Domestic Cats: Management of a Charismatic Non-Native Species

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ABSTRACT: The domestic cat is a charismatic and pervasive non-native predator whose population in the United States is an estimated 114-188 million. When permitted to roam outdoors, cats pose serious risks to the health and welfare of wildlife, people, and the cats themselves. Despite overwhelming evidence to support keeping cats indoors, many municipalities continue to endorse the maintenance of cats outdoors through Trap-Neuter-Release at the behest of feral cat advocacy programs and their vocal grassroots supporters. The American Bird Conservancy (ABC) *Cats Indoors* program strives to raise awareness about the negative impacts of outdoor cats, to educate policy makers and the public, and to promote responsible pet ownership. We review the scientific evidence that necessitates keeping cats from roaming outdoors and how ABC's *Cats Indoors* program is working to protect wildlife, cats, and people.

KEY WORDS: American Bird Conservancy, *Cats Indoors* program, domestic cat, *Felis catus*, feral cat, management, non-native predator, trap-neuter-release

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INTRODUCTION

The management of domestic cats (*Felis catus*) in the United States elicits strong emotional responses from many people, due in part to the fact that cats are both a non-native predator and a highly popular pet species. Cat ownership has experienced a marked upward trend in recent decades, and estimates suggest that there are 114-188 million domestic cats in the United States (Dauphine and Cooper 2009, Lepczyk et al. 2010, Loss et al. 2013). Approximately 60-160 million of those cats are permitted to roam outdoors without restriction (Dauphine and Cooper 2009, Loss et al. 2013), and the presence of these free-roaming cats has serious implications for the health and welfare of cats, wildlife, and people.

Although many institutions and levels of government agree that managing outdoor cat populations is necessary and desirable, how to do so has emerged as a matter of much debate in recent years. Effective management programs for the growing numbers of feral cats, which have been estimated to number from 30-100 million in the United States (Jessup 2004, Loss et al. 2013), has been at the center of this debate. In communities across the country, feral cat advocates promote policies to sanction and sustain outdoor colonies of feral cats through a program called Trap-Neuter-Release (TNR), despite evidence that such programs are ineffective and do not properly account for ecological or public health concerns (Longcore et al. 2009).

In this paper, we evaluate the critical need for management of free-roaming domestic cats by reviewing the published science that establishes that keeping cats indoors or otherwise restricted from roaming is better for cats, wildlife, and people. We also discuss how American Bird Conservancy (ABC), a non-profit organization dedicated to the conservation of native birds and their habitats throughout the Americas, and its *Cats Indoors* program are working to promote public education, scientifically informed public policy, and responsible pet ownership that result in the effective management of these non-native predators.

JUSTIFICATION FOR MANAGEMENT

Risks to Cats

Free-roaming domestic cats experience a wide range of threats that are either absent or much reduced for cats maintained exclusively indoors. The cumulative result of these threats for many cats is untimely death from disease, starvation, or trauma (AVMA 2014). For example, seroprevalence of feline leukemia virus and feline immunodeficiency virus, two infectious diseases which can be fatal to cats (Hartmann 2011), has been shown to be significantly higher in cats allowed outdoors (Levy et al. 2006). Recommended management for these diseases has included keeping cats indoors where they can be effectively quarantined from infected cats (Levy et al. 2006, Little 2011). Similarly, free-roaming cats may be subject to parasites. In Florida, Andersen et al. (2003) suggested that feral cats may be a reservoir for hookworms, and Akucewich et al. (2002) found that over 92% of randomly selected feral cats were infested with fleas.

Outdoor cats are also exposed to traumatic events. Dangers include being struck by vehicles or attacked by dogs, other cats, people, and wildlife. Although domestic cats are efficient non-native predators, they may also be prey for some species. In particular, coyotes (*Canis latrans*) appear to be adept cat predators. Though not always killing cats for food (Gehrt 2007, Grubbs and Krausman 2009), coyote diet has been identified to consist of domestic cats by as much as 42%, and such outcomes may be easily avoided by keeping cats indoors (Grubbs and Krausman 2009).

Risks to Wildlife

The presence of free-roaming domestic cats in the environment has been shown to negatively impact native

wildlife. Globally, domestic cats have contributed to the extinction of 33 species of birds, mammals, and reptiles and are the principal threat to 8% of the critically endangered species in these taxa (Medina et al. 2011). The International Union for the Conservation of Nature lists domestic cats among the world's worst non-native invasive species (Lowe et al. 2000). Not only do free-roaming domestic cats have direct impacts on wildlife (e.g., predation), their presence in the environment also disrupts behaviors and leads to indirect mortality (Bonnington et al. 2013).

