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ARTICLE



The significance of landholder gender and previous knowledge of control methods for effective feral cat (*Felis catus*) management in south-eastern Australia

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ABSTRACT

Invasive animals, such as feral cats, are considered non-threatening by some social groups due to their similarity to companion animals, and this can pose a threat to the success of invasive species management through lack of support. Feral cat management is undertaken across southern Australia, and it is therefore important to determine the social factors that influence levels of support for different control measures amongst stakeholders. In this study, we use a landholder questionnaire to assess acceptance of feral cat control methods on properties on Kangaroo Island, South Australia and near to the Grampians National Park in western Victoria. We found that differences in opinion between genders and levels of previous knowledge of feral cat management methods influenced the likelihood that landholders would allow the application of particular methods on their properties, and that men were more likely to accept all available cat control methods than women. Management authorities are recommended to tailor messages across genders in a way that introduces the facts surrounding both feral cat impacts and management programs.

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Invasive species management can be controversial depending on the species in question, and where and how it is managed (2018; Gosling, Stavisky, and Dean 2013; Garcia-Llorente et al. 2008). Though management has benefitted greatly from a wealth of research on technical aspects, less has been done to investigate the social factors that influence the success of various campaigns to control invasive species or the debates that occur as a result of management planning and implementation in different regions (Garcia-Llorente et al. 2008). Research undertaken in this field is often focused on community perceptions of specific invasive species within one location and findings suggest that those perceptions can be heavily influenced by demographics, culture, and individual values (Bardsley and Edward-Jones 2006; Frewer 1999). Further, it has been found that our value systems together with levels of risk perception aid in shaping our view of the environment more broadly, which in turn can influence reactions towards invasive species and their management (Estevez et al. 2014; Farnworth, Campbell, and Adams 2011).

In some instances, invasive species are not perceived to be a threat by community members, and are instead thought to need saving and nurturing (Hatley 2003; Hunter and Brisbin 2016; Pets4Homes 2020). This may be because species such as feral cats (*Felis catus*) are the same species as their companion

animal counterparts, which are generally viewed as cuddly, cute, and non-threatening, often with high levels of associated anthropomorphism (Bickford et al. 2012). In countries such as Australia and New Zealand, feral cats are more often perceived as damaging invasive species that need to be managed because of the threat they pose to vulnerable native wildlife populations (Australian Government Department of the Environment 2015a; Aguilar and Farnworth 2012). Nevertheless, the idea of using a range of lethal control methods on a feral animal that is also the same species as a companion animal can cause ethical dilemmas, which in turn can reduce support for particular management interventions (Green and Rohan 2012; Deak et al. 2019). The question then becomes whether the public has considered the implications of using non-lethal versus lethal methods of management on feral cats, and how vulnerable populations of native wildlife would be impacted if the cats are not removed. We have previously approached this question by investigating different social aspects that may influence feral cat management, including land-use type, location and differences in island versus mainland communities, but focus here on the demographic attributes that could influence feral cat management, with a focus on gender and its potential relationship with levels of knowledge of invasive species management.

Attitudes and gender differences in invasive species management

Previous research suggests that gender is an influential factor in developing values in relation to society, and that these values help to shape attitudes around wildlife and its management (Lloyd, and Miller 2010). Traditionally across cultures, women are taught to be more compassionate and to have stronger 'ethics of care,' whereas men are taught to focus on building competitiveness, a sense of independence and family protection (Zelezny, Chua, and Aldrich 2000). This can translate into the different roles that men and women play in managing the environment, where men also tend to hold more authoritative positions in organisations and to value direct action in dealing with threats (Fish et al. 2010). However, the theory that a compassionate nature imparted through culture translates to women caring more about the environment is only one of many potential theoretical influences over a person's perceptions and behaviours (Wehrmeyer and McNeil 2000). An emerging theory held by more critical ecofeminists, states that the female compassion for nature develops from a recognition of the oppression felt as a result of sustained dualism that can be seen in culture/nature, as it is seen in male/female relationships (Wehrmeyer and McNeil 2000). Such an argument infers that women treated as subordinate figures may have a greater sense of connection with the natural world, as they are more familiar with oppression in society (Wehrmeyer and McNeil 2000).

In many historical and contemporary societies, women have less access to resources, less ownership of property, and less decision-making powers than men, which in turn can increase their vulnerability to negative environmental impacts and change (Fish et al. 2010; Zelezny, Chua, and Aldrich 2000). Lack of power leaves many women more susceptible and risk averse to environmental shocks, which may also lead them to be more hesitant to support strong environmental management interventions than men (Fish et al. 2010; Wald et al. 2018). It is also often assumed that men are more pragmatic and accepting of lethal methods, especially in invasive species control, and are more likely to agree that their welfare can to some extent be discounted in their eradication (Dougherty, Fulton, and Anderson 2003; Zinn and Pierce 2002; Bremner and Park 2007). Women on the other hand are generally seen to be more influenced by emotion, basing their attitudes toward lethal control on their beliefs, attitudes and values around pain, suffering and death (Dougherty, Fulton, and Anderson 2003; Zinn and Pierce 2002). In fact, a range of studies suggest that due to their personal understanding of risk, women often have a deeper consideration of the state of the environment, and the risks that accompany its management (Zinn and Pierce 2002; Fish et al. 2010; Sharp, Larson, and Green 2011).

Even if men and women hold broadly similar environmental values, women have been shown to be more likely than men to respond with higher levels of concern for any environmental action that could potentially harm themselves, other humans, or other living creatures (Wehrmeyer and McNeil 2000; Zelezny, Chua, and Aldrich 2000). For example, a study of deer control in New York found that men were more likely to support lethal control methods, whereas women were more likely to choose contraception as the most appropriate method. This was thought to be partially due to women taking greater consideration than men both of animal welfare and of associated risk factors to the community (Dougherty, Fulton, and Anderson 2003; Wehrmeyer and McNeil 2000).

Further, it is important to consider the possible influence of the 'white male' effect on gender differences in risk perception in invasive species management (Finucane et al. 2000). This theory implies that white males may perceive less risk than other groups, including women, because they are usually more directly involved in the creation, management, and benefits of any particular technology, making it more likely for men to support both lethal and non-lethal management options (Finucane et al. 2000). This theory goes on to suggest that because of their technical response capacities, white males exhibit less concern for environmental change or the consequences of technological interventions in the natural environment (Zelezny, Chua, and Aldrich 2000). These differences reflect the idea that direct impacts of invasive species and their management are felt differently depending on gender, and that this might further influence attitudes towards using non-lethal methods as opposed to lethal methods to manage species such as feral cats.

