Prioritizing cat-owner behaviors for a campaign to reduce wildlife depredation

Wayne L. Linklater1,2 | Mark J. Farnworth3 | Yolanda van Heezik4 | Kevin J. Stafford5 | Edith A. MacDonald6

1Centre for Biodiversity and Restoration Ecology, School of Biological Sciences, Victoria University of Wellington, Wellington, New Zealand
2Department of Environmental Science, Policy and Management, University of California, Berkeley, California
3School of Animal, Rural and Environmental Sciences, Nottingham Trent University, Nottinghamshire, UK
4Department of Zoology, Otago University, Dunedin, New Zealand
5Institute of Veterinarian, Animal and Biomedical Sciences, Massey University, Palmerston North, New Zealand
6Department of Conservation, Biodiversity Unit, Wellington, New Zealand

Correspondence
Wayne L. Linklater, Centre for Biodiversity and Restoration Ecology, School of Biological Sciences, Victoria University of Wellington, P.O. Box 600, Wellington 6140, New Zealand.
Email: wayne.linklater@vuw.ac.nz

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Behavior prioritization is underutilized but critical to the success of conservation campaigns. It provides an understanding of the target audience’s values, transcending conflict, and informing the design of achievable and effective advocacy campaigns. Depredation by domestic cats may depress wildlife populations, leading to conflict between cat owners and conservationists. We surveyed veterinarians and cat owners at veterinary clinics to prioritize a list of nine cat-management behaviors. Cat-owner behaviors were ranked by their (a) likelihood of implementation and (b) current adoption rate by cat owners, (c) perceived effectiveness at reducing predation on wildlife, and (d) veterinarians’ opinions about their impact on cat welfare. Bringing cats in at night, from before dusk until after dawn, was revealed to be the behavior most suited to a campaign to reduce cats’ hunting. Behaviors ranked as more effective for conservation (e.g., 24-hr cat confinement) were unlikely to be adopted by cat owners or not supported by veterinarians, whose expert and normative support may be critical to a campaign. Although more conservation-effective behaviors received a lower priority, we discuss the repeated use of behavior prioritization to achieve incremental reductions in cat predation by engaging with cat owners.

KEYWORDS
behavior prioritization, cat welfare, conservation behavior, conservation campaign, domestic cat, Felis catus, human behavior change, veterinarian

1 | INTRODUCTION

The primary causes of environmental and biodiversity decline are anthropogenic: habitat destruction, pollution, over-population, and over-harvesting (Wilson, 2003). Addressing the root causes of these problems requires that human behaviors change (Schultz, 2011). Changing peoples’ behavior is challenging, but the application of social science to conservation problems might mitigate human-caused biodiversity decline (Bennett, Roth, Klain, Chan, Christie et al., 2017a). Attempts to change behavior should be guided by theoretical frameworks drawn from social marketing (Kotler, Roberto, & Lee, 2002; McKenzie-Mohr, Lee, Schultz, & Kotler, 2012; Michie, Atkins, & West, 2014; Weinreich, 1999), social psychology (Ajzen & Driver, 1992; Fishbein & Cappella, 2006), and integrated systems for knowledge management (Allen et al., 1998). The body of literature where these concepts and methods have been applied
to conservation challenges is growing but still small (Bennett, Roth, Klain, Chan, Clark et al., 2017b; Schultz, 2014).

Fundamental to successful behavior change is first identifying what behaviors (actions) to advocate to the target audience (e.g., the wider public). To conservationists, the mitigation actions required can appear obvious (e.g., buying products sold with less packaging or reducing cats’ opportunities to hunt wildlife). However, a trade-off often exists between an action’s conservation impact and the likelihood that the target audience will implement the behavior. Behaviors most likely advocated by conservationists are not necessarily those most likely to be widely adopted. An empirical and evidential strategy called behavior prioritization has been developed to resolve this trade-off (Schultz, 2011). It should be the first stage of campaigns to change behavior (McKenzie-Mohr et al., 2012).