Domestic cats are instinctive hunters that will hunt and kill regardless of hunger (Adamec 1976, Churcher and Lawton 1987). This instinctive behavioral trait combined with their close affiliation with humans amplifies the impacts of free-roaming cats, which may occur in densities 10-100 times those of native predators and reach over 1,500 animals per km^2 (Liberg et al. 2000, Sims et al. 2008). Loss et al. (2013) estimated the total mortality to birds and mammals in the United States as a result of predation by domestic cats. They found that 1.4-3.7 billion birds and 6.9-20.7 billion mammals are killed every year and that cats are likely the number one source of direct, anthropogenic mortality for these taxa. The authors also estimated that 69% of bird mortality and 89% of mammal mortality was caused by un-owned (e.g., feral) cats. Yet, owned cats are still responsible for considerable wildlife mortality and may have larger impacts on wildlife than previously understood. Loyd et al. (2013) monitored owned, free-roaming cats using miniature cameras (i.e., "KittyCams") attached to individual cats to quantify total cat-caused wildlife mortality. They observed that only 23% of cat kills were returned to the home, thus suggesting that previous studies and personal observations relying on prey returns or owner surveys may severely underestimate prey capture rates by hunting cats.

Free-roaming cats also have indirect effects on wildlife. Sub-lethal effects caused by cats alter wildlife behavior and may have considerable implications for population and community dynamics (Agrawal 2001). For example, reduced feeding of nestling birds can reduce both growth rates and condition (Dunn et al. 2010), and altered parental behavior may increase predation risk. Bonnington et al. (2013) evaluated the sub-lethal effects of cats on nesting birds and observed a reduction in parental provisioning of young by one-third, without any compensatory food load size, and an increase in daily nest predation by an order of magnitude. The authors posited that free-roaming cats may contribute to the "reduced chick conditions and smaller clutch sizes that characterize urban bird populations in comparison with their rural conspecifics" (Chamberlain et al. 2009).

Transmission of disease to wildlife is another indirect effect that may result from domestic cats roaming outdoors. Toxoplasmosis, a disease caused by infection with the parasitic protozoan *Toxoplasma gondii*, is particularly noteworthy because of the role of felids as the definitive host for the parasite and the potentially serious risks (e.g., death) associated with infection for intermediate hosts, which may include all endothermic vertebrate species (Tenter et al. 2000). Intermediate hosts may become infected by consuming infected tissues or by contact with fecal oocysts excreted by infected felids. These oocysts have the potential to linger in the environment for up to 18 months (Frenkel 2000, Tenter et al. 2000) and may contaminate terrestrial, freshwater, and marine environments. As a result, *T. gondii* infection has been identified in a wide variety of species including endangered Hawaiian monk seals (*Monachus schauinslandi*), threatened southern sea otters (*Enhydra lutris nereis*), endangered Nēnē (*Branta sandvicensis*), endangered Antillean manatees (*Trichechus manatus manatus*), and Eurasian otters (*Lutra lutra*), among others (Work et al. 2002, Conrad et al. 2005, Honnold et al. 2005, Bossart et al. 2012, Chadwick et al. 2013).

Risks to People

Domestic cats that roam outdoors are not only at a higher risk of transmitting diseases to each other and wildlife but may also transmit diseases to people. These cats pose a potential public health threat. Two diseases that stand out both in prevalence and potential severity of exposure are toxoplasmosis and rabies. *T. gondii* infection similarly affects people as it affects other species (above). Humans may become infected by ingestion or inhalation of oocysts, eating undercooked and infected meat, vertical transmission during pregnancy, blood transfusions, or organ transplants (Tenter et al. 2000, Hill and Dubey 2012). The consequences of infection vary, and infections deriving from oocysts may be more prevalent than from tissue cysts in infected meats (Hill et al. 2011). Congenital toxoplasmosis acquired by the fetus during pregnancy can lead to deafness, blindness, seizures, mental retardation, abortion, and neonatal death (Tenter et al. 2000, Torrey and Yolken 2013). Infection may also be fatal for individuals with weakened immune systems (Tenter et al. 2000, Montoya and Liesenfeld 2004, Torrey and Yolken 2013). Immunocompetent adults are at risk of chorioretinitis, lymphadenopathy, multi-organ failure, schizophrenia, Alzheimers Disease, obsessive compulsive disorder, depression, brain cancer, and memory loss (Montoya and Liesenfeld 2004, Kubesci et al. 2011, Hill and Dubey 2012, Torrey and Yolken 2013, Gajewski et al. 2014, Undseth et al. 2014).

The public health risk from *T. gondii* infection is increased by the pervasiveness of roaming cats and the number of oocysts they shed. Up to 74% of domestic cats will acquire *T. gondii* during their lifetimes, and each infected cat may shed hundreds of millions of oocysts during active infection (Tenter et al. 2000). An oocyst can survive periods of cold and dehydration and may remain viable in the environment for up to 18 months (Frenkel 2000, Tenter et al. 2000). Torrey and Yolken (2013) stated that, "because cats are now so ubiquitous in the environment, one may become infected by neighboring cats which defecate in one's garden or play area, or by playing in public areas such as parks or school grounds. Indeed, as cats increasingly contaminate public areas with *T. gondii* oocysts it will become progressively more difficult to avoid exposure." Oocyst exposure is likely the most common route of exposure in the United States because there is not a strong tradition of eating undercooked meat. Indeed, Boyer et al. (2011) identified

that 78% of mothers with congenitally infected infants acquired their infection from oocysts.

