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Minimizing the Effects of Free-Ranging Domestic Cats on Wildlife: A Framework that Integrates Social and Biological Information

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ABSTRACT: Recently, there has been growing interest in the study of the biology of free-ranging cats and their effects on wildlife, generating new estimates of cat densities and predation rates. Although such biological data are important to consider when formulating management strategies, they have done little to stifle conflict between stakeholder groups or reduce the number of cats on the landscape and their ecological impacts. In many cases, this research has actually rekindled debate, often pitting wildlife biologists against animal welfare organizations and the general public. While some social science research regarding human perceptions of free-ranging cats exists, these studies are often initiated after conflict has occurred or after a controversial management strategy has been implemented. Furthermore, few studies have focused on the perceptions of owned free-ranging cats, although these cats may comprise a large proportion of cats on the landscape. The most effective, humane, and socially-acceptable management strategies will involve front-end integration of both social and biological science information as well as inclusion of diverse stakeholders. Our ongoing research provides a framework that wildlife managers, pest managers, animal protection organizations, and local government entities can use to develop socially-relevant and biologically-effective management programs for owned free-ranging domestic cats. This framework involves social science research methods grounded in social psychological theories to help predict human thought and behavior, as well as biological methods to assess cat impacts. Lastly, using our own research as a model, our framework compiles guiding principles that help managers develop effective communication programs aimed at promoting conservation-relevant behaviors.

KEY WORDS: animal control, communication, conservation, domestic cat, *Felis catus*, human dimensions, social science, survey, wildlife

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INTRODUCTION

Free-ranging domestic cats (*Felis catus*) impose risks on the natural systems they inhabit. Predation by cats impacts local populations of birds and small mammals, and cats may act as disease transmission agents to wildlife or compete with local predators (Crooks and Soulé 1999, Baker et al. 2005, Brown et al. 2008, van Heezik et al. 2010). Conversely, cats that spend time outside can incur a variety of risks from wildlife, including harassment and predation by native carnivores and increased exposure to disease (Crooks and Soulé 1999, Grubbs and Krausman 2009, Bevins et al. 2012). Thus, allowing cats outdoors is a topic of significant importance to conservation biology as well as to pet, ecosystem, and wildlife health.

There is an inherent social dimension to the issue of free-ranging cats as humans are often their caregivers and can contribute to the cause of as well as the solution to this issue. However, management of free-ranging cats has become a highly controversial topic that often pits wildlife professionals against animal rights organizations due to cats' roles as both charismatic pets and predators of wildlife (Peterson et al. 2012). Despite ubiquitous media attention, there is a paucity of literature regarding public perceptions of free-ranging cats and their interactions with wildlife. Social science examinations that explore the public perceptions of *owned* free-ranging cat

issues are notably absent from the literature, although these owned cats may comprise a large proportion of cats on the landscape (Thomas et al. 2012).

A full examination of this issue must include both biological studies of owned free-ranging cats as well as social science assessments of public opinions regarding the topic. In response to this need, we are conducting a study that integrates biological and social science approaches to examine actual and perceived risks associated with owned outdoor cats along the wildland-urban interface (WUI) near Boulder, Colorado (Gramza, unpubl.). Exploring the social factors surrounding the issue of free-ranging domestic cats can minimize risks to both cats and wildlife. Further, identifying risk perceptions and misconceptions regarding free-ranging domestic cats can be used to inform targeted communication strategies aimed at reducing the risks that cats incur and impose in the environment.

In the first phase of the study, we conducted a human dimension survey of residents in the area in 2011-2012 to explore their attitudes, beliefs, and risk perceptions concerning cats and their interactions with wildlife. To examine the ecological role of free-ranging cats, we monitored their movement patterns with remote camera surveys and GPS telemetry. In this paper, we describe our research framework and highlight some key findings to date to illustrate how social and biological science may

be integrated to inform communication programs that promote desirable public behaviors and management actions. It is our hope that managers can use our integrated approach as a model to manage other ecologically relevant and controversial species.

STUDY AREA

We performed our research along a gradient of urbanization in the Front Range of Colorado west of the city of Boulder. We categorized the study area into two levels of urbanization: urban/suburban and exurban. Urban/suburban areas were defined as all residences within the city limits of Boulder that were also adjacent to the WUI, defined as the boundary between the western edge of Boulder and adjacent natural areas. Exurban residences were all other parcels within Boulder County west of the city of Boulder that were 1) outside the boundaries of cities with 700 people or more, 2) less than 40 acres in size, and 3) immersed in natural habitat (following Theobald 2005). Given the landscape of western Boulder County, we assumed that all homes west of Boulder and outside of city limits were immersed in natural habitat.

