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Cats and wildlife: an animal welfare perspective.

by

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Abstract

While there is no question that outdoor cats have an impact on wildlife, the extent and significance of this impact is the subject of considerable debate. The controversy surrounding outdoor cats can be traced back at least a century, with contemporary claims of threats to global biodiversity bringing animal welfare and conservation interests directly into opposition, largely over the means of managing conflicts. The irony in this is that cat defenders and cat detractors generally agree that it is in the best interests of cats that they should be shielded from the vagaries of outdoor life. While there are practical and implementable ways to begin addressing the management concerns surrounding outdoor cats the current polarization seems to militate strongly against cooperation. This paper reviews some of the complexity surrounding the issue of outdoor cats and suggests possible approaches to overcoming these conflicts.

Keywords: cats, *Felis catus*, outdoor cats, management, animal welfare, conservation, environmental impacts

Introduction

Owned and unowned cats (*Felis catus*) have long been implicated as threats to wildlife. Where early claims cast cats as threats to bird species of economic importance to farmers and game birds that were important to hunters (Forbush, 1916; Wilson & Vreeland, 1917), later concerns focused on threats to bird populations generally (George, 1978; Proulx, 1988; Coleman, Temple, & Craven, 1997). Today, cats are visualized by some conservationists as threats to global biodiversity (Dauphine & Cooper, 2009; Loss & Marra, 2017).

Efforts to manage cats range from keeping pets indoors (ABC, 2018) to recommendations to employ the landscape level eradication of entire populations (Bloomer & Bester, 1992). Cat management engages diverse communities of interest, including municipal animal control agencies, local humane societies, rescue groups, national animal welfare organizations, academics, conservationists, veterinary professionals, wildlife damage managers, local, state and federal government agencies, birding enthusiasts, cat enthusiasts, nongovernmental organizations and commercial pest control companies among others, each following their own particular praxis. While these interests ideally share the common goal of seeing fewer cats outdoors, they are often in conflict over what management is justified and how it should be conducted, and prioritized (Barrows, 2004; Cowan & Warburton, 2011). To some, the environmental threat represented by cats is so great as to argue control is warranted “by any means necessary” (Marra & Santella, 2016), while others argue that even where control is justified the welfare of cats must always be taken into consideration (Slater, 2007). Debate about cats is often gridlocked over the means by which management should occur, even as management is increasingly viewed as a conservation priority.

The purpose of this paper is to address the historic and contemporary controversy over cats and wildlife from an animal welfare and protection perspective. The paper reviews some of the claims made against cats, touches on some aspects of the varying contexts involving management and discusses some of the means of resolving conflicts with cats as currently advocated. To judge from the extensive literature on the subject, in most of the contexts in which cats are found they are not well managed. There is a need for clearer thinking, better integration of science and technology, improved policy and planning, more effective public engagement and reconceptualization of the roles different stakeholders play in outdoor cat management.

Claims about cats

The principal claim made today against outdoor cats is that they prey upon wildlife valued by humans (Doherty, Davis, van Etten, Algar, Collier et al., 2015; Loss, Will & Marra, 2013). Concerns about this were first raised in antiquity (Engels 1999), but until recently cats were generally more valued for their role in rodent control than for any harm they did to other species (Blaisdell 1993). In conducting what was probably the first survey of cat predation, Forbush (1916) concluded that free-ranging cats were a “great and growing evil” but not to be blamed for following their “natural propensities.”

A more recent survey, this time tallying cat predation in an English village (Churcher & Lawton, 1987), renewed the debate about outdoor cats after a long hiatus. May (1988) used data from that study to project a nation-wide level of impact in Britain, sparking an exchange over the validity of such extrapolation and the general nature of “feline delinquency” (Proulx, 1988; Fitzgerald, 1990; Jarvis, 1990). In the United States, a survey taken in rural Wisconsin (Coleman & Temple, 1993) was also extrapolated to provide a national estimate of the impact of

cats on birds, becoming immediately a point of conflict between cat and bird advocates (Marra & Santella, 2016). Concurrent with the rise of conservation biology as a discipline, the role of outdoor cats and their impacts on endangered and threatened species was raised as a special concern, especially on islands (Medina, Bonnaud, Vidal, Tershy, Zavalete et al., 2011) and for ecological communities with naïve or particularly susceptible prey species (King, 1984; Doherty et al., 2015; Woinarski, Legge & Dickman, 2019).

Some other contemporary claims include:

- concern for the role cats may play in carrying and introducing pathogens that affect the health of humans and their pets (Gerhold & Jessup, 2012), wildlife (Jessup, Miller, Kreuder-Johnson, Conrad, Tinker et al., 2007) and animals in food production (Langham & Porter, 1991);
- cats acting as ecological competitors with raptors and other native predators (George, 1974);
- cats depressing bird populations through sublethal effects (Beckerman, Boots & Gaston, 2007, Bonnington, Gaston & Evans, 2013);
- cats altering prey behavior (Stone, Snell & Snell, 1994);
- cats burdening efforts to rehabilitate native wildlife (Loyd, Hernandez & McRuer, 2017);
- cats impeding the reintroduction of native species (Moseby, Read, Paton, Copley, Hill et al., 2011); and
- domestic cats interbreeding with wild cats (*F. silvestris*) to dilute gene stocks (Germain, E., Benhamou, S., & Poule, M. L., 2008).

There have also been concerns expressed about environmental damage resulting from the negative impact on global fisheries stocks to satisfy demand for pet food (De Silva & Turchini, 2008) and to highly localized impacts from the production of urine and feces (Twardek, Peiman, Gallagher & Cooke, 2017; McNamara, O'Kiely, Whelan, Forristal, Fuller et al., 2001).

Cats also have a very long history of association with humans (Vigne, Guilane, Debus, Hay & Gerald, 2004) during which they have been valued as predators of species (primarily rodents) injurious to human interests (Elton, 1953; Alasdair, 2012). Cats are also now favored as human companions (Serpell, 2000) and this development creates its own culture of concern regarding cats. Outdoor cats can be harmed or killed by vehicles or by wild and domestic animals. Cats living outdoors face starvation, experience high kitten mortality and are subject to various acts of cruelty from humans (Lockwood, 2005; Loyd, Hernandez, Abernathy, Shock & Marshall, 2013). The protection of cats and the promotion of their welfare engages many groups as well as individuals (Slater, 2007).