All of this earlier theory and research has important implications for feral cat management, because according to the Theory of Planned Behaviour (TPB), individuals who hold more positive attitudes towards a behaviour and recognise a strong social norm in participating in the behaviour are more likely to support or perform the behaviour (Kalnicky, Brunson, and Beard 2018). In addition, those who believe that their actions will likely result in the desired effect are also more likely to support or perform the behaviour (Kalnicky, Brunson, and Beard 2018). Therefore, in relation to our particular study, the TPB would suggest that because men perceive less risk and are more pragmatic towards feral cat management, they would be more likely to accept and potentially participate in using or allowing the use of all management methods than women who would be more reticent to accept or participate in certain management interventions.

While we examine the gender implications of the TPB in this paper, previous work also suggests that individual values and attitudes may also differ based

on the circumstances of a person's experiences and situation (Bremner and Park 2007; Zelezny, Chua, and Aldrich 2000). For instance, a study of mountain lion management found that differences were evident in the acceptability of management methods between men and women where a mountain lion had killed a human (Zinn and Pierce 2002). However, there were no significant differences in attitudes when a lion had only been seen in the area or had killed a domestic pet. This response suggests that gender alone is unlikely to determine the likelihood of any individual's response to particular management approaches, and that other issues will influence perceptions of risk or value that will in turn impact upon levels of support for particular interventions (Wehrmeyer and McNeil 2000). For instance, levels of prior knowledge about any particular invasive species, such as feral cats, and their impacts could be a factor in determining levels of support for a management campaign (Deak et al. 2019). Thus, it is important to understand how demographic factors such as gender interact with other variables to alter a person's willingness to support or reject different forms of intervention to manage invasive species (Zinn and Pierce 2002; Wehrmeyer and McNeil 2000).

Knowledge and familiarity in invasive species management

Knowledge of a particular topic is hugely influential over environmental management decisions. Knowledge limitations or misunderstandings may reduce support for feral cat management, which would suggest a need for analyses of the knowledge that different demographic groups hold about the management of the species to guide development of targeted educational resources (Sharp, Larson, and Green 2011). For that reason, workshops and community education programs often focus on informing a community about a target invasive species and the threat that it poses to their particular environment, industry or community, both to influence public perceptions and gain support for management programs (Deak et al. 2019; Bardsley and Edward-Jones 2006). In a study on public perceptions of invasive, exotic species in Scotland, it was found that the majority of participants were broadly interested and supportive of conservation management efforts, but that the community required additional information about invasive species management if interventions were to include the use of lethal control methods (Bremner and Park 2007; Sharp, Larson, and Green 2011). Further, in a study specifically examining the relationship between the TPB and invasive species management (Kalnicky, Brunson, and Beard 2018), community attitudes towards the management of the species itself were found to have a significant influence over whether they would participate in management or

support particular interventions. Such research suggests that by developing new knowledge about the complex interactions between gender, knowledge, social perceptions and support for feral animal management, more sophisticated management approaches could be developed that have the potential to improve outcomes.

Feral cat management in south-eastern Australia

Feral cats pose a significant threat to wildlife, livestock and humans around the world, and particularly in Australia (Spotte 2014; Doherty et al. 2016; Taggart et al. 2019a, 2019b). Regions of Australia, including the states of Victoria and South Australia, have begun to take action to create and implement feral cat management programs to control populations within their jurisdictions (Victoria State Government 2018; Natural Resources Kangaroo Island 2015). In South Australia, a Kangaroo Island Feral Cat Eradication Program has been created and is currently in the process of being implemented in line with an action plan which aims to eradicate feral cats from the 440,500 hectare island by the year 2030 (Natural Resources Kangaroo Island 2015). This program has been in effect since 2015, and has trialled numerous feral cat control methods on the island to determine the best course of action that will eliminate cats with minimal risks to wildlife, working animals and stock (Kangaroo Island Feral Cat Eradication Program 2018). In Victoria, feral cat management has only recently been considered, following the declaration of feral cats as an exotic pest in July of 2018 (Victoria State Government 2018). The Victorian Feral Cat Declaration was written to provide potential guidelines for the management of feral cats within the state, although a firm action plan has yet to be established (Victoria State Government 2018). Research into community attitudes around various cat control methods in this region is an important part of planning and implementation in the future, especially regarding the use of poisons, which generated community concerns after being used previously in other feral mammal management campaigns in the area.

Feral cat management programs generally involve the conjoint use of methods, and in both South Australia and Victoria these include poison baiting with either Eradicat® (sodium fluoroacetate; '1080') or Curiosity® (paraaminopropiophenone; 'PAPP'), shooting, cage trapping, padded leg-hold trapping, detector dogs, Maremma dogs (used as guardian dogs), exclusion fencing, and a new trial method, known as the Felixer™ grooming trap (Larson et al. 2011; Australian Government Department of the Environment 2015b; Read et al. 2019). The application of any particular method can be contentious for a number of reasons, some of which are due to misunderstandings and knowledge gaps around the science behind feral cat

management (Moon, Blackman, and Brewer 2015). Although both South Australia and Victoria briefly address the technical aspects associated with management in their Feral Cat Management documentation, there has been little analysis or discussion about community attitudes towards feral cat management in the target areas, especially as they pertain to use on private property (Victoria State Government 2018; Natural Resources Kangaroo Island 2015).

It is important that local communities understand why invasive species such as feral cats are being managed, so that programs reliant upon both cross-tenure logistical support and government funding are able to maintain public backing (2018). Further, when a social license for government officers to act is contested, such as when there are polarised differences in public levels of support for any action, it becomes essential to recognise what factors may be causing this polarisation to determine how changes could be made to facilitate effective management outcomes (Herzele, Aarts, and Casaer 2015). This paper examines the influence of gender on different attitudes towards feral cat management methods within each community (Kangaroo Island, South Australia; and Grampians region, Victoria) in association with knowledge of non-lethal and lethal feral cat control methods. The analysis of the relationship between gender and knowledge informs a discussion of the implications for the planning of invasive species management programs. The specific hypothesis tested is that the levels of social license to implement particular feral cat control methods on private property will differ significantly with an individual's gender in association with their previous knowledge of feral cat management methods.

