion of respondents who selected this option reach 50%. WIRES, the Police and the Local Council were also relatively popular options.

Table 4.32: Responses to Q25: “If you or a family member were attacked by a kangaroo, what would you do?”

	HH	HP	LR	SB	SG	RV
Do nothing	10%	2%	5%	6%	2%	4%
Deal with it yourself	17%	9%	18%	13%	13%	8%
Call National Parks	41%	40%	38%	31%	47%	55%
Call WIRES	17%	32%	34%	28%	24%	7%
Call the Police	28%	19%	18%	26%	38%	12%
Call the local council	17%	30%	16%	29%	36%	13%
Other	3%	4%	5%	4%	5%	NA
No response	3%	2%	2%	0%	2%	3%
Call the manager of the Retreat Village (RV only)	NA	NA	NA	NA	NA	53%

Because they were offered different response options, the Retreat Village respondents were not compared with those from the other groups. No significant differences were observed between communities ($\chi^2 = 23.73$, P-value = 0.4768, DF = 24).

Q26: Are you concerned about kangaroos as a disease risk, for humans, in your area?

The clear majority of respondents, from each community group, selected “No” in response to this question (Table 4.33).

Table 4.33: Responses to Q26: “Are you concerned about kangaroos as a disease risk, for humans, in your area?”

	HH	HP	LR	SB	SG	RV
Yes	7%	6%	2%	6%	6%	8%
No	86%	89%	88%	84%	83%	75%
I am unsure	7%	6%	11%	9%	11%	14%
No response	0%	0%	0%	1%	0%	3%

No significant differences were observed between communities ($\chi^2 = 6.94$, P-value = 0.7314, DF = 10).

Question 27: Have you received any information, e.g. a leaflet from wildlife managers, about how to live with kangaroos in your area?

Only from South Grafton did the majority of respondents (60%) indicate that they had received some information from wildlife managers about how to live with kangaroos (Table 4.34). In other communities, the proportions of people who had received such information ranged from 13% to 34%.

Table 4.34: Responses to Q27: “Have you received any information, e.g. a leaflet from wildlife managers, about how to live with kangaroos in your area?”

	HH	HP	LR	SB	SG	RV
Yes	31%	13%	18%	34%	60%	33%
No	59%	81%	73%	57%	36%	60%
I am unsure	7%	4%	9%	8%	4%	3%
No response	3%	2%	0%	1%	0%	4%

Significant differences were observed between communities ($\chi^2 = 51.15$, P-value = < 0.0001, DF = 10).

Q28: Should people who move into an area with wildlife, such as kangaroos, be provided with information on how to best live with these animals?

More than 90% of respondents from each of the six community groups supported the idea of providing residents with information about how to live with wildlife (Table 4.35).

Table 4.35: Responses to Q28: “Should people who move into an area with wildlife, such as kangaroos, be provided with information on how to best live with these animals?”

	HH	HP	LR	SB	SG	RV
Yes	97%	94%	93%	94%	96%	92%
No	3%	4%	2%	3%	1%	3%
I am unsure	0%	2%	5%	1%	2%	3%
No response	0%	0%	0%	2%	1%	3%

No significant differences were observed between proportions of communities’ responses to this question ($\chi^2 = 6.60$, P-value = 0.7627, DF = 10).

4.3.2 Demographic Information

Q29A: Gender of respondents

In each community, more females responded to the questionnaire than males in a ratio of approximately 3 to 2, i.e. 60% female and 40% male (Table 4.36).

Table 4.36: Responses to Q29A: “Gender”

	HH	HP	LR	SB	SG	RV
Male	45%	38%	45%	39%	37%	42%
Female	59%	68%	63%	62%	67%	53%
No response	0%	0%	0%	0%	1%	6%

N.B. From each community, some questionnaires noted that both male and female persons had completed the questionnaire. Thus, column totals exceed 100%.

No significant differences were observed between communities ($\chi^2 = 2.59$, P-value = 0.7621, DF = 5).

Q29B: Education

Most respondents had at least a junior high-school level of education (Table 4.37). Hungry Head respondents were more likely to have terminated their education at a tertiary level than the other groups. Conversely, respondents from the Retreat Village, who were least likely to have a Tertiary education, were most likely to have finished their education at High School (7 – 10).

Table 4.37: Responses to Q29B: “Education”

	HH	HP	LR	SB	SG	RV
No formal education	0%	0%	0%	0%	1%	1%
Primary	0%	2%	0%	2%	3%	5%
Secondary (7-10)	17%	40%	43%	39%	32%	51%
Secondary (11-12)	41%	38%	25%	24%	33%	27%
Tertiary	41%	19%	27%	31%	30%	9%
No response	0%	2%	5%	4%	1%	7%

To avoid low cell values, responses were combined to form three categories: “Year 7 – 10 High School or less”, “Year 11 – 12 High School” and “Tertiary”. Significant differences were observed between communities ($\chi^2 = 36.81$, P-value = 0.0001, DF = 10). With the Retreat Village removed from the analysis, no significant differences were observed ($\chi^2 = 11.89$, P-value = 0.1563, DF = 8).

Q29C: Background

In Lake Russell and South Grafton, more than 50% of respondents identified themselves as being “rural” (Table 4.38). Similarly, from Hungry Head and Safety Beach, more than half of the respondents indicated that they were “coastal”. From Heritage Park, fewer than half of the respondents chose any one of the background options, with the most frequently selected background being “city” (49%).

Table 4.38: Question 29C: “Background”

	HH	HP	LR	SB	SG	RV
Rural	41%	38%	54%	45%	73%	42%
Coastal	62%	47%	36%	60%	19%	49%
City	34%	49%	46%	43%	26%	52%
No response	0%	0%	2%	1%	0%	3%

A significant difference was observed between communities that chose the various background options in response to this question ($\chi^2 = 52.43$, P-value < 0.0001, DF = 10). However, with South Grafton removed from the analyses no significant differences were observed between communities ($\chi^2 = 8.92$, P-value = 0.3493, DF = 8).

Q29D: Value Types

The most popular choices among respondents were statements corresponding to “Naturalistic”, “Moralistic”, “Humanistic” and “Ecologistic” values (Table 4.39). Interestingly, the Retreat Village also had proportionally more respondents choose the “Aesthetic” and “Utilitarian” responses than the other community groups.

Table 4.39: Responses to Question 29D: “Value Types”

Phrase described:	HH	HP	LR	SB	SG	RV
Aesthetic	3%	15%	9%	7%	6%	24%
Dominionistic	0%	0%	0%	0%	1%	3%
Ecologistic	31%	28%	30%	45%	32%	37%
Humanistic	7%	21%	33%	12%	11%	21%
Neutralistic	3%	8%	4%	4%	8%	12%
Moralistic	7%	26%	25%	26%	22%	29%
Negativistic	0%	0%	0%	0%	0%	0%
Scientistic	0%	6%	5%	6%	1%	8%
Utilitarian	3%	4%	0%	6%	3%	18%
Naturalistic	55%	38%	51%	49%	41%	43%
No response	3%	15%	9%	7%	6%	3%

Significant differences were observed between communities ($\chi^2 = 79.61$, P-value = 0.0002, DF = 40).

4.3.3 Questions asked only of Retreat Village Participants

Q10: How do you feel about the following statement: “The kangaroos should be allowed to remain within the bounds of the Retreat Village”

More than half of the respondents supported, to some extent, the statement in Question 10 (Table 4.40). Conversely, just 26% of people disagreed or strongly disagreed.

Table 4.40: Responses to Q10: “How do you feel about the following statement: “The kangaroos should be allowed to remain within the bounds of the Retreat Village”

Strongly agree	30%
Agree	27%
Neither agree nor disagree	17%
Disagree	9%
Strongly disagree	17%
No response	1%

Q22: Who do you feel should be responsible for ensuring that people and kangaroos do not come into conflict in your community?

Most respondents felt DEC should take responsibility for preventing inter-specific conflict (Table 4.41). Fewer, but still substantial proportions, selected the options of “the Retreat Village Management” and “the Retreat Village residents”.

Table 4.41: Responses to Question 22: “Who do you feel should be responsible for ensuring that people and kangaroos do not come into conflict in your community?”

NPWS (Now D.E.C.)	53%
Local Council	16%
Retreat Village Management	42%
Retreat Village residents	32%
None of these	6%
No response	5%

Q16: Have nearby kangaroos ever made you feel uncomfortable about stepping out of your house?

More than a third of respondents indicated they had been made to feel uncomfortable, about leaving their home, because of the presence of nearby kangaroos (Table 4.42).

Table 4.42: Responses to Q16: “Have nearby kangaroos ever made you feel uncomfortable about stepping out of your house?”

Yes	34%
No	65%
I am unsure	1%
No response	0%

4.3.4 Cross-tabulations

Many different cross-tabulations could have been undertaken but those presented here are restricted to those which were most likely to provide information that was useful for managers.

A cross-tabulation of Q1: “How often do you see live kangaroos?” and Q9: “How do you feel about the following statement: It is important to have kangaroos in my local area”

Most respondents of both groups agreed that local kangaroos were important to them (Table 4.43).

Table 4.43: Results of a cross-tabulation of Q1: “How often do you see live kangaroos?” and Q9: “How do you feel about the following statement: It is important to have kangaroos in my local area”

	Daily contact (n = 473)	Weekly or less frequent contact (n = 51)
Strongly agree	26%	33%
Agree	23%	27%
Neither agree nor disagree	7%	10%
Disagree	4%	2%
Strongly disagree	1%	0%

Since few respondents saw kangaroos less than daily, respondents who chose “weekly” or less frequent contact were combined into one group for this comparison. Differences between the two groups were not significant ($\chi^2 = 3.18$, P-value = 0.5288, DF = 4).

A cross-tabulation of Q1: “How often do you see live kangaroos?” and Q19: “Are you concerned about the potential for conflict between people and kangaroos in your area?”

Around 50% of both groups’ respondents were not concerned about local conflict with kangaroos, compared to approximately 40% who were (Table 4.44).

Table 4.44: Results of a cross-tabulation of Q1: “How often do you see live kangaroos?” and Q19: “Are you concerned about the potential for conflict between people and kangaroos in your area?”

Concerned?	Daily contact (n = 473)	Weekly or less frequent contact (n = 51)
Yes	39%	40%
No	54%	52%
I am unsure	5%	6%
No response	2%	2%

Differences between the two groups were not significant ($\chi^2 = 0.07$, P-value = 0.9654, DF = 2).

Comparison of mean length of residence for respondents who chose different options for Q7: “Since you moved to your present address have local kangaroo numbers...”

Within each community One-way Analysis of Variance tests were used to compare mean length of residency between groups who had selected the various response options for Q7: “Since you moved to your present address have local kangaroo numbers...”.

No significant differences were observed between the mean length of residency in the communities for HH, HP, LR, SB or SG. For RV, however, there were significant differences between the three groups (F = 6.81, P = 0.0017, DF = 2). A post hoc, comparison of means test revealed that the mean length of residency did not differ significantly between

“Increased” and “Stayed about the same” response groups but these both differed from the “Decreased” response group (Figure 4.3).

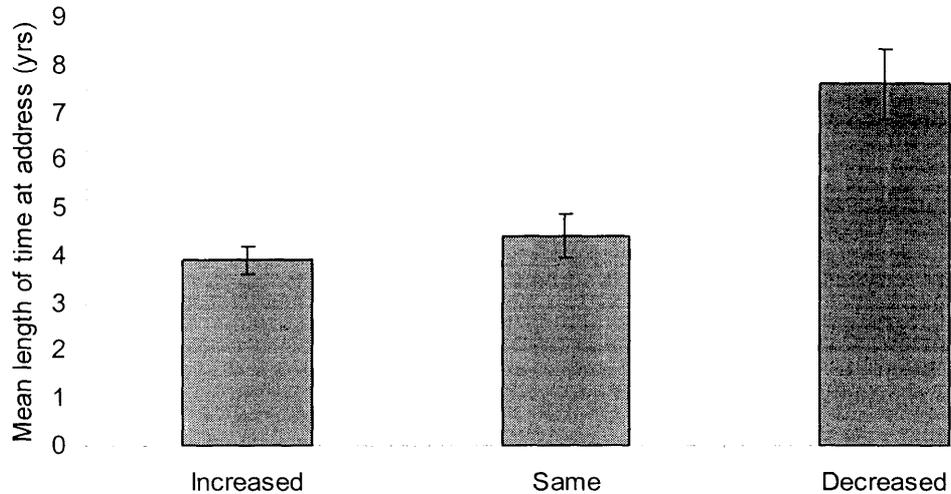


Figure 4.3: Mean length of residency for response groups to Question 7: “Since you moved to the Retreat Village, have the numbers of kangaroos in your area...”

A cross-tabulation of Q6: “Did you know there were kangaroos in the area before you moved there” and Q9: “How do you feel about the statement: It is important to have kangaroos in my local area.”

Those people who were aware of kangaroos before they moved to their local areas were more likely to agree and less likely to disagree that the animals’ presence was important (Table 4.45).

Table 4.45: Results of a cross-tabulation of Q6: “Did you know there were kangaroos in the area before you moved there” and Q9: “How do you feel about the statement: It is important to have kangaroos in my local area.”

“It is important to have kangaroos in my local area”	Aware of kangaroos before they moved to the area (n = 446)	Not aware of kangaroos before they moved to the area (n = 78)
Strongly agree/Agree	68%	46%
Neutral	22%	25%
Disagree/Strongly disagree	9%	28%
No response	1%	1%

Significant differences were observed between groups ($\chi^2 = 6.01$, P-value = 0.0495, DF = 2).