Behavioral prioritization is founded on the principle of engaging with the target audience before, not after, mitigating actions are decided. Early engagement with the target audience helps to define the full spectrum of possible mitigation actions from the myriad possible. It also quantifies which actions the target audience do not currently perform but are, nonetheless, able and most likely to adopt and implement. This information, when combined with information about the behaviors of conservation benefit contributes to ranking behaviors and deciding which should be advocated (McKenzie-Mohr, 2000). Behaviors that have a low likelihood of adoption, even though they may have a high conservation impact, will receive a low ranking. Advocacy campaigns, instead, prioritize behaviors that are likely to have a conservation impact and high likelihood of adoption, although those behaviors are currently uncommon (Hine, Please, McLeod, & Driver, 2015). Following this process avoids wasting time and resources on behaviors that will not be adopted (Hine et al., 2015).

Domestic cats (*Felis catus*) as predators pose a significant risk to the conservation of wildlife in many parts of the world, particularly if they stray and re-wild to become feral (Blancher, 2013; Brickner-Braun, Geffen, & Yom-Tov, 2007; Dickman, 2014; Liberg, 1984; Loss, Will, & Marra, 2013; Loyd, Hernandez, Carroll, Abernathy, & Marshall, 2013). While the hunting by feral cats is known to cause population declines in wildlife, it is not clear that pet cats are also so ubiquitously detrimental. The evidence is mixed (Barratt, 1997; Barratt, 1998; Calver, Grayson, Lilith, & Dickman, 2011; Kikillus, Chambers, Farnworth, & Hare, 2016; Sims, Evans, Newson, Tratalos, & Gaston, 2008; van Heezik, Smyth, Adams, & Gordon, 2010). The impact of pet cats might be small or idiosyncratic in space, time, and among prey species. Nonetheless, it is certain that they kill wildlife that conflicts with growing efforts to improve the biodiversity value of anthropogenic landscapes (i.e., reconciliation ecology) or ecological restoration projects around and within them (Hanmer, 2017). Areas of high ecological value and biodiversity habitat are often, and increasingly, found adjacent to or within urban landscapes (Aguilar, Farnworth, & Winder, 2015), especially because they are supported by nature-loving urbanites. Yet, pet ownership, particularly of cats, is on the rise, and especially high in cities (American Pet Products Association, 2018; Pet Food Manufacturers Association, 2018). There has emerged, therefore, a growing and high-profile conflict between cat ownership and biodiversity conservation (Loss, Will, Longcore, & Marra, 2018; Walker, Bruce, & Dale, 2017). A precautionary approach to managing cat predation may be warranted.

In New Zealand, cats are a particularly serious biodiversity threat because much of its native fauna (i.e., birds and reptiles) evolved without mammalian predators (McCarthy, 2005; McLennan et al., 1996; van Heezik et al., 2010). In New Zealand’s cities, around 35% of households have at least one cat—a rate similar to, or higher than, estimates from other countries (summarized and compared in van Heezik et al., 2010; see also Baldock, Alexander, & More, 2003 for Australia, 25%; Downes, Canty, & More, 2009 for Ireland, 10.4%; and Murray, Browne, Roberts, Whitmarsh, & Gruffydd-Jones, 2010 for the United Kingdom, 26%). Public opinions where biodiversity conservation and cat ownership and welfare intersect vary dramatically depending on both the beliefs and attitudes of the respondent (Farnworth, Watson, & Adams, 2014; Peterson, Hartis, Rodriguez, Green, & Lepczyk, 2012) and the lifestyle of the cat (i.e., companion, stray or feral; Farnworth, Campbell, & Adams, 2011; Walker et al., 2017). In New Zealand, similar to other countries, there is a robust, ongoing, and emotional debate about mitigating the biodiversity impact of domestic cats (Morgan Foundation, 2013; Walker et al., 2017).