Methodology

Study areas

This study examined local residential attitudes towards various feral cat control measures on the 440,500 hectare Kangaroo Island (KI), South Australia and around the 1,672 km² Grampians National Park in Victoria (Deak et al. 2019). KI is fortunate to have been spared the devastating impacts of the introduced red fox (*Vulpes vulpes*) and European rabbit (*Oryctolagus cuniculus*), and is thus renowned for ecotourism values associated with its high levels of biodiversity and role as a sanctuary for several endangered species, such as Rosenberg's goanna (*Varanus rosenbergi*) and the southern brown bandicoot (*Isodon obesulus*) (Natural Resource Kangaroo Island 2020). KI is also home to a number of endemic island species, such as the KI short-beaked echidna (*Tachyglossus aculeatus multia-culeatus*) and the KI dunnart (*Sminthopsis fuliginosus aitkeni*). Along with ecotourism, the island has important livestock industries, including sheep-farming

(Spence 2020). The presence of feral cats on KI threatens both the biodiversity of the island through direct predation of wildlife, and the livestock industry through disease transmission (Taggart et al. 2019a). As a result, the island established a feral cat eradication program in 2015 (Kangaroo Island Feral Cat Eradication Program 2018; Taggart et al. 2019b, 2019a, 2020).

The Grampians National Park is also well known for its ecotourism with a diverse array of natural landscapes, native wildlife, and endemic plants, and for the surrounding productive sheep-farming and other livestock-related industries (Parks Victoria 2020). Invasive predators such as the red fox (*Vulpes Vulpes*), which pose a threat to native wildlife and livestock in the region, are managed using poison baiting, fumigation, and fencing (Horner and Platt 1993; Taggart et al. 2015). Feral cats were only recently declared a pest species in 2018 by the state of Victoria due to their threat to wildlife and livestock, and are being integrated into the pre-existing feral pest predator management campaigns (Victoria State Government 2018).

The two locations were chosen for this study, partly because sheep farming and nature-based tourism are essential industries in both places; partly because foxes and rabbits are absent from one landscape and not the other; and, partly because of their differing stages of feral cat management. Management of feral cats on KI is more advanced than those in the Grampians region, with community control efforts on the island going back to the 1990s and the formal feral cat eradication program established in 2015 (Paton 1994, 2003). It was recognised that differences in the planning and implementation of the feral cat control programs in the two places could provide useful insights into the importance of levels of community awareness of feral cat management. By undertaking the comparative case-study, we hope to develop a sophisticated understanding of how gender and prior knowledge in both locations links to willingness to support the development of more effective management actions.

Study Design

To examine the relationships between prior knowledge and demographic characteristics of the KI and Grampians communities and their attitudes toward feral cat control, a questionnaire was designed for distribution to landholders and other members of the public at both locations. A survey questionnaire was chosen as a means to approach the community, as opposed to interviews or focus groups, as it allowed for a large sample to receive and respond to an exact set of questions within each location during the same time period. The survey consisted of a number of short answer and multiple-choice questions, and both quantified and qualified answers using Likert scales, a heat map and written responses.

Questions were designed to examine familiarity with and social acceptability of feral cats and particular management methods, as well as demographic questions that included a map for participants to select their most relevant property for which their answers related. After assessing respondents' awareness of different feral cat management methods, the questionnaire then included a brief description of each control method (Appendix 1) to allow respondents to subsequently answer questions regarding the likelihood of them allowing the use of particular control methods on their land. The descriptions of each method were kept as short as possible, with about four to five sentences explaining what was entailed and how effective it was in relation to its cost. The potential risks to native wildlife and domestic pets were also highlighted where necessary, in order to present participants with as much information as possible as to the benefits and risks of different methods. The questionnaire was reviewed by both Parks Victoria and the KI Natural Resource Management Board and was pre-tested by colleagues in the University of Adelaide Ecology and Evolutionary Biology department.

The questionnaire was designed to take respondents approximately 15 to 20 minutes to complete. It was made available online, with an anonymous link used to access the site over the internet. Previous studies have shown that online questionnaires may not be as successful in reaching a full range of landholders as mail-out questionnaires, and so we decided that mailing out hardcopies of an invitation to the questionnaire would enhance our response rate (Fielke and Bardsley 2014). It was also acknowledged that a hardcopy invitation requires a further level of interaction involving the person choosing to participate or not. To prevent participants taking the questionnaire more than once, a 'Prevent Ballot-box Stuffing' option was developed through cookies placed on any previous participant's browser.

Participant Information Sheets were sent out to 1,508 addresses on KI and 3,500 post office box addresses in the Grampians National Park and surrounds in western Victoria, using the Australia Post Unaddressed Mail Service. A Facebook page was also created to promote the questionnaire with the same link that had been included on the Participant Information Sheets, but with a different code for entry in order to trace where participants had sourced information about the questionnaire. Facebook Community groups for the designated localised areas were contacted and asked to promote the page or the link within their group pages. A local radio station near the Grampians region (ABC Ballarat) and the local newsletter on KI (The Islander) also provided a means of promoting the questionnaire. The questionnaire was open from 26 September 2018 to 31 January 2019 in order to allow time for farmers and other landholders

to receive the letter or flyer in the mail and to fill out the questionnaire at their leisure.

To access the questionnaire, participants were required to enter a code that was provided to them via the targeted invitation letter or the online Facebook advertisement. Participants were then asked whether they were responding for KI or the Grampians region, and their answer determined which version of the questionnaire they could access. Although the two questionnaires were very similar, one question was added to the Grampians version that was not relevant to KI residents about whether or not private property as well as Crown land should be managed, and a region-specific map was provided in each case to allow participants to identify the location of the property for which they had answered.

After the 31 January 2019, results were collected from the online survey program and were exported into an Excel spreadsheet, which could then be read into the program R. We had a 5% response rate from the initial contact through the Participant Information Sheets, with a 72% completion rate, receiving back 243 completed questionnaires, and 93 partially completed questionnaires. To clean the data, any questionnaires that were only partially completed or did not include key demographic information were removed, leaving 202. Only questionnaires completed by participants who marked their gender as either male or female could be included in the analysis, as the 8 participants who listed their gender as other did not allow for an adequate representation sample. In the end 194 questionnaires were analysed, with 101 female respondents and 93 male respondents. Results were analysed using Mann-Whitney U tests initially to examine broad relationships, followed by the application of an Ordinal Logistic Regression Model to discern differences in influence between factors and to create predictions. Written responses were analysed by gender according to coded themes in answers as to why or why not respondents would support different methods of feral cat management.

Results

Likelihood of using various feral cat methods on private property

Of the 194 participants, 52% of respondents were female and 48% were male. There was an equal number of participants from each location, with 51% of respondents from the Grampians and 49% from KI. Almost half of the participants (48%) were between the ages of 45 and 64, and most either lived in a house on a large acreage (37.6%) or on a residential-sized block (21.1%). Of the methods of communication listed, this study's survey was considered to be the most useful for learning about feral cat management,

with 63% of participants finding it to be highly useful, 32% saying that it was somewhat useful and 5% saying that it was not useful at all. Forty-nine percent of participants considered online news to be a highly useful method for learning about feral cat management, with 32% calling it somewhat useful and with 9% claiming that it was not useful at all. Ten percent of participants said that they did not use online news to learn about the topic. Sharing information about feral cat management through word-of-mouth was considered highly useful by 47% of participants, somewhat useful by 45% and not useful at all by 2%. Five percent of participants said that they did not use word-of-mouth. The least popular communication method for learning about feral cat management was through blogs, as only 6% of participants found blogs to be highly useful and 25% considered them to not be useful at all, with 37% saying that they were only somewhat useful. Thirty percent of participants said that they have not tried to use online blogs to gather information on feral cats.