RESEARCH APPROACH AND KEY FINDINGS

Social Science Component: Resident Surveys

Our survey was grounded in theory and concepts from social psychology adapted for use in understanding wildlife and other natural resource-related issues. Specifically, our approach focused on the application of attitude theory (Ajzen and Fishbein 1980, Eagly and Chaiken 1993, Manfredi 2008) and the concept of risk perceptions (Slovic 1987, Gore et al. 2009). In this context, attitudes, which guide individual behaviors, refer to one's overall evaluation (e.g., good/bad) of a particular entity or issue, such as cats being allowed outside. Beliefs refer to the specific cognitions that form the basis for attitudes, often representing how individuals feel about the outcomes of a given issue. This would include thoughts regarding the advantages and disadvantages of cats spending time outside (e.g., cats having a better quality of life or disrupting the balance of nature) as well as more specific beliefs about risks, or risk perceptions (e.g., threats to cat safety from predation or cats negatively impacting prey populations). Risk perceptions can influence wildlife-related attitudes and support for wildlife management programs (Riley and Decker 2000, Gore 2004).

We created and administered questionnaire surveys following a modified Dillman approach (Dillman et al. 2009) consisting of multiple survey mailings to residents in the study area from November 2011 through January 2012. The sampling frame was identified using GIS-based county tax parcel data that allowed for owner information (mailing address) to be linked to spatial information about parcel location in relation to the natural areas of interest.

We measured attitudes by asking respondents on a 7-point scale to indicate whether "having outdoor pet cats in your neighborhood" is good, bad, or neither, and their overall level of approval of "people allowing their cats to spend time outdoors." Attitudes toward cat management strategies were measured on a 7-point scale from highly unacceptable to highly acceptable. Management actions

included the legal mandate of certain outdoor cat restrictions (e.g., leash laws or prohibition of cats being allowed outdoors), sterilization, vaccination, and licensing. We measured risk perceptions using a series of statements representing possible outcomes of cats spending time outdoors. These included questions about bidirectional risks regarding cats in the ecosystem. Risk perceptions were recorded on a 7-point scale from extremely unlikely to extremely likely.

We used fixed response options to measure the following sociodemographic variables: age, gender, income, education, and type of community where respondents were raised (urban or rural). Cat ownership factors were: current cat ownership (yes/no) and outdoor restrictions (fixed choices of keeping cats indoors at night versus allowing cats outdoors only under human supervision, and an open-ended "other"). We also asked respondents why they let their cats outside or restricted their movement (open-ended response).

In total we received 917 completed surveys for 34.5% response rate (Gramza, unpubl.). We also completed a non-response check ($n = 47$) on select variables of interest and only found a practical difference between respondents and nonrespondents with respect to interest in owned free-ranging cat issues, with respondents being more interested in owned free-ranging cat issues than nonrespondents.

As a whole, respondents thought that owned outdoor cats were slightly bad and they neither approved nor disapproved of people allowing their cats outdoors (Gramza, unpubl.). However, these attitudes were different based on cat ownership status and behavior: Indoor-only cat owners had the most negative attitudes toward owned free-ranging cats, whereas owners who allowed their cats outdoors with and without restriction had the most positive attitudes. Respondents found less restrictive cat management actions, such as sterilization and vaccination, to be most acceptable, and more restrictive strategies, such as requiring cats to be kept indoors or restrained, the least acceptable. The acceptability of cat management strategies followed the same pattern as the general attitudes with regards to cat ownership and behavior: Indoor-only cat owners found all cat management strategies more acceptable than non-owners, outdoor cat owners who employ some cat restriction behaviors, and outdoor cat owners who employ no restrictions.

We asked respondents 16 risk perceptions questions about the risks that owned free-ranging cats both incur and impose. Risks included disease transmission with wildlife, other pets, and humans; predation by native predators; mortality from cars or other pets; stolen or lost cats; cats damaging private property; and cat predation on wildlife (Gramza, unpubl.). Respondents thought the risk of cats giving diseases to humans was the least likely (slightly to moderately unlikely), and the risk of cats getting injured or killed by coyotes and mountain lions were the most likely (moderately likely). Risk perceptions differed based on cat ownership status and behavior: Cat owners who let their cats outdoors with or without any restrictions had the lowest risk perceptions, whereas non-owners and indoor-only cat owners had the highest risk perceptions.