A cross-tabulation of Q9: “How do you feel about the statement: It is important to have kangaroos in my local area” and Q11: “Which of the following scenarios would you prefer in your local area?”

Almost 90% of people who agreed or strongly agreed that local kangaroos were important wanted to see free-roaming kangaroos in their area, compared to less than half of people who responded indifferently to Q9 (Table 4.46). Just 6% of people who disagreed that kangaroos were important wanted the animals roaming free in their area.

Table 4.46: Results of a cross-tabulation of Q9: “How do you feel about the statement: It is important to have kangaroos in my local area” and Q11: “Which of the following scenarios would you prefer in your local area?”

Preferred scenario	Agree that local kangaroos are important (n = 340)	Neither agree nor disagree that local kangaroos are important (n = 122)	Disagree that local kangaroos are important (n = 61)
Free-roaming kangaroos	88%	47%	6%
Kangaroos with a restricted distribution	12%	46%	50%
No kangaroos at all	0%	4%	42%

Significant differences were observed between groups ($\chi^2 = 257.76$, P-value < 0.0001, DF = 4).

A cross-tabulation of Q16: “Have you ever hit a kangaroo with your car, in your local area?” and Q15: “Are you concerned about the prospect of vehicle accidents with kangaroos in your area?”

Almost 80% of people who have had local accidents with kangaroos are concerned about the prospect of local vehicle accidents compared to 56% of those who have not (Table 4.47).

Table 4.47: Result of a cross-tabulation of Q16: “Have you ever hit a kangaroo with your car, in your local area?” and Q15: “Are you concerned about the prospect of vehicle accidents with kangaroos in your area?”

Are you concerned about the prospect of local accidents with kangaroos?	Have had a local accident with a kangaroo (n = 80)	Have not had a local accident with a kangaroo (n = 346)
Yes	79%	56%
No	21%	41%
I am unsure	0%	3%

A two-by-two table comparison revealed significant differences between groups (Yates corrected $\chi^2 = 11.82$, P-value = 0.006, DF = 1).

A cross-tabulation of Q16: "Have you ever hit a kangaroo with your car, in your local area?" and Q17: "Which of the following would you prefer to minimise traffic accidents with kangaroos?"

Those people who have had a local accident with kangaroos were more likely to select increased lighting and a reduction in the number of kangaroos as accident mitigation methods than those people who have not had a similar experience (Table 4.48).

Differences between the two groups were significant ($\chi^2 = 25.34$, P = 0.0001, DF = 5).

Table 4.48: Results of a cross-tabulation of Q16: "Have you ever hit a kangaroo with your car, in your local area?" and Q17: "Which of the following would you prefer to minimise traffic accidents with kangaroos?"

	Have had a local accident with a kangaroo (n = 80)	Have not had a local accident with a kangaroo (n = 346)
Wildlife warning signs	59%	68%
Reduced speed limits	23%	34%
Barriers to keep wildlife off roads	12%	17%
Reduce the number of kangaroos	28%	17%
Increased lighting along roads	33%	14%
None of these	31%	41%

By breaking-down this comparison into a series of two-by-two tables it was possible to examine the proportions of respondents who did support and did not support particular between the two groups. Only support for "Increased lighting" differed significantly ($\chi^2 = 16.84$, P-value = 0.0000).

A cross-tabulation of dog ownership with Q13: “Are you concerned that dogs, in your area, interact in a negative way with kangaroos?”*

More dog owners, proportionally, indicated they were not concerned about the potential for negative interactions between dogs and kangaroos than respondents from the group who were not dog owners (Table 4.49).

Table 4.49: Results of a cross-tabulation of dog ownership with Q13: “Are you concerned that dogs, in your area, interact in a negative way with kangaroos?”

	Dog owner (n=181)	Non-owner (n=179)
Concerned	38%	48%
Not concerned	48%	27%
Unsure	14%	20%
No response	1%	3%

Significant differences were observed between groups ($\chi^2 = 14.69$, P-value = 0.0006, DF = 2).

A cross-tabulation of Education and Q9: “How do you feel about the statement: It is important to have kangaroos in my local area”

People with greater educational experience were more likely to strongly agree or agree that local kangaroos were important than those respondents who finished their education at or before Year 10 of High school (Table 4.50).

Table 4.50: Results of a cross-tabulation of Education Q9: “How do you feel about the statement: It is important to have kangaroos in my local area”

It is important to have local kangaroos	Finished education at Year 10 or before (n = 240)	Finished Education at Year 11, 12 or University (n = 275)
Strongly agree or agree	60%	70%
Neither	28%	20%
Disagree or Strongly disagree	12%	9%
No response	0%	1%

Differences between the groups were significant ($\chi^2 = 6.49$, P-value = 0.0389, DF = 2).

Response groups were combined to form a single “Finished education at Year 10 or before” since there few “No formal education” and “Primary School” replies. Similarly, the replies to

* For South Grafton and the Coffs Coast communities only. The Retreat Village were not questioned about dogs.

Q9 of people who finished their education at Year 11 or Year 12 did not differ significantly from University educated respondents ($\chi^2 = 4.64$, P-value = 0.0983, DF = 2) so the two groups were combined.

A cross-tabulation of Q27: “Have you received any information about how to live with kangaroos in your area?” and Q19: “Are you concerned about the potential for conflict between people and kangaroos in your area?”

A majority of each group indicated they were not concerned about the potential for conflict between people and kangaroos in their area (Table 4.51).

Table 4.51: Results of a cross-tabulation of Q27: “Have you received any information about how to live with kangaroos in your area?” and Q19: “Are you concerned about the potential for conflict between people and kangaroos in your area?”

Are you concerned about conflict?	Yes (n = 187)	No (n = 309)
Yes	42%	38%
No	53%	53%
I am unsure	3%	6%
No response	2%	2%

Differences between the groups were not significant ($\chi^2 = 2.73$, P-value = 0.2554, DF = 2).

Cross-tabulation of Q27: “Have you received any information about how to live with kangaroos in your area” and Q22: “If you were attacked by a kangaroo what do you think you would do?”

The most popular option among informed respondents was to “curl into a ball” whilst among the uniformed group, “run away” was selected by the greatest proportion of respondents (Table 4.52). Few respondents from either group wanted to “try to fight it”.

Table 4.52: “Results of Cross-tabulation of Q27: “Have you received any information about how to live with kangaroos in your area” and Q22: “If you were attacked by a kangaroo what do you think you would do?”

	Received info (n = 187)	No info (n = 309)
Try to fight it	7%	4%
Call for help	23%	21%
Play dead	13%	13%
Run away	22%	33%
Curl into a ball	40%	18%
I am unsure	19%	31%
No response	3%	3%

Differences between the groups were significant ($\chi^2 = 33.37$, P-value < 0.0001, DF = 5)

Two-by-two table comparisons between proportions of between informed and uninformed groups that chose each response revealed significant differences for three options: “curl into a ball” ($\chi^2 = 5.79$, P-value = 0.0161, DF = 1); “run away” ($\chi^2 = 8.54$, P-value = 0.0035, DF = 1); and “I am unsure” ($\chi^2 = 8.10$, P-value = 0.0044, DF = 1).

A gender-split cross-tabulation “Have you received any information, e.g. a leaflet from managers, about how to live with kangaroos in your area?” and Q22: “If you were attacked by a kangaroo what do you think you would do?”

Differences existed between informed and uninformed respondents within each gender group (Table 4.53). For females, the most noticeable difference was that informed women were half as likely to be “unsure” about how they would respond to a kangaroo attack and twice as likely to take the recommended action of “curling into a ball” as those who had not received information about how to interact with kangaroos. For men, uninformed respondents were almost twice as likely to “run away” as those who had received information and, similar to women were more than twice as likely to “curl into a ball”.

Differences observed between the two female groups were significant ($\chi^2 = 23.21$, P-value = 0.0003, DF = 5). Likewise, differences between informed and uninformed males were also significant ($\chi^2 = 14.80$, P-value = 0.0112, DF = 5).

Table 4.53: Results of a cross-tabulation of Q27: “Have you received any information, e.g. a leaflet from managers, about how to live with kangaroos in your area?” and Q22: “If you were attacked by a kangaroo what do you think you would do?”, split by gender.

	Male		Female	
	Informed	Not informed	Informed	Not informed
Try to fight it	8%	6%	7%	2%
Call for help	13%	14%	31%	25%
Play dead	14%	13%	13%	14%
Run away	25%	43%	21%	26%
Curl into a ball	35%	14%	43%	21%
I am unsure	22%	27%	17%	34%
No response	1%	3%	4%	3%

Retreat Village Cross-tabulations

A cross-tabulation of Q9: “How do you feel about the following statement? It is important to have kangaroos in the local area” and Retreat Village Q16: “Have nearby kangaroo ever made you feel uncomfortable about stepping out of your house?”

Less than a fifth of respondents who had felt uncomfortable about stepping out of their house due to the presence of local kangaroos agreed to any extent that local kangaroos were important (Table 4.54). Conversely, nearly two-thirds of those respondents who had not been similarly uncomfortable agreed that the animals were important.

Table 4.54: Results of a cross-tabulation of Q9: “How do you feel about the following statement? It is important to have kangaroos in the local area” and Retreat Village Q16: “Have nearby kangaroo ever made you feel uncomfortable about stepping out of your house?”

Important?	Uncomfortable about stepping out of house because of 'roos (n = 48)	Not uncomfortable about stepping out of house because of 'roos (n = 87)
Strongly agree or agree	17%	66%
Neither agree nor disagree	38%	30%
Strongly disagree or disagree	46%	5%
No response	0%	0%

Differences between the groups were found to be significant ($\chi^2 = 43.19$, P-value = < 0.0001, DF = 2).

4.3.5 Results of the non-response round

Participation rates for the non-response round and overall.

Participation in the final or “non-response” round varied between communities. From Hungry Head, just three people returned questionnaires and none were interviewed (Table 4.55). In comparison, many of the Retreat Village non-respondents were interviewed and, ultimately, 70% took part in this round.

I was surprised that, across the six communities, only 3 people (one from South Grafton and two from the Retreat Village) refused a face-to-face interview. Other participants from whom I received no reply were not home when I visited their community and subsequently did not return a copy of the non-response questionnaire.

Table 4.55: Responses from the non-response round

Community	Non-respondents	Replies + Interviews	Percentage
HH	22	3	14%
HP	40	14	35%
LR	64	14	22%
SB	114	34	30%
SG	135	48	36%
RV	56	39	70%

As a result of the involvement of non-respondents in the final round of data collection, total participation rates, i.e. the percentage of residences from each community that actively participated in the project, ranged between 57% and 91% (Table 4.56).

Table 4.56: Participation rates for the six communities.

Total replies (3 rounds combined)	Residences	Participation Rate
32	51	63%
67	93	72%
66	116	57%
152	232	66%
146	233	63%
177	194	91%

Why didn't participants take part in the main or reminder rounds?

Many non-respondents indicated that they had either been too busy to take part in the project, had forgotten to reply or simply did not like filling in questionnaires, regardless of the topic of investigation. Several people also believed that their opinion would not be valuable or that management of wildlife should be left to qualified people, i.e. National Parks and Wildlife Service staff.

Comparisons of respondents with non-respondents

How often do you see live kangaroos?

Responses were combined to form two categories: Daily and Less than daily. Two-by-two tables were used to compare results within communities (Table 4.57). Hungry Head and Heritage Park respondents and non-respondents replied identically, all choosing "Daily", so a comparison was not necessary.

No significant differences were observed between HH, HP, SB, SG or RV. Significant differences were observed between the Lake Russell groups (with non-respondents generally seeing kangaroos less frequently than respondents).

Table 4.57: Results of Chi-square comparisons between the replies of each community's respondents and non-respondents for "How often do you see live kangaroos?".

	HH	HP	LR	SB	SG	RV
Chi ²	N.A.	N.A.	5.39	0	0.28	3.13
P-value			0.0203	1	0.5945	0.0769
DF			1	1	1	1

How do you feel about the following statement? "It is important to have kangaroos in my local area".

Again, responses were combined to form fewer categories. In this case, these were: "Agree"; "Neither agree nor disagree"; and "Disagree". For HH and HP cell values were too low for the comparison to be considered worthwhile.

Table 4.58: Results of Chi-square comparisons between the replies of each community's respondents and non-respondents for "How do you feel about the following statement? "It is important to have kangaroos in my local area".

	HH	HP	LR	SB	SG	RV
Chi ²	Cell values too low	Cell values too low	4.16	4.29	23.34	0.71
P-value			0.1247	0.1171	< 0.0001	0.95
DF			2	2	2	2

Significant differences were observed only between the SG groups (Table 4.58). Similar proportions of both groups "Agreed" that local kangaroos were important but non-respondents were less likely to "Neither agree nor disagree" and more likely to "Disagree".

Are you concerned about the potential for conflict between people and kangaroos in your area?

No significant differences were observed between respondents and non-respondents for this question (Table 4.59).

Table 4.59: Results of Chi-square comparisons between the replies of each community's respondents and non-respondents for "Are you concerned about the potential for conflict between people and kangaroos in your area?".

	HH	HP	LR	SB	SG	RV
Chi ²	1.66	0.07	1.39	3.74	3.28	0.96
P-value	0.6454	0.9656	0.7072	0.2905	0.3507	0.6202
DF	2	2	2	2	2	2

4.4 Discussion

People are an integral part of the peri-urban kangaroo scenario and have many roles within it. Aside from being the “victims” of kangaroo attacks or the drivers of vehicles that collide with the animals they may be the owners and neighbours of house-yards that the animals use or may share their local park or golf course with them. People’s dogs chase and bark at kangaroos. They feed, photograph and even talk to the animals. From these various perspectives people accumulate a vast amount of information, often unintentionally, about kangaroos and use it to refine their opinions of the animals and each of the scenarios they encounter them in.