Controlling cats

Consistent with the many different contexts in which they are found and impacts they may cause cats are controlled by widely diverse practices that can range from individual caregivers confining their pets to national governments creating programs to eradicate entire populations. The bulk of cat control in many countries falls to an animal care and control community made up

of private or municipal animal shelters as well as specialized rescue groups. These organizations date to the mid-nineteenth century (Unti & Rowan, 2001) and typically retain primary responsibility for accepting unwanted pets, as well as varying degrees of responsibility for control of overpopulation and cruelty cases. They employ practices such as adoption, animal control, licensing, high volume spay/neuter, subsidized spay/neuter, Trap-Neuter-Return (TNR), euthanasia and humane education to address cats as individuals or populations (CFHS, 2017).

Additional educational and public policy efforts may focus on encouraging confinement or restricting outdoor access (Beckerman, Boots & Gaston, 2007), limiting the number of cats that can be owned (Lilith, Calver, Styles & Garkaklis, 2006), advancing understanding of pet behavioral problems (Kendall & Ley, 2006) and removing and relocating problem cats (Hanson, Bonham, Campbell, Keit, Little et al., 2010).

Federal agencies in the United States may pursue control on their properties as well (AFPMB, 1996) while commercial “pest” or “nuisance” animal control businesses offer fee-based services to trap cats, typically in urban areas (Vantassel, 2013). Land management agencies employ practices such as exclusion zones (Metsers, Seddon & van Heezik, 2010) and habitat management (Alteiro, Moller & Ratz., 1998), bounties (Loyd & Miller, 2010), and lethal removal by population reduction practices such as culling (Bester, Bloomer, van Aarde, Erasmus, van Rensburg et al., 2002) or eradication (Medina et al., 2011).

A variety of techniques are used in lethal cat control, including gunshot (Hildreth, Vantassel & Hynstrom, 2010), poisoning (Eason & Frampton, 1991), body-gripping traps (Hildreth, Vantassel & Hynstrom, 2010), live-trapping followed by a lethal procedure (Campbell, Harper, Algar, Hanson, Keitt et al., 2011), fumigation (Parkes, Fisher, Robinson & Aquirre-Munoz, 2014), hunting with dogs (Hanson et al., 2010) and the release of pathogens (Cleaveland, Thirgood & Laurenson, 1999). Non-lethal tactics include deterrents such as bells (Nelson, Evans & Bradbury, 2005), bibs (Hall, Fontaine, Bryant & Calver, 2015), sonic devices (Nelson, Evans & Bradbury, 2006), and fencing (Moseby & Read, 2006).

Considerable effort is currently focused on reproductive control of cats in the form of improved sterilization (Bradshaw, J.W.S., Horsfield, G.F., Allen, J.A., & Robinson, I.H., 1999; Algar, Hilmer, Nickels & Nickels, 2011), contraception (Levy, Miller, Crawford, Ritchey, Ross et al., 2004)) and novel techniques such as gene drive (Deardon, Gemmell, Mercier, Lester, Scott et al., 2018) and gene silencing (Dissen, Lomniczi, Boudreau, Chen, Davison & Ojeda, 2012).

While lethal management practices, such as poisoning or the use of disease are (or should be) highly controversial, most of the current controversies focus on a non-lethal management approach known as Trap-Neuter-Return (TNR or some similar term). In this procedure, stray and feral cats are trapped and sterilized and then returned to where they were trapped, typically to live in groups (colonies) that are monitored and cared for by one or more individuals (Neville, 1989). There are many variants associated with this procedure, including various treatments to evaluate health and fitness (Gibson, Kelzer & Goldring, 2002), administer immunizations (Fisher, Quest, Dubovi, David, Tucker et al., 2007), adopt out tame cats and kittens (Hughes & Slater, 2002), optimize efficiency through “flagship” programs (Boone, Briggs, Hiby, Lawler, Levy et al., 2014), and better understand human-cat relationships (Centonze & Levy, 2002; Finkler & Terkel, 2011).

TNR has been well studied (Hughes, Slater & Haller, 2002; Slater, 2004; Levy, Isaza & Scott, 2014; Spehar & Wolf, 2018) and modeled (Andersen, Martin & Roemer, 2004; Schmidt, Swannack, Lopez & Slater, 2009; Loyd & DeVore, 2010; McCarthy, Levine & Reed, 2013). As

is the case with any type of population management, TNR can fail to reduce the size of cat colonies, typically when sterilization falls below a certain level (Miller, Boone, Briggs, Lawler, Levy et al., 2014), and when immigration by stray and abandoned cats leads to colony growth (Castillo & Clarke, 2003). These factors and the complaint that TNR leaves cats at large and capable of preying on wildlife (Jessup, 2004) have led to the concept being broadly rejected by conservationists (Jessup, 2004; Longcore, Rich & Sullivan, 2009; Marra & Santella, 2016). Others argue that, like any management practice, TNR simply needs to be modified and optimized (Foley, Foley, Levy & Paik, 2005; Boone 2015; Boone et al. 2014) and that it would be contrary to accepted practice in wildlife management to take any tool out of the toolkit (R. Schmidt, pers. com., April 2009).

Ethics and cat management

Perhaps unsurprisingly, dialogue surrounding the ethics of outdoor cats and their management is as rich, complex and wide-ranging as everything else about them. For example, Barrows (2004) focuses narrowly on the ethical concerns faced by veterinarians in controlling outdoor cats, while Cowan and Warburton (2011) focus on much broader concerns about the ethics of eradication programs at landscape levels. Wolf and Schaffner (2019) address a changing ethical landscape, arguing a shift away from an anthropocentric to a zoocentric virtue ethic tied to the no-kill movement in animal welfare.

Human responsibility for outdoor cats has long been argued (Forbush, 1916; Coleman, Temple & Craven, 1997; Finkler & Terkel, 2012), even human culpability (Lynn, 2016), but not, apparently, to the extent of determining human obligations (Burgess-Jackson, 1998). Responsibility in terms of religious duty and as an element of dominion (Gentry, 1900) has fallen out of favor, although Palmer (2001) raises contemporary questions involving domination and human/animal power relations surrounding a pet cat. Even the vilification deriving from earlier symbolism relating to femininity and evil is said to still pervade beliefs about cats (Smith, 1999).