The majority of participants had strong opinions regarding the techniques that they would or would not allow to be used on their property. Cage trapping was found to be the most acceptable technique for use with 85.5% of all participants agreeing that they would be 'Highly Likely' to allow the use of this method of cat control on their property. Other cat control methods with good support included shooting (63.7%) and the use of detector dogs (57%). Baiting with Curiosity® was one of the least popular options, with only 39.4% of questionnaire participants listing that they would be 'Highly Likely' to use this method of cat control on their property, and 39.4% of participants agreeing that they would be 'Highly Unlikely' to support this management option. Baiting with Eradicat® was slightly more popular with 40.2% of participants indicating that they would be 'Highly Likely' to allow the use of this control method, and another 39.7% indicating that they would be 'Highly Unlikely' to allow the use of this technique on their property. The use of Felixer™ grooming traps was a method that was more supported than baiting with Eradicat® or Curiosity®, with 51% of participants agreeing that they would be highly likely to allow the use of this cat control method as opposed to the 34.4% that were highly unlikely to use these traps. This result was despite the Felixer™ grooming trap delivering the same poison as used in Eradicat® baits, which had been explained to participants prior to them answering the question. These differences may be a result of how information about the Felixer grooming traps has been disseminated throughout the different regions, and participants may not have made the connection between Felixer™ grooming traps using the same poison as used in Eradicat® baits. Conversely, participants may have understood that risk of non-target species poisoning was lower when using Felixer® grooming

traps due to specific targeting of predator species using species recognition software, compared to the less target specific aerial or ground baiting techniques.

The differences in opinion observed between those who indicated that they were highly likely to allow the use of cat control methods that contain poison and those who indicated that they were highly unlikely to allow the use of these methods suggests that the data and therefore people's opinions are highly polarised on this issue (Figure 1). This polarisation could potentially be explained by the demographic makeup of the participants (Table 1).

Influence of gender differences

In this study, gender difference was analysed in association with previous knowledge of feral cat control methods and location (KI and the Grampians) in relation to the likelihood of participants allowing the use of feral cat control methods on their land (Table 2). Gender differences presented significant evidence of influencing polarisation within the data, as did previous knowledge of cat control methods; however, location itself did not have a significant influence on the likelihood of allowing the use of various methods. Though other attributes including land-use type and education were also tested in this study, the strong evidence around gender differences and previous knowledge of cat control methods as significant factors influencing the likelihood of allowing the use of various methods led to a more in-depth investigation into the interactions between the two variables.

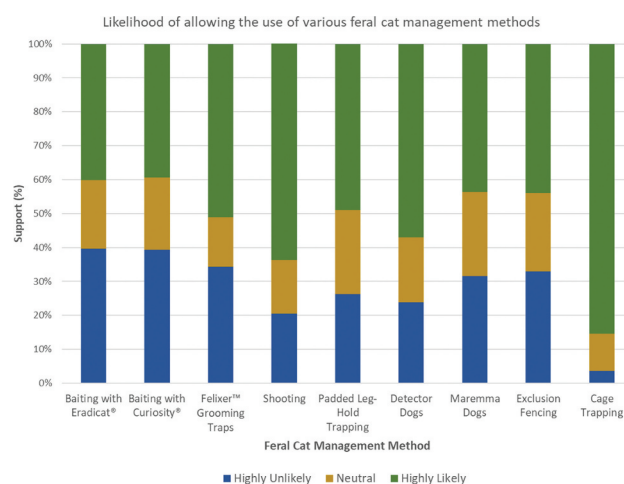


Figure 1. The overall results of a set of survey questions that were designed to examine the likelihood of allowing the use of several feral cat (*Felis catus*) control methods on private properties on Kangaroo Island and in the Grampians (n=194). Participants were asked to rate their likelihood of use for each control method on a 7-point Likert scale of 1 to 7, which was then grouped into three sections for analysis including Highly Unlikely (1-2) (blue), Neutral (3-5) (gold), and Highly Likely (6-7) (green).

Table 1. Demographic make-up of feral cat management questionnaire participants (n = 194). This questionnaire was distributed to landholders on Kangaroo Island and in the Grampians and surrounding suburbs, and to assess how demographics could influence attitudes around feral cat management requested demographic information including gender, location, age, property description.

Gender	
Male	52%
Female	48%
Location	
Kangaroo Island	49%
The Grampians	51%
Age	
18–24	1%
25–44	27.3%
45–64	48%
65+	23.7%
Property Description	
House on a large acreage (>10 ha)	37.6%
Small acreage (6–10 ha)	10.3%
Larger sized block (2–5 ha)	13.9%
Residential sized block (<2 ha)	21.1%
Unit or apartment	4%
Other	13.4%

Table 2. A Mann-Whitney-U test was run to determine the influence of gender differences, previous knowledge of cat control methods, and location on the likelihood of using particular feral cat management methods on private property on Kangaroo Island, SA and in the Grampians region of Victoria. The results of the test suggest that gender differences and previous knowledge of cat control methods influence the likelihood of using particular methods, but that location does not. Values indicate significance (p) where values < 0.05.

Feral Cat Management Method	Gender Differences	Previous Knowledge	Location
Baiting with Eradicat®	< 0.001*	0.464	0.426
Baiting with Curiosity®	0.005	0.003*	0.628
Felixer® Grooming Traps	< 0.001*	0.003*	0.011*
Cage Trapping	0.327	< 0.001*	0.169
Padded Leg-Hold Trapping	0.002*	0.139	0.143
Shooting	0.013*	< 0.001*	0.169
Detector Dogs	0.356	< 0.001*	0.085
Maremma Dogs	0.283	0.025*	0.058
Exclusion Fencing	0.327	< 0.001*	0.058

The Mann-Whitney-U test for gender differences revealed that there were significant variations in which feral cat control methods men or women would likely allow the use on their properties (Table 2). There were no significant differences in gender and attitudes between the two locations. The most significant gender differences were recorded in association with baiting with Eradicat® ($p < 0.001$), Felixer™ grooming traps ($p < 0.001$), padded leg-hold trapping ($p \sim 0.002$), baiting with Curiosity® ($p \sim 0.005$) and shooting ($p \sim 0.013$), where in each man seemed to be more supportive of the use of the method. These results may indicate differences in attitudes around the acceptability of types of cat control methods used, as each method mentioned involves the use of either poison or another technique that could be considered

inhumane by some sections of the general public. The methods that do not involve contact or initial harm to the animal, such as cage trapping, detector dogs, Maremma dogs and exclusion fencing did not yield significantly different results for gender, indicating that there was little difference in attitudes between men and women around these cat control methods, perhaps because these methods were viewed overall as more humane.