Research on the challenge cats pose to biodiversity conservation has, until now, largely focused on understanding cat habitat-use and depredation (e.g., in New Zealand: Aguilar et al. 2015; Kikillus et al., 2016; UK: Hamer, Thomas, & Fellowes, 2017; USA: Loyd et al., 2013; Australia: Lilith, Calver, & Garkaklis, 2008). Research dedicated to the human dimension of changing cat owner behavior is comparatively uncommon but important (e.g., Gramza, Teel, VandeWoude, & Crooks, 2016; MacDonald, Millfont, & Gavin, 2015; McDonald, Farnworth, & Clemen, 2018; McLeod, Hine, & Bengsen, 2015; McLeod, Hine, Bengsen, & Driver, 2017; Peterson et al., 2012; Walker et al., 2017). Proposed solutions have largely focused on changes to law and governance, gradually imposing greater constraints and obligations on cat ownership (Walker et al., 2017). However, these solutions do not resolve the conflict with cat owners, the risk of widespread non-compliance, and the costs of enforcement. More research to understand how to engage with cat owners is required to resolve the conflict and mitigate cats’ predatory impacts in ways that are...
motivated by, and motivating to, cat-owners (McLeod, Hine et al. 2017).

The aim of our study was to identify and prioritize cat-owner behaviors for a future advocacy campaign that is effective amongst cat owners. Our objective is to evaluate what cat-owner behaviors are most likely to be adopted and reduce domestic cats’ depredation of wildlife. Our expectation is that a behavior’s conservation benefit will need to be traded-off against its likelihood of adoption, especially perceptions about its negative consequences for cat welfare.

2 METHODS

2.1 Behaviors and behavioral prioritization

Cat owners could take numerous actions to mitigate the impact of their cat on native wildlife, for example, keep their cats inside, restrict them to an outdoor enclosure, or make them wear a collar with a bell. We selected nine behaviors that cat owners could implement to mitigate the impact of their domestic cat’s predation on native species. The behaviors were selected based on a literature review (Table 1) and on the authors’ knowledge of existing and potential behaviors that would limit cat wandering and hunting.

We adopted McKenzie-Mohr’s (2000) formula for behavioral prioritization that numerates the conservation gain of the behavior, the current penetration rate of each behavior, and the probability of each behavior being adopted by the target audience (cat owners). Specific to our context and problem, we modified McKenzie-Mohr’s (2000) formula by adding a fourth variable: veterinarians’ ranking of the impact of the behavior on cat welfare, because we were interested in delivering our future advocacy campaign from veterinary clinics. Veterinarians have a strong expert and normative

| Behavior                  | Details                                         | Impact                                                                 |
|---------------------------|------------------------------------------------|------------------------------------------------------------------------|
| Cat inside at night       | Cat brought inside from dusk until dawn every night | Reduce home range; cat home range correlated to predation (Robertson, 1998); time outside correlated to predation (McDonald, MacLean, Evans, & Hodgson, 2015) |
| Cat inside 24 hr          | Keep cat inside 24 hr a day                     | Reduce home range; cat home range correlated to predation (Morgan et al., 2009); time outside correlated to predation (McDonald et al., 2015) |
| Cat collar                | Put a cat bell and collar on your cat; collar has identification on it | Alert prey to reduce successful hunting (Gordon, Matthaei, & van Heezik, 2010; Harrod, Keown, & Farnworth, 2016); nuisance cats can be identified |
| Register your cat, like a dog | Register your cat, like a dog, with local council | Cats identified as pets and not feral; nuisance cats can be identified |
| Micro-chip                | Have a micro-chip inserted into cat and added to database | Cats identified as pets and not feral; nuisance cats can be identified |
| Contain via fencing       | Contain your cat to your property via fencing  | Reduce home range; cat home range correlated to predation (Morgan et al., 2009); predation in owner's yard (Kays & DeWan, 2004); no welfare difference (Kasbaoui, Cooper, Mills, & Burman, 2016) |
| Restrict cat to an outdoor run | Restrict your cat to an outdoor run (enclosure) | Reduce home range; cat home range correlated to predation (Morgan et al., 2009); no welfare difference (Kasbaoui et al., 2016) |
| Limit the number of cats  | Limit the number of cats in your household (e.g., to 4 per household) | Predation rate not correlated to number of cats in household (Lilith, Calver, Styles, & Garkakis, 2006) |
| Desex                     | Desex your cat                                  | No difference in predation rate of desexed and intact cats (Hall et al., 2016b) |
influence over cat owners, particularly with respect to animal welfare (Harrod et al., 2016; MacDonald et al., 2015). Veterinarians have been successful advocates in previous owner-behavior change initiatives (e.g., Byers et al., 2014 for improving owner and dog health) and could also be an important influence on cat owners. Thus, we wanted to ensure they would also support the prioritized behavior. The likely effectiveness of a behavior was calculated using the augmented prioritization formula:

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\text{Effectiveness} = \text{Conservation Impact} \times \text{Likelihood of Adoption} \times (1 - \text{Current Penetration Rate}) \times \text{Cat Welfare}. \]

“Conservation impact” is represented by the average of the authors’ scores between 1 and 10. “Likelihood of adoption” and “Cat welfare” (based on veterinarians’ opinions about the actions’ impact) were an average Likert score (range 1, significant negative impact, to 7, significant positive impact). “Current penetration rate” was represented as a proportion of survey respondents (ranging from 0 to 1). Behaviors were then ranked based on their Effectiveness with higher scores being judged better subjects for an advocacy campaign.

### 2.2 Study population

We quantified the variables for the behavioral prioritization formula by surveying cat owners at 10 veterinary clinics and practices in three New Zealand cities: Wellington, Dunedin, and Palmerston North. Wellington is the nation’s capital city and its second-largest metropolitan area. Approximately 191,000 residents live within the 290 km² city limits, and an additional 280,000 residents live in the wider metropolitan area including smaller adjacent cities. Dunedin has a population of 120,000 and Palmerston North 80,000 residents (Department of Statistics, New Zealand, 2016).

A list of all veterinary clinics and practices in the three New Zealand cities was compiled from public listings. Clinics in each city were selected and contacted by telephone, informed of the study and its purpose, and asked if they would participate in the research. Two attempts were made to contact the clinics and obtain participation. Two clinics in Palmerston North, three in Dunedin, and five in Wellington agreed and participated.

### 2.3 Surveying

During November and December 2014, customers in the 10 veterinary clinics were approached by a research assistant after they had checked into reception and were waiting for their appointment. A script was prepared to ensure consistency in the recruitment process and avoid bias. The research assistant identified themselves as being from the local university and conducting research on cat welfare. The customer was asked to self-complete a survey which took approximately 5 min to complete (Supplementary File Data S1).

The survey asked respondents to quantify how likely they would engage in the nine behaviors on a Likert scale from 1 to 7 (7 being highly likely). Respondents were also asked which of the nine behaviors they were already performing.