Given this wealth of public experience and potential range of opinion within it, it seems strange that managers’ interactions with people, regarding kangaroos in peri-urban contexts, have largely been based around a one-way flow of instructions to the public. A community meeting following the 1996 attack in South Grafton was a rare exchange of information between managers and people other than those few members of the community who had previously actively pursued some involvement in the management process. However, even following this first attempt at involving the public’s views in management, it was unclear whether residents of other communities, who also have peri-urban kangaroos, would hold similar experiences and preferences.

Internationally, it has become clear that it is important for urban wildlife managers to consider information about the public’s views and experiences (Henderson *et al.*, 2000). For example, in North America, researchers have used public survey techniques to assist the development of socially acceptable management for urban wildlife species such as Canada Geese (Coluccy *et al.* 2001), White-tail deer (Stout *et al.*, 1997; Loker *et al.*, 1999) and elk (Lee & Miller, 2003). Similarly, researchers have begun to apply such techniques in Australia (Jones & Everding, 1994; Thomas & Jones, 1999) but the practice is not yet widespread.

However, the local managers involved in this research showed an interest in better understanding public views of peri-urban kangaroo issues. Through the co-operation of these individuals, it was possible to identify a range of perceived problems that managers face in dealing with this scenario. Specifically, they wanted to know:

- What expectations the community had in terms of how kangaroo issues are dealt with?

- What preference does the community have for managing aggressive kangaroos?
- Are interactions with kangaroos important to the community?, and
- Are education efforts about living with kangaroos having a worthwhile impact?

This study was able to provide answers to these questions, demonstrating there is value for this type of research in management of peri-urban kangaroos. Importantly, however, the results of this case study have further significance because they demonstrate that whilst many peri-urban experiences with kangaroos are common, other views, including preferences for management, can vary significantly between individuals and communities.

Such similarities and differences are the focus of the following discussion, which attempts to illustrate how the gathered information could be of value in refining and improving local management of interactions between people and peri-urban kangaroos.

4.4.1 Feedback from residents who live with peri-urban kangaroos

The questions asked of respondents sought information which can be grouped loosely into three categories:

1. information which described the respondents;
2. information about respondents' experiences with kangaroos; and
3. information about respondents' preferences for management

After considering whether the observed data was representative of the communities' actual experiences and opinions, this discussion deals with each of the above categories, focusing particularly on observed similarities and differences that may be of value to management of local peri-urban kangaroos.

Did the observed results represent the wider populations in each community?

Results from communities with greater response rates are more likely to be representative of the true range of views present within their populations. Based on the Retreat Village's 70% response rate, for example, one can be relatively confident that the range of views within the community have been sampled and an accurate insight into their distribution has also been gained.

However, since smaller proportions of residents from other communities replied an assessment of whether the samples accurately represented the views of these communities was undertaken using the results of the non-response survey.

The general absence of significant differences between non-respondents and respondents in terms of their frequency of contact with kangaroos was positive as it suggests the group who did not reply do not have substantially different experiences from respondents. Importantly, there was no difference in the level of concern expressed by non-respondents and respondents regarding conflict with local kangaroos. This suggests that, within communities, non-respondents had not chosen to not take part because they were less concerned about aggression from kangaroos than other residents.

Whilst non-respondents from Lake Russell tended to see kangaroos less frequently than respondents from the same area this was not seen as a major limiting factor to the dataset, although it may suggest that managers can expect such people to be less likely to show an interest in local kangaroo management.

One important significant difference, however, was detected between respondents and non-respondents. South Grafton non-respondents displayed much less support for the importance of local kangaroos than respondents from the same area. This difference may explain why participation was lowest in this community despite issues of kangaroo aggression and other conflict with residents having such a high local profile (see *Explaining differences in response rates*, below). In practical terms this difference suggests that community-wide perceptions of the animals may be more negative than is evident from the respondents' views.

Generally, the absence of differences between respondents and non-respondents suggests that the data provides an acceptable indication of the experiences and preferences of residents within these communities.

Who were the respondents? Similarities and differences between communities.

Overall, more similarities were observed between communities' respondents, in terms of demographic variables, than differences. Respondents from each area were generally

consistent in terms of the ratio of gender participation, the extent of their educational experience, their background and even in their self-selected value types.

As observed in both the Wild Horse and Flying-fox case studies, women tended to be more likely to respond to wildlife related questionnaires than men. Importantly, the absence of significant differences between communities showed that response rates of both genders were consistent.

The significant difference observed between the formal educational experience of the Retreat Village respondents and those from the other five communities was understandable given the minimum age of the Retreat Village respondents was 55 years. Since people of this age and above would generally be expected to have terminated their education at an earlier stage than younger individuals it is reasonable to assume that there was no local educational bias present regarding the project.

Consistency was observed among the 5 coastal communities, in terms of background, but a significant difference between these respondents and those from South Grafton made good sense. It is understandable that the people from this community tended to be more rural and less coastal or metropolitan than the Coffs Coast and Retreat Village respondents since South Grafton is located around 40km from the coast and is surrounded by agricultural production. Further, being a smaller than the coastal centres of Coffs Harbour and Port Macquarie, and not immediately adjacent to the coast, the area might be less attractive to metropolitan people looking to make a now popular “sea-change” to their lifestyle.

Lastly, my crude attempt to gain insight into the deeper values respondents held regarding wildlife showed very similar responses between communities with the Naturalistic, Ecologistic, Moralistic and Humanistic responses most prevalent. Key differences were observed between the other five communities and the Retreat Village, where greater proportions of respondents selected Aesthetic and Utilitarian responses. These differences, like educational experience, are also conceivably related to inter-generational variation. In the United States, for example, Kellert (1996) described a decrease in the proportion of the population that expressed a utilitarian value towards wildlife throughout the 20th Century.

Given the simple explanations for observed variation between communities it seems likely that observed variation was due to inherent differences between communities' populations rather than because of particular biases in the survey methodologies.

4.4.2 Respondents' experiences and preferences

Rather than attempting to artificially separate the two, interlinked categories of experiences and preferences, the following sections generally deal with specific results in the order that corresponding questions occurred within the Kangaroo Management Questionnaire. In some cases I have deviated from this pattern to bring together relevant results that were not adjacent within the survey or to appropriately deal with select cross-tabulations.

Question 1: How often do you see live kangaroos?

Although a significant difference did exist in the frequency of contact that Safety Beach and Retreat Village respondents had with kangaroos, compared to the other four communities, cross-tabulations with respondents' belief in the importance of local kangaroos and also with the concern regarding local conflict with the animal revealed no differences between people who saw the animals daily and those who saw them less frequently, such as weekly or monthly. In the absence of any such relationship, the most important information to be drawn from this question, regarding contact with kangaroos, was that in each community, kangaroos are part of most respondents' lives, every day.

Question 2: Where do you see kangaroos?

Firstly, the observed results regarding where respondents see kangaroos provides a clear indication that the animals are using the same range of areas within each community. It also indicates to managers that respondents from each of these six communities are most likely to see kangaroos in their own yard or yards on their street rather than elsewhere in their local areas. As a result, the issue of peri-urban kangaroo management is literally "close-to-home" for these people and consequently might be expected to be taken very personally.

Question 3: If you see kangaroos in your yard, do they do any of the following?

The overall significant difference found to exist between Safety Beach and the other communities, in terms of responses to Question 3, may be due to the local kangaroos' use of the Golf Course located at the northern edge of the community. Generally, most local kangaroos can be found in this area during the day. It has available water and many areas where animals can rest under trees and shrubs, which correspond with differences in the use of yard resources compared to the other communities.

The fact that respondents consistently reported observing animals grazing in their yards came as little surprise since grass is the principle food source for Eastern Grey Kangaroos and these residential areas provide it in abundance. Similarly, since lawns and soft garden beds provide a comfortable substrate to lie on, it was not surprising that most respondents also described animals resting in their yards.

Variation in the reports of kangaroos drinking water from yards is likely to be related to differential availability of water sources between communities. In Hungry Head, Heritage Park and Lake Russel many residents have dams, ponds or wetlands in, or adjacent to their yards which provide ample opportunities for local kangaroos to access water. In the other communities, similar water sources may be less common due to smaller block sizes. However, meeting attendees did note that kangaroos also drink from bird-baths, pets' water bowls and even from dripping taps so large water sources are clearly not requisite for kangaroos to obtain water in urban areas.

The high proportions of respondents who reported kangaroos eating "other garden plants" were somewhat surprising as Eastern Grey Kangaroos are not generally known for extensively browsing shrubs or trees. During the project they were, however observed eating new growth of an unidentified *Casuarina* sp., at Hungry Head. Although kangaroos clearly will eat plants other than grass, the high incidence of these reports might be explained by the presence of other macropods, such as Swamp wallabies, *Wallabia bicolor*, and Red-necked Wallabies, *Macropus rufrogriseus*, in these areas. These two species readily browse a range of plants and both species are known to occur within the study areas.

Aside from demonstrating the similarity of experiences between communities such observations may also provide managers with hints for addressing use of house yards in cases where residents are concerned about the animals presence but not are not interested in, or able to, erect fencing to exclude them.

Clearly limiting access to resources that are important to kangaroos might, in turn, reduce the attractiveness of residents' yards. Whilst grazing seems like an ideal issue to address, given Australian's love of lawns, it is unlikely that people will be readily convinced to remove the grass from their yards. Similarly, action might be taken for reducing access to drinking water or making areas kangaroos for resting less comfortable, e.g. replacing substrate under trees and shrubs with something uncomfortable to rest on. Obviously, testing these options fell outside the scope of this project but such research may be valuable for ongoing management of kangaroos in these and other communities with similar experiences.

Question 4: Which of the following kangaroos do you see?

The absence of significant differences between communities' responses to Question 4 showed residents from each community were being exposed to a similar range of kangaroo "types". Therefore particular communities do not seem to be more at risk of coming into contact with classes of kangaroo that could be considered more likely to be aggressive, e.g. males or single females with young, which might be expected to increase concern relative to other areas.

Question 5: How long ago did you move to this address?

The six communities have existed for various amounts of time. Heritage Park for example, is only around 8 years old. Alone, the length of time that people have lived in their community may not be of direct value managers but in conjunction with other data, such as their views of trends within the kangaroo population it can provide additional insight into respondents' perspectives (see Question 7).

Question 6: Did you know there were kangaroos in your area before you moved there?

The Coffs Coast communities (HH, HP, LR and SB) did not differ significantly reinforcing the similarity of experience between residents from these areas. Even though most people

from South Grafton and Retreat Village knew about the presence of local kangaroos prior to moving to the areas, each community had a group of respondents who were not similarly aware. Thus, these two areas differed significantly in their experience to the other four communities. These results raise the question of why people choose to live in these communities and whether if some choose to do so because of the kangaroos, they will differ in management-related opinion compared to those who choose to do so for other reasons, such as the people who are unaware of the animal presence (see *Limitations, Future Research* below).

Question 7: Since you moved to the area have kangaroo numbers...?

Generally, few people believed that the local population of animals in their community had decreased although at Safety Beach and in Heritage Park there were greater proportions of people with this view than elsewhere.

Attempts to see whether perceptions of changes in the local population were associated with length of time people had resided in their community did not reveal obvious trends, other than in the Retreat Village. In that group, people who thought kangaroos have decreased in numbers had generally lived in the area for a significantly longer period of time than those people with other views.

Whilst for the Retreat Village there is a suggestion of some reason for the observed variation in respondents' views, the absence of other obvious trends within groups, reflects the difficulty of understanding subjective assessments of changes in the local population. For example, depending upon overlap in people and kangaroos use of resources, individuals may perceive relatively more or fewer kangaroos compared to other residents.

Consequently, whilst understanding people's views of local population trends may provide greater context for their preferences for management, objective monitoring of the population will remain important for understanding actual changes and could prove useful for settling disputes about management that are based in perceptions rather than fact.

Question 8: If you knew then what you know now about living with kangaroos would you still have moved there?

Across the six communities the impacts of local kangaroos tended not to be sufficiently great that people would not choose to live in the area if they had the chance again. This is, however, an extreme measure of disaffection with local impacts and may be insufficiently sensitive to detect significant concerns among residents. Consequently, it would probably not be used alone to gauge how communities feel about interactions with kangaroos but does show managers that none of the communities differ at this extreme level.

Question 9: How do you feel about “It is important to have kangaroos in the local area?”

Again, the Coffs Coast communities were closely aligned in their general support for the issue of the importance of local kangaroos. Moreover, unlike many of the respondents from South Grafton and the Retreat Village who responded neutrally or disagreed to some extent, they tended to strongly agree that the animals were important.

Anecdotal evidence from these areas suggests that increased importance of kangaroos among local communities could be associated with increased expectations that managers will provide solutions to negative interactions with kangaroos that benefit both species, or at least do not impact significantly upon the animals. Conversely, in the Retreat Village or South Grafton where fewer residents value the animals respondents may be less likely to support management options that aim to maintain the animals or benefit them in some way (see *Question 23*, below).

Question 10: Which of the following would you prefer to see in your local area?

As for Question 9, respondents did not differ overall between the Coffs Coast communities. In this case their similarity was based in a general desire for there to be free-roaming kangaroos in their local areas. This has obvious ramifications for local management as it suggests these people are not interested in options that will result in restrictions on the local distribution of the animals. Further this has ramifications for local landscape planning as developments that will impact the free-roaming ability of animals are likely to be unsupported.