Biological Science Component: GPS Telemetry and Camera Surveys

We conducted GPS telemetry and remotely-triggered camera surveys of domestic cats along the WUI to quantify cat movement within natural areas adjacent to urban development. We tracked 12 domestic cats with GPS backpacks (CatTraQ, Catnip Technologies, Hong Kong and Anderson, SC) with owner consent for one continuous month each season for 1 year (2012-2013). Study cats were recruited from the homes of survey participants. The GPS units collected cat locations every 15 minutes and employed rechargeable batteries, recording over 30,000 locations on study cats over the course of the study (Gramza, unpubl.). This GPS telemetry provided unprecedented high-resolution data on cat daily movement patterns, home ranges, habitat selection, and potential interactions with wildlife along the WUI.

We also placed 25 motion-activated Cuddeback cameras (Expert, Capture, and Attack models, Cuddeback, Green Bay, WI) at varying distances along 5 transects perpendicular to the WUI west of Boulder. Each transect contained 5 cameras, one at each of 5 distance intervals (0 m, 100 m, 250 m, 500 m, and 1,000 m) from the WUI. From October 2011 to October 2012, remote cameras recorded a total of 254 photographs of cats, 8,729 of wildlife, 136,397 of dogs, and 474,852 of humans in the study area (Gramza, unpubl.). The camera data enabled us to investigate activity patterns of domestic cats and the distance into which they encroach on natural areas, as well as the composition of the wildlife community in the vicinity.

Domestic cats were captured on 10 cameras. Of these 10 cameras, 4 cameras were located 0 m from the WUI, 4 cameras were 100 m from the WUI, 1 camera was located 500 m from the WUI, and 1 camera was located 1,000 m from the WUI. As expected, domestic cats seem to stay close to human settlements along the WUI. However, wildlife also were captured close to the WUI. In fact, 9 of the cameras that captured domestic cats also captured mountain lions, 8 captured coyotes, and 6 captured bobcats; these provide evidence of spatial overlap of domestic cats and 3 of their potential predators. Furthermore, we captured 2 photos of domestic cats interacting with predators: one showed a domestic cat and a coyote facing each other and the other was of a mountain lion with a cat in its mouth (Gramza, unpubl.).

In the same study area, collaborators at Colorado State University and the Colorado Division of Wildlife have tracked the movements of mountain lions and bobcats, allowing further evaluation of potential interactions between domestic and wild felids. Additionally, a collaborative research project concurrently screened domestic cats, bobcats, and mountain lions in the study area for diseases, including zoonotic pathogens such as *Toxoplasma gondii* and *Bartonella* spp. that may infect wild and domestic felids and humans. Along the Front Range, *Toxoplasma gondii* IgG seroprevalence (indicating past exposure to the pathogen) was 3.7, 30.77, and 55.38, and *Bartonella* spp. seroprevalence was 10.17, 14.29, and 9.57 for domestic cats, bobcats, and mountain lions, respectively (Bevins et al. 2012).

DISCUSSION

A primary goal of our interdisciplinary research is to inform communication programs to reduce the risks that outdoor cats both incur and impose and to provide a framework that translates well to replication by managers. Specifically, our results can help: 1) identify specific target audiences and their characteristics; 2) provide assessments of *perceived* risk that can be compared against measures of *actual* risk obtained from the other components of the study to identify gaps or misperceptions in public understanding; and 3) determine which risk mitigation strategies are likely to have higher levels of public support and appeal to outdoor cat owners.

In our study, we have learned that most people think that risks related to cats transmitting or contracting diseases in the environment are not likely, but think that the risks of cats being injured or killed by predators are likely (Gramza, unpubl.). The people who allow their cats outside have the lowest risk perceptions; these are the people who would be targeted to employ cat restriction behaviors in communication efforts. We know from our study that predation on cats occurs and that cats and wildlife carry pathogens that they can spread to one another and to humans (Bevins et al. 2012, Gramza, unpubl.). Therefore, it will be important to communicate these localized risks so they are salient to outdoor cat owners, while also promoting cat restriction strategies that make cat owners feel like they can actually protect their cats from these risks.