The values held by cat caregivers play a significant role in understanding outdoor cats as predators, especially where the belief is that cats need to roam for their psychological well-being or that the life of the cat has more value than the wildlife s/he preys on (Slater, 2004; Crowley, Cecchetti & McDonald, 2019). Longcore (2012) argues that feral cat advocates “appear unable” to feel compassion for the suffering of victims of cat predation, to emphasize a point about asymmetric valuation. Differential valuation is also suggested when the victims of cats are treated unequally. For example, are the sparrows (*Passer domesticus*) making up the bulk of victims in the Churcher & Lawton study (1987) to be regarded as less “important” than, say, the petrels (*Pterodroma sandwichensis*) that cats take from burrows in Hawaii (Judge, Lippert, Misajon, Hu & Hess, 2012)? If, as many conservationists would argue, house sparrows are of less concern (in large part because they are non-native throughout much of their global range) then it seems minimally reasonable to assess and include an analysis of the types of wildlife harmed by cats when estimating such enormous total wildlife loss to cat predation as is sometimes done (e.g., Loss, Will & Marra, 2013). How much moral consideration is given to cats and the prey they claim as victims is worthy of further exploration.

Palmer (2003, 2015) explores the ethics of cat management in depth, treating issues ranging from moral agency to material dependence while visualizing cats in many categories, including as members of human communities. She argues that the heart of the moral debate over Trap and Euthanize (TE) and TNR lies in the different prioritization of values by conservationists and welfarists, placing cats in what Marks (2014) calls an “ethical no man’s land.” This is especially the case where cats are deemed to be “pests” and the object of concerted eradication efforts, as

in Australia and New Zealand whose governments are driving national programs to remove feral cats entirely from the environment (NZCAC, 2017; Commonwealth of Australia, 2015).

To date cat eradications have been successful only on fairly small islands (Nogales et al., 2004; Medina et al., 2011). And even for these eradications, various ethical issues should be addressed, including failure (high welfare cost for little welfare benefit), non-target impacts (including trophic cascades and mesopredator release) and the welfare impact of different methods and tools used to kill (Cowan & Warburton, 2011). Some accommodation to the latter occurs in efforts to find and use more “humane” toxicants (Eason, Miller, MacMorran & Murphy, 2014) as well as selective delivery systems (Read, Giglotti, Darby & Lapidge, 2014), to improve (relatively) the welfare of animals targeted for killing as well as reduce impacts to non-target species.

Where eradication cannot be achieved, the welfare impacts of population reduction (culling) must be assessed in the context of outcomes (Braysher, Buckmaster, Saunders & Yates, 2012), especially when under some conditions no benefits seemingly accrue (Lazenby, Mooney & Dickman, 2015). There are obvious and serious welfare implications to programs that repeatedly kill animals to control populations versus those that conduct removal on a one-time basis. How programs are justified, and their benefits assured are critical to proper management planning (Littin, Mellor, Warburton & Eason, 2004; Littin, Fisher, Beausoleil & Sharp, 2014). Sharp and Saunders (2012) propose that feral cat management be based on an ethical framework (rationale) that is organized around a code of practice from which standard operating procedures can be derived. The idea is laudable if welfare improvements are considered a prominent part of the planning process and can be upgraded continuously. Similarly, Lynn (2018) describes the process of conducting an ethics-based policy review that seeks to investigate the “moral facts” of an issue under investigation – another reasonable step in dealing with ethical issues surrounding cats.

Cats as social constructs

As with many other animals, cats can mean different things to different people at different times. Such differences may lead reasonable people to disagree as cats become surrogates for other embedded social discords (Goedeke & Herda-Rapp, 2005). Calls for the elimination of free-roaming cats were originally framed in the context of threats to birds of economic importance (Forbush, 1916) and later as threats to bird populations in general (May, 1988) before being framed in the context of cats as a globally significant “invasive” species (Marra & Santella, 2016; Doherty, Glen, Nimmo, Ritchie & Dickman, 2016). An urgent call to “do something” about outdoor cats now cycles through public discourse, generating memes such as “Must cats die so birds can live?” (Pressler, 2013) and “The Evil of the Outdoor Cat” (Conniff, 2014).

Counterarguments are framed around the issue of human responsibility and the moral dilemmas that widespread killing of cats would represent, evoked through titles such as “*Cat wars: the moral shame of conservation*” (Lynn, 2016) and “*Stakes grow higher in cat-bird wars*” (King 2016). Understanding cats as social constructs is as relevant as understanding them in their biological and ecological contexts. Among the areas ripe for investigation are:

- deciphering how meanings about cats are produced,
- the rhetorical tools used by groups adopting differing views about cats,
- the power relations between those groups,
- the arenas of social institutions engaged in debate, and

the importance of social networks for the actors involved (Goedeke & Herda-Rapp, 2005: 7).

Recognizing and elucidating these factors and related factors may be critical to bringing opposing sides to the table.

Discussion

The problems associated with managing outdoor cats will not be resolved anytime soon. Controlling cats is a challenging and complex task, with biological, legal, cultural, institutional, ecological, historical, scientific, economic, ethical, political and social dimensions. Outdoor cats range from those that are wholly owned companions that are allowed to roam outdoors to truly feral and unsocialized cats that are part of the wild landscape. Such cats are non-randomly distributed in both time and space and are present in numbers that vary widely (from 0.1 cats per km² to a 1,000 or more cats per km²) from one place to another. Typically, cats in wild areas are present at densities of around 1 cat per km² or less. The very high cat densities are found in heavily modified human landscapes. Cat predation is “ephemeral, unpredictable, and spatially dispersed” (Cooper, Loyd, Murante, Savoca & Fickinson, 2012: 12), making efforts to mitigate predation impacts difficult and requiring “different strategies in different places, at different scales, in different communities of people, and at different times” (Linklater & Steer, 2018: 4). Although claims have been made that the problem is simply an overpopulation of outdoor cats that must be addressed “by any means necessary” (Marra & Santella, 2016) such simplistic constructs provide no workable pathway along which acceptable management and social acceptance lies.