Conversely, from the Retreat Village and South Grafton there is evidence of not only reduced support for free-roaming kangaroos but the potential for significant intra-community conflict over management. For example, in South Grafton the community is split between those who want free-roaming kangaroos and those who want some restriction on the animals' movements and, unlike the Coffs Coast where such a view was almost absent, a group who want no kangaroos at all. Similarly, in the Retreat Village there was a greater level of support for options other than free-roaming kangaroos but rather than showing similar support as South Grafton for not having them on roads or in yards, a fifth of respondents didn't want the animals in the Village at all, but still did want them nearby.

Such intra-community variation in public opinion may be particularly difficult for managers to deal with as accommodating one group's preference may result in conflict with a substantial proportion of other residents. At least by identifying such variation in advance, managers have an opportunity to address it proactively.

By attempting to understand the reasons for such differences, managers may take steps to deal with variation in management preferences. For example, in the case of the Retreat Village, 83% of those people who did not want kangaroos in the community were concerned about the potential for conflict with the animals, compared to just 31% of respondents who wanted the kangaroos to be free-roaming. In such a case, addressing concern about conflict might provide a way to increase respondents' capacity to accept other management options.

Questions 11 – 14: Dog issues

Dogs represented a definite point of contention at public meetings, other than in the Retreat Village where attendees did not consider them to be an issue because the only pets present in the area must be kept inside the owner's residences.

No significant differences existed in proportions of dog owners between communities which meant that any effort by managers to address dog-related issues would potentially involve about half of each respondent population.

Despite observed similarity in extent of dog ownership, how owner-respondents restrained their pets varied significantly. As a consequence, the levels of effort required to achieve

compliance with local government regulations regarding dog control, i.e. ensuring dogs in a public place are under the effective control of some competent person by means of an adequate leash (NSW Companion Animals Act, 1998), which would likely benefit the welfare of both local kangaroos and pet dogs, might also vary a great deal between communities.

Dog-owning respondents from the various communities also indicated differential involvement of their pets in chasing or barking at kangaroos. Generally, however, dog owners were less likely to be concerned about the prospect of negative interactions between dogs and kangaroos than those respondents who were not dog owners. Again, this highlights a potential point of conflict within communities, particularly where local kangaroos are viewed as important, such as in the four Coffs Coast areas.

Since respondents provided some accounts of local kangaroos killing or injuring canine pursuers it may be possible for managers to use this information to convince dog-owners of the danger of letting pets chase the animals, with positive welfare benefits for both species. Obviously care would need to be taken to frame such an awareness campaign in a way that did not generate unnecessary concern about the prospect of attacks on humans.

The recurring pattern of similarity among Coffs Coast communities but a significant difference between them and South Grafton was once again evident in responses to how negative interactions between dogs and kangaroos should be approached. That South Grafton respondents were more likely to support kangaroo control and less likely to support dog control than the Coffs Coast respondents reinforced the image of a subset of the South Grafton community who generally either did not value kangaroos or disliked them.

Question 15: Are you concerned about the prospect of vehicle accidents with kangaroos in your area?

Although previously identified by managers in the Australian Capital Territory as a key problem of kangaroos in urban areas (K.A.C., 1997), vehicle accidents with these animals has previously received little management focus in the six communities of interest. Certainly, several of the areas feature kangaroo warning signs for drivers but no concerted effort has been made to understand the frequency of road accidents or find effective ways to reduce them.

It was therefore particularly interesting to find that concern about such traffic accidents was consistently high among both South Grafton and the Coffs Coast communities. This suggests it is a topic worthy of more attention from managers. Problematically, responsibility for such an issue ranges across different levels of Government, i.e. local council and the State Roads and Traffic Authority, because some areas have both local roads and highways within and adjacent to them. Residents from Hungry Head expressed frustration related to previous attempts to get these authorities involved since each preferred that the other take the lead in effectively managing local kangaroo-related accidents.

The significantly different view held by the Retreat Village respondents probably comes from the fact that the entire area has a 10km per hour speed limit. Consequently, many attendees at the community meeting were confident that they can avoid collisions with kangaroos. Interestingly, people in this area were concerned that startled kangaroos might collide with cars, which may account for some of the 40% of respondents who did show concern about traffic accidents with the animals. Indeed, during the meeting, one respondent reported that a visitor to the Retreat Village had suffered damage to his car when a startled kangaroo fled her yard and jumped onto the parked vehicle.

Question 16: Have you ever hit a kangaroo with your car, in the local area?

Respondents from Hungry Head and South Grafton were much more likely to have experienced a kangaroo-vehicle accident than those from the other four communities. This highlights the need for these areas to be examined further to see why such incidents might be occurring more frequently there.

Interestingly, through the cross-tabulation of results from Questions 15 and 16, it became clear that although significant differences in concern about traffic accidents existed between residents who had experienced kangaroo-vehicle accidents, and those who had not, a majority of both groups were concerned about such incidents. Thus, taking a community-wide approach to addressing concern seems most appropriate.

Question 17: Which of the following would you prefer to minimise traffic accidents with kangaroos?

Just as the incidence of vehicle accidents differed between communities so too did respondents' preferences for ways to mitigate such accidents. With the exception of the Retreat Village, which as discussed above was generally less concerned about the prospect of accidents due to local conditions, a clear majority of respondents from the other 5 communities wanted warning signs for motorists. Interestingly, discussions with residents suggested that these were typically desired not to assist locals but rather to alert visitors to the danger of such accidents within these areas. Further, since one respondent from South Grafton indicated that the local council had previously rejected her calls for more local signage on the basis that they were generally not desired, such results may be cause for a re-evaluation of such a view.

Aside from this one, generally popular option, the results showed that tailoring management to specific communities may be preferable, dependent upon the success of the strategies that respondents preferred. In this way managers can proactively address conflict between what locals want and the known limitations of such methods' effectiveness. For example, the majority of respondents from these communities want wildlife warning signs but these have been shown to have a limited effect in reducing wildlife-vehicle collisions (Pojar *et al.*, 1975). Consequently, communities may first need to be convinced that there are more effective ways to reduce local accidents, e.g. through extension, before other methods can be successfully implemented.

Further, understanding why people have preferences for particular accident mitigation measures may be an important part of the management process on this issue. To this end, identifying differences in preferences between people who have had a local accident with kangaroos and those who have not, may provide valuable insight into local perspectives.

For example, the cross-tabulation between residents who had hit a kangaroo with their car, or not, and specific preferences for how the frequency of such accidents could be minimised showed significant differences between the groups with different experiences. This comparison revealed that people involved in accidents with kangaroos tended to be less

inclined to want warning signs or reduced speed limits but much more likely to want a reduced number of local kangaroos or increased lighting along roads.

Such results might be interpreted as meaning that people who have had accidents were aware of the possibility before-hand, so signs would not have helped. Rather, it seems that people who have experienced accidents tend to believe that the solution lies less in what drivers could do to avoid collisions, and more in manipulating external factors, such as local kangaroo densities or ensuring that roads have sufficient lighting. Of course, it is important to remember that such relationships have not been shown to be causal and may be influenced by other factors but they do suggest that a closer examination of people's preferences may be worthwhile to develop effective ways of alleviating what is perceived by the majority of local respondents in five of these six communities, as a significant problem.

Question 18: In community meetings, some residents suggested that people could do more to live in harmony with wildlife in the local area. Would you agree with any of the following...?

Once again there was evidence that wildlife in general was less important for the South Grafton respondents than for those from the relatively homogeneous Coffs Coast communities. For each of the options for suggested options for harmonious local interactions between people and wildlife, South Grafton respondents showed the least support and, reciprocally, were more likely to select "none of these" in reply.

Importantly, however, a clear message was evident for local landscape planners, developers and managers. Around half, or more, of each community's respondents wanted blocks left vacant for wildlife to use. This is particularly interesting since a representative from the Coffs Harbour City Council confirmed that leaving such green-space was not a compulsory requirement for land developers (Mark Graham, personal communication).

Question 19: Are you concerned about the potential for conflict between people and kangaroos in your local area?

Mainly because of concern about the potential for people to be seriously injured but also because of the potential backlash that could be associated with such an event, managers have

been particularly interested in limiting the potential for conflict between people and kangaroos in areas where the two species live together.

The results showed, however, that whilst each community had respondents who shared managers' concerns, the proportions of these individuals varied greatly. In fact, some communities' respondents were mostly unconcerned about conflict between people and kangaroos.

The Coffs Coast communities, that were largely unconcerned about conflict between people and kangaroos, differed significantly from South Grafton and the Retreat Village, that had greater proportions of residents who were concerned. As a consequence of these views, managers might expect quite different community management foci between these areas and, in the case of South Grafton and the Retreat Village, possibly greater conflict between local residents.

Where people are concerned about conflict with kangaroos, one might expect that there will be a great emphasis on active management and a desire for managers to "do something" to ensure such conflict does not occur. Conversely, less involvement might be required to this end, by communities who are generally not concerned about such occurrences. Indeed, in community meetings this trend was observed with Coffs Coast people less interested in managers becoming actively involved from this perspective than ensuring that the animals would persist. Conversely, at the Retreat Village a great proportion of respondents seemed interested managers being involved in reducing the likelihood of conflict.

Question 20: Which of these scenarios are you most concerned about in your local area?

The multiple-section approach used in Question 20 proved difficult to interpret in terms of the relative concern about kangaroos attacks compared to other scenarios. However, South Grafton respondents were consistently more concerned about kangaroo attacks when compared to respondents from the other communities. Further, regardless of the alternative, at least 20% of the South Grafton respondents were most concerned about kangaroo attacks. Interestingly, the composition of this group varied between the different sections of the question.

These findings confirm that concern about kangaroo attacks is present among a substantial proportion of South Grafton respondents compared other communities.

Question 21: Which are you most concerned about in terms of aggression towards people?

Aside from demonstrating that communities could differ in their perceptions of whether male and or female kangaroos were of concern regarding human-kangaroo aggression, responses to Question 21 also reinforced the difference in general concern about conflict with these animals between communities. The increased proportion of concern about male and female kangaroos evident from South Grafton and the Retreat Village accounted for a reduced selection of “I am not concerned” by respondents from these areas, relative to those from the Coffs Coast communities.

Question 22: If you were attacked by a kangaroo, what do you think you would do?

Across all of the communities, running away and curling into a ball were the most popular choices for dealing with a kangaroo attack but generally were selected only as frequently as the “I am unsure” option. Interestingly, Redman and Jarman (1999) advocated curling into a ball but recommended not running away if confronted by an aggressive kangaroo. Thus, the respondent populations were generally split between a recommended option, a non-recommended option and having no idea what they would do if attacked.

The one difference from this general pattern was South Grafton, where a reduced proportion of respondents intended to run away, almost half would curl into a ball, and the lowest proportion of “I am unsure” responses were recorded. Since other results also showed that this community had the greatest proportion of respondents who had received information from managers about how to live with kangaroos it seemed that there might be some relationship between the two.

Consequently cross-tabulations were undertaken to look at possible associations between receiving information from managers about how to live with kangaroos and what people would do if attacked. Firstly, uninformed respondents were more likely to be unsure than respondents about what they would do in such a situation. Further, informed respondents were more than twice as likely to choose the recommended option of “curl into a ball” and a

third less likely to choose “run away” than uninformed respondents. Since these contributed to significant differences between uninformed and informed groups, where informed respondents were more likely to choose key, correct options, managers might be somewhat confident that their education efforts can improve community understanding of the appropriate way to deal with such negative interactions.

Obviously, such analyses are not an ideal substitute for controlled tests of the impact of education campaigns but they do provide managers with an indication of likely associations between supply of information and respondents choices. Further, whilst the overall results were promising for local managers who were trying to better prepare people for incidents of kangaroo aggression, many informed respondents still chose less than ideal options, suggesting there is a way to go in optimizing education efforts. If managers are interested in increasing the proportion of respondents in these communities who are prepared to react appropriately to kangaroo aggression it seems additional effort will be required not only in distributing information but in ensuring it is as effective as possible in delivering specific messages to target audiences.

Question 23: If a kangaroo has been aggressive towards people should it...?

Generally, relocation was the favoured option for dealing with aggressive kangaroos across all six communities. Unfortunately, local managers have several reasons for being hesitant to follow this line of action for several reasons. Firstly, aside from the variety of welfare issues associated with the capture, transport and release of kangaroos, relocation relies upon correctly identifying the aggressive individual from among the local population. Whilst it has been shown that people can learn to recognise individual kangaroos (Jarman *et al.* 1989) the ability of an attack victim to do so may be questionable, particularly if they had little time to see the animal responsible. Further, such activities can be expensive and require individuals with appropriate expertise to maximise the chances of success.

Despite these problems, which one might assume that few respondents have considered, it is clear that managers need to seriously consider this option or at least how to manage aggressive kangaroos without disaffecting the majority of individuals who prefer relocation over other options.

Rather than being unusual, the general preference for non-lethal control of aggressive kangaroos actually reflects a recurring phenomenon in studies of urban-wildlife conflict. In North America it has been shown that acceptance of lethal methods of control were actually more strongly associated with damage by wildlife than with impacts on human safety (Loker *et al.*, 1999).

Other studies from overseas, investigating community preferences for urban deer management have also found lethal control to be unpopular, with participants instead preferring translocation (Decker & Gavin, 1987; Stout *et al.*, 1997; Chase *et al.*, 1999). Similarly, in Australia, only minimal support was recorded for killing Torresian crows (Jones & Everding, 1994) in suburban areas.

Aside from the general preference for translocation of aggressive animals, there were also key differences between communities. Unlike many other questions, in this case South Grafton and the Retreat Village differed significantly from each other as well as from the Coffs Coast communities. In South Grafton around a third of respondents wanted aggressive kangaroos killed, placing managers in a difficult position since lethal control is typically achieved by shooting but this is not typically feasible in residential areas due to safety concerns. Conversely, the Retreat Village displayed the lowest proportional support for killing aggressive kangaroos and the highest proportional support for relocating them. This variation emphasises that even groups which appear to be particularly similar may hold quite different preferences for management.