We also have learned that people find less restrictive behaviors such as mandatory spay/neutering and vaccination to be more acceptable management actions than mandatory outdoor restrictions or banning outdoor cat activity altogether. Open-ended responses in our surveys also revealed that many cat owners allow their cats outdoors because they believe cats are happier outdoors (Gramza, unpubl.). Consequently, promoting indoor-only strategies might not appeal to a large number of cat owners in our study area. However, other outdoor restriction techniques not specified in our surveys (e.g., cat enclosures that let cats go outside but not roam freely), are becoming popular. Further, walking cats on leashes and using cat-bibs that prevent cats from pouncing on prey (Calver et al. 2007) are also viable options. Such techniques still allow cats to have outdoor access but reduce the risks of cats interacting with wildlife, and these could easily be promoted in a communication program or messaging campaign.

When designing and implementing communication programs, it is important not only to communicate actual risk statistics but also to promote behaviors that have a high likelihood of adoption and are effective at reducing risks. Because effective communication programs often require substantial time and monetary resources, it is vital to partner with other organizations that share a common goal. In our case, we have partnered with a local conservation nonprofit (Boulder County Audubon Society), an animal welfare organization (Animal Assistance Foundation), and a municipal natural resource agency (City of Boulder Open Space and Mountain Parks). Such organizations share common goals of conserving native

wildlife and their habitats and reducing companion animal suffering.

Ultimately, the success of applied wildlife research can be measured in part by the success of management that results from it. In our case, and for many human-wildlife conflict issues, effective management actions usually depend upon the behavior and attitudes of the public. Below we summarize some guiding principles for successful communication strategies aimed at behavior change of target populations. Where applicable, we elaborate how our research can be used as an example to follow these principles.

- 1) **Know the target audience** (Clayton and Myers 2009, Jacobson 2009, Schweizer et al. 2009, McKenzie-Mohr et al. 2012, Clayton et al. 2013). In our study, we used mail survey data regarding sociodemographics, cat restriction behaviors, motivations for restriction activities, and public attitudes, beliefs, and risk perceptions to inform targeted messages and communication strategies regarding owned free-ranging cats.
- 2) **Make the issue local and salient** (Clayton and Myers 2009, Jacobson 2009, Schweizer et al. 2009, McKenzie-Mohr et al. 2012). We used local data regarding biological risks to target risk and belief misperceptions in order inform communication strategies aimed at increasing cat restriction behavior.
- 3) **Promote self-efficacy of behaviors** (Clayton and Myers 2009, Jacobson 2009, Schweizer et al. 2009, McKenzie-Mohr et al. 2012). Through communication strategies, it is important to empower people to adopt restriction behaviors by emphasizing the ability of cat owners to minimize risks through their own behaviors.
- 4) **Promote impactful behaviors** (Clayton and Myers 2009, McKenzie-Mohr et al. 2012). Promoting leash restraint and cat enclosure greatly reduces the bidirectional risks of outdoor cats, and these behaviors can be easy to perform.
- 5) **Identify measurable and achievable objectives** (Jacobson 2009, McKenzie-Mohr et al. 2012). In communication strategies, using observational studies to determine if people are actually performing the desired behaviors will allow managers to measure the effectiveness of programs at reaching the targeted objectives.
- 6) **Solicit a public commitment to engage in the target activity** (Jacobson 2009, McKenzie-Mohr et al. 2012). In our study, this guideline can be addressed by encouraging in-person program participants to sign a pledge stating that they will restrict their cat's activity to protect their cat, their family, and wildlife.
- 7) **Use insiders and trusted others to help promote relevant behaviors** (Jacobson 2009, Clayton and Myers 2009, McKenzie-Mohr et al. 2012). In our study, this guideline can be addressed by using local cat owners to demonstrate cat restriction activities at in-person communication programs. Partnering with trusted local organizations and employing

neighborhood ambassadors to distribute items such as informational pamphlets can also help.

8) **Pilot the program and evaluate the results**

(Jacobson 2009, McKenzie-Mohr et al. 2012). A small-scale pilot program can be useful to evaluate approaches before pooling available resources into a large communication campaign. This can be accomplished through focus groups; pre- and post-pilot program surveys; and observational studies as described in our case study above.

In conclusion, our integrative and collaborative approach serves as a model to facilitate a more holistic understanding of complex social-biological problems. Using this approach will ensure that wildlife managers have the proper data to make management decisions that are both biologically meaningful and socially relevant. Further, this approach can inform effective and targeted communication strategies that promote information transfer and encourage behavior change of target populations. Human-wildlife conflicts necessarily involve human behaviors, so consideration of the human dimension is critical for efficient and effective management and mitigation efforts.

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