Further, where men were more likely to allow the use of most of the cat control methods involved in the study, women were likely to only allow the use of the methods that did not involve the use of poison or involve direct physical contact with the individual cat (Figure 2). Reasons mentioned for this difference in attitude might be because women stated that they did not want to risk the poison baits being picked up by non-target species, pets or children, and men were opposed to having the baits picked up by non-target species. Men were also more likely to mention that they would prefer all methods be used, as feral cats needed to be eradicated as quickly as possible. There also seemed to be evidence of polarisation within the female population itself. Although more than half of women were supportive of the use of padded leg-hold trapping, Maremma dogs, and exclusion fencing, the percentages of women who would and would not allow the use of these less assertive methods were similar (Figure2).

Influence of previous knowledge of cat control methods on participant attitudes

After gender differences, previous knowledge was the next most significant factor influencing attitudes around cat control methods and showed strong evidence of polarisation within the dataset. Results of the Mann-Whitney-U test indicate that with the exception of two methods, all methods yielded significant differences depending on whether participants had heard of the cat control method or not, which suggests that effective knowledge and communication within feral cat management could be essential to gaining social license (Table 2). Further, there were significant differences in percentages of people who had heard of the method or not according to location, especially in relation to some of the newer methods (Table 3). Of the people who were unfamiliar with the use of baiting with Eradicat®, 30% were from KI and 70% were from the Grampians. Similarly, 26% of those who were not familiar with Felixer™ grooming traps were from KI, and 74% were from the Grampians. For baiting with Curiosity®, 44% of people who were unfamiliar with the method were from KI, and 56% came from the Grampians.

There was strong evidence of polarisation between the results for baiting with Curiosity®, in relation to

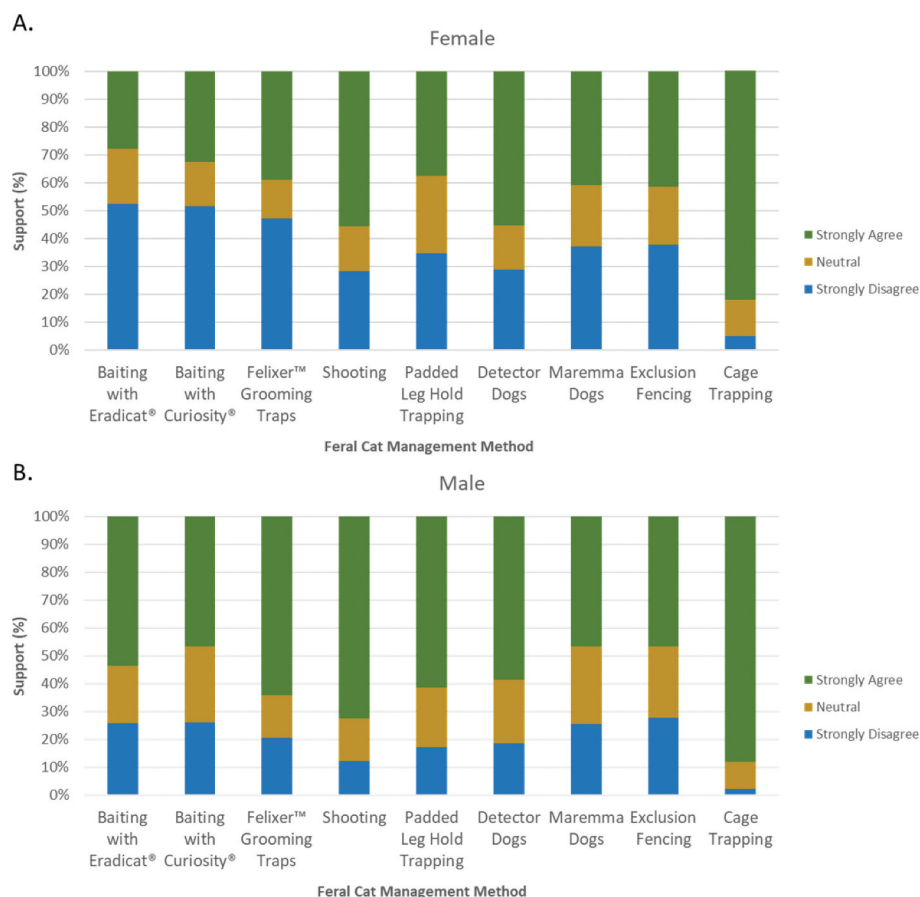


Figure 2. Each plot represents the total number of participants of each gender who responded to the question regarding whether they would be likely to allow the use of different feral cat management methods on their property. Plot A describes the likelihood for females to accept the use of various methods, and plot B describes the likelihood for men to accept the use of the methods. Each colour on the graph represents a level of likelihood that a participant will use a certain cat control method: “Highly Unlikely” (blue), “Neutral” (gold) or “Highly Likely” (green).

Table 3. A Mann-Whitney-U test was run to determine the influence of location on previous knowledge of cat control methods between participants on Kangaroo Island, SA and in the Grampians region of Victoria. The results of the test suggest that previous knowledge of some cat control methods is influenced by location. Values indicate significance (p) where values < 0.05 are significant.

Feral Cat Management Method	Previous Knowledge
Baiting with Eradicat®	<0.001*
Baiting with Curiosity®	0.011*
Felixer® Grooming Traps	<0.001*
Cage Trapping	0.117
Padded Leg-Hold Trapping	0.399
Shooting	0.419
Detector Dogs	<0.001*
Maremma Dogs	0.399
Exclusion Fencing	< 0.001*

those who were highly likely to allow the use of the method and those who were not, despite most having not previously heard of the cat control method prior to taking the questionnaire. The results suggest that although people may be willing to allow the use of baiting with Curiosity® if they have not heard of it, there is a greater chance that they would allow the use of this method if they have previously heard of it.

Results indicated that 42% of the participants who had not previously heard of the Felixer grooming trap were highly unlikely to allow its use, compared to the 39% who had not heard of it but were highly likely to allow its use (Figure 3). On the other hand, 63% of those who had heard of Felixer™ grooming traps previously were highly likely to allow its use, versus the 26% who had previously heard of it and were highly unlikely to allow its use. These results further suggest that previous knowledge may be essential to gaining social license, as people who have knowledge about a method may be more likely to negotiate its use. Data also suggests that this particular method may not be as well-known as some of the other methods proposed, possibly because it is a relatively new technique still being trialled.