Question 24: If kangaroos are culled to reduce the population size, is it important to you that they be used for something, e.g. pet food or leather?

Responses to Question 24 provided two key pieces of information that were relevant for managers. Firstly, those people who did not specifically object to culling generally believed that culled animals should be used for something. Secondly, other than in South Grafton, each community contains a core group of around one third of respondents who object to local kangaroos being culled. Thus, any decisions to undertake culling is likely not to be supported by a core group of local residents.

Question 25: If you or a family member were attacked by a kangaroo, what would you do?

Most respondents were likely to call some agency or authority following an attack by a kangaroo but the range of different likely contacts suggests that some inter-agency communication will be required both to ensure a consistent response and so that the relevant authorities are promptly made aware of the situation. Generally, NPWS and the local council were most likely to be contacted about attacks. Coincidentally, these are the two groups who have been identified by NPWS as preferred contacts (Redman & Jarman, 1999).

Respondents' preferences for who they would call differed between communities. For example, few people from the Retreat Village indicated that they were likely to call the local council but at least half indicated an intention to call the site manager, probably because they are used to this person as a first point-of-call for issues occurring within their community.

Further, the intention of almost 40% of South Grafton respondents to call the Police was higher than among any other group. Given the relatively high proportion of respondents from this community who thought that aggressive kangaroos should be killed, it may be that these people have an expectation that the Police, who carry guns, may be able to resolve the situation by shooting the animals.

Obviously, if managers want to ensure that specific agencies are contacted following such negative interactions then increased awareness of the appropriate contacts should be targeted via communication with residents of these communities.

Question 26: Are you concerned about kangaroos as a disease risk, for humans, in your area?

Most respondents from each of the six communities expressed no concern about disease transmission by kangaroos. Consequently, it seems there is little need for managers to specifically address this issue in particular areas, despite the concern of individual residents, e.g. the meeting attendee from Hungry Head who believed he had contracted Q-fever from kangaroos.

Nonetheless, monitoring this opinion, over time, may be valuable for managers to detect changes, particularly increased concern which may be associated with changes in residents' comfort in living near the animals and therefore their preferences for managing kangaroos.

Question 27: Have you received any information, e.g. a leaflet from wildlife managers, about how to live with kangaroos in your area?

The pattern of affirmative responses to Question 27 generally matched the information provided to me by NPWS about provision of leaflets to the South Grafton and Coffs Coast communities (David Redman, personal communication) as well as a visit to the Retreat Village to discuss local wildlife issues (Amanda Smith, personal communication). However, two unexpected results were observed. Firstly, despite three years of repeated contact by NPWS, via letter drops, in the area of South Grafton that I surveyed, just 60% of respondents indicated having received such information. Secondly, although no formal efforts have been made by NPWS to educate Lake Russell residents about living with kangaroos, almost a fifth of respondents indicated having received some such information.

The disparity between effort and response in South Grafton suggests that managers may need to diversify the means they use to get information to people as it seems it may be only 60% effective in even registering with them, let alone having an effect on their behaviour.

Although it is possible that the Lake Russell results reflect some lack of reliability in responses it may alternatively be interpreted as evidence that suggest that local residents have been active in distributing some of the information about living with kangaroos that is freely available from the local Coffs Harbour NPWS office (David Redman, personal communication)

Question 28: Should people who move into an area with wildlife, such as kangaroos, be provided with information on how to best live with these animals?

At community meetings, attendees made it clear local residents both add to and draw from communal knowledge about interacting with the animals. However, the meetings had equally shown that many people felt that new residents may not learn quickly enough through such passive means and that active efforts to educate them might be beneficial. This may explain

the absence of differences between communities and suggests why respondents who are current residents believe that new residents will be aided by receipt of information from managers about how to live with kangaroos.

Potentially, there may also be situations where communal knowledge might simply not exist, for example where a large number of people moved into a kangaroo-inhabited area more or less simultaneously. This is particularly relevant as current expansion of both Safety Beach and the Retreat Village will create two such situations.

4.4.3 Questions specific to the Retreat Village

Q10: How do you feel about the following statement: “The kangaroos should be allowed to remain within the bounds of the Retreat Village”

At the Retreat Village community meeting, the issue of whether or not kangaroos should be allowed to stay was the focus of much debate. At the time it seemed that the community was roughly split between accepting and rejecting the animals’ presence. Since the results show most respondents were in favour of the animals staying, it seems management may be better focussed on facilitating harmonious interaction between people and kangaroos, particularly through building capacity for concerned residents to cohabitate with the animals, rather than trying to find acceptable ways to remove them.

Q22: Who do you feel should be responsible for ensuring that people and kangaroos do not come into conflict in your community?

It was perhaps more interesting to see that respondents generally did not accept responsibility for harmonious interaction with wildlife than to see which agency or authority they felt should be responsible. This suggests a heavy reliance on managers to solve problems on residents’ behalf. To address this issue in the long term, whilst also meeting the community’s apparent preference for kangaroos remaining in the Retreat Village (above), managers might consider trying to empower residents to live harmoniously with kangaroos and avoid negative interactions rather than being dependent upon others for reactive solutions.

Q16: Have nearby kangaroos ever made you feel uncomfortable about stepping out of your house?

Raised only as an issue by residents of the Retreat Village, concern about leaving their home because of nearby kangaroos was revealed to be quite a widespread phenomenon. Ultimately, 1 in 3 respondents indicated that they have had such an experience. Since it would be unrealistic to ignore such a widespread issue, it seems managers can either remove the kangaroos or build residents' capacity to deal with such situations appropriately. In light of the community's wish to maintain the animals, it seems the latter option requires further investigation.

4.4.4 Other cross-tabulations

The importance of local kangaroos

One of the key differences between respondents from the Coffs Coast communities and those from South Grafton and the Retreat Village was varying views other importance of local kangaroos. As a result I sought to explore relationships between this and other variables.

The significant difference observed in views of the importance of local kangaroos between respondents who were aware of the presence of local kangaroos before moving to the area, and those who were not, adds some weight to an argument for not only ensuring that the animals' presence is advertised but so too the community's general attitude towards kangaroos. By giving prospective residents an indication that, for example, the vast majority of residents believe the local kangaroos are important (as in the Coffs Coast communities) these people would have the opportunity to decide whether or not their views are likely to fit comfortably with those of their new neighbours and the community might be less likely to display significant internal variation regarding the animals' importance or how they should be managed.

Further support for such an option may be drawn from the results of a cross-tabulation between respondents' preferences for scenarios involving kangaroos in their local community and the extent to which they agreed the animals were important. Among the people who agreed or strongly agreed that kangaroos were important to them almost 90% wanted the animals to be free-roaming. This percentage dropped to 47% in the neutral group and down to just 6% among those respondents who disagreed or strongly disagreed. Conversely, whilst none of the people who agreed local kangaroos were important wanted no local kangaroos, more than 40% of the group who disagreed also selected "No kangaroos at all" in response to Question 11. Therefore, it seems that an injection of people who do not believe the animals are important into a community of residents that generally agrees that they are, might result in conflict regarding management preferences such as the amount of freedom the animals should be allowed.

Explaining differences in response rates

Although it is tempting to focus first on the lower response rates, the aberrant result in this project was the participation of Retreat Village residents. At 71% it was considerably higher than those observed from the other 5 communities and was no doubt associated with recent local incidents of aggression by kangaroos toward people. Given the occurrence of these confrontations it seems that I probably could not have sampled at a better time, since kangaroo aggression and how to deal with it were consequently highly topical issues.

For the other communities, where similar incidents had not recently occurred to similarly boost people's interest in kangaroo management, quite consistent response rates were observed. For the Coffs Coast this was expected but given the history of negative interactions between people and kangaroos in South Grafton I was initially surprised to see less than half of the community respond.

On closer examination, however, several issues probably contributed to a low level of participation from this community, where kangaroo management is ongoing. Management in the area is largely based in saturating the local community with information about how to live with kangaroos or reminders, such as warning signs at the local primary school and Golf Club, that there is the potential for negative interactions with the animals. Consequently, it seems that many locals may be reaching a point of frustration, or fatigue, on the issues of local kangaroos and were therefore simply not interested in replying to the questionnaire.

This, together with a significant difference between Grafton respondents and non-respondents based on the latter group being more inclined to disagree with the local importance of the animals provides better perspective of why they were less likely to want to contribute to a project about the animals.

Feedback from the distribution of results to participating communities

One of the important aspects of this research was ensuring that participating communities received some feedback on the project and thanks for taking part. Whilst it was not the specific aim of distributing the results summary to generate more responses from residents, at least one person from each community contacted me to thank me for the results and to talk more about their experiences with local kangaroos. In each case, the people who contacted

me were happy to know that the information they supplied had contributed to “something”, rather than having simply disappeared.

4.4.5 Limitations

Non-response

This attempt evaluate the effectiveness of survey-based research in assisting peri-urban kangaroo management was not without its limitations. As with any project dependent upon community-participation, the success of data collection ultimately relies on the public’s willingness to attend meetings, complete questionnaires or take part in interviews. Naturally, it is possible to enhance this willingness by tailoring the approach used to obtain people’s involvement (Dillman, 2000) but some individuals will still choose not to participate.

As in the previous two case studies, bridging the gap between respondents and non-respondents was challenging. However, the small geographic scale of this project meant that an attempt to use face-to-face interviews to gather non-response data was possible. Although due to time constraints I necessarily limited the non-response effort to a single visit to each community, the small proportion of people who declined a brief interview about local kangaroo was promising for similar, future research, particularly if multiple visits are possible to account for residents who are not at home.

Future research

Aside from a diverse range of ecological research that could be undertaken to compliment this investigation of the social aspects of peri-urban kangaroos, and consequently provide managers with a holistic view of the scenario they are trying to manage, other avenues of research were uncovered. Paramount among these was the question of why patterns of responses observed in this study occurred at all.

Whilst this project was aimed at examining the preferences held by the residents of kangaroo-inhabited communities it was not my intention to investigate the deeper causes for relationships between them. Indeed, it is immediately more important for local managers to simply know that these communities did differ, rather than why they did.

However, in the longer term, understanding the factors that drive observed similarities and differences observed between communities such as those examined in this research, may enhance both future management and planning.

Although not explicitly examined, it seemed that residents' motivation for moving to these communities may be closely tied to their kangaroo-related preferences. Residents from the Coffs Coast communities seem to have chosen to live in these areas based on a desire for a particular lifestyle which is, for many, dependent upon the presence of kangaroos. This seems to explain why there was widespread support in these areas for the importance of local kangaroos and the notion that they should be free-roaming.

By comparison, Retreat Village residents did not see kangaroos as being similarly essential to a satisfying lifestyle in the local area. Many still seemed to find the animals important, perhaps explaining why they did not want aggressive animals to be killed, but others would be happier if the animals did not exist so close to homes.

Lastly, in South Grafton, kangaroos were a low priority for many residents, especially non-respondents. Unlike the Coffs Coast, or even the Retreat Village, where people appeared to be seeking a particular experience that in some way involved kangaroos, for many South Grafton residents the occurrence of kangaroos did not aid their decision to live there. Rather, some people seemed to have moved to the area almost in spite of the kangaroos, which they consider to be a significant nuisance.

Whilst these descriptions of possible reasons for wanting to live in each of the areas are crude they serve to demonstrate that there may be cause for deeper investigation.

4.5 Summary

In evaluating this case study it is clear that it is possible to engage the residents of kangaroo-inhabited communities in such a way that managers' questions about what the community wants, especially regarding expectations and specific preferences for managing local kangaroos, can be answered.

By opening lines of communication with residents it became possible not only to better understand the reality of what managers see as focal issues, such as local concern about kangaroo aggression, but also to identify other aspects of living with kangaroos that deserve attention, e.g. widespread community concern about kangaroo-vehicle collisions.

The results also made it clear that despite similarities in residents' experience between six communities where people live in close proximity to kangaroos, a range of significant differences existed in their views of the animals, their concerns about interactions with them, and their preferences for how they should be managed. Importantly, such variation occurred not only within communities, but also between them.

Whilst one might expect that communities with little history of conflict would differ in management preference from those where kangaroo aggression has a significant public profile, finding that even these latter communities do not necessarily want aggressive animals dealt with in the same way is an important indication that managers should further continue investigations such as this. Identifying such inter-community variation is valuable for optimising management of peri-urban kangaroo because the differences observed between communities suggest that adopting a generic response to managing interactions between people and kangaroos is likely to be inappropriate.

Ultimately, it seems that by investigating the human-dimensions of interactions between people and peri-urban kangaroos, it is possible to providing managers with valuable information about relevant experiences and preferences of both individuals and whole communities.

5. Synthesis

A decade has passed since Australian wildlife managers were encouraged to go beyond a scientific focus (Korn, 1994) and better understand the human dimension (Temby, 1995) but there has not yet been a widespread uptake of human dimensions research in this country.

In the State of New South Wales, where the three case studies of this thesis were based, managers generally do not actively seek to understand what the public knows, feels or wants with regard to wildlife. Rather, their understanding of the social context they work in is forged from the submissions of motivated individuals and special-interest groups or as the result of opportunistic interactions with the public. Such an approach has been termed “passive-receptive” (Decker & Chase, 1997).

Whilst this may have served managers well in an era when the public generally accepted their expertise and authority, it is clear that times have changed. In contemporary society, public dissension regarding appropriate or preferred wildlife management has become relatively common and there is increasing pressure on managers to meet particular social expectations (Decker & Enck, 1996). These changes in the public demand a more “inquisitive” approach (Decker & Chase, 1997) from managers, to ensure that management planning and action are relevant to the public, else they place themselves at risk of conflict.