Rabies also represents a serious public health threat because it is almost always fatal if untreated and because of the wide variety of species that are vulnerable. Although wildlife species account for the majority of rabid animals in the United States, domestic cats are consistently the top source of rabies among domestic animals (Dyer et al. 2013). As compared to wildlife, cats also present a disproportionate risk for potential human exposures because people, especially children, are more likely to interact with them (Roebling et al. 2013). Up to 38,000 people receive rabies post-exposure prophylaxis (PEP) every year due to potential exposure, and approximately 16.5% (6,270) of those are due to cats (Christian et al. 2009). Free-roaming cats spending their entire time outdoors (e.g., feral cats) are at an increased risk both because of a lack of vaccination and necessary boosters and a higher likelihood of interaction with other rabid animals. Moore et al. (2000) reported that 82% of PEP administration in Pennsylvania due to cats was for contact with feral, stray, or un-owned cats.

TRAP-NEUTER-RELEASE (TNR)

Due to the large number of free-roaming cats in the United States and their impacts on the health and welfare of cats, wildlife, and people, it is clear that domestic cat management is necessary. Many conservation, public health, veterinary, and animal welfare organizations agree that restricting domestic cats from roaming free is a preferred alternative for pet cats. However, how to deal with the 30-100 million feral cats (Jessup 2004, Loss et al. 2013) remains a matter of much public debate. One program often promoted by advocates for feral cats and subscribers of a "No Kill" philosophy is TNR, a process by which feral cats are trapped, sterilized, and then released back into the environment (Longcore et al. 2009). These cats are then often maintained in colonies by supplemental feeding and may receive some level of medical care.

Although practitioners often claim that TNR is the only effective, humane method to reduce feral cat populations, the scientific literature indicates that TNR is neither effective nor humane. Not only does TNR fail to reduce feral cat colony populations, they may in fact lead to an increase in cat colony size (Castillo and Clarke 2003, Foley et al. 2005, McCarthy et al. 2013). Foley et al. (2005) stated, "no plausible combinations of life history variables would likely allow for TNR to succeed in reducing population size, although neutering approximately 75% of the cats could achieve control (which is unrealistic)." When compared to humane euthanasia, TNR has consistently been shown to be less effective at achieving control and reducing feral cat populations (Andersen et al. 2004, Schmidt et al. 2009, Lohr et al. 2013, McCarthy et al. 2013).

The practice of releasing feral cats back into the environment through TNR programs is also not humane to the cats, wildlife, or people. The maintenance of feral cat colonies through TNR is a manifestation of preferential treatment for one species (i.e., domestic cats) and ignores the impacts these cats have (Barrows 2004, Jessup 2004, Longcore et al. 2009). TNR does not eliminate substantial risks of injury or disease for feral cats, direct and indirect impacts on native wildlife, or public health concerns (Barrows 2004, Jessup 2004). Roebling et al. (2013) concluded that even TNR programs that included rabies vaccinations during the sterilization process "are not effective methods for reducing public health concerns or for controlling feral cat populations." In summary, TNR generally fails to meet any of the reasons for cat management.

AMERICAN BIRD CONSERVANCY AND *CATS INDOORS*

ABC is a conservation organization that uses the peer-reviewed literature to guide its policies. ABC's *Cats Indoors* program is an education initiative that has been working to raise awareness about the scientifically valid consequences of free-roaming cats since 1997. The program publicizes independent studies that augment understanding of the impacts of free-roaming cats and that identify effective and appropriate management strategies. Results and conclusions of such studies are communicated broadly to policy makers and the general public. Other available educational materials include brochures, public service announcements, scientific literature, academic reports, and professional society position statements. The *Cats Indoors* program also writes editorials, provides testimony, and issues reports to provide objective scientific perspectives to proposed policies and initiatives. All provided materials and actions are an effort to promote responsible pet ownership and free-roaming cat management based on the peer-reviewed scientific literature.

CONCLUDING REMARKS

Based on the large and growing number of domestic cats in the United States (Lepczyk et al. 2010) and their associated impacts, effective management of these non-native species is critical. ABC, other science-based organizations, scientists, and science communicators have a responsibility to provide the best information to the public and policy makers. Furthermore, despite the opposition of some organizations interested in maintaining colonies of cats outdoors, the peer-reviewed scientific literature indicates that prohibition of TNR and effective management of all free-roaming cats will simultaneously benefit the health and welfare of domestic cats, wildlife, and humans. Such positions may even be widely popular (Lohr and Lepczyk 2013). Rather than maintain cats outdoors and allow the vocal desires of a minority of stakeholders to trump and trample the rights and desires of the remaining human population, communities and governments should seek regulations that prohibit free-roaming domestic cats and permanently remove any existing feral cat colonies.

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