To calculate the conservation impact, we used a modified Delphi technique (Murry & Hammons, 1995). This technique is used to develop consensus by a panel of experts on a particular topic and is widely used in public health (DeVillers, DeVillers, & Kent, 2005). The authors, all animal and conservation biologists, were asked in an open-ended fashion to provide their input about the direct conservation impact of each owner behavior based on the literature and their knowledge. A direct impact is one that reduces an individual and owned cat’s ability to hunt and kill native wildlife. Once this information was shared and discussed amongst them, all five authors individually ranked each behavior on a scale of 1 to 10 (10 having the greatest impact). The indirect impacts of an owner’s behavior were not considered (Dickman, 2007; Lilith et al., 2006). For example, de-sexing (sterilization) may reduce the cat population over time to lower cats’ hunting at a population level, but its impact is indirect because the de-sexed cat still hunts (Hall, Bryant, et al., 2016b). Furthermore, an owner’s behavior may directly reduce a cat’s hunting (the direct impact) but increase hunting by other smaller introduced mammalian predators such as rats (an indirect impact) (as speculated in Wood, Seddon, Beaven, & van Heezik, 2016). To date, however, there have been few studies to look at the overall impact (cumulative effect of direct and indirect) of reduced cat predation on native species to inform cat management practices. Hence, we adopted the precautionary approach (Calver et al., 2011; Grayson & Calver, 2004; Lilith et al., 2006) by assuming that domestic cats pose a direct risk to native wildlife (e.g., Morgan et al., 2009 found 11% of birds caught by cats were native and 18% of all prey species were skinks). However, it was accepted that the overall extent of the impact is unknown (direct plus indirect). The authors, therefore, were instructed to base their ranking on the direct impact of an individual cat and not the population of cats. The average ranking of each behavior was shared with the group followed by a discussion until a consensus was reached.

The impact of behaviors on cat welfare was determined by surveying veterinarians. A link to an electronic survey was sent out via the New Zealand Veterinarian e-newsletter (September 25 to October 26, 2014) with a follow-up
reminder email sent 10 days before the survey closed. In that survey, veterinarians were asked to rate on a scale of 1 to 7 (7 being the greatest positive impact) the impact of the nine behaviors on cat welfare (Supplementary File Data S2). We also asked the veterinarians to rank the nine behaviors for their impact on wildlife on a scale of 1 to 7 (7 having the greatest positive impact) so that we could compare with the animal welfare ranking. Veterinarians were also asked: what their primary interest/practice type was (companion animal, equine, large animal/livestock, or wildlife).

3 | RESULTS

Surveys \((n = 159)\) were completed (no missing data) by customers at veterinary clinics and 173 veterinarians completed their survey over a 4-week period. Most of the veterinarians (97%) identified as companion, small animal veterinarians.

The authors ranked “Cats inside 24 hours” as likely to cause a greater direct reduction in cat depredation than other actions, while cat registration, micro-chipping, de-sexing, and limiting the number of cats that could be owned were thought most likely to have a trivial benefit (Table 2). Limiting the roaming of the household cat(s) by containing them inside at night, or fencing them into the property or an enclosure, were considered to have a moderate to high biodiversity conservation benefit. Collaring cats was thought to have a moderate benefit too. The behaviors most likely to be adopted in descending order were de-sexing cats, limiting the number of cats per household, microchipping cats, and bringing them inside all night (Table 2). Registering cats (as is the practice for dogs in New Zealand), or putting a collar on them, were less likely to be adopted. Containing cats to the property via a fence, keeping cats inside 24 hr a day, and restricting cats to a run, were the actions that cat-owners thought they were least likely to implement.

Most (96%) of cat owners currently had less than four cats in their household and 96% of respondents had de-sexed their cat(s). Almost two-thirds (64%) of cats were microchipped. Just over a quarter (29%) of respondents locked their cat inside at night every night and 26% of cat owners collared their cats. The other cat-owner behaviors: “Cats in 24 hr a day”, “register cat like a dog”, “contain cat to property via a fence”, and “restrict cats to a run”; had a current penetration rate of 1% or less.

The behaviors ranked by veterinarians with the greatest positive impact on cat welfare were de-sexing, microchipping, limiting the number of cats per household, and cats kept inside at night, all having mean scores greater than five. “Registering a cat like a dog” and “containing cats to property via fence” received intermediate scores. “Cats wearing a collar”, “restricting cats to a run”, and “keeping cats inside 24 hours” received considerably lower scores for their positive impact on cat welfare.