As Jones *et al.* (1998) suggested, such a change in Australian wildlife professionals’ fundamental approach to public involvement is likely to be slow. Consequently, this study was not conducted with an expectation that wildlife managers en masse would suddenly alter the way they approach their task.

Instead, I believed that if demonstrable benefit could be derived from engaging the public about wildlife management, as seemed likely based on the overseas experience (Vining & Ebreo, 1991; Decker & Chase, 1997), then it might be possible to build managers’ interest and confidence in engaging the public both about wildlife and about themselves. In this way, it seemed possible to enhance the legitimacy of human dimensions research, and thereby address a key impediment to its uptake (Decker *et al.*, 1989; Gigliotti & Decker, 1992; Temby, 1995; Jones *et al.*, 1998).

Because I anticipated that the majority Australian wildlife professionals would, like me, lack experience with social research, I used simple approaches that tended to focus mainly on aspects of human dimensions found at the “top” of the cognitive hierarchy (Fulton *et al.*, 1996). I make no apologies for this strategic choice, and it was not my intention to dismiss either the significant advances in human dimension approaches that are evident among the existing body of international research (see, for example, Human Dimensions of Wildlife Management), or the alternative approaches previously applied here in Australia (Miller, 2000). Rather, I felt that, based on the relative infancy of human dimensions research in this country, a “crawl-before-you-walk” ethic was most appropriate.

To this end, I aimed to utilise human dimensions research in real-world scenarios to evaluate its effectiveness for the Australian experience. In spite of Decker & Enck’s (1996) warnings about the limited ability of problem-focused studies to “*contribute to a generalisable knowledge base*” or to “*provide new insights into human attitudes and behaviours*” the promise of “*immediate utility*” for management made such an approach seem most appropriate for the current stage the discipline, and managers, have reached.

Similar problem-focused studies previously undertaken in Australia have demonstrated their utility primarily through an ability to test managers’ assumptions against reality. Jones & Everding (1994), for example, used simple human dimensions research to better understand preferences for management of Torresian Crows, whilst Jones & Thomas (1998) compared management preferences for Australian Magpies between groups of people with different experiences of the animals.

In both instances, the authors noted the “surprising” results obtained. As well as being an important point of commonality with this research, such unexpected results represent an important incentive for Australian managers to adopt human dimensions research.

Although such studies may also confirm the expectations of managers, it is rejection of pre-existing assumptions, in particular which may be particularly appealing to Australian wildlife professionals. This is because these professionals operate in a political environment where they may be increasingly held accountable for their decisions. Moreover, erroneous social assumptions may prove to be equally damning as scientific ones.

The Wild Horse Case Study exemplifies the problems that surprise outcomes can pose for managers as well as the effects of social accountability. The latent assumption of public acceptance of aerially culling wild horses was not wholly accurate and the resulting fracas and politically-driven ban on aerial culling cost the National Parks and Wildlife Service (NPWS) both credibility and the option to employ an important control technique for wild horses in the future.

This study showed it was likely that such outcomes could have been avoided by first examining the human dimensions of that scenario. The obvious heterogeneity among respondents suggested that managers needed to invest more time and effort in deciding upon an appropriate course of action.

Similarly, both the Flying-fox and peri-urban kangaroo case studies offered some surprising and important insights into public attitudes towards and preferences for wildlife management.

Again, like Jones & Thomas (1998) who found that preferences for magpie management differed between people with different experiences of the animals, so too this research revealed differences between respondents in association with experience. However, in this case responses varied significantly between entire geographic treatments, suggesting that management initiatives for Flying-foxes may be received differentially between various parts the State.

In the case of kangaroos, whilst respondents from some communities with similar experiences shared preferences for local management of the animals, others, including the two with the greatest history of conflict with the animals, differed significantly. Like the Flying-fox case study these results suggested that a homogenous approach to management would not be appropriate.

An active approach to understanding the public also provided benefit via identification of alternative options for management. This was best demonstrated by the general support observed among public respondents for subsidies for crop-mitigation measures which do not harm Flying-foxes, e.g. exclusion netting. Results suggested that the public appeared to value both fruit growers' right to make a living and the animals' welfare rather than preferring one

over the other. The high levels of support for such an option make it worthy of further investigation.

Finally, an inquisitive human dimensions approach in the kangaroo scenario, revealed that managers' focus on preventing and effectively dealing with kangaroo aggression towards people was overshadowed by public concern about traffic accidents with kangaroos. Although initial reactions from South Grafton residents following initial attacks suggested to managers that dealing with dangerous kangaroos should be their primary focus, consulting with stakeholders in a representative way provided a clear indication that more residents, particularly those from other communities, were actually concerned about the incidence of animals being hit by cars. This showed that consulting with residents could also provide context for management priorities.

Despite some limitations in the methods used, which might be addressed by a more strategic choice to aim for quality of information, rather than quantity (Dillman, 2000), this project successfully applied human dimensions research to Australian wildlife management scenarios.

Like previous Australian problem-focused studies (Jones & Everding, 1994; Jones & Thomas, 1998), it was made clear that benefits of this research for managers lay in the ability to test assumptions about the public or specific stakeholder groups, before risking those assumptions in real-world management. This, in particular was seen to offer substantial benefit to managers in an increasingly demanding social environment.

Across various geographic scales and for a range of common problems, including vertebrate pest management, wildlife damage, threatened species conservation and urban wildlife, actively seeking information from the public about their views, knowledge and preferences, produced valuable results for management, including novel insights.

As a consequence I believe this project has shown that human dimensions research can be applied in the Australian context to understand people and, therefore, improve wildlife management.

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Appendices

Appendix A: The 2002 Wild Horse Management Questionnaire

Appendix B: The 2003 Flying-fox Management Questionnaire

Appendix C: The 2004/2005 Kangaroo Management Questionnaire

Appendix D: Feedback for participants from the Kangaroo Management Questionnaire

If you feel that an important aspect of this subject has been overlooked or if you wish to add further comments, please use this space:

Thank you for your time and co-operation



Human Dimensions Research
"Understanding people to better manage wildlife"

**Human Responses to
Wild Horse Management in
Guy Fawkes River National Park**

Mail-out questionnaire 2002

Guy Ballard
Ecosystem Management
University of New England
Armidale, NSW, 2351
Phone 02 6773 5217
E-mail: wildlife@une.edu.au

Section One - Personal Details

The information collected from this section will allow comparisons to be made between groups of respondents with similar characteristics. Please tick or cross the box of the response that best describes you.

As stated in the introductory letter, all information that you provide is confidential

1A. Gender:

- Male
 Female

1B. Age: In what year were you born?

19____

1C.1 Background (Region): Is your background rural, coastal or metropolitan?

- Rural
 Coastal
 Metropolitan

1C.2 Background (Type): In relation to your answer above, are you from a town, city or property?

- Town
 City
 Property

1D. Allegiance:

Which of the following do you consider yourself to be?

- A rural person
 A coastal person
 A city person
 None of these

1E. Education

What is the highest level of education that you have obtained. If you are currently enrolled in a course that is a higher level of education than you have previously studied, please select the level that corresponds to your current enrollment.

4I. Based on the heritage value of the wild horses in the GFRNP, would you support the establishment of a managed, heritage herd?

- Yes, in Guy Fawkes River National Park
 Yes, outside the National Park, on State land
 Yes, outside the National Park, on private land
 No
 Other (*Please print*) _____

Additional Comments:

If you have anything else to add on the issue of Wild Horse Management, please use the space on the next page.

Thanks

Thank you very much for taking the time to complete this survey. Your assistance will help us to better understand the public's knowledge of and preferences for different approaches to this important wildlife management issue.

Results

The results of this study will be available from Guy Ballard after 01/01/03.

You can contact Guy at:

Ecosystem Management
University of New England
Armidale, NSW, 2351
E-mail: wildlife@une.edu.au

4F. Do you feel that these findings justify maintaining the Guy Fawkes River National Park wild horses?

- Yes, these findings justify maintaining all of the wild horses
- Yes, these findings justify maintaining some of the wild horses
- No, these findings do not justify maintaining any of the wild horses
- I am unsure

4G. Before the Working Party was established, the NSW Minister for the Environment determined that any horses with heritage significance would not be killed but would be removed from the Guy Fawkes River National Park.

Do you agree with this plan?

- Yes
- No
- I am unsure
- This issue is unimportant to me

Comments: _____

4H. Do you feel that the findings of the Heritage Working Party justify any special management of these horses?

- Yes, these findings justify special management
- No, these findings do not justify special management
- I am unsure
- This issue is unimportant to me

Comments: _____

- Primary school education
- High school graduate, *please specify level, e.g. Year 9* _____
- University undergraduate degree
- University postgraduate degree
- No formal education

1F.1 Shooting:

Have you ever shot animals for recreation?

- Yes
- No

1F.2 Have you ever shot animals for profit or for the purpose of reducing their numbers?

- Yes
- No

1G.1 Involvement with horses

Have you ever owned a horse?

- Yes
- No

1G.2 If "yes", about how many horses have you owned?

(Please print) _____

1G.3 If you have owned a horse, about how long ago did you last own a horse?

(Please print) _____

1G.4 How often do you have live contact with horses?

- Never
- Daily
- Weekly
- Fortnightly
- Monthly
- Six monthly
- Less than once a year

1G.5 Are you a member of any horse or equestrian organisations?

- Yes
- No

1G.6 If "yes", which horse or equestrian organisation/s do you belong to?

(Please print): _____

1G.7 Have you seen wild horses in Australia?

- Yes
- No
- I am unsure

1G.8 If you have seen wild horses in Australia, where have you seen them?

(Please print): _____

Section Two - Knowledge and Beliefs

This section will allow comparison and examination of respondents' opinions and their level of factual knowledge about horses. Please tick or cross the box that corresponds to your preferred answer.

2A. Wild horses eat plant species that are also consumed by cattle, sheep and native animals such as kangaroos.

- I agree
- I disagree
- I am unsure
- This issue is unimportant to me

4E.2 For which of the following animals should aerial culling be permitted?

(You may choose more than one animal if you wish)

- Kangaroos
- Wild pigs
- Emus
- Wild dogs
- Wallaroos
- Wild goats
- Wild cattle
- None of these 7 species of animals should be culled aerially
- No animals of any sort should be culled aerially

4F. The NSW Minister for the Environment's Heritage Working Party prepared a report on the horses of the Guy Fawkes River National Park. The following is an excerpt from that report.

The working party concludes that these horses:

Are important in the cultural history of the Guy Fawkes area

Have special association with a group of persons of importance in the cultural history of the Guy Fawkes area, namely the Light Horse regiments

Have a strong association with some sections of communities in the Guy Fawkes area

Are important in demonstrating the principal characteristics of an item of significant national cultural heritage, namely the brumby

For these reasons, the Working Party concludes that the Guy Fawkes River National Park horses have significant local heritage value, sufficient to warrant their being managed on this basis.

4C.2 Do you currently agree that aerial culling of wild horses should be totally banned in NSW?

- Yes
- No
- I am unsure
- This issue is unimportant to me

4D. Associate Professor Anthony English, from the Faculty of Veterinary Science, at the University of Sydney, prepared an independent report in the October 2000 culling operation for the NSW Minister for the Environment. He found that the culling operation was conducted in a humane manner. He also recommended that aerial culling be retained as a method of controlling feral animals in NSW, including wild horses. Charges brought against NPWS for inhumane treatment of animals during the culling operation were formally dismissed in 2002.

Does this change your opinion about the ban on aerial culling of wild horses?

- Yes
- No
- I am unsure
- This issue is unimportant to me

4E. If you object to horses being shot (aerially or otherwise) as a means of population control, please select your reason/s for this from the list below.
(You may choose more than one option)

- I don't support controlling animals by killing them
- I appreciate/love horses
- I don't believe that shooting horses is humane
- I believe that horses have a special relationship with people and do not deserve to be shot
- Other (Please specify): _____

2B. Wild horses are native to Australia.

- I agree
- I disagree
- I am unsure

2C. Wild horse cause damage to native trees by chewing bark and roots.

- I agree
- I disagree
- I am unsure

2D. Wild horses cause significant damage to soils in Australia.

- I agree
- I disagree
- I am unsure

2E. Wild horses are significant competitors with native species such as kangaroos.

- I agree
- I disagree
- I am unsure

2F.1 Which of the following scenarios would you prefer to see in NSW?
(You may choose more than one option)

- No wild horses at all
- No wild horses in any NSW National Parks
- Wild horses in all NSW National Parks
- Wild horses in some NSW National Parks
- Wild horses on private land or special reserves
- Other (Please specify): _____

2F.2 If you want wild horses to exist in NSW should they be:

- Managed populations
- Unmanaged populations
- I am unsure

Section Three

Preferred Management for wild horses in NSW National Parks

This section will aid the development of a better understanding of the public's preferences relating to wild horse management

3A. Do you support aerial culling of wild horses in NSW National Parks?

- No, I do not support it under any circumstances
- Yes, I support it
- Yes, I support it but only under certain circumstances
(Please specify) : _____

- I am unsure
- This issue is unimportant to me

3B. If all of the following were practical options, which would be your preferred methods of control for wild horses?

(You may select more than one option)

- No control
- Aerial shooting
- Ground-based shooting
- Contraception
- Poisoning
- Capture and euthanasia
- Capture and removal to private property
- Capture and removal for consumption by humans/pets

3C. Are any of these methods unacceptable to you?