Conflicts with cats are serious, at least from an anthropocentric point of view. Outdoor cats can and do impose a considerable toll on wildlife, in particular on a local basis (Balough, Ryder & Marra, 2011). The killing of wildlife by well-fed companion cats is, at all times, an unnecessary toll on wild animals. Like pigeons (Jerolmack, 2008), cats have lived with humans for thousands of years and human attitudes to cats have varied from worship to hatred over millennia (Lawrence, 2003). Unfortunately, the current controversies over outdoor cats find opposing sides holding such different values that they may not even be able to agree on how to define the problems involved (Warburton & Norton, 2011). Little progress or consensus can be expected until compromise is reached, and a central ground occupied.

Some time ago, Warner (1985) insightfully identified the conditions necessary for effective control of outdoor cats: determine numbers accurately, determine impacts accurately, and determine acceptable means of control. These determinations can be made at any scale – local, regional, or national – but are likely to be most practically and effectively applied at the local level. Duffy & Capece (2011) propose “compromise management” as a way forward in addressing conflict with outdoor cats. Such compromises are rare but working examples are available – e.g., in Portland, Oregon (Sallinger & Kraus, 2014).

This might mean eradicating cats in areas of high native biodiversity or in landscapes (such as islands) where endemic species may be specifically threatened by cat predation and where reintroduction can be prevented. In other landscapes of low or moderate biological value, one might seek to educate the public to reduce the impacts of their own cats on local wildlife and allowing programs such as TNR in areas of low diversity or in certain urban areas.

Other, more specific, approaches can and should be imagined, such as emphasizing very localized conservation efforts consistent with emerging understanding of cat home ranges

(Kays, Dunn, Parson, McDonald, Perkins et al., 2020), testing of management intensity to better select management strategy (Boone, Miller, Briggs, Benka, Lawler et al., 2019), using cultural as well as conceptual models to improve understanding of value conflicts over outdoor cat management (Leong, Gramza & Lepczyk, 2020) or linking human-cat relations to ecological processes in a 'companion animal ecology' (Crowley, Cecchetti & McDonald, 2020).

Both conservation biology and animal welfare are marginal human activities with relatively little power in these times. Neither can afford to become diverted by internal conflict when they share a common goal – in this case improved welfare for cats and wildlife both.

References

- Alasdair, A. (2012). *The Cat: A short history*. USA: Alasdair & Donaldson.
- Algar, D., Hilmer, S., Nickels, D., & Nickels, A. (2011). Successful domestic cat neutering: first step towards eradicating cats on Christmas Island for wildlife protection. *Ecological Management & Restoration*, 12(2), 93-101.
- Alterio, N., Moller, H., & Ratz, H. (1998). Movements and habitat use of feral house cats *Felis catus*, stoats *Mustela erminea* and ferrets *Mustela furo*, in grassland surrounding yellow-eyed penguin *Megadyptes antipodes* breeding areas in spring. *Biological Conservation*, 83(2), 187-194.
- American Bird Conservancy (ABC), (2018). Cats and Wildlife. Retrieved September 3, 2018 from: <https://abcbirds.org/program/cats-indoors/cats-and-birds/>
- Andersen, M. C., Martin, B. J., & Roemer, G. W. (2004). Use of matrix population models to estimate the efficacy of euthanasia versus trap-neuter-return for management of free-roaming cats. *Journal of the American Veterinary Medical Association*, 225(12), 1871-1876.
- Armed Forces Pest Management Board (AFPMB). (1996). *Guidelines for reducing feral/stray cat populations on military installations in the United States*. Washington, DC: Defense Pest Management Information Analysis Center.
- Balough, A. L., Ryder, T. B., & Marra, P. P. (2011). Population demography of Gray Catbirds in the suburban matrix: sources, sinks, and domestic cats. *Journal of Ornithology*, 152(3), 717-726.
- Barrows, P. L. (2004). Professional, ethical, and legal dilemmas of trap-neuter-release. *Journal of the American Veterinary Medical Association*, 225(9), 1365-1369.
- Beckerman, A. P., Boots, M., & Gaston, K. J. (2007). Urban bird declines and the fear of cats. *Animal Conservation*, 10, 320-325.
- Bester, M. N., Bloomer, J. P., van Aarde, R. J., Erasmus, B. H., van Rensburg, P. J. J., Skinner, J. D., Howell, P.J., & Naude, T. W. (2002). A review of the successful eradication of feral cats from sub-Antarctic Marion Island, Southern Indian Ocean. *South African Journal of Wildlife research*, 32(1), 65-73.
- Blaisdell, J. D. (1993). A most convenient relationship: the rise of the cat as a valued companion animal. *Between the Species*, 9(4), 219-230.
- Bloomer, J. P., & Bester, M. N. (1992). Control of feral cats on sub-Antarctic Marion Island, Indian Ocean. *Biological Conservation*, 60(3), 211-219. doi:10.1016/0006-3207(92)91253-O
- Bonnington, C., Gaston, K. J., & Evans, K. L. (2013). Fearing the feline: domestic cats reduce avian fecundity through trait-mediated indirect effects that increase nest predation by other species. *Journal of Applied Ecology*, 50(1), 15-24. doi:10.1111/1365-2664.12025
- Boone, J. D., Briggs, J. R., Hiby, E., Lawler, D. F., Levy, J. K., Miller, P. S., Nutter, F.B., Slater, M.R. & Zawistowski, S. (2014). Improving and evaluating Trap-Neuter-Return management for outdoor cats on the human landscape. In R.M. Timm & J.M. O'Brien (Eds.) *26th Vertebrate Pest Conference*, (Pp. 229-234). Davis: University of California.
- Boone, J. D. (2015). Better trap–neuter–return for free-roaming cats: Using models and monitoring to improve population management. *Journal of Feline Medicine and Surgery*, 17(9), 800-807. doi:1098-612X.
- Boone, J. D., Miller, P. S., Briggs, J. R., Benka, V. A. W., Lawler, D. F., Slater, M., Levy, J. K. & Zawistowski, S. (2019). A long-term lens: Cumulative impacts of free-roaming cat management strategy and intensity on preventable cat mortalities. *Frontiers in Veterinary Science*, 6(238). doi:10.3389/fvets.2019.00238
- Bradshaw, J. W. S., Horsfield, G. F., Allen, J. A., & Robinson, I. H. (1999). Feral cats: their role in the population dynamics of *Felis catus*. *Applied Animal Behaviour Science*, 65(3), 273-283.