Effectiveness was calculated using the augmented behavioral prioritization formula. Behaviors were ranked based on their total score, with the greatest score aligning to the behavior that should be the target of the future advocacy campaign (Table 2). “Keeping cats inside at night, from before dusk until after dawn” had the highest score and thus

| Authors | Cat owners | Veterinarians |
|---------|------------|---------------|
| Conservation impact | Likelihood of adoption | Current penetration rate | Cat welfare | Effectiveness score | Rank |
| Cat(s) in at night | 6.0 | 4.82 ± 0.26 | 0.29 | 5.46 ± 0.12 | 110.53 | 1 |
| Contain to property via fence | 7.6 | 2.12 ± 0.21 | <0.01 | 4.10 ± 0.12 | 65.40 | 2 |
| Collar | 5.4 | 3.57 ± 0.27 | 0.26 | 3.28 ± 0.013 | 46.79 | 3 |
| Cat in 24 hr | 10.0 | 1.76 ± 0.16 | <0.01 | 2.28 ± 0.11 | 39.73 | 4 |
| Restrict cat to run | 8.4 | 1.38 ± 0.11 | <0.01 | 2.81 ± 0.13 | 32.25 | 5 |
| Register cat like dog | 1.6 | 3.94 ± 0.29 | <0.01 | 4.83 ± 0.14 | 30.14 | 6 |
| Microchip | 1.6 | 4.97 ± 0.28 | 0.64 | 5.91 ± 0.09 | 16.92 | 7 |
| Limit number of cats | 3.6 | 5.54 ± 0.23 | 0.96 (<4 cats) | 5.69 ± 0.09 | 4.54 | 8 |
| De-sex | 2.2 | 6.77 ± 0.10 | 0.96 | 6.20 ± 0.09 | 3.69 | 9 |

Conservation impact is represented by an average score (range 1 to 10). Likelihood of adoption and veterinarian opinions about the impact of the action on cat welfare are represented by average (±1 SE) Likert scores on a scale of 1 to 7. Current penetration rate is represented as a proportion of survey respondents (ranging from 0 to 1). Behaviors were ranked based on their calculated effectiveness score with higher scores being judged better subjects of an advocacy campaign. Calculation of effectiveness was based on the modified McKenzie-Mohr (2000) formula: effectiveness score = conservation impact × probability of adoption × (1-current penetration rate) × cat welfare.
received a behavioral prioritization rank of 1. This behavior also had the highest probability of adoption, a moderate penetration rate, and a perceived robust impact on cat welfare and conservation outcomes (Table 2).

4 | DISCUSSION

Behavioral prioritization techniques have been used much more widely and for substantially longer in fields such as public health (e.g., Booth 1992), but are under-utilized in biological conservation (Schultz, 2011). Our work contributes to a small but growing number of examples where behavioral prioritization has been conducted as a guide to behavioral change interventions for species management (Please, Hine, Skoien, Phillips, & Jamieson, 2017; Skoien, Please, & Hine, 2016; Verbeek, Oosterhout, & Grantley, 2014), including a recent example with domestic cats (McLeod, 2017).

Advocacy campaigns have a history of omitting the behavioral prioritization stage (Weinreich, 1999), especially in conservation (Johnson, Kazakov, & Lynch, 2007; McKenzie-Mohr, 2000; Novacek, 2008). Instead, conservation experts can be inflexible about the action the target audience should take and believe their opinions superior (expert righteousness). Experts can also assume they know what the target audience thinks about the problem and possible solutions, believing that their own knowledge and beliefs are representative of that audience (expert naïveté). As a result, the behavior that conservationists select and advocate to the public, while having the potential to achieve substantial conservation gains, nonetheless fails because the public do not implement it (McKenzie-Mohr et al., 2012; Eisenhauer & Nicholson 2005; Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007). Behavioral prioritization (Schultz, 2011) is a systematic approach to avoid this mistake.