(You may select more than one option)

- No control
- Aerial shooting
- Ground-based shooting
- Contraception
- Poisoning
- Capture and euthanasia
- Capture and removal to private property
- Capture and removal for consumption by humans and/or pets

Section Four

Public reponse to management of wild horses in Guy Fawkes River National Park

This section is designed to explore how people respond to different management options for wild horses in the Guy Fawkes River National Park

4A. Have you ever visited Guy Fawkes River National Park (GFRNP)?

- Yes
- No
- I am unsure

4B.1 Are you aware of the wild horse culling operation undertaken in October, 2000 by NSW National Parks and Wildlife Service in the Guy Fawkes River National Park?

- Yes
- No
- I am unsure

4B.2 If you are aware of the operation, how did you hear about it?

- I don't remember
- TV
- Radio
- Print Media, e.g. newspapers and/or magazines.
- Word of mouth
- Other

4C.1 Following this culling operation, the NSW Minister for the Environment completely banned aerial culling of wild horses in NSW.

Did you agree with this decision at the time?

- Yes
- No
- I am unsure
- I was unaware of this decision

5D A key aspect of managing Flying Foxes is understanding changes in the size of the population. Some people have indicated that they are not confident that the counts of Flying Foxes are sufficiently accurate. Do you feel that counts of Grey-Headed Flying Foxes are accurate enough?

Yes No I didn't know they were counted I am unaware of the methods I am unsure

Section Six: Public Responses to Future Management Options for Fruit Growers.

Consultation with members of the public resulted in the following suggestions for potentially managing future conflict between Flying-Foxes and fruit growers. Please read these options and then answer the question below. Your response is important in determining the level of public support for each.

Option A: Industry Restructure –

Rather than have ongoing conflict with flying foxes, commercial fruit growers would be given the option to be paid to permanently remove their orchards.

Option B: Netting Subsidies –

To make netting affordable to growers who wish to remain in the Industry, subsidies would be offered for crop protection netting.

Option C: Remuneration for fruit damaged by Flying Foxes –

Where Flying Foxes rely on commercial fruit for food or where netting is not an option, growers who want to remain in the Industry would be remunerated for the fruit damaged by Flying Foxes.

6A Do you see merit in exploring any of these potential management options? (You may tick more than one option)

Yes, Option A Yes, Option B Yes, Option C No, none of these I am unsure

Thank you very much for completing this questionnaire.

If you have any further comments about Grey-Headed Flying Foxes or their management, please use this space to write them down.

A Survey of Interactions Between Grey-Headed Flying Foxes and the Public.

Thank you for taking part in this important project. This research is being conducted for the NSW Flying Fox Consultative Committee by Guy Ballard, a PhD student at the University of New England. The questions have been designed in consultation with members of the public. Your responses are anonymous. Please do not place your name on this questionnaire.

Section One: Local Experiences with Flying Foxes

The section addresses experiences you have had with Flying Foxes. Your responses will be important in determining the type and frequency of interactions that occur between people and Flying Foxes across NSW. Please tick the box next to your preferred response.

Q1A. Have you ever heard of animals called Flying Foxes? Yes No I am unsure

Q1B. Have you seen Flying Foxes in the wild? Yes No I am unsure

Q1C. Have you ever touched or held a Flying Fox? Yes No I am unsure

Q1D. Do Flying Foxes in your garden, or local area, wake you at night? Yes No I am unsure

Q1E. How often do you notice Flying Foxes in your local area?

All year round For six months of the year For three months of the year

For one month of the year A fortnight per year Less than a fortnight per year Never

Q1F. Please indicate when you notice Flying Foxes in your local area by circling the month or months from the list below.

January	February	March	April	May	June
July	August	September	October	November	December

Q1G. How do you know when Flying Foxes are in your local area? (You may select more than one option.)

Not applicable I see them I hear them I smell them Other: Please describe _____

Q1H. Are you, or is someone you know well, a Flying Fox carer or rescuer?

Yes No I am unsure. >>> If yes, which "carer organisation" are you associated with? _____

Q1I. Do you live near (within one kilometre of) a Flying Fox roost or camp site?

Yes No I am unsure

Q1J. Should potential residents be told that there is a Flying Fox roost/camp site near the house before they rent or live in it?

Yes No I am unsure

Section Two: Personal Details

This section will provide a better understanding of trends in attitudes, views and preferences held by groups with similar characteristics. Your responses are anonymous.

Q2A. Are you: Female Male

Q2B. In what year were you born? 19_____

Q2C. What is the highest level of education you have completed?

No formal education Primary school High school – Year 7 - 10 High school – Year 11/12

TAFE Certificate or similar Undergraduate University degree Postgraduate University degree

Q2D. In which region have you spent the greatest proportion of your life? (You may tick more than one option if applicable)

Coastal Rural Metropolitan

Q2E. If you were NOT born in Australia: (i) What year did you arrive in this country? _____

(ii) What is your country of origin? _____

Q2F. To improve communication with all members of the public, we would like to know the following:

(i) Do you have any difficulty reading English? Yes No

(ii) Do you have any difficulty understanding spoken English? Yes No

(iii) Did you require help from someone else to complete this questionnaire? Yes No

Section Three:

Please respond to the following series of statements (not necessarily facts) about Flying Foxes that have been expressed by members of the public. Your responses will provide an understanding of people's opinions about Flying Foxes.

Please circle your responses.
(1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, 5 = strongly disagree)

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
3A Flying Foxes are intelligent animals.....	1	2	3	4	5
3B Flying Foxes are a significant problem for the NSW Fruit Growing Industry in areas east of the Great Dividing Range.....	1	2	3	4	5
3C Flying Foxes are important in NSW forest ecosystems as pollinators and seed dispersers.....	1	2	3	4	5
3D Flying Foxes prefer to eat commercial fruit species rather than native foods (eg. Blossom).....	1	2	3	4	5
3E Flying Foxes should be eradicated from fruit growing areas.....	1	2	3	4	5
3F Any commercial fruit grower with a firearms licence should be able to shoot Flying Foxes to protect their crop.....	1	2	3	4	5
3G There should be no restriction on the number of Flying Foxes that Commercial Fruit Growers can shoot to protect their crops.....	1	2	3	4	5
3H Damage to backyard fruit and plants is a small price to pay for having Flying Foxes in the local area.....	1	2	3	4	5
3I Flying Foxes are threatened by habitat removal and loss in NSW.....	1	2	3	4	5
3J Humans do not benefit sufficiently from Flying Foxes for them to be protected in NSW.....	1	2	3	4	5
3K I would be concerned if, in the future, Flying Foxes only existed in zoos and fauna reserves.....	1	2	3	4	5
3L Killing Flying Foxes should be completely banned in NSW.....	1	2	3	4	5
3M Governments should offer subsidies for methods of fruit crop protection, like netting, that do not harm Flying Foxes.....	1	2	3	4	5
3N The noise and odour of Flying Foxes is a small price to pay for having these animals in your local area.....	1	2	3	4	5
3O To stop Flying Foxes eating commercial fruit crops we should replant native foods and replace important habitat for them.....	1	2	3	4	5
3P Flying Foxes deserve to be protected from harm in NSW.....	1	2	3	4	5
3Q Flying Foxes should be protected because they are "cute".....	1	2	3	4	5
3R Many Commercial Fruit Growers, east of the Great Dividing Range in NSW, are forced to undertake costly and laborious management to reduce Flying Fox damage to their crops.....	1	2	3	4	5
3S Flying Foxes are a significant disease risk to people in NSW.....	1	2	3	4	5

Section Four: Damage to Domestic Fruit Trees and Gardens

Many people grow fruit in their "backyards" and Flying Foxes are known to sometimes feed on this fruit. This section is designed to determine how widespread feeding by Flying Foxes on "backyard" fruit is, and the type of methods, if any, that people use to prevent damage to their plants and fruit. All responses are anonymous.

4A What type of fruit do you grow at home? (Please tick all appropriate boxes)

None – Please go to 4C. Apples/ Pears Bananas Nectarines Peaches
 Lychee Guavas Mangoes Citrus Paw Paws
 Macadamia Figs Other (Please specify) _____

4B Which of these trees, plants or fruit suffer damage from Flying Foxes in your garden? (Please tick all appropriate boxes)

Apples/ Pears Bananas Nectarines Peaches
 Lychee Guavas Mangoes Citrus
 Paw Paws Eucalyptus Palm trees Other (Please specify) _____

4C If any other non-fruit plants suffer damage from Flying Foxes in your garden, please list them: _____

4D Do you use any of the following methods to protect your backyard fruit trees or other plants from Flying Foxes? (You may select more than one)

No, I don't need to No, I don't want to Yes, I use loosely draped netting
 Yes, I use tightly stretched netting Yes, I use plastic bags to scare them away Yes, I shoot them
 Yes, I fire guns to scare them away but not to harm them Yes, I use lights/torches to scare them away Yes, I poison them
 Yes, I use smoke or fires to scare them away Yes, my dog scares them away Other, please specify: _____

4E Which of the methods you selected above is most effective in preventing flying fox damage to your fruit trees/plants or other parts of your garden? (You may select more than one option if you believe they are equally effective)

Draped netting Tightly stretched netting Wind-chimes to scare them away
 Plastic bags to scare them away Shooting them Firing guns to scare them away
 Using lights/torches to scare them away Poisoning them Using smoke or fires to scare them away
 My dog scaring them away None Other. Please specify: _____

4F Do Flying Foxes cause significant problems for you in any of the following ways? (Please tick all options that are significant problems for you)

Create an unpleasant odour in your area Damage trees or garden plants Make excessive noise that disturbs
 Create a mess in your yard or on your property None of these Other. Please specify: _____

Section Five: Other questions

The questions in this section are based around issues that growers and members of the public raised during community meetings about Flying Foxes.

5A Why do you believe Grey-Headed Flying Foxes have reached population levels that require them to be listed as vulnerable?

(You may select more than one option.)

- I do not know why these animals are "vulnerable"
 Clearing of habitat/food for housing and infrastructure
 Clearing of habitat/food for agricultural purposes
 Culling by Commercial Fruit Growers
 Competition from other Flying Fox species
 Other: Please describe _____

5B Do you believe that Grey-Headed Flying Foxes should be listed as a vulnerable species?

- Yes No I am unsure

5C Please select the response that best describes your opinion of why Flying Foxes cause damage to fruit crops:

(You may select more than one option)

- Flying Foxes damage fruit crops because they prefer to eat commercial fruit more than native food
 Flying Foxes damage fruit crops because there is not enough native food
 Flying Foxes damage fruit crops because there are too many Flying Foxes
 Flying Foxes damage fruit crops because they are an easy-to-find, consistent food source
 I am unsure why Flying Foxes damage fruit crops

Wildlife-Values

For some time, wildlife managers in other countries have used information about people's wildlife-related values to help improve management. A secondary aim of this research is to explore whether there is a relationship between peoples' wildlife values and how they want kangaroos managed, to see whether this information would be of any benefit in Australia.

D. Which of the following statements best describes you?

- I prefer attractive or interesting animals
- I like to control or master animals
- I am more interested in animals' roles in the environment than in specific animals
- I am deeply emotionally attached to animals
- I have no particular feelings or opinions about wildlife
- I am primarily interested in the ethical treatment of animals
- I dislike or am not interested in animals
- I am interested in understanding how animals function, rather than in the animals themselves
- I am most interested in how animals can be used to benefit people
- I am interested in animals as part of being immersed in nature

Please use this space to add any further comments about kangaroos or their management

Thank you very much for your time and assistance

A Survey of Human-Kangaroo Interactions on the Coffs Coast

(This survey will take 5 to 10 minutes to complete)

1. How often do you see live kangaroos?
 Daily Weekly Fortnightly Monthly
 Six monthly Never
2. Where do you see kangaroos? (*Please select all relevant options*)
 In your yard In yards on your street In yards on nearby streets
 In local parks On vacant blocks Undeveloped land/paddocks
3. If you see kangaroos in your yard, do they do any of the following? (*Select all relevant options*)
 Eat lawn grass Eat other garden plants Drink water, e.g. from a pond
 Rest or lay about None of these
 Other: (Please describe) _____
4. Which of the following kangaroos do you see? (*Please select all relevant options*)
 Males & females Single males Single females with young
 All of these at different times
5. How long ago did you move to this address? _____ years.
6. Did you know there were kangaroos in the area before you moved there?
 Yes No I am unsure
7. Since you moved to your present address, have the numbers of kangaroos in your area
 Increased Decreased Stayed about the same
 I am unsure
8. If you knew then (when you moved to your current address) what you know now, about living with kangaroos, would you still have moved in?
 Yes No I am unsure
9. How do you feel about the following statement? '*It is important to have kangaroos in my local area*'
 I Strongly agree
 I Agree
 I Neither agree nor disagree
 I Disagree
 I Strongly disagree
10. Which of the following scenarios would you prefer for your local area?
 Free-roaming kangaroos
 Kangaroos, but not in house yards
 Kangaroos, but not on roads
 No kangaroos at all
11. If you have a dog or dogs are they: (*Please select all relevant options*)
 Always behind a fence Always tied up Able to roam freely
 Restrained only at night I don't have a dog