- Braysher, M., Buckmaster, T., Saunders, G., & Krebs, C. J. (2012). Principles underpinning best practice management of the damage due to pests in Australia. In R.M. Timm (Ed.), 25th Vertebrate Pest Conference, (Pp. 300-307). Davis: University of California.
- Burgess-Jackson, K. (1998). Doing right by our animal companions. *The Journal of Ethics*, 2(2), 159-185.
- Campbell, K. J., Harper, G., Algar, D., Hanson, C. C., Keitt, B. S., & Robinson, S. (2011). Review of feral cat eradications on islands. In C. R. Veitch, M. N. Clout, & D. R. Towns (Eds.), *Island invasives: eradication and management* (pp. 37-46). Gland, Switzerland: IUCN.
- Canadian Federation of Humane Societies (CFHS). (2017). *Cats in Canada 2017: a five year review of cat overpopulation*.
- Castillo, D., & Clarke, A. L. (2003). Trap/neuter/release methods ineffective in controlling domestic cat "colonies" on public lands. *Natural Areas Journal*, 23(3), 247-253.
- Centonze, L. A., & Levy, J. K. (2002). Characteristics of free-roaming cats and their caretakers. *Journal of the American Veterinary Medical Association*, 11, 1627-1633.
- Churcher, P. B., & Lawton, J. H. (1987). Predation by domestic cats in an English village. *Journal of Zoology, London*, 212(3), 439-455.
- Cleaveland, S., Thirgood, S., & Laurenson, K. (1999). Pathogens as allies in island conservation? *Trends in Ecology & Evolution*, 14(3), 83-84. doi:10.1016/S0169-5347(98)01527-4
- Coleman, J. S., & Temple, S. A. (1993). Rural residents' free-ranging domestic cats: a survey. *Wildlife Society Bulletin*, 21(4), 381-390.
- Coleman, J. S., Temple, S. A., & Craven, S. R. (1997). Cats and wildlife: a conservation dilemma, Madison, WI: University of Wisconsin. Retrieved November 1, 2017 from: <http://www/misc.edu/wildllife/e-pubs.html>.
- Commonwealth of Australia, (2015). *Threat abatement plan for predation by feral cats*. Retrieved December 21, 2018 from www.environment.gov.au/biodiversity/threatened/tap-approved.html
- Conniff, R. (2014). The evil of the outdoor cat. *New York Times*. Retrieved September 3, 2018 from <https://www.nytimes.com/2014/03/22/opinion/sunday/the-evil-of-the-outdoor-cat.html>
- Cooper, C. B., Loyd, K. A. T., Murante, T., Savoca, M., & Dickinson, J. (2012). Natural history traits associated with detecting mortality within residential bird communities: can citizen science provide insights? *Environmental Management*, 50(1), 11-20.
- Cowan, P., & Warburton, B. (2011). Animal welfare and ethical issues in island pest eradication. In C.R. Veitch, M.N. Clout & D.R. Towns (Eds.), *Island Invasives: eradication and management*. (Pp. 418-421), Occasional Paper of the IUCN Species Survival Commission No. 42.
- Crowley, S. L., Cecchetti, M., & McDonald, R. A. (2019). Hunting behaviour in domestic cats: An exploratory study of risk and responsibility among cat owners. *People and Nature*, 0(0), 1-13. doi:10.1002/pan3.6
- Crowley, S. L., Cecchetti, M., & McDonald, R. A. (2020) Our wild companions: Domestic cats in the Anthropocene. *Trends in Ecology & Evolution*. doi:10.1016/j.tree.2020.01.008
- Dauphine, N., & Cooper, R. J. (2009). Impacts of free-ranging domestic cats (*Felis catus*) on birds in the United States: a review of recent research with conservation and management recommendations. In T.D. Rich, C. Arizmendi, D.W. Desmarest & C.R. Thompson (Eds.), *Proceedings of the Fourth International Partners in Flight Conference: Tundra to Tropics*. (Pp. 205-219).
- Dearden, P. K., Gemmell, N. J., Mercier, O. R., Lester, P. J., Scott, M. J., Newcomb, R. D., Buckley, T. R., Jacobs, J. M.E., Goldson, S.G. & Penman, D. R. (2018). The potential for the use of gene drives for pest control in New Zealand: a perspective. *Journal of the*