In New Zealand, as has occurred in Australia (e.g., Department of Local Government, 1994), the first proposals to reduce cats’ hunting of wildlife have been to first regulate cat ownership and legislate for cat confinement. However, reliance on voluntary compliance and problems with enforcement often result in less-than-effective adoption than anticipated by government agencies (McLeod et al., 2015). While some changes can be achieved this way, a significant number of cat owners may not be swayed by new rules and passively, or actively, flout them, allowing their cats to roam. Non-compliance poses uncertainties about the usefulness of policies and risks encouraging opposition. An alternative, or reinforcing, strategy would be to understand cat owners’ experience and beliefs about cat husbandry and their implications for animal welfare and biodiversity impacts (McLeod, 2017). Then, those beliefs can be used to identify cat-owner behaviors with both benefits for biodiversity and a high likelihood of adoption.

5 | PRIORITISING BEHAVIORS FOR A CAMPAIGN

Identifying the values of cat owners and working within their current value system is essential for behavior change, rather than implementing a top-down approach to change cat owner beliefs and values (Manfredo et al., 2017; McLeod, Driver, Bengsen, & Hine, 2017). By following the behavioral prioritization process, we identified keeping cats inside at night as a behavior for a future advocacy campaign. As expected, the prioritized behavior was not the one with the greatest conservation value (i.e., maximum reduction in cat predation) nor did it have the greatest likelihood of adoption by cat owners. Instead, the behavior identified optimizes the trade-off between likely conservation impact and probability of adoption, with strong support from veterinarians.

Behavioral prioritization, by integrating several critical considerations and viewpoints, and not exclusively the conservation benefit, also exposed and quantified particular values and beliefs that could significantly impact the success of a campaign. For example, 67% of veterinarians thought that keeping cats inside 24 hr a day would have a significant negative impact on cat welfare (a belief that might not be always true, for example, Kasbaoui et al., 2016), although it would also reduce cats’ hunting to zero. Moreover, 24-hr containment is a behavior that cat owners identify as unlikely to be achievable. Thus, implementing an advocacy campaign for keeping cats inside 24 hr a day would more likely fail to motivate cat owners and lose the support of veterinarians who are a strong influence on cat owners.

While we have demonstrated the behavior prioritization process for the biodiversity conservation goal of reducing domestic cat predation, it remains for us to demonstrate that the prioritized behavior can be successfully advocated and adopted by the cat-owning public. To achieve this, we need to understand (a) what values and beliefs drive cat owners when keeping their cat inside at night, (b) how to appeal to these drivers in an advocacy campaign, and then (c) conduct and evaluate an advocacy campaign that is guided by these. For example, cat owners are less likely to believe that cats kill wildlife or they underestimate its magnitude. Thus, cat owners are less likely to be motivated to act to reduce cat predation of wildlife (Lilith et al., 2006; MacDonald et al., 2015). Instead, cat owner’s willingness to keep cats in at night is better motivated by owners’ perceptions that cats are more likely to be injured at night (e.g., cat fighting and traffic). It therefore follows that the best course of action may be to appeal to cat owners to confine cats inside for their welfare (Toukh sati, Young, Bennett, &
Coleman, 2012). Campaigns around cat safety rather than their impact on wildlife may be more effective (McLeod, Hine et al. 2017). Discovering and applying these understandings should be the subject of future work.

Finally, we confined our study to cat owners visiting veterinary clinics. Those surveyed are likely to be particularly responsible cat owners who are more responsive to others', especially veterinarians', suggestions about how to care for cats. Other cat owners who are less likely to seek the services, and act on the advice, of a veterinarian may behave differently. Understanding those cat owners would require a different survey method and we would expect the behavior prioritization to yield different, perhaps very different, results. Nonetheless, understanding and changing the behavior of a community begins first with the people and actions that are most tractable and moves incrementally on to those that are more difficult to implement and survey, in order to harness the potential for normative social expectations to generate a behavior-change cascade.