Examination of the survey data on baiting indicated that unlike baiting with Curiosity®, there was no significant difference in the likelihood of allowing the use of baiting with Eradicat® between those who had and those who had not heard of the method (Figure 3). Results suggest that baiting with Eradicat® is one of the more well-known feral cat control methods, and that

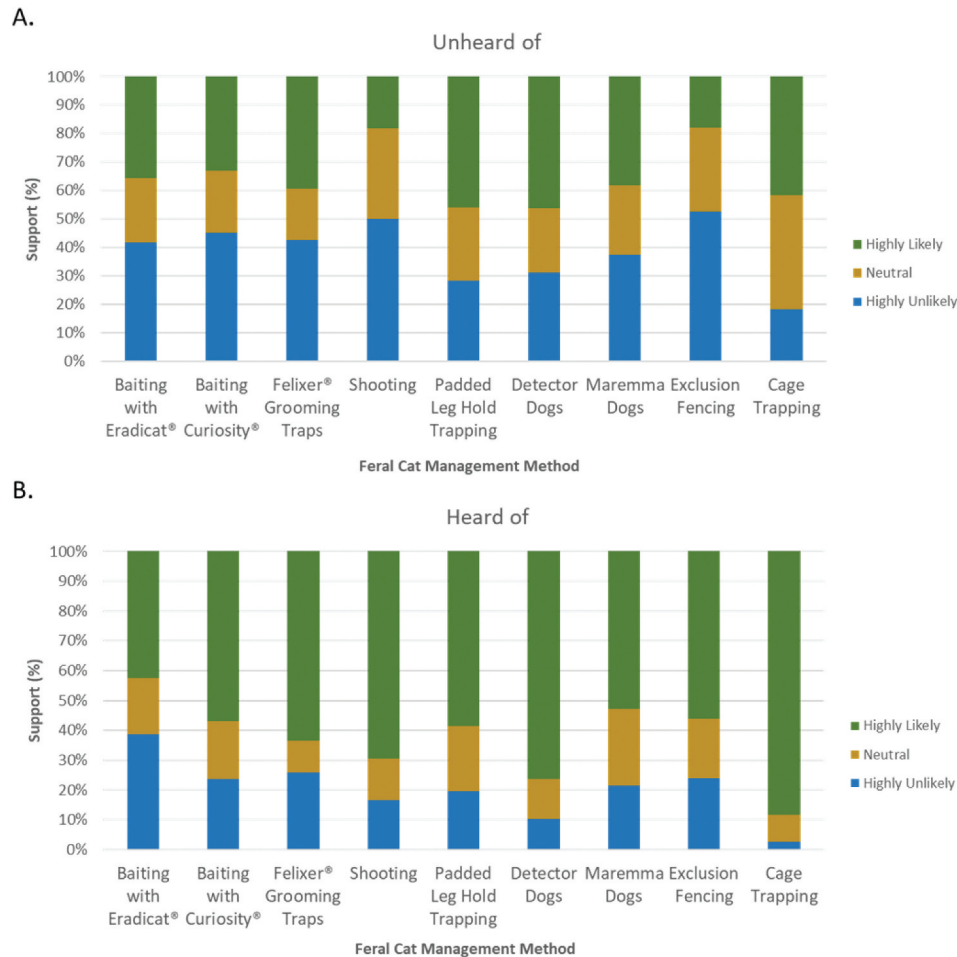


Figure 3. The above plots represent the total number of participants who had and had not previously heard of the various feral cat management methods, and their likelihood of allowing the use of these methods on their properties. Plot A describes the likelihood for those who have not heard of the particular feral cat management method to accept the use of the method in question, and plot B describes the likelihood for those who have heard of it to accept its use. Each colour on the graph represents a level of likelihood that a participant will use a certain cat control method: “Highly Unlikely” (blue), “Neutral” (gold) or “Highly Likely” (green).

there must be a reason other than lack of knowledge as to why it is so highly contested amongst the general public and other stakeholders. There is also the possibility that knowledge of target specificity influences attitudes to where Felixer® grooming traps are slightly more acceptable than either method of poison baiting.

Gender differences vs. previous knowledge of methods

In examining the interaction between gender and previous knowledge of cat control methods over acceptance of particular methods, the results of the ordinal logistic regression model (Table 3) suggested that attitudes toward control methods involving the use of baits, or leg-hold trapping were influenced more strongly by gender, whereas methods like exclusion fencing, detector dogs, Maremma dogs, and cage trapping were influenced more strongly by previous knowledge of the control method. Shooting and baiting with Curiosity® appeared to be influenced strongly

by both gender difference and an individual’s previous knowledge of that particular control method (Table 4).

Data suggests that of the people who were highly unlikely to allow the use of baiting with Eradicat® as a control method ($n = 77$), the majority, or about 70%

Table 4. An Ordinal Logistic Regression model was used to compare the influence of gender differences and previous knowledge on the likelihood of participants using particular feral cat control methods on Kangaroo Island, SA and in the Grampians region of Victoria. In all cases, at least one of the factors heavily influenced the likelihood of use. Values indicate significance (p) where values < 0.05 are significant.

Feral Method	CatManagement	Gender Differences	Previous Knowledge
Baiting with Eradicat®		$< 0.001^*$	0.732
Baiting with Curiosity®		0.002^*	0.002^*
Felixer® Grooming Traps		0.004^*	0.878
Cage Trapping		0.359	$< 0.001^*$
Padded Leg-Hold Trapping		0.002^*	0.195
Shooting		0.021^*	$< 0.001^*$
Detector Dogs		0.695	$< 0.001^*$
Maremma Dogs		0.188	0.04^*
Exclusion Fencing		0.584	$< 0.001^*$

were women. Of the women who had not heard of baiting with Eradicat® (n = 39), 56% were highly unlikely to allow the use of the method, and only 21% were highly likely to allow its use (Figure 4). While of the men who had not heard of baiting with Eradicat® (n = 28), the majority (57%) were still likely to allow the use of the method, and only 21% were highly unlikely to allow its use. Further, of the women who had heard of baiting with Eradicat® previously (n = 62), 50% were still highly unlikely to allow the use of the method, though 32% were highly likely to allow its use (Figure 4). Fifty-two percent of men who had heard of baiting with Eradicat® (n = 65) were willing to allow the use of the method, and 28% were highly unlikely to allow its use. These findings further underpin that gender strongly influences attitudes towards the use of baiting with Eradicat® ($p < 0.001$) (Table 4).