12. If you have a dog or dogs do they: *(Please select all relevant options)*
- Chase kangaroos Bark at kangaroos
 Neither of these Other dogs in my area chase or bark at kangaroos
 I don't have a dog
13. Are you concerned that dogs, in your area, interact in a negative way with kangaroos?
- Yes No I am unsure
14. Do you think restrictions should be placed on the dogs or on the kangaroos to stop this?
- On neither On both On dogs
 On kangaroos I am unsure
15. Are you concerned about the prospect of vehicle accidents with kangaroos in your area?
- Yes No I am unsure
16. Have you ever hit a kangaroo in your car, in your local area?
- Yes No I do not drive a car
17. Which of the following would you prefer to minimise traffic accidents with kangaroos
(Please select all relevant options)
- Wildlife warning signs for motorists
 Reduced speed limits
 Speed humps or chicanes to slow vehicles down
 Barriers to keep wildlife off roads
 A reduction in the number of kangaroos in the local area
 Increased lighting along roads
 None of these
 Other: *(Please describe)* _____
18. In community meetings, some local residents suggested that people could do more to live in harmony with wildlife in your local area. Would you agree with any of the following suggestions?
(Please select all relevant options)
- Banning dogs
 Banning cats
 Banning fences to allow wildlife to move freely through the area
 Keeping some blocks vacant for wildlife to use and move across
 Maintaining grassed areas as part of each property
 None of these
 I am unsure
19. Are you concerned about the potential for conflict between kangaroos and people in your area?
- Yes No I am unsure
20. For each of these scenarios, which occurrence are you most concerned about in your local area?
- i. Kangaroo attacks OR Dog attacks OR Neither
ii. Kangaroo attacks OR Snake bites OR Neither
iii. Kangaroo attacks OR Magpie attacks OR Neither
iv. Kangaroo attacks OR Road accidents OR Neither
v. Kangaroo attacks OR People hurting wildlife OR Neither

21. Which are you more concerned about, in terms of potential for aggression towards people?
- I am not concerned Female kangaroos Male kangaroos
 Both males and females I am unsure
22. If you were attacked by a kangaroo, what do you think you would do?
- Try to fight it Call for help Play dead
 Run away Curl into a Ball I am unsure
23. If a kangaroo has been aggressive towards people should it:
- Be killed Be left alone Be relocated away from people
 I am unsure
24. If kangaroos are culled to reduce the population size, is it important to you that they be used for something, for example, pet food or leather?
- I don't support culling of kangaroos Yes, they should be used if culled
 No, there is no need to use them if culled I don't have a preference
25. If you or a family member were attacked by a kangaroo, what would you do?
- Do nothing Deal with it yourself Call National Parks
 Call WIRES Call the Police Call the local council
 Other: *(Please describe)* _____
26. Are you concerned about kangaroos as a disease risk for humans, in your area?
- Yes No I am unsure
27. Have you received any information, e.g. a leaflet from wildlife managers, about how to live with kangaroos in your area?
- Yes No I am unsure
28. Should people who move into an area with wildlife, such as kangaroos, be provided with information on how to best live with these animals?
- Yes No I am unsure

Personal Details: Responses to this section will help us develop an idea of how this wildlife management issue is seen by different groups of people and whether there are any significant differences between them.

- A. Are you: Male Female
- B. What is the highest level of education you have completed? *(Please select one option)*
- No formal education
 Primary school
 High school (Years 7 – 10)
 High School (Years 11 – 12)
 University Degree
- C. Have you spent most of your life in: *(Select all relevant options)*
- Rural areas Coastal areas City areas

Please turn the page

Context and attitudes in human-kangaroo interactions

Some feedback on your interactions with kangaroos

Over the past two years we have been conducting research into how people within your local community interact with kangaroos. Now, in addition to thanking you for your help we'd like to give you an insight into some of the feedback from your local area and other nearby areas where people live in close contact with kangaroos.

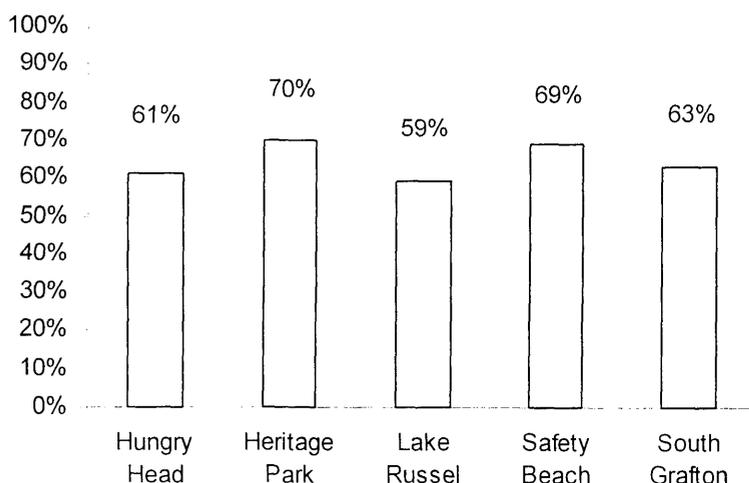
Media Interest

The story that we have pieced together from South Grafton and the Coffs Coast, about kangaroos in urban areas, has drawn interest from across Australia, and overseas, and has been covered by television (The Today Show), as well as radio and newspaper sources (e.g. The Australian, The Sydney Morning Herald and The Daily Telegraph).

What we've learned

After contacting more than 700 households along the Coffs Coast and in South Grafton, in 5 communities where people live in close contact with kangaroos, we've collected a huge amount of information. This data has now been passed to the NSW National Parks and Wildlife Service and is also being made available to local councils so that they can use your feedback to better manage the interactions that occur between people and wildlife in your local area.

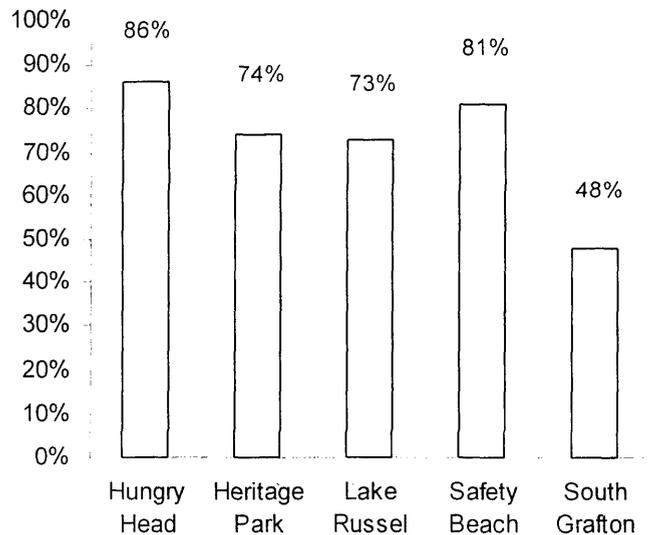
Participation Rates – The percentage of households that took part



We were overwhelmed by the response of people from within the study areas. At least 59% of the households from each community contributed to this research project, allowing us to be confident that we have gathered representative data from each area.

Is it important, to people from your area, to have kangaroos locally?

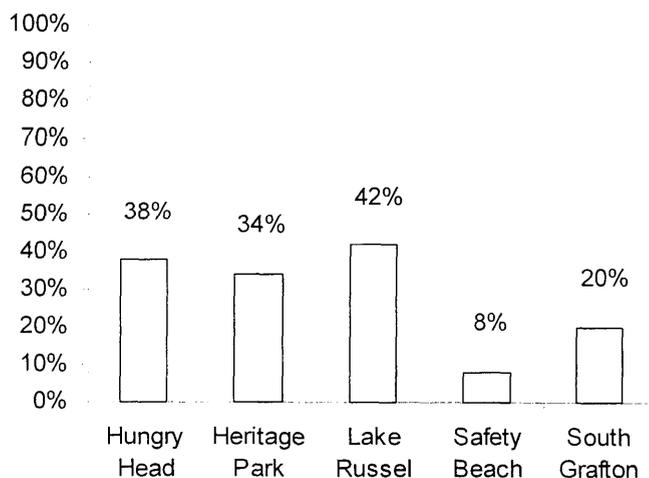
As you can see from the graph on the right, the Coffs Coast communities were fairly similar in terms of the proportions of people who indicated that it is important to them, to have kangaroos in their local area. South Grafton, however, was quite different, with less than half of the people surveyed answering that local kangaroos are important to them. This difference is important as it reinforces the fact that communities can differ significantly in their members' attitudes toward wildlife.



Dogs and kangaroos

During public meetings in 2003, local residents indicated that free-roaming dogs and kangaroos sometimes came into conflict. As a result, we asked some questions about dogs in your local area. Incidentally, we found that between 45% (Hungry Head) and 57% (Lake Russel) of respondents were dog owners.

Are your dogs able to roam freely?



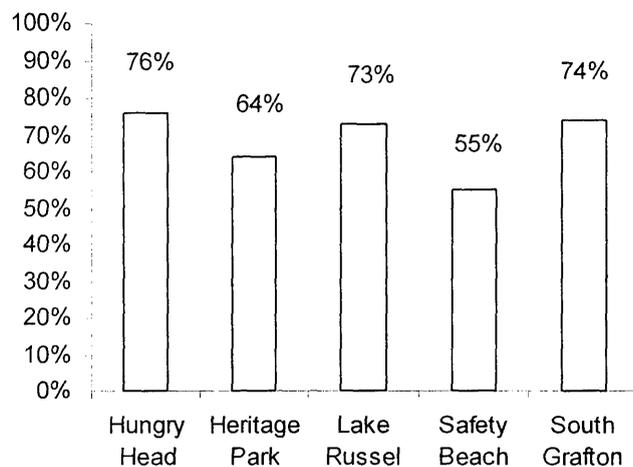
The percentage of dog owners who said that their dog/s were able to roam freely varied substantially between communities. Just 8% of Safety Beach's dog owning respondents said that their pet/s could roam freely compared to nearly half (42%) of dog owning respondents from Lake Russel, and more than a third from Hungry Head and Heritage Park.

Further, 34% of South Grafton respondents who own dogs, said that their dog/s chase kangaroos, compared to 19% from Lake Russel, 15% from Hungry Head and 10% from Heritage Park and Safety Beach.

Motor-vehicle accidents with kangaroos

Concern about the prospect of having a motor-vehicle accident with kangaroos ranged between, 55% and 76% across the 5 communities.

Also, in Hungry Head and South Grafton, more than 33% of respondents have had a motor vehicle accident with kangaroos in the local area, compared with 16% of Safety Beach respondents and less than 10% from Heritage Park and Lake Russel.



Reducing motor vehicle accidents with kangaroos

Of all the options for reducing motor vehicle accidents with kangaroos, wildlife warning signs were the most popular choice in each of the 5 communities we surveyed. In South Grafton (which had the lowest level of support for wildlife warning signs) 65% of respondents wanted signs. Heritage Park had the highest support for wildlife warning signs with 87% of respondents choosing this option. In between were Lake Russel (68%), Hungry Head (76%) and Safety Beach (78%).

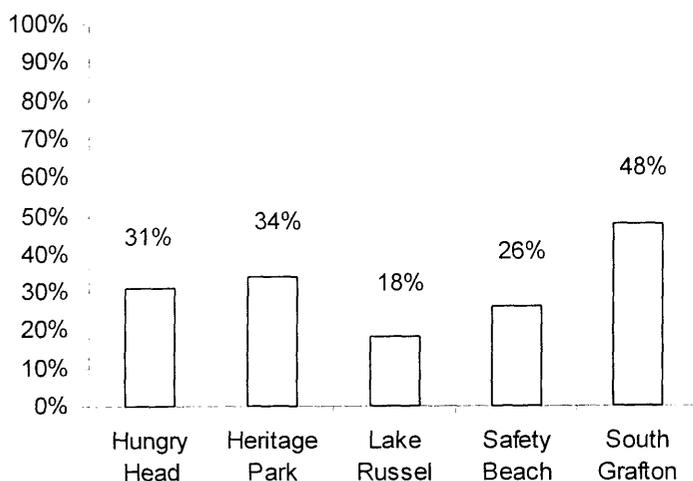
Another option, but less popular, chosen for reducing the prospect of motor vehicle accidents with kangaroos was the reduction of the local kangaroo population. From South Grafton, more than a third of respondents chose this option (36%). Just 13% of Lake Russel respondents selected the same option and less than 10% did so from the other three communities. No-one from Hungry Head selected this option at all.

Living in harmony with wildlife – your preferences

Another issue raised in community meetings was that of living more harmoniously with wildlife in urban areas. We wanted to know how much support some of the suggestions that local people made would get from their neighbours. Three examples are provided below:

- Between 5% (Lake Russel) and 21% (Safety Beach and Hungry Head) of respondents agreed with a ban on dogs.
- Between 18% (South Grafton) and 34% (Heritage Park and Hungry Head) agreed with a ban on cats.
- Between 46% (Lake Russel) and 64% (Safety Beach) agreed with keeping some blocks vacant for wildlife to use and move across.

Concerns about conflict between people and kangaroos



The clear majority of respondents from the four Coffs Coast communities were not concerned about the potential for kangaroos coming into conflict with people. From South Grafton, however, respondents were split almost evenly between those who were concerned (48%) and those who were not (47%). The remainder were either unsure or did not answer this question.

Should people who move into an area with wildlife, such as kangaroos, be provided with information on how to best live with these animals?

Overwhelmingly, respondents from all five communities indicated support for providing information to new residents in areas that contain wildlife, such as kangaroos. In each instance more than 90% of respondents chose this option.

What's next? – Interviewing victims or witnesses of kangaroo attacks

We were surprised by the number of people who reported that they had experienced aggression by kangaroos. We now hope to conduct brief interviews (5 – 10 minutes) with as many people as possible who have had such an experience, so that we can better understand the context of kangaroo aggression. It is our aim to use this information to help people interact with kangaroos safely.

If you have experienced or witnessed aggression (growling, chasing, physical attack etc) by kangaroos toward people or pets, we would like to speak to you. An information sheet for participants was included in the envelope with this summary.

Please contact Guy Ballard at Ecosystem Management, UNE, Armidale, NSW, 2351, by phoning him on (02) 6773 5217 or by e-mailing him at wildlife@une.edu.au

Thank you again for your assistance with this research