- Royal Society of New Zealand*, 48(4), 225-244.
- De Silva, S., & Turchini, G. M. (2008). Towards understanding the impacts of the pet food industry on world fish and seafood supplies. *Journal of Agricultural and Environmental Ethics*, 21, 459-467.
- Dissen, G. A., Lomniczi, A., Boudreau, R. L., Chen, Y. H., Davidson, B. L., & Ojeda, S. R. (2012). Applying gene silencing technology to contraception. *Reproduction in Domestic Animals*, 47 Suppl 6, 381-386. doi:10.1111/rda.12016
- Doherty, T. S., Davis, R. A., van Etten, E. J. B., Algar, D., Collier, N., Dickman, C. R., Edwards, G., Masters, P., Palmer, R., & Robinson, S. (2015). A continental-scale analysis of feral cat diet in Australia. *Journal of Biogeography*, 42(5), 964-975. doi:10.1111/jbi.12469
- Doherty, T. S., Glen, A. S., Nimmo, D. G., Ritchie, E. G., & Dickman, C. R. (2016). Invasive predators and global biodiversity loss. *Proceedings of the National Academy of Sciences*, 113(40), 11261-11265. doi:10.1073/pnas.1602480113
- Duffy, D. C., & Capece, P. (2012). Biology and impacts of Pacific island invasive species 7. The domestic cat (*Felis catus*). *Pacific Science*, 66(2), 173-212.
- Eason, C. T., & Frampton, C. M. (1991). Acute toxicity of Sodium Monofluoroacetate (1080) baits to feral cats. *Wildlife Research*, 18, 445-449.
- Eason, C. T., Miller, A., MacMorran, D. B., & Murphy, E. C. (2014). Toxicology and ecotoxicology of para-aminopropiophenone (PAPP) -- a new predator control tool for stoats and feral cats in New Zealand. *New Zealand Journal of Ecology*, 38(2), 00-00.
- Elton, C. S. (1953). The use of cats in farm rat control. *British Journal of Animal Behaviour*, 1(1), 151-155.
- Engels, D. (1999). *Classical Cats*. London and New York: Routledge.
- Finkler, H., & Terkel, J. (2011). Dichotomy in the emotional approaches of caretakers of free-roaming cats in urban feeding groups: Findings from in-depth interviews. *Anthrozoos*, 24(2), 203-218. doi:10.2752/175303711X12998632257413
- Finkler, H., & Terkel, J. (2012). The contribution of cat owners' attitudes and behaviours to the free-roaming cat overpopulation in Tel Aviv, Israel. *Preventive Veterinary Medicine*, 104(1-2), 125-135. doi:10.1016/j.prevetmed.2011.11.006
- Fischer, S. M., Quest, C. M., Dubovi, E. J., David, R. D., Tucker, S. J., Friary, J. A., Crawford, P. C. Rieke, T. A. & Levy, J. K. (2007). Response of feral cats to vaccination at the time of neutering. *Journal of the American Veterinary Medical Association*, 230(1), 52-58.
- Fitzgerald, B. M. (1990). Is cat control needed to protect urban wildlife? *Environmental Conservation*, 17(2), 168-169.
- Foley, P., Foley, J. E., Levy, J. K., & Paik, T. (2005). Analysis of the impact of trap-neuter-return programs on populations of feral cats. *Journal of the American Veterinary Medical Association*, 227(11), 1775-1781.
- Forbush, E. H. (1916). *The Domestic Cat: bird killer, mouser, and destroyer of wildlife*. Boston: Massachusetts State Board of Agriculture.
- Gentry, T. G. (1900). *Intelligence in Plants and Animals*. New York: Doubleday & Co.
- George, W. G. (1974). Domestic cats as predators and factors in winter shortages of raptor prey. *Wilson Bulletin*, 86(4), 384-396.
- George, W. G. (1978). Domestic cats as density independent hunters and "surplus killers". *Carnivore Genetics Newsletter*, 3, 282-287.
- Gerhold, R. W., & Jessup, D. A. (2012). Zoonotic diseases associated with free-roaming cats. *Zoonoses and Public Health*, 59(supp), 1-7.
- Germain, E., Benhamou, S., & Poulle, M. L. (2008). Spatio-temporal sharing between the European wildcat, the domestic cat and their hybrids. *Journal of Zoology*, 276(2), 195-203. doi:10.1111/j.1469-7998.2008.00479.x
- Gibson, K. L., Kelzer, K., & Golding, C. (2002). A trap, neuter, and release program for feral cats on Prince Edward Island. *Canadian Veterinary Journal*, 43, 695-698.

- Goedeke, T. L., & Herda-Rapp, A. (2005). Introduction. In T. L. Goedeke & A. Herda-Rapp (Eds.), *Mad About Wildlife*. (Pp. 1-21). Boston: Brill.
- Hall, C. M., Fontaine, J. B., Bryant, K. A., & Calver, M. C. (2015). Assessing the effectiveness of the Birdsbesafe® anti-predation collar cover in reducing predation on wildlife by pet cats in Western Australia. *Applied Animal Behaviour Science*, 173, 40-51. doi:10.1016/j.applanim.2015.01.004
- Hanson, C. C., Bonham, J. E., Campbell, K. J., Keitt, B. S., Little, A. E., & Smith, G. (2010). The removal of cats from San Nicolas Island: methodology. In R.M. Timm & K.A. Fagerstone (Eds.), 24th Vertebrate Pest Conference. (Pp. 72-78), David: University of California.
- Hildreth, A. M., Vantassel, S. M., & Hygnstrom, S. E. (2010). *Feral cats and their management*. Lincoln, NE: University of Nebraska.
- Hughes, K. L., & Slater, M. R. (2002). Implementation of a feral cat management program on a university campus. *Journal of Applied Animal Welfare Science*, 5(1), 15-28.
- Hughes, K. L., Slater, M. R., & Haller, L. (2002). The effects of implementing a feral cat spay/neuter program in a Florida county animal control service. *Journal of Applied Animal Welfare*, 5(4), 285-298.
- Jarvis, P. J. (1990). Urban cats as pests and pets. *Environmental Conservation*, 17(2), 169-171.
- Jerolmack, C. (2008). How pigeons became rats: The cultural-spatial logic of problem animals. *Social problems*, 55(1), 72-94.
- Jessup, D. A. (2004). The welfare of feral cats and wildlife. *Journal of the American Veterinary Medical Association*, 225(9), 1377-1383.
- Jessup, D. A., Miller, M. A., Kreuder-Johnson, C., Conrad, P. A., Tinker, M. T., Estes, J., & Mazet, J. A. (2007). Sea otters in a dirty ocean. *Journal of the American Veterinary Medical Association*, 231(11), 1648-1652.
- Judge, S., Lippert, J. S., Misajon, K., Hu, D., & Hess, S. C. (2012). Videographic evidence of endangered species depredation by feral cat. *Pacific Conservation Biology*, 18, 293-296.
- Kays, R., Dunn, R. R., Parsons, A. W., McDonald, B., Perkins, T., Powers, S. A., Shell, L., McDonald, J. L., Cole, H., Kikillus, H., Woods, L., Tindle, H. & Roetman, P. (2020) The small home ranges and large local ecological impacts of pet cats. *Animal Conservation*, doi:10.1111/acv.12563
- Kendall, K., & Ley, J. (2006). Cat ownership in Australia: barriers to ownership and behavior. *Journal of Veterinary Behavior*, 1, 5-16.
- King, B. J. (2016). Stakes grow higher in cat-bird wars. Retrieved November 11, 2018 from <https://www.npr.org/sections/13.7/2016/09/29/495883093/stakes-grow-higher-in-the-cat-bird-wars>
- King, C. M. (1984). *Immigrant killers: introduced predators and the conservation of birds in New Zealand*. Auckland, NZ: Oxford University Press.
- Langham, N. P. E., & Porter, R. E. R. (1991). Feral cats (*Felis catus* L.) on New Zealand farmland. I. Home range. *Wildlife Research*, 18, 741-760.
- Lawrence, E. A. (2003). Feline fortunes: Contrasting views of cats in popular culture. *J. Popular Culture* 36:623-635.
- Lazenby, B. T., Mooney, N. J., & Dickman, C. R. (2015). Effects of low-level culling of feral cats in open populations: a case study from the forests of southern Tasmania. *Wildlife Research*, 41(5), 407-420. doi:10.1071/WR14030
- Leong, K. M., Gramza, A. R. & Lepczyk, C. A. (2020). Understanding conflicting cultural models of outdoor cats to overcome conservation impasse. *Conservation Biology* 34:1190-1199.
- Levy, J. K., Miller, L. A., Crawford, P. C., Ritchey, J. W., Ross, M. & Fagerstone, K. A. (2004). GnRH immunocontraception of male cats. *Theriogenology*, 62, 1116-1130.
- Levy, J. K., Isaza, N. M., & Scott, K. C. (2014). Effect of high-impact targeted trap-neuter-return and adoption of community cats on cat intake to a shelter. *The Veterinary Journal*, 201(3), 269-274. doi:10.1016/j.tvjl.2014.05.001