6 | INCREMENTAL PROGRESS

Our research found that almost 30% of cat owners bring their cat inside at night but less than 1% confined their cat inside or to their property 24 hr a day. This is a similar rate to Australians engaging in the same behaviors more than a decade ago (e.g., 34%, Van de Kuyt, 2004; 38%, Lilith et al., 2006) at which time there was also very low support among Australian cat-owners for 24-hr confinement. In Australia, 24-hr cat confinement was also not considered an essential component of responsible pet ownership with some viewing all-day confinement as cruel and “unnatural” (McCarthy, 2005; McLeod et al., 2015; Rochlitz, 2005). Lilith et al. (2006) also found only 6% of cat owners confined their cats to their property via an enclosure, but there was greater acceptance and implementation of bringing cats inside at night (Grayson & Calver, 2004). However, starting in the late 1990s advocacy campaigns about cat owner behavior began (Hall et al., 2016a; McLeod et al., 2015) and many Australian towns and states (e.g., Cat Act, Department of Local Government, Sport and Cultural Industries, 2011) adopted cat-confinement legislation at small scales, but avoided all-day confinement due to the public backlash (McCarthy, 2005). As a result, cat owner behavior changed over time. For example, more recently Toukhsati et al. (2012) found in the state of Victoria, Australia, 80% of cat owners contained their cat to their property during the night and 41% during the day too (i.e., 24-hr confinement), with 26% of owners having an enclosed yard or run. Likewise in Tasmania, those owners who were motivated to practice a nightly curfew became significantly more likely to state an intention to fully contain their cat(s) indoors (McLeod, 2018).

The incremental changes in cat-owner behavior that have occurred in Australia were preceded by a large amount of research to understand cat owners' propensity to adopt new actions (Grayson & Calver, 2004) that has led to successful government regulation of cats (Denny & Dickman, 2010). Cat owner adoption of targeted behaviors (i.e., night time confinement) led to greater support for other, originally more challenging, management behaviors (e.g., cats inside 24-hr a day or confined to property). Once the first prioritized behavior has been embedded in the target audience, that is, the penetration has greatly increased, another behavior that has greater conservation gains but requires greater cat-owner commitment can be advocated (in our study this could be cats inside 24 hr or confining cats to owners' property via fencing). Thus, asking people to keep cats inside at night may prime cat owners to adopt a future behavior that is a larger commitment, that is, a foot-in-door technique. This step-wise approach over time appears to have been successful because attitudes and beliefs among cat owners have shifted in Australia over the last decade (Hall, Adams, et al., 2016a; Toukhsati et al., 2012).

7 | CONCLUSIONS AND RECOMMENDATIONS

Aspiring immediately to behavior-change goals with greatest conservation benefit, but with little hope the targeted audience will adopt or engage in the behavior, raises the risk of disengagement by cat owners. It may also polarize the debate, and even result in a reversal of progress. Focusing, instead, on achievable, smaller behavior changes in the short term raises the possibility of on-going incremental change. Over longer periods of time it is possible to move toward other related behaviors and more aspirational goals, via the spill-over effect (Thøgersen & Crompton, 2009) or foot-in-door technique (Burger, 1999; Truelove, Carrico, Weber, Raimi, & Vandenbergh, 2014). By designing and implementing an advocacy campaign that focuses, first, on a behavior acceptable to cat owners (i.e., bringing cats inside at night in New Zealand) over time, there could be a more substantial shift in behavior with greater conservation benefit. Although globally objectives may differ, we strongly suggest that engaging with cat-owners in this way may enable substantial change. Incremental changes through behavior prioritization may deliver longer-term and sustained reductions in the impact of domestic cats on native wildlife while not exacerbating conflicts and risks of non-compliance.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

AUTHOR CONTRIBUTIONS

All the authors contributed to research design, interpreting data, and writing the manuscript. W.L. wrote the application that funded the research. W.L. and Y.v.H. organized and coordinated surveying and data gathering. E.M. and W.L. collated data and conducted the statistical analyses and wrote the first draft of the manuscript.

ORCID

Wayne L. Linklater https://orcid.org/0000-0003-2627-693X
Edith A. MacDonald https://orcid.org/0000-0002-7733-424X

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Additional supporting information may be found online in the Supporting Information section at the end of this article.

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