In relation to allowing the use of Curiosity® baits, the majority (58%) of women who had not previously heard of the method (n = 76) were highly unlikely to allow its use, whereas 26% were highly likely to. In contrast, a large portion of the men who had not heard of the method before (n = 66) were still highly likely to allow its use (41%), whereas 30% were highly

unlikely. Of the women who had heard of baiting with Curiosity (n = 25), 32% were highly unlikely to allow the use of the method, but the majority (52%) were highly likely to allow its use. Of the men who had heard of the method previously (n = 26), 62% were highly likely to allow its use and 15% were highly unlikely. In this instance, women seemed to be more strongly biased towards not using Curiosity® baits if they had not previously heard of the method, but were more likely to allow its use if they had heard of it, whereas men seemed to be more accepting of the method even if they had not heard of it previously. This suggests that both gender and previous knowledge played an important role in the likelihood of allowing use of Curiosity® baits (Figure 4).

The results for the Felixer™ grooming traps (Figure 4) indicate that of women who had not heard of this method before (n = 59), the majority (56%) would be highly unlikely to allow its use, and 25% would be highly likely to allow its use. Sixty percent of men who had not heard of the method before (n = 40) were highly likely to allow its use, and 22% were highly unlikely to allow its use. Of the women who had heard of Felixer™ grooming traps previously (n = 41), the

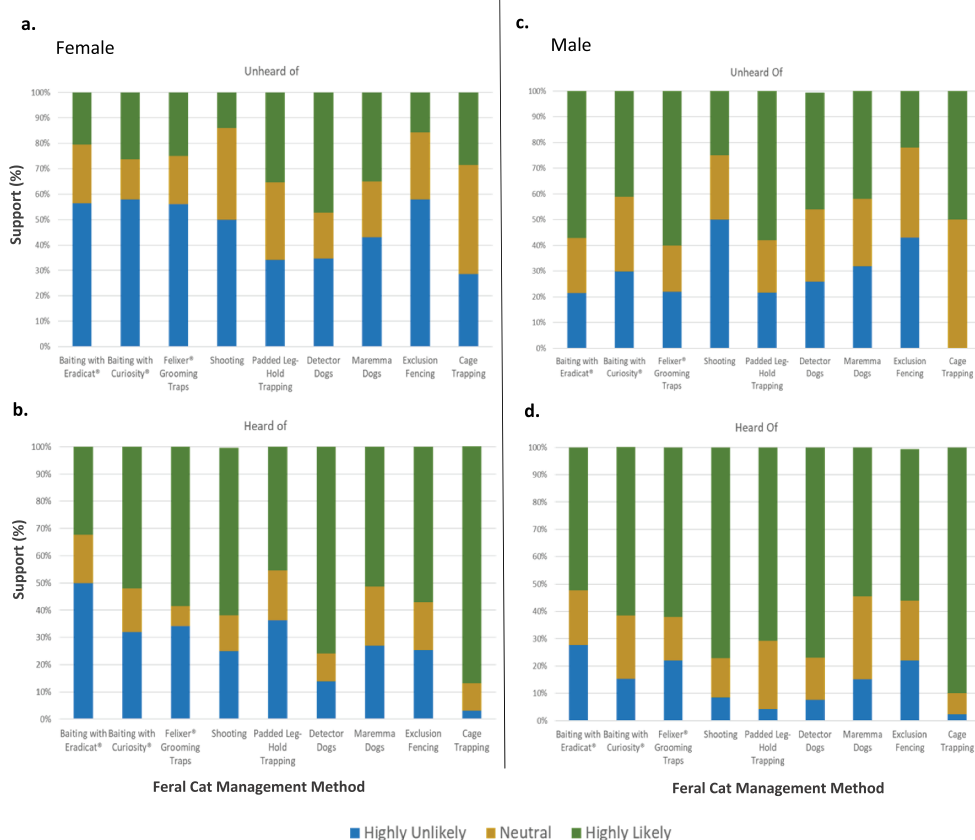


Figure 4. Percentages were calculated to determine the proportions of male and female participants from Kangaroo Island, SA and the Grampians region of Victoria who had and had not previously heard of particular feral cat management methods. Graphs display the breakdown of the relationship between levels of likelihood of allowing the use of feral cat management methods for (A.) women who have heard of these methods and (B.) those who have not heard of these methods previously (C.) men who have heard of these management methods and (D.) those have not. Each colour on the graph represents a level of likelihood that a participant will use a certain cat control method: “Highly Unlikely” (blue), “Neutral” (gold) or “Highly Likely” (green).

majority (59%) would be highly likely to allow its use, and 34% were highly unlikely (Figure 4). Similarly, 62% of men who had heard of the method ($n = 45$) were highly likely to allow its use and 22% were highly unlikely. (Figure 4). Although previous knowledge of the method did not seem to influence attitudes around the use of Felixer™ grooming traps as much as gender difference, it was apparent that women who had not heard of the method were much more likely to not support its use than men.

Further, we asked respondents whether they believed that there were better ways to manage feral cats than those mentioned in the questionnaire. A total of 14% of women strongly agreed that there were better methods, 46% were neutral or unsure, and 40% strongly disagreed. Of the men who were asked if there were better ways to manage feral cats, 4% strongly agreed that there were better methods, 55% were neutral or unsure, and 52% strongly disagreed. Common themes identified in the written responses provided by participants included women suggesting that they would not use poison such as Eradicat® baits due to the potential risk towards humans, pets and children, and men suggesting that they would be against the use of Eradicat® due to the potential risk towards non-target species. Further, exclusion fencing was identified by participants as a method that was expensive and inefficient.

Discussion

This study supports the argument that interactive effects of gender and previous knowledge of a cat control method play a vital role in explaining people's attitudes towards feral cat management (Dougherty, Fulton, and Anderson 2003; Bremner and Park 2007). Location was also a factor in relation to previous knowledge in this case, as people from KI were more familiar with the lethal methods using poison than those in the Grampians, which indicates perhaps that communication on the island has been effective, but also that many people in the Grampians region may not have been made aware of these methods yet (Barton Laws et al. 2015).

Men were more likely to permit the use of all management methods on their property, including lethal ones, as a way to manage feral cats as quickly as possible, whereas women were more likely to disagree with the use of lethal methods such as poison, preferring the less efficient methods such as cage trapping and shooting. At the same time, women were less likely to support methods that they were not previously familiar with and did not know enough about, suggesting that previous knowledge may play a more significant role in association with gender, rather than just gender effects alone in predicting support for the use of feral cat management methods. This finding is

likely to be at least partly explained by the belief that women in general tend to be more risk adverse than men and are likely to avoid activities that they are uncertain about and perceive as high risk (Larkin and Pines 2003; Zinn and Pierce 2002).