- Lilith, M., Calver, M., Styles, I., & Garkaklis, M. (2006). Protecting wildlife from predation by owned domestic cats: application of a precautionary approach to the acceptability of proposed cat regulations. *Austral Ecology*, 31, 176-189.
- Linklater, W., & Steer, J. (2018). Predator Free 2050: A flawed conservation policy displaces higher priorities and better, evidence-based alternatives. *Conservation Letters*, 11(6), e12593.
- Littin, K. E., Mellor, D. J., Warburton, B., & Eason, C. T. (2004). Animal welfare and ethical issues relevant to the humane control of vertebrate pests. *New Zealand Veterinary Journal*, 52(1), 1-10.
- Littin, K. E., Fisher, P., Beausoleil, N. J., & Sharp, T. (2014). Welfare aspects of vertebrate pest control and culling: ranking control techniques for humaneness. *Scientific and Technical Review of the Office International des Epizooties (Paris)*, 33(1), 281-289.
- Lockwood, R. (2005). Cruelty toward cats: changing perspectives. In D. J. Salem & A. N. Rowan (Eds.), *The State of the Animals 2005* (Pp. 15-26). Washington, DC: Humane Society Press.
- Longcore, T. (2012). No-kill movement means death for birds. *Bird Calls*, 16(3), 3.
- Longcore, T., Rich, C., & Sullivan, L. M. (2009). Critical assessment of claims regarding management of feral cats by trap-neuter-return. *Conservation Biology*, 23(4), 887-894.
- Loss, S. R., Will, T., & Marra, P. P. (2013). The impact of free-ranging domestic cats on wildlife of the United States. *Nature communications*, 4(1396), 1-7.
- Loss, S. R., & Marra, P. P. (2017). Population impacts of free-ranging domestic cats on mainland vertebrates. *Frontiers in Ecology and the Environment*, 15(9), 502-509. doi:10.1002/fee.1633
- Loyd, K. A. T., & DeVore, J. L. (2010). An evaluation of feral cat management options using a decision analysis network. *Ecology and Society*, 15(4), 10. <http://www.ecologyandsociety.org/vol15/iss14/art10>
- Loyd, K. A. T., Hernandez, S. M., Abernathy, K. J., Shock, B. C., & Marshall, G. J. (2013). Risk behaviours exhibited by free-roaming cats in a suburban US town. *Veterinary Record*, 173(12), 1-6. doi:10.1136/vr.101222.
- Loyd, K. A. T., Hernandez, S. M., & McRuer, D. L. (2017). The role of domestic cats in the admission of injured wildlife at rehabilitation and rescue centers. *Wildlife Society Bulletin*, 41(1), 55-61. doi:10.1002/wsb.737
- Loyd, K. A. T., & Miller, C. A. (2010). Factors related to preferences for trap-neuter-release management of feral cats among Illinois landowners. *Journal of Wildlife Management*, 74(1), 160-165.
- Lynn, W. (2016). Cat wars: the moral shame of conservation. Retrieved January 3, 2017 from https://www.huffingtonpost.com/entry/cat-wars-the-moral-shame-of-conservation_us_57f697bde4b0f5cec18b7eeb
- Lynn, W. (2018). Bringing ethics to wild lives: Shaping public policy for Barred and Northern Spotted owls. *Society & Animals*, 26(2), 217-238.
- Marks, C. A. (2014). How much suffering is OK when it comes to pest control? *Ecos*, 194.
- Marra, P. P., & Santella, C. (2016). *Cat Wars: The devastating consequences of a cuddly killer*. Princeton, NJ: Princeton University Press.
- May, R. M. (1988). Control of feline delinquency. *Nature (London)*, 332(6163), 392-393.
- McCarthy, R. J., Levine, S. H., & Reed, J. M. (2013). Estimation of effectiveness of three methods of feral cat population control by use of a simulation model. *Journal of the American Veterinary Medical Association*, 243(4), 502-511.
- McNamara, K., O'Kiely, P., Whelan, J., Forristal, P. D., Fuller, H., & Lenehan, J. J. (2001). Vertebrate pest damage to wrapped, baled silage in Ireland. *International Journal of Pest Management*, 47(3), 167-172. doi:10.1080/09670870010011082
- Medina, F. M., Bonnaud, E., Vidal, E., Tershy, B. R., Zavaleta, E. S., Donland, C. J., Keitt, B.S.,