The fact that women hesitate to allow methods that they are not completely familiar with to be used on their property may also provide evidence that they are placing greater emphasis on a range of additional factors in decision-making around feral cat management, such as the potential harm to other animals or people (Larkin and Pines 2003; Zelezny, Chua, and Aldrich 2000). Some of the main reasons mentioned by women for not accepting the use of poison baiting, for instance, were that they did not want the baits to be consumed by pets or wildlife, and they also did not want the baits to be picked up by children. Men who were against baiting with either Eradicat® or Curiosity® also mentioned that it was due to the potential of non-target wildlife species ingesting the poison, but there were less mentions of that issue by men than by women. Further, women were more likely to strongly agree that there are better ways to manage feral cats than the methods mentioned within the questionnaire, while men seemed more confident that the methods that were mentioned within the questionnaire were the best ways to manage feral cats. At the same time, approximately 55% of men were unsure if there actually were better management methods available, and 46% of women felt the same suggesting that further community engagement may improve the confidence in the community around management abilities and methods. Management would also benefit from future in-depth research and education on the ethical considerations surrounding management decisions in relation to gender.

Other responses provided mostly by men about their attitudes towards management inferred that feral cats needed to be eradicated at all costs, which may be the main motivation for the majority choosing to use all of the cat control methods on their property. It is possible, too, that men and women hold different levels of responsibility for any potential harm to either non-target species or people if there allowed the methods to be used (Zinn and Pierce 2002; Zelezny, Chua, and Aldrich 2000). For women, there could be a greater sense of responsibility felt for potential risks and consequences from the direct use of poison, and they may be more cautious in wanting to avoid those consequences if they are not informed enough about the methods (Zinn and Pierce 2002; Fish et al. 2010; Wehrmeyer and McNeil 2000). Further, the consequences of making the choice to allow lethal methods such as poison to be used may take precedence over the consequences of letting feral cat populations decline very gradually, if at all, in vulnerable environments (Zinn

and Pierce 2002; Wehrmeyer and McNeil 2000). Men may feel a different level of responsibility towards potential risks due to their knowledge of feral cat management methods or concern of the impacts of feral cats, or possibly due to the white male effect that provides them with a confidence in any interventions. Men may also be considering the effectiveness of the methods to be more important than the potential negative consequences to non-target individuals, whereas women may consider the opposite (Zelezny, Chua, and Aldrich 2000). Additional research would also benefit from investigating gender differences in this regard in different contexts.

Effectiveness is an important overall factor that needs to be considered in decision-making around invasive species management, because even though the public might be in favour of one method over another, that method might not be very effective, or may be too labour intensive or economically unfeasible to achieve an outcome such as eradication (Doherty and Ritchie 2017; McCarthy, Levine, and Reed 2013). Cage trapping was found to be the most popular method among both men and women in this study. However, cage-trapping is one of the most labour intensive, ineffective and expensive means of attempting to control feral cats, especially because feral cats tend to be wary of traps and are difficult to catch (Phillips et al. 2005). The least popular option for management among the public was baiting with Eradicat®, even though this method is considered the cheapest and most effective method of all those presented (Algar et al. 2011; Dundas, Adams, and Fleming 2014). For example, eradicating cats from Faure Island Western Australia using Eradicat® only cost about 4 USD/ha (Algar et al. 2010), compared to 500 USD/ha for the San Nicolas Island USA cat eradication with its primary requirement to use cage trapping and impoundment on the mainland (Hanson et al. 2015; Fisher et al. 2015). Participants in our study were provided with information about the effectiveness of the method, as well as the cost and the appropriate stages of management in which to use each method prior to answering questions about the likelihood of use, which may suggest that men are more flexible and willing to compromise on the use of methods than women depending on the effectiveness of the method itself in removing cats from an area (Zinn and Pierce 2002; Zelezny, Chua, and Aldrich 2000; Larkin and Pines 2003). At the same time, additional studies need to be undertaken on the proportion of men and women directly involved in invasive species management, as well as those involved in land management and the roles they fulfill. This may provide further insight into the

involvement and experience of both men and women in addressing feral cats, and how these direct experiences may shape attitudes in the future for each gender.

The relationship between gender and previous knowledge of feral cat control methods as detailed in this study provides evidence that cognitive and experiential differences between genders influence decision-making around feral cats, and that effective communication is essential in gaining social licence for feral cat management (Dougherty, Fulton, and Anderson 2003; Loyd, and Miller 2010). People who are familiar with feral cat impacts and particular methods are better able to determine where they stand in accepting or rejecting method use, such as was the case for cage trapping and baiting with Eradicat®. Women seem to require a greater amount of information on both feral cat impacts and management techniques if they are to support a method, whereas men seem to require less information prior to providing support for a method. Information provided by management should be clear and engaging, but also targeted to different groups. Clearly to generate broad community support for the use of a lethal method in the landscape there is a need to explain in depth: how it works; how it will affect individual feral cats; its effectiveness in reducing harm; the environmental and economic losses caused by feral cats; and, how it may impact non-target species.

Conclusion

In addressing the issues around attitudes towards particular methods of feral cat management, especially those considered lethal or dangerous to humans and non-target species, it is important for management agencies to create materials or educational programs that can be used to inform the general public about the feral cat management approaches taking place in the region. It is important for messages to be tailored for a broad audience, but could also be targeted across genders in a way that introduces the facts surrounding impacts of feral cats as well as the feral cat management programs. As women tend to disagree more than men with the use of lethal methods and also consider additional factors to practicality in assessing management methods, messages will need to inform while also emphasizing the consideration and compassion taken towards both people and wildlife that might be affected by the methods. Finally, further detailed studies into gender value differences and how they interact with knowledge to influence attitudes towards removing invasive species using appropriate methods need to be con-

ducted for feral cats and other species that have direct, damaging influences on the environment.

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Author's Contributions

All authors contributed to the study conception and design. Material preparation was performed by Brooke P. Deak, Bertram Ostendorf, David A. Taggart, David E. Peacock, and Douglas K. Bardsley. Data collection, data analysis and the first draft of the manuscript was written by Brooke P. Deak, and all other authors provided supervision and edits, commenting on previous versions of the manuscript. All authors read and approved the final manuscript.

Availability of Data and Material

All data and materials support published claims and comply with field standards. Due to the nature of the raw data, it will not be made available for use.

Code Availability

All code supports published claims and complies with field standards. Due to the nature of the study, the R code will not be made available for use.

Disclosure statement

The authors declare that they have no conflicts of interest.

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