- Le Corre, M., Horwath, S. V. & Nogales, M. (2011). A global review of the impacts of invasive cats on island endangered vertebrates. *Global Change Biology*, 17(11), 3503-3510.
- Metsers, E. M., Seddon, P. J., & Heezik, Y. M. v. (2010). Cat-exclusion zones in rural and urban-fringe landscapes: how large would they have to be? *Wildlife Research*, 37, 47-56.
- Miller, P. S., Boone, J. D., Briggs, J. R., Lawler, D. F., Levy, J. K., Nutter, F. B., Salter, M. & Zawistowski, S. (2014). Simulating Free-Roaming Cat Population Management Options in Open Demographic Environments. *PLoS One*, 9(11), e113553. doi:10.1371/journal.pone.0113553
- Moseby, K. E., & Read, J. L. (2006). The efficacy of feral cat, fox and rabbit fence exclusion designs for threatened species protection. *Biological Conservation*, 127, 429-437.
- Moseby, K., Read, J., Paton, D., Copley, P., Hill, B., & Crisp, H. (2011). Predation determines the outcome of 10 reintroduction attempts in arid South Australia. *Biological Conservation*, 144(12), 2863-2872.
- Nelson, S. H., Evans, A. D., & Bradbury, R. B. (2005). The efficacy of collar-mounted devices in reducing the rate of predation of wildlife by domestic cats. *Applied Animal Behaviour Science*, 94, 273-285.
- Nelson, S. H., Evans, A. D., & Bradbury, R. B. (2006). The efficacy of an ultrasonic cat deterrent. *Applied Animal Behaviour Science*, 96, 83-91.
- Neville, P. F. (1989). Feral cats: management of urban populations and pest problems by neutering (pp. 261-268). New York: Chapman and Hall.
- New Zealand Companion Animal Council (NZCAC). (2017). *New Zealand National Cat Management Discussion Paper*. Retrieved January 3, 2019 from: <http://www.nzcac.org.nz/images/downloads/nz-national-cat-management-strategy-discussion-paper.pdf>.
- Nogales, M., Martin, A., Tershy, B. R., Donlan, C. J., Veitch, D., Puerta, N., Wood, B. & Alonso, J. (2004). A review of feral cat eradication on islands. *Conservation Biology*, 18(2), 310-319.
- Palmer, C. (2001). Taming the wild profusion of living things. *Environmental Ethics*, 23(4), 339-358.
- Palmer, C. (2003). Placing animals in urban environmental ethics. *Journal of Social Philosophy*, 34(1), 64-78.
- Palmer, C. (2015). Value conflicts in feral cat management: Trap-neuter-return or trap-ethanize? In M.C. Appleby, D.M. Weary & P. Sandoe (Eds.), *Dilemmas in Animal Welfare*. (Pp. 148-168), CAB International.
- Parkes, J., Fisher, P., Robinson, S., & Aguirre-Munoz, A. (2014). Eradication of feral cats from large islands: an assessment of the effort required for success. *New Zealand Journal of Ecology*, 38(2), 307-314. doi:http://www.newzealandecology.org/nzje/
- Pressler, J. (2013). Must cats die so birds can live? *New York Magazine*, 12 pp.
- Proulx, G. (1988). Control of urban wildlife predations by cats through public education. *Environmental Conservation*, 15(4), 358-359.
- Read, J., Gigliotti, F., Darby, S., & Lapidge, S. (2014). Dying to be clean: pen trials of novel cat and fox control devices. *International Journal of Pest Management*, 60(3), 166-172. doi:10.1080/09670874.2014.951100.
- Sallinger, B. & Kraus, K. (2014). Cats and wildlife: A new approach to addressing cat overpopulation in the Portland Metropolitan Region. Proc. 26th Vert. Pest Conference, Univ of California, Davis, <https://escholarship.org/uc/item/5ng0f0c8>.
- Schmidt, P. M., Swannack, T. M., Lopez, R. R., & Slater, M. R. (2009). Evaluation of euthanasia and trap-neuter-return (TNR) programs in managing free-roaming cat populations. *Wildlife Research*, 36, 117-125.

- Serpell, J. (2000). Domestication and History of the Cat. In D. C. Turner & P. Bateson (Eds.), *The Domestic Cat: The biology of its behaviour* (Pp. 179-192). Cambridge: Cambridge University Press.
- Sharp, T., & Saunders, G. (2012). Model code of practice for the humane control of feral cats. Australia: Department of Sustainability, Environment, Water, Population and Communities.
- Slater, M. R. (2002). *Community Approaches to Feral Cats*. Washington, D.C.: Humane Society Press.
- Slater, M. R. (2004). Understanding issues and solutions for unowned, free-roaming cat populations. *Journal of the American Veterinary Medical Association*, 225(9), 1350-1354.
- Slater, M. R. (2007). The welfare of feral cats. In I. Rochlitz (Ed.), *The Welfare of Cats*. (Pp. 141-176). Dordrecht, The Netherlands: Springer.
- Smith, N. (1999). The howl and the pussycat: feral cats and wild dogs in the Australian imagination. *The Australian Journal of Anthropology*, 10(3), 288-305.
- Spehar, D. D., & Wolf, P. J. (2018). The impact of an integrated program of return-to-field and targeted trap-neuter-return on feline intake and euthanasia at a municipal animal shelter. *Animals*, 8(4), 55. doi:10.3390/ani8040055
- Stone, P. A., Snell, H. L., & Snell, H. M. (1994). Behavioral diversity as biological diversity: introduced cats and lava lizard wariness. *Conservation Biology*, 8(2), 569-573.
- Twardek, W. M., Peiman, K. S., Gallagher, A. J., & Cooke, S. J. (2017). Fido, Fluffy, and wildlife conservation: The environmental consequences of domesticated animals. *Environmental Reviews*, 25(4), 381-395. doi:10.1139/er-2016-0111
- Unti, B., & Rowan, A. N. (2001). A social history of postwar animal protection. In D.J. Salem & A.N. Rowan (Eds.), *The State of the Animals 2001*. (Pp. 21-37), Washington DC: Humane Society Press.
- Vantassel, S. M. (2013). *The Practical Guide to the Control of Feral Cats*. Lincoln, Nebraska: Wildlife Control Consultants, LLC.
- Vigne, J. D., Guilaine, J., Debue, K., Haye, L., & Gerard, P. (2004). Early taming of the cat in Cyprus. *Science*, 304(5668), 259.
- Warburton, B., & Norton, B. G. (2009). Towards a knowledge-based ethic for lethal control of nuisance wildlife. *Journal of Wildlife Management*, 73(1), 158-164.
- Warner, R. E. (1985). Demography and movements of free-ranging domestic cats in rural Illinois. *Journal of Wildlife Management*, 49(2), 340-346.
- Wilson, C. H., & Vreeland, F. K. (1917). License the domestic cat. *American Game Protective Association Bulletin*, 6(1), 11-14.
- Woinarski, J. C. Z., Legge, S. M., & Dickman, C. R. (2019). *Cats in Australia: Companion and killer*. Clayton South VIC: CSIRO Publishing.
- Wolf, P. J., & Schaffner, J. E. (2019). The Road to TNR: Examining Trap-Neuter-Return Through the Lens of Our Evolving Ethics. *Frontiers in Veterinary Science*, 5(341). doi:10.3389/fvets.2018.00341